GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 37, Number 1 (March 2006). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extension reports unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA JEFFERSONIANUM (Jefferson Salamander). USA: PENNSYLVANIA: Chester Co.: Pond on St. Peters Rd. near intersection with Wells Rd. (40°12.78'N, 75°43.75'W). 14 February and 20, 23, 27 March 2005. Nadine Bergeron and Helen Brower of the Amphibian Preservation Alliance (bshiningwoman@hotmail.com). Verified by Ned Gilmore. Academy of Natural Sciences (ANSP 36020). Two adults were observed crossing the road 14 February and 20 adults on 20 March. 17 adults were observed crossing the road in the opposite direction on 23 March and 27 adults on 27 March. Two adults were observed in 2003, nine in 2004, and seven in 2006 at the same location. Extends range of species in southeastern Pennsylvania (Hulse et al. 2001. Amphibians and Reptiles of Pennsylvania and the Northeast. Cornell University Press, Ithaca, New York. 419 pp.).

Submitted by **MAC F. GIVEN**, Neumann College, Aston, Pennsylvania 19014, USA; e-mail: mgiven@neumann.edu.

AMBYSTOMA MACULATUM (Spotted Salamander). USA: ARKANSAS: Lincoln Co.: Wooded area 3.2 km SW of Star City (Sec. 13, T9S, R8W). 15 April 2006. Henry W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 30135). Verified by Stanley E.Trauth. New county record in southeastern Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press. Fayetteville).

Submitted by **HENRY W. ROBISON**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA; e-mail: hwrobison@saumag.edu.

AMBYSTOMA MACULATUM (Spotted Salamander). USA: ILLINOIS: Franklin Co.: Fitzgerrell Park road within Wayne Fitzgerrell State Park. GPS coordinates are as follows: N 0329676m and W 4218592m, zone 16 using NAD27 CONUS map datum in UTMs. 9 March 2006. Chad R. Dolan and James T. Lamer, Illinois Natural History Survey (INHS 20029). Verified by Chris Phillips, Illinois Natural History Survey. First county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois). The salamander was caught by hand, on the road during heavy rainfall, air temperature of 13.9°C. This was the only *Ambystoma maculatum* observed, however, three Tiger Salamanders (*A. tigrinum*) were also collected from this road.

Submitted by **CHAD R. DOLAN, JAMES T. LAMER,** and **JOHN K. TUCKER,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

AMBYSTOMA MACULATUM (Spotted Salamander). USA: TENNESSEE: Union Co.: Chucks Swan Wildlife Management Area managed by the Tennessee Wildlife Resources Agency located in the White Hollow Quad (36°18'36"N, 83°57'43"W, NAD 83). 3 April 2005. W. Mark Thurman, Jon M. Davenport, and Josh R. Austin Peay State University Museum of Zoology. APSU 17705. Verified by A. Floyd Scott. Adult under tin at Heneagar Pond. New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. [Hard copy and Internet versions, the latter of which includes links to information on Tennessee herpetology having appeared since 1996], http://www.apsu.edu/amatlas/—accessed 20 December 2005).

Voucher specimens collected under authority of Tennessee Wildlife Resources Agency; field work supported by Tennessee Wildlife Resources Agency and Austin Peay State University.

Submitted by **JOSHUA R. ENNEN** (e-mail: Joshua.Ennen@usm.edu) and **JON M. DAVENPORT**, Austin Peay State University, Clarksville, Tennessee 37040, USA; and **W. MARK THURMAN,** Tennessee Wildlife Resources Agency, 464 Industrial Blvd., Crossville, Tennessee 38555, USA.

AMBYSTOMA OPACUM (Marbled Salamander). USA: TENNESSEE: Lauderdale Co.: John Tully Wildlife Management Area managed by the Tennessee Wildlife Resources Agency located in the Golddust Quad (35.677220°N, -89.807900°W, NAD 83). 22 May 2006. Daniel Stanfield, Tennessee Wildlife Resources Agency. Austin Peay State University Museum of Zoology, APSU 18178. Verified by A. Floyd Scott. One *A. opacum* found while conducting a visual encounter survey in bottomland hardwoods near Cold Creek. Temperature at collection was 17°C. New county record that extends the range of the species in Tennessee into the southwestern corner of Lauderdale Co. (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. Hard copy and Internet versions, the latter of which includes links to information on Tennessee herpetology having appeared since 1996, http://www.apsu.edu/amatlas/; accessed 05 June 2006).

Voucher image collection made under the authority of the Tennessee Wildlife Resources Agency; field work supported by State Wildlife Grant (SWG) funding under the authority of the U.S. Fish and Wildlife Service.

Submitted by **CHRIS HUNTER**, Tennessee Wildlife Resources Agency Region I, 200 Lowell Thomas Drive, Jackson, Tennessee 38301, USA; e-mail: christopher.hunter@state.tn.us.

AMBYSTOMA OPACUM (Marbled Salamander). USA: TENNESSEE: Union Co.: Chucks Swan Wildlife Management Area managed by the Tennessee Wildlife Resources Agency located in the White Hollow Quad (36°20'50"N, 83°53'44"W, NAD 83). 3 April 2005. W. Mark Thurman, Jon M. Davenport, and Josh R. Ennen. Austin Peay State University Museum of Zoology. APSU 17705. Verified by A. Floyd Scott. Larvae in temporary pool beside White Creek, upstream of gauging station. New county record. (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. Hard copy and Internet versions, the latter of which includes links to information on Tennessee herpetology having appeared since 1996. http://www.apsu.edu/amatlas/; accessed 20 December 2005).

Voucher specimens collected under authority of Tennessee Wildlife Resources Agency; field work supported by Tennessee Wildlife Resources Agency and Austin Peay State University.

Submitted by **JON M. DAVENPORT** (e-mail: JMD1125@ecu.edu) and **JOSHUA R. ENNEN**, Austin Peay State University, Clarksville, Tennessee 37040, USA; **W. MARK THURMAN,** Tennessee Wildlife Resources Agency, 464 Industrial Blvd., Crossville, Tennessee 38555, USA.

AMBYSTOMA OPACUM (Marbled Salamander). USA: VIRGINIA: Augusta Co.: Shenandoah National Park (SNP). UTM E 692173 and N 4234579, NAD83. 20 April 2006. Milwaukee Public Museum (color voucher photo MPM P733). Larval specimen found in vernal pool in mixed hardwood forest. First record of this species within SNP (established 1939) and extends the known distribution along the eastern edge of the Shenandoah Valley NNE by 32 km (Mitchell and Reay 1999. Atlas of Amphibians and Reptiles in Virginia. Spec. Publ. No. 1, Virginia Dept. Game and Inland Fish. 122 pp.). Rockingham Co.: UTM, E 697900 and N 4242111, NAD83. 19 April 2006. MPM P734, color voucher photo. Larval specimen found in vernal pool in mixed hardwood forest. New county record and extends the known distribution along the eastern edge of the Shenandoah Valley NNE by 42 km (Mitchell and Reay 1999, *op. cit.*). Both specimens verified by Don Church, University of Virginia. These records were obtained while conducting contract research for Northeast Region of the USGS Amphibian Research and Monitoring Initiative.

Submitted by **WILLIAM BROWN**, Blue Ridge Biological, 978 Bull Yearling Road, Stanardsville, Virginia 22973, USA (e-mail: wbrown@blueridgebiological.com); and **JOHN L. BLACKBURN III**, Applied Ecology Research Group, University of Canberra, ACT 2601, Australia.

AMPHIUMA TRIDACTYLUM (Three-toed Amphiuma). USA: TENNESSEE: Fayette Co.: Wolf River Wildlife Management Area managed by the Tennessee Wildlife Resources Agency located in the SE Moscow Quad (35.029960°N, -89.266880°W, NAD 83). 11 July 2006. Daniel Stanfield and Tom Pratt of the Tennessee Wildlife Resources Agency. Austin Peay State University Museum of Zoology (APSU 18215). Verified by A. Floyd Scott. One specimen found in a turtle basket at a pond site in bottomland hardwoods. Air temperature at collection was 35°C. New county record that extends the range of the species in Tennessee into the eastern portion of Fayette Co. (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. Hard copy and Internet versions, the latter of which includes links to information on Tennessee herpetology having appeared since 1996, http://www.apsu.edu/amatlas/; accessed 22 August 2006).

Voucher image collection made under the authority of the Tennessee Wildlife Resources Agency; field work supported by State Wildlife Grant (SWG) funding under the authority of the U.S. Fish and Wildlife Service.

Submitted by **CHRIS HUNTER**, Tennessee Wildlife Resources Agency Region I,, 200 Lowell Thomas Drive, Jackson, Tennessee 38301, USA, e-mail: christopher.hunter@state.tn.us.

BOLITOGLOSSA ALBERCHI. MÉXICO: VERACRUZ: Municipality of Uxpanapa: La Horqueta (17°13'14.4"N, 94°12'53"W), 43 m elev. 7 January 2005. José Luis Aguilar-López. Verified by Luis Canseco-Márquez. Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México (MZFC 18379). First record for Uxpanapa, extending its known range in Veracruz ca. 177 km (airline) SE of the type locality near Sontecomapan (Playa Escondida) in the Los Tuxtlas area (García-Paris et al. 2002. Re. Esp. Herp. 16:43–71). The nearest published record for this species is in Chiapas, extending its range ca. 57 km (airline) NW from the El Ocote region (Muñoz Alonso et al. 1996. *In* Vásquez Sánchez and March Mifsut [eds.], Conservation y Desarrollo Sustentable en La Selva El Ocote, Chiapas, pp. 87–147. ECOSUR, San Cristobal de Las Casas [as *B. mexicana*]). The specimen was caught in a rubber tree plantation located in lowland rainforest.

Submitted by **JOSÉ LUIS AGUILAR-LÓPEZ,** Laboratorio de Herpetología, Escuela de Biología, Benemérita Universidad Autónoma de Puebla, C.P. 72570, Puebla, México (e-mail: jlal.herp@gmail.com); **CARLOS HERNÁNDEZ-JIMÉNEZ,** Museo de Zoología, Facultad de Ciencias, UNAM, C.P. 04420, México, D.F.; and **YOAZIM MELGAREJO-VÉLEZ,** Laboratorio de Herpetología, Escuela de Biología, Benemérita Universidad Autónoma de Puebla, C.P. 72570, Puebla, Mexico.

DESMOGNATHUS FUSCUS FUSCUS (Northern Dusky Salamander). USA: TENNESSEE: Union Co.: Chucks Swan Wildlife Management Area managed by the Tennessee Wildlife Resources Agency located in the White Hollow Quad (36°20'50"N, 83°53'44"W, NAD 83). 3 April 2005. W. Mark, Jon M. Davenport, and Josh R. Ennen. Austin Peay State University Museum of Zoology, APSU 17705. Verified by A. Floyd Scott. Adult under rock in spring feeding into White Creek, upstream of gauging station. New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. Hard copy and Internet versions, the latter of which includes links to information on Tennessee herpetology having appeared since 1996, http://www.apsu.edu/amatlas/; accessed 20 December 2005).

Voucher specimens collected under authority of Tennessee Wildlife Resources Agency; field work supported by Tennessee Wildlife Resources Agency and Austin Peay State University.

Submitted by **W. MARK THURMAN,** Tennessee Wildlife Resources Agency, 464 Industrial Blvd., Crossville, Tennessee 38555, USA (e-mail: Mark.Thurman@state.tn.us); **JOSHUA R. ENNEN** and **JON M. DAVENPORT**, Austin Peay State University, Clarksville, Tennessee 37040,USA.

DESMOGNATHUS OCHROPHAEUS (Allegheny Mountain Dusky Salamander). CANADA: ONTARIO: Regional Municipality of Niagara, Niagara Gorge (north of Niagara Falls) near Queenston (43°00'N, 79°00'E). 5 June 1989. Wayne F. Weller and James Kamstra. Royal Ontario Museum (ROM 19813). Verified by Devin J. Mills and Rob Tervo based on morphological features. Two salamanders were found in a seepage area under rocks and logs. The habitat consists of a single cascade channel on a 77% slope gradient fed by groundwater seeps and flowing into the Niagara River. The salamander collected at the locality in 1989

had originally been identified as *D. fuscus* (ROM 19613) (Kamstra 1991. Can. Field-Nat. 105:561–563). Upon further investigation of morphological features it is evident that the voucher is actually *D. ochrophaeus*. In 2004, the Ontario Ministry of Natural Resources (OMNR) collected tissue samples from 19 salamanders over a period of several months. Mitochondrial DNA sequence comparisons of cytochrome b between the 19 *Desmognathus* salamanders discovered at the Queenston site and known *D. fuscus* and *D. ochrophaeus* from adjacent New York State indicate that the entire Queenston population is comprised of *D. ochrophaeus* (Markle and Green 2005. Molecular Identification of Allegheny Mountain Dusky Salamanders, *Desmognathus ochrophaeus*, in Southern Ontario. Report for Ontario Ministry of Natural Resources, Vineland, Ontario. 8 pp.). The other population of *Desmognathus* salamanders within the Niagara Gorge were confirmed to be *D. fuscus*. OMNR is currently studying the ecology of both populations. The Queenston specimens represent the first record of *D. ochrophaeus* in Ontario, and remain the only population known within the province.

Submitted by **TRICIA M. MARKLE** (e-mail: tricia.markle@mail.mcgill.ca), **DAVID M. GREEN**, Department of Biology, Redpath Museum, McGill University, 859 Sherbrooke St. West, Montreal, Quebec, H3A 2K6, Canada; **ANNE YAGI**, Ontario Ministry of Natural Resources, 4890 Victoria Ave, P.O. Box 5000, Vineland Station, Ontario, L0R 2E0, Canada; and **WAYNE F. WELLER**, Ontario Power Generation Inc., Hydro Business Environment Division, 14000 Niagara Parkway, RR #1, Niagara-on-the-Lake, Ontario, L0S 1J0, Canada.

EURYCEA CIRRIGERA (Southern Two-lined Salamander). USA: TENNESSEE: Hickman Co.: Cave Branch Cave (Tennessee Cave Survey Num. HI3) (35°40'37"N, 87°42'20"W). 22 July 2006. Matthew L. Niemiller and Brian T. Miller. Verified by Vincent A. Cobb. Adult collected and deposited in the Herpetology Collection at Middle Tennessee State University, MTSU 368C. First county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. Internet version [http://www.apsu.edu/amatlas] contains links to information regarding Tennessee distribution of amphibians recorded since 1996; accessed 1 August 2006).

Submitted by **MATTHEW L. NIEMILLER**, Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, Tennessee 37996, USA (e-mail: mniemill@utk.edu); and **BRIAN T. MILLER**, Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee, 37132, USA (e-mail: bmiller@mtsu.edu).

EURYCEA CIRRIGERA (Southern Two-lined Salamander). USA: TENNESSEE: Union Co.: Chucks Swan Wildlife Management Area managed by the Tennessee Wildlife Resources Agency located in the White Hollow Quad (36°20'50"N, 83°53'44"W, NAD 83). 3 April 2005. W. Mark Thurman, Jon M. Davenport, and Josh R. Ennen. Austin Peay State University Museum of Zoology, APSU 17705. Verified by A. Floyd Scott. Adult under rock beside White Creek, upstream of gauging station. New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. Hard copy and Internet versions, the latter of which includes links to information on Tennessee herpetology having appeared since 1996, http://www.apsu.edu/amatlas/; accessed 20 December 2005).

Voucher specimens collected under authority of Tennessee Wildlife Resources Agency; field work supported by Tennessee Wildlife Resources Agency and Austin Peay State University.

Submitted by **W. MARK THURMAN** Tennessee Wildlife Resources Agency, 464 Industrial Blvd., Crossville, Tennessee 38555, USA (e-mail: Mark.Thurman@state.tn.us); **JOSHUA R. ENNEN** and **JON M. DAVENPORT**, Austin Peay State University, Clarksville, Tennessee 37040, USA.

EURYCEA LONGICAUDA LONGICAUDA (Long-tailed Salamander). USA: VIRGINIA: Albemarle Co.: Shenandoah National Park, UTM E 696356 and N 4222471, NAD 83. 21 July 2001. Milwaukee Public Museum (color voucher photo MPM P735). Verified by Don Church, University of Virginia. Adult found under rock at the edge of Moorman's River (south fork), 8.65 km W of White Hall, Virginia. New county record and second known record east of the Blue Ridge Mountains in Virginia (Mitchell and Reay 1999. Atlas of Amphibians and Reptiles in Virginia. Spec. Publ. No. 1, Virginia Dept. Game and Inland Fish. 122 pp.). Research permit # SHEN-2001-SCI-0005.

Submitted by **WILLIAM BROWN**, Blue Ridge Biological, 978 Bull Yearling Road, Stanardsville, Virginia 22973, USA (e-mail: wbrown@blueridgebiological.com); and **JOSEPH C. MITCHELL,** Department of Biology, University of Richmond, Richmond, Virginia 23173, USA (e-mail: dr.joe.mitchell@gmail.com).

EURYCEA LUCIFUGA (Cave Salamander). USA: TENNESSEE: Hardin Co.: Entrance to Pickwick Pot (Tennessee Cave Survey Num. HR6) (35°01'37"N, 88°10'28"W). 2 July 2006. Adult collected and deposited in the Herpetology Collection at Middle Tennessee State University (MTSU 356C). First county record and most southwestern record in Tennessee (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. Internet version [http://www.apsu.edu/amatlas] contains links to information regarding Tennessee distribution of amphibians recorded since 1996; accessed 01 August 2006). Hickman Co.: Cave Branch Cave (Tennessee Cave Survey Num. HI3) (35°40'37"N, 87°42'20"W). 22 July 2006. MTSU 360C, adult. First county record. Lewis Co.: Allens Creek Cave (Tennessee Cave Survey Num. LS3) (35°26'15"N, 87°35'47"W). 22 July 2006. MTSU 359C, adult. First county record. All of the above specimens were collected by Matthew L. Niemiller and Brian T. Miller, and verified by Vincent A. Cobb.

Submitted by **MATTHEW L. NIEMILLER**, Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, Tennessee 37996, USA (e-mail: mniemill@utk.edu); and **BRIAN T. MILLER**, Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee, 37132, USA (e-mail: bmiller@mtsu.edu).

EURYCEA LUCIFUGA (Cave Salamander). USA: TENNESSEE: Union Co.: Chucks Swan Wildlife Management Area managed by

the Tennessee Wildlife Resources Agency located in the White Hollow Quad (36°21'24"N, 83°55'30"W, NAD 83). 3 April 2005. W. Mark Thurman, Jon M. Davenport, and Josh R. Ennen. Austin Peay State University Museum of Zoology, APSU 17705. Verified by A. Floyd Scott. Adult in crevice of cave opening. New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. Hard copy and Internet versions, the latter of which includes links to information on Tennessee herpetology having appeared since 1996, http://www.apsu.edu/amatlas/; accessed 20 December 2005).

Voucher specimens collected under authority of Tennessee Wildlife Resources Agency; field work supported by Tennessee Wildlife Resources Agency and Austin Peay State University.

Submitted by **JOSHUA R. ENNEN** (e-mail: Joshua.Ennen@usm.edu) and **JON M. DAVENPORT**, Austin Peay State University, Clarksville, Tennessee 37040,USA; **W. MARK THURMAN,** Tennessee Wildlife Resources Agency, 464 Industrial Blvd., Crossville, Tennessee 38555, USA.

NECTURUS MACULOSUS (Mudpuppy). USA: ILLINOIS: HENDERSON CO.: large adult salamander was live caught in a standard commercial fishing hoop-net in the Mississippi River near Dallas City, Illinois. 12 January 2004. Collected by Ron Newman, commercial fisherman. Illinois Natural History Survey (INHS 19580). Verified by Chris Phillips. Specimen is a first county record (Phillips 1999. Field Guide to Amphibians and Reptiles of Illinois).

Submitted by **JOHN K. TUCKER, JAMES T. LAMER,** and **CHAD R. DOLAN,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

NOTOPHTHALMUS PERSTRIATUS (Striped Newt). USA: FLORIDA: LEVY CO.: Goethe State Forest (29°32'0.5"N, 82°36'21.7"W). 7 March 2006. Collected by Clinton P. Smith, Libby Zimmerman, and James Blush. Verified by Kenneth L. Krysko. Florida Museum of Natural History, University of Florida (UF 146015, UF 146033). County record (Franz and Smith 1993. Distribution and Status of the Striped Newt and Florida Gopher Frog in Peninsular Florida, Report to Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program, Tallahassee. 74 pp.). Three individuals (paedomorphic and terrestrial adults) were dipnetted from a prairie pond. A previous specimen was observed in Levy Co. by L. Zimmerman in February 2005 (29°21'42.6"N, 82°35'56.4"W) but no voucher specimen was collected. This closes a range gap for the species, which has been observed from adjacent counties. This new population is located ca. 1 km S of an adjacent population in Alachua Co. (voucher specimens collected 16 March 2006, UF 146012 and 24 March 2006, UF 146020).

Submitted by **CLINTON P. SMITH**, Florida Fish and Wildlife Conservation Commission, Gainesville, Florida 32601, USA (e-mail: sscpsmith@hotmail.com); and **LIBBY ZIMMERMAN**, Division of Forestry, Dunnellon, Florida 34431, USA.

NOTOPHTHALMUS VIRIDESCENS (Eastern Newt). USA: ILLINOIS: JERSEY CO.: Salamanders were live caught by minnow-fyke net in Doc's pond on the premises of Principia College, N 731407 and W 4313891, zone 15 using NAD27 CONUS map datum in UTM's. 20 April 2006, 2030 h. Five specimens collected by James T. Lamer and John K. Tucker, Illinois Natural History Survey (INHS 19963–19967). Verified by Chris Phillips, Illinois Natural History Survey. First county records (Phillips 1999. Field Guide to Amphibians and Reptiles of Illinois). Approximately 70 newts were caught in two minnow-fykes during a 24 h set. Both males and females displaying breeding characteristics were captured.

Submitted by **MARY JANE S. HOFF,** Principia College, Elsah, Illinois 62028, USA; **JAMES T. LAMER, JOHN K. TUCKER,** and **CHAD R. DOLAN,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

PLETHODON ALBAGULA (Western Slimy Salamander). USA: TEXAS: EDWARDS CO.: 6.4 air km WSW Camp Wood (29°39'00.6"N; 100°05'31.6"W). 28 January 2006. Texas Cooperative Wildlife Collections, TCWC 90870–90872. 13.6 road km N Jct FM 2631 on FM 355 (29°55'40.9"N; 100°00'48.1"W). 28 January 2006. TCWC 90873–90874. New county record and westernmost known records for the species (Dixon 2000. Amphibians and Reptiles of Texas. Second Ed. Univ. of Texas A&M Press, viii + 421 pp.). All material collected by Toby J. Hibbitts and verified by James R. Dixon.

Submitted by **TOBY J. HIBBITTS**, Texas Cooperative Wildlife Collections, Department of Wildlife and Fisheries Sciences, Texas A&M University, 2258 Tamu, College Station, Texas 77843-2258, USA; e-mail: thibbitts@tamu.edu.

PLETHODON DORSALIS (Northern Zigzag Salamander). USA. TENNESSEE: CAMPBELL CO.: Norris Dam State Park located in Norris Quad (NAD 27, UTM Zone16, Easting 759030, Northing 4014830). 11 March 2006. John E. Copeland, Daniel Douglas, and Eric Good. Austin Peay State University Museum of Zoology, APSU 18166–18167. Verified by A. Floyd Scott. One specimen caught under a log and one under a coverboard. New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

Submitted by **JOHN E. COPELAND** (e-mail: john.copeland@lmunet.edu), **DANIEL DOUGLAS**, and **ERIC GOOD**, Department of Mathematics and Natural Sciences, Lincoln Memorial University, Harrogate, Tennessee 37752, USA.

PLETHODON DORSALIS (Northern Zigzag Salamander). USA: TENNESSEE: MAURY CO.: Twilight zone of Pompie Cave (Tennessee Cave Survey Num. MU19) in Yanahli Wildlife Management Area (35°32'42"N, 86°53'25"W). 2 January 2006. Matthew L. Niemiller and Brian T. Miller. Verified by A. Floyd Scott. Color photo voucher in Austin Peay State University Herpetological Collection (APSU 18182). First county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

Submitted by **MATTHEW L. NIEMILLER** and **BRIAN T. MILLER**, Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee 37132, USA (e-mail: bmiller@mtsu.edu).

PLETHODON GLUTINOSUS (Northern Slimy Salamander). USA: TENNESSEE: BEDFORD Co.: Vicinity of Warren Springs, 3.4 km NE of the town of New Herman (35°21'03"N, 86°24'34"W). 27 April 2006. Brad M. Glorioso and Matthew L. Niemiller. Verified by Brian T. Miller. Voucher specimen in Herpetology Collection at Middle Tennessee State University (MTSU 343C). First county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

Submitted by **BRAD M. GLORIOSO**, Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee, 37132, USA (e-mail: bmg2g@mtsu.edu); and **MATTHEW L. NIEMILLER,** Department of Ecology and Evolutionary Biology, The University of Tennessee, Knoxville, Tennessee 37996, USA (e-mail: mniemill@utk.edu).

SIREN INTERMEDIA. (Lesser Siren). USA: TENNESSEE: FAYETTE Co.: Wolf River Wildlife Management Area managed by the Tennessee Wildlife Resources Agency located in the SE Moscow Quad (35.031960°N, -89.266790°W, NAD 83). 12 July 2006. Daniel Stanfield and Tom Pratt of the Tennessee Wildlife Resources Agency. Austin Peay State University Museum of Zoology (APSU 18214). Verified by A. Floyd Scott. One specimen found in a minnow trap at Mineral Slough. Air temperature at collection was 31°C. New county record that extends the range of the species in Tennessee into the eastern portion of Fayette Co. (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. [Hard copy and Internet versions, the latter of which includes links to information on Tennessee herpetology having appeared since 1996], http://www.apsu.edu/amatlas/, accessed 22 August 2006).

Voucher image collection made under the authority of the Tennessee Wildlife Resources Agency; field work supported by State Wildlife Grant (SWG) funding under the authority of the U.S. Fish and Wildlife Service.

Submitted by **CHRIS HUNTER**, Tennessee Wildlife Resources Agency Region I, 200 Lowell Thomas Drive, Jackson, Tennessee 38301, USA; e-mail: christopher.hunter@state.tn.us.

SIREN INTERMEDIA NETTINGI (Western Lesser Siren). USA: ARKANSAS: CLEVELAND Co.: Backwaters of Saline River at U.S. Hwy. 79, 56 km NE of Kingsland (Sec. 27, T9S, R11W). 28 October 2005. Henry W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 30136). Verified by Stanley E.Trauth. New county record in southern Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

Submitted by **HENRY W. ROBISON**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA; e-mail: hwrobison@saumag.edu.

SIREN INTERMEDIA NETTINGI (Western Lesser Siren). USA: TEXAS: MATAGORDA Co.: Specimen collected from the stomach of a female American Alligator with a SVL of 99.1 cm. The alligator was captured in Brant Lake on the Mad Island Wildlife Management Area by Marc Ealy, Kevin Kriegel, Todd Merendino, and Matt Nelson (28°41.322'N, 96°02.618'W) on 30 June 2005. The alligator was lavaged and released in Brant Lake. Diet analysis was conducted at Texas A&M University (TCWC 91579). Verified by Toby Hibbitts. New county record (Dixon 2000. Amphibians and Reptiles of Texas, Second edition, Texas A&M Univ. Press, College Station. 421 pp.). Fills in the hiatus between Brazoria and Calhoun counties.

Submitted by **KJ LODRIGUE, JR.**, Texas A&M University, Department of Wildlife & Fisheries Sciences, College Station, Texas 77843-2258, USA.

ANURA

ACRIS GRYLLUS GRYLLUS (Southern Cricket Frog). USA: NORTH CAROLINA: ANSON Co.: 4.2 km NW Pee Dee (34°57'57"N, 79°55'15"W). 16 June 2006. J. C. Beane and L. T. Pusser. Verified by Alvin L. Braswell. North Carolina State Museum of Natural Sciences (NCSM 70971). New county record. Extends range west of Pee Dee River and ca. 17 km WNW of nearest records in Richmond Co. (NCSM files). Martof et al. (1980. Amphibians and Reptiles of the Carolinas and Virginia, University of North Carolina Press, Chapel Hill, 264 pp.).

Submitted by **JEFFREY C. BEANE**, North Carolina State Museum of Natural Sciences, Research Laboratory, 4301 Reedy Creek Road, Raleigh, North Carolina 27607, USA (e-mail: jeff.beane@ncmail.net); and **L. TODD PUSSER**, P.O. Box 122, West End, North Carolina 27376 USA (e-mail: tpusser@nc.rr.com).

APLASTODISCUS (= HYLA) SIBILATUS. BRAZIL: ALAGOAS: Murici Municipality, Fazenda Bananeira (09°15'S, 35°50'W, 550 m elev.). 16 November 2005. M. G. De Lima, G. Skuk, C. A. G. Cruz, M. Cardoso da Silva. Museu de História Natural da Universidade Federal de Alagoas, Maceió, Alagoas (MUFAL 5853–5854). Verified by C. A. Gonçalves da Cruz. Previously known from the municipalities of Cairu, Ibirapitanga, Itamari, and Santa Terezinha, Bahia State, northeastern Brazil (Cruz et al. 2003. Bol. Mus. Nac., N. S. Zool., Rio de Janeiro. 503:1–13). First state record, extends known distribution ca. 588 km N from Cairu, Bahia State.

Submitted by **MARCELO G. DE LIMA** (e-mail: delima@graffiti.net), **GABRIEL SKUK** (e-mail: gabrielskuk@aol.com), Museu de História Natural da Universidade Fedral de Alagoas, 57021-090, Maceió, Alagoas, Brazil; and **MONICA C. CARDOSO DA SILVA,** Departamento de Vertebrados, Museu Nacional/UFRJ, Quinta da Boa Vista, 20940-040 Rio de Janeiro, RJ, Brazil (e-mail: monicardoso@click21.com.br).

BATRACHYLA LEPTOPUS (Gray Wood Frog). CHILE: XI REGION DE AYSEN: COYHAIQUE PROVINCE: Coyhaique National Reserve (71°30'5"W, 45°31'33"S, 762 m elev.). January 2006. H. Díaz - Páez and J. C. Ortiz. Museo de Zoología de la Universidad de Concepción (MZUC 32134, juvenile, 12.76 mm SVL; MZUC 32135–32137, adult males 27.34; 31.38; and 29.01 mm SVL). Verified by C. Ubeda. Río Ibañez (72°47'13"W, 46°11'38"S, 500 m elev.). January 2006. H. Díaz-Páez and J. C. Ortiz (MZUC 32034–32035, juveniles, 14.41 and 17.75 mm SVL, respectively; and MZUC 32036, adult male, 29.17 mm SVL). Verified by Pedro

Victoriano. Cei (1962. Batracios de Chile. Ed. Universidad de Chile, Santiago de Chile. 128 pp. + cviii) states that the distribution of this species in Chile extends from Concepcion to Puerto Bueno, Magallanes, but his map shows a discontinuous distribution from Concepcion to Aysén, and one point in Puerto Bueno in Magallanes. No voucher specimens support Cei's distribution. Formas and Brieva (2000. Gen. Mol. Biol. 23:43–48) reported the species range as from Concepción (36°47'S) to Cerro Mirador (40°08'S) with a single southern voucher specimen from the insular area of Chiloé.

The specimens mentioned herein are the first vouchers from Aysén Region. They establish a new southern range limit, and extend the known range of this species ca. 386 km SW from Chiloé island (Cei 1962, *op. cit.*).

Submitted by **HELEN DÍAZ PÁEZ** and **JUAN CARLOS ORTIZ**, Departamento de Ciencias Básicas, Campus Los Ángeles, Universidad de Concepción, Casilla 341, Los Ángeles, Chile and Departamento de Zoología, Facultad de Ciencias Naturales y Oceanográficas, Universidad de Concepción, Casilla 160-C, Concepción, Chile.

BUFO DEBILIS DEBILIS (Eastern Green Toad). USA: TEXAS: KENT CO.: FM 1081, 5 mi S jct FM261 with FM1081 (33.3839°N, 100.9132°W). 25 June 2003. J. D. McVay and M. R. J. Forstner. Verified by T. LaDuc, University of Texas, Texas Natural History Collection. TNHC 62604. New county record (Dixon 2002. Amphibians and Reptiles of Texas. 2nd Ed. Texas A&M University Press, College Station, Texas. 421 pp.). Specimen represents the first record for the county and fills a regional east/west distribution gap. Specimen was collected under TPWD permit SPR-1097-912.

Submitted by **JOHN D. McVAY**, Department of Biological Sciences, Texas Tech University, Lubbock, Texas 79409, USA (e-mail: john.mcvay@ttu.edu); and **M. R. J. FORSTNER**, Department of Biology, Texas State University at San Marcos, San Marcos, Texas 78666, USA.

BUFO AMERICANUS (American Toad). USA: ILLINOIS: SCOTT CO.: Three male toads were found calling from an ephemeral pond at the junction of Rt 100 and Sand Rd. (N 711482 and W 4389337, zone 15 using NAD27 CONUS map datum in UTM's). 6 April 2006. John K. Tucker and James T. Lamer. Deposted at the Illinois Natural History Survey in Champaign/Urbana, Illinois (INHS 20021–23). Verified by Chris Phillips. First county records (Phillips 1999. Field Guide to Amphibians and Reptiles of Illinois). Several *B. americanus* were heard calling from this site. The pond bordered an agricultural field. Substrate consisted mostly of sandy soil. In addition to the *B. americanus*, *Pseudacris streckeri*, *Rana blairi*, and *R. sphenocephala* were all heard calling from this site.

Submitted by **JAMES T. LAMER, JOHN K. TUCKER,** and **CHAD R. DOLAN,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

BUFO FOWLERI (Fowler's Toad). USA: TENNESSEE: WARREN CO.: Along the Collins River, 0.8 km ENE of the town of Shellsford (35°40'29"N, 85°42'11"W). 13 June 2006. Joshua A. Miller, Jacob H. Miller, Matthew L. Niemiller, and Brian T. Miller. Verified by Vincent A. Cobb. Voucher specimen in Herpetology Collection at Middle Tennessee State University (MTSU 152A). First county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

Submitted by **JOSHUA A. MILLER, JACOB H. MILLER, MATTHEW L. NIEMILLER,** and **BRIAN T. MILLER** (e-mail: bmiller@mtsu.edu), Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee 37132, USA.

CARDIOGLOSSA SCHIOETZI (NCN). REPUBLIC OF CAMEROON: Mount Mbam, West Province (05°56'04"N, 10°43'36"E), ca. 1700 m asl. 28–29 July 2006; Mount Oku, Northwest Province (06°14'45"N, 10°30'23"E), ca. 1950 m asl. 16 August 2006. David C. Blackburn, Katherine S. Blackburn, L. Nono Gonwouo, Pien Huang, and Marcel Talla. Museum of Comparative Zoology (MCZ A-137911–15, 137926). Verified by José Rosado. Previously recorded from the Oshie-Obudu mountain ridge, including both the Obudu Plateau in the Cross River State of Nigeria and Acha Tugi in the Southwest Province of Cameroon (Amiet 1981. Ann. Fac. Sci. Yaoundé 28:117–131). These two localities represent, respectively, the northwestern and southeastern extents of the geographic range of this species. MCZ A-137911 (male; snout–urostyle length, SUL 23.2 mm), 137912 (male; SUL 24.2 mm), 137913 (male; SUL 24.4 mm), 137914 (male; 24.2 mm), and 137915 (male; SUL 24.4 mm) were collected between 1930 and 2100 h in primary forest near a small Fulani village on Mount Mbam. Many males of this species were calling from the leaf litter along the banks of a small, shallow stream. MCZ A-137926 (male; SUL 27.0 mm) was collected at 2000 h while calling from the leaf litter in the forested part of a farm along a steep bank of a small, shallow stream in Elak-Oku village on Mount Oku. In life, specimens were a grayish light tan with brown dorsal markings and black inguinal and lateral markings. Based on lateral and ventral coloration and pattern, as well as call structure, these specimens correspond to *C. schioetzi* and not the closely related *C. melanogaster*. The nearest previously reported locality for *C. schioetzi* is Acha Tugi, which is ca. 75 km from Mount Oku and ca. 100 km from Mount Mbam. These two new records significantly extend the range of this species, which was recently evaluated to be endangered (IUCN et al. 2006 <www.globalamphibians.org>).

Submitted by **DAVID C. BLACKBURN**, Department of Organismic and Evolutionary Biology, Harvard University, 26 Oxford Street, Museum of Comparative Zoology, Cambridge, Massachusetts 02138, USA; e-mail: dblackb@fas.harvard.edu.

CHAUNUS POMBALI (NCN). BRAZIL: ESPIRITO SANTO: Nova Lombardia (19°54.053'S, 40°29.897'W, 512 m elev.), Museu de Biologia Prof. Mello Leitão, Santa Teresa, Espírito Santo (MBML 4648); Vargem Alta (19°55.408'S, 40°38.838'W, 862 m elev.), MBML 4646 and 4649; and Pousada Paradiso (19°55.558'S, 40°35.416'S, 684 m elev.), MBML 4647. All collected 20–25 April 2006 by D. Rödder and G. J. Guarnirei and verified by M. Hoffmann. Species known from Atlantic Rain Forest and transitional areas with the Cerrado in the state of Minas Gerais, Brazil (Baldisseria et al. 2004. Arquivos do Museu Nacional, Rio de Janeiro 62:255–282). First state record, extends the distribution

200 km eastward from Parque Nacional do Caparaó, Minas Gerais, Brazil.

Submitted by **DENNIS RÖDDER**, Zoologisches Forschungsmuseum Alexander Koenig, Adenauer Allee 160, D-53113 Bonn, Germany (e-mail: d.roedder.zfmk@uni-bonn.de); **GRACIMÉRIO J. GUARNIREI**, Rua São Lourenço, 1093 Santa Teresa, Espírito Santo, Brazil (e-mail: gracimerio@yahoo.com.br); and **ROGÉRIO L. TEIXEIRA**, Museu de Biologia Prof. Mello Leitão, Av. José Ruschi, 4, Centro, 29650-000, Santa Teresa, Espítio Santo, Brazil (e-mail: rogeteix@terra.com.br).

ELEUTHERODACTYLUS COQUI (Coqui). UNITED STATES VIRGIN ISLANDS: St. John: Cruz Bay, grounds of Westin Resort (18°19.456'N, 64°47.047'W). 22 May 2002. J. Hardin Waddle. Verified by Kenneth L. Krysko. Virgin Islands National Park Collection (VIIS 41480–41482). First record for St. John, although *E. coqui* is known from St. Thomas and St. Croix (Schwarz and Henderson 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distribution, and Natural History. Univ. Florida Press, Gainesville, Florida, 720 pp.). The three specimens were collected near a drainage ditch located in a landscaped and irrigated area.

Submitted by **J. HARDIN WADDLE**, U.S. Geological Survey, Box 110485, University of Florida, Gainesville, Florida 32611-0485, USA (e-mail: hardin_waddle@usgs.gov); **MARQUETTE E. CROCKETT**, Florida Cooperative Fish and Wildlife Research Unit, Box 110485, University of Florida, Gainesville, Florida 32611-0485; and **KENNETH G. RICE**, U.S. Geological Survey, Florida Integrated Science Center, 3205 College Avenue, Ft. Lauderdale, Florida 33314, USA.

ELETHERODACTYLUS MEDEMI (NCN). COLOMBIA: CAQUETA: Municipio de Florencia, Corregimiento El Caraño, Vereda Las Brisas (01°42'17"N, 75°43'26"W), ca 1300 m elev. 27 June 2005. C. Malambo-L. and A. Marin-V. Museo de Historia Natural Universidad de la Amazonia, Florencia-Caquetá, Colombia (UAM 438–439). Verified by J. D. Lynch. This species, endemic to Colombia, was previously known only from the departments of Cundinamarca and Meta (Lynch 1994. Rev. Acad. Colomb. Cienc. 19[72]:187–193; Lynch 2006. Caldasia 28[1]:135–155) with the southernmost record in the Municipio de Cubarral (ca. 03°35'N, 73°35'W). First department record and the southernmost for the species, extends known range ca. 312 km south from the previous southern record.

Submitted by **CESAR MALAMBO-L.** (e-mail: malambocesar@latinmail.com) and **ANATOLY MARIN-V.** (e-mail: kuposqui@yahoo.com.mx), Museo de Historia Natural Universidad de la Amazonia, Florencia, Caquetá, Colombia.

ELEUTHERODACTYLUS PAULODUTRAI (NCN). BRAZIL: ALAGOAS: Quebrangulo: Reserva Ecológica de Pedra Talhada (09°19'S, 36°28'W, 370 m elev.). 22 May 2006. M. G. de Lima, B. V. S. Pimenta, C. A. G. Cruz, and G. O. Skuk. Verified by B. V. S. Pimenta. Museu de História Natural da Universidade Federal de Alagoas, Maceió, Alagoas (MUFAL 6124–6125). Previously known from the coastal region in the State of Bahia (Napoli and Brandão 2003. Herpetol. Rev. 34:161). First state record, extends distribution ca. 666 km N from Ilhéus, State of Bahia.

Submitted by **MARCELO G. DE LIMA** (e-mail: delima@graffiti.net) and **GABRIEL O. SKUK** (e-mail: gabrielskuk@aol.com), Museu de História Natural da Universidade Fedral de Alagoas, 57021-090, Maceió, Alagoas, Brazil.

GASTROPHYRNE CAROLINENSIS (Eastern Narrow-mouthed Toad). USA: ARKANSAS: Van Buren Co.: Wooded area 3.2 km N of Gravesville (Sec. 23, T9N, R13W). 28 April 2006. Henry W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 30132). Verified by Stanley E. Trauth. New county record in northern portion of state (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

Submitted by **HENRY W. ROBISON**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA: e-mail: hwrobison@saumag.edu.

HYLA ARENICOLOR (Canyon Treefrog). USA: UTAH: Iron Co.: Kanarraville, at mouth of Spring Creek Canyon (37°21.20'N, 113°10.90'W, datum: NAD27/WGS84), 1722 m elev. 18 May 2006. J. H. Reed. Verified by J. Sites. Two specimens (pair found in amplexus) deposited in Monte L. Bean Museum (BYU 5870–5871). Three additional individuals observed in vicinity. County record. Two calling males and one adult female were found below the upstream "narrows" of the canyon at 37°30.65'N, 113°9.99'W in late April. By early June, there were tadpoles from the narrows down to about the mouth of the canyon. By 27 June the stream was intermittent at the mouth, but there were still a few tadpoles as low as 37°31.24'N, 113°11.06'W (1714 m elev.). 62 tadpoles were in an isolated pool at 37°31.24'N, 113°11.02'W (1720 m elev.). The stream became continuous above 37°31.18'N, 113°10.90'W (1727 m elev.) and there were abundant tadpoles upstream to the narrows from that point on. In early July, a flash flood washed out most of the tadpoles; those left were in the lower section from 37°31.09'N, 113°10.72'W (1738 m elev.) and lower. A calling male and an adult female were observed at 37°31.12'N, 113°10.75'W (1736 m elev.) and another calling male at 37°31.15'N, 113°10.80'W (1734 m elev.). No adults or tadpoles were ever found above the narrows, and the stream was completely dry throughout the narrows by 14 July. Extensive explorations have failed to document *H. arenicolor* in Kanarra Creek, the next drainage to the north. Spring Creek thus appears to be the northerly limit of the species along the Hurricane Cliffs faultline of southwest Utah.

Submitted by **ROBERT N. REED** (e-mail: robert_reed@usgs.gov), **MARK GROVER** (e-mail: grover@suu.edu), and **JOHN H. REED**, Department of Biology, Southern Utah University, Cedar City, Utah 84720, USA. Present address of RNR: Invasive Species Science Branch, USGS Fort Collins Science Center, 2150 Centre Ave, Bldg C, Fort Collins Colorato 80526, USA.

HYLA CINEREA (Green Treefrog). USA: ARKANSAS: Sharp Co.: near Co. Rd 64, 3.2 km E jct with Co. Rd 51, ca. 5 km SE of Hardy. 10 September 2005. Josh Engelbert and Jacob Sawyer. Verified by Chris T. McAllister. Arkansas State University Museum of Zoology Herpetology Collection (ASUMZ 29401). New county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville, 421 pp.).

Submitted by **JOSH R. ENGELBERT** (e-mail: okieherper@yahoo.com), **JACOB A. SAWYER** (e-mail: jacob.sawyer@smail.astate.edu), and **STANLEY E. TRAUTH**, Department of Biological Sciences, P.O. Box 599, State University, Arkansas 72467, USA (e-mail: strauth@astate.edu).

HYLA CINEREA (Green Tree Frog). USA: ILLINOIS: JERSEY Co.: Large chorus of *H. cinerea* was heard calling from Lower Stump Lake, a backwater lake along the Illinois River (N 0711520 and W 4318112, zone 15 using NAD27 CONUS map datum in UTM's). 3 June 2006. John K. Tucker and James T. Lamer. Illinois Natural History Survey in Champaign/Urbana, Illinois (INHS 20052–58). Verified by Chris Phillips. First county records (Phillips 1999. Field Guide to Amphibians and Reptiles of Illinois). This record is the northernmost record of this species reported from Illinois. The frogs were calling from dead stalks of Rough Cocklebur (*Xanthium strumarium*). Collected on clear night with scattered lightning. Large chorus also heard calling from Upper Stump Lake only separated from Lower Stump by a narrow levee.

Submitted by **JOHN K. TUCKER, JAMES T. LAMER,** and **CHAD R. DOLAN,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

HYLA CINEREA (Green Treefrog). USA: TEXAS: FAYETTE Co.: 3.84 road km N FM 1291 on Haw Creek Road (29°58'14.6"N; 96°39'50.2"W). 2 May 2006. David Laurencio and Toby J. Hibbitts. Verified by James R. Dixon. Texas Cooperative Wildlife Collections, TCWC 90942–90944. New county record (Dixon 2000. Amphibians and Reptiles of Texas. Second Ed. Univ. of Texas A&M Press, viii + 421 pp.).

Submitted by **DAVID LAURENCIO** and **TOBY J. HIBBITTS**, Texas Cooperative Wildlife Collections, Department of Wildlife and Fisheries Sciences, Texas A&M University, 2258 Tamu, College Station, Texas 77843-2258, USA (e-mail: thibbitts@tamu.edu).

HYLA FEMORALIS (Pine Woods Treefrog). USA: NORTH CAROLINA: ANSON Co.: 4.2 km NW Pee Dee (34°57'57"N, 79°55'15"W). 16 June 2006. J. C. Beane and L. T. Pusser. Verified by Alvin L. Braswell. North Carolina State Museum of Natural Sciences (NCSM 70973). New county record. Extends range west of Pee River and ca. 28 km W of nearest records in Richmond Co. (NCSM files) (Martof et al. 1980. Amphibians and Reptiles of the Carolinas and Virginia, University of North Carolina Press, Chapel Hill, 264 pp.).

Submitted by **JEFFREY C. BEANE**, North Carolina State Museum of Natural Sciences, Research Laboratory, 4301 Reedy Creek Road, Raleigh, North Carolina 27607, USA (e-mail: jeff.beane@ncmail.net); and **L. TODD PUSSER**, P.O. Box 122, West End, North Carolina 27376, USA (e-mail: tpusser@nc.rr.com).

HYLA GRATIOSA (Barking Treefrog). USA: NORTH CAROLINA: ANSON Co.: 4.2 km NW Pee Dee (34°57'57"N, 79°55'15"W). 16 June 2006. J. C. Beane and L. T. Pusser. Verified by Alvin L. Braswell. North Carolina State Museum of Natural Sciences (NCSM 70974). New county record. Extends range west of Pee Dee River and ca. 25 km WSW of nearest records in Richmond Co. (NCSM files) (Martof et al. 1980. Amphibians and Reptiles of the Carolinas and Virginia, University of North Carolina Press, Chapel Hill, 264 pp.).

Submitted by **JEFFREY C. BEANE**, North Carolina State Museum of Natural Sciences, Research Laboratory, 4301 Reedy Creek Road, Raleigh, North Carolina 27607, USA (e-mail: jeff.beane@ncmail.net); and **L. TODD PUSSER**, P.O. Box 122, West End, North Carolina 27376, USA (e-mail: tpusser@nc.rr.com).

HYLA SQUIRELLA (Squirrel Treefrog). USA: NORTH CAROLINA: ANSON Co.: 4.2 km NW Pee Dee (34°57'57"N, 79°55'15"W). 16 June 2006. J. C. Beane and L. T. Pusser. Verified by Alvin L. Braswell. North Carolina State Museum of Natural Sciences (NCSM 70975). New county record (NCSM files). Fills gap between Richmond and Union counties and part of range hiatus shown in Conant and Collins (1998. A Field Guide to Reptiles and Amphibians of Eastern and Central North America, Third Edition, Expanded, Houghton Mifflin Company, Boston and New York, 616 pp.) and in Martof et al. (1980. Amphibians and Reptiles of the Carolinas and Virginia, University of North Carolina Press, Chapel Hill, 264 pp.).

Submitted by **JEFFREY C. BEANE**, North Carolina State Museum of Natural Sciences, Research Laboratory, 4301 Reedy Creek Road, Raleigh, North Carolina 27607, USA (e-mail: jeff.beane@ncmail.net); and **L. TODD PUSSER**, P.O. Box 122, West End, North Carolina 27376, USA (e-mail: tpusser@nc.rr.com).

HYMENOCHIRUS CURTIPES (NCN). REPUBLIC OF CONGO (Congo Brazzaville): LIKOUALA DISTRICT: near Ganganya Brousse (01°30.848'N, 17°56.272'E), 318 m elev. 9 November 2005, 0900 h. Kate Jackson. National Museum of Natural History, Smithsonian Institution (USNM 563881–82). Previously reported in the Democratic Republic of Congo (Congo Kinshasa), in the provinces Bas-Congo, Kinshasa, Bandundu, and Equateur (Bourgeois 1961. Mus. Roy. Afr. Centrale, Tervuren, Ser: 8, 103[8]:169–183; Noble 1924. Bull. Amer. Mus. Nat. Hist. 49:147–347; Witte 1930. Rev. Zool. Bot. Afr. 19:232–274; Witte 1934. Ann. Mus. Congo Belge. Zool. Ser: 1, 3, 4:153–188). This pair was found in amplexus, resting against a fish-net on the surface of water ca. 1 m deep, in seasonally flooded forest. A photograph of USNM 563881 can be viewed at <www.amphibiaweb.org>. First report of the genus from the Republic of Congo.

Submitted by **KATE JACKSON**, Department of Zoology, University of Toronto, 25 Harbord Street, Toronto, Ontario, M5S 2R5, Canada (e-mail: k.jackson@utoronto.ca); and **MANFRED BEIER**, Institute of Human Genetics, University of Duesseldorf, Universitätsstr. 1, 40225 Duesseldorf, Germany.

HYPOPACHUS VARIOLOSUS (Sheep Frog). BELIZE: BELIZE DISTRICT: Crooked Tree Village (17°45'N, 88°32'W). 16 June 2005. Donna S. McCollum. Verified by Julian C. Lee. Cincinnati Museum Center (CMNH HP 242). New district record (Lee 1996. The Amphibians and Reptiles of the Yucatan Peninsula. Cornell University Press, Ithaca, New York).

Submitted by **JEFFREY G. DAVIS**, Cincinnati Museum Cen-

ter – Fredrick and Amye Geier Research and Collections Center, 1301 Western Avenue, Cincinnati, Ohio 45203-1130, USA (e-mail: anura@fuse.net); and **DONNA S. McCOLLUM**, School of Interdisciplinary Studies, Miami University, Oxford, Ohio 45056, USA (e-mail: mccollds@muohio.edu).

HYPSIBOAS FREICANECAE (NCN). BRAZIL: ALAGOAS: Murici, Fazenda Bananeiras (09°13'S, 35°52'W). 14–18 November 2005. Museu Nacional, Universidade Federal do Rio de Janeiro, Brazil (MNRJ 40896–40900). Verified by U. Caramaschi. Previously known only for the type locality: Municipality of Jaqueira, Pernambuco, Brazil (Carnaval and Peixoto 2004. Herpetologica 60[3]:387–395). First state record, extends southern range ca. 56 km airline from the type locality.

Submitted by **MONICA C. S. CARDOSO** (e-mail: monicardoso@click21.com.br) and **CARLOS ALBERTO G. CRUZ** (e-mail: cagcruz@uol.com.br), Departamento de Vertebrados, Museu Nacional/UFRJ, Quinta da Boa Vista, 20940-040 Rio de Janeiro, RJ, Brazil; **MARCELO G. DE LIMA** (e-mail:delima@graffiti.net) and **GABRIEL SKUK** Departamento de Zoologia, Universidade Federal de Alagoas, Praça Afrânio Jorge, 57072-970, Maceió, AL, Brazil (e-mail: gabrielskuk@aol.com).

PSEUDACRIS CRUCIFER (Spring Peeper). USA: ILLINOIS: McDonough Co.: Campus of Western Illinois University, Macomb, Illinois in an ephemeral pool, ca. 50 m from a branch of the Lamoine River (N 0695928 and W 4482919, zone 15 using NAD27 CONUS map datum in UTM's). 31 March 2006. James T. Lamer and John K. Tucker. Illinois Natural History Survey in Champaign/Urbana, Illinois (INHS 19979–80). Verified by Chris Phillips, Specimens are first county records (Phillips 1999. Field Guide to Amphibians and Reptiles of Illinois). The frogs were found in amplexus at an air temperature of 10°C at 2322 h. Both *P. triseriata* and *P. crucifer* were calling from this site.

Submitted by **JAMES T. LAMER, JOHN K. TUCKER,** and **CHAD R. DOLAN,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

PSEUDACRIS CRUCIFER (Spring Peeper). USA: ILLINOIS: Pike Co.: Illinois Rt. 104, E of Meredosia, Illinois (N 0700965 and W 4410073, zone 15 using NAD27 CONUS map datum in UTM's). 30 March 2006, 2339 h, during a slow, steady rain. James T. Lamer, John K. Tucker, and Chad R. Dolan. Illinois Natural History Survey in Champaign/Urbana (INHS 19978). Verified by Chris Phillips. Specimen is a first county record (Phillips 1999. Field Guide to Amphibians and Reptiles of Illinois).

Submitted by **JAMES T. LAMER, CHAD R. DOLAN,** and **JOHN K. TUCKER,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

PHYLLODYTES LUTEOLUS. BRAZIL: RIO DE JANEIRO: Municipality of São João da Barra: Grussaí (21°44'S, 41°02'W). 8–10 November 1999. F. H. Hatano, C. F. D Rocha, and D. Vrcibradic. Museu Nacional, Rio de Janeiro (MNRJ 42416–19). Verified by José P. Pombal Jr and Mônica C. S. Cardoso. Individuals were collected in restinga habitat, inside ground bromeliads. The species appeared to be locally abundant, as numerous individuals were heard calling from inside bromeliads. *Phyllodytes luteolus* is reported to occur from the states of Paraíba to Espírito Santo (Frost 2004. Amphibian Species of the World: An Online Reference. Version 3.0, http://research.amnh.org/herpetology/amphibia/index.html). First record for the state of Rio de Janeiro and southernmost record for the species (and for the genus as well), extending its distribution ca. 125 km to the southwest of Guarapari, in the state of Espírito Santo, the previous southernmost reported locality (Bokermann 1966. An. Acad. Bras. Ciênc. 38:335–344; Peixoto and Cruz 1988. Rev. Brasil. Biol. 48:265–272).

Submitted by **DAVOR VRCIBRADIC, FÁBIO H. HATANO, CARLOS FREDERICO D. ROCHA,** and **MONIQUE VAN SLUYS**, Departamento de Ecologia, Universidade do Estado do Rio de Janeiro, 20550-011, Rio de Janeiro, RJ, Brazil.

RANA AREOLATA (Crawfish Frog). USA: ILLINOIS: Franklin Co.: DOR, Fitzgerrell Park road within Wayne Fitzgerrell State Park (N 0330390 and W 4219034, zone 16 using NAD27 CONUS map datum in UTM's). 9 March 2006. Chad R. Dolan and James T. Lamer. Illinois Natural History Survey in Champaign/Urbana, Illinois (INHS 20030). Verified by Chris Phillips. First county record (Phillips 1999. Field Guide to Amphibians and Reptiles of Illinois). This frog and several conspecifics were found dead on the road during heavy rainfall at 13.9°C air temperature at 0249 h. No *Rana areolata* were heard calling, only large choruses of Western Chorus Frogs (*Pseudacris triseriata)*.

Submitted by **CHAD R. DOLAN, JAMES T. LAMER,** and **JOHN K. TUCKER,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

RANA CAPITO AESOPUS (Florida Gopher Frog). USA: FLORIDA: Gilchrist Co.: Ft. White Mitigation Park (29°54.94'N, 82°46.88'W). November 2005. Florida Museum of Natural History (UF 145525, photo voucher). Verified by K. L. Krysko. New county record. Near mouth of active Gopher Tortoise (*Gopherus polyphemus*) burrow in sandhill habitat.

Submitted by **MELISSA P. TUCKER** and **CATHY R. HANDRICK**, Florida Fish and Wildlife Conservation Commission, 3377 East U.S. Highway 90, Lake City, Florida 32055, USA (e-mail: cathy.handrick@myfwc.com).

RANA CATESBEIANA (American Bullfrog). USA: TEXAS: Madison Co.: 9.12 road km N FM 1696 on TX 90 (30°51'24.5"N; 95°56'38.8"W). 3 May 2006. Toby J. Hibbitts and David Laurencio. Verified by James R. Dixon. Texas Cooperative Wildlife Collections, TCWC 90924. New county record (Dixon 2000. Amphibians and Reptiles of Texas. Second Ed. Univ. of Texas A&M Press, viii + 421 pp.).

Submitted by **TOBY J. HIBBITTS** and **DAVID LAURENCIO**, Texas Cooperative Wildlife Collections, Department of Wildlife and Fisheries Sciences, Texas A&M University, 2258 Tamu, College Station, Texas 77843-2258, USA (e-mail: thibbitts@tamu.edu).

RANA PALUSTRIS (Pickerel Frog). USA: TENNESSEE: Hardin Co.: Stream within Jerrolds Cave (Tennessee Cave Survey Num. HR15) (35°12'26"N, 87°59'24"W). 2 July 2006. Matthew L. Niemiller and Brian T. Miller. Verified by Vincent A. Cobb. Herpetology Collection at Middle Tennessee State University (MTSU

161A, an adult). First county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. Internet version [http://www.apsu.edu/amatlas] contains links to information regarding Tennessee distribution of amphibians recorded since 1996; accessed 01 August 2006).

Submitted by **MATTHEW L. NIEMILLER**, Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, Tennessee 37996, USA (e-mail: mniemill@utk.edu); and **BRIAN T. MILLER**, Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee 37132, USA (e-mail: bmiller@mtsu.edu).

RANA PALUSTRIS (Pickerel Frog). USA: TENNESSEE: MAURY Co.: Twilight zone of Pompie Cave (Tennessee Cave Survey Num. MU19) in Yanahli Wildlife Management Area (35°32'42"N, 86°53'25"W). 16 June 2006. Jacob H. Miller, Joshua A. Miller, Matthew L. Niemiller, and Brian T. Miller. Verified by Vincent A. Cobb. Herpetology Collection at Middle Tennessee State University (MTSU 151A). First county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

Submitted by **JACOB H. MILLER, JOSHUA A. MILLER, MATTHEW L. NIEMILLER**, and **BRIAN T. MILLER** Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee 37132, USA (e-mail: bmiller@mtsu.edu).

RANA SYLVATICA (Wood Frog). USA: NORTH DAKOTA: WARD Co.: 48°10'39.4"N, 101°17'45.2"W, Highway 83, Minot State University Applied Amphibian Field Ecology Lab, Drift Fence Site #2, NDSU Agricultural Research Station Farm Pond. 25 July 2006. Kenneth C. Cabarle. Verified by Chris Beachy. Minot State University, Cyril Moore Science Center Research Collections, curator Guy Hanley (CMSCRCDF-2006-002). First county record (Wheeler and Wheeler 1966. The Reptiles and Amphibians of North Dakota. University of North Dakota Press, Grand Forks, North Dakota). Adult collected from pitfall traps at amphibian drift fence site, semi-permanent pond in agricultural area. This locality represents an extension within this species range (Lannoo [ed]. 2005. Amphibian Declines: The Conservation Status of United States Species. University of California Press, Berkeley and Los Angeles; Wheeler and Wheeler 1966, *op. cit.*). Special thanks to Minot State University and North Dakota INBRE for funding this research.

Submitted by **KENNETH C. CABARLE**, Department of Biology, Minot State University, 500 University Avenue West, Minot, North Dakota 58707, USA; e-mail: kenneth.cabarle@minotstateu.edu.

RANA SYLVATICA (Wood Frog). USA: TENNESSEE: UNION Co.: Chucks Swan Wildlife Management Area managed by the Tennessee Wildlife Resources Agency located in the White Hollow Quad (36°20'50"N, 83°53'44"W, NAD 83). 3 April 2005. W. Mark Thurman, Jon M. Davenport, and Josh R. Ennen. Austin Peay State University Museum of Zoology, APSU 17705. Verified by A. Floyd Scott. Larvae caught in a temporary pond close to White Creek, upstream of gauging station. New county record. (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. Hard copy and Internet versions, the latter of which includes links to information on Tennessee herpetology having appeared since 1996, http://www.apsu.edu/amatlas/; accessed 20 December 2005).

Voucher specimens collected under authority of Tennessee Wildlife Resources Agency; field work supported by Tennessee Wildlife Resources Agency and Austin Peay State University.

Submitted by **W. MARK THURMAN,** Tennessee Wildlife Resources Agency, 464 Industrial Blvd., Crossville, Tennessee 38555, USA; **JOSHUA R. ENNEN** and **JON M. DAVENPORT**, Austin Peay State University, Clarksville, Tennessee 37040, USA (e-mail: Mark.Thurman@state.tn.us).

SCAPHIOPUS COUCHII (Couch's Spadefoot). USA: COLORADO: PROWERS Co.: 3.0 km W, 1.3 km N confluence of Cat Creek and Clay Creek (NAD 27, UTM Zone 13, Easting 705190, Northing 4195994). 24 July 2006. Joey Kellner and Amy Kellner. UCM Ancillary Collection 158 (toadlet: IMG 2341) and UCM-AC 159 (tadpoles: IMG 2336). Photos of tadpole and metamorph verified by Lauren J. Livo. First record for county and easternmost record in Colorado to date, expanding the known range 36 km to the SE of the nearest record in Bent Co. (Mackessy et al. 1999. Herpetol. Rev. 30:107).

Submitted by **JOEY KELLNER** and **AMY KELLNER**, 9500 South Estes Way, Littleton, Colorado 80127, USA.

SCINAX CUSPIDATUS (NCN). BRAZIL: ALAGOAS: Marechal Deodoro: Praia do Saco da Pedra (09°44'S, 35°49'W, sea level). 19 May 2006. M. G. De Lima, G. O. Skuk, C. A. G. Cruz, and B. V. S. Pimenta. Verified by B. V. S. Pimenta. Museu de História Natural da Universidade Federal de Alagoas, Maceió, Alagoas (MUFAL 6122–6123). The historical distribution of this species was the coastal region in the states of Espírito Santo, Rio de Janeiro, and Bahia (Silvano and Pimenta 2001. Herpetol. Rev. 32:273). This is a first state record, extending the distribution ca. 820 km N from Porto Seguro, Bahia State.

Submitted by **MARCELO G. DE LIMA** (e-mail: delima@graffiti.net) and **GABRIEL O. SKUK** (e-mail: gabrielskuk@aol.com), Museu de História Natural da Universidade Federal de Alagoas, 57021-090, Maceió, Alagoas, Brazil.

SCINAX SIMILIS (Cochran's Snouted Treefrog). BRAZIL: ESPIRITO SANTO: Santa Teresa, Pousada Paradiso (19°55.558'S, 40°35.416'W, 684 m elev.). 13 March 2006. R. L. Teixeira, D. Rödder, and G. J. Guarnirei. Museu de Biologia Prof. Mello Leitão, Santa Teresa, Espírito Santo (MBML 4482–4483). Linhares, Povoação, Fazenda Três Ilhas. 6 March 2001. A. P. Almeida (MBML 2409–2412). All verified by M. Hoffmann. Species known from Manguinhos, Bom Successo, and Amorim in the state of Rio de Janeiro (Cochran 1955. U.S. Nat. Mus. Bull. 206, 423 pp.). First state record, extending the distribution ca. 450 km N from the nearest known population in Manguinhos, Rio de Janeiro.

Submitted by **DENNIS RÖDDER**, Zoologisches Forschungsmuseum Alexander Koenig, Adenauer Allee 160, D-53113 Bonn, Germany (e-mail: d.roedder.zfmk@uni-bonn.de); **GRACIMÉRIO J. GUARNIREI**, Rua São Lourenço, 1093 Santa

Teresa, Espírito Santo, Brazil (e-mail: gracimério@yahoo.com.br); and **ROGÉRIO L. TEIXEIRA**, Museu de Biologia Prof. Mello Leitão, Av. José Ruschi, 4, Centro, 29650-000, Santa Teresa, Espírito Santo, Brazil (e-mail: rogeteix@terra.com.br).

SYRRHOPHUS CYSTIGNATHOIDES (Rio Grande Chirping Frog). USA: TEXAS: GRIMES CO.: Bedias, at jct FM 1696/2620 in vacant lot (30°46'31.8"N, 95°56'46.7"W). 7 May 2006. Toby J. Hibbitts and David Laurencio. Verified by James R. Dixon. Texas Cooperative Wildlife Collections, TCWC 90924. This invasive species has spread over much of southeast Texas. New county record (Dixon 2000. Amphibians and Reptiles of Texas. Second Ed. Univ. of Texas A&M Press, viii + 421 pp.).

Submitted by **TOBY J. HIBBITTS** (e-mail: thibbitts@tamu.edu) and **DAVID LAURENCIO**, Texas Cooperative Wildlife Collections, Department of Wildlife and Fisheries Sciences, Texas A&M University, 2258 Tamu, College Station, Texas 77843-2258, USA.

GYMNOPHIONA

CAECILIA CARIBEA (Pensilvania Caecilian). COLOMBIA: DEPARTMENT OF ANTIOQUIA: Medellín municipality, sector Belen (6°14'09.28"N, 75°36'37.51"W), 1580 m elev. February 1998. Donated by A. Restrepo. Museo de Herpetología Universidad de Antioquia, Medellín, Colombia (MHUA 3915). Verified by J. D. Lynch. Previously known only from the type locality: southern tributary stream of Samana River, Pensilvania municipality, Department of Caldas, Colombia (Lynch 2000 "1999." Rev. Acad. Colomb. Cienc. 23:317–337). *C. caribea* has been reported in Antioquia (Ruiz et al. 1996. Rev. Acad. Colomb. Cienc. 20:365–415), but an exact locality was not provided and a voucher is not available. This specimen is the first documented record for Antioquia and extends the distribution toward the northern part of Cordillera Central ca. 106 km NW from the type locality.

Submitted by **MAURICIO RIVERA-CORREA**, Grupo Herpetológico de Antioquia (GHA), Instituto de Biología, Universidad de Antioquia, Laboratorio 7-121, A.A. 1226, Medellín, Colombia; e-mail: mauriciorivera79@yahoo.com.ar.

CROCODILIA

CROCODYLUS ACUTUS (American Crocodile). USA: FLORIDA: MONROE CO.: Dry Tortugas: Dry Tortugas National Park, East Key, (24°38'57.6"N, 82°48'18.5"W). 24 May 2002. Michael S. Cherkiss, Oron L. Bass, Jr., and Frank J. Mazzotti. Photograph voucher deposited in the Everglades National Park, SFCMC Collection (DRTO 3545). Verified by John Thorbjarnarson. The historical geographic distribution of *C. acutus* in Florida included southern mainland Florida (Kushlan and Mazzotti 1989. J. Herpetol. 23:1–7) to the lower Florida Keys, with a photograph taken of a crocodile in 1935 on a beach in Key West (Neill 1971. The Last of the Ruling Reptiles: Alligators, Crocodiles, and Their Kin. 486 pp.). Recent sightings in Key West include an individual ca.1.5 m total length sighted swimming along a beach and a crocodile 2.5 m total length captured within a lagoon adjacent to a residential community (O'Hara 2005. Key West Citizen, 22 August 2005; MSC, pers. obs.). Here we report a specimen of *C. acutus* ca. 2.5 m total length observed in the Dry Tortugas National Park, marking the most isolated distribution within U.S. borders.

Submitted by **MICHAEL S. CHERKISS** (e-mail: mcherkis@ufl.edu) and **FRANK J. MAZZOTTI** (e-mail: fjma@ufl.edu), Department of Wildlife Ecology and Conservation, Fort Lauderdale Research and Education Center, University of Florida, 3205 College Avenue, Davie, Florida 33314, USA; **ORON L. BASS, JR.**, South Florida Natural Resources Center, Everglades National Park, 40001 State Road 9336, Homestead, Florida 33034, USA (e-mail: sonny_bass@nps.gov).

TESTUDINES

CHELYDRA SERPENTINA (Snapping Turtle). USA: ILLINOIS: CASS CO.: Beardstown Illinois, near 6th Street, West of US 67 (T18N, R12W, Section 16SE). 26 April 2001. John K. Tucker. Verified by Chris Phillips. Illinois Natural History Survey in Champaign/Urbana, Illinois (INHS 20031). First county record (Phillips 1999. Field Guide to Amphibians and Reptiles of Illinois). Turtle was removed from a pit along a drift fence which was constructed on sandy dredge spoil located along a backwater of the Illinois River.

Submitted by **JOHN K. TUCKER, JAMES T. LAMER,** and **CHAD R. DOLAN,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

CHRYSEMYS PICTA (Painted Turtle). USA: WASHINGON: WHITMAN CO.: Route 23, Ewan (47°07.020'N, 117°43.773'W), 515 m elev. 16 September 2006. Alex Dornburg. Verified by Kenneth V. Kardong. Color photo voucher deposited in the Washington State University Conner Museum Collection (CRCM–P–25). Adult found basking alongside roadway near drainage. Ambient temperature was 27°C. First county record. This record fills a gap in distribution data, as this species is found in neighboring Adams, Lincoln, Spokane, and Walla Walla counties (Hallock and McAllister 2005. Washington Herp Atlas. http://www.dnr.wa.gov/nhp/refdesk/herp/).

Submitted by **ALEX DORNBURG** (e-mail:dornburgalex@yahoo.com) and **ROBERT E. WEAVER,** School of Biological Sciences, Washington State University, Pullman, Washington 99164, USA (e-mail: weaverr@wsu.edu).

GRAPTEMYS OUACHITENSIS OUACHITENSIS (Ouachita Map Turtle). USA: KANSAS: KINGMAN CO.: Taken in a turtle trap in Smoots Creek just north of the South Fork of Ninnescah River (37°34.66'N, 97°49.813'W) on 15 October 2004. Shawn W. Casley. Natural History Museum, University of Kansas color slides (KU CT 11936–43). Verified by Lynnette Sievert. New county record (Taggart 2006. Kansas Herpetofaunal Atlas: an online reference. http://webcat.fhsu.edu/ksfauna/herps/index.asp?page=species). Three males were collected in a turtle trap using beef liver as bait. The turtles were photographed and are presently alive at Emporia State University in the Department of Biological Sciences.

Submitted by **SHAWN W. CASLEY** and **GREG SIEVERT,** Department of Biological Sciences, Emporia State University, Emporia, Kansas 66801, USA (e-mail: gsievert@emporia.edu).

GRAPTEMYS PSEUDOGEOGRAPHICA KOHNII (Mississippi Map Turtle). USA: TEXAS: Colorado Co.: Intact and identifiable mummified remains were found amid flood debris, 1.42 km NW of the intersection between FM 949 and Frelsburg Road on FM 949 (29.73949°N, -96.41312°W). 18 June 2006. J. Duvall and M.R.J. Forstner. Verified and accessioned by Toby Hibbits, Curator of Herpetology, Texas Cooperative Wildlife Collection (TCWC 91303). Skin samples were retained in ethanol at Texas State University (MJF 11019). First occurrence west of the Brazos River drainage system and first county record (Dixon 2000. Amphibians and Reptiles of Texas. 2nd ed. Texas A&M Univ. Press, College Station).

Submitted by **DAVID RODRIGUEZ, JOSEPHINE DUVALL,** and **MICHAEL R.J. FORSTNER,** Texas State University, San Marcos, Texas 78666, USA (e-mail: daverdz5@yahoo.com).

KINOSTERNON SUBRUBRUM HIPPOCREPIS (Mississippi Mud Turtle). USA: TEXAS: Aransas Co.: 28°14'18.5"N, 67°48'15.3"W. 01 August 2006. Curtis Jones. Verified by Lee Fitzgerald. New county record (Dixon et al. 2000. Amphibians and Reptiles of Texas. Texas A&M University Press, College Station. 195 pp. Map 45). Adult found crossing road on the Aransas National Wildlife Refuge. Because of recent rain events there was an abundance of standing water.

Submitted by **CURTIS JONES**, Aransas National Wildlife Refuge, P.O. Box 100 Austwell, Texas 77950, USA.

LEPIDOCHELYS KEMPII (Kemp's Ridley Seaturtle). USA: FLORIDA: Brevard Co.: Canaveral National Seashore, Playalinda Beach (UTM 17 533727 E, 317327 N). 13 June 2006. Florida Museum of Natural History photo voucher (UF 149613). Verified by Steve Johnson. This is the first record of a Kemp's Ridley nesting in Brevard Co. and only the fifth documented individual to nest on the east coast of Florida. This is the second Kemp's Ridley to nest in Canaveral National Seashore, and is 24.8 km S of the first record in 2003 (Fish and Wildlife Institute, Florida Fish and Wildlife Conservation Commission. 19 February 2006. Reported Nesting Activity of Kemp's Ridley, *Lepidochelys kempii* in Florida 1975–2005).

Submitted by **ROBERT H. HEGNA**, Department of Biology, Olivet Nazarene University, Bournbonnais, Illinois 60914, USA (e-mail: RHHegna@aol.com); and **MATTHEW J. WARREN**, **CANDACE J. CARTER** (e-mail: Candace_Carter@nps.gov), and **JOHN C. STINER** (e-mail: John_Stiner@nps.gov), Canaveral National Seashore, Titusville, Florida 32796, USA.

MACROCHELYS TEMMINCKII (Alligator Snapping Turtle). USA: LOUISIANA: Morehouse Parish: Bayou Bonne Idee near the end of Journey's End Road. 11 April 1997. Joe Evans. Verified by John L. Carr. Natural History Museum, University of Kansas (KU CT 11925, photo voucher, carapace only). First parish record (Dundee and Rossman 1989. The Amphibians and Reptiles of Louisiana, Louisiana St. Univ. Press, Baton Rouge. 300 pp.).

Submitted by **GEORGE M. PATTON** and **MARTHA ANN MESSINGER**, 2022 Gemini Drive, Bastrop, Louisiana 71220-3467, USA (e-mail: gpatton@bayou.com).

PELODISCUS SINENSIS (Chinese Softshell Turtle). MALAYSIA: SARAWAK: FIRST DIVISION: Sungei Sarawak: Kuching (01°35'N, 110°20'E). 2001. K. A. Jensen and I. Das. USDZ 2.4931. Verified by Kelvin K. P. Lim. First specific locality. This species has been seen for sale on the streets of downtown Kuching and on five occasions found traveling from one canal to another during rainstorms, between 2001–2006. It has been cultured for food at one licensed locality in Kuching for over 10 years. Presence of this soft-shell turtle in the rivers and canals around Kuching indicates that there is an established local population. The species is native to temperate Asia including China, Vietnam, Taiwan, and Hainan, and the Amur River of Russia (Ananjeva et al. 1998. Amphibians and Reptiles. Encyclopedia of the Nature of Russia. ABF Press, Moscow. 574 pp.), and introduced to a number of places around tropical Southeast Asia, primarily as escapees from turtle farms (Lim and Das 1999. Turtles of Borneo and Peninsular Malaysia. Natural History Publications [Borneo] Sdn. Bhd., Kota Kinabalu. xii + 151 pp.).

Submitted by **KAREN A. JENSEN** (e-mail: kitti_jensen@yahoo.com), and **INDRANEIL DAS,** Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, 94300, Kota Samarahan, Sarawak, Malaysia (e-mail: idas@ibec.unimas.my).

STERNOTHERUS CARINATUS (Razor-backed Musk Turtle). USA: TEXAS: Trinity Co.: Specimen found dead from unknown causes 500 m NE of the Trinity River under an elevated portion of State Highway 19 (30°52'24.4"N, 95°23'10.9"W). 23 September 2006. TCWC 91576. Verified by Toby Hibbitts. New county record (Dixon 2000. Amphibians and Reptiles of Texas, Second edition, Texas A&M Univ. Press, College Station. 421 pp.). Partially fills in the hiatus in east Texas between Houston and Tyler counties.

Submitted by **KJ LODRIGUE, JR.**, Texas A&M University, Department of Wildlife & Fisheries Sciences, College Station, Texas 77843-2258, USA; and **GRAHAM S. CRIGLOW**, Brazos Valley Museum of Natural History, 3232 Briarcrest Drive, Bryan, Texas 77802, USA.

STERNOTHERUS ODORATUS (Stinkpot). USA: LOUISIANA: Morehouse Parish: Irvin's Lake (32°57'N,91°56'W). February 1955. G. M. Patton. Verified by John L. Carr. Field Museum of Natural History (FMNH 246797). First parish record (Dundee and Rossman 1989. The Amphibians and Reptiles of Louisiana, Louisiana St. Univ. Press, Baton Rouge. 300 pp.).

Submitted by **GEORGE M. PATTON** and **MARTHA ANN MESSINGER**, 2022 Gemini Drive, Bastrop, Louisiana 71220-3467, USA (e-mail: gpatton@bayou.com).

TRACHEMYS SCRIPTA ELEGANS (Red-eared Slider). USA: TEXAS: Madison Co.: Specimen collected in baited trap ca. 2.7 km S of Madisonville, at the intersection of State Highway 90 and County Road 106 in Caney Creek (30°54'41.7"N, 95°54'38.4"W). 23 September 2006. TCWC 91580. Verified by Toby Hibbitts. New county record (Dixon 2000. Amphibians and Reptiles of Texas, Second edition, Texas A&M Univ. Press, College Station. 421 pp.). Fills in the hiatus between Grimes and Leon counties.

Submitted by **KJ LODRIGUE, JR.**, Texas A&M University, Department of Wildlife & Fisheries Sciences, College Station,

Texas 77843-2258, USA; and **GRAHAM S. CRIGLOW**, Brazos Valley Museum of Natural History, 3232 Briarcrest Drive, Bryan, Texas 77802, USA.

TRACHEMYS SCRIPTA ELEGANS (Red-eared Slider). USA: TEXAS: TRINITY CO.: Specimen found dead from unknown causes 400 m NE of the Trinity River under an elevated portion of State Highway 19 (30°52'20.9"N, 95°23'14.6"W). 23 September 2006. TCWC 91575. Verified by Toby Hibbitts. New county record (Dixon 2000. Amphibians and Reptiles of Texas, Second edition, Texas A&M Univ. Press, College Station. 421 pp.). Partially fills in the hiatus in east Texas between Houston and Polk counties.

Submitted by **KJ LODRIGUE, JR.**, Texas A&M University, Department of Wildlife & Fisheries Sciences, College Station, Texas 77843-2258, USA; and **GRAHAM S. CRIGLOW**, Brazos Valley Museum of Natural History, 3232 Briarcrest Drive, Bryan, Texas 77802, USA.

LACERTILIA

ANOLIS FUSCOAURATUS (Papa-vento da Amazônia; Amazon Slender Anole). BRAZIL: MINAS GERAIS: CARATINGA MUNICIPALITY: Reserva Particular do Patrimônio Natural Feliciano Miguel Abdala (19°43'53"S, 41°49'00"W). December 2000. J. Cassimiro. Museu de Zoologia da Universidade de São Paulo, São Paulo (MZUSP 95078, J. Cassimiro field number 317). Verified by M. T. Rodrigues. Previously known from Bolivia, Peru, Ecuador, Colombia, Venezuela, Guyana, Suriname, French Guiana, and Atlantic Rain forests of Brazil (Ávila-Pires 1995. Zool. Verh. Leiden 299:1–708; Peters and Donoso-Barros 1970. Catalogue of the Neotropical Squamata. Part II. Lizards and Amphisbaenians. Bull. U.S. Natl. Mus. 297:1–293). There are a small number of literature records from Brazil giving precise localities, with the southern limit being the state of Espírito Santo (Williams and Vanzolini 1980. Pap. Avul. Zool. 34[6]:99–108). This first state record extends the known distribution ca. 185 km airline W from the closest known locality in Linhares, state of Espírito Santo (Rocha 1998. Anais do VIII Seminário Regional de Ecologia, pp. 869–881).

Submitted by **JOSÉ CASSIMIRO** (e-mail: geckoides@yahoo.com.br), Departamento de Zoologia, Instituto de Biociências, Universidade de São Paulo. Caixa Postal 11.461, CEP 05422-970, São Paulo, SP, Brazil; **VINÍCIUS XAVIER** (e-mail: vinic@int.efoa.br), Universidade Federal de Alfenas, Rua Gabriel Monteiro da Silva, 714, CEP 37130-000, Alfenas, MG, Brazil; and **JAIME BERTOLUCI**, Departamento de Ciências Biológicas, Escola Superior de Agricultura "Luiz de Queiroz," Universidade de São Paulo, Av. Pádua Dias, 11, CEP 13418-900, Piracicaba, SP, Brazil (e-mail: bertoluc@esalq.usp.br).

ANOLIS HETERODERMUS (Flat Andes Anole): COLOMBIA: PUTUMAYO DEPARTMENT: VALLE DE SIBUNDOY: Municipio de Colón (01°11'N, 76°58'W), 300 m N of the cemetery, Private Natural Reserve "El Recuerdo, 2100 m elev. 21 December 2001. J. J. Mueses-Cisneros. Colección de Reptiles, Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá (ICN 10594). Municipio de Colón (01°11'N, 76°58'W), 2060 m elev. 21 July 2004. T. Villarreal (ICN 10597). Municipio de Santiago (01°09'N, 77°00'W), Vereda Vijinchoy, on route to Patascoy volcano, along the Río Cristales, 2180 m elev. 11 July 2004. J. J. Mueses-Cisneros (ICN 10595-6). All verified by J. D. Lynch. This species is endemic to Colombia. Previously known from the Departments of Antioquia, Boyacá, Caldas, Cauca, Cundinamarca, Huila, and Valle, with the southernmost record in the El Tambo (02°24'N, 76°50'W), Cauca department (Lazell 1969. Breviora 325:1–23). First department records and southernmost for the species, extends known range ca. 150 km S from the southernmost previously known locality. It is highly probable that *A. heterodermus* is also present in Ecuador, because the Valle de Sibundoy is located at 01°05'–01°12'N and 76°53'–77°00'W, ca. 80 km from the boundary between Colombia and Ecuador.

Submitted by **JONH JAIRO MUESES-CISNEROS,** Instituto de Ciencias Naturales Universidad Nacional de Colombia, Apartado 7495, Bogotá, D.C., Colombia; e-mail: jjmueses@gmail.com.

ANOLIS SAGREI (Brown Anole). MÉXICO: VERACRUZ: Municipality of Minatitlán: ca. 1 km N of Minatitlán (18°01'40"N, 94°34' 01"W). 10 Nov 2004. Joan Gastón Zamora Abrego. Verified by Edmundo Pérez Ramos. Colección Herpetológica, Facultad de Ciencias, UNAM (MZFC 17763). Second record for Veracruz and extends the known range of the species ca. 88 km NW from Catemaco, San Andrés Tuxtla, Veracruz (Benítez 1997. *In* Gonzáles et al. [eds.], Historia Natural de los Tuxtlas, pp. 495–500. Univ. Nac. Autó. México, D.F.). The specimen was found on a tree in rainforest.

Submitted by **JOAN GASTÓN ZAMORA-ABREGO** (e-mail: joangastn@yahoo.com.mx), **URI OMAR GARCÍA-VÁZQUEZ**, **ADRIÁN NIETO-MONTES DE OCA,** and **LUIS CANSECO-MÁRQUEZ,** Museo de Zoología, Facultad de Ciencias, UNAM, A.P. 70-399, México D.F. 04510.

BRACHYMELES APUS (Bornean Limbless Skink). MALAYSIA: SARAWAK: MIRI DIVISION, Trail between Lepo Bunga and Pa' Rebata (03°57'43.5"N, 115°33'51.0"E). 1520 m elev. Indraneil Das. 25 September 2000. (ZRC 2.6197). Verified by Kelvin K. P. Lim. Found DOR on an abandoned logging track, at the mid-elevation of Gunung Murud. The left side of its head partially eaten by ants. The original montane forest vegetation at that elevation has been removed through clear-felling. The species was only known from Bundu Tuhan (06°01'S, 116°32'E), nr. Headquarters of Gunung Kinabalu National Park, Sabah, Malaysia (Hikida 1982. Copeia 1982[4]:840–844). The present record is the first for Sarawak, and an extension of range ca. 250 km to the southwest.

Submitted by **INDRANEIL DAS**, Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, 94300, Kota Samarahan, Sarawak, Malaysia; e-mail: idas@ibec.unimas.my.

CERCOSAURA ARGULUS (Elegant Eyed Lizard). BRAZIL: AMAZONAS: Municipality of Beruri, Reserva de Desenvolvimento Sustentável Piagaçu-Purus, Lago Ayapuá, Igarapé Ajará (04°24.988'S, 62°15.609'W, WGS 84, 11 m elev.). 29 October 2004. F. Waldez. Coleção de Anfíbios e Répteis, Instituto Nacional de Pesquisas da Amazônia, Manaus, Amazonas, Brazil (INPA-H 13845, female, 43.6 mm SVL). Igarapé Jabuti (04°26.698'S, 62°15.867'W, WGS 84, 18 m elev.). 26 May 2005.

F. Waldez. (INPA-H 13846, male, 38.2 mm SVL). Verified by V. T. Carvalho. First state record. This is an expected occurrence because the species was previously known from Bolivia, Colombia, Ecuador, French Guiana, Peru, and in the Brazilian states of Pará and Rondônia (Avila-Pires 1995. Zool. Verh. Leider. 299:1–706). This record extends the known distribution about 340 km SE (airline) from the nearest known locality: Ecological Reserve of Rio Jamari approximately 70 km SE of Porto Velho city, Rondônia, Brazil (Avila Pires, *op. cit.*).

Submitted by **FABIANO WALDEZ** (e-mail: fwaldez@inpa.gov.br) and **RICHARD C. VOGT** (e-mail: vogt@inpa.gov.br), Coleção de Anfíbios e Répteis, Instituto Nacional de Pesquisas da Amazônia, Campus II, Av André Araújo, 2936, CP 428, CEP 69.083-000, Manaus, Amazonas, Brazil.

CTENOSAURA SIMILIS (Black Spiny-tailed Iguana). USA: FLORIDA: Monroe Co.: No Name Key at N end of Spanish Channel Drive (24°42'11.7"N, 81°19'52.2"W, NAD83; elev. < 1 m). 02 May 2006. Kevin M. Enge. Verified by Gunther Köhler. Florida Museum of Natural History photo voucher (UF 149600). New county record (Krysko et al. 2003. Florida Sci. 66:74–79). Adult female observed at 1115 h on a railroad tie in a vacant lot along a limestone coastline vegetated primarily by mangroves, Australian Pine (*Casuarina equisetifolia*), and Sea Grape (*Coccoloba uvifera*). Several adults were observed in April 2006 at this site. On 02 May 2006 at 1130–1140 h, an adult was observed on private properties to the east along Bahia Shores Rd (photo voucher UF 149601) and at the N end of No Name Rd (24°42'9.2"N, 81°19'44.8"W). Phillip G. Frank (pers. comm.) knows of juveniles being collected on the island in 2005, suggesting a reproducing population.

Submitted by **KEVIN M. ENGE**, Florida Fish and Wildlife Conservation Commission, 5300 High Bridge Road, Quincy, Florida 32351, USA (e-mail: kevin.enge@myfwc.com); **KENNETH L. KRYSKO**, Division of Herpetology, Florida Museum of Natural History, Dickinson Hall, University of Florida, Gainesville, Florida 32611, USA (e-mail: kenneyk@flmnh.ufl.edu); and **ANDREW P. BORGIA**, P.O. Box 4346, Key West, Florida 33041, USA.

CYRTOPODION SPINICAUDA (Spiny-tailed Thin-toed Gecko). IRAN: TEHRAN PROVINCE: Farahzaad Mountain NW of Tehran City, southern side of Central Alborz Protected Area (35°48'10"N, 51°20'23"E). 2000 m elev. 06 May 2006. Omid Mozaffari. Verified by S. C. Anderson. Iranian Society for the Study of Reptiles and Amphibians (ARIA 1000). First record for Tehran Province. An adult male was found at 1100 h under a small stone in a sloping field at the foot of mountain. The nearest reported locality for this species is from Shahrud, Semnan Province, ~ 400 km E of the locality reported here (Anderson 2000. The Lizards of Iran. Society for the Study of Amphibians and Reptiles, Ithaca, New York. 364 pp.). This is the third record for this species in Iran.

Submitted by **OMID MOZAFFARI**, No.21 Taleghani 3 Street, Ashrafi Esfehani Highway, Tehran, Iran, 14699-76599; e-mail: omozaffari@yahoo.com.

DIXONIUS VIETNAMENSIS (Vietnam Leaf-toed Gecko). VIETNAM: TAY NINH PROVINCE: Ba Den Mountain (11°21'06"–24'37"N, 106°08'41"–11'28"E), ca. 50–60 m elev. Nguyen Ngoc Sang, Hoang Duc Dat, and Nguyen Xuan Dong. Institute of Tropical Biology, Museum of Zoology (ITBMZ R05 40–47; eight adult specimens). 30 September 2005. Verified by Indraneil Das. Previously known from Nha Trang, Khanh Hoa Province (Das 2004. Raffles Bull. Zool. 52[2]:629–634). First provincial record, and ca. 320 km SW of Nha Trang.

Submited by **NGUYEN QUANG TRUONG**, **DOAN VAN KIEN**, and **NGUYEN QUOC THANG**, Department of Vertebrate Zoology, Institute of Ecology and Biological Resources, 18 Hoang Quoc Viet, Hanoi, Vietnam.

EUMECES LATICEPS (Broad-headed Skink). USA: OHIO: Butler Co.: Located as it was basking on fallen tree in the southern portion of Hueston Woods State Park (39°33'58"N, 84°45'00"W). 16 June 2006. David E. Russell and Gary W. Gerald. Miami University Herpetology Collection (MUHC 0153 photo voucher). Verified by Scott M. Moody. First county record (Wynn and Moody 2006. Misc. Cont. No. 10. Ohio Biological Survey, Columbus, Ohio. 80 pp.).

Submitted by **DAVID E. RUSSELL** and **GARY W. GERALD** Department of Zoology, Miami University, Oxford, Ohio 45056, USA; e-mail: geraldgw@muohio.edu.

EURYLEPIS TAENIOLATUS (Ribbon-sided Skink). IRAN: SEMNAN PROVINCE: 2.85 km NW of Delbar Field Station, Touran Protected Area (35°58'36.5"N, 58°02'18.8"E). 1206 m elev. 05 May 2004. Omid Mozaffari. California Academy of Sciences (CAS 228608). Verified by James F. Parham. First record for Semnan Province. An adult male was found at 1000 h under a 30 × 40 cm rock in a stone field at the foot of a small mountain. The nearest reported localities are along the Tajan River in eastern Khorasan Province, ca. 450 km NE of the locality reported here, close to the border with Turkmenistan and Afghanistan (Anderson 2000. The Lizards of Iran. Society for the Study of Amphibians and Reptiles, Ithaca, New York. 442 pp.). This is the third record for this species in Iran and the first from the Kavir Desert basin.

Submitted by **OMID MOZAFFARI**, No.21 Taleghani 3 Street, Ashrafi Esfehani Highway, Tehran, Iran, 14699-76599; e-mail: omozaffari@yahoo.com.

GYMNOPHTHALMUS UNDERWOODI (Smooth-scaled Worm Lizard). NETHERLANDS ANTILLES: SINT MAARTEN: Point Blanche, Back Bay. 22 March 2003. H. van Buel. Verified by Robert W. Henderson. MPM P732. First record for St. Maarten (Powell et al. 2005. The Reptiles and Amphibians of the Dutch Caribbean: St. Eustatius, Saba, and St. Maarten. St. Eustatius National Parks Foundation, Gallows Bay, St. Eustatius, Netherlands Antilles). This species, endemic to northern South America and possibly native on some southerly Lesser Antillean islands, was previously known to occur on Lesser Antillean islands as far north as Antigua and Barbuda and from St. Thomas, U.S. Virgin Islands (Williamson and Powell 2004. Cat. Amer. Amphib. Rept. 793:1–5). The lizard was in almond leaf litter on sand 400–500 m from shore.

Submitted by **HANS VAN BUEL**, Nieuwstraat 44, 2910 Essen, Belgium (e-mail: van.buel@belgacom.net); and **ROBERT POWELL**, Department of Biology, Avila University, Kansas City, Missouri 64145, USA (e-mail: robert.powell@avila.edu).

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). USA: ILLINOIS: WILLIAMSON CO.: Marion (37°44'N, 88°56'W). 01 October 2004. Juveniles collected in Marion city limits at a human habitation and deposited at Southern Illinois University Vertebrate Fluid Collection (SIUC R-4534). An additional juvenile (SIUC R-4533) was collected 03 March 2006 and a photo voucher (SIUC R-4535) of a juvenile collected 25 August 2003. Verified by Chris Phillips. New state record and extends the geographic range of the gecko in the Midwest (previous most northern record being Fayetteville, Arkansas; Trauth et. al. 2004. The Amphibians and Reptiles of Arkansas, University of Arkansas Press). Individuals first collected in fall 2002 which indicates a breeding population. Likely transported north along Interstate Highway 57.

Submitted by **WILLIAM T. McDOWELL**, Southern Illinois University School of Medicine, Carbondale, Illinois 62901, USA (e-mail: mcdowell@siumed.edu); **ALLAN K. WILSON**, DCI Biologicals, 301 West Main Street, Carbondale, Illinois 62901, USA (e-mail: akwilson7@hotmail.com); and **DAVE B. CLARK**, Clark Photography, 112 East Jefferson Street, Marion, Illinois 62959, USA.

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). USA: TEXAS: ANGELINA CO.: Town of Zavalla, ca. 40 m NE of Texas 63 (0.8 km E of Jct. Highway 69). UTM (NAD 83) 15 R, 0364765 N, 3447969 W, 79 m elev. 18 July 2006. Robert C. Jadin, Sarah A. Orlofske, Allyson M. Modra, and Jessica L. Coleman. University of Texas at Arlington–Amphibian and Reptile Diversity Research Center (UTA R-54331). Verified by Ronald L. Gutberlet, Jr. The specimen, an adult (SVL 47 mm), was taken on a brick wall at 0115 h at Zavalla Public Schools. Several other adult *H. turcicus* were observed as well. New county record (Dixon 2000. Amphibian and Reptiles of Texas. 2nd Ed. Univ. of Texas A&M Press, viii+421 pp.).

Submitted by **ROBERT C. JADIN** (e-mail: snakeman1982@hotmail.com), **JESSICA L. COLEMAN**, **ALLYSON M. MODRA**, Department of Biology, University of Texas at Tyler, 3900 University Blvd., Tyler, Texas 75799, USA; and **SARAH A. ORLOFSKE**, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, USA.

LEPIDOPHYMA TARASCAE (Tarascan Tropical Night Lizard). MÉXICO: GUERRERO: Municipality of José Azueta: Ejido San Ignacio, 200 m N El Abrojal (17°49'57"N; 101°34'34"W), 234 m elev. 16 June 1998. Gustavo Peña. Verified by Luis Canseco Marquez. Museo de Zoología, Facultad de Ciencias, UNAM (MZFC 18078). First record for Guerrero, extending the known range ca. 148 km (airline) E from the type locality on the coast of Michoacan, and ca. 16 km (by Mex. Hwy. 200) WNW from Caleta de Campos, Michoacan (Bezy and Camarillo 2002. Cont. Sci. Nat. His. Mus. Los Angeles Co. [493]:1–41). The lizard was found in tropical deciduous forest.

Submitted by **URI OMAR GARCÍA-VÁZQUEZ, CARLOS A. HERNANDEZ-JIMENEZ,** and **EDMUNDO PÉREZ-RAMOS,** Museo de Zoología, Facultad de Ciencias, UNAM, A.P. 70-399, México D.F. 04510, México; e-mail: urigarcia@gmail.com.

LIOLAEMUS OCCIPITALIS (Sand Lizard). URUGUAY: DEPARTAMENTO DE ROCHA: Santa Tereza Park: La Moza Beach (33°58'17.2"S, 53°31'51.8"W). 08 March 2006. Colección de Vertebrados, Universidad de la República Oriental del Uruguay, Montevideo (ZVC-R 6390–92); VALLIZAS: left margin of the Vallizas Creek (34°19'58.7"S, 53°47'26.2"W). 10 March 2006. (ZVC-R 6387–89); BARRA DO CHUÍ: Uruguayan side of the Chuí Creek (33°45'26.9"S, 53°23'15.4"W). 11 March 2006. (ZVC-R 6393–95). All collected by L. Verrastro, M. Schossler, and C. M. da Silva, and verified by M. Meneghel. Species previously known in Brazil from Chuí (Rio Grande do Sul) to Florianópolis (Santa Catarina). First country records, extends the known distribution ca. 120 km S from Barra do Chuí: Brazilian side of Chuí Creek, Brazil (Lema and Fabián-Beurmann 1977. Iheringia, Sér. Zool., Porto Alegre 50:61–92).

Submitted by **LAURA VERRASTRO** (e-mail: lauraver@ufrgs.br), **MARTIN SCHOSSLER**, and **CAROLINE M. DA SILVA**, Laboratório de Herpetologia, Departamento de Zoologia, Instituto de Biociências, Universidade Federal do Rio Grande do Sul, Av. Bento Gonçalves, 9500. Bloco IV, prédio 43.435. CEP. 91.540-000, Porto Alegre, Rio Grande do Sul, Brazil.

OPHISAURUS ATTENUATUS ATTENUATUS (Western Slender Glass Lizard). USA: ARKANSAS: UNION CO.: Marysville (Sec. 27, T17S, R18W). 22 April 2006. Henry W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 30137). Verified by Stanley E. Trauth. New county record in southern Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

Submitted by **HENRY W. ROBISON,** Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA: e-mail: hwrobison@saumag.edu.

PHRYNOSOMA CORNUTUM (Texas Horned Lizard). USA: NEW MEXICO: SANDOVAL CO.: Town of Cochiti Lake. MSB 66805, DOR gravid female with eggs (N = 21), collected 11 June 2003; MSB 66806, DOR adult, collected 11 June 2003; MSB 66807, DOR adult, collected 12 June 2003. UTM coordinates 378707 E, 3945534 N, NAD 83, Zone 13, 1713 m. elev. Verified by J. Tom Giermakowski. New county record (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. Univ. of New Mexico Press, Albuquerque. xix + 431 pp.). Extends distribution northward from Bernalillo Co. May be an introduced population.

Submitted by **MARK L. WATSON**, New Mexico Department of Game and Fish, P.O. Box 25112, Santa Fe, New Mexico 87504, USA.

SPHAERODACTYLUS KIRBYI (NCN). ST. VINCENT AND THE GRENADINES: MUSTIQUE ISLAND, Macaroni Beach (12°53'N, 61°11'W). 30 March 2006. Mark de Silva. Verified by S. B. Hedges. MPM 33979–33980. New island record. The species was previously known only from Bequia in the St. Vincent Grenadines (Lazell 1994. Breviora 496:1–20). The lizards were found in leaf litter above the high-tide line.

Submitted by **ROBERT POWELL**, Department of Biology, Avila University, Kansas City, Missouri 64145, USA (e-mail: robert.powell@avila.edu); and **ROBERT W. HENDERSON**, Sec-

tion of Vertebrate Zoology, Milwaukee Public Museum, Milwaukee, Wisconsin 53233-1478, USA (e-mail: rh@mpm.edu).

SERPENTES

AGKISTRODON CONTORTIX PHAEOGASTER (Osage Copperhead). USA: KANSAS: Coffey Co.: Slead Native Prairie next to Jacobs Creek on the Flint Hills National Wildlife Refuge, ca. 4500 m S of Hartford, ca. 800 m N on 16th Rd (38°16'01.9"N, 95°56'42.0"W). 01 August 2004. B.W. Maher. Natural History Museum, University of Kansas color slides (KU CT 11934–35). Verified by Lynnette Sievert. New county record replacing lost county record specimen (Taggart 2006. Kansas Herpetofaunal Atlas: an Online Reference: http://webcat.fhsu.edu/ksfauna/herps/index.asp?page=species). Juvenile specimen captured along silt-fence in single-ended funnel trap. PIT tag #451E721A05 inserted; individual was photographed and released as part of an ongoing research project. A second specimen was found dead in the same trap array on 03 August 2004 and was deposited in the Sternberg Museum of Natural History (MHP 12139).

Submitted by **BRYAN W. MAHER** and **GREG SIEVERT**, Department of Biological Sciences, Emporia State University, Emporia, Kansas, 66801, USA; e-mail: gsievert@emporia.edu.

AGKISTRODON PISCIVORUS LEUCOSTOMA (Western Cottonmouth). USA: ARKANSAS: Johnson Co.: 2.4 km E Lamar (Sec. 17, T9N, R22W). 10 June 2005. Gene Leeds. Verified by S. E. Trauth. Arkansas State University Herpetological Museum (ASUMZ 30266). New county record filling a distributional hiatus in the Arkansas River Valley between Franklin and Pope counties (Trauth et al. 2004. Amphibians and Reptiles of Arkansas. Univ. Arkansas Press, Fayetteville. 421 pp.). This snake has now been reported from 66 of 75 (88%) counties of the state (Trauth et al., *op. cit.*:365–368, fig. 521) and will undoubtedly be found in several others.

Submitted by **HENRY W. ROBISON**, Department of Biology, Southern Arkansas University, Magnolia, Arkansas 71754, USA (e-mail: hwrobison@saumag.edu); and **CHRIS T. McALLISTER**, Department of Physical and Life Sciences, Chadron State College, Chadron, Nebraska 69337, USA (e-mail: cmcallister@csc.edu).

AGKISTRODON PISCIVORUS LEUCOSTOMA (Western Cottonmouth). USA: TEXAS: Milam Co.: Live specimen was found 3.1 km S intersection Highway 79 and Highway 36 on Highway 36 (30.68927°N, -96.83472°W). 23 June 2006. Verified by Toby Hibbits, Texas A&M University, Texas Cooperative Wildlife Collection. TCWC 91307. New county record (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M University Press, College Station, Texas. 148 pp.). The female specimen (SVL 602 mm, TL120 mm, 380 g) was collected from under a bridge on Highway 36.

Submitted by **JULIE A. PARLOS** (e-mail: jparlos@txstate.edu), **JOHN H. DUVALL-JISHA,** and **M.R.J. FORSTNER,** Department of Biology, Texas State University, San Marcos, Texas 78666, USA.

ARIZONA ELEGANS ELEGANS (Kansas Glossy Snake). USA: KANSAS: Chase Co.: DOR at Chase County Fishing Lake, ca. 3.4 km W of Cottonwood Falls (38°22.052'N, 96°35.417'W). 07 September 2005. Michelle Gilkerson, Peter Tuttle, Victor Tuttle, and Greg Sievert. Sternberg Museum of Natural History (MHP 12140). Verified by Lynnette Sievert. New county record and extends the range east 94 km into the middle of the Flint Hills Ecoregion of Kansas (Taggart 2006. Kansas Herpetofaunal Atlas: an Online Reference. http://webcat.fhsu.edu/ksfauna/herps/index.asp?page=species). The first specimen from Chase Co. was found on 24 June 2005, ca. 1 km W of the DOR specimen and is being maintained alive at Emporia State University. This species was only known from sandy soils in Kansas and these are the first two specimens from the Flint Hills Ecoregion in either Kansas or Oklahoma.

Submitted by **GREG SIEVERT, MICHELLE GILKERSON, VICTOR TUTTLE**, and **PETER TUTTLE**, Department of Biological Sciences, Emporia State University, Emporia, Kansas, 66801, USA (e-mail: gsievert@emporia.edu).

BOIGA DRAPIEZII (White-spotted Cat Snake). THAILAND: RANONG PROVINCE: Muang District: Namtok Ngao National Park, Ngao Waterfall. Caught at night on forest floor, ca. 3 m from stream, beside Park HQ. 26 November 2004. Y. Chuaynkern, J. Sheridan, C. Chuechat, and S. Makchai. Thailand Natural History Museum (THNHM 01173). Verified by Jarujin Nabhitabhata. First provincial record. Previously known from southern Thailand in Phangnga, Songkhla, Pattani, and Narathiwat Provinces (Nabhitabhata et al. "2000" 2004. Checklist of Amphibians and Reptiles in Thailand. Office of Environmental Policy and Planning, Bangkok. 152 pp.).

Submitted by **YODCHAIY CHUAYNKERN** (e-mail: ychuaynkern@yahoo.com) and **SUNCHAI MAKCHAI,** Thailand Natural History Museum, Technopolis, Khlong 5, Khlong Luang, Pathum Thani, 12120 Thailand (e-mail: sunchaimakchai@yahoo.com).

COLUBER CONSTRICTOR FLAVIVENTRIS (Eastern Yellow-bellied Racer). USA: NEW MEXICO: Guadalupe Co., 5 km SE Vaughn off US 60, high grassland, ca. 1783 m elev. 13 September 2002. B. Hubbs. Live adult (ca. 1 m TL) under tin, released. Voucher photo in Los Angeles County Museum (LACM PC 1393). Verified by Kent Beaman. New county record. Vaughn, Jct. US 60 and US 54; 34.5934°N, 105.189°W. 09 August 2005. C. B. Grogan and W. L. Grogan. Adult found DOR. Verified by Howard Snell (MSB 72535). Specimens fill gap in the range of this species in the Pecos River basin of records 138 km to the NE in Quay Co. and 185 km SSE in Curry Co., and those in the Rio Grande basin 140 km NW in Bernalillo Co. and 150 km SW in Socorro Co. (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. University of New Mexico Press, Albuquerque, 431 pp.).

Submitted by **BRIAN HUBBS**, P.O. Box 26407, Tempe, Arizona 85285, USA (e-mail: milkmanbrian@hotmail.com); **CHARLES B. GROGAN**, Department of Music, University of Arizona, Tucson, Arizona 85721, USA (e-mail: cgrog@earthlink.net); and **WILLIAM L. GROGAN, Jr.**, Department of Biological Sciences, Salisbury University, Salisbury, Maryland 21801, USA (e-mail: wlgrogan@salisbury.edu).

CROTALUS HORRIDUS (Timber Rattlesnake). USA: NORTH CAROLINA: Rowan Co.: 8 km NE Richfield; ca. 800 m E of jct. of Reaves Island Road [SR 2148] and River Road on Alcoa Game Land (35.5298°N, 80.2085°W). 05 September 2006. Mitchell Mimier. Verified by Alvin L. Braswell. North Carolina State Museum of Natural Sciences (ALB 11931, photo voucher). New county record (Palmer and Braswell 1995. Reptiles of North Carolina. University of North Carolina Press, Chapel Hill. 263 pp.). Gravid female in various stages of decomposition. The head and tail had been removed.

Submitted by **WESLEY M. ANDERSON** (e-mail: weanderson@davidson.edu) and **MICHAEL E. DORCAS**, Department of Biology, Davidson College, North Carolina 28035-7118,USA (e-mail: midorcas@davidson.edu).

CROTALUS HORRIDUS (Timber Rattlesnake). USA: TEXAS: Washington Co.: 0.6 mi N of Texas Hwy 105 (30°17'11"N, 096°14'34"W), 293 ft elev. 15 September 2006. Bob L. Tipton and Angelita Chavez Tipton. Verified by Travis J. LaDuc. Texas Natural History Collections-Texas Memorial Museum-University of Texas (TNHC 65338). New county record. (Dixon 2000. Amphibians and Reptiles of Texas. Second Edition. Texas A&M University Press, College Station, Texas, 421 pp.). A large juvenile (422 mm) female, with one button taken DOR fresh on a paved road, hardwood forest to both sides of the road (east and west), large pasture area beginning both sides of the road about 50 m N of where the snake was collected.

Submitted by **BOB L. TIPTON** and **ANGELITA CHAVEZ TIPTON**, 15622 Ten Oaks, Tomball, Texas 77377, USA (e-mail: btipton@ghg.net); and **THOMAS A. SINCLAIR**, 12903 Cloverwood Drive, Cypress, Texas 77429-2028, USA (e-mail: tsinclair2@houston.rr.com).

CROTALUS TRISERIATUS TRISERIATUS (Mexican Dusky Rattlesnake). MÉXICO: TLAXCALA: 0.8 km S Puebla state line off Mex. Hwy. 119. 11 July 1970. P. Hubbell. Verified by George Bradley. UAZ 34495. New state record (Campbell and Lamar 2004. Venomous Reptiles of the Western Hemisphere. Cornell Univ. Press, Ithaca, New York. 870 pp.). Although Gloyd (1940. Spec. Publ. Chicago Acad. Sci. 4:1–270) and Klauber (1972. Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind. 2nd ed. Univ. California Press, Berkeley, California. 1533 pp.) considered Tlaxcala to be within the geographic range of *C. triseriatus*, actual records from the state appear to be lacking.

Submitted by **ROBERT W. BRYSON, JR.**, School of Life Sciences, University of Nevada, Las Vegas, Las Vegas, Nevada 89154-4004, USA; e-mail: brysonjr@unlv.nevada.edu.

DRYOCALAMUS TRISTRIGATUS (Three-lined Tree Snake). BRUNEI DARUSSALAM: Temburong District: Kuala Belalong Field Studies Centre (04°32'N, 115°09'E). ca. 100 m elev. 06 September 2005. Jonas Maximilian Dehling. Zoological Museum of the Department of Biology, Universiti Brunei Darussalam, Bandar Seri Begawan, Brunei Darussalam (UBD G002). Verified by T. Ulmar Grafe. BELAIT DISTRICT: Sungei Liang (04°40'N, 114°28'E; ca. 5 m elev.). 15 October 1992. Indraneil Das. (UBD ID-525). Verified by Joseph K. Charles. First country records, in addition to records from Sabah and Sarawak (Stuebing 1991. Raffles Bull. Zool. 39[2]:323–362), besides Pulau Natuna in Indonesia, and Balabac and Palawan in the Philippines (Das 2006. A Photographic Guide to the Snakes and Other Reptiles of Borneo. New Holland Publishers [UK], Ltd., London/Ralph Curtis Books, Sanibel Island, Florida. 144 pp.).

Submitted by **JONAS MAXIMILIAN DEHLING**, Department of Animal Ecology and Tropical Biology, Biozentrum, University of Würzburg, Am Hubland, D-97074 Würzburg, Germany (e-mail: Jonas.M.Dehling@stud-mail.uni-wuerzburg.de); and **INDRANEIL DAS**, Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, 94300, Kota Samarahan, Sarawak, Malaysia (e-mail: idas@ibec.unimas.my).

HYDRODYNASTES GIGAS (False Water Cobra). BRAZIL: PARAÍBA: João Pessoa (07°08'S, 34°51'W). 31 March 2006. G. A. P. Filho. Coleção Herpetológica do Departamento de Sistemática e Ecologia, Universidade Federal da Paraíba, João Pessoa, Paraíba (UFPB 4316). 28 August 1987 (UFPB 2441). 1 August 1986 (UFPB 2442). 18 August 1986, M. Rodrigues. Museu de Zoologia da Universidadade de Sao Paulo, Sao Paulo (MZUSP 8985). Mamanguape: Área de Proteção Ambiental (06°47'S, 34°56'W). 2002. G. Skuk. (UFPB 3678, 4316). All verified by F. L. Franco. Previously known from northern Argentina, eastern Bolivia, Paraguay, southern, western, central, and northern Brazil (States of Rio Grande do Sul, Paraná, São Paulo, Mato Grosso do Sul, Mato Grosso, Rondônia, Amapá, and Pará), and French Guiana (Bernarde and Moura-Leite 1999. Herpetol. Rev. 30:54; Giraudo and Scrocchi 2002. Smithsonian Herpetol. Info. Serv. 132:1–53; Hoogmoed 1982. Mem. Inst. Butantan 46:219–254; Peters and Orejas-Miranda 1986. Catalogue of the Neotropical Squamata, Part I. Snakes [Revised Ed.], Smithsonian Inst. Press, Washington, D.C.). First state records, extending the distribution nearly 3000 km northwards and 1400 km eastwards from the nearest known records (São Paulo, State of São Paulo and Paragominas, State of Pará, respectively).

Submitted by **GENTIL A. PEREIRA FILHO,** Herpetologia, Departamento de Sistemática e Ecologia, Universidade Federal da Paraíba, João Pessoa, Brazil (e-mail: gentilfilho@yahoo.com); and **GIOVANNA GONDIM MONTINGELLI,** Instituto de Biociências da Universidade de São Paulo, Departamento de Zoologia, São Paulo, SP; Herpetologia, Museu de Zoologia da Universidade de São Paulo, São Paulo, SP, Brazil; e-mail: giovanna@ib.usp.br).

HYPSIGLENA TORQUATA (Nightsnake). USA: NEVADA: Washoe Co.: West side of Anaho Island, Pyramid Lake (39.957°N, 119.519°W; 1165 m elev.). 28 July 2006. C. M. Gienger and Kellie M. Kuhn. Verified by R. E. Espinoza. UNR 7721. First record of this species from Anaho Island. This species has gone undetected in previous herpetological surveys of Anaho Island (Woodbury 1966. The History and Present Status of the Biota of Anaho Island, Pyramid Lake Nevada. Unpub. M.S. Thesis. Univ. Nevada-Reno). This record is a notable addition to the snake fauna of the island as *Crotalus lutosus* and *Pituophis melanoleucus* are the only other snake species known from the island.

Submitted by **C. M. GIENGER**, **KELLIE M. KUHN**, and **C. RICHARD TRACY**, Department of Biology, MS-314, University of Nevada, Reno, Reno, Nevada 89557, USA (e-mail: gienger@biodiversity.unr.edu)

HYPSIGLENA TORQUATA (Nightsnake). USA: WASHINGTON: WHITMAN Co.: Wawawai Grade Road (46°37.728'N, 117°20.611'W), 297 m elev. 28 August 2006. Alex Dornburg. Verified by Andrew T. Storfer. Washington State University Conner Museum Collection (CRCM-P022, photo voucher). Adult found basking on roadway at 2107 h. First county record. This record extends the range of the species 48 km into southeastern Washington along the Snake River (Hallock and McAllister 2005. Washington Herp Atlas. http://www.dnr.wa.gov/nhp/refdesk/herp/).

Submitted by **ALEX DORNBURG** (e-mail: dornburgalex@yahoo.com) and **SCOTT E. VANDER PLOEG,** School of Biological Sciences, Washington State University, Pullman, Washington 99164, USA (e-mail:svanderploeg@wsu.edu).

LAMPROPELTIS CALLIGASTER (Yellow-bellied Kingsnake). USA: TENNESSEE: WARREN Co.: Along the Collins River, 1.2 km ENE of the town of Shellsford (35°40'30"N, 85°41'56"W). 13 June 2006. Matthew L. Niemiller, Joshua A. Miller, Jacob H. Miller, and Brian T. Miller. Verified by Vincent A. Cobb. Voucher specimen in Herpetology Collection at Middle Tennessee State University (MTSU 180S). Adult female captured while swimming across the Collins River. First county record and extends range ca. 47 km NE from Coffee Co. (Niemiller 2005. J. Tennessee Acad. Sci. 80:6–12) to the margin of the Eastern Highland Rim and Cumberland Plateau physiographic province (Conant and Collins 1998. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Houghton Mifflin Co., Boston, Massachusetts).

Submitted by **MATTHEW L. NIEMILLER** (e-mail: mniemill@utk.edu), **JOSHUA A. MILLER**, **JACOB H. MILLER**, and **BRIAN T. MILLER**, Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee, 37132, USA (e-mail: bmiller@mtsu.edu).

LAMPROPELTIS TRIANGULUM (Milksnake). USA: COLORADO: DOLORES Co.: Coal Bed Canyon, 11 km W, 3 km N Dove Creek; NAD83, UTM Zone 12, Easting 673578, Northing 4184287. 18 August 2006. Lea Bonewell, Chris Kloster, and Jenn Logan. UCM Ancillary Collection 326. Verified by Lauren J. Livo. The specimen was collected in Coal Bed Canyon during a night survey for bats. First record for county (Hammerson 1999. Amphibians and Reptiles in Colorado, 2nd Ed. University Press of Colorado, Niwot).

Submitted by **CHRIS KLOSTER**, Colorado Division of Wildlife, Durango Service Center, 151 E. 16th St., Durango, Colorado 81301, USA.

LEPTODEIRA ANNULATA CUSSILIRIS (Duellman's Cat-eyed Snake). MÉXICO: PUEBLA: MUNICIPALITY OF TLATLAUQUITEPEC: Mazatepec: (20°01'06.5"N, 97°25'38.2"W), 537 m elev., in a coffee plantation. 23 September 2005. Israel Solano Zavaleta. Verified by Edmundo Pérez Ramos. Colección Herpetológica del Museo de Zoología Alfonso L. Herrera, UNAM (MZFC 17722). First record for Puebla and a range extension of 26 km NW of the closest known locality at Jalacingo, Veracruz (Duellman 1958. Bull. Amer. Mus. Nat. Hist. 114:1–152). An earlier specimen from San Antonio Limon, Veracruz, was erroneously reported as being from Puebla (Duellman, *op. cit.*).

Submitted by **ISRAEL SOLANO-ZAVALETA** (e-mail: crotalus.viper@gmail.com), **ANDRÉS ALBERTO MENDOZA-HERNÁNDEZ** (e-mail: andreasmeher@gmail.com), and **LUIS CANSECO-MÁRQUEZ,** Museo de Zoología, Facultad de Ciencias, UNAM, A.P. 70-399, México D.F. 04510, México (e-mail: lcm@correo.unam.mx).

LEPTOTYPHLOPS BORAPELIOTES (NCN). BRAZIL: RIO GRANDE DO NORTE: Serra Negra do Norte (6°06'S, 37°04'W). 25 April–04 May 2003. D. de Oliveira Mesquita. Verified by P. Passos. Coleção Herpetológica da Universidade de Brasília, Brasília (CHUNB 30571). This species was only known from seven localities of the Caatinga xeric formation (Vanzolini 1996. Papeis Avul. Zool., S. Paulo 39[15]:281–291). Northernmost record for the species, extends the known distribution ca. 110 km NW from Junco do Seridó, State of Paraíba, and ca. 250 km NW from Lagoa Paparí, State of Rio Grande do Norte.

Submitted by **JIANCARLO ULLOA**, Setor de Herpetologia, Departamento de Vertebrados, Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, 20940-040, Brazil; e-mail: julloa@mn.ufrj.br.

LIOPHIS MERIDIONALIS (NCN). BRAZIL: ESPÍRITO SANTO: Município de Linhares, 19°23'S, 40°04'W. A. P. Almeida. 17 September 2001. Instituto Butantan, São Paulo (IB 70927). 18 November 2003 (IB 70929).Verified by O. A. V. Marques. A. P. Almeida. 19 October 2003. Museu Nacional, Rio de Janeiro (MNRJ 11087). Verified by R. Fernandes. Published distribution of the species includes the Brazilian Amazon, Cerrado, and Atlantic forests from the state of Rio Grande do Sul to São Paulo. The distribution also includes Argentina, Bolivia, and Paraguay (Yuki et al. 1997. Bol. Mus. Paraense Emílio Goeldi, sér. Zool. 13[1]:3–10; Dixon 1989. Smithson. Herpetol. Infor. Serv. Ser., 79; Valdujo and Nogueira 2001. Herpetol. Rev. 32:128–130). First record for the state of Espírito Santo, extends the range over 1000 km northward in the coastal Atlantic forest.

Submitted by **ANTONIO DE PADUA ALMEIDA**, Projeto TAMAR-IBAMA, Reserva Biológica de Comboios, Caixa Postal 105, CEP 29.900-970, Linhares, ES, Brazil (e-mail: tonim@tamar.org.br); **JOÃO LUIZ GASPARINI**, IPEMA - Instituto de Pesquisas da Mata Atlântica, Av. Hugo Viola, 1001/218 A, Jardim da Penha, CEP 29060420, Vitória, ES, Brazil (e-mail: gaspa.vix@terra.com.br); and **VALDIR JOSÉ GERMANO**, Instituto Butantan, Avenida Vital Brazil, 1500, CEP 05503-900, SP, Brazil (e-mail: valgermano@butantan.gov.br).

MASTICOPHIS LATERALIS LATERALIS (California Striped Racer). USA: CALIFORNIA: PLUMAS Co.: Hwy 70 at Rodger's Flat (39°57'48.1"N, 121°16'36.6"W, datum: WGS84; 2020 ft. [616 m] elev.). DOR adult male (California Academy of Sciences 233409; 649 mm SVL; 920 mm TL; 50.5 g). 03 May 2006. Verified by Jens Vindum. First known occurrence of this species in Plumas Co. (Koo and Vindum 1999. Amphibians and Reptiles of the Plumas National Forest: Historical Collections and California Academy of Sciences 1998 and 1999 Surveys. Unpubl. report on file, Department of Herpetology, California Academy of Sciences. San Francisco, California). In neighboring Butte Co., *M. lateralis lateralis* is found between 330–2160 ft elevation in brushy and

chaparral vegetation (Hayes and Cliff 1982. Herpetol. Rev. 13:85–87) and has been documented in the North Fork Feather River Canyon along the left bank near Arch Rock (39°05'08"N, 121°23'29"W; pers. obs.), Shady Rest Area (CAS 233408), Pulga Road, 0.2 mi. NE of intersection with Hwy 70 (CAS 233407), 2.6 mi. NE of Jarbo Gap on Hwy 70 (CSUC 2290), Hwy. 70 near Bardee's Bar (DOR; 39°46'49.1"N, 121°27'7.2"W; pers. obs.), and upstream of the Poe Powerhouse along the right bank (39°44'35.4"N, 121°28'24.7"W; pers. obs.) and along the left bank (39°43'54.8"N, 121°28'0.8"W; pers. obs.). We thank Jens. V. Vindum for his review of this note.

Submitted by **KEVIN D. WISEMAN** and **KARLA R. MARLOW**, Garcia and Associates (GANDA), 2601 Mission Street, Suite 600, San Francisco, California 94110, USA (e-mail: kwiseman@garciaandassociates.com).

MICRUROIDES EURYXANTHUS (Sonoran Coralsnake). USA: ARIZONA: La Paz Co.: Plomosa Mountains, Plomosa Drive (33.80340°N, 114.07933°W [NAD27]). 18 June 2004. Charles W. Linkem and Jimmy A. McGuire. MVZ 244267. Verified by Ted Papenfuss. This is the second county record of *Micruroides euryxanthus* in La Paz Co., after UAZ 45840, found in 1984 in the Chocolate Mountains, 47 km SSW of Quartzite (Palmer and Devos 1986. Herpetol. Rev. 17:27) and the third record west of the 114[th] parallel. This specimen fills a gap between two disjunct records, UAZ 45840 to the southwest and USNM 38044 (collected in 1908 in Signal, Mohave Co., Arizona) to the northeast. This record is 85 km SW of USNM 38044 and 75 km NE of UAZ 45840. The three samples mentioned, and ASU 34681 (collected in 2004 in the Cerbat Mountains, Mohave Co., Arizona; Cobb 2004. Herpetol. Rev. 35:293) suggest that the range of *M. euryxanthus* might extend to the Arizona-California border, while current sampling places the range within 24 km of the border. Distributional data are based on a search of ca. 80 institutional collections by A. T. Holycross.

Submitted by **CHARLES W. LINKEM,** University of Kansas, Natural History Museum and Biodiversity Research Center, Dyche Hall, 1345 Jayhawk Blvd, Lawrence, Kansas 66045, USA (e-mail:cwlinkem@ku.edu); and **JIMMY A. McGUIRE**, University of California Berkeley, Museum of Vertebrate Zoology, 3101 Valley Life Sciences Building, Berkeley, California 94720, USA.

NERODIA FLORIDANA (Florida Green Watersnake). USA: FLORIDA: Washington Co.: Pine Log State Forest (30°25.685'N, 85°53.053'W). 05 August 2006. John G. Himes. Verified by Paul E. Moler. Florida Museum of Natural History (FLMNH 149598–149599). New county record, near northwest periphery of distribution (Gibbons and Dorcas 2004. North American Watersnakes. A Natural History. University of Oklahoma Press, Norman). Specimens found in receding pool. At least three additional specimens were observed, but not collected, at same locality on 29 July 2006.

Submitted by **JOHN G. HIMES**, Florida Fish and Wildlife Conservation Commission, 3911 Highway 2321, Panama City, Florida 32409-1658, USA.

NERODIA RHOMBIFER (Diamond-backed Watersnake). USA: TEXAS: Lavaca Co.: Green-Dixon City Park (29°27'01"N, 97°10'57"W). 18 June 2006. Verified by Toby Hibbitts. Texas Cooperative Wildlife Collection (TCWC 90980). New county record (Dixon 2000. Amphibians and Reptiles of Texas. 2[nd] Ed. Texas A&M University Press, College Station, Texas. 421 pp.). First record for the county and completes distributional records, east to west and north to south in this region.

Submitted by **JOHN H. DUVALL-JISHA** (e-mail: JD1307@txstate.edu), **JACOB T. JACKSON,** and **M.R.J. FORSTNER**, Department of Biology, Texas State University at San Marcos, San Marcos, Texas 78666, USA (e-mail: MF@txstate.edu).

NERODIA SIPEDON (Midland Water Snake). USA: TENNESSEE: Jefferson Co.: 11 June 1951. J. Mecham. Texas Tech University (TTU 3777). Verified by T. J. LaDuc. It is absent from county record map in Gibbons and Dorcas (2004. North American Watersnakes. University of Oklahoma Press, Norman. 438 pp.); verified as new county record by A. F. Scott of Austin Peay State University (pers. comm.). Incomplete locality listed in ledger: "Tenn: Jefferson Co.: E. (25 mi E)." Specimen and entire TTU collection transferred to the TNHC (The University of Texas at Austin) in 2000.

Submitted by **JOHN D. McVAY**, Department of Biological Sciences, Texas Tech University, Lubbock, Texas 79409, USA; e-mail: john.mcvay@ttu.edu.

OPHEODRYS AESTIVUS (Rough Greensnake). USA: ARKANSAS: Sharp Co.: near County Road 64, 3.2 km E of jct with County Road 51, ca. 5 km SE of Hardy. 01 July 2006. Jacob Sawyer. Verified by Benjamin A. Wheeler. Arkansas State University Museum of Zoology Herpetology Collection (ASUMZ 30196). New county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville, 421 pp.).

Submitted by **JACOB A. SAWYER** (e-mail: jacob.sawyer@smail.astate.edu) and **STANLEY E. TRAUTH**, Department of Biological Sciences, P.O. Box 599, State University, Arkansas 72467, USA (e-mail: strauth@astate.edu).

OPHEODRYS AESTIVUS (Rough Greensnake). USA: TEXAS: Austin Co.: DOR 1 km N intersection Highway 949 and Mill Creek Road on Mill Creek Road (29.87441°N, -96.31300°W). 18 June 2006. Verified by Toby Hibbits. Texas Cooperative Wildlife Collection (TCWC 90977; SVL 606 mm, TL 149 mm, 23 g). New county record (Dixon 2000. Amphibians and Reptiles of Texas. 2[nd] Ed. Texas A&M University Press, College Station, Texas. 421 pp.). This is the first recorded specimen from within Austin County, completing its distribution on the Texas coastal plains.

Submitted by **JULIE A. PARLOS** (e-mail: jparlos@txstate.edu), **JOSEPHINE DUVALL,** and **M.R.J. FORSTNER,** Department of Biology, Texas State University, San Marcos, Texas 78666, USA.

OPHEODRYS AESTIVUS (Rough Greensnake). USA: TEXAS: Williamson Co.: Six DOR specimens from five localities within the Sun City development of Georgetown, Texas. Intersection San Saba and Sun City Blvd. (09 April 2006, TNHC 65411; and 28 Sept. 2006; TNHC 65424); east end of Stetson Trail (08 May 2006, TNHC 65060), under Berry Creek Bridge at Del Webb Blvd (15 May 2006, TNHC 65061); Trail Rider, 400 m S of intersection

with Whispering Wind (24 May 2006, TNHC 65410), and intersection of Scissortail and Chickadee (09 Sept. 2006, TNHC 65423). Verified by Travis LaDuc. First county records (Dixon 2000. Amphibians and Reptiles of Texas. 2nd Edition. Texas A&M Univ. Press, College Station, 421 pp.).

Submitted by **JAMES L. CHRISTIANSEN**, Texas Natural History Collections, Texas Natural Science Center, The University of Texas at Austin, Austin, Texas 78705, USA.

PANTHEROPHIS (= ELAPHE) OBSOLETA (Western Ratsnake). USA: ARKANSAS: CLEVELAND CO.: 6.4 km NW of Rison (Sec. 31, T8S, R11W). 05 May 2006. Henry W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 30138). Verified by Stanley E. Trauth. New county record in southern Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville, 421 pp.).

Submitted by **HENRY W. ROBISON**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA; e-mail: hwrobison@saumag.edu.

PSEUDOLEPTODEIRA URIBEI (Uribe's False Cat-eyed Snake). MÉXICO: MICHOACÁN: Ejido Maquili, Aquila (18°34'46"N, 103°35'46"W), 96 m elev. 21 March 2005. Alejandro Mijangos. Verified by Aurelio Ramírez-Bautista and Javier Alvarado. Colección de Herpetología, Instituto de Recursos Naturales, Universidad Michoacana de San Nicolás de Hidalgo (INIRENA 0573). New state record that bridges the gap between previous records from coastal areas of Jalisco and Guerrero (García and Ceballos 1994. Field Guide to the Reptiles and Amphibians of the Jalisco Coast, Mexico. Fund. Ecol. Cuixmala, A.C., Inst. Biol. U.N.A.M, D.F.).

Submitted by **ALEJANDRO MIJANGOS**, **DOLORES HUACUZ**, and **ADRIAN QUIJADA-MASCAREÑAS**, Laboratorio de Herpetología, Facultad de Biología, Universidad Michoacana de San Nicolás de Hidalgo (UMSNH), Morelia 58040, Michoacán, México.

RAMPHOTYPHLOPS BRAMINUS (Braminy Blindsnake). MÉXICO: CAMPECHE: Municipality of Ciudad de Carmen (18°40'20.7"N, 91°44'42.2"W). 19 December 2005. Israel Solano Zavaleta. Verified by Edmundo Pérez Ramos. Colección Herpetológica del Museo de Zoología Alfonso L. Herrera, UNAM (MZFC 18282). First record for Yucatán, extending its range ca. 362 km W of Chetumal, Quintana Roo (Cedeño-Vázquez et al. 2003. Herpetol. Rev. 34:393–395). The specimen was found in mangrove vegetation.

Submitted by **ISRAEL SOLANO ZAVALETA, URI OMAR GARCÍA VÁZQUEZ** (e-mail: urigarcia@gmail.com), and **LUIS CANSECO MÁRQUEZ**, Museo de Zoología, Facultad de Ciencias, UNAM, A.P. 70-399, México D.F. 04510.

SIBYNOPHIS MELANOCEPHALUS (Black-headed Collared Snake). BRUNEI DARUSSALAM: TEMBURONG DISTRICT: Kuala Belalong Field Studies Centre; a tributary of Sungai Belalong, Sungai Mata Ikan (04°32'N, 115°09'E; ca. 110 m elev.). 23 August 2005. Jonas Maximilian Dehling. Zoological Museum of the Department of Biology, Universiti Brunei Darussalam, Bandar Seri Begawan, Brunei Darussalam. UBD G001. Verified by T. Ulmar Grafe. First country record, in addition to records from Sabah and Sarawak (Stuebing and Inger 1999. A Field Guide to the Snakes of Borneo. Natural History Publications [Borneo] Sdn. Bhd., Kota Kinabalu, Malaysia. viii + 254 pp.). A juvenile specimen (SVL 19.1 cm, total length 30.2 cm; 163 ventrals, 144 subcaudals). During examination, the snake dropped its tail tip which measured 22 mm and comprised 33 subcaudals.

Submitted by **JONAS MAXIMILIAN DEHLING**, Department of Animal Ecology and Tropical Biology, Biozentrum, University of Würzburg, Am Hubland, D-97074 Würzburg, Germany; e-mail: Jonas.M.Dehling@stud-mail.uni-wuerzburg.de.

STEGONOTUS CUCULLATUS (Slatey Grey Snake). AUSTRALIA: QUEENSLAND: TOWNSVILLE: Alligator Road, Alligator Creek (19°24'18"S, 146°56'42"E). 08 April 2005. Deborah Bower. QM J83445. Verified by Andrew Amey. Fresh DOR female (SVL 766 mm) found at 2100 h. All specimens of *S. cucullatus* located in Townsville have been associated with relatively cool, wet, montane habitats, correlated with its preference for high rainfall habitats in the relatively dry Townsville region. Previous specimens were found at Mt. Stuart (QM J81126) and Hervey's Range (QM J61798, J67364). Our specimen was found on the Mt. Elliot range. It represents the most southern record of the species and extends its range by 19 km from the previous southern limit, specimen (QM J81126) from Mt. Stuart, Townsville.

Submitted by **DEBORAH SHEENA BOWER** (e-mail: bower@aerg.canberra.edu.au), and **DANE FRANCIS TREMBATH**, Applied Ecology Institute, University of Canberra, Canberra, Australian Capital Territory, Australia 2601 (e-mail: trembath@aerg.canberra.edu.au).

STENORRHINA FREMINVILLII (Freminville's Scorpion-Eating Snake). MÉXICO: QUINTANA ROO: Municipality of Othon P. Blanco, Ejido Caobas (18°26'34"N, 89°05'02"W). 01 June 2004. Víctor H. Luja. Verified by Oscar Flores-Villela. Colección Herpetológica, Museo de Zoología, El Colegio de la Frontera Sur, Unida Chetumal, Quintana Roo (ECO-CH-H-2571). A new municipality record that bridges a gap for this species on the Mexican portion of the Yucatán Peninsula between the Chetumal area of Quintana Roo to the east (Lee 1996. The Amphibians and Reptiles from the Yucatan Peninsula. Cornell Univ. Press, Ithaca, New York. 500 pp.) and 15 miles E Escárcega, Campeche (LSUMZ 33378; not recorded by Lee 1996, *op. cit.*) to the west. The specimen was found alive during the morning on a dirt road in an area containing tropical deciduous forest.

Submitted by **VICTOR H. LUJA**, Centro de Investigaciones Biológicas del Noroeste (CIBNOR), Mar Bermejo #195 Colonia Playa Palo de Santa Rita, La Paz, Baja California Sur, 23090, México; e-mail: lujastro@yahoo.com.

STOLICZKIA BORNEENSIS (Stoliczka's Water Snake). MALAYSIA: SARAWAK: Miri Division, vicinity of Samling Camp at Ravenscourt (04°05'14.1"N, 115°28'42.7"E). 1351 m elev. Indraneil Das. 17 October 2003. Raffles Museum of Biodiversity Research, Zoological Reference Collection, National University of Singapore (ZRC 2.6214). Verified by Kelvin K. P. Lim. Found on root and moss-covered bank of stream, at the mid-elevation of

Gunung Murud. The original vegetation at that elevation, comprising montane forests, had been mostly removed through clear-felling. The species was only known from an unspecified site in the Gunung Kinabalu (ca. 06°01'S, 116°32'E) region, Sungei Rompon on Gunung Trus Madi (summit at 05°33'N, 116°31'E), and the Crocker Range National Park (05°24'N, 116°07'E), all within Sabah State, East Malaysia (Das 2006. Amphib. Rept. Conserv. 4[1]:3–11; Stuebing 1991. Raffles Bull. Zool. 39:323–362). The present record is the first for Sarawak, and an extension of range ca. 250 km to the southwest from the Crocker Range record.

Submitted by **INDRANEIL DAS**, Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, 94300, Kota Samarahan, Sarawak, Malaysia; e-mail: idas@ibec.unimas.my.

STORERIA DEKAYI WRIGHTORUM (Midland Brownsnake). USA: ARKANSAS: Dallas Co.: 1.6 km E of Sparkman on St. Hwy 9 (Sec. 26, T9S, R17W). 06 May 2006. Henry W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 30133). Verified by Stanley E.Trauth. New county record in southern Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville, 421 pp.).

Submitted by **HENRY W. ROBISON**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA: e-mail: hwrobison@saumag.edu.

STORERIA DEKAYI WRIGHTORUM (Midland Brownsnake). USA: ARKANSAS: Sharp Co.: near Spring River ca. 5 km SW of Hardy. 27 October 2006. Jacob Sawyer. Verified by Benjamin A. Wheeler. Arkansas State University Museum of Zoology Herpetology Collection (ASUMZ 30333). New county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville, 421 pp.)

Submitted by **JACOB A. SAWYER** (e-mail: jacob.sawyer@smail.astate.edu) and **STANLEY E. TRAUTH**, Department of Biological Sciences, P.O. Box 599, State University, Arkansas 72467, USA (e-mail: strauth@astate.edu).

TANTILLA ALTICOLA (Boulenger's Centipede Snake). COLOMBIA: NARIÑO: Municipio de Barbacoas, corregimiento El Diviso, vereda Berlín, Reserva Natural Biotopo Selva Húmeda, (01°24'40.5"N, 78°17'06.4"W), 600 m elev. 17 July 2006. J. J. Mueses-Cisneros (in pitfall traps). Colección de Reptiles, Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá. (ICN 10857). Verified by J. D. Lynch. First record for Nariño Department. This species is known from Nicaragua, Costa Rica, Colombia (Wilson. 1982. Milwaukee Publ. Mus. Contrib. Biol. Geol. 52:9–12), and Panama (Castillo et al. 1990. Scientia [Panama] 5:73–84). Previously known in Colombia from the departments of Antioquia Risaralda and Chocó, with the southernmost record in San José del Palmar (ca. 04°54'N, 76°15'W), Chocó Department (Castaño-M et al. 2004. *In* Rangel-Ch. [ed.], Colombia Biodiversidad Biótica IV, pp. 599–631). This new record is the southernmost record for the species extending its range ca. 450 km southwest from the previous southernmost record..

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TANTILLA MELANOCEPHALA (NCN). ST. VINCENT AND THE GRENADINES: Mustique Island: near Lovell Village (12°53'N, 61°11'W). 03 January 2006. Mark de Silva. MPM 33978. Verified by Larry D. Wilson. First island record. Species of *Tantilla* are previously unknown in the West Indies. *Tantilla melanocephala* has a very wide mainland distribution (Guatemala to Uruguay) and also occurs on Trinidad (head pattern D of Wilson and Mena 1980. San Diego Soc. Nat. Hist. Mem 11:1–58). We assume that this individual was a stray that was unintentionally introduced onto Mustique, possibly with sand brought by ship from Trinidad (M. de Silva, in litt.).

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TANTILLA SCHISTOSA (Red Earth Centipede Snake). MÉXICO: QUINTANA ROO: Municipality of Othon P. Blanco, Nueva España Lagoon, 23 km S Ejido Caobas (18°15'11"N, 89°02'33"W), 150 m elev. 01 June 2004. Víctor H. Luja. Verified by Oscar Flores-Villela. Colección Herpetológica, Museo de Zoología, El Colegio de la Frontera Sur, Unida Chetumal, Quintana Roo (ECO-CH-H-2579). First record for Quintana Roo, and a ca. 60 km range extension from the closest known record of Toward Hill, Orange Walk District, Belize (Lee 1996. The Amphibians and Reptiles from the Yucatan Peninsula. Cornell Univ. Press, Ithaca, New York). The specimen was found at night on a road in tropical deciduous forest.

Submitted by **VICTOR H. LUJA**, El Colegio de la Frontera Sur (ECOSUR) Unidad Chetumal. Av. Centenario km. 5.5, A.P. 424. C.P. 77059, Chetumal, Quintana Roo, México; e-mail: lujastro@yahoo.com.

TYPHLOPS RETICULATUS (Reticulate Worm Snake). COLOMBIA: CÓRDOBA: Puerto Libertador: Mina Carbones del Caribe yacimiento Bijao, 98 m elev. (07°51.993'N; 75°43.389'W). 30 July 2005. J. Carvajal-Cogollo and H. Gonzalez. Colección de reptiles Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá D.C, Cundinamarca, Colombia (ICN 10452). Verified by O. V. Castaño. Species is known from tropical South America east of the Andes, in Colombia, Venezuela (Falcon, Carabobo, Monagas, TF Amazonas, Yaracuy), Guyana, French Guiana, Surinam, Brazil, W Peru, N Bolivia (Peters and Orejas-Miranda 1970. Catalogue of the Neotropical Squamata: Part I. Snakes. Smithsonian. Inst. Bull. 297:1–347; Uetz 2005. www.embl-heidelberg.de/~uetz/LivingReptiles.html). In Colombia it has been recorded east of the Andes in the Oriniquia and the Amazonia, present in the mountain range of the Macarena but without exceeding 750 m elev. (Pérez-Santos and Moreno 1988.

Ofidios de Colombia. Monografía, Torino, 517 pp.). New state record for Colombia at the department of Córdoba and northernmost record from South America, extends known range to Cordillera Occidental ca. 600 km airline N from nearest locality.

Submitted by **JUAN E. CARVAJAL-COGOLLO,** Instituto de Ciencias Naturales, Universidad Nacional de Colombia. Apartado Aéreo 7495, Bogotá, Colombia; e-mail: jecarco@yahoo.es.

VIRGINIA VALERIAE ELEGANS (Western Smooth Earthsnake). USA: ARKANSAS: OUACHITA CO.: 0.6 km W of Hampton at Champagnolle Creek bridge on St. Hwy. 4 (Sec. 1, T14S, R14W). 14 October 2005. Patrick Daniel. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 30134). Verified by Stanley E.Trauth. New county record in southern Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville. 421 pp.).

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Herpetological Review, 2006, 37(4), 502.

The Forgotten Amphibians of the Republic of Maldives

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According to the major databases "Amphibian Species of the World" (http://research.amnh.org/herpetology/amphibia/index.php), "AmphibiaWeb" (http://amphibiaweb.org), and "Global Amphibian Assessment" (http://www.globalamphibians.org), amphibians do not occur on the Maldives (verified in January 2006). In contrast, at least one travel guide (Därr 2005), and several documents on the internet (e. g., www.bluepeacemaldives.org/biodiversity.htm and http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/005/ac792e/AC792E02.htm) indicate the occurrence of one or two amphibian species, *Bufo melanostictus* and *Rana* (= *Sphaerotheca*) *breviceps* in this country. At least some of these records appear to be based on the book of P. C. Webb (1988 [1989]) which, however, was not available from libraries in Germany. A search in HerpNet (http://herpnet.org) revealed the existence of several voucher specimens of *Bufo melanostictus* in the Museum of Comparative Zoology (MCZ A-2445 and A-98720–98732 from Kaafu (= Male Atoll) and MCZ A-2446 from Addu Atoll), all collected by the Agassiz Expedition to the Maldives, most or all in 1901. An older publication (Phillips 1958) listed *Bufo melanostictus* with the following comments: "Nos. 8, 9, half-grown: Malé. Previously recorded from Malé Atoll and Addu Atoll (Laidlaw). Plentiful in Malé; mainly nocturnal; noisy croacking on wet nights. Maldivian name = Bouk." In the introduction to this paper Miss Grandison and Mr. Battersby of the British Museum (Natural History) are acknowledged for the identification of the amphibian and reptile collection. It is therefore likely that the two mentioned specimens were deposited in the BMNH. This publication and the voucher specimens leave little doubts that *Bufo melanostictus* is (or was) actually present on the Maldives. In contrast, vouchers of *Sphaerotheca breviceps* from the Maldives could not be traced and its occurrence in this country might be considered as in need of confirmation.

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Call For SSAR Symposium Proposals

Symposia are important components of the Annual Meeting. They allow researchers in a given subfield to come together and present the latest research in that area; society members benefit by interacting with the symposium participants. We invite the submission of symposium proposals for SSAR at the 2008 Annual Joint Meetings of Ichthyologists and Herpetologists (JMIH) in Montreal, Canada. The following guidelines have been agreed to by SSAR, HL, and ASIH.

Proposal Submission.—Proposals (3-page maximum) for consideration by SSAR should contain the following:

- ▶ Symposium Title (or Topic).
- ▶ Name of the Symposium Organizer (phone number and e-mail address) and Symposium Co-organizers.
- ▶ Information on topic and background.
- ▶ What benefit is the topic to the Society?
- ▶ List of potential speakers and topics.
- ▶ Length of symposium (1/2 day or 1 day).
- ▶ Sources of funding other than SSAR.
- ▶ SSAR funding requested, with a short budget (maximum per request = $1,500).

PROPOSALS DUE TO SSAR COORDINATOR **by 1 February 2007**.

Proposals should be submitted to the Coordinator: Dr. Richard D. Durtsche, Department of Biological Sciences, Science Center 148, Nunn Dr., Northern Kentucky University, Highland Heights, Kentucky 41099, USA; or electronically to: durtsche@nku.edu (as PDF, Word, or RTF documents).

SSAR Review Process:

- ▶ Proposals received by the SSAR symposium coordinator will be sent for external review, and comments forwarded to the SSAR Board by mid-February.
- ▶ Recommendations from the SSAR Board (proposals ranked on merit) will be sent to the JMIH Meeting Planning Committee (MPLC) by March 1.
- ▶ The top-rated proposal from each of the four primary societies will be automatically accepted. The remaining four slots will be filled according to the rank order of merit.
- ▶ Final decisions will be made and symposium organizers will be informed of the decision by the Chair of the MPLC by 31 March one year in advance of the JMIH.

BOOK REVIEWS

Herpetological Review, 2006, 37(4), 503–504.

Amphibians of East Africa, by Alan Channing and Kim M. Howell. 2005. Cornell University Press, Sage House, 512 East State Street, Ithaca, New York 14850, USA (www.cornellpress.cornell.edu). xi + 418 pp., 24 pls. Hardcover. US $ 45.00. ISBN 0-8014-4374-1.

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The amphibians of eastern Africa can be divided into two distinct faunae. Firstly, there are widespread species that are also found in central and southern Africa. Secondly, and perhaps most interestingly, there are many species endemic to the mountains and coastal forests, both of which are recognized as hotspots of global biodiversity (Brooks et al. 2002). In terms of African amphibians, East Africa contains two 'hotpots' of diversity: the Eastern Arc Mountains of Tanzania and Kenya and the Albertine Rift mountains of Uganda, Rwanda, Burundi, and eastern Democratic Republic of Congo (Stuart et al. 2004). While herpetologists have been working in eastern Africa for more than a century, there has never been a comprehensive field guide for amphibians that is comparable to the many available for southern Africa (e.g., Rose 1962; Stewart 1967; Passmore and Carruthers 1979; Channing 2001). To date, the most thorough insight into the amphibian fauna of Kenya and Tanzania is found in the many publications of Arthur Loveridge that detail his field expeditions in eastern Africa. Over the past two decades there has been extensive survey work in both Uganda and Tanzania, which has resulted in both range extensions and the description of new species. In their book, *Amphibians of East Africa*, Alan Channing and Kim Howell provide an up-to-date summary of and an excellent introduction to the amphibian diversity found in Kenya, Tanzania, and Uganda. This book is a good complement to Channing's (2001) *Amphibians of Central and Southern Africa* and it will surely become a mainstay in the library of anyone interested in African herpetology.

The book begins with a brief history of research on East African amphibians as well as short chapters on the topography and habitats found in East Africa and threats to and conservation status of amphibian species. The historical account of East African amphibian research provides the unfamiliar reader with an excellent quick introduction. Amateur and professional herpetologists may also appreciate several books by Arthur Loveridge that are popular accounts of his field research: *Many Happy Days I've Squandered* (1944), *Tomorrow's a Holiday* (1947), and *I Drank the Zambezi* (1953). These first few chapters are welcome expansions of similar sections that comprise the Introduction to Channing's (2001) earlier book. While Channing and Howell indicate that at least one of the provided maps is 'simplified,' the information on the maps of topography, rainfall, and vegetation (Figs. 2–5) could have been expanded considerably. For instance, the topographic map provides the location of only four mountains; readers unfamiliar with the many mountains of the Eastern Arc may be confused and will need to rely on a more detailed map. This section would also be improved if literature references were included for the details provided on the distribution and description of the habitats found in eastern Africa. The chapter detailing the threats to and conservation status of East African amphibians provides sufficient detail for a general introduction and is based on the recent Global Amphibian Assessment (Stuart et al. 2004). However, as it is not incorporated into the individual species accounts, this information may be overlooked by some readers.

The bulk of the book consists of species accounts and keys to both families and genera. These comprehensive keys are the first of their kind for amphibians of these three African countries and their publication will be very useful, especially to amateur herpetologists. The keys for each family are followed by keys for each genus as well as species accounts, which are organized alphabetically. Most keys are quite adequate and some, such as those for *Phrynobatrachus* and *Ptychadena*, are very useful. Some herpetologists may be disappointed by the key for the genus *Probreviceps*, which is based largely on geography, and the lack of a key for *Hyperolius*. However, as both genera are taxonomically quite difficult, the authors cannot be faulted. In general, the keys require the specimen to be in hand in order to be identified. Every species account is accompanied by a point locality map that is an outline of Kenya, Tanzania, and Uganda. The family and species accounts are strengthened by many interesting natural history notes. References for these observations are usually provided in the bibliography but are not cited in the text. All photographs are printed in color in a series of plates in the middle of the book. In general, I found the images to be of lower quality than those found in Channing's (2001) previous book. Following the species accounts, there is a chapter on tadpoles and a short chapter written in Kiswahili on East African amphibian diversity and classification. A concluding bibliography focuses on East African amphibians, but includes references dealing with amphibians from other countries as well (e.g., Somalia, Democratic Republic of Congo, Angola, Rwanda, and Cameroon). Finally, there is a systematic index with page number references for every species account.

This book provides any interested naturalist with a good introduction to the amphibians of Kenya, Tanzania, and Uganda. The book is generally well-organized and provides the most thorough summary of East African amphibian diversity to date. I know of no omissions of amphibian taxa that occur in these three countries. Even though the information for a given species, including conservation status, species accounts, color photographs, and tadpole descriptions, is distributed throughout the book, the book should still function as a handy guide in the field. Through a combination of the text and the distributional maps, one should be able to predict the amphibian fauna that will be encountered at a

given locality. As noted in the introduction, the distributional maps are based on the literature, museum collections, and field notes of the authors and their colleagues; unfortunately, specific sources for the distribution data for are not provided in the species accounts. It is unclear why the authors did not include the amphibian faunae of Rwanda and Burundi as these are commonly included within East Africa (e.g., Spawls et al. 2002; Stevenson and Fanshawe 2003).

I found several misstatements in the text, but most are inconsequential. In the section on classification, the families of amphibians in East Africa are briefly described and the genera occurring there are listed. However, in several cases it is not noted that the genera mentioned are only those that occur in East Africa. Thus, it is incorrect that the Scolecomorphidae consists of one genus (p. 36; corrected on p. 349), that the Bufonidae consists of six genera, and that the Hyperoliidae consists of five genera (p. 37). Likewise, for both *Nectophrynoides* and *Leptopelis*, the number of species stated to occur in East Africa is inconsistent with the number of species accounts provided. In general, the authors follow the conventional family-level taxonomy of Frost (2004), but amphibian systematists may be frustrated by the lack of explanation for placing the anuran ranoid family Petropedetidae (e.g., *Arthroleptides*, *Cacosternum*, and *Phrynobatrachus*) within the Ranidae.

Other errors or inconsistencies will be confusing or misleading for the amateur and professional alike. For example, the authors state that nothing is known of the breeding biology of *Arthroleptis adolfifriederici* and *Afrixalus uluguruensis*, yet there are color plates that depict clutches of eggs assigned to both species. In addition, the treatment of *Parhoplophryne usambarica* is odd as, to my knowledge, there is only a single specimen known. Channing and Howell state that *P. usambarica* "females reach a length of 23 mm" and that this "species inhabits leaf litter" (p. 227) but the holotype is an immature female that was collected in a wild banana plant (Barbour and Loveridge 1928). There are several inconsistencies in spelling. For instance, two different spellings are used for the Taita Hills in Kenya (e.g., Taita, p. 93; Teita, p. 19). The authors use the conventional spelling for the Shambala people (e.g., p. 4, 177) but also employ two other variant spellings (Sambaa, p. 4; Shambara, p. 69; Gordon 2005). Similarly, other languages are referred to using multiple terms: Ganda and Luganda; Makonde and Kimakonde; Nyakusa and Kinyakusa; Yao and Kiyao.

Inclusion of names for different genera and species in languages indigeneous to Kenya, Tanzania, and Uganda makes this book particularly useful to field biologists. Remarkably, Channing and Howell have included names from more than 40 languages, although several of these are not typically spoken in East Africa (e.g., Chewa (Malawi), Kalanga (Zimbabwe), or Lwena (Zambia and Angola)). There are a few inconsistencies, and the local names given to particular species are probably best considered as tentative. For instance, *jula* is cited as both the Shambala word for "all frogs" as well as the specific name of *Bufo brauni*. Likewise, *isodo* is cited as both the Gisu name for "all frogs" and the specific name for *Afrana angolensis*. I do not think that the authors intended to provide a definitive list and in many cases certain words apply to multiple taxa (such as in many of the Ugandan languages where the same words are used for *Afrana*, *Ptychadena*, and *Phrynobatrachus* species).

One point that is implicit throughout the book is that there is still little known about the biology of most East African amphibians. Future research should focus on aspects of biology including diet, breeding biology, and tadpole ecology. Without this information, it is difficult to make informed conservation management choices regarding preservation of particular habitats or captive breeding programs. Undoubtedly, Channing and Howell's book will be very useful to field biologists as it provides a thorough introduction to the amphibians of East Africa. Most importantly, this work highlights that there is still much to be done even in biodiversity hotspots in which the fauna is relatively well documented.

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Herpetological Review, 2006, 37(4), 505–508.

Amphibians and Reptiles of Pakistan, by Muhammad Sharif Khan. 2006. Krieger Publishing Company (info@krieger-publisher.com). 328 pp. Hardcover. US $145.00. ISBN 1-89464-952-3.

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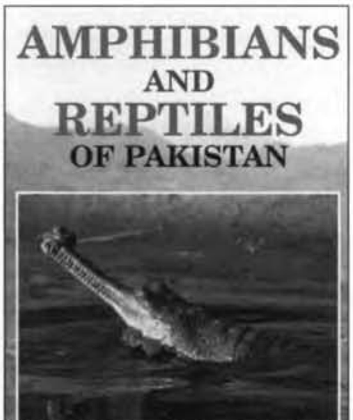

Pakistan's location and rather diverse topographical features (widely albeit mistakenly considered by some as entirely arid) have much to do with its rich herpetofauna. The country forms the easternmost frontier of a number of Palearctic taxa, stretching from northern Africa and Europe, as well as the westernmost edge of Oriental ones, extending from eastern Asia. This country, thus, forms the melting pot of two distinct faunas, and includes a number of autochthonous elements, particularly amongst its high altitude saurofauna and its deserticolous snakes. Much of Pakistan's biota is under threat, from development and overexploitation, as well as from lack of knowledge (Anon., 2000).

Islam took early root here, and some of the greatest human migrations took place around the middle of last century, when millions of Muslims from the newly independent (in 1947) India crossed over to Pakistan, just as millions of Hindus and other non-Muslims from Pakistan fled their homes in Pakistan in favor of India. This was accompanied by free bloodletting on both sides, abetted, if not aided by local governments, and was to result in mutual hostility and suspicion (and three wars) for nearly five decades. Only very recently have overtures of peace been made and both nations seem to have forsaken violence in favor of nation-building. Under such historic circumstances, research or explorations of a shared fauna had taken a back seat, and much of the information on the biota of the borders of these volatile nuclear-armed neighbors stem from expeditions and other boundary missions conducted during colonial times.

The importance of science for the welfare of her citizens was not lost to Pakistan's new ruling class. In an inaugural address to the All-Pakistan Science Conference in 1949, the then Governor-General H. E. Khawaja Nazimuddin noted "If we are to build our State on progressive lines and bring about a radical change in the living conditions of our people, we shall have to make them scientific minded and harness the resources of science for the solution of the problems facing the country" (Anon. 1950). Over half a century later, this truth is being realized.

This work is by Pakistan's foremost student of herpetology, Professor Muhammad Sharif Khan, formerly of the Herp Laboratory, Rabwah, Pakistan. For the last decade, Khan has been living in the U.S., and has published widely on all herpetofaunal groups, both in his native Pakistan and, more recently, in books published in the West. The volume under review can be considered a synthesis of a life's work on an interesting fauna, and as such, has no peer.

After a brief dedication (to Dr. and Mrs. Habib Ullah Khan, Ahsanul Islam, Robert Mertens and Sherman A. Minton, after some of whom the author has already named snake species) and a Foreword (by Kraig Adler), are the Preface (which describes the organization of the book), Acknowledgments and an extended Introduction (including a useful political map of Pakistan). Chapter 1 shows 24 species and subspecies of amphibians and 203 of reptiles in the national checklist. The total taxon count is hard to arrive at from this chapter. Adler (p. ix), in his Foreword, counted 24 species (but this includes subspecies recognized for Pakistan by Khan). In the species list, there are inconsistencies in the format adopted, with the inclusion of subspecies name of some (e.g., *Bufo melanostictus* and *Bufo viridis*), but not all (e.g., *Lissemys punctata andersoni* and *Eryx tataricus*) polytypic taxa where the type subspecies do not occur in Pakistan. Included as valid is Khan's (1997) *Bufo siacheninsis*, treated as synonymous with *B. latastii* Boulenger, 1882, by Stöck et al. (2001). Two additional taxa may be added to this fauna. Das et al. (1998) revived from obscurity the lygosomine skink, *Asymblepharus tragbulensis*, collected from the western Himalayas by the Pamir Boundary Commission towards the end of the nineteenth century, and Macey et al. (2006) included *Bufoniceps laungwalansis* from Pakistani territory, based on the largely unpublished work of the late Walter Auffenberg (T. Papenfuss, pers. comm.).

As to the main body of the book itself, I am pleased to see maps printed in two colors, each species distribution represented with a dot map. It would perhaps been useful to have a gazetteer of localities, but this would increase the number of pages (and the cost). Some of the Pakistani endemics have been illustrated from life for the first time in color. Certainly, it was the first time I saw color images of *Bufo melanostictus hazarensis* (page 44), *Bufo viridis zugmayeri* (page 52), *Paa barmoachensis* (page 62), *Paa hazarensis* (page 64), *Paa sternosignata* (page 65), *Cyrtopodion kohsulaimanai* (page 129), *Siwaligekko dattanensis* (page 146), *Siwaligekko mintoni* (page 147), and *Enhydris pakistanica* (page 196). Surprisingly, *Chamaeleo zeylanica* is not illustrated. While this species may be rare in Pakistan, images of this species are readily available from populations in India and Sri Lanka. A handful of photographs are of preserved specimens– still useful in my opinion– and better than a 100-word description.

On the matter of nomenclature used in this work, it is somewhat of a mixed bag. Traditionally, workers in the Subcontinent have clung to Smith's three volumes on reptiles in the *Fauna of British India* series, published 1931, 1935, and 1943, overlaying it with new revisions for particular groups. The amphibian taxonomy follows that proposed primarily on phenetic criteria by Dubois (1986; 1992). Some of the relevant papers may not have been available to the author, and indeed, the amphibians will see a substantial change at the generic level if *The Amphibian Tree of Life* nomenclature of Frost et al. (2006) is adopted. Nomenclature for turtles is somewhat dated in that it does not follow Spinks et al. (2004),

in which both Pakistani species of *Kachuga* are assigned to *Pangshura*, and in the allocation of this and related genera to the Emydidae rather than the Geoemydidae. Lizard nomenclature is more current, in that the following genera are used: *Brachysaura*, *Laudakia*, *Trapelus* (following Moody's 1980 upublished thesis); *Mesalina* (from Arnold 1986); *Eutropis* (following Mausfeld et al. 2002); *Novoeumeces* (fide Griffith et al. 2000). On the other hand, Khan adopts his recent (Khan 2003a, 2005b) higher classification of geckos (including the genera *Altigekko*, *Indogekko*, and *Siwaligekko*) that most modern workers would hesitate to accept because of its phenetic approach. This does not, of course, imply that the work of the author on the group is trifling, and Khan's (2003b) review of *Cyrtopodion* presents much new information relevant to both systematics and natural history of these lizards. Nomenclature adopted for snakes is again largely from Smith (1943), with updates based on the work of more recent authors, such as *Amphiesma* (fide Malnate 1960); *Hemorrhois* (adopting the nomenclature of Inger and Clark 1943; Schätti and Utiger 2001); *Platyceps* (fide Schätti and Utiger 2001); *Daboia* (fide Hermann et al. 1992); and *Gloydius* (fide Hoge and Romano-Hoge 1981). Dated or otherwise incorrect nomina used include: *Agrionemys* for *Testudo* (fide Crumly 1982; Sqalli-Houssaini and Blanc 1990; Le et al. 2006, although most recently, Parham et al. 2006, made a case in its support); *Scincella* for the Pakistani *Asymblepharus* (see Eremchenko and Szczerbak 1980); *Ptyas mucosus* for *P. mucosa* (see David and Das 2004); *Pelamis platurus* for *P. platura* (fide Lanza and Boscherini 2000); and *Praescutata* for *Thalassophis* (see McDiarmid et al. 1999). Khan (1998, 1999a, 1999b) described four taxa of scolecophidians that Wallach (2000) showed to be poorly diagnosed and incorrectly named. Nonetheless, both in the present volume and in a recent paper (Khan 2005a), the author continues to use the names as valid without justification, but corrects the names of the new taxa.

The 14-page bibliography captures most of what has been published on the regional herpetofauna. Missing are a number of works on the fauna of adjacent Afghanistan (such as Sharma 1976; Kuch 2004), neighboring areas of India, especially Kashmir, Rajasthan, and Gujarat (e.g., Krishna and Dave 1960; Sharma and Sharma 1975; Sahi and Duda 1985; 1986; Sahi et al. 1996; Daniel and Shull 1964; Daniel 2002) and China (e.g., Pope 1935; Zhao and Adler 1993). For the sake of completeness, I would like to add to this list the following references relevant to the herpetology of Pakistan: Adler et al. (2000), Alcock (1898), Anderson and Leviton (1966), Annandale (1906a, 1906b), Auffenberg (1988, 1994), Auffenberg and Rehman (1995), Auffenberg et al. (1989, 1990), Baig and Böhme (1991), David et al. (1999), Dowling (1993), Eremchenko (1987), Finn (1898), Gritis and Voris (1990), Helfenberger (2001), Leviton and Anderson (1970), Malnate (1960; 1962), Mertens (1953, 1954), Singh (1991), Smith (1933), Stemmler (–Gyger) (1969), Stickel (1951), Stoliczka (1872), Szczerbak (1991), Utiger et al. (2002), Waltner (1991), and Wüster and Thorpe (1992).

Species accounts vary in size, and are typically over a page in length, and include the current scientific name and authority, the original description, type locality information, diagnosis, color, natural history notes, and distribution. Conveniently for readers, a color image of the species and distribution map is set alongside the species account. After the species accounts are: Chapter 8 ('Distribution and Affinities of Herpetofauna'), Chapter 9 ('Herpetology of Habitat Types'), Chapter 10 ('Altitudinal Distribution of the Herpetofauna of Pakistan'), Chapter 11 ('Snakebite Problem in Pakistan'), Chapter 12 ('Threats to the Herpetofauna of Pakistan'), and finally, the bibliography and two pages of 'Suggested reading.' The work concludes with the index, which is in the form of a useful table, allowing species accounts, images, distributional maps, and figures to be found separately.

The author and copy editor at Krieger deserve congratulation for not letting too many typos and other mistakes slip by, and I noticed only a few: Rafiuesque for Rafinesque (page 1), *Sphaeroteca* for *Sphaerotheca* (pages 1, 8, 66, 67 et seq.), *Teratoscincus* Strauch, 1863 is not set in bold face (page 3), *Uromastyx asmussi* for *Uromastyx asmussii* (pages 3 and 174), *Stutiger* for *Scutiger* (page 52), squamata for Squamata (page 291), texa for taxa (page 295), and 1874 for 1884, for an early book on the topic by Murray (1884).

Krieger Publishing has produced a large number of herpetological titles in the last 20 years. To be fair to this publisher, the titles published would perhaps not be entertained by most publishers because of their limited market. On the other hand, this and all other works are overpriced (this particular volume, at its retail price a staggering 20% of Pakistan's current annual per capita income) and can be improved on in terms of color separation, choice of images, and photo editing. The price factor alone will keep the volume away from the hands of those who need the volume most. A number of images will appear familiar to readers as they are printed from the original Kodachromes by Sherman Minton (and reproduced in black-and-white in his 1966 work).

In summary, I recommend Khan's new offering to all interested in the fauna of the Subcontinent or those of West Asia, although I guess only those who can fork out US $145 (plus postage) can afford to possess a personal copy.

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CAUDATA

AMBYSTOMA TIGRINUM MAVORTIUM (Barred Tiger Salamander). **EXTRALIMITAL POPULATIONS**. The natural range of *Ambystoma tigrinum mavortium* extends from central Nebraska to south Texas, USA (Conant and Collins 1991. Reptiles and Amphibians Eastern and Central North America, Houghton Mifflin Co., Boston, Massachusetts). The common practice of using Tiger Salamander larvae (water dogs) as fish bait has resulted in introductions of *A. t. mavortium* beyond its natural range (Petranka 1998. Salamanders of the United States and Canada, Smithsonian Press, Washington 587 pp.).

We report extralimital populations of *A. t. mavortium* from the unincorporated communities of Alpine and Ramona, San Diego Co., California. We consider both populations to be established because of the documentation of larvae (Alpine) or recently transformed individuals (Ramona). Specimen vouchers from the Alpine population have been deposited in the herpetological collection of the California Academy of Science, San Francisco, California (CAS). Vouchers were also sent to H. Bradley Shaffer, Department of Zoology, University of California, Davis, California, for genetic analysis.

On 6 February 1996, *A. t. mavortium* larvae (ca. 30 mm TL) were first detected in the vicinity of upper Chocolate Canyon in the unincorporated community of Alpine (R2E T15S Sec 29). Subsequent surveys resulted in additional observations of *A. t. mavortium* larvae: Spring 1996 (ca. 35 mm TL); 16 March 2001 (ca. 25 mm TL; CAS 233270); 28 March 2003 (ca. 17 mm TL; CAS 233721); 4 April 2003 (ca. 35 mm TL; CAS 233274); 4 May 2003 (ca. 43mm TL); April 2004; and 12 March 2005 (ca. 50mm TL; CAS 233723). Three of the larvae collected in 2003 were maintained in aquaria and photographed 25 months later to determine the pattern and coloration of individuals representing this population. Additional locality records of *A. t. mavortium* within the town of Alpine include a surface-active adult taken during Winter 1994 (R2E T15S Sec. 32), another on 12 January 2005 (R1E T16S Sec. 11), as well as the excavation of an adult from a residential garden in Spring 1999 (R2E T15S Sec. 33). Although no specimens were collected from these three additional locations, both surface-active individuals were photo documented. The Alpine population is now known to occupy an area of both the San Diego River watershed having been found in the area of upper Chocolate Canyon, and the Sweetwater River watershed, occurring in an unnamed drainage along Harbison Canyon Road.

Additional records of *A. t. mavortium* within San Diego Co. include three individuals captured within a few meters of the West Branch drainage located southeast of the unincorporated community of Ramona (R1W T13S Sec. 36). In Spring 2002, an adult was captured, and during Spring 2003, on separate dates, a recently transformed individual and an adult were captured. Individuals were photo documented prior to being released at the places of capture. This population also occurs within the San Diego River watershed.

Due to the limited amount of information, aspects of these populations such as source of introduction, length of time as an established population, population size, and the extent of their distribution remain unresolved.

This note provides source information for the *A. tigrinum* population of Alpine, San Diego Co., represented on the range map (extreme southwest portion of mainland California) in Stebbins (2003. Western Reptiles and Amphibians, 3rd. ed., Houghton Mifflin Co., Boston, Massachusetts), as referenced in Jennings (2004. An Annotated Check List of the Amphibians and Reptiles of California and Adjacent Waters, California Dept. Fish and Game 90[4]:161–213), and in Lemm (2006. Field Guide to Amphibians and Reptiles of the San Diego Region. University of California Press. Berkeley, California).

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AMBYSTOMA TIGRINUM TIGRINUM (Eastern Tiger Salamander). **BURROW DESCRIPTION.** Relatively little is known about burrows of the Eastern Tiger Salamander (Semlitsch 1983. Can. J. Zool. 61:616–620; Madison and Ferrand III 1998. Copeia 1998:402–410; Gruberg and Stirling 1972. Herpetol. Rev. 4:85–89). During winter 2005, we radio-instrumented four *A. t. tigrinum* as they exited a breeding wetland in southwest Georgia, USA. In all instances, animals were tracked to underground burrows with one or more visible entrances. The area and depth of burrows were measured when we attempted to recover the transmitters; measurements varied considerably among individuals.

One radio-tagged female was located in a burrow seven days after release. The burrow was adjacent to an agricultural field and firebreak, and was 6 m from the base of a large live oak, *Quercus virginiana*. The burrow meandered through an area ca. 0.5 × 0.50 m and reached a maximum depth of 0.30 m. Only one entrance was found; the burrow terminus was an elliptical cavity.

A tagged male was also located seven days after release. It spent two days in a shallow, branched burrow network. Total burrow length was ca. 4 m with a total area of 1.0 × 3.5 m. Although most of the tunnels were shallow, the burrow reached a maximum depth of 0.20 m. There was no tree canopy over the burrow system and

the burrow system was 13 m from the base of the nearest live oak. There were small oaks (*Quercus* spp.) in the area immediately surrounding the burrow.

A second tagged male was tracked to a burrow three days after release. It spent at least two days at this location and was observed once in the entrance of the burrow. The burrow was surrounded by shrubs and small oaks in the understory with a large, mature hardwood overstory. Burrow area was 1.0 × 1.5 m and was at least 0.40 m deep. The burrow led to a thick root bed.

The third tagged male was tracked to a burrow network the day after release and spent at least four days at this site. The burrow system was adjacent to a firebreak and agricultural field with little or no vegetation. The burrow network was shallow (< 3 cm) and covered an area 3.0 × 5.0 m with more than 10 different tunnels leading to openings at the surface. We tracked this animal over a 2 h period (2100–2300 h) in February and found that it moved throughout the burrow network.

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DESMOGNATHUS MONTICOLA (Seal Salamander) and ***DESMOGNATHUS QUADRAMACULATUS*** (Black-bellied Salamander). **INTRAGUILD PREDATION** (IGP) and **AUTOUROPHAGY**. Although experimental studies demonstrate that plethodontid salamanders are intraguild predators, there are few records from nature of interspecific predation by salamanders. A previous note (Bernardo 2002. Herpetol. Rev. 33:121) reported three distinct IGP interactions involving six different plethodontid species in the field. Here we document a fourth distinct IGP interaction involving a new pairing and one additional species. Upon arrival at a waterfall in Union Co., Georgia (USA) on 13 May 2005, we observed a large (ca. 70 mm SVL) *Desmognathus monticola* with what appeared to be its own recently autotomized tail in its mouth (Fig. 1). As we puzzled over this observation for a few moments, the salamander backed under a large rock into a burrow. We then noticed a freshly dead subadult *Desmognathus quadramaculatus* (ca. 40–50 mm SVL) about a meter away from where we had observed the *D. monticola*. The smaller individual had recently sustained significant injuries and was dead. It was missing its right hind limb, its tail, and it had a fresh bite mark along the left side if its trunk (Fig. 2); the bite penetrated the skin revealing musculature (circled in Fig. 2), and the wounds to the limb and tail were fresh and bloody. We presume that the missing body parts were consumed by the *D. monticola*, although we were unable to capture it. From these observations we conclude that the two salamanders had a predatory encounter. The larger individual also apparently sustained an injury causing it to autotomize its tail. Tail autotomy is common among salamanders during predatory interactions (Bernardo and Agosta 2005. Biol. J. Linn. Soc. 86:309–331). The other noteworthy feature of this interaction is the apparent retrieval and planned consumption of its own autotomized tail by *D. monticola*. Tail autotomy during predatory encounters has been shown to increase survival, but because tails are generally highly nutritious, tail loss also may impinge on reproductive phenotypes and other fitness components (Bernardo and Agosta 2005, *op. cit.*). Autourophagy permits recovery of these valuable resources when the predator fails to eat the tail. This behavior has been documented in lizards (e.g., Clark 1971. J. Exp. Biol. 176:295–302), but we are unaware of any records of tail recovery and ingestion by salamanders.

FIG. 1. Adult *Desmognathus monticola* consuming its own tail following a predatory event with a sub-adult *D. quadramaculatus*.

FIG. 2. Deceased sub-adult *Desmognathus quadramaculatus*, showing significant injuries apparently sustained during a predatory event with a larger *D. monticola*. Circled area denotes exposed musculature; note also missing left rear leg and tail.

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DICAMPTODON COPEI (Cope's Giant Salamander). **PREDATION.** *Dicamptodon copei*, restricted in distribution to western Washington and northwestern Oregon, is ecologically poorly known (Jones et al. 2005. Amphibians of the Pacific Northwest. Seattle Audubon Society, Seattle, Washington. 227 pp.). Few specific dietary data exist. Antonelli et al. (1972. Northwest Sci. 46:277–289) reported prey in 2 arachnid groups; 2 fish genera; 2 mollusc groups at an ordinal level; and 8 insect orders at a family level, including a gryllid orthopteran adult; but precisely which of these are *D. copei* prey is unknown because the data are a composite from *D. copei* and *D. tenebrosus*. In a general account, Nussbaum et al. (1985. Amphibians and Reptiles of the Pacific Northwest. University of Idaho Press, Moscow. 332 pp.) reported

that *D. copei* "feed on almost all available aquatic organisms small enough to be ingested," adding that "immature insects form the bulk of the diet;" their comments on prey taxon specificity were restricted to the statement that "fish eggs, small fish, eggs and tadpoles of [Coastal] Tailed Frog (*Ascaphus truei*), and smaller larvae of their own kind and the Pacific Giant Salamander [*D. tenebrosus*] are also eaten." Hence, we augment the sparse species-specific dietary data on this species with an observation of *D. copei* from southwestern Washington with orthopteran prey.

On 12 Sept 2001 at 1459 h, DJD and RFP encountered a 73 mm SVL (13.5 g, 65 mm tail) paedogenic *D. copei* that was submerged under a cobble sitting on gravel in a small step-pool (30 cm max depth) in a small (0.6 m average width) headwater stream. The *D. copei* was found in a second-order reach in a late-rotation age Douglas-fir (*Pseudotsuga menziesii*) forest managed for timber in the Stillman Creek Basin, Willapa Hills (46°28'51.70"N, 123°12'45.67"W, WGS 84; elev. 639 m). When first found, the *D. copei* had part of an orthopteran hindlimb protruding from its mouth. In the process of handling the *D. copei* for measurement, the intact hindlimb was removed and found severed at the articulation point of the femur with the body. Viscous fluid clung to its severed end. We preserved the disarticulated leg and released the *D. copei* at its site of capture.

Identification of the orthopteran leg revealed it to be the left hind leg of a camel cricket, *Tropidischia xanthostoma* (Rhaphidophoridae; Orthoptera). Rhaphidophorids, a cosmopolitan family of hygrophilic omnivorous orthopterans with many cavernicolous species (Vandel 1965. Biospeleology—The Biology of Cavernicolous Animals. Pergamon Press, London, England. 524 pp.), are a group we have often observed in the coastal Pacific Northwest landscape. The orientation of the leg (head of the femur inside the salamander) leads us to believe that the *D. copei* ate the remainder of the cricket. This represents the first record of a *D. copei* consuming a rhaphidophorid cricket.

The Weyerhaeuser Company, through Douglas Runde, facilitated work on their lands, Washington Department of Fish and Wildlife funded the surveys, and David A. Nickel (Systematic Entomology Lab., Agriculture Research Service, USDA, Beltsville, Maryland) identified the cricket.

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DICAMPTODON TENEBROSUS (Pacific Giant Salamander). **DEFENSE.** In the Pacific Northwest, *Dicamptodon* spp. are the largest salamanders having both terrestrial and neotenic forms (Petranka 1998. Salamanders of the United States and Canada, Smithsonian Institution Press, Washington and London. 587 pp.). They also are an important food source for garter snakes (*Thamnophis* spp.) which, as they grow in size, increasingly prey on larger salamanders (Lind and Welsh 1990. J. Herpetol. 24:104–106; Lind and Welsh 1994. Anim. Behav. 48:1261–1273). Although this behavioral trend is hypothesized to increase snake survival (Lind and Welsh 1994, *op. cit*), large terrestrial *Dicamptodon* spp. can pose a significant threat to predatory garter snakes. Diller (1907. Science 26:907–908) observed a terrestrial giant salamander firmly grasping the head of a garter snake with its jaws for several hours, which resulted in the death of the snake; and Graf (1949. Copeia 79–80) made a similar observation, but the snake was eventually released by the salamander. Here, we present a description of a terrestrial *D. tenebrosus* engaged in a fight with an adult California Red-sided Garter Snake (*Thamnophis sirtalis infernalis*) over a half-century since the last published report of a similar event.

On 14 April 2001 at 1500 h, in an old-growth redwood forest at Montgomery Woods State Park, Mendocino Co., California, USA (39°13'46.2"N, 123°23'22"W), SVS encountered a *D. tenebrosus* (ca. 17.5 cm TL) biting the head of a *T. s. infernalis* (ca. 75 cm TL, largest diameter ca. 3.75 cm). The salamander was biting the snake head-on, possessing the entire upper cranium posterior to the eyes and up to the dorsal stripe in its jaws. The snake's head was extremely flattened, disarticulated, and bloodied from the salamander's bite. Initially, the snake was vigorously thrashing side-to-side, coiling, and trying to pin the salamander to free itself. In response, the salamander moved and rolled with the action of the snake, righting itself every time without releasing its grip. By 1545 h the snake showed reduced activity, having spent much of its energy trying to escape the salamander, and was still bleeding profusely from the head. Following 45 min of observation, SVS left the area. At 1745 h, SVS returned to the area and found the salamander still maintaining its grip on the snake in the same position as first discovered. Although the snake was still alive, it was extremely lethargic and appeared close to death. Unfortunately, due to waning daylight, SVS departed the area and did not return to investigate the outcome of the fight.

We assume that antagonistic encounters like this occur as a result of snakes actively pursuing salamanders. Although formal accounts of interactions between *Thamnophis* spp. and terrestrial *Dicamptodon* spp. are few (Diller, *op. cit.*; Graf, *op. cit.*), we suspect these types of events are probably common, though rarely observed. Most accounts of active predation of *Dicamptodon* spp. by *Thamnophis* spp. have been largely relegated to larval or neotenic salamanders occupying aquatic habitats where they occur at high densities and are more readily observed (Lind and Welsh 1990, 1994, *op. cit.*). Future demographic research on giant salamanders is needed to better understand their terrestrial ecology and interactions with potential predators such as garter snakes.

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PLETHODON VEHICULUM (Western Red-backed Salamander). **REPRODUCTION**. On 2 Aug 2002, we found a nest of the Western Red-backed Salamander, *Plethodon vehiculum*, 80 m from the southern bank of the lower Pachena River (48°48'25"N, 125° 06'28"W), in a Sitka Spruce floodplain forest (> 250 years old), ca. 4 km from the town of Bamfield, Vancouver Island, Brit-

ish Columbia. While searching for earthworms, we dug with our hands into loose moss, litter, and humus at the base of a decayed tree stump. We uncovered a clutch of 12 eggs within a small hollow created by the root of a hemlock sapling and a piece of decayed wood (12 × 5 × 1.5 cm) about 10 cm under the surface. The grape-like cluster of eggs was enclosed in a gelatinous membrane with a stalk attached to the underside of the wood. We noted the presence of an adult who crawled further underground before we could verify its identity. We quickly replaced the nest to its original position.

We revisited the site on 19 Aug 2002 to photograph the nest (photographs of the nest and accompanying adult were deposited in the Royal British Columbia Museum image database). We estimated adult SVL to be > 50 mm but did not handle the individual for exact measurements. The large size suggests that the adult was likely a female. Eyes and small legs were visible within each egg. One egg was 0.56 cm in diameter. On 29 Sept 2002, we returned to the site and found only a small gelatinous lump on the wood. The substrate appeared as we had left it.

This nest description is noteworthy for two reasons. First, only two other natural nests of *P. vehiculum* have been documented in the literature. They were found 12 cm apart beneath a rock (40 × 30 × 15 cm) in talus at the base of a shear roadside basalt outcrop near Klickitat Lake, Oregon (Hanlin et al. 1979. J. Herpetol. 13:214–216). Leonard et al. (1993. Amphibians of Washington and Oregon. Seattle Audobon Society, Seattle. 168 pp.) suggested that nests and eggs of *P. vehiculum* are not well documented because most egg clutches are probably located well beneath the surface. The nest that we found was at a shallow depth under humus and wood, where it would be considerably more vulnerable to predation, desiccation, and soil compaction than would eggs in deeper nest sites. Second, this clutch of 12 eggs is notably larger than the clutches of 8 and 9 reported by Hanlin et al. (1979, *op. cit.*) and the clutch of 9 laid by a captive female (Stebbins 1951. Amphibians of Western North America. Univ. California Press, Berkeley. 539 pp.). It is within the high end of the range reported for ovarian clutches (6–19 eggs per clutch; mean = 10.43; N = 65) for the species in Oregon (Peacock and Nussbaum 1973. J. Herpetol. 7:215–224). The adult associated with the nest was within the range of females measured on Vancouver Island (42–58 mm SVL; Ovaska and Gregory 1989. Herpetologica 45:133–143).

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PSEUDOTRITON RUBER RUBER (Northern Red Salamander). **SIZE AND SUBTERRANEAN AGGREGATION**. Conant and Collins (1998. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. 3rd ed., expanded. Houghton Mifflin, Boston. 616 pp.) reported 181 mm total length (TL) as the maximum size for *Pseudotriton ruber ruber*. Herein, we report an aggregation of exceptionally large *P. r. ruber* from a cave, many approaching the reported maximum size.

On 20 October 2005, 14 *P. r. ruber* were discovered in Anderson Spring Cave, a state-owned cave on Pigeon Mountain, Walker Co., Georgia, USA. All individuals were found underneath rocks in the cave stream, ca. 25–75 m beyond the twilight zone. Water depth of the stream ranged from 2–10 cm. Thirteen individuals were captured, measured to the nearest mm using a metric rule, and weighed to the nearest 0.5 g using a Pesola scale. The largest individual measured 113 mm SVL, 180 mm TL, and weighed 27.0 g. Three other individuals exceeded 110 mm SVL, 175 mm TL, and 25.0 g. Mean size ± 1 SD for the 13 captured individuals was 102.7 ± 7.6 mm SVL, 164.8 ± 11.1 mm TL, and 19.7 ± 4.4 g mass. The smallest individual from Anderson Spring Cave (92 mm SVL, 155 mm TL, 17.0 g) was larger than the largest individual (female 85 mm SVL) out of 316 specimens collected by Bruce (1978. Copeia 1978:417–423) in the southern Blue Ridge of North Carolina. A voucher photograph was taken of the largest individual and placed into the Herpetological Collection at Austin Peay State University (APSU 18055).

Female *P. ruber* grow larger than males (Bruce 1978, *op. cit.*); however, sex is difficult to determine externally. During autumn, females disappear from surface sites, presumably to brood eggs, and are not observed on the surface until late autumn or winter (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Inst. Press, Washington, DC. 587 pp.). Although adults are common in headwater springs and seeps (Hunsinger 2005. *In* M. Lannoo [ed.], Amphibian Declines: The Conservation Status of United States Species, pp. 860–862. Univ. of California Press, Berkeley and Los Angeles), *P. ruber* has infrequently been reported from caves. The salamanders observed in Anderson Spring Cave may represent a breeding aggregation of exceptionally large females. Males may also be present within the aggregation. The two largest individuals from Anderson Spring Cave were found brooding separate egg masses beneath the same rock, and another large female had ova visible through her venter. Communal nesting has not been documented in *P. ruber*, although Miller and Niemiller (2005. Herpetol. Rev. 36:429) observed presumably two females brooding an egg mass in the twilight zone of a cave stream in DeKalb County, Tennessee, in September 2004. Walker (1931. *In* Pfingsten and Downs 1989. Salamanders of Ohio. Ohio Biol. Surv. Bull. New Series Vol. 7 No. 2. 315 pp.) discovered 22 adults on 24 March within a few square meters in a spring in Knox County, Ohio, and suggested that the concentration may have been related to hibernation. Rather than hibernation, we suggest the aggregation may have been related to reproduction.

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ANURA

ACRIS CREPITANS BLANCHARDI (Blanchard's Cricket Frog). **MORPHOLOGY.** Cricket Frog dorsal background color varies from light to dark gray or from light tan to dark reddish-brown (Milstead et al. 1974. Evolution 28:489–491). The vertebral stripe of *A. crepitans* is polymorphic, and can be a varying shade of red (red, brown, reddish brown), green, or gray (Pyburn 1961. South-

west. Nat. 6:164–167). According to Nevo (1973. Evolution 27:353–367), gray is most frequent, followed by red, and then green.

Some *A. crepitans* lack the prominent vertebral stripe and have completely green dorsal surfaces (Gray 1995. Trans. Illinois State Acad. Sci. 88:137–138; L. M. Blackburn, pers. comm.). This rare color pattern was observed during May–August 2004 and May–August 2005 at a semi-permanent wetland at Ford Lake Park in Ypsilanti, Michigan, USA. The *A. c. blanchardi* found at Ford Lake Park were similar to the specimens reported by Gray (1995, *op. cit.*): the green dorsal surface color was brighter than the olive or tan background color, and covered the head, body, limbs, and feet. About 76% (13/17) of the Cricket Frogs captured at Ford Lake Park exhibited this green color pattern. The wetland at Ford Lake Park has more emergent vegetation, which might provide a green color pattern background that matches the green dorsal surface of these Cricket Frogs. Cricket Frog coloration might be an adaptation to predation, as coloration that matches substrate color allows Cricket Frogs to vanish as soon as they stop moving (Milstead et al. 1974. *op. cit.*). Nevo (1973. *op. cit.*) suggested that color morph frequency might differ between neighboring microhabitats based on substrate color. Frequencies of red and green morphs varied significantly with the substrate color of the pond, which could be due to selective predation and/or habitat selection by morphs (Nevo 1973. *op. cit.*). To the best of my knowledge, this is the first recorded account of the green color pattern variant in Blanchard's Cricket Frogs in Michigan.

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ACRIS CREPITANS BLANCHARDI (Blanchard's Cricket Frog) **PREDATION.** Known predators of the Northern Cricket Frog (*Acris crepitans*) include frogs, fish, snakes, turtles, birds, and mammals (Gray and Brown. 2005. *In* Lannoo [ed.], Amphibian Declines: The Conservation Status of United States Species, pp. 47–54. University of California Press, Berkeley). The only previously recorded anuran predator of *A. crepitans* is the American Bullfrog (*Rana catesbeiana*) (Lewis 1962. Trans. Illinois State Acad. Sci. 55:80–83). Here I report predation of a juvenile Blanchard's Cricket Frog (*Acris crepitans blanchardi*) by an adult Green Frog (*Rana clamitans*). To the best of my knowledge, this represents the first record of predation by a *R. clamitans* on a Cricket Frog.

Although *R. clamitans* are commonly associated with *A. crepitans*, there are no published records of Green Frog predation on Cricket Frogs (Hay 1998. *In* Lannoo [ed.], Status and Conservation of Midwestern Amphibians, pp. 79–82. University of Iowa Press, Iowa City). Green Frogs eat insects, slugs, snails, crayfish, spiders, flies, caterpillars, butterflies, moths, small snakes, and frogs (Jenssen 1967. Copeia 1967:214–218). I observed an adult *R. clamitans* capture and consume a juvenile *A. c. blanchardi* on 17 Aug 2005, between 1530–1540 h along the shoreline of a permanent wetland at the Port Huron State Game Area in Port Huron, Michigan, USA. Although I noticed the legs of the *A. crepitans* dangling from the mouth of the *R. clamitans*, I did not notice a struggle by the Cricket Frog to free itself. After capturing the Cricket Frog in its mouth, the Green Frog jumped away and consumed its prey. The Blanchard's Cricket Frog is declining at an alarming rate in the northern portions of its range, and the exact cause of this decline is unknown (Harding 2000. Amphibians and Reptiles of the Great Lakes Region. Univ. Michigan Press, Ann Arbor). Hay (1998, *op. cit.*) speculates that the association between *R. clamitans* and *A. crepitans* might be partially responsible for Cricket Frog declines. Information on predators and Cricket Frog mortality can assist researchers in determining the cause of these declines and suggest management techniques to conserve the species.

Thanks to Ernie Kafcas at the Michigan Department of Natural Resources for access to Port Huron State Game Area.

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ALSODES GARGOLA (Rana del Catedral). **PREDATION.** Predation by Odonata naiads on anuran larvae is a major cause of tadpole mortality (Heyer et al. 1975. Biotropica 7:100–111). However, it has not been reported under natural conditions on anurans of Patagonia. Here we present the first record of predation by Odonata naiads on tadpoles of the frog *Alsodes gargola*, which is endemic to northwest Patagonia, Argentina. *Alsodes gargola* inhabits oligotrophic high altitude lakes and mountain streams (200–2000 m elev.). Adults and juveniles are highly aquatic, although they may also live in terrestrial environments near water. *Alsodes gargola* tadpoles have a long larval period and overwinter at least one year (Logares and Úbeda 2004. Herpetol. Rev. 35:368–369), therefore the species is only associated with permanent aquatic environments, where different tadpole cohorts typically coexist.

During a study of the *A. gargola* tadpole population (2004–2005) in aquatic mountain environments in Nahuel Huapi National Park, Río Negro Province, Argentina, we monitored the population in a stream in Valle de los Perdidos (41°14'32"S; 71°16'7"W, 1375 m elev.), surrounded by a mosaic of deciduous *ñire* (*Nothofagus antarctica*) thicket, altitudinal steppe, and hygrophilous meadow (*mallín*). The normal regional rainfall pattern causes this stream to carry noticeably less water towards the end of the austral summer. In April 2005 (austral autumn) it began to rain later than usual and the level of the stream dropped so far that its flow was interrupted, forming long, isolated pools of water where the tadpole population was temporarily confined. On 2 April, many of the tadpoles showed signs of attack on their bodies. No evidence of predation had been recorded previously. Various nymphs of *Rhionaeschna variegata* Fabricius (Odonata, Anisoptera, Aeshnidae) naiads, measuring 8–35 mm, were found in the pools. *Rhionaeschna variegata* is the most ubiquitous, widely distributed Anisoptera species in Patagonia. It is found to Tierra del Fuego, where it is the only Odonata species (Muzón 1995. Rev. Soc. Entomol. Argent. 54:1–14). Exuvia were found on the shore, providing evidence of recent metamorphosis. Tadpoles from two isolated pools were analyzed: Pool 1 (length 2.3 m; max. mean depth 0.33 m; volume 2.1 m^3) and Pool 2 (length 4.3 m; max. mean depth 0.61 m; volume 1.3 m^3). The entire tadpole population was sampled at the beginning

of austral summer (23 Dec 2004) and the beginning of austral autumn (2 April 2005). The total length of each tadpole was measured and the developmental stage determined (Gosner 1960. Herpetologica 16:183–190). The percentage of injured tadpoles was calculated, and the location of the injuries on the body recorded (tail vs. head-trunk). For each pool, initial abundance (N_0) and final abundance (N_1) data were used to calculate mortality $[(N_0-N_1)/N_0]\times100$.

To confirm these attacks, *R. variegata* naiads (14–35 mm) and *A. gargola* tadpoles (40–66 mm) were returned to the laboratory, and after acclimatization for 48 h at 18°C, were placed in different combinations of sizes in polyethylene containers containing dechlorinated water and suspended roots of stream plants. Observations were made for 7 full days, at a constant temperature of 18°C and a natural light-and-dark regime.

In the laboratory, the tadpoles placed in the containers with the naiads did not exhibit evasive behavior or avoid contact. After 36 h, all naiads larger than 26 mm repeatedly attacked tadpoles of all sizes, and this behavior persisted throughout the period of observation. The most active times were dawn and dusk. The tadpoles managed to escape from most attacks, although they were sometimes injured. Injuries of the abdomen were always fatal, while no attack on the tail led to tadpole death. Naiads fed first on the tadpole abdomen. Large naiads (≥ 34 mm) succeeded in killing large tadpoles (66 mm). The remaining carcasses (remains of cartilage and musculature) and the type of injuries observed allow us to assume that the carcasses observed in the field were the result of naiad predation. In the laboratory, the *Rhionaeschna variegata* naiads were noticeably voracious, and able to attack and eat tadpoles twice their size, using the "sit and wait" hunting strategy (resting concealed in submerged vegetation waiting for the prey to pass) which is typical of this species (Gullan and Cranston 1994. The Insects. An Outline of Entomology. Chapman and Hall, London, 491 pp.).

The tadpoles collected were at stages 25–40 (Gosner, *op. cit.*), and belonged to different cohorts. In Pool 1, we counted 113 tadpoles during the first sampling (density: 55 tadpoles/m^3), and 90 at the second sampling (density: 45 tadpoles/m^3). In addition, 215 newly hatched tadpoles were recorded. In Pool 2, we counted 66 tadpoles at the first sampling (density: 51 tadpoles/m^3), and 28 at the second sampling (density: 21 tadpoles/m^3). There was no recruitment of new larvae. During the second sampling (austral autumn), tadpoles of all stages showed signs of attack with recently inflicted, bleeding injuries or injuries in the process of healing. Mortality in the population attributable to naiad predation was 20.3% in Pool 1 and 57% in Pool 2, over a period of 101 days. In Pool 1, 62 tadpoles (20.3 %) had injuries: 61 on the tail and only 1 on head-trunk. In Pool 2, 17 tadpoles (60 %) had injuries: 8 on the tail and 9 on head-trunk. On two visits to the site, 14 and 21 days later, fewer naiads were found perching on the submerged roots, and exuvia were found outside the water. Many of the injured tadpoles were found to have healed completely, judging from the presence of whitish scar tissue.

Because of its long larval stage, *A. gargola* is limited to permanent water bodies. In its pristine environments, the species has no native vertebrate predator. Furthermore, in its alpine aquatic environments (above the tree line) no arthropod predator is known. However, in streams at lower altitudes, *A. gargola* tadpoles might coexist with Odonata naiads. When these streams carry a normal amount of water, attacks must be rare, judging by the lack of injured tadpoles observed. But under exceptional environmental conditions, such as the ones reported here (summer–autumn drought), which leads to atypical confinement in still waters, there is a greater likelihood of *A. gargola* tadpoles encountering *Rhionaeschna variegata* naiads, and the tadpoles become highly vulnerable to predation. Thus, during very dry years, the tadpole population confined to pools may face high levels of predation, and suffer high percentages of mortality. These are the only losses recorded for *A. gargola* in pristine environments (without exotic fish species).

Further studies are needed to elucidate the atypical though intensive role of predation by Odonata naiads as predators in the dynamics of the *A gargola* tadpole population in streams subject to large fluctuations in the flow of water or during exceptionally dry years.

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APLASTODISCUS ARILDAE (Green Tree Frog). **PREDATION.** Spiders might be among the most important predators of frogs (Hayes 1983. Biotropica 15:74–76). Numerous reports have been published on members of the family Pisauridae (*Thaumasia* and *Dolomedes*) feeding on adult hylid frogs (Bastos et al. 1994. Herpetol. Rev. 25:118; Pramuk and Alamillo 2002. Herpetol. Rev. 33:46–47; Marra et al. 2003. Herpetol. Rev. 34:55; Jeffery et al. 2004. Herpetol. Rev. 35:158). These spiders are often found near watercourses, a habitat shared with members of the closely related family Trechaleidae (Carico 1993. J. Arachnol. 21:226–257). On 20 Nov 2005 at 2320 h in Serra do Japi (23°11'S; 46°52'W; 1030 m), municipality of Jundiaí, State of São Paulo, Brazil, an adult female trechaleid spider (*Trechaleoides biocellata*) was observed on rocks close to the water and 1.2 m from a male *Aplastodiscus arildae* (SVL 35.6 mm; mass 2.3 g). The treefrog was calling on a leaf of a bush 1.1 m high at the edge of a stream. Forty- five minutes later, the same spider was found with the frog partially digested in its chelicerae at the same site where the frog was observed earlier. A voucher specimen of *T. biocellata* collected at the same site was deposited in the spider collection of Instituto Butantan, São Paulo, SP (IBSP 59522).

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ATELOGNATHUS PATAGONICUS (Rana Acuática de Laguna Blanca). **OVERWINTERING TADPOLES.** Only one anuran species (*Alsodes gargola*) from Patagonia, Argentina has been reported to have tadpoles overwinter (Logares and Ubeda 2004. Herpetol. Rev. 35:368–369). Herein we report overwintering tadpoles of *Atelognathus patagonicus,* an endangered anuran from the northwest Patagonian steppe of Argentina. This semi-aquatic frog is endemic to the endorrheic wetland system of Laguna Blanca National Park and surrounding areas (Neuquén Province, Argentina). *Atelognathus patagonicus* is extinct from the largest lake in the system (Laguna Blanca, 1780 ha), restricting its presence to 21 neighboring smaller bodies of water (surface area between 0.5 and 60 ha). The objective of this study was to compare monthly overwintering tadpole stages in the most representative microhabitats of a permanent pond.

From January to December 2004 we studied the larval phenology of *A. patagonicus* in a permanent lagoon, Laguna Verde (20 ha) and in a temporary pond, Laguna Batea (2 ha). Both are located in Laguna Blanca National Park and close to Laguna Blanca. Overwintering tadpoles were only detected in the permanent lagoon (Laguna Verde, 39°00'28"S, 70°23'07"W; elev. 1250 m). During the winter, Laguna Verde is characterized by the presence of ice, with frequent snowstorms and southwest wind gusts to 140 km/h. Annual rainfall is < 360 mm and the most extreme air temperatures recorded were -23°C in July 2000 and 34.5°C in February 2002 (period 1999–2003).

The following results were obtained from June to August 2004, when the harshest winter climatic conditions and the lowest temperatures were reported. Water temperature was recorded every hour using a Data Logger Hobo Water Temp Pro and data were analyzed using Box Car Pro 4. The minimum mean monthly water temperature was recorded in July (2.8°C). The shoreline was sampled selecting the most representative microhabitats: a) coarse fragments (gravel, boulder and bedrock), b) mix (gravel and sand), and c) fine sediment (dominated by sand). Tadpoles were captured using aquatic funnel traps (30 cm long and 11 cm diam), and body length and Gosner stage was determined (Gosner 1960. Herpetologica 16:183–190). All tadpoles were returned unharmed to their original capture site. Traps were placed parallel to the shoreline at 20–80 cm depth with 5 m interval between each one in each microhabitat. Because of the harsh climatic conditions, the number of traps set per month and per microhabitat differed (June = 90 traps/total, 30 traps/microhabitat; July = 39 traps/total, 15 traps/microhabitat a and c, and 9 traps/microhabitat b; August = 42 traps/total, 15 traps/microhabitat b and c, and 12 traps/ microhabitat a. Traps were left in place overnight.

During the entire study, 114 *A. patagonicus* tadpoles were captured at Gosner Stage 35–41 (Gosner 1960, *op. cit.*), which included individuals belonging to two cohorts (embryos hatching during early and late summer). No differences were found in the Gosner stage between months ($\chi^2 = 0.63$, 2 df, P = 0.73). Total length of the entire series ranged from 21–31.6 mm SVL; mean body length was 26.16 ± 0.5 mm. Captures were more abundant in July (N = 63; mean/trap = 1.61) than June (N = 12; mean/trap = 0.13) or August (N = 39; mean/trap = 0.93). Significant differences in the number of individuals by microhabitat ($\chi^2 = 65.27$, 4 df, P <0.001) and no differences in the stages between each microhabitat ($\chi^2 = 1.00$, 2 df, P = 0.61) were found. Tadpoles were more abundant in microhabitat a (N = 88; mean/trap = 1.54) than in microhabitat b (N = 20; mean/trap = 0.37) and than in c (N = 6; mean/trap = 0.13).

Few published observations of overwintering tadpoles come from the Northern Hemisphere and there is only one published account in southern South America (Logares and Úbeda, *op. cit.*). Herein we report the first data for overwintering tadpoles in relatively low altitudes of the Patagonia steppe, Argentina. *Atelognathus patagonicus* tadpoles showed two overwintering cohorts, suggesting that individuals can metamorphose at two different rates. Despite the extreme climatic conditions of winters, Patagonian steppe summers are almost four months long, allowing tadpoles to take advantage of the high seasonal productivity during warm summers. As in other amphibians, the ability of larvae to overwinter could be an adaptation to the harsh climatic conditions that characterize the Patagonian steppe.

This information is important because of the paucity of natural history data for this species (Cuello 2002. *Atelognathus patagonicus* (Anura, Leptodactylidae): distribución, hábitat, fenología y estado de conservación en el Parque Nacional Laguna Blanca y sus alrededores. Licenciature Thesis, Univ. del Comahue, Bariloche, Argentina 87 pp.; Fox et al. 2005 Copeia 2005:921–929) and its conservation status. *Atelognathus patagonicus* is listed as Endangered (IUCN 2004) and "In danger of extinction" (Secretaría de Medio Ambiente, Argentina, 2004).

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BARYCHOLOS TERNETZI (Chimbo Frog). **PREDATION.** Amphibians are common prey for a great variety of vertebrates, arthropods, and even carnivorous plants (Duellman and Trueb 1986. Biology of Amphibians. McGraw-Hill, New York; Pough et al. 1998. Herpetology. Prentice-Hall, New Jersey). Members of

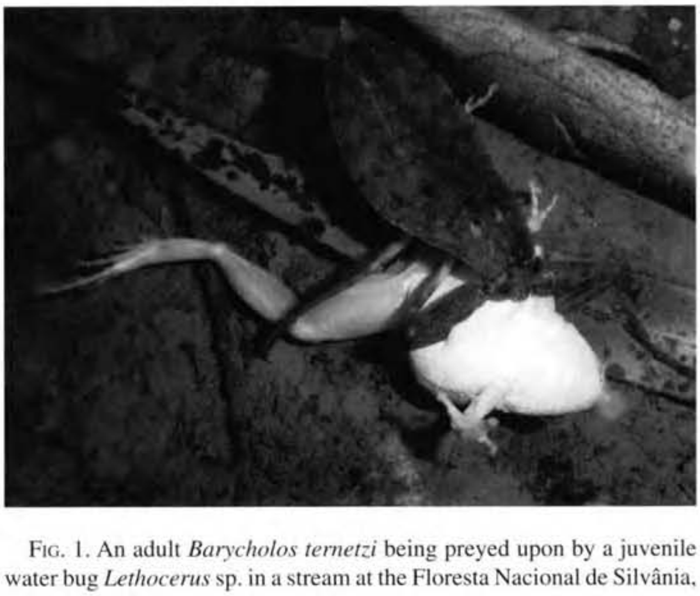

FIG. 1. An adult *Barycholos ternetzi* being preyed upon by a juvenile water bug *Lethocerus* sp. in a stream at the Floresta Nacional de Silvânia, State of Goiás, Brazil.

the family Belostomidae are predaceous aquatic insects from medium to large size, that colonize many types of aquatic habitats in tropical and temperate regions (Lauck and Menke 1961. Ann. Ent. Soc. Amer. 54:644–657). Here, we report the predation of an adult frog, *Barycholos ternetzi*, by a nymph of a water bug (*Lethocerus* sp.).

On 14 Oct 2005 at 2130 h, in a stream at the Floresta Nacional de Silvânia, State of Goiás, Brazil, a juvenile water bug was observed jumping toward an adult *B. ternetzi*. When the water bug was disturbed by our presence, it captured the frog and dove into the water to a depth of ca. 15 cm. Submerged in the water, the water bug remained grasping the frog from its ventral region (Fig. 1), which was trying to escape. A digital photograph was deposited with the Laboratory of Animal Behavior of the Universidade Federal de Goiás.

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BUFO NEBULIFER (Coastal Plains Toad). **URBAN ROAD MORTALITY**. Although motorways may affect wildlife populations investigators have performed few studies on the road mortality of wildlife (Lode 2000. J. Human Environ. 29:163–166), especially herpetofauna. The numbers of wildlife casualties on roads and railways have consistently grown as traffic, vehicle speeds, and their infrastructure networks have increased (Seiler et al. 2004. Wildl. Biol. 10:183–191). Amphibians and reptiles tend to be particularly susceptible to the ecological effects of roads (Forman and Alexander 1998. Ann. Rev. Ecol. Syst. 29:1–207). Road mortality along a 3.6 km section of a two-lane paved road adjacent to Big Creek National Wildlife Area on Lake Erie frequently included numerous amphibians (7 species, 30,034 individuals) and reptiles (10 species, 864 individuals; Ashley and Robinson 1996. Can. Field Nat. 110[3]:403–412). In most previous studies of road mortality, the roads crossed or were in some way associated with natural areas, thus providing significant data associated with large populations of amphibians and reptiles.

The Bowie Co., Texas study site was adjacent to Texas A&M University-Texarkana and Texarkana College on Virginia St. and Coolidge St. in Texarkana. Both paved, heavily trafficked, two-lane city-streets run parallel with, adjacent to, and approximately equidistant from Cow Horn Creek (a small stream that traverses Texarkana and receives much urban runoff). These streets differ in that Coolidge St. is lined by a subdivision on the side opposite Cow Horn Creek. Virginia St. is lined by a grassy field and the immediate area provides more habitat for wildlife. The roads were surveyed on foot for amphibian and reptile mortality on a 1.6 km stretch of Virginia St. on 1, 7, 14, 17, 20, and 28 June 2005. A 1.6 km stretch of Coolidge St. was surveyed on 17, 20, and 27 June 2005. Mean ambient temperature during surveys was 30.5°C (SD = 6.44). Data were tabulated and analyzed using MiniTab 13.30 Statistical Software (MiniTab, Inc., State College, Pennsylvania). This study is the first to examine *Bufo nebulifer* road mortality associated with movements to and from a breeding chorus.

Bufo nebulifer (N = 57) was the only species associated with road mortality in this study. Mortality data were normally distributed (Anderson-Darling: $A^2 = 0.604$, $P = 0.080$). Road mortality appeared higher on Virginia St. (N = 53, mean = 8.83 toads/survey, SE = 3.40) than on Coolidge St. (N = 4, mean = 1.33, SE = 1.33), but these differences were marginally significant (Two-sample T-test: $t = -2.05$, $df = 6$, $P = 0.086$; Neter et al. 1996. Applied Linear Statistical Models, 4th ed. McGraw-Hill. Boston, Massachusetts). The condition of specimens after mortality made sex determination difficult to impossible in most cases.

These data stimulate speculation regarding the influence of human habitation on habitat use by amphibians, particularly *B. nebulifer*. These data also suggest that *B. nebulifer* was originating from and returning to the grassy fields when mortality occurred. This implies that the breeding chorus in Cow Horn Creek was composed mostly of individuals originating from the grassy fields and that this habitat is important for the survival of this species in the immediate area. To deduce what influences undeveloped grassy fields and similar habitats occurring in urban environments have on sustaining urban populations of *B. nebulifer* and other herpetofauna will require more extensive studies.

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BUFO WOODHOUSII (Woodhouse's Toad). **SURVIVAL.** Records that demonstrate maximal natural longevity are virtually nonexistent for anurans, or amphibians in general. Records from captive specimens have demonstrated longevities as high as 36 yr for *Bufo bufo* (Duellman and Trueb 1986. Biology of Amphibians. McGraw-Hill Book Co., New York. 670 pp.). Here, we describe the longevity of a wild *Bufo woodhousii* that was initially monitored in 1978 (Engeman and Engeman 1996. Northwest. Nat. 77:23; Engeman and Engeman 2003. Northwest. Nat. 84:45), including 9 yrs of records on its emergence from hibernation (Engeman and Engeman 1996. *op. cit.*). The toad first appeared as an adult in 1978 in a basement window well of a home in suburban Denver, Colorado. It was observed alive every year to 2003 when in July it was observed dead in the window well of undetermined cause. Given that the toad was an adult when first observed, and that it was observed alive in 26 successive years, implies the toad was at least 27 years old at the time of its death. This toad was not a captive specimen, but the window well site in which it lived probably offered protection from most potential predators and also probably provided reliable arthropod food sources and moisture, thereby imparting optimal circumstances for maximal longevity. We could not find reference to a greater longevity for a wild amphibian.

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COPHIXALUS ORNATUS (Ornate Nursery Frog). **CHYTRIDIOMYCOSIS.** Chytridiomycosis is an emerging infectious disease that has been linked to amphibian population declines worldwide (Berger et al. 1998. Proc. Natl. Acad. Sci. 95:9031–9036). The chytrid fungus *Batrachochytrium dendrobatidis*, causative agent of chytridiomycosis, has an incredibly broad host range: it is currently known to infect over 150 amphibian species spanning two orders and 14 families (Speare and Berger 2004. www.jcu.edu.au/school/phtm/PHTM/frogs/chyglob.htm, updated with recently published accounts). Only seven of these species, however, are direct developers that bypass the free-swimming tadpole stage (*Eleutherodactylus cruentus, E. emcelae, E. melanostictus, E. karlschmidti, E. saltator, E. coqui, Leiopelma archeyi*). Tadpoles are thought to be an important life stage with respect to disease transmission: they stand a high chance of being exposed to the fungus' aquatic zoospores, and they do not succumb to chytrid infections, making them likely disease reservoirs (Daszak et al. 1999. Emerg. Inf. Dis. 5:735–748). Currently, there are no records of chytridiomycosis in Australian direct-developing frog species.

On 23 Sept 2005, KMK captured a male *Cophixalus ornatus* (Microhylidae) that was calling while perched on a leaf 2 m from the edge of Babinda Creek (70 m elev.), in Queensland, Australia. KMK firmly ran a cotton swab over the frog's dorsum, ventrum, sides, thighs, and the webbing of its feet, and used quantitative PCR (Boyle et al. 2004. Dis. Aquat. Org. 60:141–148) to test for the presence of *Batrachochytrium dendrobatidis*. Thirty-one chytrid zoospores were detected on the swab. This represents the first record of chytridiomycosis in an Australian direct-developing frog species, and only the eighth record worldwide.

There are no published reports of population declines in *C. ornatus*, a species whose large geographic range encompasses the localities of many of north Queensland's recent amphibian declines and disappearances, including that of *Taudactylus acutirostris* (the last known individual of which died of chytridiomycosis in 1995; Wright et al. 2001. J. Herpetol. Med. Surg.). Our finding of chytridiomycosis in *C. ornatus* supports the hypothesis that while all frog species might be exposed to the disease, there are ecological differences among sympatric species that might lead to different disease outcomes, ranging from no effect on the population to mass mortality events and local extinctions (Daszak et al. 1999, *op. cit.*; Hero et al. 2005 J. Zool. Lond. 267:221–232).

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CRINIA SIGNIFERA (Eastern Froglet). **REPRODUCTION.** Multiple males simultaneously in amplexus with the same female is rarely reported in anurans. One of the species in which this behaviour is well documented is the quacking froglet *Crinia georginia* (Roberts et al. 1999. Anim. Behav. 57:721–726). Here I report multiple male amplexus for another member of the genus. *Crinia signifera* is the most widespread and abundant frog in eastern Australia. The observation reported here was made in wet subalpine flat heathland in the Thomsons Run area of the Mount Baw Baw Plateau on the 18 Nov 2003. Morning conditions had been clear and sunny, however by the time the amplexing frogs were found, conditions were cloudy and cool.

At ca. 1400 h a female *C. signifera* was observed on the surface of a pool in a sphagnum bog. Upon noting my presence, she attempted to dive into the detritus at the bottom of the pond. She could not dive successfully and upon closer examination two males were found to be clasping her. The first male was in inguinal amplexus, while the second male was clasping in a slightly lateral position with one arm around the hind leg of the female and other arm around the body of the first male. Both males were approximately the same size while the female was at least twice as large. The trio was observed for ten minutes after which they were disturbed and the second male released his hold and dove into the detritus. There were numerous eggs on the base of the pond where the female was first observed. I did not observe any further instances of multiple male amplexus in the remaining 13 days of fieldwork, although amplexing pairs were observed on three other occasions. Upon conversation with other workers it was mentioned that they had also observed instances of multiple males amplexing one female (Woodford, pers. comm.; Hollis, pers. comm.).

Multiple males in amplexus with a single female have not previously been reported in C. *signifera*. Two factors could potentially increase the likelihood of this behaviour occurring in high altitude populations. First this observation was made at peak breeding time for *C. signifera* on the Mt. Baw Baw Plateau. Four weeks earlier the area had been covered in snow, while several weeks later the number of frogs observed was clearly reduced. By mid December the ponds in the sphagnum bog had begun to dry up. This explosive breeding pattern may increase the potential for multiple males to be in the close proximity with single females. Secondly, the diurnal breeding behaviour of highland *C. signifera* may also increase the probability of males seeing females. Conversely, diurnal breeding may simply increase the potential for the behaviour to be noted by observers.

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ELEUTHERODACTYLUS JOHNSTONEI (Johnstone's Whistling Frog). **HABITAT**. An increasing number of reptile and amphibian species have been documented to take advantage of the novel habitat provided by human night lighting (e.g., Perry and Lazell 2000. Herpetol. Rev. 31:247). Nonetheless, information is lacking for most species. Only one species of *Eleutherodactylus* is known to utilize the night-light niche (Henderson and Powell 2001. Carib. J. Sci. 37:41–54). *Eleutherodactylus johnstonei* is associated with humans in the Netherlands Antilles (Powell et al. 2005. The Reptiles and Amphibians of the Dutch Caribbean: St. Eustatius, Saba, and St. Maarten. St. Eustatius National Parks

Foundation, St. Eustatius, Netherlands Antilles), but has not previously been reported foraging at artificial lights.

At 2000 h on 5 Oct 2005, following several very rainy days, I observed a number of frogs arrayed around solar-powered trail lights on Saba, Netherlands Antilles. The observation was made at the Ecolodge Hotel (ca. 500 m elev.). Darkness had fallen ca. 1 h earlier, and a light rain was falling. Frog vocalizations were very loud, and many individuals were active on the vegetation. However, few frogs were occupying unlit lights, which were interspersed with the lit ones. A survey of all lights at the hotel identified 9 lit and 24 unlit trail lights, all solar. Despite being rather dim, the lights were attracting numerous small insects that were perched on or flitting about them. Lit units had 0–7 frogs on them (mean = 3.0, SD = 2.87). In contrast, unlit lights only had 0–3 frogs (mean = 0.3, SD = 0.76), a statistically significant difference (Mann-Whitney $U = 47.5$, $Z = 2.919$, $p = 0.004$). In addition, a brighter fluorescent light located at a height of about 2 m on the back of the hotel restaurant had ca. 30 frogs arrayed near it, an occurrence which hotel staff reported to be common.

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ELEUTHERODACTYLUS NITIDUS NITIDUS (Shiny Peeping Frog). **BODY TEMPERATURE**. The Mexican endemic, *Eleutherodactylus n. nitidus*, has been little studied. Dixon (1957. Master's Sci. Dissert., Grad. Sch. Agric. Mech. Coll. Texas, pp. 40–59) discussed distribution and geographical variation, and Lynch (1986. Herpetologica 42:248–258) discussed taxonomy. Woolrich-Piña et al. (2005. Anfibios y Reptiles del Valle de Zapotitlán Salinas, Puebla. UNAM-CONABIO, 54 pp. México) provide a more recent overview of natural history. On 13 July 2004, between 2200 and 0100 h we collected 10 *E. n. nitidus* on Cerro Chacatecas, Municipio Zapotitlán Salinas, Puebla, México. Cloacal temperature (T_C) was recorded using a quick-reading thermometer. We also recorded microhabitat temperature (air T_A, and substrate T_S) where the frogs were found. Mean T_C was $16.24 + 0.6$°C, mean T_A was $14.02 + 0.2$°C, and mean T_S was $14.8 + 0.3$°C. A positive and significant correlation was found between T_C and the temperature of the microhabitat ($T_C = -7.79 + 1.71\ T_A$, $r = 0.58$, $P = 0.008$, $N = 10$, for the air; $T_C = -9.24 + 1.72\ T_S$, $r = 0.807$, $P = <0.008$, $N = 10$, for the substrate).

Our results confirm a tendency toward thermoconformity in environmental and organismic temperatures as proposed by Huey and Slatkin (1976. Quart. Rev. Biol. 51[3]:363–384).

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HYLA SQUIRELLA (Squirrel Treefrog). **REFUGIA.** Entomologists commonly use trap-nests to monitor cavity-nesting Hymenoptera. These trap-nests consist of 5 × 10 cm pine timber cut into 12-cm lengths. Five lengths are then stacked and strapped together. Each piece of timber is predrilled in each side to have either a 3.2, 4.8, 6.4, 7.9, or 12.7 mm diameter hole, 8 cm in depth. Thus, each trap-nest consisted of five pieces of wood containing 2 holes of each diameter. They are suspended with wire from tree trunks and branches. We set these wooden traps (N = 10) at Devil's Millhopper Geological State Park, Gainesville, Alachua Co., Florida, USA, from May 2003 to 25 Jan 2005. The habitat is a limestone sinkhole in mixed hardwood forest/pine flatwoods. On 25 Jan 2005, a juvenile *Hyla squirella* (SVL = 18.9 mm) had backed into an abandoned nest of a leafcutting bee, *Megachile xylocopoides* (Hymenoptera: Megachilidae), in a 12.7 mm diameter trap-nest. The abandoned nest which the frog inhabited was incomplete, consisting of 1–2 cells and was constructed from cut leaves lining the 12.7 mm diameter hole. The hylid died after capture; both the frog and the bee nest were deposited in the Herpetology Collection at the Florida Museum of Natural History (UF 143740). We observed other *H. squirella* (ca. 10 times) using trap-nests as refugia, perhaps hibernacula, at the same site during January and February of previous years. We removed all of these frogs from the traps and released them.

Hyla squirella are notorious for their nondiscriminatory habitat selection (Carr 1940. Univ. Florida Publ., Biol. Sci. Ser. 3[1]:1–118; Wright and Wright 1949. Handbook of Frogs and Toads of the United States and Canada. Third Ed. Cornell University Press, Ithaca, New York). Moreover, *H. squirella* typically are collected when they seek refuge in PVC pipe traps suspended from trees (Boughton et al. 2000. Am. Midl. Nat. 144:168–177; Bartareau 2004. Herpetol. Rev. 35:150–152; Muenz and Smith 2005. Herpetol. Rev. 36:75). This is the first instance of which we are aware of *H. squirella* utilizing the nests of megachilid bees as refugia, although we do not know if these hylids utilize naturally constructed megachilid nest cavities in woody vegetation. We recommend further investigation to determine the frequency, seasonality, and significance of this behavioral relationship with cavity nesting hymenoptera in natural situations.

These observations were made during a study of cavity-nesting hymenopterans in north-central Florida conducted by DS. This study was conducted under Permit 08170410 issued by the Florida Department of Environmental Protection.

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LEPTODACTYLUS MARAMBAIAE (Marambaia White-lipped Frog). **DEATH FEIGNING.** Death feigning, or thanatosis, is a defense strategy widespread in anurans (Duellman and Trueb 1986. Biology of Amphibians. McGraw-Hill, Inc. 670 pp.). However, it has been rarely reported for the Neotropical family Leptodactylidae (Hartmann et al. 2003. Herpetol. Rev. 34:50; Toledo et al. 2005.

Herpetol. Bull. 91:29–31). Here we present the first report of death feigning in *Leptodactylus marambaiae*, a small leptodactylid (up to 40 mm SVL; Izecksohn 1976. Rev. Brasil. Biol. 36:527–530) endemic to the Restinga da Marambaia, in Rio de Janeiro State, southeastern Brazil (Frost 2004. Amphibian Species of the World: An Online Reference. Version 3.0, http://research.amnh.org/herpetology/amphibia/index.html). The Restinga da Marambaia is a thin strip of land, 42 km long, situated between Sepetiba Bay and the Atlantic Ocean, connected to the mainland by a narrow isthmus. It is covered predominantly by sandy soils and xerophytic vegetation (i.e. "restinga" habitat). Almost nothing is known about the biology and natural history of *L. marambaiae* (Izecksohn, *op. cit.*).

On 4 Oct 2005, at the western portion (2°04'07.4"S, 43°52'56.1"W) of the Restinga de Marambaia, three of us (CCS, RVM, and DV) found several individuals of *L. marambaiae* on the ground, among the grass, at night. At 2116 h, upon being picked up for observations, one individual (ca. 25 mm SVL) became immobile with limbs held close to the body, in typical death-feigning posture, even after being turned belly up. After being prodded with a finger by one observer, it stretched the front limbs a little, but continued immobile. It remained motionless for about two minutes, and was then released (whereupon it "came back to life" and jumped away). Death-feigning behavior similar to the one observed here have been reported for other anurans (Sazima 1974. J. Herpetol. 8:376–377; Zamprogno et al. 1998. Herpetol. Rev. 29:96–97; Vaz-Silva et al. 2004. Herpetol. Rev. 35:371; Toledo 2004. Herpetol. Rev. 35:371–372). To our knowledge, the only other species of *Leptodactylus* for which death feigning has been reported is *L. labyrinthicus* (Toledo et al., *op. cit.*) in the large-sized *L. pentadactylus* group. This note presents the second record of thanatosis in the genus *Leptodactylus*, and the first for a species in the small-sized *L. fuscus* group.

We thank the Força Aérea Brasileira for logistical support, and especially Captain Walter for allowing access to the area and making many facilities available. During this study CCS received a graduate grant from FAPERJ and RVM received a graduate grant from CNPq. MVS received a research grant from CNPq. Fieldwork was also supported by Conservation International/CEPF and the Instituto Biomas.

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LEPTODACTYLUS NATALENSIS (Bubbling Frog) **PREDATION.** *Leptodactylus natalensis* occurs along the littoral of Brazil, extending from the northeast region to Rio de Janeiro (Heyer 1994. Smithson. Contrib. Zool. 546:1–124). During a study in a temporary pool at the Estação Ecológica do Tapacurá, a remnant of the Atlantic Forest located in the municipality of São Lourenço da Mata, in the state of Pernambuco (09°07'S; 34°60'W), we observed predation of *L. natalensis* eggs by the Scorpion Mud Turtle (*Kinosternon scorpioides*). *Leptodactylus natalensis* digs nest cavities along the edge of pools where the eggs are laid within a white foam and covered by foliage (dead vegetation) or herbaceous roots (Santos and Amorim 2005. Zoociências 7:39–45). On 18 May 2003 the presence of a nest at the east margin of the pool was recorded; it rained heavily in the region during the night and early morning of the next day and the area surrounding the nest was flooded. This caused the foliage-covered nest to float on the surface of the water (depth ca. 30 cm after the rain). During the afternoon of 19 May 2003, between 1439 and 1456 h (air temperature 26°C), a *K. scorpioides* was observed in the water feeding on the eggs dispersed among the foam for a period of 7 minutes. This is the first recorded instance of *L. natalensis* egg predation by *K. scorpioides.*

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LITORIA JUNGGUY (Stoney Creek Frog). **PREDATION.** Reports of frog predation are biased towards those on tadpoles and juvenile frogs, and there are few reports on the predation of adult frogs, particularly of larger species. Here I report the apparent predation of a large adult *Litoria jungguy*, by a Long-finned Eel (*Anguilla reinhardtii*), during the course of a radio tracking study at a stream near Babinda, tropical north Queensland, Australia (145°55'S, 17°18'E, 20 m elev.). *Litoria jungguy* is a relatively large, terrestrial hylid frog, common in tropical north Queensland. During a radio tracking study, a female *L. jungguy* (SVL = 65.3 mm, mass = 26.8 g) was captured during the night of 17 March 2005 and fitted with a small (0.68 g) radio-transmitter attached to the frog externally with a silicon tubing waist-belt. During the study, frogs were located both diurnally and nocturnally for ca. two weeks. The last sighting of the frog was at 1930 h on 22 March 2005, when it was observed on terrestrial vegetation ca. 3 m from a stream. The following night at 2030 h, the transmitter signal was strongest under the submerged root mass of a tree in the same stream. For the next five days, I tracked the signal up and downstream along the river, which typically moved ca. 10 m between observations. The signal always originated from underwater and I was never able to observe any animal due to the signal coming from undercut banks, root masses, and dense terrestrial vegetation. On the 28 March 2005 at 1200 h I recovered the transmitter, still attached to the tied waistband. As it would have been impossible for the waistband to remain tied and fall off the frog, due to the small waist-size and robust thighs of the frog, the frog must have been eaten by a large, aquatic predator. *Anguilla reinhardtii* was the only such predator present in the study stream, was commonly encountered, and published behavior and habitat preferences for the species match those observed in my study (Pusey et al. 2004. Freshwater Fishes of North-eastern Australia. CSIRO Publishing, Collingwood). I therefore conclude that the *L. jungguy* was predated upon by an *A. reinhardtii*.

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MANTIDACTYLUS LIBER (NCN) and ***M. DEPRESSICEPS*** (NCN). **CROSS-SPECIES MATING.** Among the Malagasy herpetofauna, mantellines are one of the major clades of frogs, and are characterized by several features related to reproduction and mating behavior (Blommers-Schlösser 1979. Beaufortia 29:1–77). To date all known *Mantidactylus* and *Mantella* males lack strong mating amplexus, nuptial pads, and release calls (Glaw and Vences 1994. A Field Guide to the Amphibians and Reptiles of Madagascar. 2nd edition. Vences and Glaw, Köln. 480 pp.). The femoral glands of these frogs have been suggested as a possible organ to stimulate the female during the fertilization of the eggs (Glaw and Vences 1994, *op. cit*), or to aid in attachment to female during reproduction (Brizzi et al. 2003. *In* B. G. M. Jamieson [ed.], Reproductive Biology and Phylogeny of Anura. Science Publ., New Hampsire. 452 pp.), but these hypotheses have not been tested.

Reproductive behavior has been best studied in species such as *Mantidactylus liber* and *M. depressiceps* (Blommers-Schlösser 1975. Beaufortia 23:15–25) that belong to the subgenus *Guibemantis* in the genus *Mantidactylus*. They deposit eggs on leaves overhanging stagnant waters where tadpoles later complete their development. Females and males, which are of similar body size, sit on vertical leaves, the males at higher positions, with their posterior body and hind limbs covering the female's head and anterior dorsum. The sperm of male probably slides down the back of the female reaching the eggs laid by the female (Blommers-Schlösser 1975, *op. cit.*; 1979, *op. cit.*). There have been no records of mixed mating or hybridization among these species.

FIG. 1. Male *Mantidactylus liber* (small specimen, top) mating with a female *M. depressiceps* (bottom) that already has deposited its (white) eggs. Photographed at Ranomafana National Park, 21 Jan 2004.

On 21 Jan. 2004, before sunset (ca. 1700 h), we observed a large breeding aggregation of *M. depressiceps*, *M. liber*, and *M. tornieri* in a roadside ditch along the road between Vohiparara and Ranomafana (21°15.387' S, 47°24.602' E, 1013 m elev., Ranomafana National Park). Explosively timed intense breeding was observed during three consecutive days whereas subsequently only single individuals were found. During several instances we observed male-male combat in *M. depressiceps*, and an instance in which a sneaking male interrupted a mating pair.

In one case a male *M. liber* attempted to mate with a female *M. depressiceps* that had just deposited her clutch of typical white eggs (Fig. 1). Females of these species are known to guard eggs for minutes or hours after their deposition. *Mantidactylus liber* is a distinctly smaller species than *M. depressiceps*, yet the male performed rhythmical reproductive movements with its hind limbs over the female's head as typical (Blommers-Schlösser 1975, *op. cit.*). This behavior was continuous for at least 10 min before the individuals separated, probably disturbed by the heavy rain and our photography. These observations demonstrate that cross-species mating is possible in sympatric explosive breeding *Mantidactylus*, despite their different advertisement calls and body size, and lack of amplexus behavior.

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PHYLLOMEDUSA BURMEISTERI (Leaf Frog). **BEHAVIOR.** In many anurans, territorial behavior is common during male-male interactions (Martins et al. 1998. Amphibia-Reptilia 9:46–90). It is accomplished through behavioral patterns ranging from calls (advertisement, territorial, and/or encounter calls) to physical combat (Halliday and Tajedo 1995. *In* Heatwole and Sullivan [eds.], Amphibian Biology, Volume 2: Social Behaviour, pp. 419–468. Surrey Beatty & Sons). The data available for aggressive behavior in *Phyllomedusa* show that breeding aggregations of this species are characterized by low number of individuals, site fidelity, complex vocal repertoire, visual communication, and male-male combat, suggesting that calling males exhibit territorial behavior (Abrunhosa and Wogel 2004. Amphibia-Reptilia 25:125–135).

Herein, we report attempted dislodgment of an amplectant male *P. burmeisteri* by two solitary males. The observation were made in gallery forest vegetation over a stream near the Mucuri River (17°44'S, 41°43'W), municipality of Poté, State of Minas Gerais,

FIG. 1. Aggressive behavior (i.e., fighting) in *Phyllomedusa burmeisteri*, depicting three males in direct contact with the female, while a fourth male waits nearby.

Brazil, on 1 Dec 2004. The observation started when the pair was already in amplexus, ca. 2.5 m above ground, and three solitary males were perched on nearby bushes, emitting advertisement calls. The dislodgment attempt started when one of the solitary males approached the pair, trying to grasp the female from the ventral surface. During this confrontation, the amplectant male physically contacted the intruder male, stretching and retracting his legs (alternating the legs), trying to remove the intruder from the female and himself. This behavior of the amplectant male was similar to that reported by Abrunhosa and Wogel (2004, *op. cit.*) during acoustic interactions between calling males. The intruder, in turn, seized the head of the amplectant male while still holding the female's ventral surface. At this moment, the female was suspended from a leaf by her feet, still being held by the two males. The second solitary male joined the group, but stayed in a position opposite of the female and the other two males, with his head directed toward top. The female remained suspended from the leaf with her feet, while the three males grasped her, emitting encounter calls and using their nuptial excrescences to attack the opponents. A third solitary male was perched nearby and was not directly involved in the dislodgment attempt (Fig. 1). After ca. 40 min the female fell on the vegetation and only the first male remained in amplexus. The latter phases of courtship (oviposition) were not observed.

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PHYLLOMEDUSA TRINITATIS (Trinidad Leaf Frog). **HABITAT USE**. *Phyllomedusa trinitatis* is generally considered to be a widespread, lowland species that occurs in secondary forests and along forest edges (Murphy 1997. Amphibians and Reptiles of Trinidad and Tobago. Krieger Publishing Co., Malabar, Florida. 245 pp.). In Trinidad, this frog has rarely been observed at elevations exceeding 100 m (Kenny 1969. Studies of the Fauna of Curacao and Other Caribbean Islands 29(108):1–78). Here, we report an observation of *P. trinitatis* in montane rainforest during the wet season.

On 24 July 2005 at 1745 h EST, we captured an adult female *P. trinitatis* at our camp on Morne Bleu Ridge in the Northern Range of Trinidad (10°43'53"N, 61°15'08"W; WGS 84; elev. 823 m). Local vegetation at this site is typical for montane rainforest and features several species of palms, bromeliads, lianas, and small trees with a closed canopy between 15–18 m. The frog (80 mm SVL) was caught shortly before dusk, observed briefly, photographed, and released. At the time of the observation, there was virtually no precipitation. However, for the preceding 24 h (especially from 1800 h on 23 July to 1500 h of 24 July), our camp had been inundated with a steady and, at times, heavy rainfall (ca. 2 cm/h).

Murphy (1997, *op. cit.*) noted the occurrence of seven anuran species in the montane rainforests in Trinidad, including two bromeliad-breeding specialists (*Flectonotus fitzgeraldi* and *Phyllodytes auratus*, an endemic) and five widespread, habitat generalists (*Bufo marinus*, *Mannophryne trinitatis*, *Phrynohyas venulosa*, *Eleutherodactylus urichi*, and *Leptodactylus validus*). Our observation increases this total and indicates that *P. trinitatus* might more extensively use montane rainforests than previously believed.

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RANA CATESBEIANA (American Bullfrog). **DIET**. Bullfrogs are opportunists capable of capturing a wide variety of prey, including flying insects, bats, and birds (Bury and Whelan 1984. US Fish Wildl. Serv. Publ. 155. USDI, Washington, DC). Here I present evidence of an additional bird species caught as prey: Anna's Hummingbird (*Colypte anna*).

On 20 Aug 2003, at Valentine Pond in Joseph Grant County Park in Santa Clara Co., California, USA (37°19'14.043"N, 121°40'22.226"W), I captured an adult female *R. catesbeiana* (178 mm SUL, 595 g, gape 64 mm). After a photograph was taken, the frog was killed and stored in a cooler until the end of the workday.

That evening I weighed and measured the frog, removed the entire digestive tract, and froze it for later processing. Months later, I thawed the sample and opened the stomach to discover it contained a darkling beetle (*Eleodes dentipes*), a Pacific Treefrog (*Hyla regilla*), and the feathers and partially digested bones of a hummingbird. The tail feathers were intact, but bones of the posterior skeleton disintegrated at the slightest touch. I opened the rest of the digestive tract and discovered the remaining feathers and the ramphotheca of an Anna's Hummingbird. The presence of the reddish gorgette feathers confirmed the hummingbird bird was a male, and that the bird had been swallowed headfirst.

I thank D. Clark of the Santa Clara County Parks Department for his facilitation and help with the survey.

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RANA CATESBEIANA (American Bullfrog). **MORTALITY**. *Rana catesbeiana* is an ambush predator with a highly varied diet (Bury and Whelan 1984. U.S. Fish Wildl. Serv. Res. Publ. [155]:1–23). Snakes, including garter snakes (*Thamnophis* spp.; McKamie and Heidt 1974. Southwest. Nat. 19:107–111; Bury and Whelan, *op. cit.*), are occasionally taken, but the Northwestern Garter Snake (*Thamnophis ordinoides*) has not been reported as prey, despite the fact that the introduced range of *R. catesbeiana* broadly overlaps that of *T. ordinoides* in the Pacific Northwest (Nussbaum et al. 1983. Amphibians and Reptiles of the Pacific Northwest. Univ. Press of Idaho, Moscow. 332 pp.; Leonard et al. 1993. Amphibians of Washington and Oregon. Seattle Audubon Society, Seattle. 168 pp.; Dvornich et al. 1999. Washington State Gap Analysis. http://wdfw.wa.gov/wlm/gap/dataprod.htm). Moreover, reports of mortality resulting from consumption of prey are rare for ranid frogs, despite their generally voracious feeding habits. Hence, we here provide an unusual observation of *R. catesbeiana* predation on *T. ordinoides*, an event that apparently resulted in the death of the former.

At 1700 h on 10 April 2005, we encountered a dead adult (121 mm SVL) female *R. catesbeiana* on the muddy bank of a farm pond in Marion County, Oregon (45°13'56"N, 122°47'22"E, WGS 84; elev. 55 m). We found the frog 1.5 m up the bank, its limbs outstretched in a crawling position. Closer examination revealed that the frog had the tail of a snake protruding from its cloaca. The frog had lost at least 25% of its body volume to desiccation. Its ventral surface, particularly the undersides of its legs and feet, was reddish in color, as opposed to the white or cream color of a healthy American Bullfrog.

Dissection of the frog revealed the protruding tail was *T. ordinoides* (> 400 mm SVL) of unknown sex (combined mass of frog and snake = 127 g). The anterior portion of the snake, in the frog's esophagus, was partly digested. In particular, the skin and muscle tissue on the snake's head (located in the lower esophagus) was digested enough to reveal the bones of the skull. Curiously, the portion of the snake in the frog's stomach (a ca. 100 mm long segment) appeared undigested, with skin and scales still intact. Progressing posteriorly, the segment of the snake passing through the frog's intestine (a piece > 100 mm long) was increasingly digested. The last 106 mm of the snake protruded from the

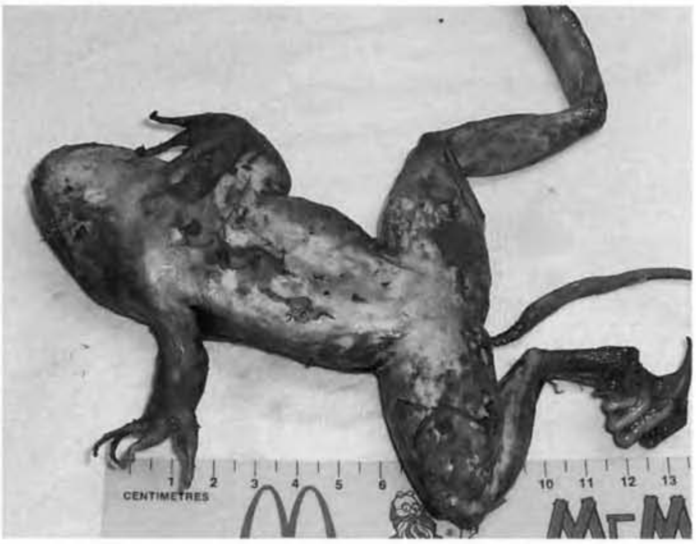

FIG. 1. Dead *Rana catesbeiana* (121 mm SVL) with tail of *Thamnophis ordinoides* protruding from vent.

frog's cloaca. Of this last part, the 10 mm closest to the frog's body had been reduced to spine; the remaining 96 mm of tail were completely intact, with no noticeable digestion of the skin, scales, or muscle tissue.

The frog's internal organs were found in varying states of necrosis. In best shape were the lungs, heart, and upper digestive tract (esophagus and stomach); the lungs appeared least decomposed of all and were still red. The lower portions of the intestine were the most decomposed; in particular, a section of the large intestine between 1.5 and 5.5 cm anterior to the frog's cloaca was black and entirely necrotic. The snake's scales had perforated this section of intestine, presumably as the snake passed through tail-first. The intestine at this point was impacted, and several centimeters of the intestine were "bunched up" around the tail of the snake. The advanced decomposition of the length of snake extending from this point to the cloaca suggested that this portion of the snake had been fixed in place for a relatively long time.

We hypothesize that the events leading to the frog's death were as follows: The frog ate the snake, swallowing it tail first. As the diameter of the snake's body passing through the frog's intestine increased, the backward-pointing, keeled scales caught on the frog's intestinal wall, causing impaction and subsequent perforation of the intestine. As a result of this perforation, bacteria from the fecal material and putrefying snake initiated a localized infection that quickly became systemic, killing the frog.

Two points of this observation are noteworthy. First, the identity of the prey reveals that the introduced *R. catesbeiana* preys on *T. ordinoides*, an observation for which this represents the first published record. Second, this observation illustrates a risk associated with eating rough-bodied prey (e.g., snakes with keeled scales), even if the defensive capabilities of the prey species are ineffective in preventing their consumption.

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RANA DRAYTONII (California Red-legged Frog). **PREY.** Few dietary data exist for *Rana draytonii*, a taxon only recently recognized as a full species (Shaffer et al. 2004. Mol. Ecol. 13:2667–2677). Available data are those of Hayes and Tennant (1985. Southwest. Nat. 30:601–605), who reported on the gastrointestinal tract contents of 35 post-metamorphic frogs collected in Los Angeles, San Bernardino, and Santa Barbara counties, California, USA. Moreover, its federal status as a threatened species since 1996 (US Fish and Wildlife Service 1996. Fed. Regist. 61:25813–25833) has limited the ease of gathering additional dietary data. Hayes and Tennant (*op. cit.*) reported a single adult *Peromyscus californicus* in two female *R. draytonii* (117 and 128 mm SVL; MPH, unpubl. data). To these data, we add two additional observations.

Henry Carsten Kellers collected a 126 mm SVL adult female *R. draytonii* (United States National Museum of Natural History [USNM] 52899) at Calistoga (38°34'N, 122°34'W WGS 84; elev. 110 m), Napa Co., California. The collection date is unknown, but the accession date is 27 Sept 1915. The location is imprecise, but springs and marshes were extensive in the vicinity of Calistoga at the time of collection (Archuleta 1977. The Brannan Saga, Early Day Calistoga. Smith-McKay Printing, San Jose, California. 116 pp.). The stomach of this frog contained a *Microtus californicus*, which was nearly adult-sized based on the 20.1 mm length of its left hind foot (Jameson and Peeters 2004. California Mammals. Revised ed. Univ. California Press, Berkeley. 440 pp.).

On 2 May 1996, GBR collected a dead and desiccated adult female *R. draytonii* (USNM 539491) in altered coastal scrub habitat in a fenced compound with several sewage percolation ponds (see Rathbun et al. 1997. Herpetol. Rev. 28:85 for details) operated by the Cambria Community Services District, ca. 6 km NW of Cambria (35°35'48"N, 121°07'08"W, WGS 84; elev. 5 m), San Luis Obispo Co., California. This frog, whose size and mass were recorded as 119 mm SVL and 167 g on 18 March 1996 (Rathbun et al., *op. cit.*), had an adult *Reithrodontomys megalotis* (USNM 568171) in its stomach.

Two aspects of these observations merit comment. *Rana draytonii* makes significant seasonal forays into terrestrial habitat (Rathbun et al., *op. cit.*; Bulger et al. 2003. Biol. Conserv. 110:85–95), so opportunities for largely nocturnally foraging adults to encounter small mammal prey may be frequent. Both of these small mammal species often occur at high densities in mesic terrestrial habitats near aquatic habitats in coastal California (Blaustein 1980. Behav. Ecol. Sociobiol. 6:247–255). Second, as with the previously published observations of small mammal prey (Hayes and Tennant, *op. cit.*), these observations involve adult female frogs. Females average ca. 20 mm SVL larger than males (Hayes and Miyamoto 1984. Copeia 1984:1018–1022), so females may consistently take larger prey than males.

Steve Gotte, Roy McDiarmid, and Robert Fisher (USGS Patuxent Wildlife Research Center), and Jeremy Jacobs (Smithsonian Institution) assisted in the examination the *R. draytonii* specimens, identification of the mammal prey, and provision of measurements. GBR's 1996 work was conducted under federal subpermit NBSPBS-1.

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RANA SYLVATICA (Wood Frog). **TERRESTRIAL AMPLEXING PAIRS**. On the evening of the 17 April 2005, at ca. 2100 h, three amplexing pairs of *Rana sylvatica* were found on Crowe's Line Road near Bobcaygeon, Ontario, Canada (44°33'N, 78°33'W). The pairs were likely heading toward a large chorus of 200–300 male *R. sylvatica* (as well as two other chorusing species) in the wetland on the other side of the road (the direction in which the female of each pair was oriented). Upon further investigation of the wetland, ca. 25–30 freshly deposited *R. sylvatica* egg masses were found. The air temperature was 10–12°C, and the water temperature in the wetland was 12°C. The sky was clear and three quarters of the moon was visible; the humidity was low; the road was not moist nor were the ditches particularly wet.

The discovery of terrestrial amplexing pairs suggests that male *R. sylvatica* might have an alternate mating strategy to attending and participating in a chorus, that is, intercepting and amplexing a female on land and then being piggy-backed by the female to a suitable oviposition site.

These specimens are currently reposed at Trent University, Peterborough, Ontario and are part of an ongoing study of emerging wildlife diseases in Ontario. We thank Michael Berrill and Jean Duffus for comments on earlier versions of this note.

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RANA SYLVATICA (Wood Frog). **TADPOLE MAXIMUM SIZE.** On 24 July 2004, eight *Rana sylvatica* tadpoles were collected at Pointe-des-Monts, Québec, Canada (49°19'8"N, 67°24'30"W), on the north shore of the St.-Lawrence River. These tadpoles, up to 66 mm TL, are the largest reported for the species. Maximum TL reported in the literature is 48 mm (Conant and Collins 1998. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. 3rd ed. Houghton Mifflin Co., Boston, Massachusetts. 616 pp.), 49 mm (Wright and Wright 1949. Handbook of Frogs and Toads of the United States and Canada. Comstock Publ. Assoc., Ithaca, New York. 640 pp.), and 50 mm (Orton 1952. Amer. Midl. Nat. 47:382–395). Our tadpoles are up to 16 mm longer TL. About 15 tadpoles were seen in this pool; eight were collected and deposited at the Canadian Museum of Nature (CMNAR 35819). Total lengths are 66.3, 65.8, 65.7, 65.0, 63.7, 62.3, 61.4, and 56.22 mm, the last having a broken caudal fin. Body lengths (tip of snout to base of hind limbs) range from 20.8 to 22.3 mm. All have hind limbs and are at Gosner Stages

38–39 (Gosner 1960. Herpetologica 16:183–190).

Tooth row formula for most of these tadpoles is 3/4 (3 upper rows and 4 lower). Two tadpoles have 3/3 tooth rows, but one seems to have partially broken mouthparts.

These tadpoles were in a 6 × 7 m pool in bedrock, 30 cm deep, located 60 m from the St.-Lawrence River. It was bordered with Black Crowberry (*Empetrum nigrum*) and Leatherleaf (*Chamaedaphne calyculata*). The water was salty, with a marine fauna: Blue Mussel (*Mytilus edulis*), Steamer Clam (*Mya arenaria*), Periwinkle (*Littorina* sp.), Sandworm (*Nereis virens*), and barnacle (*Balanus* sp.). Coniferous forest was about 100 m N of the pool.

The major interest in this discovery is to understand why these northern shore line Wood Frog tadpoles are so big: has their growth been enhanced or their metamorphosis inhibited? It seems likely that the pool would have frozen solid during the winter, so they might have grown to this exceptional size in the two months since the breeding season.

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RANA SYLVATICA (Wood Frog). **CHYTRIDIOMYCOSIS.** The chytrid fungus, *Batrachochytrium dendrobatidis* (BD), has been implicated in mass amphibian mortalities and global population declines (Berger et al. 1998. Proc. Natl. Acad. Sci. 95:9031–9036; Pounds et al. 2006. Nature 439:161–167). On 25 July 2002, a dead subadult male *Rana sylvatica* (26 mm SVL; 1.8 g body weight after ethanol fixation) was collected near a pond on the Kenai National Wildlife Refuge, Alaska, USA (60.62741°N, 150.81557°W, WGS 84). The frog was preserved in ethanol and shipped to the U.S. Geological Survey, National Wildlife Health Center (NWHC) in Madison, Wisconsin, USA. A whole-body radiograph of the specimen showed a normal musculoskeletal system with a paucity of calcium carbonate in the paravertebral endolymphatic sacs. Histological sections of two hindlimb digits and ventral skin (pelvic patch area) showed mild hyperkeratosis of the epidermis with numerous 6–12 μ diameter empty chytrid thalli within keratinized cells of the *stratum corneum*. These epidermal lesions were diagnosed as mycotic hyperkeratotic epidermitis due to infection by BD. On 18 July 2002, five dead tadpoles were observed at this site but not submitted for disease diagnosis. Calling adult Wood Frogs, egg masses, or tadpoles were detected in 18 of 26 site visits during 2000–2005, and live frogs were documented at the site each year. This site borders a gravel road. There are no reptiles or fish at this site. No other species of amphibian has been detected on the Kenai Refuge during surveys of >100 ponds during 2000–2005. Waders and nets are disinfected with 5% bleach solution between sites. This is the first report of a BD-infected frog from Alaska. The effects of BD at such a high northern latitude, and on this population, are unknown. The specimen is stored in ethanol at the National Wildlife Health Center (Case #4848-041).

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RANA YAVAPAIENSIS (Lowland Leopard Frog). **EGG AND TADPOLE PREDATION.** Ranid frogs in the western United States have been disproportionally affected by amphibian declines (Bradford 2005. *In* M. Lannoo [ed.], Amphibian Declines: The Conservation Status of United States Species, pp. 916–925. Univ. California Press, Berkeley). Among the many causative agents for these declines, predation by non-native fishes has been strongly implicated, especially in naturally fish depauperate areas (Bradford 2005, *op. cit.*). However, first-hand descriptions of egg predation by introduced fish have rarely been reported. Here, I describe predation on a *Rana yavapaiensis* egg mass by non-native catfish in southern Arizona.

On 20 August 2002, I watched two *Ameiurus melas* (Black Bullhead; Deborah Sebesta, USFS District Biologist, Coronado National Forest, pers. comm.), each ca. 25–35 cm long, prey upon a *R. yavapaiensis* egg mass. The egg mass was located within 5–10 cm of the water's surface, ca. 2.5 m from the creek shore, in water 1.0–1.5 m deep, in a slow moving oxbow of Peck Canyon in southern Arizona (31°29'N, 111°04'W). The substrate was coarse sand and gravel. The eggs were just hatching, Gosner Stages 20–25 (Gosner 1960. Herpetologica 16:183–190), and the hatchling tadpoles were still in a tight aggregation around or within the egg mass. The fish repeatedly swam through the egg mass with mouths open, turning around for another run after passing beyond the eggs by 10–30 cm. The possibility exists that the eggs were of *R. chiricahuensis*, also recorded from the general area. However, on this day hundreds of *R. yavapaiensis* metamorphs were observed, with no *R. chiricahuensis* documented from this length of the canyon (unpubl. data).

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RHACOPHORUS KAJAU (White-eared Tree Frog). **FOOT FLAGGING.** A population of *Rhacophorus kajau* occurs at Kubah National Park (01°33'N, 110°12'E), Matang, Sarawak, Malaysia (Borneo). While being photographed *ex-situ* indoors on 11 Dec 2005 and 22 Jan 2006, two adult males exhibited a behavior previously unreported in this species. While keeping the forelimbs planted on the substratum (in both cases, green leaves), the hind limbs were extended upward, and turned counter-clockwise at the level of the knee, with the undersurfaces of the shanks and sole touching the posterior of the dorsum of the body (Fig. 1). The entire action was performed in under 1 sec. Males of *R. kajau* are typically found in social groups of up to five in the wild. We suggest that the behavior, exhibited under stress such as handling associated with photography or the bright light from a flash, simulates the behavior, and is a warning to conspecifics, when the pale undersurfaces of limbs, black webbing, and/or the typically con-

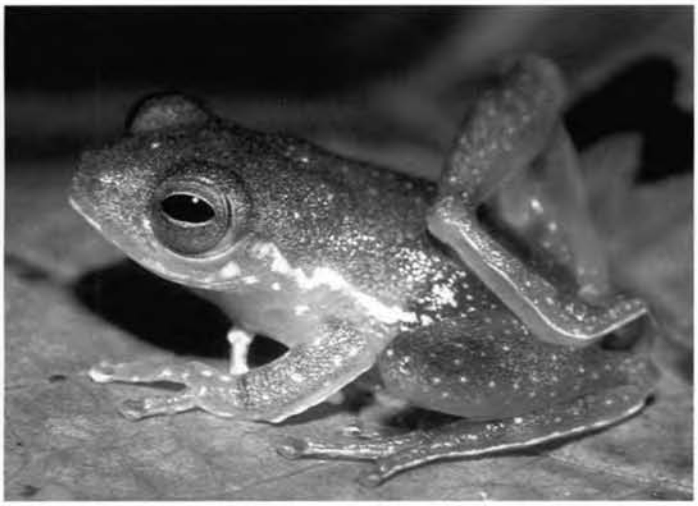

FIG. 1. Foot-flagging in *Rhacophorus kajau*, showing a hind limb turned counter-clockwise at the level of the knee.

cealed orange-colored trailing edges of the thighs are briefly exposed. Other examples of foot flagging reported in anuran amphibians (e.g., Hödl and Amézquita 2001. *In* M. J. Ryan [ed.], Anuran Communication, pp. 121–141. Smithsonian Institution Press, Washington, D.C. and London; Malhotra and Davis 1991. J. Bombay Nat. Hist. Soc. 88:157–166; Davison 1984. Sarawak Mus. J. 33:177–178) are associated with reproduction.

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SCINAX ALCATRAZ (Alcatraz Snouted Treefrog). **PREDATION.** *Scinax alcatraz* is endemic to Ilha dos Alcatrazes and listed as critically threatened by IUCN (2004. Guidelines for protected area management categories). The natural history of this species has not been studied in detail. Here we describe the first report of *S. alcatraz* predation by a spider. The observations were made at Ilha dos Alcatrazes, an island of 135 ha located 35 km off the coast of São Paulo State, Brazil (24°06'S, 45°42'W). On 22 Nov 2005 at 2230 h, we observed an immature Wandering Spider (*Oligoctenus medius*; Ctenidae) preying on an adult male *S. alcatraz* (23.8 mm SVL) on a bromeliad leaf. At the moment of the observation, the spider was biting the middle section of the treefrog's thigh (Fig.1). The frog was alive but motionless with legs extended. We captured the prey and predator separately. In a few hours, the treefrog was dead. Our observation corroborates studies suggesting that spiders may be important predators of frogs (Hayes 1983. Biotropica 15[1]:74–76). The specimen of *S. alcatraz* is deposited at Coleção de Anfíbios, Departamento de Zoologia, UNESP – Campus Rio Claro, Brazil (accession number CFBH 10463). The specimen of *O. medius* is deposited at Coleção de Aranhas, Instituto Butantan, São Paulo, Brazil (accession number IBSP 59750).

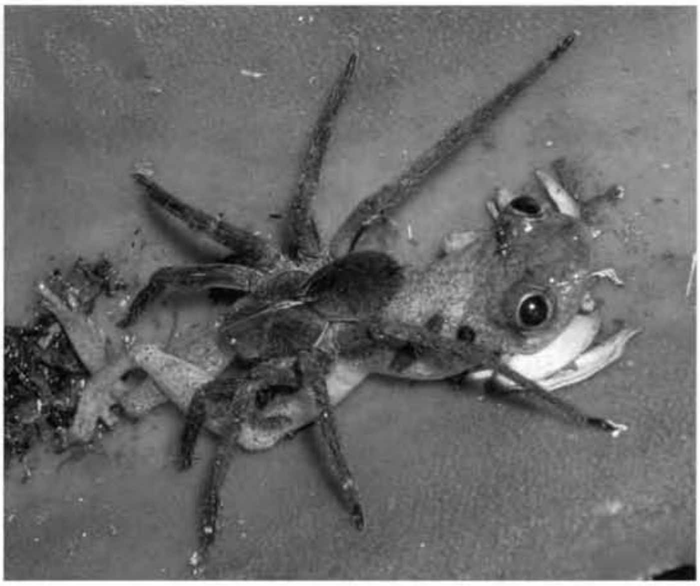

FIG. 1. Adult male *Scinax alcatraz* being captured and envenomated by an immature Wandering Spider on Ilha dos Alcatrazes, Brazil.

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THOROPA MILIARIS (Rock River Frog). **TADPOLE PREDATION**. Anurans are preyed upon by several types of invertebrates (Hinshaw and Sullivan 1990. J. Herpetol. 24:196–197; Marra et al. 2003. Herpetol. Rev. 34:55–56; Peltzer and Lajmanovich 2003. Herpetol. Rev. 34:231; Tsuji 2005. Herpetol. Rev. 36:125–127). Information is available on insects as predators of both adult (Haddad and Bastos 1997. Amphibia-Reptilia 18:295–298; Brasileiro et al. 2003. Herpetol. Rev. 34:137; Toledo 2003. Phyllomedusa 2:105–108) and tadpole (Azevedo-Ramos et al. 1992. J. Herpetol. 26:335–338; Hero et al. 1998. Austr. J. Ecol. 23:474–482; Azevedo-Ramos and Magnusson 1999. Copeia 1999:58–67; Eterovick and Sazima 2000. Amphibia-Reptilia 21:439–461) anurans in Brazil. The nocturnal frog *Thoropa miliaris* is a leptodactylid endemic to the Brazilian Atlantic Rainforest

Biome that lives on and among wet rocks in all stages of its life cycle (Bokermann 1965. An. Acad. Bras. Ci. 37:525–537). Here, we report an incidence of predation on a *T. miliaris* tadpole by an insect larva.

At 2328 h on 24 Sept 2005 at the Mãe D'Água dam (23°10'92.3"S, 44°12'04.4"W) in Ilha Grande, an island located in the southern coast of Rio de Janeiro State, municipality of Angra dos Reis, southeastern Brazil, two of us (CCS and CVA) observed a larval *Tropisternus* sp. (Coleoptera, Hydrophilidae, total length 10.8 mm) attacking a tadpole *T. miliaris* (body length 8.0 mm, total length 25.0 mm) in a small stream in the forest. Larval *Tropisternus* cannot be identified to specific level. The larva was moving along the water film on a rock when it captured the tadpole, grabbing it by the tail base, and entered the tadpole's body through the vent tube. The insect took about two minutes to kill the tadpole and then started eating it from the inside, which it did for around 12 minutes. Then it broke part of the tadpole's tail and started squeezing it and consuming the flesh at the broken end of the tail, for about nine minutes. It then stopped eating, but after seven minutes it restarted. At 0014 h it stopped again. The observation lasted about one hour. During this period, another larval *Tropisternus* sp. attempted to capture two other tadpoles but was unsuccessful. The larva was collected and deposited at the Coleção Entomológica do Departamento de Zoologia da Universidade Federal do Rio de Janeiro (DZRJ-1975).

Previously reported predators of eggs and tadpoles of *Thoropa miliaris* are conspecific tadpoles (Giaretta and Facure 2004. Biota Neotropica 4:1–10) and adult *Cyclorhamphus boraceiensis* (Hartmann et al. 2003. Herpetol. Rev. 34:50). Dipteran larvae (maggots) have been reported as predators of eggs of *Thoropa lutzi* (Bokermann, *op. cit.*). This is the first report of predation by an insect on *T. miliaris* tadpoles.

We thank Davor Vrcibradic for helpful suggestions on the manuscript, and Janira Martins Costa and Nelson Ferreira Junior for identifying the insect larva. We thank the Centro de Estudos Ambientais e Desenvolvimento Sustentável (CEADS/UERJ) for local support and for making many facilities available. During this study CCS received a graduate fellowship from FAPERJ, and CFDR (Processes No. 307 653/2003-0 and 477981/2003-8) and MVS (Process No.301401/04-7) received Research Grants of the Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq.

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XENOPUS LAEVIS (African Clawed Frog). **SURFACE PREY CAPTURE**. The aquatic *Xenopus laevis* is regarded as predominantly feeding on aquatic invertebrates (Inger and Marx 1961. Explor. Parc. Natn. Upemba 64:1–85; Kazadi et al. 1986. Ann. Soc. R. Zool. Belg. 116:227–234; Schoonbee et al. 1992. Wat. S. Afr. 18:227–236). However, some field studies also report a large number of terrestrial invertebrates in the stomach contents of *Xenopus*. Tinsley et al. (1996. *In* Tinsley and Kobel [eds.], The Biology of *Xenopus*, pp. 35–59) suggested that *Xenopus* might capture prey from the water surface, but "this possibility has been inadequate to explain the very high proportion of terrestrial prey in the diet …". Here we present some field observations of surface prey capture of *X. laevis*.

Observations were made during field studies on *Xenopus* in three periods: 1–13 Jan 1994, 9 Jan – 4 Feb 1995, and 3 Jan – 19 Feb 1996. The study site was the "Torchwood Pond" (24°25'S, 30°50'W) near Hoedspruit, NE Transvaal, South Africa. This seasonal pond was 65 m^2 in size, located at the wooded slope of the Drakensberg Mountains at an altitude of 750 m, and contained a native population of about 80–100 *Xenopus*, most of them marked.

On 4 Jan 1994 at 0030 h, flying termites passed the pond and hundreds of them dropped into the water. We observed numerous *Xenopus*, body floating in typical posture of 45° under water and eyes above the water or swimming, locating, and catching the wriggling insects. One male (62 mm SVL) caught eight termites within about 20 min.

Two cases of surface prey capture during light rainfall were recorded at 2030 h on 16 Jan 1995. Probably due to the rain, several small moths (ca. 10–15 mm length) were trapped on the water surface. Some *Xenopus* were floating and swimming at the surface. Within about 10 min, we observed two *Xenopus* collecting one moth each. Size and sex of both *Xenopus* could not be recognized due to the choppy water surface.

At 2230 h on 6 Feb 1996, while observing an adult female *Xenopus* (73 mm SVL), a moving cricket (ca. 30 mm length) was spotted on the water's surface. The female was floating at the surface and started swimming toward the cricket a distance of about 20 cm, caught the cricket, and swallowed it under water.

At 2000 h on 18 Feb 1996, a preying mantis (ca. 70 mm length) dropped from an overhanging branch. A female *Xenopus* (75 mm SVL) sitting in shallow water, started swimming over a distance of about 40 cm and caught the mantis. It took about 10 min for the female to swallow the big insect.

Similar observations were made in several nights in all three study periods, indicating that surface prey capture might be a regular event. The only aquatic invertebrates observed in the pond were a few water bugs (Heteroptera) and hand sized crabs (*Potamon* sp.), suggesting that potential aquatic prey might be limited. Surface prey capture as reported herein may explain, for e.g. confined ponds or lack of aquatic prey, high frequencies of terrestrial invertebrates in the stomach contents of *Xenopus*. It might also explain the ability for excellent analyses of water-surface waves with the lateral-line organs of *Xenopus* (Elepfandt 1996. *In* Tinsley and Kobel [eds.], pp. 98–120, *op. cit.*).

We are indebted to Prof. Duncan Mitchell (Johannisburg) and H. Stander (Hoedspruit) for enabling access to the "Torchwood Pond."

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TESTUDINES

CHELODINA OBLONGA (Narrow-breasted Snake-necked Turtle). **PLANKTON FEEDING BEHAVIOR.** The turtle genera *Chelodina, Macrochelodina, Chelus, Hydromedusa* (Chelidae), and *Chitra* and *Pelochelys* (Trionychidae) display a high degree of specialization for catching fast-moving prey like fish and shrimps. All those genera have long necks, elongated and flat heads with rather weak jaws, and forward-positioned eyes that provide good binocular vision. Their feeding behavior involves accurate, fast strikes at prey items and a gape and suck mechanism: an explosive expansion of the throat generates an inrush of water that carries the prey with it. The mouth is then closed to a crack, the water expelled, and the prey swallowed (Legler 1978. Can. J. Zool. 56:2449–2453; Pritchard 1984. Symp. Zool. Soc. London 52:87–110; Thomson 2003. http://www.chelonia.org/Articles/longneck_flathead_evolution.htm). *Chelodina oblonga* has a thick neck and, in relation to body size, the longest neck of all Australasian snake-necked turtles. Its food reportedly consists of small fish, shrimps, freshwater crayfish, aquatic insects, tadpoles, frogs, small water birds, carrion, and some plant material (Burbidge 1967. The Biology of South-western Australian Tortoises. Ph.D. Thesis, The University of Western Australia, Perth. 165 pp.; Cann 1998. Australian Freshwater Turtles. Beaumont Publishing, Singapore. 292 pp.).

On 28 and 29 December 2005 in the early afternoon I observed for several hours *C. oblonga* from a boardwalk across Tomato Lake, a suburban lake of Perth, Western Australia, while they were feeding on undetermined plankton that accumulated in clouds under the water surface at the sun/shade intersection caused by the boardwalk. In water depths of about 1–2 m several groups of 2–6 adult turtles of both sexes were stationary or swam slowly in the lower water zone and repeatedly extended their necks in slow motion upward into the plankton clouds while gaping the mouths wide open and maximally expanding the throats through water intake before closing the mouth to a crack, expelling most of the water and showing swallowing movements of the neck. Individual turtles repeated this behavior in intervals of about 20 seconds. These feeding behaviors of *C. oblonga*, with the necks slowly extending upward and the throats expanding before the necks were pulled back for swallowing, was reminiscent of the slow pulsating feeding movements of other plankton-feeding organisms like baleen whales and whale and basking sharks.. Thus, although the long neck, flat head, and wide throat of *C. oblonga* appear to be adaptations to catch fast-moving prey through a high speed strike combined with gape and suck feeding (Thomson, *op. cit.*), the species can also use its specialized neck and head morphology to ingest masses of slow-moving or near-stationary small planktonic organisms. Until now, this feeding behavior and food source has apparently not been reported for *C. oblonga* or other snake-necked turtles.

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CHELONIA MYDAS (Green Seaturtle). **NESTING.** Although Green Seaturtle juveniles have been documented in Virginia's waters, nesting has never been reported (Mitchell 1994. The Reptiles of Virginia. Smithsonian Inst. Press, Washington, D.C.). Excavation of an oviposition site and deposition of 124 eggs by a Green Seaturtle was observed at a public beach in the community of Sandbridge, City of Virginia Beach, Virginia, USA (36.71370°N, 75.93123°W, NAD 83), on 1 August 2005. Because the oviposition site was below the high-tide line and in a heavily used public recreation area, wildlife biologists from nearby Back Bay National Wildlife Refuge excavated the nest and relocated it to a secure site behind the primary dune line on the Refuge. Of the 124 eggs deposited, 120 were relocated. After an incubation period ranging from 58–63 days, 99 hatchlings emerged on 28 September 2005, one on 29 September, eight on 1 October, and six on 3 October (95% success rate). All were released on the same night of emergence. This is the northernmost record of an oviposition site for this species. The previous northernmost nesting record is ca. 77 km S of the Virginia/North Carolina line, near Nags Head, North Carolina (M. Godfrey, Sea Turtle Project, North Carolina Wildlife Resources Commission, pers. comm., 2005). Palmer and Braswell (1995. Reptiles of North Carolina, Univ. NC Press, Chapel Hill) noted that the northernmost locality was at Cape Hatteras, North Carolina. Photos (KU-CT 11959) were taken by Pam Gelman, verified by Joseph Mitchell, and deposited at the University of Kansas.

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CHELONIAN SPECIES. RECORD CARAPACE LENGTHS FOR ILLINOIS. Maximum sizes attained by turtles in various portions of their ranges are not often reported. We began trapping and nesting surveys of turtles in west-central Illinois, USA, in 1994 and continued through 2006. During that time we have collected data on 27,206 turtles of ten different species, a total that excludes data collected on hatchlings. In this note we present new state maximum size records (carapace length) for six Illinois species including a range-wide size record for the Red-eared Slider (*Trachemys scripta elegans*).

Turtles were collected in baited hoop traps, unbaited fyke nets, or by hand at nesting areas. Turtles were returned to the laboratory where they were marked, weighed, measured, and then released at the collecting area (Tucker et al. 1998. J. Herpetol. 32:294–298). Only the initial capture for each individual was included in the analysis. Maximum sizes were compared to those in Smith (1961. Illinois Nat. Hist. Surv. Bull. 28:1–298) and Phillips et al. (1999. Illinois Nat. Hist. Surv. Man. 8:xv, 1–282) for Illinois and to Ernst et al. (1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 578 pp.) and Conant and Collins (1991. A Field Guide to Reptiles and Amphibians. 3rd ed. Houghton Mifflin Co., Boston, Massachusetts. 450

Table 1. Descriptive statistics for ten species of turtles collected in west-central Illinois.

Species	N	Carapace Length Mean (std)/ range	Carapace Width Mean (std)/ range	Carapace Height Mean (std)/ range	Plastron length Mean (std)/ range	Mass Mean (std)/ range
Chelydra serpentina/ Snapping Turtle	468	27.0 (6.4) 3.2–40.5	23.0 (5.3) 3.1–32.5	11.6 (2.7) 1.9–16.8	20.1 (4.5) 2.3–29.7	5940 (3368.7) 10.9–16000
Apalone mutica/ Smooth Softshell	8	21.2 (5.8) 15.8–28.8	18.0 (4.5) 13.7–23.9	4.8 (2.2) 2.8–7.7	14.8 (4.2) 11.0–20.2	1071 (943.2) 265–2290
Apalone spinifera/ Spiny Softshell	416	23.2 (8.0) 4.8–50.0	19.2 (6.1) 4.2–39.6	5.1 (1.8) 1.2–11.5	16.5 (5.8) 3.2–32.5	1540 (1643.5) 11.2–9400
Sternotherus odoratus/ Stinkpot	633	10.2 (2.2) 2.4–14.6	7.3 (1.9) 1.6–17.6	4.3 (0.8) 1.2–9.9	7.6 (1.7) 1.7–10.7	205 (97.1) 3.1–510
Terrapene carolina/ Eastern Box Turtle	36	13.4 (0.8) 12.1–14.7	10.5 (0.7) 9.2–11.8	6.9 (0.5) 5.8–7.6	13.7 (0.8) 12.2–15.7	556 (110.0) 350–850
Chrysemys picta/ Painted Turtle	848	13.9 (2.7) 3.5–19.5	10.2 (1.7) 3.2–13.9	4.9 (1.0) 1.5–9.5	13.0 (2.5) 3.1–18.0	401 (187.7) 7.11–980
Trachemys scripta elegans/ Red-eared Slider	24682	18.1 (4.6) 3.0–30.2	13.5 (3.1) 3.0–21.7	6.7 (1.8) 1.4–12.5	16.7 (4.2) 2.7–26.7	984 (589.3) 6.2–3510
Graptemys geographica/ Northern Map Turtle	16	14.1 (4.1) 8.1–20.5	10.9 (2.9) 7.1–15.4	5.1 (1.8) 2.9–9.5	12.6 (3.8) 7.0–18.2	459 (374.0) 61–1100
Graptemys pseudogeographica/ False Map Turtle	22	14.1 (3.2) 10.4–21.0	10.7 (2.5) 8.5–17.4	4.8 (1.2) 3.8–7.5	12.4 (2.9) 9.2–18.9	387 (349.7) 160–1260
Graptemys ouachitensis/ Ouachita Map Turtle	45	13.5 (4.7) 6.9–24.3	10.3 (3.4) 6.1–17.8	5.0 (1.9) 2.7–9.3	11.7 (4.2) 6.0–21.0	445 (474.8) 45–1780

Measurements of length and height are in cm; mass is listed in g.

pp.) along with other more recent references cited below for the United States.

Dimensions for all captured turtles are listed in Table 1. State record carapace lengths were recorded for six species (Table 2). Illinois collecting sitess for each of the record-sized turtles are Swan Lake, Calhoun Co., for the Spiny Softshell (*Apalone spinifera*) and the Common Snapping Turtle (*Chelydra serpentina*); Spunky Bottoms, Brown Co., for the Red-eared Slider (*Trachemys s. elegans*) and the Painted Turtle (*Chrysemys picta*); the Illinois River adjacent to Swan Lake, Calhoun Co., for the Smooth Softshell (*Apalone mutica*); and Gilbert Lake, Jersey Co., for the Stinkpot (*Sternotherus odoratus*). Our size records for female Red-eared Sliders exceeded the previously reported range-wide record for females of 29.2 cm for a specimen from Missouri (Johnson 2000. The Amphibians and Reptiles of Missouri. 2nd ed. Missouri Department of Conservation, Jefferson City, Missouri. 400 pp.). Such large specimens are uncommon, and we collected only three individuals with a carapace length of 30 cm or greater among the more than 24,500

Table 2. Maximum carapace lengths (cm) for turtles from Illinois and the United States. Measurements are for females except where noted.

Species	Current study	Smith (1961)	Phillips et al. (1999)	Ernst et al. (1994)	Conant & Collins (1991)
Apalone spinifera	50.0	28.2	38	54.0	43.2
Apalone mutica	28.8	23.3	28.0	35.6	35.6
*Chelydra serpentina**	40.5	30	N	49.4	49.4
Chrysemys picta	19.5	16.6	18	20.3	25.1
Trachemys s. elegans	30.2	22.9	26	28	28.9
*T. s. elegans**	26.1	N	N	20	N
Sternotherus odoratus	14.6	12.8	13	13.7	13.7

Symbols: * data collected from males; N = not given.

individuals observed. However, other slider subspecies attain much larger carapace lengths (Ernst et al. 1994, *op. cit.*). Our state record for the Stinkpot (Tucker and Lamer 2005. Herpetol. Rev. 36:314) is just slightly smaller than the range-wide record of 15 cm (Ewert 2005. Herpetol. Rev. 36:314) for a specimen from Indiana.

The fairly large number of new state records that we report almost certainly reflects our intensive trapping program. Trapping was mostly conducted in backwaters of the Illinois River rather than in the river itself. Consequently, we caught few map turtles, which are generally riverine species (Dreslik and Phillips 2005. J. Freshwater Ecol. 20:149–164). Our collections of terrestrial turtles such as the Eastern Box Turtle (*Terrapene carolina*) were also small. This is an upland species and not common in the floodplain areas that we surveyed. In contrast, numbers of Sliders dominate our collections. Despite the small numbers of riverine specialists that we examined, we believe it is important to report these records because size in turtles is usually associated with reproductive output and can vary geographically (Iverson 1992. Herpetol. Monogr. 6:25–42; Tucker et al. 1998, *op. cit.*).

Brian J. Towey, Megan Dooling, and Mika Avara helped with trapping. Collecting at the Stump Lake was made possible by Neal Booth and Kim Postlewait (Illinois Department of Natural Resources) at the Mississippi River State Fish and Wildlife Area in Rosedale, Illinois. Access to Swan Lake and Gilbert Lake was made possible by John Mabery (US Fish and Wildlife Service) at the Two Rivers National Wildlife Refuge-Brussels District. Collections at Spunky Bottoms were funded by the Nature Conservancy and we thank Theron Hobson for his assistance. We also thank Jim Beasley, Beasley Fish of Grafton, Illinois for providing bait. Collecting was done under Illinois Department of Natural Resources scientific permit authorization to Tucker.

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CHELYDRA SERPENTINA (Common Snapping Turtle). **DIET**. *Chelydra serpentina* is an omnivorous species known to consume a variety of vertebrates, invertebrates, and vegetation (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington D.C. 578 pp.; Palmer and Braswell 1995. Reptiles of North Carolina. UNC Press, Chapel Hill, North Carolina. 412 pp.). Clams and mussels have been listed among the invertebrates taken by *C. serpentina*, yet none has been identified to species. Here we report an instance of predation on a freshwater mussel and provide a positive identification of species.

One of us (SKH) captured a male *C. serpentina* (345 mm CL, 250 mm PL, 9.5 kg) in a small sandy pool near a culvert between two human-made ponds within the Auburn University North Fisheries Unit on 19 September 2005 ca. 3 km N of Auburn, in north-central Lee Co., Alabama, USA (UTM 16 641280E, 36 15474N; datum: WGS 84; elev. 200 m). Upon close examination of the turtle it was observed that freshwater mussel shell fragments were protruding from the cloaca, which appeared to be entirely blocked by this indigestible material. We removed several of the fragments and determined the mussel was *Utterbackia imbecillis*, the Paper Pondshell. *Utterbackia imbecillis* is an ecologically tolerant and widespread pearly mussel (Bivalvia: Paleoheterodonta, Unionoida; Unionidae), common in lentic bodies of water in the Mississippi River drainage basin and the basins of other rivers draining into the Gulf of Mexico (Parmalee and Bogan 1998. The Freshwater Mussels of Tennessee. University of Tennessee Press, Knoxville 328 pp.). The turtle was held for six days, during which time the remaining fragments were passed or removed with forceps. The total dry weight of the *U. imbecillis* shell fragments was 78 g. *Utterbackia imbecillis* shells are notably thinner than those of other unionids and closed shells containing decaying animals are often found floating on the surface of ponds and sluggish rivers during summer and early fall. Although it is possible that these mussels were taken on the substrate surface, we speculate that this turtle encountered and fed upon dead *U. imbecillis* found floating at the surface of these warm, shallow, nutrient-rich ponds.

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DEIROCHELYS RETICULARIA RETICULARIA (Eastern Chicken Turtle). **TERRESTRIAL REFUGIUM DURATION.** *Deirochelys reticularia* is an aquatic turtle known to hibernate and aestivate terrestrially (Buhlmann 1995. J. Herpetol. 29:173–181). Buhlmann and Gibbons (2001. Chelon. Cons. Biol. 4[1]:115–127) reported that, among 150 *D. reticularia* inhabiting a Carolina bay in South Carolina, terrestrial refugium duration ranged from 121–285 consecutive days, with an average of 185 days. Buhlmann (*op. cit.*) reported a maximum of 156 days spent in terrestrial refugia among six *D. reticularia* radio-tracked in a Virginia population. Here I report an exceptionally long use of terrestrial refugia by *D. reticularia*.

Between 6 September 1998 and 12 February 2006, I radio-tracked 17 *D. reticularia* alternately utilizing a large ephemeral pond, a permanent human-made lake and beaver swamp complex, and interlying terrestrial sandhill habitat, dominated by longleaf pine (*Pinus palustris*), wiregrass (*Aristida stricta*), and scrub oaks (*Quercus* spp.) (Sandhills Game Lands, ca. 17.7 km NW of Wagram, Scotland Co., North Carolina, USA). While all but two of the turtles spent at least some time on land while being tracked, two individuals remained in terrestrial refugia for exceptionally long periods.

A subadult female (straightline CL 109 mm, 177 g) was initially captured in the ephemeral pond on 13 May 2000, taken into the laboratory, fitted with a transmitter on 19 May, and released back into the pond on 20 May. On 26 May she was found in a terrestrial refugium ca. 390 m from the pond. On 28 May she was found to have moved ca. 6 m. She remained in that spot until 4–6 August; on 6 August she was found to have moved ca. 136 m. On 10 February 2001, I replaced her transmitter in the field. On 17 February she was found to have moved 2 m and an additional 11 m on 24 February. She remained in that spot until 13 April; on that date she moved ca. 119 m. On 2 June she was found to have moved ca. 31 m, following a prescribed burn that passed over her refugium between 28 May and 2 June. She remained in that location

until at least 30 March 2002 (her transmitter was again replaced in the field on 27 January 2002). On 24, 29, and 30 March, she was found awake and alert with her head protruding from the leaf litter. On 6 April she was found in the permanent lake/beaver swamp complex, ca. 470 m from her most recent terrestrial refugium and ca. 700 m from the ephemeral pond where she was originally captured. She remained there until her signal was lost on 1 June 2002. This turtle spent a minimum of 674 consecutive days in terrestrial refugia—more than twice the maximum of 285 days reported by Buhlmann and Gibbons (*op. cit.*).

An adult female (CL 180 mm, 689 g) was initially captured while hibernating terrestrially on 24 February 2001, at a point ca. 200 m from the dry ephemeral pond and ca. 500 m from the lake/beaver swamp complex. She was taken into the laboratory, fitted with a transmitter on 2 March, and replaced in her terrestrial hibernaculum on 3 March. She remained in that spot until 18–25 May; on 25 May she was found to have moved ca. 104 m. She remained there until 2 June, when she was found to have moved ca. 36 m, following a prescribed burn that passed over her refugium between 28 May and 2 June. She remained in that spot until 13 April 2002 (her transmitter was replaced in the field on 18 November 2001). On that date she was found moving overland ca. 132 m from her most recent refugium, and on the following day she was found in the beaver swamp complex (ca. 500 m from her original capture site), where she remained until her signal was lost on 13 June 2002. This turtle endured a minimum of 413 consecutive days in terrestrial refugia (almost certainly considerably longer, as she had likely been in terrestrial aestivation/hibernation for several months before being found).

During most of the period these two turtles spent on land, the ephemeral pond was dry or nearly so. The remaining 15 turtles tracked in this population spent periods ranging from zero to at least 259 consecutive days in terrestrial refugia. In all cases, terrestrial refugia were shallow depressions dug by the turtles at, or up to ca. 5 cm below, the surface of the sandy soil. In most cases, when only the surface litter was brushed aside, the top of the turtle's carapace was visible. On the few occasions when I disturbed them, the turtles always appeared awake and would move if touched, even in very cold weather. On at least three occasions, prescribed fires passed directly over turtles without harming them, though the surface litter and survey flags marking the turtles' locations were consumed. Turtles were monitored opportunistically at fairly frequent intervals (an average of ca. every 4–5 days) while in terrestrial refugia, and there was little or no possibility of their having moved to water and then back to their refugia during the short intervening periods.

These observations indicate that *D. reticularia* is strongly drought-resistant and capable of enduring periods of nearly two years in terrestrial refugia. Why some turtles exhibited this behavior rather than moving directly into the lake/beaver swamp complex is unknown. Possibly the permanent water was perceived as suboptimal habitat and only entered as a "last resort" when energy reserves were nearly depleted; however, several individuals migrated directly from the ephemeral pond to the permanent lake, covering the distance (a minimum of ca. 670 m) in less than 24 h.

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GLYPTEMYS INSCULPTA (Wood Turtle). **GENERATIONAL TWINNING**. Twinning has been reported for several species of North American freshwater turtles (Plymale et al. 1980. Florida Sci. 43:97–102; Tucker and Jansen 1997. Copeia 1997:166–173). Twinning in *Gyptemys insculpta* has been reported at least once (Oldfield and Moriarty 1994. Amphibians and Reptiles Native to Minnesota. University of Minnesota Press. 131 pp.) previous to this report. The twin turtles in that report were captive-hatched from a wild-caught gravid female in August 1985.

One of the 1985 twins was raised in captivity and bred annually to a captive-bred female of similar age since 1996. In June 1997, this pair produced a clutch of seven eggs. Three of the eggs were fertile. One of the fertile eggs failed after about 40 days of incubation, one hatched normally at 70 days, and one had not hatched at 90 days. The unhatched egg was opened and found to contain one small live embryo and one dead embryo attached to the same yolk (JFBM 13514). Both embryos appeared normal. None of the subsequent seven clutches from this pair of turtles has produced twins.

This is the first published record of generational twinning in turtles. Previous studies (Tucker and Janzen 1997, *op. cit.*; Yntema 1970. Anat. Rec. 166:491–498; Yntema 1971. Copeia 1971:755–758) only looked at twins produced from wild nests. Additional studies will be needed to determine if generational twinning is genetically based or due to chance developmental anomalies.

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GLYPTEMYS INSCULPTA (Wood Turtle). **DIET.** North American Wood Turtles are known to feed opportunistically on a variety of plant and animal species. Food preferences may differ geographically and shift seasonally but include a variety of green leaves, fruits, flowers, fungi, and invertebrates (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington D.C. 578 pp.; Farrell and Graham 1991. J. Herpetol. 25:1–9; Strang 1983. J. Herpetol. 17:43–47). As part of a larger study analyzing home range, movement patterns, and microhabitat usage, I used radio telemetry to observe 15 adult *G. inscuplta* in Butler Co., Iowa (at the southwestern limit of the species' range) from May 2003 to May 2006 and noted feeding events and food sources when possible. Noted Wood Turtle food sources in Butler Co. (listed in order of frequency of observation) included grasses, slugs, violet leaves (*Viola* sp.), prairie ragwort leaves (*Senecio plattensis*), black raspberries (*Rubus* sp.), earthworms, snails, and dandelion leaves (*Taraxacum officinale*). To date, *S. plattensis*, a plant with toxic properties, has not been reported as a food item for *G. insculpta*.

Senecio (=*Packera*) *plattensis* [Asteraceae] is distributed broadly from the east coast to the midwest of North America; its range

overlaps with *G. insculpta* in Iowa, Michigan, Minnesota, New Hampshire, Pennsylvania, West Virginia, Wisconsin, and Virginia. *Senecio plattensis* occurs frequently within the study sites in Butler Co., Iowa; it is found in sandy soil and commonly occurs in clearings in the forest canopy with a variety of grasses, sedges, and forbs, and along riverbanks in mixed species assemblages dominated by *Salix* spp. (saplings) and *Bromus* spp. (grasses). Wood Turtles in Butler Co. frequently utilize both of these microhabitats.

Senecio spp. are known to contain a variety of toxic pyrrolizidine alkaloids (otocecine-type: senkirkine, hydroxysenkirkine, and petasitenine; and retronecine type: jacobine, isatidine, retrorsine, riddelliine, senecionine, and seneciphylline) that are variously hepatotoxic, genotoxic, tumorigenic, carcinogenic, and mutagenic (Fu et al. 2004. Drug Metabolism Reviews 36:1–55). Pyrrolizidine alkaloids (PAs) are produced by over 6000 members of several plant families (Asteraceae, Boraginaceae, Leguminosae) and are reported to be the most common poisonous plant compounds that affect wildlife, livestock, and humans worldwide (Steenkamp et al. 2000. Ther. Drug. Monit. 22:302–306; Stegelmeier et al. 1999. J. Nat. Toxins 8:95–116).

I have only witnessed *G. insculpta* feeding on the ovate basal leaves at ground level, despite the availability of flower heads on short stems. For example, an adult male Wood Turtle (923.6 g, carapace length 186.14 mm) was observed on 15 May 2004 feeding on prairie ragwort; the turtle ate the majority of several basal leaves from two adjacent plants between 1611 h and 1624 h, then moved 0.5 m and partially consumed a dandelion leaf (*Taraxacum officinale*) at 1633 h. The turtle then moved 1.5 m and basked in a stand of willow saplings (*Salix* spp.) until 1740 h. After basking, cloacal temperature was 26.2°C; air temperature was 18.4°C.

Eight adult (two males and six females) *G. inscuplta* have been observed feeding on *S. plattensis* between May 2004 and April 2006. Several individuals have been observed to feed repeatedly on *S. plattensis* and to date none has shown visible signs of acute or chronic toxicity. Of over 870 sightings on 46 marked turtles between May 2003 and May 2006, I have observed only two fatalities, neither related to ingestion of *S. plattensis*.

Pyrrolizidine alkaloid poisoning is apparently unreported for herbivorous reptiles, but is well-documented in numerous insect, fish, bird, and mammal species (Candrian et al. 1984. Food Chem. Toxicol. 22:223–225; Chan et al. 2003. Toxicol. Lett. 144:295–311; Cheeke and Pierson-Goeger 1983. Toxicol. Lett. 18:343–349; Hendricks et al. 1981. Exp. Mol. Pathol. 35:170–183). Barnard (1996. Reptile Keeper's Handbook. Krieger Publ. Co., Malabar, Florida) includes *Senecio* spp. on a list of plants that are poisonous to reptiles, but apparently this is based on toxicity to humans. To my knowledge, it is undetermined if herbivorous reptiles, particularly turtles, exhibit toxicity upon ingesting PAs or if toxicity might be mitigated by enzymatic or bacterial alteration of the toxins.

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GEOCHELONE CARBONARIA (Red-footed Tortoise). **SWIMMING.** The presence of tortoises (Testudinidae) on islands and both sides of large river systems suggests that they must be capable of swimming or, at a minimum, floating to facilitate passive transport in currents. It has been suggested that tortoises float due to their high carapace height-to-width ratios (Patterson 1973. J. Herpetol. 7:373–375), yet few published accounts exist that document swimming activity by tortoises. Swimming accounts have been published for *Geochelone nigra* (Beebe 1924. Galapagos World's End. Putnam's Sons, London), *Gopherus polyphemus* (Brode 1959. Herpetologica 15:101–102; Carr 1952. Handbook of Turtles: The Turtles of the United States, Canada, and Baja California. Cornell Univ. Press. Ithica, New York), *Geochelone* (*Testudo*) *gigantea* (Gaymer 1968. J. Zool. 154:341–363), and *Testudo graeca* (Gasith and Sidis 1982. Copeia 1982:200–201). Although these tortoises are not particularly well-shaped for swimming, several of these authors noted that the tortoises float quite buoyantly, are capable of keeping their head above water, and are capable of controlling their direction of movement, in some cases in the presence of a current (Brode, *op. cit.*; Carr, *op. cit.*; Beebe, *op. cit.*; Gaymer, *op. cit.*).

On 17 May 2006, at 1650 h, an adult female *G. carbonaria* (ca. 35 cm linear carapace length) was observed swimming across the Uraricoera River (a third-order tributary to the Amazon River, located in Roraima State, northern Brazil) from the mainland to the 110,000 ha riverine island, Maracá Ecological Reserve. The tortoise was observed by JNS from a boat for ca. 10 min as it was carried downstream by the current, yet making progress towards the opposite bank of the 150 m wide river, as it alternately paddled with its forelimbs. The tortoise's head and top one-third of its carapace were above water (Fig. 1), but when approached too closely, the tortoise stopped swimming and held its head below water for ca. 30 sec. A juvenile *G. carbonaria* of unknown sex (22 cm linear carapace length) was also observed swimming and was captured for measurement in the same river as it arrived close to the island shore at ca. 1300 h on 12 June 2004.

The island towards which both of these tortoises were swimming has both *G. carbonaria* and *G. denticulata*, suggesting that both species are capable of swimming, although this is yet to be documented for the latter. To our knowledge, this is the first report

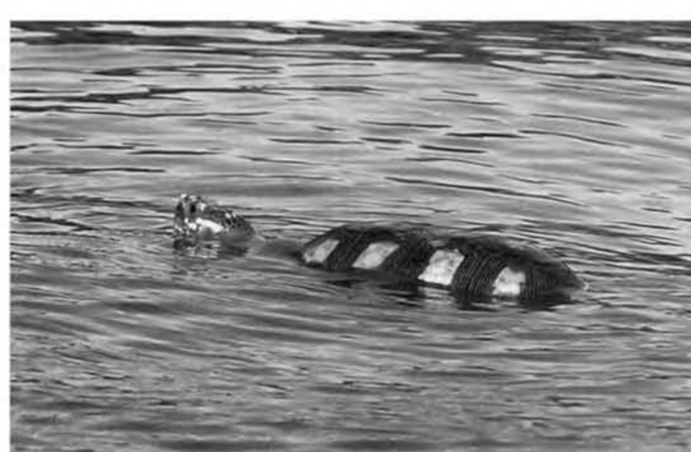

FIG. 1. Female *Geochelone carbonaria* swimming across the Uraricoera River, Roraima State, northern Brazil, 17 May 2006.

of *G. carbonaria* actively swimming.

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HEOSEMYS SPINOSA (Spiny Hill Turtle). **DIET**. *Heosemys spinosa* is reportedly primarily herbivorous in the wild, though captives accept both plant and animal matter (Lim and Das 1999. Turtles of Borneo and Peninsular Malaysia. Natural History Publications [Borneo] Sdn. Bhd., Kota Kinabalu. xii + 151 pp.; Pritchard 1979. Encyclopedia of Turtles. TFH Publications, Neptune, New Jersey. 895 pp.). However, apparently there are no published studies on the natural diet of this species. Fecal samples from four individuals (two females, one male, one juvenile) were analyzed for content. Three animals (a male, a female, and a juvenile) originated from Kubah National Park (01°33'N, 110°12'E), Sarawak, Malaysia (Borneo). A fourth (a female) was from the vicinity of Balai Ringin (01°03'N, 110°45'E), a fishing village also in Sarawak. The three individuals from Kubah had seeds of an indeterminate type of plant as well as other plant material, and parts of indeterminate insects. The fecal sample from the adult female from Balai Ringin contained plant material, unknown insect parts, vertebrae from an unidentified fish species, several phalanx bones from a monkey, either a macaque (*Macaca* sp.) or a langur (*Presbytis* sp.), presumably taken by scavenging.

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HYDROMEDUSA TECTIFERA (South American Snake-necked Turtle). **ALTITUDINAL RECORD**. The geographic distribution of South American snake-necked turtles (*Acantochelys radiolata*, *Hydromedusa maximiliani*, *H. tectifera*, and *Phrynops hogei*) and their habitat preferences are still inadequately defined, and these turtles' populations are being reduced because of environmental disturbances (Ernst and Barbour 1989. Turtles of the World. Smithsonian Institution Press, Washington, DC 313 pp.; Rocha et al. 2000. *In* Bergallo et al. [Orgs.], A Fauna Ameaçada de Extinção do Estado do Rio de Janeiro, pp. 79–87. EdUERJ). These species typically inhabit rivers, lakes, and swamps along the coastal lowlands from Brazil to Argentina (Achaval and Olmos 2003. Anfíbios y Reptiles del Uruguay. 2da. Edición corregida y aumentada. Graphis, Montivideo, Uruguay. 136 pp.; Ernst and Barbour, *op. cit.*; Pritchard 1979. Encyclopedia of Turtles. TFH Publ. Co., Neptune, New Jersey. 895 pp.). On 15 September 2001 at 0915 h, a male *Hydromedusa tectifera* (carapace length ca. 20 cm) was found resting underwater (water temperature 17.8°C) at a depth of 50 cm at the Poço Verde (22°30'S, 43°02'W; 450 m elev.), in the Parque Nacional da Serra dos Órgãos, Rio de Janeiro State, Brazil. The turtle was captured and identified for JALP and JPF, photographed, and then released. This finding constitutes the highest elevation for which this species has been recorded.

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KINOSTERNON SCORPIOIDES ALBOGULARE (White-throated Mud Turtle). **FEEDING BEHAVIOR AND DIET.** The feeding behavior and diet of *Kinosternon scorpioides albogulare* was studied at the Caribbean island of San Andres, Colombia, during a survey of the population conducted from March to July 2002. On this island these turtles inhabit both freshwater ponds and mangroves, with more than 98% of the total population living in the latter (Forero-Medina, Chelon. Cons. Biol., *in press*). Direct observations on feeding behavior were conducted during the study, and stomach flushing (Legler 1977. Herpetologica 33:281–284) was used on 50 individuals for determining dietary composition. Stomach contents were preserved in alcohol, and the items were identified to taxonomic category. The turtles displayed both diurnal and nocturnal feeding activity. A nocturnal pattern occurring at the fresh water ponds, where it is almost impossible to observe an individual during the day. In the mangroves, however, they were frequently seen active during the day. Most of the stomachs were found to be empty, but some of them contained identifiable items. These included seeds, coleopteran elytra, small gastropods, arthropods, and larval crustaceans (zoea) and dipterans. These last two items were found in large quantities in some specimens. During observed feeding events, the identified prey were a small fish and an aquatic coleopteran in the freshwater ponds, and a fruit (*Annona* sp.) on the floor of a mangrove habitat. Turtles were also frequently observed ingesting organic wastes such as coconut leftovers, disposed by people living next to the mangroves. These results suggest that the species is omnivorous and opportunistic and that it uses resources such as fruits or arthropods depending on their availability.

Feeding in *K. s. albogulare* can be terrestrial or aquatic. Carr and Mast (1988. Trianea [Act.Cient.Tecn. INDERENA] 1:87–97) suggested that the terrestrial invertebrates consumed by *K. herrerai* had likely fallen onto the water; however, our observations on *K. s. albogulare* confirm both aquatic and a terrestrial feeding behavior. A notable item found in the diet of some individuals is a large quantity of dipteran larvae. A study on the feeding behavior of *K. s. cruentatum* (Monge-Najera and Moreva-Brenes 1987.

Herpetol. Rev. 18:7–8) found a strong preference for eating mosquito larvae; one individual consumed 148 in 24 h. These results suggest that turtles could play a role in the control of mosquitoes on the island. They could also be contributing to nutrient cycling processes in the mangroves as they consume organic waste and dead animals such as crabs, as observed by one of us (Castaño, unpubl.). Continued studies may reveal additional items consumed by the species and seasonal and temporal changes in dietary preferences.

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PHRYNOPS HILARII (Hilaire's Side-necked Turtle). **REPRODUCTION.** A number of factors are known to influence the incubation time and size of chelonian neonates (Kohler 2005. Incubation of Reptile Eggs. Krieger Publ. Co., Malabar, Florida. 214 pp.). However, much reported data is based on artificially incubated eggs, where eggs are exposed to constant temperatures during the incubation period. Here I present data on the longest known incubation period of a *Phrynops hilarii* clutch in non-controlled environment.

A female *Phrynops hilarii* was found after it had been hit by a vehicle in a road in southern Rio Grande do Sul state, Brazil. The animal was still alive but later died in the laboratory. This female had a carapace length (CL) of 338 mm, plastron length of 299 mm, and a body mass of 3600 g. Upon necropsy, fourteen intact eggs were found in its oviducts, six in the right side and eight in the left side. Egg measurements showed low variability, both in diameter (greater dimension: mean = 33.6 ± 0.477, lesser: mean = 32.0 ± 0.350) and weight (mean = 20.5 ± 0.489 g). Total egg mass represented approximately 9% of the body mass of the female. Initially, egg viability was considered unlikely, and the eggs were placed in a closed jar and kept on a shelf exposed to ambient room temperatures. This room was heated during the coldest winter months, while in summer, air conditioning was turned on only during working hours in the laboratory.

Of the 14 eggs placed in the jar, 10 hatched successfully, one hatchling died during hatching, two eggs contained dead embryos in different stages of development, and one was classified as nonviable due to absence of visible embryonic development. Hatching was verified after a period of 418 days. Of the 10 successful hatchlings, CL of nine ranged between 41 and 42.6 mm, and one was notably smaller at CL 38.8 mm (N = 10; mean = 41.3; SD = 1.03; Min. = 38.8; Max. = 42.6). No abnormalities in scute pattern were observed. Incubation periods of 100–300 days have been reported for turtles in this genus, with ± 150 days being noted for captive-bred *P. hilarii* (Fabius 2004. Manouria 7[25]:28–38). Reports that this species might deposit eggs during two laying periods in fall and spring (March–May, September–December) with a single hatching period in late summer or fall suggests that *P. hilarii* embryos might enter a state of diapause under certain conditions (R .Vogt, pers. comm.; Fabius, *op. cit.*). This might explain the survival of embryos under presumably stressful conditions and extended incubation period reported here.

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TRACHEMYS SCRIPTA ELEGANS (Red-eared Slider). **REPRODUCTION.** The natural range of *Trachemys scripta elegans* is centered in the south-central United States, from Illinois to the Gulf of Mexico. Because of its prominence in the international pet trade, the species now can be found over much of the United States, and its introduction has been documented throughout the world (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington. 578 pp.). There has been speculation as to whether and where introduced Red-eared Sliders can reproduce in the wild in California (Bury and Luckenbach 1976. Biol. Conserv. 10:1–14). Successful nesting or presumed breeding (i.e., gravid females) in northern California were reported by Bury and Luckenbach (*op. cit.*) at Clear Lake, by Spinks et al. (2003. Biol. Cons. 113:257–267) at the University of California, Davis, and by Fidenci (2006. Herpetol. Rev. 37:80) in the Mount Tamalpais Watershed, Marin Co. Here, we report additional evidence of reproduction in *T. s. elegans* in the wild in northern California.

On 27 April 2001, MPB and R. Corwin found a hatchling *T. s. elegans* in a fyke net set for salmonid surveys at Stony Creek, immediately upstream from its confluence with the Sacramento River, Glenn Co.. This area is southeast of the city of Orland. The turtle was 41 mm CL (straight-line carapace length). On 31 May 2001, in a slough about one mile east of Stony Creek, GML captured a hatchling *T. s. elegans* (53 mm CL). In this same remote area, GML has captured, marked, and released 88 *T. s. elegans*, seven of which were <100 mm CL. Over the course of a two-year mark-recapture study in 2004 and 2005 on the eastern half of the Bufferlands in Elk Grove (city), Sacramento Co., LCP captured 240 individual *T. s. elegans*, 18 of which were <100 mm CL (smallest = 34.6 mm CL). On 17 June 2005, E. Meyer, W. Wegner, and D. Degross visited a pond on the north side of the Sacramento River, Redding (city), Shasta Co. Several adult *T. s. elegans* and Pacific Pond Turtles (*Actinemys marmorata*), the native turtle, were observed basking on logs in the pond. One adult male *T. s. elegans* (139 mm CL) was captured in a small turtle trap baited with canned sardines. One hatchling *T. s. elegans* (34.8 mm CL), of four observed basking on a log in the shallows, was captured with a dip net.

The observation of multiple hatchling and juvenile *T. s. elegans* reported here, along with previously cited reports, suggests that successful reproduction is occurring in the wild in northern California and that these young turtles were wild-bred and not released pets.

Stebbins (2003. Western Reptiles and Amphibians. 3rd ed. Houghton Mifflin Co., Boston, Massachusetts. 533 pp.) noted that *T. s. elegans* has been introduced into California's Central Valley (Sacramento-San Joaquin drainages). This watershed encompasses a considerable proportion of lowland habitats and, until recently (see Fidenci, *op. cit.*), included all of the prior and present cases of

successful breeding of *T. s. elegans* in northern California. To date, known cases of reproduction in *T. s. elegans* in northern California are in or near urban areas, where it is more likely that pet turtles will escape or be released. The mild Mediterranean climate of the Central Valley may facilitate the survival and successful breeding of introduced *T. s. elegans*. With these additional sightings of reproduction in northern California, it appears that established populations of *T. s. elegans* are more widespread than previously recognized. Further research should focus on whether introduced populations of Sliders are a potential threat to the native *A. marmorata*.

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CROCODYLIA

CAIMAN CROCODILUS (Spectacled Caiman). **PREDATION/EAVESDROPPER.** The use of mating signals by unintended receivers, or eavesdroppers, is a widespread phenomenon and has been documented in several signal modalities (Zuk and Kolluru 1998. Quart. Rev. Biol. 73:415–438). Several predators and parasites use mating calls of other species to locate their prey/host. Male frogs calling to find a mate are known to attract predators such as frog-eating bats (*Trachops cirrhosus*: Tuttle and Ryan 1981. Science 214:677–678; Ryan and Tuttle 1983. Anim. Behav. 31:827–833) and opossums (*Philander opossum*: Tuttle et al. 1982. Biotropica 13:233–234), and parasites such as blood-sucking flies (*Corethrella* spp.: McKeever 1977. Mosquito News 37:522–523). Here, I report observations of eavesdropping on advertisement calls of frogs and toads by *Caiman crocodilus* from Gamboa (9°07.0'N, 79°41.9'W, datum: WGS84; elev. 35 m), Panama.

The diet of *C. crocodilus* includes a wide variety of foods; young caiman eat mostly aquatic arthropods (insects and crustaceans), whereas adults feed mainly on fishes and frogs (Savage 2002. The Amphibians and Reptiles of Costa Rica. University of Chicago Press, Chicago. 934 pp.). Yet, no reports exist on what cues caimans use to find the frogs they eat. Given that *C. crocodilus* hunt at night when most frogs call, their use of prey-emitted cues seems likely. *Caiman crocodilus* are known to be attracted to distress calls of the Smokey Jungle Frog, *Leptodactylus pentadactylus* (LeVering 1999. Unpubl. Ph.D. dissertation, University of Texas, Austin). LeVering (*op. cit.*) showed that *L. pentadactylus* frogs under attack produce distress calls that resemble the calls produced by young caimans. Such distress calls attract adult Spectacled Caimans, some of which interfere and may increase the probability of the frog escaping.

Between 1 and 14 August 2005, I observed the responses of two adult and two juvenile *C. crocodilus* to playbacks of frog advertisement calls. I broadcast calls of four species of frogs common in the area of Gamboa (Panama) from a speaker placed at ground level. I played a series of calls of 5–10 individuals of each species for 30 min with the purpose of trapping blood-sucking flies, *Corethrella* spp., that are attracted to advertisement calls of frogs. Only calls of one frog species were played during each 30-min interval, and calls were presented at the call rate at which they were originally recorded.

When I was setting up the trap to collect flies between 2010 and 2245 h on 1 August 2005, I noticed an adult (ca. 200 cm TL) *C. crocodilus* in a small pond 10–12 m from the pool of water next to which I had placed the trap. I first broadcast calls of *Eleutherodactylus diastema*, a small arboreal frog, and only a few *Corethrella* flies were attracted. I then played the calls of *L. pentadactylus,* and when I returned to close the trap I found an adult *C. crocodilus* by the trap, looking directly at the speaker (Fig. 1). The caiman had displaced the speaker about 10 cm and claw marks were present on the ground nearby. When I approached the trap, the caiman went back to the pond where I originally saw it at the beginning of the evening. After that, I played calls of *Agalychnis callidryas*, a slender medium-sized treefrog, but did not attract caiman. Finally, I broadcast calls of the toxic toad *Bufo marinus* and a caiman, apparently the same one based on overall morphology, approached the speaker again. On 10 August 2005, another adult (ca. 170 cm TL) caiman in an area about 100 m away approached a speaker playing *B. marinus* calls. On both nights, the caimans that approached the speaker moved it with their head and feet and scratched the area around it with their claws. On 2 and 14 August 2005 between 2000 and 2200 h, I broadcast calls of *L. pentadactylus* and *B. marinus* at 30-min intervals to juvenile caimans (ca. 70 cm TL) that were within 7–10 m of the speaker. In no case did the small caimans move in the direction of the calls.

FIG. 1. Adult *Caiman crocodilus* attracted to a speaker broadcasting *Leptodactylus pentadactylus* calls. The trap was originally intended to attract *Corethrella* flies.

These observations suggest that adult *C. crocodilus* use advertisement calls of frogs to locate their prey. Further, they seem to selectively approach terrestrial frogs large enough to offer a substantial meal (e.g., *L. pentadactylus* and *B. marinus*). Studies that further investigate caiman prey selectivity based on advertisement calls of frogs are necessary to confirm this observation. Crocodilians other than Spectacled Caimans are known to feed on frogs and toads (*Crocodylus acutus*: Savage, *op. cit.*; *Crocodylus moreleti*: Perez-Higareda et al. 1989. Copeia 1989:1039–1041). For instance, Morelet's Crocodiles have a diverse diet that includes *B. marinus* and *Rana vaillanti* (Perez-Higareda et al., *op. cit.*). Hence, use of prey-emitted cues by crocodilians that feed heavily on anurans deserves exploration.

These observations were possible thanks to the support of the Smithsonian Tropical Research Institute (STRI) through a fellowship conducted to study *Corethrella* flies in the same area. I thank Bill Wcislo for his support as STRI sponsor and Mike Ryan for referring me to the study done by Kate LeVering. Marc Hayes provided valuable comments that improved this manuscript.

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LACERTILIA

ANOLIS ALLISONI (Allison's Anole/Camaleón Azul). **NECTAR FEEDING**. As recently as the ecological review in Schwartz and Henderson (1991. Amphibians and Reptiles of the West Indies: Descriptions, Distribution, and Natural History. University of Florida Press, Gainesville. 720 pp.), nectarivory among anole lizards remained undocumented. Yet, over the last decade, more attention has been paid to lizard behavior when they are near flowers, resulting in scattered evidence for polychrotid lizards feeding on nectar and/or pollen (e.g., *Anolis carolinensis*: Bartlett 1995. Reptiles 2:48–65; Himes 1998. Herpetol. Rev. 29:236; Campbell and Bleazy 2000. Herpetol. Rev. 31:239; *A. conspersus*: Echternacht et al. 2000. Herpetol. Rev. 31:173; *A. grahami*: Losos and Queiroz 1997. Natural History 108:34–39; *A. porcatus*: Townsend 2003. Herpetol. Rev. 34:141–142; and *A. stratulus*: Perry and Lazell 1997. Herpetol. Rev 28:150–151). Cuban anoles may seem an exception to this pattern, but the many dietary studies on Cuban anoles, based almost entirely on stomach contents analyses (e.g., review in Rodríguez-Schettino 1999. The Iguanid Lizards of Cuba. University of Florida Press, Gainesville. 384 pp.) rather than behavioral observations, have provided little opportunity to record nectarivory. However, two anoles native to Cuba have been identified as nectar feeders in Florida: *A. porcatus* (an introduced species) on the ornamental Areca Palm (*Chyrsalipedocarpus lutescens*; Townsend, *op. cit.*), and the native *A. carolinensis* on two native palms: *Serenoa repens* and *Sabal palmetto* (Campbell and Bleazy, *op. cit.*). For this reason, I document nectarivory in *A. allisoni* in Cuba.

Between 0830 and 0930 h on 17 June 2003, I observed several females and juveniles of *A. allisoni* lapping nectar from the flowers of the ornamental palm 'Adonidia' (*Veitchia merrillii*, Arecaceae) in a garden in the Balcón de la Sierra (Bartolomé Masó). This palm is native to the Philippines but is common in Cuba (Leiva 1999. Las Palmas en Cuba. Ed. Científica-Técnica. La Habana, Cuba. 84 pp.). In this garden, *A. allisoni* is relatively abundant, and the species is often seen (often 3–4 on the same trunk) climbing these palms at heights < 2 m. On 10 occasions, females and juveniles were observed visiting flowers for nectar. Although several males were present in different palms at similar heights as females and juveniles, I never observed them visiting flowers during this period. My observation is similar to behavioral data obtained in captivity, where juveniles of different Cuban anoles have been observed feeding on nectar directly from flowers (L.V. Moreno, pers. comm.). In this garden, flowers of *V. merrillii* were also frequently visited by honeybees, but I did not observe aggressive interactions between lizards and bees, although on one occasion, a juvenile *A. allisoni* left when a honeybee arrived at the same flower. Remaining lizard-plant interactions occurred without *Apis mellifera* presence.

An insectivorous diet has been reported for *A. allisoni*, both in island (Cuba) (Rodríguez-Schettino, *op. cit.*) and mainland (Mexico) situations (Lee 1996. The Amphibians and Reptiles of the Yucatan Peninsula. Comstock Publ. Assoc., Ithaca, New York. 500 pp.). This observation documents a new example of lizard nectar feeding in island habitats, where this phenomenon has been observed relatively more frequently than in mainland situations (Olesen and Valido 2003. Trends Ecol. Evol. 18:177–181), and where lizards have the potential to act as pollinators. Lizard pollination of plants has been experimentally demonstrated in but a few cases (e.g., the lacertid *Podarcis lilfordi* from the Balearic Islands [Traveset and Sáez 1997. Oecologia 111:241–248; Pérez-Mellado and Casas 1997. Copeia 1997:593–595], and the scincid *Niveocincus microlepidotus* in Tasmania [Olsson et al. 2000. Biol. J. Linn. Soc 71:191–202]), but together with scattered indirect evidence from New Zealand (Whittaker 1987. New Zealand J. Bot. 25:315–328; Eifler 1995. Oecologia 101:228–233), Mauritius (Nyhagen et al. 2001. J. Trop. Ecol. 17:755–761), the Canary Islands (Fong and Ferrer 1995. Herpetol. Rev. 26:35–36; Valido et al. 2002 Acta Oecologica 23:413–419), New Caledonia (Bauer and Sadlier 2000. The Herpetofauna of New Caledonia. SSAR Publications, Ithaca, New York. 310 pp.), and the Seychelles (Cheke 1984. *In* Stoddart [ed.], Biogeography and Ecology of the Seychelles Islands, pp. 331–360. W. Junk Publishers, The Hague), these observations imply that greater attention should be paid to the possibility of lizard pollination (Proctor et al. 1996. The Natural History of Pollination. Harper Collins, London. 479 pp.).

Here, I reported nectarivory by a Cuban anole on an exotic palm. However, if we consider the abundance of palms in Cuba (about 80 native species; Leiva, *op. cit.*) along with the ability of *Anolis* to exploit nectar from palm flowers and hummingbird feeders (*A. carolinensis*: Liner 1996. Herpetol. Rev. 27:78), or bottles of honey left open in houses in Cuba (*A. porcatus*: A. Fong., pers. comm.), interactions between anoles and native palms that involve nectarivory and perhaps pollination should be expected.

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ANOLIS SAGREI (Cuban Brown Anole). **PREDATION**. Native to Cuba and the Bahamas, *Anolis sagrei* was first observed in the Florida Keys in the 1880s, and by the 1970s had spread across Florida (Meshaka et al. 2004. The Exotic Amphibians and Reptiles of Florida. Krieger Publishing, Malabar, Florida. 155 pp.). *Anolis sagrei* seems to flourish in disturbed habitats but can inhabit nearly any habitat in Florida (Campbell 2003. Herpetol. Rev. 34:173–174). Little is known of the ecology of its introduced populations, but indigenous predators may have a controlling effect. Here we report the first observation of a Red-shouldered Hawk (*Buteo lineatus*) preying on *A. sagrei.*

At ca. 1400 h on 7 May 2006, we observed an adult *B. lineatus* capture and eat an adult (ca. 14 cm total length) *A. sagrei*. Our observation was made in an old-growth cypress (*Taxodium distichum*) strand on the edge of a small (ca. 10 × 10 m) pool, located near the end of the Big Cypress bend boardwalk (25°56'49"N, 81°28'9"W, datum NAD 83: elev. 2 m) in Fakahatchee Strand State Park. We initially saw the hawk in flight, then it perched ca. 3 m above the ground on a *T. distichum* branch. It remained in this position for ca. 15 min, then flew down to the ground and seized the body of the *A. sagrei* with its talons. The *A. sagrei* was quickly consumed whole and the hawk flew to another perch and preened its talons and flight feathers. From capture to ingestion, the episode took ca. 50 sec.

Prior to this observation, the Broad-winged Hawk (*Buteo platypterus*) was the only other raptor reported to prey on *A. sagrei* in Florida (Meshaka et al., *op. cit.*). *Buteo lineatus* forages both above and below the canopy, searching for prey from the air or a perch (Stevenson and Anderson 1994. The Birdlife of Florida. University Press of Florida, Gainesville, Florida. 892 pp.). The wide variety of prey items in the diet of *B. lineatus* indicates that it is not a prey specialist (Stevenson and Anderson, *op. cit.*; Bednarz and Dinsmore 1985. Can. Field Nat. 99:262–264). The diet may change seasonally in relation to food availability, but mammals, lizards, and amphibians are the most common categories of prey items delivered to nests (Bednarz and Dinsmore, *op. cit.*). We commonly found *B. lineatus* perched on branches in old-growth cypress strand, a kind of diurnal perch at which individuals are cryptic. In Florida, A. *sagrei* perches in trees and shrubs but is most often found close to, or directly on, the ground (Meshaka et al., *op. cit.*) and will escape by running along the ground, perhaps in part because the primary predator avoidance behavior is avoiding a predator's visual field (Regalado 1998. Carib. J. Sci. 34:211–217). The use of uncovered microhabitat by *A. sagrei* increases its likelihood of predation by this Florida raptor.

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ARTHROSAURA RETICULATA (Reticulated Creek Lizard). **PREDATION.** The Amazon Fishing Spider (*Ancylometes rufus*, Pisauridae) is an opportunistic predator of small vertebrates (e.g., fishes, frogs, and tadpoles; Azevedo and Smith 2004. *In* Borges et al. [eds.], Janelas para Biodiversidade no Parque Nacional do Jaú, pp. 135–142. Fundação Vitória Amazônica, Manaus; Menin et al. 2005. Phyllomedusa 4:39–47). Here, we present the first report of *A. rufus* preying on the gymnophthalmid lizard *Arthrosaura reticulata*.

The observation occurred at 1430 h on 12 December 2002 at Reserve Adolpho Ducke, in the municipality of Manaus, State of Amazonas, Brazil (02°54'S, 59°53'W, datum: WGS 84; elev. 78 m). We encountered an adult male *A. rufus* (32.9 mm TL) in terra-firme forest, motionless and camouflaged in the leaf-litter, capturing a young male *A. reticulata* (37.8 mm SVL) that passed nearby. The spider secured the body of the lizard with its chelicerae, whereupon the lizard immediately autotomized its tail. While we attempted to collect the spider, it released the lizard. The lizard survived, remaining motionless, for ca. 4 min before succumbing to the effects of the spider's venom. These two species occur in similar habitats near bodies of water (Avila-Pires 1995. Zool. Verh. Leider. 299:1–706; Höfer and Brescovit 2000. Insect Syst. Evol. 31:323–360), which may facilitate this occasional intraguild predation.

The *A. reticulata* (INPA-H 16058) and the *A. rufus* were deposited in the herpetological and invertebrate collections, respectively, of the Instituto Nacional de Pesquisas da Amazônia. T. R. Gasnier verified the identity of the *A. rufus*.

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ASPIDOSCELIS LINEATISSIMUS (Colima Whiptail Lizard). **PREDATION.** *Aspidoscelis lineatissimus* inhabits Tropical Dry Forest in Pacific Mexico from Nayarit to Guerrero (García and Ceballos 1994. Fundación Ecológica de Cuixmala-Instituto de de Biología UNAM, México; Smith and Taylor 1950. Bull. U.S. Natl. Mus. 199:1–253). The Mexican government regards this species as requiring special protection, a criterion established under the authority of the Secretaria de Recursos Naturales y Medio Ambiente (NOM-SEMARNAT-059-2001). Several investigators have studied *A. lineatissimus* (Walter 1970. Herpetologica 26:359–365; Ramirez-Bautista and Uribe-Peña 1989. Herpetol. Rev. 20:70; Ramirez-Bautista 1994. Manual y Claves Ilustradas de los Anfibios y Reptiles de la Region de Chamela, Jalisco. Tesis Doctoral, Facultad de Ciencias, Universidad Nacional Autonoma de México; Ramirez-Bautista et al. 2000. Copeia 2000:712–722), but data on predators are lacking. Hence, we report an observation of *Salvadora mexicana* predation on *A. lineatissimus* from coastal Jalisco, México.

During a herpetofaunal survey on 16 October 2004, we photographed an adult (85 cm SVL) male *S. mexicana* consuming an adult (ca. 16 cm SVL) male *A. lineatissimus* in the municipality of La Huerta, 65 km N of Barra de Navidad (19°31'24.2"N, 105°02'11.7"W, datum: NAD 27; elev. 47 m). The snake was not collected. SG made the observation near the margin of the Chamela River; dominant riparian vegetation included *Crescentia alata*, *Astianthus viminalis*, *Tabebuia chrysantha*, *Coccoloba* sp., *Lonchocarpus* sp., and *Thouinidium decandrum*. Tropical Decidu-

ous Forest dominates upland vegetation in the area (Lott 2002. *In* Noguera et al. [eds.], Historia Natural de Chamela, pp. 99–136. Instituto de Biología, Universidad Nacional Autonoma de Mexico, Ciudad de Mexico; Raymundo Ramírez-Delgadillo, pers. comm.). When first observed, the snake had already begun feeding on the lizard, which was being ingested headfirst. When about 40% of the lizard had been ingested, the snake released the lizard, presumably to better reposition it to continue swallowing. Ultimately, the snake swallowed the lizard; the feeding sequence we were able to observe took ca. 25 min.

Salvadora mexicana, which occurs in several vegetation associations along the Pacific Coast of Mexico from Nayarit to Oaxaca (Garcia and Ceballos, *op. cit.*), has a diet that is incompletely understood, but Bogert (1939. Publ. Univ. California Los Angeles Biol. Sci. 1:177–236) reported that a *S. mexicana* secured by Walter Mosauer at Tierra Colorada (Guerrero) had eaten an adult *Cnemidophorus* (= *Aspidoscelis*) *guttatus*. Moreover, other species of *Salvadora* are known to eat whiptails and racerunners (Coues 1875. Rept. Geog. Geol. Expl. Surv. West 100th Meridian 5:585-633; Bogert, *op. cit.*), which likely reflects a pattern in the genus.

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CALEDONISCINCUS HAPLORHINUS (Strand Litter Skink). **PREDATION.** *Caledoniscincus haplorhinus* is a small skink endemic to New Caledonia that has been reported primarily from the southwest coast from Nouméa to Pindaï and Pouembout with scattered records further north. Records on the east coast are few, but this probably reflects a lack of collecting effort in the appropriate habitat in this area. This skink occurs also on most islands in the region including Ouvéa, Maré, and Lifou in the Loyalties, and on Île Surprise and the Belep Islands off the northern end of New Caledonia. It seems absent from Île Huon, the northernmost part of New Caledonia territory and from the Isle of Pines (Bauer and Sadlier 2000. The Herpetofauna of New Caledonia. Society for the Study of Amphibians and Reptiles in cooperation with the Institut de Recherche pour le Développement. 310 pp.). No data exist on its predators (Bauer and Sadlier, *op. cit.*), although other large skinks (e.g., *Lioscincus nigrofasciolatum* and *Phoboscincus garnieri*, both likely syntopic with *C. haplorhinus*) are anticipated predators. Here we report a case of predation on *C. haplorhinus* by an avian predator.

At ca. 1000 h on 28 November 2005, RLG observed and photographed an adult *Todiramphus sanctus canacorum* (Sacred Kingfisher) carrying an adult (ca. 45 mm SVL) *C. haplorhinus* in his bill (Fig. 1). This bird species was regularly seen bringing skinks to feed its chicks in a nest located in the lower part of a dead Coconut Tree (*Cocos nucifera*) along the beach. The observations took place on Islet Beautemps-Beaupré (20°24'35"S, 166°08'30"E, datum: WGS 84; elev. 5 m).

FIG. 1. Sacred Kingfisher carrying an adult *Caledoniscincus haplorhinus*.

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CNEMASPIS KENDALLII (Kendall's Rock Gecko). **PREDATION**. Myrmecophagy, consumption of ants as prey, is a common nutritional strategy among amphibians and reptiles (e.g., poison dart frogs—Caldwell 1996. J. Zool. [London] 240:75–101; desert horned lizards—Blackshear and Richerson 1999. Texas J. Sci. 51:147–152). The reverse strategy, ants actively preying on living amphibians and reptiles rather than just scavenging on their remains, is something for which we have found no evidence in the literature. We have heard anecdotes according to which groups of foraging ants, including army ants as well as other species, opportunistically attacked small frogs and lizards, and even hatching tortoises (*Testudo graeca*; Y. Werner, pers. comm.). However, to the best of our knowledge predation by a solitary ant on an amphibian or reptile has never been reported in the literature. This is not surprising since, ordinarily, amphibians and reptiles outsize

ants. However, size may not limit predation by ants on lizards where giant ants exist. For this reason, we report an observation of predation by a giant ant on a gecko from Peninsular Malaysia. At ca. 1500 h on 24 July 2003, during a visual survey for reptiles and amphibians in lowland dipterocarp forest (Grismer et al. 2004. Asiatic Herpetol. Res. 10:244–276) along the Tekek-Juara Trail on Pulau Tioman, Pahang State (2°49'N, 104°10'E; elev. 125 m) a solitary individual of the Malaysian Giant Forest Ant (*Camponotus gigas*) was observed carrying an unusually large prey item in its mandibles. This species is one of the world's largest ants, reaching nearly 3 cm total body length. It is known to engage in ritual combat (Pfeiffer and Linsenmair 2001. J. Ethol. 19:75–85), and procurement of sizeable prey items is not unusual for an aggressive species such as this. Close examination of the relatively fresh, partially digested, fleshy mass revealed the prey item to be a small individual of the saxicolous gecko *Cnemaspis kendallii* (specimen collected and its identity verified by L. Lee Grismer). During our herpetological survey work in the rainforest of Pulau Tioman, we have frequently observed individuals of *C. gigas* crisscrossing the leaf litter, either as a means of surveying an area surrounding a colony or on solitary foraging excursions. During such forays, these ants cover some of the habitat used as hiding places by *C. kendallii*. We presume that the gecko captured by this ant fell victim to a chance encounter, since ordinarily a gecko would easily outrun an ant. However, a small *C. kendallii* would probably not be able to outwrestle the powerful mandibles of these ants.

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COPHOSAURUS TEXANUS (Greater Earless Lizard). **MORTALITY**. Prey selection among lizards involves decisions made during pursuit and capture that have positive consequences when food is acquired but potentially negative consequences if the intended prey presents injury-producing or life-threatening antipredator defenses (Sherbrooke 2002. Herpetol. Rev. 33:312). Hence, we document the death of a *Cophosaurus texanus* that may be the result of ingested prey.

At 1206 h on 15 May 2005 near the Indio Mountains Research Station headquarters 40 km SW of Van Horn, Hudspeth Co., Texas, USA (30°46'35"N, 105°00'55"W, datum: WGS 84; elev. 1215 m), we observed a gravid female *C. texanus* (65 mm SVL, 33 mm tail, partly regenerated) moving erratically on the floor of an arroyo within a Chihuahuan Desert scrub habitat. Despite our approach, the lizard never attempted to flee. Failure to flee was also peculiar because it was exposed to elevated midday air temperatures in full sun; ambient air temperature was estimated to be ca. 35°C, and substrate temperature undoubtedly greater. Such conditions would normally have compelled the lizard to flee a potential predator (our presence) or to find a shaded refuge. Instead, when the lizard made forward movements, which occurred several times during our observation, it would pause, close its eyes, and then slowly shift its head from side to side. The lizard died after 14 min of

FIG. 1. Female *Cophosaurus texanus* and two honeybees (*Apis mellifera*) removed from the contents of its stomach. The honeybee on the left is shown for comparison.

displaying that behavior fully exposed to unshielded sunlight. External inspection of the lizard revealed no signs of injuries, trauma to the skin, or subcutaneous bleeding, so we assumed that its death was probably not the result of predator attack.

Necropsy confirmed lack of physical trauma to the lizard, and inspection of its stomach revealed that it had recently fed on the following undigested insect prey: one ant (Formicidae), one beetle (Coleoptera), two termites (Isoptera), two bugs (Rophalidae), one mantis (Mantidae), two sweat bees (Halictidae) and two worker honeybees (Apidae: *Apis mellifera*; Fig. 1). Prior investigations of *C. texanus* diet (Barbault 1978. La Terre et la Vie. 32:135–150; Barbault and Maury 1981. Oecologia 51:335–342; Maury 1981. *In* Barbault and Halffter [eds.], Ecology of the Chihuahuan Desert: Organization of Some Vertebrate Communities, pp. 119–142. Publ. Instituto de Ecología, Mexico; Smith et al. 1987. Great Basin Nat. 47:175–185; Maury 1995. J. Herpetol. 29:266–272; Kasson 2001. Herpetol. Rev. 32:40) have not reported honeybees. Moreover, we initially noticed that both bee stingers were detached from their bodies, which would be the case if envenomation had occurred in a normal defensive manner (Caron 1999. Honey Bee Biology and Beekeeping. Wicwas Press, Cheshire, Connecticut. 355 pp.). One stinger was later found imbedded in the mouth lining and the other in the stomach. Hence, our observation suggests that the lizard died after being stung subsequent to ingesting the two honeybees. Whether death was directly caused by venom toxicity or alternatively by the lizard becoming disoriented and behaviorally incapacitated by the toxin, which eventually led to a fatal state of overheating, is not known.

Both the preserved lizard and its stomach contents were deposited in the Laboratory for Environmental Biology, Centennial Museum, The University of Texas at El Paso (UTEP 19226). We thank Paul Lenhart for prey item identification.

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***ENYALIUS* SP.** (NCN). **PREDATION.** Species of *Enyalius* usually use a combination of cryptic coloration and immobility to avoid predation (Pianka and Vitt 2003. Lizards: Windows to the Evolution of Diversity. University of California Press, Berkeley. 333 pp.). However, herein we describe the first predation records on an undescribed species of *Enyalius* from Brazilian cerrado by a Black-tufted-ear Marmoset (*Callithrix penicillata*).

Observations occurred on 21 September and 4 October 2005 at Jardim Botânico de Brasília, Distrito Federal, Brazil (15°51'38.15"S, 47°49'51.20"W, datum: WGS 84; elev. 1127 m), in an area of mesotrophic "cerradão" forest. In the first observation, the dominant female of a *C. penicillata* group was first observed at a height of ca. 1 m eating an *Enyalius* sp. by the head; the latter appeared to be a female based on the dorsal color pattern of paravertebral stripes. The marmoset continued eating the rest of the body while her two infants produced begging calls and attempted to reach the lizard without success. The predation event was observed for 47 min, with the female marmoset being constantly interrupted by her group mates' harassment.

In a second observation, the same dominant female was again sighted at a height of ca. 1 m eating another *Enyalius* sp. by the head. In this case, the dorsal color pattern, consisting of lozenges, did not allow sex identification. After a few attempts one of the subordinate females stole the lizard from the dominant animal, and was able to eat the remaining parts of the body, which included the hind limbs and tail. Both marmosets were observed eating the lizard for a total time of ca. 35 min.

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HEMIDACTYLUS TURCICUS (Mediterranean Gecko). **DIURNAL BURROWS; REFUGIA.** *Hemidactylus turcicus*, an introduced species found throughout the southeastern United States (Conant and Collins. 1998. Reptiles and Amphibians of Eastern/Central North America. 3rd ed., Houghton Mifflin Co., Boston, Massachusetts. 450 pp.), typically is associated with buildings and other human structures (Rose and Barbour 1968. Am. Midl. Nat. 79:159–168; Dundee and Rossman 1989. Amphibians and Reptiles of Louisiana. Louisiana State University Press, Baton Rouge. 295 pp.). Known for its arboreal habits with adults foraging higher on walls than juveniles (Gomez-Zlatar and Moulton 2005. Florida Sci. 68:206–214; Paulissen and Buchanan 1991. J. Arkansas Acad. Sci. 45:81–83), information on its terrestrial behavior is limited. Hence, we describe an observation of a group of *H. turcicus* occupying a rock pile in the Liberty Eylau region of Texarkana (33°20.066'N, 94°05.189'W, datum: NAD 27; elev. 162 m), Bowie Co., Texas, USA.

At ca. 1600 h on 3 May 2006, we were moving a large pile of flagstone located in a overgrown rock garden on a 2-ha field situated in a rural-urban interface. Immediately to the south are ca. 518 ha of grazed grassland and forest abutting the Sulfur River. Immediately to the north is a residential area composed of lots from 0.1 to 1.21 ha. The rocks were scattered no more than four stones deep and located ca. 25 m from the nearest building. The pile encompassed an area of ca. 5 × 3 m and was overgrown with native and introduced vegetation including Day Lilies (*Hemerocallis* sp.), Evening Primrose (*Oenothera lamarckiana*), Pink Wood Sorrel (*Oxalis regneli*), and various grasses.

The rocks were removed one at a time and piled into a cart. The first *H. turcicus* was observed under a large (ca. 1 m) diameter flagstone stacked on top of several smaller (ca. 30 cm) flagstones. We continued to remove stones and observed four more *H. turcicus* prior to removing all but the rocks in direct contact with the ground. Of the 12 similarly sized rocks (ca. 30 cm each) located on the ground, three harbored *H. turcicus* in what appeared to be burrows. All *H. turcicus* appeared to be adults (ca. 50–60 mm SVL). The first burrow was linear and tube-shaped (139 mm × 20 mm) with an entrance positioned at the edge of the flagstone, under which the burrow was located. The second burrow was also tube-shaped but had a 90° bend located 100 mm from the entrance (also positioned at the edge of the respective piece of flagstone) creating an L-shaped tube (131 mm × 17.2 mm). In both burrows, the rock formed the burrow roof under which it was constructed. The sides and base of the burrows were composed of a sandy loam typical of Bowie Co. A third *H. turcicus* was observed in a refugium under a rock, but this refugium did not have the tube structure of the other burrows. This third refugium was dish-shaped and ca. 60 mm in diameter. It was unclear whether this structure was a burrow or simply a space that the *H. turcicus* chose to occupy. Upon removal of the rocks, no *H. turcicus* were observed in the immediate vicinity of the original rock garden where they were released or in the cart where the rocks had been deposited through 11 May 2006. This final observation suggests these animals abandon their burrows if disturbed.

This cluster of observations suggests that *H. turcicus* is not restricted to buildings, and may even be more abundant in other kinds of habitats near human dwellings. These observations suggest that positioning rock gardens near homes can provide important habitat for this species. Further, removal of or aversion to providing such potential habitat may be an important tool for removal or suppression of populations of this introduced invasive species.

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HEMIDACTYLUS TURCICUS (Mediterranean Gecko). **PREY; PREDATION.** Invasive species are becoming an increasingly important consideration for conservation, but how invasive species interact with one another remains poorly understood. We contribute to that understanding with an observation of *Hemidactylus turcicus* predation on the Red Fire Ant (*Solenopsis invicta*) immediately followed by fire ant predation on the same animal.

Hemidactylus turcicus is a small insectivorous gecko widely distributed by human activities (Wojcik et al. 2001. Am. Entomol. 47:16–23), common throughout the mid-southern United States. The Red Fire Ant, the most widely distributed of two *Solenopsis* species introduced in the United States (http://ipmworld.umn.edu/chapters/lockley.htm, last visited on 11 May 2006), is thought to

be in competition with the regional herpetofauna for various prey (Wojcik et al., *op. cit.*; Hook and Porter 1990. Southwest. Nat. 35:477–478). Documentation also exists for *S. invicta* predation on snakes (Wojcik et al., *op. cit.*), *Bufo houstonensis* (Wojcik et al., *op. cit.*), turtles (Buhlmann and Coffman 2001. J. Elisha Mitchell Sci. Soc. 117:94–100; Moulis 1997. Chelonian Conserv. Biol. 2:433–436; Montgomery 1996. Bull. Chicago Herpetol. Soc. 31:105–106), *Aspidoscelis sexlineatus* nests (Mount et al. 1981. J. Alabama Acad. Sci. 52:66–70; Donaldson et al. 1994. Texas J. Sci. 46:98–113), and large segments of a local herpetofauna (Mount 1981. J. Alabama Acad. Sci. 52:71–78). Aggression by *S. invicta* has also been reported on *Alligator mississippiensis* (Allen et al. 1997. J. Herpetol. 31:318–321; Reagan et al. 2000. J Herpetol. 34:475–478), *Caretta caretta* (Allen et al. 2001. Florida Entomol. 84:250–253), and *Gopherus polyphemus* (Wetterer and Moore 2005. Florida Entomol. 88:349–354). These observations indicate that *S. invicta* can be an aggressive herpetovore.

At ca. 2300 h on 2 August 2005, a juvenile (ca. 30 mm SVL) *H. turcicus* was foraging on fire ants on our back porch (33°20.066'N, 94°05.189'W, datum: NAD 27, elev. 162 m) in Bowie Co., Texas, USA. I observed the animal feed on 6–7 ants and then left. Upon returning 20 min later, I found the animal engulfed in ants. By 0750 h the next morning, the *H. turcicus* was skeletonized. I collected the skull (length 12.2 mm, width 7.8 mm, height 4.9 mm) and deposited it in my private research/teaching collection (MLM 1).

This observation suggests that interspecific predator-prey dynamics exist between sympatric populations of *H. turcicus* and *S. invicta*.

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HOLBROOKIA MACULATA (Earless Lizard). **NECROPHILIA.** To our knowledge, reports of mating or attempted mating with a dead conspecific or heterospecific individual among squamates are confined to only three species: the Australian skink, *Tiliqua rugosa* (How and Bull 1998. Herpetol. Rev. 29:240), the Brazilian snake, *Tachymenis brasiliensis* (Amaral 1932. Mem. Int. Butantan 7:91–94), and the Long-nosed Leopard Lizard, *Gambelia wislizenii* (Fallahpour 2005. Herpetol. Rev. 36:177–178). Here, we report an observation of this behavior in *Holbrookia maculata* from northwest Texas, USA.

A large population of *H. maculata* exists on the edges of the roads in Rita Blanca National Grassland in extreme northern Texas. We studied this population while conducting research on the thermal regimes of this and several other lizard species of similar size. We recorded surface temperatures on the roads as high as 46°C, while surface temperatures of the bordering grasses were 27°C. These conditions offer a wide thermal gradient in which to function, an advantage that may attract this *H. maculata* population to the road margins.

On 14 June 2005 at 1730 h, a male *H. maculata* living along State Highway 296 (36°26.831'N, 102°44.454'W, datum: WGS 84; elev. 1307 m) was observed copulating with a dead conspecific female. The female had been spotted the previous day dead on the side of the road. Apparently, she had been partially run over by a car on 13 June, although her injuries were not extensive and her body, although moderately desiccated, was still intact. Her eyes were sunken and she was unequivocally dead. The male was observed grasping the female by the back of the neck and dragging her in short 1–2 cm jerks across the asphalt. His tail was raised and his right hemipenis appeared to be everted, although it was not clear if copulation was actually successful. This behavior persisted for at least 3–4 minutes but ceased when the researchers approached. A second male *H. maculata* was sighted ca. 0.5 m away. The second male appeared to be observing the attempted copulation and possibly had mated or was waiting to mate with the deceased female.

H. maculata breed in the spring and produce 1–2 clutches per season, depending on the age of the female (Jones and Ballinger 1987. Ecology 68:1828–1838). During the breeding season, females vary their coloration to signal courtship receptiveness or rejection, having low-intensity color early in the season and high-intensity pigmentation late in the season once they have mated (Hager 2001. J. Herpetol. 35:624–632). The behavior reported here implies that the coloration of this immobile female was adequate to induce attempted copulation.

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LIOLAEMUS cf. ELONGATUS (NCN). **BODY TEMPERATURE.** *Liolaemus cf. elongatus* inhabits the east slope of the Andean Cordillera in central-western Argentina (Morando et al. 2003. Syst. Biol. 52:159–185). Based on molecular evidence, this taxon, for which formal description is pending, is part of the "*petrophilus* group" clade within the *Liolaemus elongatus-kriegi* complex (Avila et al. 2004. Herpetologica 60:187–203). Its biology has not been addressed. Hence, here we present preliminary data on *L. cf. elongatus* thermal ecology.

In December 2004 and February 2005, we conducted field work in the Parque Nacional San Guillermo, Departamento Iglesia, Provincia de San Juan (29°15'S, 69°29'W, datum: WGS 84; elev. 3700 m), located in the Puna Phytogeographic Province. *Stipa speciosa var. breviglumis, Lyciun chanar,* and *Adesmia* spp. dominate the largely Andean flora (Cabrera and Willink 1980. Biogeografía de América Latina. Washington, D.C. 109 pp.). The data presented are based on 16 captures. To collect these data, we revisited a randomized selection of bushes and low rocks across the study site. Each individual was captured by hand, and its SVL was measured to the nearest 0.05 mm. Sex was not determined in the field because obvious sexual dimorphism was lacking. For each capture, cloacal (T_c), substrate (T_s) and air (T_a) temperatures were measured to nearest 0.1°C with a rapid-reading Miller-Weber thermometer. We took T_s at the exact point of observation, and T_a 1 cm above the substrate, both immediately following capture. We also recorded microhabitat type for each capture.

Of 26 individuals observed, 16 were captured. Mean SVL was 59.8 mm (SD = 9.5, range: 41–72, N = 15). Mean body temperature of the 16 *L. cf elongatus* was 32.0°C (SD = 2.5°C, range = 28.0–36.6°C). Mean air temperature was 29.3°C (SD = 5.6°C, range = 21.0–41.6°C). Mean substrate temperature was 35.4°C

(SD = 11.1°C, range: 22.0–57.0°C). Body size was unrelated to T_c (Spearman Rank Correlation: r_s = -0.05, P = 0.84, N = 15). Cloacal temperature and T_a were significantly correlated (Spearman Rank correlation: r_s = 0.69, P = 0.002), but T_c and T_s were not (Spearman Rank correlation: r_s = 0.43, P = 0.09). Most lizards were found on rocks (N = 16), the remainder being found under vegetation (7), on vegetation (2) or in burrows (1).

Based on the correlations among T_c, T_s, and T_a, *Liolaemus cf elongatus* seems heliothermic, similar to *L. wiegmanni* (Martori et al. 1998. Rev. Esp. Herpetol. 12:19–26) and *L. sanjuanensis* (Acosta et al. 2004. Herpetol. Rev. 35:171). In contrast, body temperature in *Liolaemus elongatus* was positively and significantly correlated with both T_a and T_s (Ibargüengoytía and Cussac 2002. Herpetol. J. 12:131–134). This species thermoregulates over a narrow range of temperature by moving among microhabitats having different temperature, i.e., basking and shuttling behavior.

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LIOLAEMUS LUTZAE (Sand Lizard). **PREDATION**. The liolaemid lizard *Liolaemus lutzae* is endemic to the "restingas" (coastal sand dune habitats) of the State of Rio de Janeiro, southeastern Brazil (Vanzolini and Ab'Saber 1968. Pap. Avuls. Zool. São Paulo 21:205–208) and is included in the Brazilian checklist of the fauna threatened with extinction as critically endangered (Machado et al. 2005. Lista da Fauna Brasileira Ameaçada de Extinção. Fundação Biodiversitas, Belo Horizonte. 157 pp.). Information regarding *L. lutzae* predators is restricted to a few records of interspecific predation (e.g., the birds *Guira guira* and *Athene cunicularia* and the ghost crab *Ocypode quadrata*) and cannibalism (Rocha 1992. Herpetol. Rev. 23:60; Rocha and Vrcibradic 1998. Cienc. Cult. 50:364–368). Here we report predation of *L. lutzae* by the snake *Philodryas patagoniensis* (Colubridae). This snake is very common in restinga habitats and is known to prey on lizards in this environment (Rocha and Vrcibradic, *op. cit.*).

At 1035 h on 23 April 2006, during population monitoring of *L. lutzae* on the sand beach habitat at the restinga of Jaconé (22°56'S, 42°40'W, datum: WGS 84; elev. 2 m), municipality of Saquarema, Rio de Janeiro, we found, under a piece of wood, a young female *P. patagoniensis* (267 mm SVL, 371 mm total length, 15.2 g) with a considerably expanded abdomen, suggesting recent prey ingestion. At the same place there was a live *Liolaemus lutzae,* which promptly escaped. We collected the snake, and posterior dissection revealed that it had ingested a juvenile male *L. lutzae* (54.5 mm SVL, 5.2 g) headfirst. The lizard was undigested, implying a recent ingestion. This is the first record of *L. lutzae* as prey of *P. patagoniensis*, which constitutes an additional source of mortality for this endangered lizard.

The snake and its prey were deposited at the reptile collection of the Museu Nacional do Rio de Janeiro, Universidade Federal do Rio de Janeiro (MNRJ 14122). Mara C. Kiefer and Davor Vrcibradic provided suggestions on the manuscript. Fundação Biodiversitas/CEPAN (Project 078H/022004) and CNPq provided funding (Processes # 307653/03 and 477981/03), and CCS received a graduate fellowship from FAPERJ.

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LIOLAEMUS OLONGASTA (NCN). **REPRODUCTION.** *Liolaemus olongasta* is an oviparous lizard inhabiting the hot arid landscape of the Monte Phytogeographic Province in northern Argentina (Cabrera and Willink 1980. Biogeografía de América Latina. Washington, DC. 109 pp.). Known from extreme western La Rioja Province and San Juan Province at 900–1600 m elevation (Etheridge 1993. Museo Regionale di Scienze Naturali 11:1–199), data on its biology are sparse. Limited study has been devoted to thermoregulation, sexual dimorphism, and time budgets (Cánovas et al. 2001. Congreso Argentina Herpetol. IV:32–33; Cánovas et al. 2002. Reunión de Com. Herpetol. Asoc. Herpetol. Argentina XVI:45; Cánovas et al. 2003. Reunión de Com. Herpetol. Asoc. Herpetol. Argentina. XVII:38). Hence, we add the first data addressing *L. olongasta* reproductive ecology.

We conducted fieldwork in a temporary creekbed near La Laja (31°19'S, 68°41'W, datum: WGS 84; elev. 700 m) Albardón Department, San Juan Province, Argentina. Data were collected every 10 days from August 2000 to August 2001 by a random pattern of revisits across the study site. Each animal was measured (SVL) and dissected for gonadal examination. In females, we recorded the number of developing follicles and oviductal eggs, the length and width of oviductal eggs, and the condition of the oviducts. In males, we recorded the width and length of testes to enable calculation of volume based on Dunham (1983. *In* Huey et al. [eds.], Lizard Ecology, pp. 261–280. Harvard Univ. Press, Cambridge, Massachusetts). Testicular volume and volume of eggs were natural log-transformed to accommodate their curvilinear functions (King 2000. J. Herpetol. 34:148–150.). Clutch size was determined from the combined number of developing follicles and eggs in the oviducts. We used the simultaneous presence of developing follicles and enlarged oviducts to suggest that more than one clutch was produced seasonally. The smallest female with vitellogenic follicles or oviductal eggs was used to estimate SVL at maturity. Males were considered sexually mature if they contained enlarged epididymides. All measurements were obtained to the nearest 0.02 mm with Vernier calipers.

Forty-three females ranged in size from 23–58 mm SVL; minimum reproductive size was 47 mm. Female body size was correlated with clutch size (Spearman: r_s = 0.64, P = 0.045, N = 10). Clutch size averaged 3.8 (SD = 1.93, range 1–8, N = 10). Between September and October, we recorded four females with developing follicles and enlarged oviducts simultaneously.

Forty-one males ranged in size from 32–62 mm SVL, minimum reproductive size was 49 mm. Testicular volume was positively correlated with body size (r^2 = 0.31, $F_{1,39}$ = 17.81, P = 0.0001, N = 41). Testicular volume varied through the gonadal cycle

(ANCOVA: $F_{9,30} = 6.5$; $P = 0.0001$; N = 41; covariate SVL). Maximum testicular volume occurred in November; the minimum was found in March.

Our data indicate that *L. olongasta* produces more than one clutch a year, as is the case with *L. darwinii* (Blanco et al. 2001. Congreso Argentina Herpetol. IV:26–27), *L. koslowskyi* (Aun et al. 1993. Cuad. Herpetol. 12:1–9), and *L. wiegmanni* (Vega 1999. Ecología de saurios arenícolas de las dunas costeras bonaerenses. Tesis doctoral, inédita, Universidad Nacional de Mar del Plata. 102 pp.). Mean clutch size of *L. olongasta* is similar to that for *L. darwinii* (mean 4.9, range 2–8, N = 40), *L. riojanus* (mean 4.2, range 3–6, N = 15) (Blanco et al. 2001., *op. cit.*; Blanco et al. 2003. Reunión de Com. Herpetol. Asoc. Herpetol. Argentina. XVII:31), *L. koslowskyi* (mean 4.2, range 3–9, N = 53) (Aun et al., *op. cit.*), *L. wiegmanni* (mean 4.6, range 4–5, N = 19), *L. multimaculatus* (mean 4.2, range 3–7, N = 29), *L. gracilis* (mean 4.7, range 4–6, N = 19) (Vega, *op. cit.*), and *L. sanjuanensis* (mean 4.5, range 3–6, N = 5; Marinero et al. 2005. Herpetol. Rev. 36:452). Reproductive activity in this species is spring–summer.

All specimens (IMCN-UNSJ 4015–4099) were deposited in the herpetology collections of Instituto y Museo de Ciencias Naturales of Universidad Nacional de San Juan.

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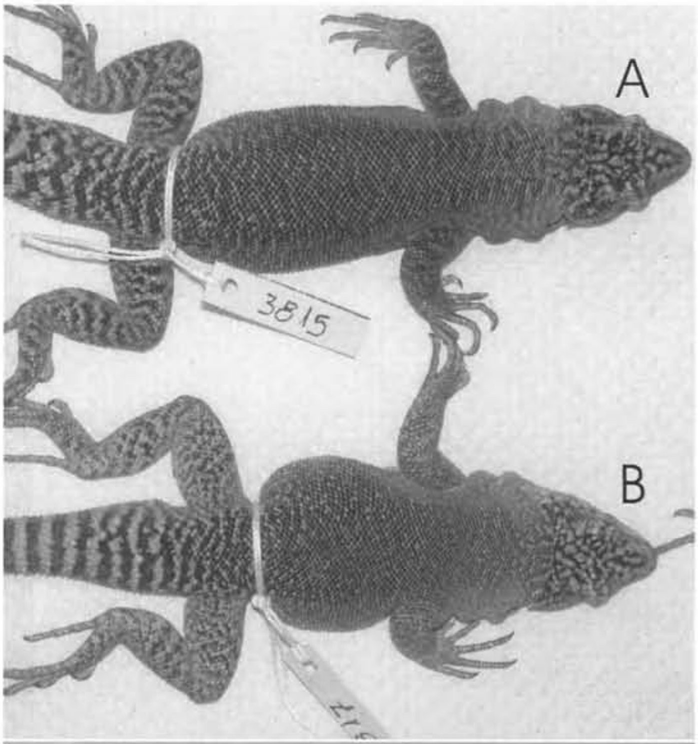
LIOLAEMUS PETROPHILUS **(Stone-loving Lizard). SCOLIOSIS.** Scoliosis and other malformations of the vertebral column like kyphosis are well known in turtles (Rhodin et al. 1984. Brit. J. Herpetol. 6:369–373; Stuart 1996. Bull. Chicago Herpetol. Soc. 31:60–61) and captive iguanas (Otero Llende and Bengoa Rodríguez 2001. Res. VII Congr. Anual Soc. Española Med. Veterinaria, pp. 24–30), but infrequently reported in wild populations of lizards (Mitchell and George 2005. Herpetol. Rev. 36:183–184). Most malformations reported for lizards include bifurcations of the tail, usually as a result of injuries (Scott 1982. Herpetol. Rev. 13:46, Smith 1946. Handbook of Lizards. Cornell Univ. Press, Ithaca, New York. 557 pp.). Here we provide the first report of scoliosis in a liolaemid lizard.

On February 2006, we caught an adult male *Liolaemus petrophilus* (75 mm SVL) on basaltic formations located 31.4 km N Gan Gan, Departamento de Telsen, Chubut (42°22'57.9"S, 68°10'45.4"W, datum: WGS 84; elev. 1246 m). The lizard exhibited a deformation over the pelvic girdle (Fig. 1). This lizard appeared to experience no obvious limitations in prey capture or mobility as it was maintained in captivity several weeks for thermoregulation experiments.

Voucher specimen (LJAMM 3817) is deposited in collection Luciano Javier Avila Mariana Morando (LJAMM) now housed in Centro Nacional Patagónico (CENPAT-CONICET), Puerto Madryn, Argentina.



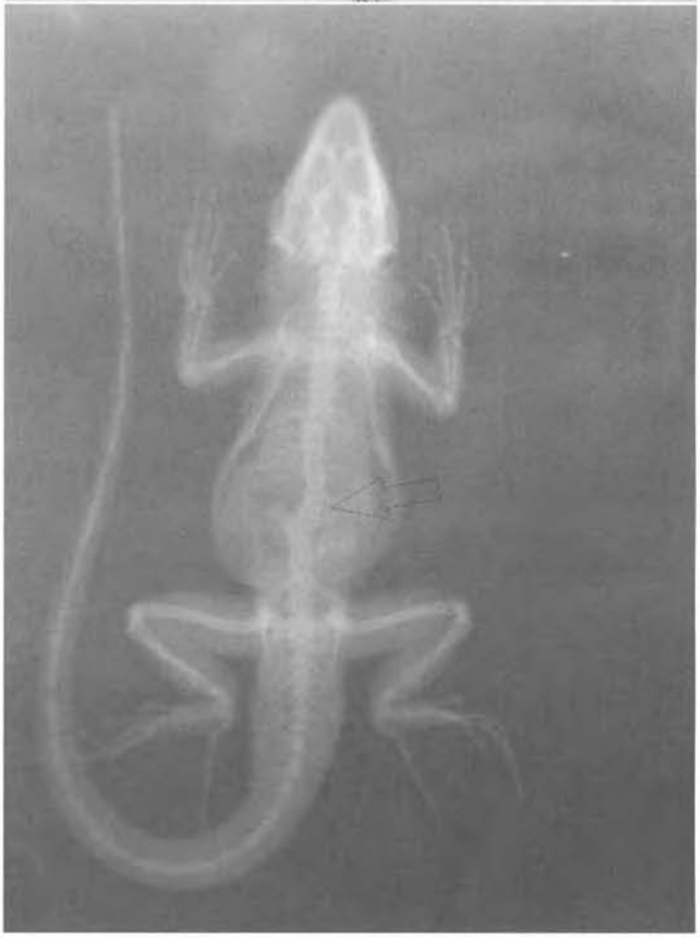


FIG. 1. Upper: Normal (A) and scoliotic (B) male *Liolaemus petrophilus*. Lower: Radiograph of the scoliotic individual; arrow indicates the area of deformity.

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LIOLAEMUS USPALLATENSIS (NCN). **CLUTCH SIZE.** *Liolaemus uspallatenisis*, a small lizard in the "*darwinii* complex" (Etheridge 1993. Boll. Mus. Reg. Nat. Sci., Torino 11:137–199), is distributed in Mendoza and San Juan provinces, Argentina. This species occurs in rocky, high-elevation habitats dominated by xerophyllous vegetation (*Larrea cuneifolia*, *Lycium* sp., and *Stipa* sp.). Other than it being oviparous, no reproductive data exist (Cei 1986. Reptiles del Centro, Centro-oeste y Sur de la Argentina. Herpetofauna de Zonas Áridas y Semiáridas. Museo Regionale di Scienze Naturali Torino. Monografie IV. 527 pp.). Hence, we report the first data on clutch size in *L. uspallatensis*.

On 17 December 2005, we captured a gravid female (58 mm SVL) *L. uspallatensis* at Barrealito Blanco, Iglesia Department, San Juan Province (30°30'S, 69°10'W, datum: WGS84; elev. 2519 m). This female was placed in a 60 × 50 × 40 cm terrarium with abundant leaves and gravel. On 24 December 2005, the female laid three eggs. The length and width of each egg were measured with Vernier calipers to the nearest 0.01 mm. The volume of each egg was calculated using the formula of an ellipsoid sphere (Dunham 1983. *In* Huey et al. [eds.], Lizard Ecology, pp. 261–280. Harvard University Press, Cambridge, Massachusetts). The eggs averaged 1.37 cm (s = 0.46) in length, 0.77 cm (s = 0.46) in width, and 0.24 cm^3 (s = 0.02) in volume. Clutch size may typically be small in this species as another female *L. uspallatensis* that had been trapped also produced three eggs (JCA, unpubl. data).

The eggs were deposited in the herpetological collection of the Institute and Museum of Natural Sciences of San Juan National University, San Juan, Argentina. We thank Eduardo Sanabria for capturing this specimen.

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MABUYA UNIMARGINATA (Central American Mabuya). **REPRODUCTION.** *Mabuya unimarginata* are live bearers with a litter size of 4–9 born in June–July (Lee 1996. The Amphibians and Reptiles of the Yucatán Peninsula. Cornell University Press, Ithaca, New York. 500 pp.). Here I report an observation that might indicate a broader birth interval.

At 1135 h on 25 April 2004, I captured an adult female (82 mm SVL, 12.4 mm tail, 12 g) *M. unimarginata* with six totally formed young (mean SVL = 32 mm). The skink was found near of a temporary pond surrounded by tropical deciduous forest, ca. 4 km SW from Ejido Caobas, Quintana Roo, México (18°26'04"N, 89°07'06"W, datum: NAD 27), elev. 150 m.

Based on their size, the unborn young were a few millimeters smaller than the known size of *M. unimarginata* neonates (ca. 35 mm; Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas. The University of Chicao Press. 934 pp.). This implies parturition during the month of May in Quintana Roo.

Oscar Flores-Villela verified the species identification. The skinks (ECO-CH-H 2542–2548) are deposited in the Colegio de la Frontera Sur (ECOSUR), Chetumal, Quintana Roo, Mexico.

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OPHIODES STRIATUS (Glass Snake). **REPRODUCTION.** Few ecological data exist on the South American anguid *Ophiodes striatus* (Borges-Martins 1998. Taxonomic Review and Phylogenetic Systematics of the Genus *Ophiodes* Wagler, 1828. Ph.D. dissertation, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil. 239 pp.), and data on reproduction are lacking. Hence, we provide data on clutch size and reproductive mode for *O. striatus* from southwestern Brazil.

At 1800 h on 23 October 2003, an adult (186 mm SVL) female *O. striatus* was collected on the campus of the Universidade Federal de Ouro Preto, Ouro Preto, Minas Gerais (20°23'S, 43°30'W; datum: WGS 84; elev. 1350 m). This area has an old bauxite mine, is currently the focus of much human activity, and has vegetation composed predominantly of exotic species as *Pinus sylvestris* and *Eucalyptus* sp. Mean annual rainfall is 2000 mm. The female *O. striatus* was in the late stages of gestation and contained 14 near-parturition, unshelled embryos (Fig. 1). Hemipenal eversion of the embryos revealed that all were males. The embryos were 46 ± 2.8 mm SVL (0.644 ± 0.02 g). This record confirms the viviparity postulated for the genus *Ophiodes* (see Leitão 1973. Ihéringia,

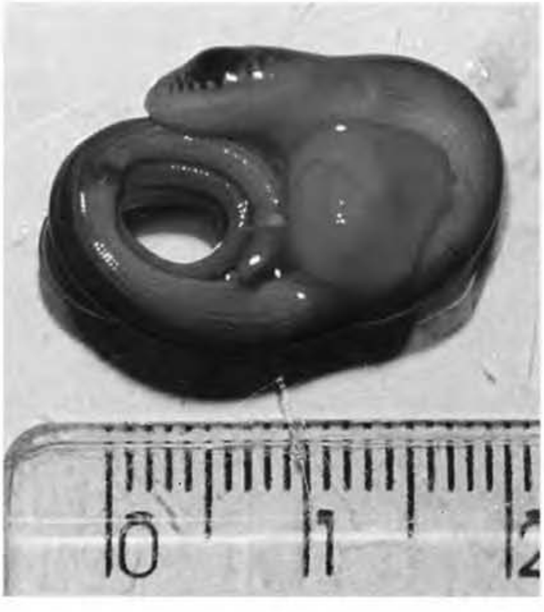

FIG. 1. Late-term embryo of *Ophiodes striatus*, removed from an adult female collected in Minas Gerais, southwestern Brazil.

Sér. Zool., Porto Alegre 42:34–39).

The female *O. striatus* (LZVUFOP 428S) and the embryos (LZVUFOP 432S) were deposited in the herpetological collection at Laboratório de Zoologia dos Vertebrados da Universidade Federal de Ouro Preto.

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OPHISAURUS ATTENUATUS LONGICAUDUS (Eastern Slender Glass Lizard). **REPRODUCTION**. Data regarding reproduction in *Ophisaurus attenuatus* has been obtained mostly from individuals in captivity, whereas field data on reproduction is extremely sparse (Blair 1961. Southwest. Nat. 6:201; Mount 1975. The Reptiles and Amphibians of Alabama. University of Alabama Press, Tuscaloosa, Alabama. 347 pp.; Trauth 1984. Southwest. Nat. 29:271–275; Fitch 1989. Occ. Pap. Mus. Nat. Hist. Univ. Kansas 125:1–50; Gerald 2005. Herpetol. Rev. 36:181–182). Moreover, although some information on habitat use by *O. a. attenuatus* exists (e.g., Force 1930. Copeia 1930:25–39; Clarke 1956. Trans. Kansas Acad. Sci. 59:213–219; Fitch, *op. cit.*), little is known about habitat use in *O. a. longicaudus*, especially for oviposition. Hence, here we augment the sparse data on reproduction and habitat important for nesting in *O. a. longicaudus* from central Tennessee, USA.

On 28 June 2005, we encountered an adult female *O. a. longicaudus* coiled around five eggs within a depression under a wooden board that was part of a coverboard array located on Arnold Air Force Base, Franklin Co. (35°20'51"N, 86°09'25"W, datum: NAD 83; elev. 335 m). Habitat consisted of an open Loblolly Pine (*Pinus taeda*) stand containing abundant 1-m tall grasses. This observation occurred ca. 10 m from a similar observation of a female glass lizard brooding eight eggs under a similar wood board in the same array of cover objects ca. 1 year earlier (2 July 2004; Gerald, *op. cit.*). While three of the eggs seemed healthy, two appeared non-viable because the shells were yellow in color, translucent, and slightly sunken in. The female (ca. 70 cm total length) was individually marked with a Passive Integrative Transponder (PIT) tag and subsequently released next to the nest. On 30 June 2005, the same female was observed coiled around the same clutch of eggs. On 8 July 2005, the female was observed coiled around only two eggs, which appeared healthy, averaging 2.55 cm in length and 1.65 cm in width (the eggs were not manipulated to minimize disturbance). One last observation of the female with the still apparently viable eggs was made on 11 July 2005.

The clutch size matches the smallest reported for *O. a. longicaudus* by Fitch (*op. cit.*) and Mount (*op. cit.*) in Kansas and Alabama, respectively. Reduction in egg number between observations may result from egg consumption by the female (see Fitch, *op. cit.*). The continuation of brooding following PIT tag marking suggests that this degree of handling and mode of marking may have little effect on *Ophisaurus* reproductive behavior. These observations, along with those made by Gerald (*op. cit.*), also suggest that open habitats containing tall grasses may be important for *O. a. longicaudus* reproduction. Additionally, use of cover objects for nesting in two subsequent years may indicate that this method might prove useful to assess reproductive behavior in this species.

We thank Michael Briggs, Jacob Briggs, and Joshua Briggs for assistance in the field.

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PODARCIS BOCAGEI (Bocage's Wall Lizard). **ABNORMAL SCALATION**. Abnormalities in scalation are common in lizards. Bilateral asymmetries are frequent (Dosselman et al. 1998. Herpetologica 54:434–447), as are supernumerary scales. Factors possibly responsible for such developmental anomalies are inbreeding and environmental stress (Braña and Ji 2000. J. Exp. Zool. 286:422–433; Crnobrnja-Isailovic et al. 2005. Amphibia-Reptilia 26:149–158). Here, we report a case of supernumerary femoral pores in a lacertid from northern Portugal.

During an extensive morphological study of Iberian *Podarcis*, an adult female *P. bocagei* (51.34 mm SVL) with an extra row of femoral pores was collected in Gião, coastal northern Portugal (41°18.777'N, 8°41.498'W, datum WGS 84, elev. 140 m). This locality is in the center of the species' distribution, which occupies areas of Atlantic climate on the northwestern Iberian Peninsula (Galán 2003. *In* Carrascal and Salvador [eds.], Enciclopedia Virtual de los Vertebrados Españoles. MNCN-CSIC, Madrid. http://www.vertebradosibericos.org/). Habitat consisted of agricultural fields separated by traditional granite walls, which the lizards use as refuges and in which they achieve high densities. Accessory rows of femoral pores were noted in both hind limbs (Fig. 1). The accessory pores (left N = 9, right N = 7) were smaller and located parallel, in a central position and posterior to the normal series (left N = 20, right N = 20). No other anomalies were found in this animal, which was measured, photographed and released at its site of capture. Examination of another 37 adults (21 males and 16 females) from the same population and 380 individuals from seven other localities across the species' range failed to reveal extra rows of femoral pores. In all the populations studied, males had significantly more femoral pores than females (t-test: $P < 0.05$ in all cases). Notably, the anomalous female had a particularly high number of pores; 20 was the maximum observed among *P. bocagei* we examined and occurred in only 2.8% of individuals (including but one female from a different locality and 10 males from various sites).

Walker (1980. J. Herpetol. 14:417–418) reported accessory femoral pores in the Collared Lizard, *Crotaphytus collaris*. However, in that case a substantial proportion of the adult population (63.7% of males, 36.3% of females) displayed the anomaly. This result, together with the fact that the population was small and isolated, led the author to invoke inbreeding rather than environmental stress to explain the phenomenon. In our case, the population is completely connected to others, and recent studies at this

FIG. 1. Female specimen of *Podarcis bocagei* from Gião, NW Portugal. The white arrows on each side delimit the additional row of femoral pores.

site have revealed no evidence of decreases in genetic diversity (Pinho et al. 2003. Biochem. Genet. 41:343–359; Pinho et al. 2006. Mol. Phylogenet. Evol. 38:266–273). The anomalous individual may simply be a local variant, but it may also be linked to unrecognized developmental stress as pesticides are commonly used to grow corn locally (pers. obs.). Other cases of supernumerary femoral pores have been reported among iguanians (e.g., *Sauromalus obesus*: Tanner and Avery 1964. Herpetologica 20:38–42), but to our knowledge, this is the first such report in lacertids.

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PRISTIDATYLUS SCAPULATUS (NCN). **BODY TEMPERATURE.** *Pristidactylus scapulatus* inhabits the east slope of the Andean Cordillera from north of San Juan in San Guillermo Provincial Reserve to Chubut Province (Cei 1986. Museo Regionale di Scienze Naturali Torino. Monografie IV. Torino, Italia. 527 pp.). It has an ambiguous conservation status; it is defined as a species for which "insufficient knowledge" exists (Lavilla et al. 2000. Categorización de los Anfibios y Reptiles de la República Argentina. Asoc. Herpetol. Arg., 97 pp.). No data currently exist on the thermal biology of any of the six species of *Pristidactylus* in Argentina. Hence, here we present preliminary data on *P. scapulatus* thermal ecology.

In December 2004 and February 2005, we conducted field work in the Parque Nacional San Guillermo, Departamento Iglesia, Provincia de San Juan (29°15'S, 69°29'W, datum: WGS 84; elev. 3400 m), located in the Puna Phytogeographic Province. *Stipa speciosa* var. *breviglumis, Lyciun chanar,* and *Adesmia* spp. dominate the largely Andean flora (Cabrera and Willink 1980. Biogeografía de América Latina. Washington, D.C. 109 pp.). Here, we present data based on 10 different *P. scapulatus* observed between 0930 and 1900 h on three different days, nine of which were captured. To collect these data, we revisited a randomized selection of bushes and low rocks across the study site. Each individual was captured by hand, and its SVL was measured to the nearest 0.05 mm. For each capture, cloacal (T_c), substrate (T_s), and air (T_a) temperatures were measured to nearest 0.1°C with a rapid-reading Miller-Weber thermometer. We took T_s at the exact point of observation and T_a 1 cm above the substrate, both immediately following capture. We also recorded microhabitat type for each capture. Following processing, animals were released at the point of capture.

Mean SVL of males was 105.4 mm (SD = 5.54, range: 96–110, N = 5) and mean SVL of females was 83.5 mm (SD = 10.27, range: 70–95, N = 4). Mean body temperature of the nine *Pristidactylus scapulatus* was 27.0°C (SD = 1.8, range: 24.0–29.5°C). Mean air temperature was 26.6°C (SD = 5.6, range: 18.0–33.0°C). Mean substrate temperature was 32.4°C (SD = 8.9, range: 19–42). Body size was unrelated to T_c (Spearman Rank Correlation: $r_s = 0.17$, $P = 0.64$). Cloacal temperature and each of T_s and T_a were correlated (Spearman Rank Correlation: $r_s = 0.80$, $P = 0.008$; $r_s = 0.85$, $P = 0.002$, respectively).

At this site, *P. scapulatus* remained active 4 h per day (1000–1300 h, with maximum activity at 1100–1200 h [64% of observations]). Of the 10 animals we found, nine were under *Lyciun chanar* shrubs and one on a *L. chanar* eating its fruits. Of captured animals, 70% attempted to escape into burrows beneath *L. chanar* shrubs; the remaining 30% did not display escape behavior.

Pristidactylus scapulatus has field body temperatures similar to *P. volcanensis* but higher than *P. torcuatus* and *P. valeriae* (Labra and Vidal 2003. *In* Bozinivic [ed.], Fisiología Ecológica y Evolutiva, pp. 207–224. Univ. Católica de Chile, Santiago, Chile). Despite the small sample size, the high correlation coefficient among T_c, T_s, and T_a suggests that *P. scapulatus* is a thermoconformer. This species may maintain relatively low temperatures by restricting the activity interval and remaining in the shade of *L. chanar* shrubs.

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SCELOPORUS OCCIDENTALIS (Western Fence Lizard). **CAUDAL MOVEMENT**. Caudal movements are commonly employed by squamates and serve several purposes. Caudal luring, the use of tail movement to attract prey, is common in snakes (Heatwole and Davidson 1976. Herpetologica 32:332–336) but rare among lizards (Pernetta et al. 2005. Herpetol. Rev. 36:320–321). However, tail autotomy, common in lizards, is typically followed by caudal movements that serve to distract potential predators and aid in escape (Arnold 1988. *In* Gans and Huey [eds.], Biology of the Reptilia, pp. 236–273. Alan R. Liss, Inc., New York). Additionally, in lizards, tail lashing has been observed in *Anolis* during male-male agonistic interactions (Ortiz and Jenssen 1982. Z.

Tierpsychol. 60:227–238). Here I report caudal movements in *Sceloporus occidentalis* immediately preceding prey capture that might serve to attract or distract prey.

At 0845 h on 13 April 2006, I observed an adult (ca. 7.5 cm SVL) male *S. occidentalis* basking on a rock ca. 15 cm off of the ground at the Santa Barbara Zoological Gardens, Santa Barbara Co., California, USA (34°25'13"N, 119°39'57"W, datum: WGS 84; elev. 9.5 m). After ca. 5 min of observation, the lizard caught sight of an insect crawling through the grass and immediately moved onto the ground to within 10 cm from the insect. The lizard promptly vibrated its tail rapidly from side to side, in a display similar to defensive behaviors of many snake species, while keeping the rest of its body motionless and watching the insect. This behavior lasted for ca. 3 seconds, after which the lizard lunged at and captured the insect, immediately ceasing tail movements. After the prey was consumed, the lizard returned to the rock where it remained for the rest of the observation interval (ca. 10 min). No further caudal movements were observed.

As I only observed one individual, tail movements are unlikely to be linked to agonistic behavior. Moreover, the behavior being observed only immediately preceding prey consumption implies a link to predation. It might be coincidental that tail movements preceded prey consumption, but other aspects of the episode suggest either caudal luring or distraction. I did not see the insect moving towards the lizard's tail, as might be expected with caudal luring, but while moving its tail, the lizard's body remained motionless while its gaze was fixed on the insect. To my knowledge, this is the first account of potential caudal luring or distraction of prey in *S. occidentalis*.

I thank Paul Hampton for reviewing an earlier version of this manuscript.

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TROPIDURIDAE (Tropidurid Lizards). **DEATH-FEIGNING.** Death-feigning, also called tonic immobility or thanatosis, is an innate, anti-predator behavior that arose independently in several animal lineages, including coleopteran insects (e.g., Acheampong and Mitchell 1997. Entomol. Exp. Appl. 82:83–89; Miyatake 2001. J. Insect Behav. 14:421–432), amphibians (e.g., Gargaglioni et al. 2001. Physiol. Behav. 72:297–303; McCallum et al. 2003. Herpetol. Rev. 34:54–55), snakes (e.g., Burghardt and Greene 1988. Anim. Behav. 36:1842–1844; Rugiero 1999. Amphibia-Reptilia 20:438–440), birds (e.g., Rovee-Collier et al. 1993. Physiol. Behav. 53:353–359; Sargeant and Eberhardt 1975. Am. Midl. Nat. 94:108–119), and mammals (e.g., Leite-Panissi et al. 2003. Brain Res. Bull. 60:167–178). In the actinopterygian fishes *Mycteroperca acutirostris* (Serranidae) and *Haplochromis livingstoni* (Cichlidae) death-feigning is also a hunting behavior (Gibran 2004. Copeia 2004:403–405; McKaye 1981. Environ. Biol. Fish. 6:361–365). In squamates, death-feigning is a widespread defensive tactic that is described from several different families, such as Anelytropsidae (Torres-Cervantes et al. 2004. Herpetol. Rev. 35:384), Crotaphytidae (Gluesing 1983. Copeia 1983:835–837), and Scincidae (Langkilde et al. 2003. Herpetol. J. 13:141–148). Among tropidurid lizards, this behavior has been observed in *Liolaemus lutzae* (Rocha 1993. Ciênc. Cult. 45:116–122) and *Eurolophosaurus nanuzae* (Galdino and Pereira 2002. Herpetol. Rev. 33:54) and *E. divaricatus* (Gomes et al. 2004; Kohlsdorf et al. 2004. Herpetol. Rev. 35:390–391), formerly *Tropidurus nanuzae* and *T. divaricatus* (Frost et al. 2001. Mol. Phylo. Evol. 21:352–371). Herein we augment available data on death-feigning in tropidurids with a brief description of this behavior in *Tropidurus torquatus* and *T. hispidus* and anecdotal records for several other species in the family.

On the morning of 21 April 2002, we observed a death-feigning display by a juvenile (35 mm SVL, 58 mm tail) *T. torquatus* following its hand capture in the urban area of Belo Horizonte, State of Minas Gerais, southeastern Brazil (19°45'S, 43°54'W; elev. 858 m). Upon capture, this individual became immobile, remaining motionless during the handling interval (about 30 s). The death-feigning posture persisted even after the animal was gently placed upside down on the ground (Fig.1A). After 1–2 min it righted itself and ran off. On 4 January 2005, an adult male *T. torquatus* (not measured) was captured by hand in a forested area of the Parque Nacional do Caparaó, municipality of Alto Caparaó, State of Minas Gerais (20°25'S, 41°50'W; elev. 1295 m). Similar to the first example, this individual became immobile upon capture, lying dorsally, extended its limbs upwards and closed its eyelids, remaining motionless during manipulation. The behavior persisted after we placed the animal upside down on the ground. After more than 1 min, it recovered and fled rapidly.

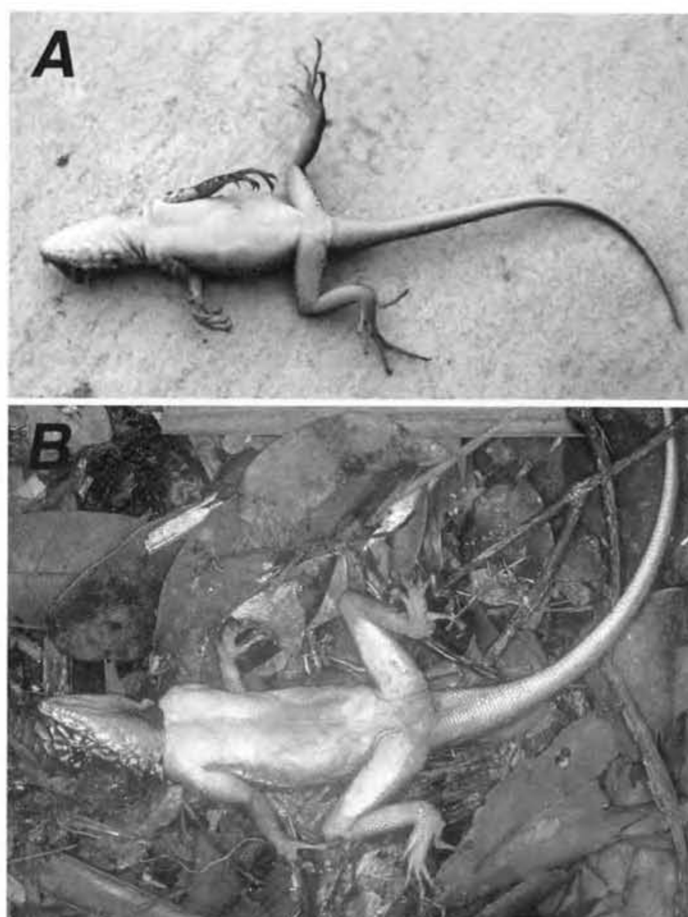

FIG. 1. Death feigning posture in (A) a juvenile *Tropidurus torquatus* from southeastern Brazil and in (B) an adult *Plica plica* from northern Brazil.

On the morning of 20 March 2005, we also observed death-feigning in an adult male *T. hispidus* (12.3 mm SVL, 14.9 mm tail, partly regenerated) following lace capture. The lizard was captured with a small lace mounted with 1 m of dental floss moored to a 1.5 m-length bamboo stick. The capture was made in the urban area of the municipality of Mucugê, State of Bahia, northeastern Brazil (13°00'S, 41°22'W; elev. 986 m; JC field number 1247). This animal's behavior was almost identical to those described above. It remained motionless for more than 1 min after release, then it ran to a rock crevice. On 15 March 2005 an adult male *T. hispidus* (not measured) that, surprisingly, was active at night (because of the presence of internal lights in the room) was captured by hand inside the headquarters building in Parque Municipal Sempre Viva, municipality of Mucugê (12°59'S, 41°20'W; elev. 967 m). After biting a thumb of JC and trying to escape by wriggling its body, it became quiescent. It persisted in this state for more than 1 min. As in the other cases, this individual recovered upon release and ran to a fissure in the house wall.

MTR has also observed death-feigning in many other tropidurids, including *Eurolophosaurus amathites*, *Plica plica* (Fig. 1B), *P. umbra*, *Strobilurus torquatus*, *Tropidurus cocorobensis*, *T. hygomy*, *T. itambere*, and *Uranoscodon superciliosum*. In all cases, the animals displayed a similar pattern of behavior and posture.

Death-feigning has not been recorded previously in *Tropidurus hispidus* (and *T. psamonastes*), even after extensive manipulation (Gomes et al. 2004. Amphibia-Reptilia 25:321–325). The similarity in this behavior among individuals of different species documented by our observations, and its widespread occurrence in the family lead us to conclude that death-feigning is a primitive characteristic in tropidurids, a conclusion also reached by Gomes et al., (*op. cit.*).

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TROPIDURUS ETHERIDGEI (NCN). **COURTSHIP**. Courtship in lizards involves many elaborate displays that are better known in iguanians and that are similar between species (Carpenter and Fergusson 1977. *In* Gans and Tinkle [eds.], Biology of the Reptilia: Volume 7. Ecology and Behaviour A, pp. 335–554. Academic Press, Orlando, Florida). Here, we report previously undescribed courtship in *Tropidurus etheridgei*.

Observations were made at 1715 h on 15 October 2003 (rainy season) in a rocky area near the municipality of Corumbá, Mato Grosso do Sul State, Brazil (19°10'49"S, 57°32'17.2"W, datum: WGS84; elev. 117 m). Courtship behavior took place on a rocky substrate near some terrestrial bromeliads (*Bromelia balansae*). The male (ca. 80 mm SVL), who displayed a bright blue dorsal coloration and red ventrolaterally and in the throat region, approached the female (ca. 60 mm SVL) with rapid series of head bobs for 1 min and circled her. The female raised up on four legs, arched her back, and presented her back to the male while raising her tail. The female slowly walked away from the male, who continue to pursue her for the next 10 min; over this period of time, he managed to bite the neck of the female twice and the base of her tail once. We did not observe copulation attempts.

Behavioral aspects of this courtship are quite similar to those described for other *Tropidurus* (Carpenter 1997. Herpetologica 33:285–289), except that they lack the swishing the tail from side to side and dewlap displays. Based on Carpenter (*op. cit.*), the female posture we recorded is a typical rejection posture showed by iguanids.

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TROPIDURUS ETHERIDGEI (Ututo). **ENDOPARASITES**. *Tropidurus etheridgei* occurs in Argentina, Bolivia, Brazil, and Paraguay. In Argentina, the species is distributed largely in the Chacoan region (Cei 1993. Reptiles del Noroeste, Nordeste y Este de la Argentina. Monogr. XIV. Mus. Reg. Sci. Nat. Torino, Italy. 949 pp.). The purpose of this note is to report *Physaloptera* sp. (Nematoda) in a population of *T. etheridgei* from Argentina.

Four *T. etheridgei* (mean SVL = 92 mm; range: 80–102 mm) from the herpetology collection of the Universidad Nacional del Nordeste (UNNEC 07916-07919), Corrientes, Argentina, were examined for helminths. All specimens are from Ingeniero Juárez, Formosa Province (23°54'S, 61°51'W, datum: WGS 84; elev. 57 m). The esophagus, stomach, small and large intestines were opened and examined under a dissecting microscope. The body cavity was also searched. One, four, and seven *Physaloptera* sp. were found in the stomachs of each of three of the *T. etheridgei*. In Argentina, *Physaloptera* sp. is known for *T. etheridgei* from Salta Province (Cruz et al. 1998. Herpetol. Nat. Hist. 6:23–31). Nematode infection frequency in the *T. etheridgei* from Ingeniero Juarez (75%) was higher than in *T. etheridgei* from Salta Province (64.5%). Also *Physaloptera* sp. have been found in others species of lizards from Argentina: *Leiosaurus belli* from Río Negro Province, *L. catamarcensis* from La Rioja Province, *Liolaemus neuquensis* from Neuquén Province (Goldberg et al. 2004. Comp. Parasitol. 2:208–214) and *Liolaemus quilmes*, *L. ornatus*, and *L. alticolor* from northwestern Argentina (Ramallo and Díaz 1998. Bol. Chil. Parasitol. 53:19–22). Ingeniero Juárez, Formosa, represents a new locality record for *Physaloptera* sp. in *T. etheridgei*.

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TROPIDURUS HISPIDUS (Thornytail Lizard). **SAUROPHAGY**. Saurophagy is often opportunistic in lizards, involving either consumption of heterospecifics (Kiefer 1998. Herpetol. Rev. 29:41) or conspecifics (Kiefer and Sazima 2002. Herpetol Rev. 33:136; Vrcbradic and Rocha 1996. Herpetol Rev. 27:201–202). This behavior has been documented in some tropidurids (Avila and Belver 2000. Herpetol. Rev. 31:174; Avila and Morando 2002. Herpetol. Rev. 33:52; Galdino and Van Sluys 2004. Herpetol Rev. 35:173) but is undocumented in *Tropidurus hispidus*, a common diurnal species found in the Guianan Shield (Gorzula and Señaris 1998. Contribution to the Herpetofauna of the Venezuelan Guayana I. A Data Base. Scientia Guaianae No. 8. 269 pp.; Vitt et al. 1996. J. Trop. Ecol. 12:81–101). *Tropidurus hispidus* is sympatric with the nocturnal gekkonid *Hemidactylus palaichthus*; these two species can be found in syntopy but are largely segregated by activity period. Agonistic interaction between these two species has not previously been recorded. Hence, we document a case of attempted predation by *T. hispidus* on *H. palaichthus*.

During a visit to Maripa (town) in the lower basin of the Caura River, northeastern state of Bolívar, Venezuela (07°23'26"N, 65°10'56"W, La Canoa; elev. ca. 70 m), we found *T. hispidus* and *H. palaichthus* syntopic and both very common. At 0800 h on 5 October 2005, we observed an adult (estimated SVL 90 mm) *T. hispidus* persistently pursue on the floor of a rural house an adult (56 mm SVL) *H. palaichthus*, repeatedly biting at the gecko until it was captured. Upon perceiving the presence of FR, the *T. hispidus* immediately released its prey and quickly retreated to a hiding place among some tables. We collected the *H. palaichthus*, which was alive but severely wounded. Examination revealed that its tail had been lost, based on the condition of the scarred stump probably several days earlier. A large piece of dorsal skin (4.2 × 9.3 mm) was missing as a result of the *Tropidurus* bite (Fig. 1). On its venter near the inguinal region, an old scar was presemt that was similar to the bite on its back in size and shape.

While we examined the wounds of the gecko, we observed that the *T. hispidus* had emerged from its hiding place, ca. 5 m away, apparently searching for its prey. We released the gecko, observing from a prudent distance. Three minutes later, the *T. hispidus* moved cautiously in the direction of the gecko and when within one meter it ran quickly to the *H. palaichthus*, grabbing it by the head and swallowing it almost to midbody before returning to its retreat site to continue ingestion. We then attempted to capture both the predator and its prey, but the *Tropidurus* again released the gecko, which, surprisingly, was still alive. The *T. hispidus* evaded capture and the *H. palaichthus* was released after its photograph was taken.

A second *H. palaichthus* (MHNLS 17485) collected the day before these observations also had an old scar on its left shoulder very similar to the injury caused by the *T. hispidus* on the gecko noted previously. These observations led us to believe that attacks on *H. palaichthus* by *T. hispidus* at this locality might be more common than suspected and that the scars observed on the geckos reveal some capacity to survive these attacks.

Previous studies have shown that *T. hispidus* is insectivorous (León et al. 1970. Bol. Soc. Biol. Concepción 42:349–354; Vitt et al., *op. cit.*), although in one study, a single anuran prey item was recovered, representing the only vertebrate recorded in its diet (Vitt et al., *op cit.*). Collectively, these data lead us to believe that saurophagy by *T. hispidus* is opportunistic.

Fig. 1. The gecko, *Hemidactylus palaichthus*, showing dorsal skin trauma as the results of a *Tropidurus hispidus* bite.

J. Celsa Señaris verified the species identities of the lizards. Voucher material is deposited in the Museo de Historia Natural La Salle (MHNLS), under numbers 17482–17483 (*T. hispidus*) and 17484–17485 (*H. palaichthus*). We thank Aaron Bauer and Marc Hayes for comments and corrections to a preliminary version of this note.

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TROPIDURUS TORQUATUS (Brown Lizard). **ENDOPARASITES**. *Tropidurus torquatus* is a common lizard in Corrientes and Misiones provinces, Argentina (Cei 1993. Reptiles del Noroeste, Nordeste y Este de la Argentina. Monogr. XIV. Mus. Reg. Sci. Nat. Torino, Italy. 949 pp.). Here we report on the presence of *Parapharingodon* sp. (Nematoda) and larvae (cystacanths) of spiny-headed worms (Acanthocephala) in *T. torquatus* from northern Argentina.

We examined six *T. torquatus* (two juveniles, mean SVL = 51 mm, and four adults, mean SVL = 95 mm; range: 56–103 mm) from Corrientes (city), Corrientes Province (27°28'01"S, 58°47'00"W, datum: WGS 84; elev. 65 m) in the herpetological collection of Universidad Nacional del Nordeste (UNNEC): 8082–8084; 8086–8088. The esophagus, stomach, small and large intestines were opened and searched for helminths under a dissecting microscope. The body cavity was also searched. A total of 11 *Parapharingodon* sp. were found in the large intestines of four adults (numbers observed in each of the four were 1, 2, 3, and 5). We also found two acanthocephalan cystacanths in the stomach wall of one of the juveniles.

To date, previous reports of *Parapharingodon* sp. in *T. torquatus* have been documented for different localities from Brazil: Salva-

dor and Canudos (Bahia), Cachimbo (Pará), Rio de Janeiro and Arraial do Cabo (Rio de Janeiro), Salobra (Mato Grosso do Sul), Mogeiro, Lagoa do Remígio, Umbeseiro and Joao Pessoa (Paraíba), Currais Novos, Ceará Mirin (Rio Grande do Norte), Garanhuns (Pernambuco) (Vicente et al. 1993. Rev. Brasiliera Zool. 10:19–168). Cystacanths of the acanthocephalan *Echinorhynchus* sp. have been found previously in Brazilian populations of this lizard (Vicente 1978. Atas Soc. Biol. Rio Janeiro 19:71–78). These findings represent the first record of *Parapharingodon* sp. and acanthocephalan cystacanths in *T. torquatus* from Argentina.

We thank M. Hamman, B. Oscherov, B. Álvarez, and A. Hernando for their advice.

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TROPIDURUS TORQUATUS (Brazilian Collared Lizard). **MORTALITY**. Humans produce innocuous-appearing artifacts that can negatively impact wild animal populations. The effects of some of these artifacts are well known (e.g., marine turtles ingesting plastic bags; Tomas et al. 2002. Mar. Pol. Bull. 44:211–216), but the effects of others remain undocumented. Hence, we document a case of accidental mortality apparently caused by such an artifact in *Tropidurus torquatus* from southeastern Brazil.

On 10 August 2000, we found a recently dead subadult male *T. torquatus* (53.7 mm SVL, 78.3 mm tail) trapped in a small piece of plastic spiral (38 mm length × 12 mm internal diameter). The animal was found on a granite outcrop near an Atlantic forest remnant located at the southern limit of the Universidade Federal do Espírito Santo, Vitória, Estado do Espírito Santo (20°16'41.3"S, 40°18'23.9"W, datum: SAD 69 Corrego Alegre; elev. 17 m).

Such plastic spirals are heavily used around the campus to bind xerox copies and class reports. Many end up broken and thrown away to be later inadvertently gathered by the gardeners that collect leaves, vegetation litter, and cut grass. These materials are used as unprocessed fertilizer or to protect exposed soil. Non-biodegradable material tends to become exposed within a few months after wet season processing decomposes organic matter and rains wash away most of the debris of smaller size. This allows lightweight, human-made, degradation-resistant material to be dispersed by wind across bare ground or rock, which is the typical habitat of this lizard (Fredericksen et al. 2003. Trop. Ecol. 44:183–194). Our observation reinforces concerns regarding the impacts of poorly degradable human-made artifacts.

The *T. torquatus* specimen (MBML 1746) was deposited in the herpetological collection of the Museu de Biologia Melo Leitão, Santa Tereza, Espírito Santo, Brazil.

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TROPIDURUS TORQUATUS (Collared Lizard, Calango). **PREY.** Lizards of the widely distributed South American genus *Tropidurus* (Rodrigues 1987. Arq. Zool., São Paulo 31:105–230) are sedentary foragers that feed predominantly on arthropods (Van Sluys 1993. J. Herpetol. 27:347–351). However, they can also prey on other lizards (e.g., Galdino and Van Sluys 2004. Herpetol. Rev. 35:173; Kiefer 1998. Herpetol. Rev. 29:41; Kokubum and Lemos 2004. Herpetol. Rev. 35:270–271; Teixeira and Giovanelli 1999. Rev. Brasil. Biol. 59:11–18), including conspecifics (e.g., Alvarez et al. 1985. Hist. Nat. 5:281–288; Dias and Rocha 2004. Herpetol. Rev. 35:398–399; Kiefer and Sazima 2002. Herpetol. Rev. 33:136). Here we record three cases of predation on vertebrates (two lizards and a treefrog) and one case of cannibalism from coastal populations of *Tropidurus torquatus*.

Lizards were captured during a study carried out in "restinga" habitats in the States of Rio de Janeiro, Espírito Santo, and Bahia (16°39'–23°05'S, 39°05'–43°30'W; datum: WGS 84; elev. 2–12 m) from November 1999 to March 2000 and dissected for stomach content analysis. We found a partially digested juvenile (ca. 33.0 mm SVL) *T. torquatus* lacking its midbody and right posterior limb in an adult male (60 mm SVL) from Guriri restinga, State of Espírito Santo, in November 1999.

We also recorded predation on other vertebrates in Jurubatiba (January 2000) and Maricá (February 2000) restingas, both in the State of Rio de Janeiro, by adult males of *T. torquatus*. In Jurubatiba, one male (79 mm SVL) had consumed a juvenile (ca. 29.7 mm SVL) *Mabuya macrorhyncha*. In Maricá, a male (84.0 mm SVL) had eaten a juvenile (ca. 42.0 mm SVL) *Cnemidophorus littoralis* (only the posterior body and the left hindlimb were undigested), and another male (ca. 74.4 mm SVL) preyed on an adult female *Scinax cuspidatus* (ca. 27.5 mm SVL), which was partially digested. We also found a piece (ca. 37.8 mm) of a tail of an adult *M. macrorhyncha* in the stomach of an adult male *T. torquatus* from Jurubatiba.

Predation by *T. torquatus* on other vertebrates has been previously recorded on conspecifics (Alvarez et al. 1985, *op. cit.*; Dutra 1996. Uso de habitats, tamanho, dieta e locais de desova de *T. torquatus* [Sauria: Tropiduridae] em Abrolhos, BA. Bachelor Thesis, Instituto de Biologia, Universidade Federal de Minas Gerais, Belo Horizonte. 56 pp.) and on the lizards *Mabuya agilis* (Teixeira and Giovanelli, *op. cit.*), *Hemidactylus mabouia* (Araújo 1991. Rev. Bras. Biol. 51:857–865; Teixeira and Giovanelli, *op. cit.*; Galdino and Van Sluys, *op. cit.*), *Gymnodactylus darwinii* (Teixeira and Giovanelli, *op. cit.*), *Cnemidophorus ocellifer* (Kokubum and Lemos, *op. cit.*), and on the treefrog *Scinax cuspidatus* (Araújo, *op. cit.*). Nevertheless, our observations of predation on *M. macrorhyncha* and on the endemic *C. littoralis* (a species threatened with extinction) constitute the first records for these taxa where *T. torquatus* was the predator. All lizards preyed upon by *T. torquatus* were juveniles, and their frequencies of occurrence among the prey sampled were low (< 4%), implying that this feeding behavior is opportunistic.

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2001.03486/99.85). Rodrigo V. Marra and Davor Vrcibradic confirmed the identity of *S. cuspidatus* and *M. macrorhyncha*, respectively. Davor Vrcibradic kindly revised the text.

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SERPENTES

AGKISTRODON CONTORTRIX (Copperhead). **DIET**. On 14 September 2004 at 0800 h, one of us (RDG) witnessed a vehicle strike a Copperhead (*Agkistrodon contortrix*) on a secondary gravel road in Botetourt Co., Virginia, USA (37°40.46'N, 79°49.52'W). The snake was collected and brought to the Department of Biology at Hollins University, where the specimen was dissected as a demonstration for students. The cranial region of the intact female snake (680 mm SVL, 762 mm TL) was the only area showing any trauma. Dissection of the stomach revealed an intact, adult female Eastern Wormsnake (*Carphophis amoenus amoenus*; 215 mm SVL) and an intact Orange-tipped Oakworm Moth (*Anisota senatoria*; a previously unreported food item of *A. contortrix*). Brown (1979. Brimleyana 1:113–124) reported *C. a. amoenus* in the gut contents of juvenile *A. contortrix*, and Palmer and Braswell (1998. Reptiles of North Carolina. University of North Carolina Press) reported *C. a. amoenus* in the gut contents of *A. contortrix* in museum specimens. As this is the third documented account of *C. a. amoenus* in the gut contents of *A. contortrix*, we should consider that *A. contortrix* may forage more fossorially, or that *C. a. amoenus* may spend more time above ground, than previously thought. The *A. contortrix* specimen and its gut contents are deposited in the Department of Biology at Hollins University (HU0151).

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CROTALUS CATALINENSIS (Santa Catalina Island Rattlesnake). **WINTER ACTIVITY**. Grismer (2002. Amphibians and Reptiles of Baja California, Including Its Pacific Islands and the Islands in the Sea of Cortés. University of California Press, Berkeley, California. 409 pp.) reports an activity period spanning from March through October for *Crotalus catalinensis*. However, during a visit to Santa Catalina Island in the winter season (November–February), we found 28 *C. catalinensis* active on the surface. On both 26 and 27 January 2005 a group of five persons searched for snakes from 1200–1600 h and from 1900–2400 h, although not every person searched this entire time period. Sunset was at approximately 1900 h; thus, a total of eleven person-hours were spent searching during the day and 25 person-hours were spent searching at night. We found four *C. catalinensis* (two males, one female, one undetermined) during the day (0.4 snakes/person-hour), whereas 24 *C. catalinensis* (five males, nine females, ten undetermined) were found at night (1.0 snakes/person-hour). When first encountered, fourteen individuals (including those found during the day) were coiled, while the rest were crawling. One male and a female were found together under a rock, but copulation was not observed. With the aid of an infrared thermometer we observed that snakes' body temperatures ranged from 14.2–30.2°C (18.7°C mean, N = 26), and air temperatures at point of snake encounters ranged from 18.0–28.0°C (21.3°C mean, N = 18).

On the night of 26 January, we attached a bobbin of thread (4 g) to the last third of the body of six snakes (four females and two males), and released them at their respective capture sites. The next morning, several females were found some distance from their capture sites (F1, ca. 630 mm SVL, 21.9 m; F2, ca. 600 mm SVL, 31.8 m; F3, ca. 380 SVL, 16.3 m). Another female (F4, ca. 670 mm SVL) and a male (M1, ca. 700 mm SVL) that were captured under the same rock had moved together around a Palo Verde Tree (*Cercidium microphyllum*) and separated; F4 traveled 22 m and M1's bobbin fell off a short distance from the release site. A second male (M2, ca. 620 mm SVL) only moved 0.5 m. On the morning of 28 January, females F1 and F4 had lost their bobbins at distances of ca. 88 m and 44 m from their last locations, respectively. In general, snake movements were linear, passing under or climbing on vegetation to a height of 0.6 m. Diurnal refugia included cavities beneath rocks, fallen Cardon Cactus (*Pachycereus pringlei*), and thickets of plants. In all cases the snake's body could be seen from above.

Capture rates on these winter nights approximate those I recorded during the 2004 rainy season (July–October), when 30 person-hours yielded 38 rattlesnakes (1.2 snakes/person-hour). These observations indicate that *C. catalinensis* also can be quite active during the winter, especially at night. The behavior and displacements observed here suggest that winter activity of *C. catalinensis* might be related to mating activities.

Suppositions of an activity season limited to March through October might be due to a lack of field work in winter, when northwesterly winds in the Gulf of California result in poor sailing conditions (Roden 1958. Pac. Sci. 12:21–45). My observations of winter activity in *C. catalinensis* are consistent with activity patterns exhibited by the closely related *Crotalus ruber* (Murphy and Crabtree 1985. Acta Zool. Mex. 9:1–16), which can be found dead on the roads of Baja California Sur by mid-February (pers. obs.).

I thank M. Martins, G. Arnaud, J. Navarro, and M. A. Leal for their assistance.

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CROTALUS CERASTES (Sidewinder). **DIET**. Although *Crotalus cerastes* are known to feed on lizards, sympatric *Sceloporus magister* (Desert Spiny Lizard) have not been reported in their diet (Funk 1965. Herpetologica 21:15–17). On 25 May 2003 at ca. 1200 h a dead *C. cerastes* (ca. 300 mm TL) was found on the side of Nipton Road, Nipton, California,USA, adjacent to Mojave National Preserve. Upon dissection I found a partially digested adult (ca. 152 mm TL) *S. magister* in the specimen's stomach.

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CROTALUS MOLOSSUS (Black-tailed Rattlesnake). **BEHAVIOR.** Here we report communal hibernation of *Crotalus molossus* in northern Yavapai Co., Arizona, USA. In Cochise Co., Arizona, *C. molossus* do not appear to aggregate during hibernation, but rather hibernate singly in crevices along rim rocks (Greene 1997. Snakes: The Evolution of Mystery in Nature. University of California Press, Berkeley. 351 pp.). However, Cochise Co. is near the latitudinal median of the range of *C. molossus*, while the Yavapai Co. populations we studied are nearer the northern terminus of its range (Campbell and Lamar 2004. The Venomous Reptiles of the Western Hemisphere. Cornell University Press, Ithaca and London. 774 pp.) and occur at relatively high elevations (1370–1675 m).

We have observed multiple *C. molossus* at 14 hibernacula in desert scrub, chaparral, and woodland communities. We have observed up to eight *C. molossus* simultaneously at a single hibernaculum and marked up to 22 individual *C. molossus* over three years at a single hibernaculum. All hibernacula were located at the base of large bedrock outcrops and ledges (> 2 m) comprised of limestone, granite, or schist, with immediately adjacent boulders and cobbles. Other species of snakes utilizing these hibernacula included Arizona Black Rattlesnake (*C. cerberus*), Black-necked Gartersnake (*Thamnophis cyrtopsis*), Striped Whipsnake (*Masticophis taeniatus*), and Western Lyresnake (*Trimorphodon biscutatus).* High site fidelity has been documented in *C. molossus* at these sites and at Tonto National Monument (Gila and Yavapai counties, Arizona) through radio-telemetry and mark-recapture research (M. Spille, G. Schuett, and E. Nowak, unpubl. data). Our observations demonstrate that *C. molossus* hibernates communally in northern, high elevation portions of its range. To our knowledge, this is the first report of communal hibernacula in *C. molossus*.

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CROTALUS SCUTULATUS SCUTULATUS (Mohave Rattlesnake). **ALBINISM**. Albinism has been previously documented in five species of *Crotalus*: *C. adamanteus, C. atrox, C. durissus, C. horridus,* and *C. viridis* (e.g., Hensley 1959. Albinism in North American Amphibians and Reptiles. Publ. Mus. Mich. State Univ. 1:133–159; Klauber 1972. Rattlesnakes. Their Habits, Life Histories, and Influence on Mankind. Univ. California Press, Berkeley, California. 1476 pp.; Dyrkacz 1981. Recent Instances of Albinism in North American Amphibians and Reptiles. SSAR Herpetol. Circ. No. 11. 31 pp.). This is the first record of albinism in *Crotalus scutulatus.*

On 30 May 2000, one of us (BA) collected a small (ca. 600 mm) female albinistic rattlesnake in sparsely vegetated desert, dominated by Creosote Bush (*Larrea tridentata*), in northeastern Kern Co., California, USA (ca. 35°35'N, 117°47'W, ca. 800 m elev.). The specimen's background color was yellowish-white with faint diamond-shaped dorsal blotches that were faintly outlined with a darker hue and bordered posteriorly by single rows of whitish scales. The tail was marked with three gray caudal rings, each being one scale row in width and separated by nearly white rings comprised of three scale rows each. The proximal rattle segment was uniformly pale yellow. The irises were tan and the tongue was pink. The crown of the head was devoid of scales in the frontal and prefrontal areas, except for a few widely separated fragments.

The faintly visible pattern, as well as the general body morphology, collection location, and habitat, were consistent with an identification of *C. scutulatus.* In captivity, this specimen has since produced typical *C. scutulatus* offspring with a normally pigmented male. Digital color images of the specimen have been deposited at the San Diego Natural History Museum (SDSNH-HerpPC 5201–03).

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CROTALUS SCUTULATUS SCUTULATUS (Mohave Rattlesnake). **MORPHOLOGY**. Absence of the rattle has been reported in six species of *Crotalus*: *C. cerastes, C. horridus,* and *C. pricei* (Klauber 1956. Rattlesnakes. Their Habits, Life Histories, and Influence on Mankind. Univ. California Press, Berkeley, California. 1476 pp.), *C. atrox* (Painter et al. 1999. Herpetol. Rev. 30:44; Holycross 2000. Herpetol. Rev. 31:177–178), *C. viridis* (Painter et al., *op. cit.*; Holycross, *op. cit.*), and *C. lepidus* (Christman et al. 2004. Herpetol. Rev. 35:62). Herein we report a mature male *Crotalus scutulatus* (LACM 159667) exhibiting total absence of the external rattle and internal rattle shaker.

The frozen headless carcass (ca. 800 mm SVL, ca. 58 mm tail length) was examined by one of us (MDC) on 8 June 2002, after having been killed in late August 1999 near Adelanto, San Bernardino Co., California, USA (ca. 34°32'52"N, 117°31'18"W, ca. 940 m elev.). Sex was verified by an everted hemipenis. Twenty-five subcaudal scales were present, consistent with the range noted (22–28, mean = 25 ± 0.2 SE) for males (N = 34) in a nearby series of *C. scutulatus* (Cardwell, unpubl. data). The exposed skin at the terminus was sooty black and surrounded by a margin of irregularly sized and shaped scales. Radiographs revealed the absence of the internal rattle shaker. It was determined that previous repeated freezing and thawing of the carcass would likely render a histological examination for scar tissue inconclusive. Digital photographs and radiographs have been deposited in the Natural History Museum of Los Angeles County (LACM-PC 1405–1411).

We thank R. Crombie, S. Goldberg, J. Jarchow, B. Moon, A. Rabatsky, and G. Schuett for advice regarding the possible etiology of this deformity and/or the potential for a conclusive determination.

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ELAPHE SPILOIDES (Central Ratsnake) **HABITAT USE.** As forests become more fragmented, the proportion of edge habitat increases. In Ontario and the northeastern United States, *Elaphe spiloides* occurs more frequently in edge habitat than due to chance (Blouin-Demers and Weatherhead 2001. Ecology 82:2882–2896; Durner and Gates 1993. J. Wildl. Manag. 57:812–826), possibly because of an increased number of avian (Paton 1994. Conserv. Biol. 8:17–26) and small mammalian prey (Blouin-Demers and Weatherhead, *op. cit.*) in this habitat type. Edge use by ratsnakes might also reflect their increased ability to thermoregulate in this habitat because of increased sun exposure (Weatherhead and Charland 1985. J. Herpetol. 19:12–19). Here, we report the habitat use and home range size of *E. spiloides* in an agriculturally fragmented forest environment in Clark Co., Illinois, USA.

Six *E. spiloides* were implanted with radio-transmitters (Model SI-2T, Holohil Systems, Ltd., Ontario, Canada) and relocated every 1–2 days between 19 May 2003 and 7 November 2004 (except during hibernation). Ambient (ca. 30 cm above shaded ground) and subject body temperatures were recorded at the time of each relocation. Spatial data was analyzed using ArcView Geographic Information System (GIS, v 3.2) or ArcGIS 8.1 (ESRI, Redlands, California) with the Xtools Extension (DeLaune 2000. Oregon Department of Forestry, Salem, Oregon), Spatial Analyst Extension, and Animal Movement Extension (Hooge and Eichenlaub 2000. Alaska Science Center – Biological Science Office, U.S. Geological Survey, Anchorage, Alaska). Individual locations were plotted using UTM coordinates on Illinois Digital Orthophoto Quadrangle (DOQ) maps imported into ArcView GIS. We calculated the home range size of each individual using the minimum convex polygon method (Jennrich and Turner 1969. J. Theor. Biol. 22:227–237). Habitat types (Table 1) were quantified within home ranges by defining habitat boundaries on the DOQ maps within ArcGIS. Edge habitat (± 15 m of the boundary between forest and any open habitat; following Blouin-Demers and Weatherhead, *op. cit.*), was assigned as a unique habitat type to test for edge preference.

Mean mass (± 1 SE) of the subjects was 654.5 ± 109.0 g, and mean snout–vent length was 119.8 ± 11.3 cm. Mean ambient temperature and snake body temperature during relocations were 23.6 ± 0.3°C and 23.2 ± 0.3°C, respectively. Subject body temperature exceeded ambient temperature during 40.8% of the relocations. Snakes were relocated a total of 417 times over periods ranging from 58 to 428 days, providing 212 sample points for the determination of home range sizes and patterns of habitat use. The mean home range size was 9.65 ± 3.62 ha. Subjects used the seven habitat types non-randomly ($G = 106.50$, df = 6, $P < 0.001$; Table 1). Of the dominant habitat types (i.e., agricultural field, deciduous forest, edge, and grassland/pasture), snakes occupied forest and forest edges more often than would be expected due to chance, and appeared to avoid open habitats ($G = 101.90$, df = 3, $P < 0.001$). Subjects also occupied forest edges more often than forest interiors, despite the fact that the latter comprised a greater proportion of available habitat ($G = 83.92$, df = 1, $P < 0.001$; Table 1).

The mean home range for *E. spiloides* in this study was on the higher end of the distribution of home ranges reported for populations in less fragmented habitats (e.g., Mullin et al. 2000. Herpetol. Rev. 31:20–22), possibly reflecting decreased availability of resources for snakes at our study site. Our subjects were located in edge habitat more often than expected (Table 1), a finding that is consistent with previous studies conducted in the northeastern U.S. (Blouin-Demers and Weatherhead, *op. cit.*; Durner and Gates, *op. cit.*). Our results contrast, however, with a study of ratsnakes in Vermillion Co., Illinois (110 km N of Clark Co., Illinois) in which ratsnakes were associated with forest habitat but were not consistently located in edges (Keller and Heske 2000. J. Herpetol. 34:558–564). In addition to assessing the impacts of anthropogenic habitat fragmentation on other snake species, future studies should explore the effects of edge habitat availability on *E. spiloides* population structure and dynamics.

TABLE 1. Pooled number of observed and expected relocations (based on proportions of habitats within a subject's home range) for six *Elaphe spiloides* radio-tracked in Clark County, Illinois, between 19 May 2003 and 7 November 2004.

Habitat Type	Observed	Expected
Agricultural Field	0	24.8
Deciduous Forest	89	124
Edge	114	60.9
Grasses	8	2.6
Buildings	1	0.1
Residential Yard	0	0.2
Road/Driveway	0	0.2

Robert Szafoni of the Illinois Department of Natural Resources (IDNR) initiated this project, and the IDNR provided funding. Collections were authorized by permit #NH03-0946 (IDNR), and surgical procedures were approved by IACUC protocol #04-007.

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MASTIGODRYAS MELANOLOMUS (Salmon-bellied Racer). **ENDOPARASITES.** *Mastigodryas melanolomus* is known on the Atlantic versant from Tamaulipas, Mexico, to western Panama and on the Pacific slope from Nayarit to western Guatemala, Costa Rica, and western and central Panama (Savage 2002. The Amphibians and Reptiles of Costa Rica. A Herpetofauna Between Two Continents Between Two Seas. University of Chicago Press, Chicago, Illinois. xx + 934 pp.). There are, to our knowledge, no published reports of endoparasites from *M. melanolomus.* The purpose of this note is to report one species of Cestoda, two species of Acanthocephala, and one species of Nematoda from *M. melanolomus.*

Seventy-one *M. melanolomus* from Costa Rica (SVL = 680 mm ± 114 SD, range: 422–941 mm) collected 1958–1962, 1964, 1966, 1967, 1971, 1974, 1982, 1983, 1985, from Alajuela Province (LACM 153462, 153475, 153505, 153509); Cartago Province (153416, 153419, 153422, 153424, 153426, 153428,153430–153436, 153439, 153441, 153445, 153460, 153463, 153466, 153469, 153474, 153477, 153478, 153480–153482, 153507,

153512); Guanacaste Province (153420, 153458,153465, 153520); Heredia Province (153453, 153461, 153518); Limón Province (153423, 153427, 153429,153438, 153443, 153446, 153483, 153510, 153511, 153516, 153517); Puntarenas Province (114114, 153418, 153421, 153425, 153442, 153450-153452, 153457, 153476, 153506, 153508, 153523); San José Province (153417, 153437, 153440, 153472, 153473, 153479, 153513, 153514) were examined from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California. A mid-ventral incision was made in the body wall; organ surfaces and mesenteries in the posterior portion of the body cavity were visually examined for helminths. Found were larval Cestoda (metacestodes in cysts), (prevalence [infected snakes/snakes examined × 100] = 13%; mean intensity [mean number of helminthes per infected lizard ± 1 SD] = 2.0 ± 1.7; range [minimum to maximum number per host] = 1–6; larval Acanthocephala (centrorhyhchid cystacanths) prevalence = 3%; mean intensity: 1.0; range: 1; Acanthocephala (oligacanthorhynchid cystacanths) prevalence = 7%; mean intensity: 3.2 ± 2.2; range: 1–6; Nematoda, larval *Porrocaecum* sp. prevalence = 3%; mean intensity 5.0 ± 5.7; range: 1–9. These were prepared as whole mounts using standard parasitological techniques (Cestoda, Acanthocephala) or cleared in glycerol (Nematoda) and identified. Vouchers were deposited in the United States National Parasite Collection (USNPC) as Cestoda: metacestode larvae (98663); Acanthocephala: Centrorhynchidae (98665); Oligacanthorhynchidae (98666); Nematoda: *Porrocaecum* sp. (98664).

Mastigodryas melanolomus feeds mainly on lizards but may also eat snakes, birds, and small mammals (Savage 2002, *op. cit.)*. The juvenile Cestoda (metacestodes) (Roberts and Janovy 2005. Gerald D. Schmidt & Larry S. Roberts' Foundations of Parasitology. McGraw Hill, Boston, Massachusetts. 702 pp.), juvenile Acanthocephala (centrorhynchs), and larval Nematoda *(Porrocaecum* sp.) probably reached *M. melanolomus* by the ingestion of infected prey items. *Mastigodryas melanolomus* likely functions as a paratenic (transport host) with development to the adult parasite occurring when the snake is eaten by a predator. This is further suggested as adults of *Porrocaecum* are normally found in birds (Anderson 2000. Nematode Parasites of Vertebrates: Their Development and Transmission. CABI Publishing, Wallngford, Oxon U.K. 650 pp.). None of the helminths found in this study was unique to Costa Rica or *M. melanolomus* (Goldberg and Bursey 2004. Carib. J. Sci. 40:62–69). Cestoda metacestode larvae, Acanthocephala centrorhynchid and oligacanthorhynchid cystacanths and Nematoda, *Porrocaecum* sp. in *M. melanolomus* are new host records.

We thank Christine Thacker (LACM) for permission to examine snakes which are part of the CRE collection donated to LACM by Jay M. Savage in 1998.

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NERODIA RHOMBIFER (Diamond-backed Watersnake). **FORAGING BEHAVIOR**. On 5 August 2005, we captured an adult male *N. rhombifer* (760 mm SVL, 244 mm tail length) in a shrimp trap that had been set 3 m deep on the bottom of the Atchafalaya River near the town of Butte La Rose in St. Martin Parish, Louisiana, USA. The river had muddy banks and bottom, was near minimum low-stage water flow, had water clarity of about 0.3 m, and lacked submerged vegetation. The snake was in the final stages of drowning when removed from the trap at about 0900 h, and hence probably entered the trap within the preceding hour. The trap was 25 cm in diameter, 76 cm long, and made of 6 mm (mesh size) hardware cloth, with a 4 cm opening in the throat. A partially decomposed long-nosed gar (*Lepisosteus osseus*) was placed in the trap as bait. In addition to the snake and bait, the trap contained about 12 medium-sized river shrimp (*Macrobrachium ohione*) and several small blue catfish (*Ictalurus furcatus*). Maximum foraging depths have not been reported for this species, although it has been observed diving in open water that was at least 3 m deep (Keck, unpubl. data, cited in Gibbons and Dorcas 2004. North American Watersnakes: A Natural History. Norman, Univ. Oklahoma Press). Our trapped specimen demonstrated a foraging depth of at least 3 m, which supports the hypothesis of Mushinsky et al. (1982. Ecology 63:1624–1629) that large watersnakes forage in deep, open water. The snake's stomach was empty. Given the strong preference of *N. rhombifer* for fish prey (Gibbons and Dorcas 2004) and the murky water, we suspect that the snake used chemosensory cues to find the strong-smelling bait fish or the catfish in the trap.

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NINIA MACULATA (Spotted Coffee Snake). **ENDOPARASITES.** *Ninia maculata* is known from northeastern Honduras, Nicaragua, Costa Rica, and western Panama (Savage 2002. The Amphibians and Reptiles of Costa Rica. A Herpetofauna Between Two Continents Between Two Seas. University of Chicago Press, Chicago, Illinois. xx + 934 pp.). To our knowledge, there are no published reports of endoparasites from *N. maculata*. The purpose of this note is to report two species of Nematoda from *N. maculata*.

Eleven *N. maculata* from Costa Rica (SVL 222 ± 23 mm SD, range: 178–258 mm) were collected 1962–1964, 1966, 1967 from Cartago Province (LACM 153828) and San José Province (LACM 153826, 153833–153837, 1538430, 153842, 153843, 153851). A mid-ventral incision was made, and the digestive tract was removed. The esophagus, stomach, small and large intestines, and body cavity were examined for endoparasites using a dissecting microscope. Two species of Nematoda were found: mature males and gravid females of *Cosmocercoides variabilis* (infection site: small and large intestines; prevalence [infected snakes/snakes examined × 100] = 45%; mean intensity [mean number of helminths per infected lizard ± 1 SD] = 8.4 ± 9.5; range [minimum to maximum number per host] = 1–24); juveniles of *Cruzia* sp. (infecton site: small and large intestines; prevalence = 18%; mean intensity = 4.5 ± 0.7; range = 4–50). These were cleared in glycerol for

study, then deposited in the United States National Parasite Collection, *Cosmocercoides variabilis* (USNPC 98852) and *Cruzia* sp. (USNPC 98853).

Two species of *Cosmocercoides* occur in the Americas, *C. dukae* and *C. varabilis* (Vanderburgh and Anderson. 1987. Can J. Zool. 65:1650–1661). The major difference between the two species is the number of rosette papillae of the male: *C. dukae* with 12 pairs; *C. variabilis* with 14–20 pairs. We have assigned these individuals to *C. variabilis* because the males possess 14 or 15 pairs of rosette papillae. *Cosmocercoides variabilis* is widely distributed in North America, where it has been reported from Caudata, Anura, Squamata, and Chelonia (Baker 1987. Mem. Univ. Newfoundland Occas. Pap. 11:1–325). Species of *Cruzia* are primarily parasites of mammals but have been reported from several species of amphibians and reptiles (Baker, *op. cit.*). Transmission of *C. variabilis* and species of *Cruzia* is direct and does not involve an intermediate host (Anderson 2000. Nematode Parasites of Vertebrates. Their Development and Transmission. 2nd Ed. CABI Publishing, Oxon, UK. xx + 650 pp.). *Ninia maculata* represents a new host record and Costa Rica is a new locality record for both *C. variabilis* and *Cruzia* sp.

We thank Christine Thacker (LACM) for permission to examine snakes, and Jessica Carlson and Dustin Goto (Whittier College) for assistance with dissections. Specimens of *N. maculata* are part of the CRE collection donated to LACM by Jay M. Savage in 1998.

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OPHIOPHAGUS HANNAH (King Cobra). **DIET**. Despite the common assertion that King Cobras primarily eat snakes, or snakes and occasionally varanids (e.g., Evans 1902. J. Bombay Nat. Hist. Soc. 14:409–418; Smith 1943. Fauna of British India: Reptilia and Amphibia, Vol. III, Serpentes. Taylor & Francis, London), few specific records of the diet of *Ophiophagus hannah* exist in the literature. Furthermore, dietary records in this species are geographically clustered, despite the species' broad distribution. Eight of 10 records that I found in which a specific prey item was named are from India. One other record (Craddock 1903. J. Bombay Nat. Hist. Soc. 15:143) is from Malaysia. Wray (1907. J. Fed. Malay States Mus. 64–65) reported on the diet of the King Cobra without naming localities for the specimens; presumably these snakes were also from Malaysia. I found no records of the diet of *O. hannah* in the wild in Thailand.

On 7 February 2005 at 0947 h, I observed a juvenile *O. hannah* (ca. 2 m SVL) beginning to swallow an adult *Rhabdophis nigrocinctus* (ca. 70 cm SVL). I was alerted to the presence of the snakes by their struggle, and when I returned with a camera, the cobra was in the process of ingesting the keelback head-first. I photographed the snakes to confirm their identities (KU Digital Archive, KUDA 001722). Both snakes were on the ground in a clearing around a small pond, about 5 m from the forest edge and 5 m from the pond edge, in dry, evergreen forest at Sakaerat Environmental Research Station, Nakhon Ratchasima Province, northeast Thailand (14°29'43.4"N, 101°55'07.4"E).

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REGINA RIGIDA (Glossy Crayfish Snake). **MAXIMUM SIZE**. An adult male *Regina rigida* collected 30 March 2005, 10 mi E of Pollock (Grant Parish, Louisiana, USA) measured 830 mm TL. This exceeds the previous record of 797 mm total length (Shoop 1959. Herpetologica 15:160) by 33 mm. The specimen is deposited in the vertebrate collection of Louisiana State University Museum of Zoology (LSUMZ 89683).

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REGINA SEPTEMVITTATA (Queen Snake). **PREDATION.** Reports of arachnids preying on snakes are uncommon (Bayliss 2001. Herpetol. Rev. 32:49; Groves and Groves 1978. Bull. Maryland Herpetol. Soc. 14:44–46; Lazcano et al. 2005. Herpetol. Rev. 36:186; McCormick and Polis 1982. Biol. Rev. 57:29–58; Zippel and Kirkland 1998. Herpetol. Rev. 29:46). Some spiders have been noted to feed on small snakes (Groves and Groves, *op. cit.*; McCormick and Polis, *op. cit.*), and a few species have been found entangled in spiderwebs (e.g. Bayliss, *op. cit.*; Zippel and Kirkland, *op. cit.*). Here, I report the first account of a spider feeding on the carcass of a subadult *Regina septemvittata*.

At 1025 h on 24 May 2003, a deceased *R. septemvittata* (325 mm SVL) was discovered while being eaten by an adult *Dolomedes tenebrosus* in Wilson Co., Tennessee, USA. The spider, an adult female with a ca. 7 cm legspan, was feeding on the snake's flesh ca. 3 cm posterior to the head under a large rock situated on the bank of Fall Creek (ca. 7 m wide). It is unclear if the spider killed the snake or located the carcass and began to consume it. Because both species appear to be abundant and share the same riparian habitats, predation by *D. tenebrosus* on *R. septemvittata* might not be uncommon.

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Sun-Basking and Desiccation in Two Frog Species from the Periphery of the Australian Arid Zone

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Amphibians are well-known for their sensitivity to water loss and relatively few species have developed adaptations that allow them to survive in xeric environments (Duellman and Trueb 1986; Warburg 1997; Zug et al. 2001). Adaptations to xeric environments include a nocturnal lifestyle, typical water-conserving resting postures, aestivation during dry conditions, and dehydration tolerance (Hillman 1980; Kobelt and Linsenmair 1992; Pough et al. 1998). Only a few species have evolved adaptations that allow them to bask in bright sun when not immersed in water (Brattstrom 1979; Buttemer 1990; Christian and Parry 1997; Duellman and Trueb 1986; Stebbins and Cohen 1995). I define sun-basking as sitting exposed to the sun for prolonged periods while access to shade is possible. Sun-basking has the advantage of allowing attainment of an increased body temperature which benefits digestion and growth (Lillywhite et al. 1973), and hence may reduce time to reach sexual maturity and allow attainment of larger body size.

Given the desiccating conditions to which frogs living in semi-arid zones are exposed they should avoid sun-basking. To my knowledge sun-basking in desert frogs has been reported only for young *Bufo debilis* (Seymour 1972). Here I report observations on sun-basking and desiccation in two frog species from the periphery of the arid zone in Australia.

The observations were made incidentally as part of a study of the population and community ecology of reptiles in Kinchega National Park, western New South Wales, Australia (32°28'S, 142°20'E). Kinchega National Park is located at the periphery of the arid zone with an average yearly rainfall of 236 mm that is highly variable between years but evenly spaced across the year (Robertson et al. 1987). Mean annual maximum temperature (1995–2002) ranged between 25.4 and 27.6°C and mean monthly maximum temperature (1992–2002) varied between 14.6 and 39.2°C.

The study area extended ca. 500 m to the north, 200 m to the east, and 500 m to the west of Kinchega Station. It consisted of Black Box (*Eucalyptus largiflorens*) riverine woodland on grey clay soil and the adjacent red sand dunes. Partial flooding of the study sites occurred in 1989, 1990, 1998, and 1999. For more details on the study area see Caughley et al. (1987) and Henle (1990).

The study site was visited every second month from September 1985 to May 1987 and yearly from 1996–2006 in February/March. During each visit, at least eight daytime and eight nocturnal visual searches of 2–3 h duration were made. In addition, temporary ponds and puddles that formed in the vicinity of the study area after heavy local rains were checked for amphibians at least once per visit at night and during the day.

The frog community in the study area consisted of four species: *Limnodynastes tasmaniensis, Neobatrachus* cf. *pictus, Litoria caerulea*, and *Litoria peronii*. A single adult of a fifth species, *Crinia parinsignifera*, was caught in a pitfall trap. All recently metamorphosed *N.* cf. *pictus* (N = approx. 50) and *L. tasmaniensis* (N = 11) were observed at night. Of 106 juvenile *L. caerulea*, eight individuals and the single juvenile *L. peronii* were observed sun-basking in May 1998. No adults of any of the four species were ever observed sun-basking in spite of > 500 *L. tasmaniensis*, > 500 *L. peronii*, > 1000 *L. caerulea*, and > 5000 *N.* cf. *pictus* observed. The difference is highly significant for *L. caerulea* ($\chi^2 = 70; \alpha = 0.00$) and *L. peroni* ($\chi^2 = 500; \alpha = 0.00$). Seymour (1972) and Freed (1980) also observed that recently metamorphosed anurans are more prone to expose themselves to the sun than adult frogs.

All sun-basking juveniles were sitting fully exposed to the sun, either on the ground between herbs (3 *L. caerulea*) or in the axilla of large leafs (1 *L. peronii* and 5 *L. caerulea*). They retained their position for the whole observation period (approximately 10 minutes) and made no effort to seek nearby shade underneath herbs or in the numerous cracks in the soil. At the time of observations there were neither clouds nor wind. It was the hottest part of the day with temperatures reaching 37.7°C (*L. caerulea*) and 29.5°C (*L. peronii*) in the shade 2 m above the ground. For *L. caerulea*, the shade temperature reached the lower limit of the range of the Critical Thermal Maximum determined by Johnson (1970).

Although limited diurnal activity also occurred in adults of all species, diurnal activity invariably occurred in shelter, such as calling from within very dense flooded bushes or from within hollow trees after rain. In addition, *L. caerulea* occasionally was seen active during the day close to artificial water bodies such as toilets or water tanks that were sheltered from the sun.

Three adult *L. caerulea* were found desiccated on dirt tracks in the morning of a sunny day and apparently failed to locate a safe retreat. In all cases, the closest safe retreats were in a distance of ≥ 20 m. These dead frogs were in a resting position with the feet tightly tucked underneath the body and the whole body forming a hemisphere.

Shady retreats are less available for adult frogs due to their larger size. Therefore, they likely have a higher desiccation risk, which probably explains why adult frogs were not observed sun-basking. A difference between juveniles and adults to withstand desiccating conditions has been shown for the African reed frog *Hyperolius nitidulus* (Rödel 2000). Physiological adaptations to winds associated with canopy locations (Buttemer 1990) may explain why sun-basking is more prominent in more arboreal frog families, such as hylids and hyperoliids, and absent in syntopic species of more terrestrial families (McClanahan and Shoemaker 1987; Rödel 2000; this study).

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Activity Season, Habitat Use, and Environmental Temperature Selection of the Prairie Racerunner (*Aspidoscelis sexlineata viridis*) at the Northern Limit of its Range

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Regulation of body temperature is a critical function in the lives of many ectotherms, particularly lizards (Huey and Slatkin 1976; Pianka and Vitt 2003). The cost of thermoregulation in ectotherms comes in the form of tradeoffs with other activities that are important for survival (e.g., feeding or predator avoidance), whereas the benefits include performing at peak metabolic and behavioral capacity (Huey and Slatkin 1976; Pianka and Vitt 2003). Lizards of the genus *Aspidoscelis* (formerly included in *Cnemidophorus*; Reeder et al. 2002) are well known for their precise thermoregulation of high body temperatures (36–42°C), which they achieve by shuttling between thermal sources and sinks (Bowker and Johnson 1980; Fitch 1958; Milstead 1957).

Thermoregulation is considered important to the metabolic and behavioral performance of racerunners (e.g., Fitch 1958; Hardy 1962). Although the thermal ecology of Prairie Racerunners (*Aspidoscelis sexlineata viridis*; previously classified in much of the upper Midwestern United States as the Six-lined Racerunner *A. sexlineata sexlineata*; Conant and Collins 1998) and other *Aspidoscelis* has been studied in other regions of the United States (e.g., Fitch 1958; Hardy 1962; Paulissen 1988; Witz 2001; Wright and Vitt 1993), very little empirical information has been published on this subspecies in the upper Midwest United States (Warner 2000). Because these regions represent the northern distributional limit of *A. s. viridis* (Conant and Collins 1998), studies of active-season duration, habitat use, and environmental temperature selection should yield important insights into the biology of this subspecies.

The duration of the active season and habitat selection by *A. sexlineata* have been reported for several regions of the United States (Fitch 1958; Hardy 1962; Witz 2001). For the upper Midwest, most information on the habitat preferences and seasonal activity of racerunners is summarized in field guides (Harding 1997; Oldfield and Moriarty 1994; Phillips et al. 1999; Vogt 1981). According to these sources, this subspecies prefers open-canopy habitats such as pine barrens, open grasslands, and oak savannas with loose dry soil and sparse ground vegetation. These habitats can experience high environmental temperatures (JMK, pers. observ.). Unfortunately, this information is qualitative, and to our knowledge there have been no attempts to quantitatively characterize the habitats used by *A. s. viridis* in the upper Midwest.

Our study was conducted to obtain quantitative ecological data, which are lacking for *A. s. viridis* in the upper Midwest. First, we determined the length of the activity season and compared our findings to other reports for the subspecies. Second, we quantified habitat use at our study site. Third, we determined whether ground-surface temperatures differed among habitats used by *A. s. viridis*. The second and third points begin to circumscribe the niche of this subspecies, which may need to be managed to insure its long-term survival in this region.

TABLE 1. Type, amount, and observed use of habitats by *Aspidoscelis sexlineata viridis* in Sauk County, Wisconsin, USA.

Habitat Type	Habitat Size (ha)	% of Study Site	Lizard Use (%)
Agriculture	279	33.7	0.0
Open bluffside	48	5.8	2.6
Closed canopy forest (bluff)	298	36.1	0.0
Conifer forest	3	0.4	0.0
Edge habitat (natural/agricultural)	35	4.2	0.0
Hillside with occasional brush/trees	12	1.5	0.0
Residential landscape	25	3.1	0.0
Oak savanna	58	7.0	58.9
Open grassland	45	5.5	38.4
Roadside grass	15	1.9	0.0
Sandblown	6	0.7	0.0
Totals	824	100.0	100.0

The study site was located in southwestern Wisconsin (Sauk County) on 824 ha of land managed by The Nature Conservancy (TNC) in the Lower Wisconsin River Valley. The habitats present included restored sand prairie and oak savanna in the lowlands, and adjacent west-to-south-facing bluffs with exposed limestone outcroppings cleared of overstory vegetation in some areas. Oak savannas had mostly sandy soils with sparsely clumped shrubby vegetation and leaf litter. Oak trees (*Quercus*), occasionally > 6 m in height and ranging from 5–40 m apart, occurred in clumped stands throughout the study site. Understory vegetation in these habitats occurred irregularly and usually consisted of raspberry (*Rubus*) tangles or xerophilous plants near the oak trees. Open grassland and sand prairie habitats also had sandy soils, but little canopy vegetation, and understory vegetation rarely exceeded 100 cm in height. Often, this understory vegetation (*Andropogon*, *Opuntia*, and *Sorghastrum*) was clumped, with intervening areas of open sand. The land bordering the TNC property was dominated by agriculture (row crops or pasture) and residential lawns with ornamental shrubs, or rubble piles near homes in the lowlands. Closed canopy forests, consisting of cedar (*Juniperus*) and oak (*Quercus*), lined the west-to-south-facing bluffs that bordered TNC property. Some of the study site has been managed since the 1970s, with past and ongoing management including native seed application, burning, and eradication of invasive plant species (*Alliaria*, *Juniperus*, and *Robinia*).

Visual surveys for active *A. s. viridis* were conducted from early April until mid-October in 2004 and 2005 and four times in August of 2003. Surveys were conducted at least 3 days each week from approximately 0930–1430 h. Typically only one surveyor (JMK) was present. The surveys were conducted by walking through all habitats at the study site (i.e., not solely in areas with high abundances of *A. s. viridis*). Although all habitats were sampled during each survey, it was not possible to survey all habitat types equally on a given day.

Upon encountering a basking lizard, several parameters were recorded at the position where it was observed. Because these lizards are apt to flee when disturbed, we only recorded data for observations in which it could be determined where the lizard was resting prior to flight. Each location was recorded using a global positioning device (Garmin® GPS III Plus; Olathe, Kansas). Habitat type was characterized in the field and confirmed via geographic information system (GIS) based on an aerial photograph (ArcMap 8.2; Table 1). Microhabitat analyses of the vegetation were also conducted, including the percent of ground cover in a 1-m^2 area centered on each lizard occurrence. We recorded soil type as sand, soil, sand/soil mix, or soil/gravel mix. Tree-canopy cover was measured via a convex densiometer (Ben Meadows, Atlanta, Georgia). We estimated soil-surface temperatures at each lizard local-

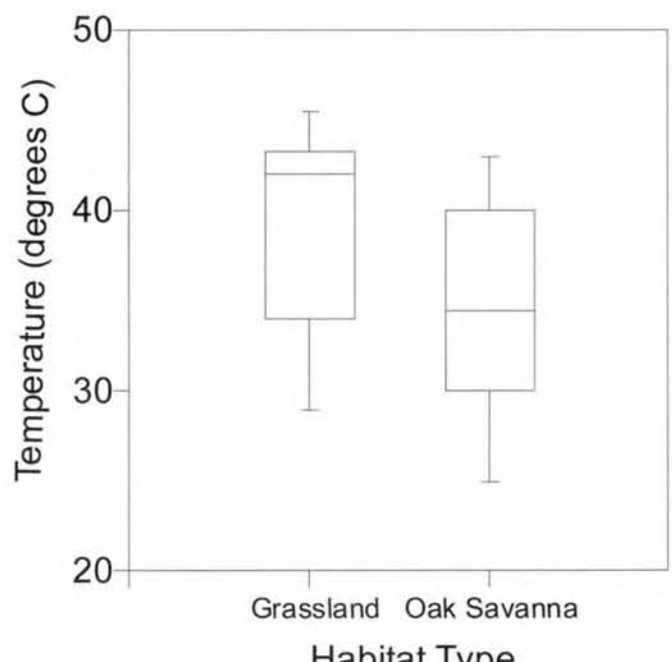

FIG. 1. Box plots: (median, 25th and 75th percentile, and range) comparing soil-surface temperatures between the two habitats in which *Aspidoscelis sexlineata viridis* was most commonly observed in Sauk County, Wisconsin.

ity by laying a glass-encased pocket thermometer (non-mercury) on the soil surface until it equilibrated, which did not exceed 5 min. Comparison of soil-surface temperatures selected by lizards between habitats was accomplished via a two-sample *t*-test conducted in Systat v. 10.0 (Point Richmond, California). The percentage of racerunner observations in a particular habitat was calculated by taking the number of observations in that habitat and dividing it by the total number of racerunner observations; however, we did not account for search effort within each habitat.

We observed active adult racerunners from 10 May–31 August in both years. The activity of hatchlings lasted several weeks longer in fall, with the latest observation occurring on 6 October. Thirty-nine observations were deemed acceptable based on the previously mentioned criteria. Of these, we recorded soil temperature on 36 occasions. In most cases, adult lizards were observed in either oak savanna (N = 23) or open grasslands and prairie (N = 15). These two habitats constitute a small portion (12.5%) of the study area (Table 1). The remaining individual (excluded from analyses) was found basking on rocky soil of a south-facing open bluff. The microhabitats in which lizards were observed had mean understory cover of 32% (range: 0–75%) and an estimated tree-canopy closure of 17.6% (range: 0–70%). Lizards were observed on soils characterized as either sand (N = 38) or soil/gravel mix (N = 1). The soil-surface temperatures selected by racerunners were relatively high (Fig. 1) and differed ($t = 2.34$; $P = 0.025$) between oak savannah (34.7°C) and open grassland (39.2°C).

The active season for adult racerunners at our study site (early May through late August) was 2–3 weeks longer than the mid-May through mid-August season proposed by Vogt (1981) for Wisconsin. The active season we observed was also slightly longer than the late May through mid-August active season proposed for the Great Lakes region by Harding (1997) and the mid-May through late August season proposed for Minnesota by Oldfield and Moriarty (1994). Although our observations are based on a small area within the state, this may be the largest population of this subspecies in Wisconsin (B. Hay, pers. comm.). However, we cannot eliminate annual variation in climate as a possible factor contributing to the differences between our estimate of activity period and the other sources. Nonetheless, because racerunners (1) are listed by the Wisconsin Department of Natural Resources (DNR; 2005) as a "Species of Greatest Conservation Need" and considered restricted in range or declining in other states within this region; (2) have short activity seasons (4 months or fewer) compared to populations in other parts of their range; and (3) their habitats in the upper Midwest, where protected, are often managed by burning, knowing the earliest and latest possible dates for racerunner activity may reduce management-related mortality.

Aspidoscelis sexlineata is widely reported to prefer open habitats (Fitch 1958; Harding 1997; Hardy 1962; Oldfield and Moriarty 1994; Phillips et al. 1999; Vogt 1981). Not surprisingly, lizards were never encountered in closed canopy habitats, such as lowland and bluffside mixed hardwood forests, which dominated the landscape adjacent to most of our racerunner observations. The high soil-surface temperatures apparently preferred by this subspecies were more commonly available in open-canopy habitats, but open grassland habitats may have been too hot (i.e., exceeding the upper preferred limit for this subspecies). This may partly explain why lizards were observed less often in open grassland than in oak savanna, although alternate hypotheses cannot be ruled out (e.g., predator or prey densities, etc.).

Our findings are relevant to those involved in the management and restoration of upper Midwest prairie habitats where this subspecies occurs. Because *A. s. viridis* is considered uncommon and declining in many upper Midwest states (Christoffel et al. 2002; Oldfield and Moriarty 1994; Phillips et al. 1999; Wisconsin Department of Natural Resources 2005), proper management of canopy and under-story vegetation in areas where this subspecies occurs is of critical importance to its conservation (Mushinsky 1985). Our results indicate that Prairie Racerunners are usually observed in two habitats that are rapidly declining throughout the United States: oak savannas and open grasslands. Therefore, protection or management of these habitats is critical, at least in this portion of the Prairie Racerunner's range.

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TECHNIQUES

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The Application of Skeletochronology to Estimate Ages of Three Species of Frogs in West Java, Indonesia

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Skeletochronology has been used successfully to estimate age in temperate and sub-temperate frogs (Halliday and Verrel 1988; Khonsue et al. 2002; Morrison et al. 2004; Reaser 2000; Ryser 1988). In temperate species, lines of arrested growth (LAGs) in bones are usually distinct and are formed during winter (Halliday and Verrel 1988; Reaser 2000; Ryser 1988). Few attempts have been made to estimate age using this method in tropical frogs (Guarino et al. 1998; Khonsue et al. 2000; Kumbar and Pancharatna 2001; Pancharatna et al. 2000) and it has not previously been applied to Indonesian frogs.

As part of a population study of three species of edible frogs in Indonesia, we examined phalanges taken from toe clips of *Fejervarya limnocharis*, *F. cancrivora*, and *Limnonectes macrodon* to determine whether it is possible to estimate the ages of individuals of these tropical species using skeletochronology. For every frog captured, we recorded sex, body size as measured by SVL (snout–vent length) and mass, and clip code. Since each frog was numbered uniquely, phalanges used for skeletochronological analysis were taken from different toes. *Fejervarya limnocharis* and *F. cancrivora* were encountered in rice fields, and *L. macrodon* was found primarily at streams.

We analysed samples from 103 *F. limnocharis* (SVL = 15.68–53.00 mm), 35 *F. cancrivora* (SVL = 14.50–56.68 mm) and 42 *L. macrodon* (SVL = 47.06–105.22 mm). Samples of the rice field frog species were taken during surveys carried out between September 2001 and June 2002 in West Java province, Indonesia, in the Residencies of Bogor and Sukabumi. Samples from Bogor were taken from rice fields in Situ Gede (06°33'50.8"S, 106°44'10.2"E, elevation 220 m above sea level) and Caringin (06°43'22.4"S, 106°49'22.8"E, elevation 478 m asl) while samples from Sukabumi were taken from Ciptarasa (06°51'07.3"S, 106°30'22.9"E, elevation 810 m asl), and Panguyangan (06°52'13.1"S, 106°31'04.4"E, elevation 760–800 m asl); both are village enclaves within Mount Halimun National Park. Samples of *L. macrodon* were taken during surveys carried out in streams at Cilember (06°39'36.7S, 106°56'42.1"E) and Ciapus Leutik (06°39'48.0"S, 106°44'42.7"E) both in Bogor Residency, from June 2002 to May 2003. Mean monthly temperatures in the area normally vary by less than 10°C over the year. The Bogor and Sukabumi Residencies are one of the wettest regions in Java, with monthly rainfalls greater than 200 mm in most locations throughout the year (Whitten et al. 1997).

Clipped toes were stored in 4% formalin and returned to our laboratory at James Cook University, Australia for processing. Each toe was wrapped in sponge and placed individually in a cassette, then decalcified overnight (approximately 24 h) in 10% formic acid solution. Toes were then embedded in wax in a vacuum infiltrated processor and cut into sections transversely at 10 μm thickness using a rotary microtome. Sections were put on slides and stained with Mayer's Haematoxylin. The best and clearest sections were chosen for observations and were examined using an Olympus BH dual-head microscope at 100x magnification to view marks of skeletal growth. Due to staining problems (sections too dark or/and curled), which make interpretation difficult, sections from 7 *F. limnocharis*, 5 *F. cancrivora*, and 1 *L. macrodon* were not included in the analysis. Lines of arrested growth (LAG) were interpreted from the occurrence of hematoxylinophilic lines in the periosteal layer in sections taken from the central regions of the diaphysis. We examined the results by analyzing the differences of mean SVL between groups that have LAGs and no LAGs (*F. limnocharis* and *F. cancrivora*) and evaluated the relationship between body size and number of LAGs using Spearman's correlation (for *L. macrodon*).

LAGs appeared as faint lines in the periosteal layer of cross sections of phalanges of *F. limnocharis* and *F. cancrivora*, whereas in *L. macrodon* they were darkly stained and distinct lines (Fig. 1). The maximum number of LAGs found in samples from *F. limnocharis* and *F. cancrivora* was one and for *L. macrodon* was five. The most common state for all species was to have no LAGs visible (73% of *F. limnocharis*, 63% of *F. cancrivora*, and 61% of *L. macrodon*). One LAG occurred in 27% of *F. limnocharis*, 37% of *F. cancrivora*, and 20% of *L. macrodon*. Only *L. macrodon* had more than one LAG (10% with 2, 7% with 3, and 2% (1 individual) with 5).

There were no significant differences in mean body size be-

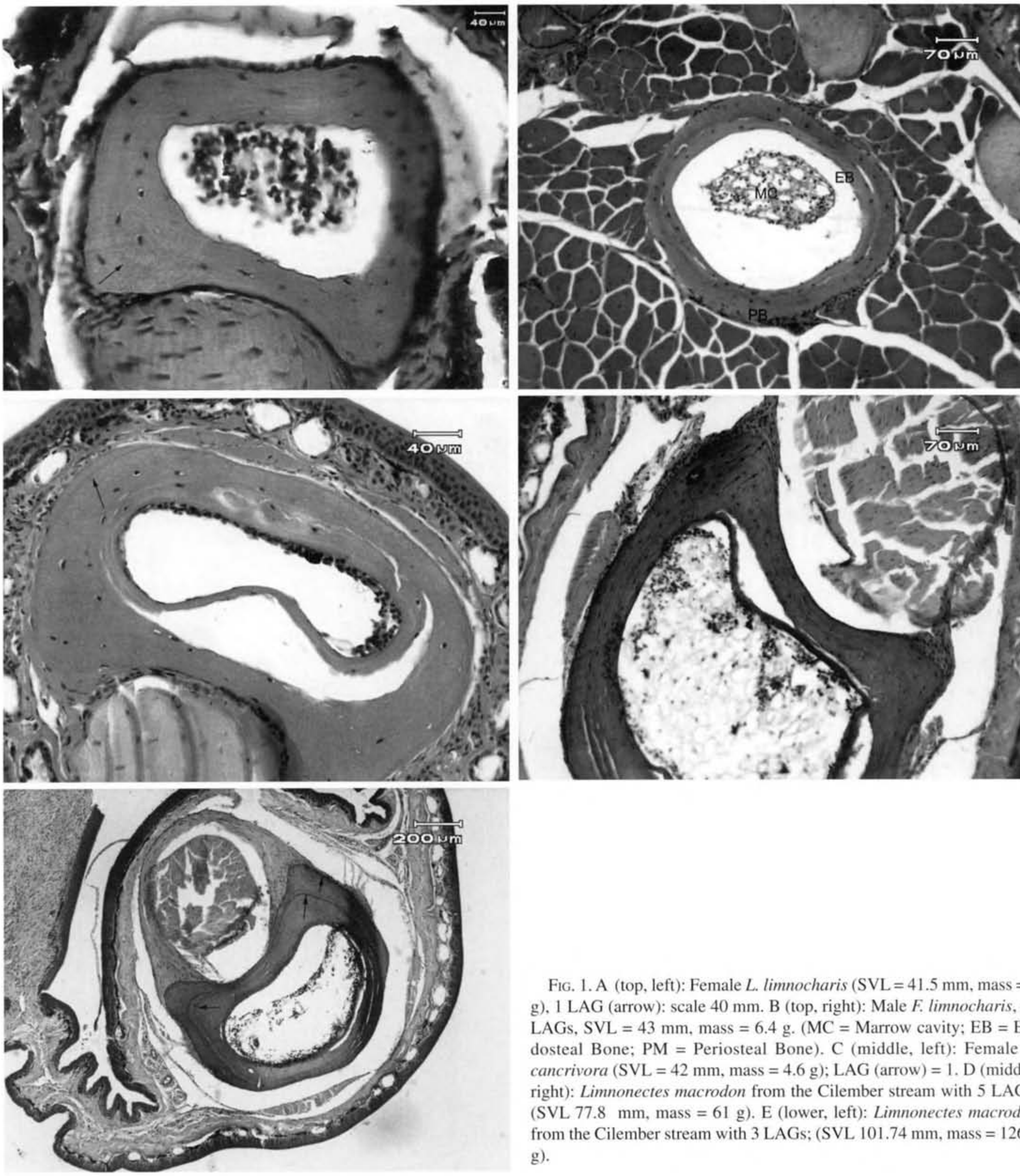

FIG. 1. A (top, left): Female *L. limnocharis* (SVL = 41.5 mm, mass = 5 g), 1 LAG (arrow): scale 40 mm. B (top, right): Male *F. limnocharis*, no LAGs, SVL = 43 mm, mass = 6.4 g. (MC = Marrow cavity; EB = Endosteal Bone; PM = Periosteal Bone). C (middle, left): Female *F. cancrivora* (SVL = 42 mm, mass = 4.6 g); LAG (arrow) = 1. D (middle, right): *Limnonectes macrodon* from the Cilember stream with 5 LAGs; (SVL 77.8 mm, mass = 61 g). E (lower, left): *Limnonectes macrodon* from the Cilember stream with 3 LAGs; (SVL 101.74 mm, mass = 126.5 g).

tween groups that had LAGs and no LAGs, both in *F. limnocharis* (t_{93} = 0.358, P = 0.723) and in *F. cancrivora* (t_{28} = 0.369, P = 0.723). However, there was a significant positive relationship between body size and LAG number in *L. macrodon* (Spearman correlation, r_s = 0.399, P = 0.01); larger *L. macrodon* tended to possess more LAGs than smaller individuals (Fig. 2). This suggests that the number of LAGs may reflect age in this species. However, since each LAG class spanned wide and overlapping ranges of snout-vent lengths, it is impossible to estimate age from the size of frogs.

Our results suggest that skeletochronology may not be useful on some species such as *F. limnocharis* and *F. cancrivora* that are active all year and live in environments in which temperature does not show major seasonal fluctuations, even when there are dis-

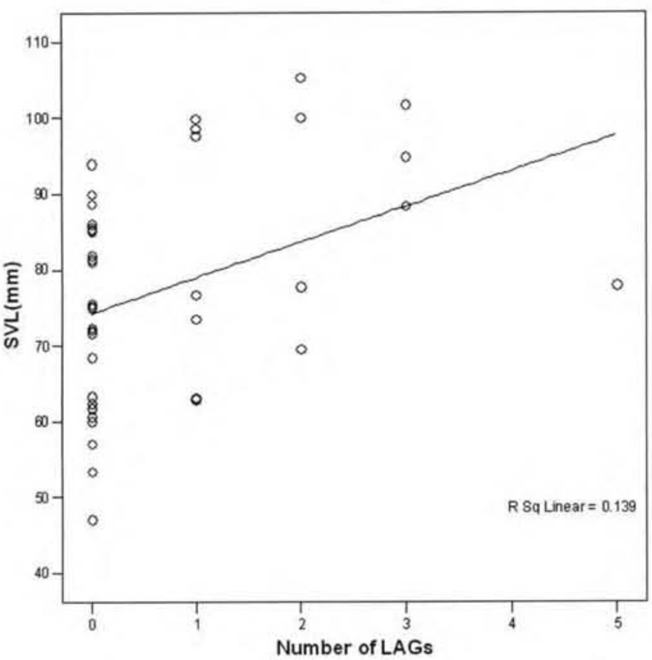

FIG. 2. Snout–vent length (mm) versus number of lines of arrested growth (LAGs) for *Limnonectes macrodon*.

tinct wet and dry seasons. Both species only showed weak LAGs, when any were evident. Population studies (Kusrini 2005) indicated that they remain in an area of habitat while conditions are favourable, but move on when conditions become unfavourable. Because individual paddy fields have varying seasonal patterns of filling and draining, sowing and harvesting, paddy-field systems taken as a whole tend to be largely aseasonal. The lack of seasonal effects on growth in these species could therefore be due to the frogs moving locally to favorable habitats as conditions change. It is also possible, however, that the age structure suggested by the LAGs we detected in these species is correct; both have been suggested to be short lived (Jaafar, 1994; Kusrini 2005).

Our results show that skeletochronology may be applicable to *L. macrodon*. LAGs found in *L. macrodon* were quite distinct, suggesting that growth was slower during certain times. In contrast to the paddy-field species, mark recapture data showed that *L. macrodon* is philopatric, remaining in place during the dry season but reducing its activity levels (Kusrini 2005). This suggests that the pattern of LAGs we found in *L. macrodon* may be due to changes in growth rate caused by seasonal rainfall patterns, with reduced growth during the dry season, which typically occupies three months each year.

Further study is required to validate that LAGs are formed annually in *L. macrodon*, either by clipping recaptured frogs in the future or possibly by examining museum specimens covering a wide range of SVL sizes.

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An Improved Technique for Scale-Clipping of Small Snakes

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Most population studies of snakes require that researchers visit the population under investigation for more than one season, and a reliable permanent marking method is thus required for long-term recognition of individual snakes. Scale-clipping was the first technique used for long-term marking of snakes (Blanchard and Finster 1933). Researchers have variously marked subcaudal scales, ventral body scales (scutes), or a combination of the two (Lang 1992). A drawback of this technique is that removed parts of scales can regenerate with time (Carlström and Edelstam 1946). Three additional disadvantages of scale-clipping have been observed: 1) it is time consuming; 2) it may draw blood and increase risk of infection; and 3) it may not be practical for small snakes (Weary 1969). Passive integrated transponders (PIT tags) have been tested on neonatal snakes without observable ill effects (Keck 1994), but use of this technology can be expensive (Morley 2002; Gibbons and Andrews 2004). However, compared to the use of PIT tags (Gibbons and Andrews 2004), cold branding with a mixture of dry ice and 95% ethyl alcohol as a coolant (Lang 1992), or heat branding (Winne et al. 2006), scale-clipping remains the most economical method for marking snakes, and has been in use for over sixty years. Typically, the selected scale is excised with a pair of small scissors (Blanchard and Finster 1933).

In September 2004, we initiated a population monitoring program for wetland and forest snakes in Taoyuan and Ilan Counties, northern Taiwan. Our scale-clipping technique is based on use of the 12-gauge hypodermic needle of a PIT tag injector. The hypodermic needle of the PIT syringe largely replaces the scissors when marking the snake, especially on small to medium sized individuals. First, the needle is inserted under the posterior end of the ventral or subcaudal scales (Fig. 1). It is then pushed under the ventral plate (scute) and through the dermis of the scale base on the other side of the scale (the underlying muscle should be exposed). The needle tip is then raised, rupturing the base of the ventral scale. This results in a well-defined triangular scar on the ventral scute (Fig. 2). The removed tissue can be preserved in ethanol for molecular studies. When the scale does not rupture as neatly as desired, a pair of scissors can be used to smooth out the margins. To date, we have marked seven snake species (*Amphiesma sauteri*, *A. stolatum*, *Elaphe carinata*, *Oligodon formosanus*, *Ptyas korros*, *Trimeresurus stejnegeri*, and *Xenochrophis piscator*) and >50 individuals over a six month period using this technique. We have experienced no problems in the execution of scale clipping and have observed scale complete regeneration.

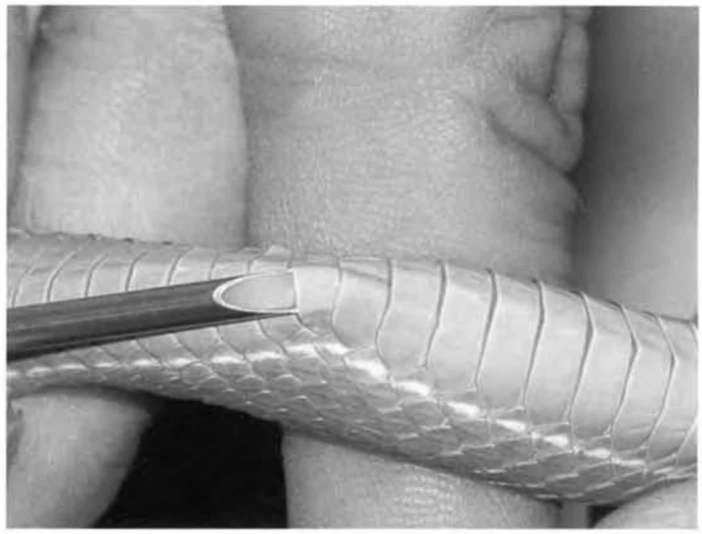

FIG. 1. The initial stage of inserting the hypodermic needle, as seen here demonstrated on the ventral scales of a female *Trimeresurus stejnegeri*.

FIG. 2. The scar and regenerated condition of the ventral scales of a *Trimeresurus stejnegeri* two months after it was made with the technique described herein.

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Burlap Bands as a Sampling Technique for Green Anoles (*Anolis carolinensis*) and Other Reptiles Commonly Found on Tree Boles

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A variety of methods have been used to study lizard populations including rubber bands, active searching and noosing (Campbell and Christman 1982; Karns 1986; Simmons 1987), pitfall traps (Fair and Henke 1997; Moseley 2004; Sutton et al. 1999), glue boards (Bauer and Sadlier 1992; Downes and Borges 1998; Durtsche 1996; Moseley 2004; Whiting 1998), extraction by hook (Bedford et al. 1995), conspecifics as bait (Zani and Vitt 1995), crickets as bait (Durden et al. 1995), refuge tubes (Moseley 2004; Strong et al. 1993), and a water-spray method (Estrada-Rodriguez et al. 2004). All of these can be used to capture lizards with varying degrees of effectiveness depending on the species, but in some cases they result in lizard mortality or stress. For example, in the southeastern United States many traps (pitfalls, glue boards, etc.) that capture anoles are frequented by red imported fire ants (*Solenopsis invicta)* that prey on captive lizards (K. Moseley, pers. comm.). Also, lizards may die before traps are rechecked or may go for extended periods without food. Likewise, techniques such as removing bark from dead wood alter the local habitat.

Burlap bands are a simple, inexpensive, and effective way to catch or monitor bole-active lizards, and may be useful for sampling other herpetofauna. Burlap bands have been used to monitor insect pests occurring in orchards (Mizell and Schifffhauer 1987; New 1967) or to simulate bark where insects hide in both hardwood (Campbell and Sloan 1977) and pine (Horn 2000) forests. Because burlap bands often harbor insect prey and serve as a refuge from predators or adverse climatic conditions, they may be effective at sampling a number of arboreal lizard species. Herein, we describe our observations of Green Anoles (*Anolis carolinensis*) and other herpetofaunal species beneath burlap bands used for monitoring insects in mature pine forests in the southeastern Coastal Plain.

Our study plots were located on the Savannah River Site, a National Environmental Research Park in the Upper Atlantic Coastal Plain of South Carolina, USA. Stands consisted of loblolly pine (*Pinus taeda*) ca. 50–55 years in age in well-drained upland soils. We placed burlap bands (Fig. 1) around mature pine trees that had been scraped to remove the outer bark at a height of 1–1.5 m. Bands were 1 × 1 m pieces of burlap fabric folded in half and sewn along the fold ca. 3 cm from the folded edge. A 1.5 m-long piece of cotton rope was threaded through the fold and tied around the tree to hold the band in place (Fig. 1). Burlap bands were checked by untying the rope and slowly pulling the burlap away from the tree while walking around the tree and examining the bole underneath.

On 19 October 2004 and 20 April 2005 we monitored 240 burlap bands spaced ca. 50 m apart throughout 16 10-ha plots (15 bands per plot). It took ca. 8 h to check all 240 burlap bands on each sampling date. We selected these dates to coincide with Moseley's (2004; see below) sampling periods in previous years on the same plots so we could compare our results to his. Burlap bands were always in the field, and data reported here are from two days of observation following long intervals without checking bands. We collected 45 Green Anoles of all age classes, averaging one anole for every 10.6 bands checked. We also observed other species beneath bands such as Eastern Fence Lizards (*Sceloporus undulatus*) (N = 7), a Gray Tree Frog (*Hyla chrysoscelis*) (N = 1), a juvenile Black Ratsnake (*Pantherophis obsoleta*) (N = 1), and Broad-headed Skinks (*Eumeces laticeps*)

FIG. 1. Burlap band used for sampling arboreal insects and herpetofauna on pine tree boles at the Savannah River Site near Aiken, South Carolina.

(N = 2). Skinks have also been noted under burlap bands on both pine and hardwood trees in a nearby forest on the Savannah River Site (W. Gibbons, pers. comm.).

Green Anoles are commonly encountered in the southeastern U.S., yet it is unclear whether existing sampling techniques represent actual population levels. For example, Greenberg et al. (1994) conducted a study in Florida scrub habitat using pitfall and funnel trap arrays to assess their relative effectiveness for capturing local herpetofauna. They captured a total of 38 anoles during a 13 month period.

Recently, Moseley (2004) sampled herpetofauna (using pitfalls, refuge tubes, and glueboards) on the same plots used in this study and captured a total of 111 Green Anoles during 14 trap-days in October 2002 and 24 trap-days in April 2003. Glueboards (N = 96) resulted in 1.97 anoles captured/trap-day, pitfall trap arrays (N = 12) resulted in 0.63 anoles/trap-day, and refuge tubes (N = 192) resulted in 0.32 anoles/trap-day. In comparison, we averaged 22.5 anoles/observation-day using burlap bands. We acknowledge limitations in these comparisons becasue varying methods sample the local community differently. However, our data show that burlap bands can be an efficient technique for targeting specific species such as Green Anoles and other arboreal lizards.

Refuge tubes are similar to burlap bands in that they are non-destructive, but refuge tubes on tree boles were not as successful in attracting anoles (K. Moseley, pers. comm.). Unlike pitfall traps and glueboards that can harm or kill captured lizards, burlap bands were non-destructive (i.e., lizards were not captured until observed, thus avoiding mortality, stress, or environmental hazards). For example, glueboards resulted in 25% mortality of anoles captured in October 2002 and 41% mortality in April 2003. The increased mortality in April was likely because of increased temperatures and fire ant activity (K. Moseley, pers. comm.).

Burlap bands provide an inexpensive monitoring tool for studies of lizards and other reptiles. Although our sampling was limited to pine forests in South Carolina, this technique should be useful for sampling bole or canopy active lizards in other forest types. This might be especially true in tropical regions where burlap is widely available and sampling may be sporadic. More research is needed to determine the efficiency of this technique for collecting different species under varying conditions and whether observations beneath burlap bands reflect actual lizard abundance.

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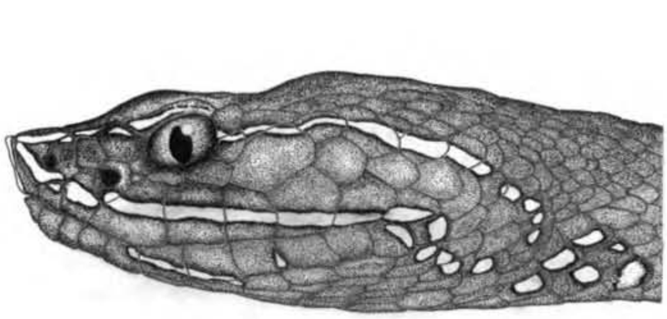

Agkistrodon bilinteatus russeolus (Cantil). México: Yucatán: 20 km ESE Mérida. UMRC 88-3. Illustration by Julian C. Lee.

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A Portable Non-Invasive Trapping Array for Sampling Amphibians and Reptiles

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Trapping is an effective means for sampling and monitoring amphibian communities within and across habitats. Amphibian trapping can involve the use of drift fences with funnel or pitfall traps (Dodd 1991; Enge 1997), or poly-vinyl chloride (PVC) pipe refugia (Boughton et al. 2000; Zacharow et al. 2003). Most amphibian monitoring projects based on trapping focus on either drift fence trapping or PVC pipe refugia, not a combination of both (Boughton et al. 2000; Dodd 1991; Enge 1997). Trapping was adopted as one of our methods to inventory amphibians in a seasonally flooded marsh habitat in Everglades National Park (ENP), Florida, USA. However, trapping in marsh habitat in ENP posed three challenges: a thin layer of marl soil with exposed limestone, a lack of trees on which to hang PVC pipe, and a wilderness designation that precludes mechanical disturbance to soil or substrate. We designed trapping structures that were non-invasive to the environment, portable, and combined PVC pipe refugia with funnel trapping along a drift fence.

Each trapping structure comprises the following items: one 2.5 cm × 10.2 cm × 305-cm wood plank, two 2.5 cm × 10.2 cm × 30.5-cm wood extensions for stability on each end, three 61-cm wood stakes, and one 122 cm × 305-cm piece of silt fencing. Three 1.2-m lengths of 5.1-cm-diameter PVC pipes were used along with three small elastic cords with hooks to support the top of the drift fence. We used collapsible, rectangular minnow traps measuring 39 cm × 24 cm × 24 cm with a 5.5 cm diam opening on each end (Nylon Net Company, Model MT4). Each structure was assembled by attaching wood stakes with screws to a 305-cm plank at both ends and the center. One 30.5-cm-long wood extension was attached perpendicular to each end of the structure for stability. The

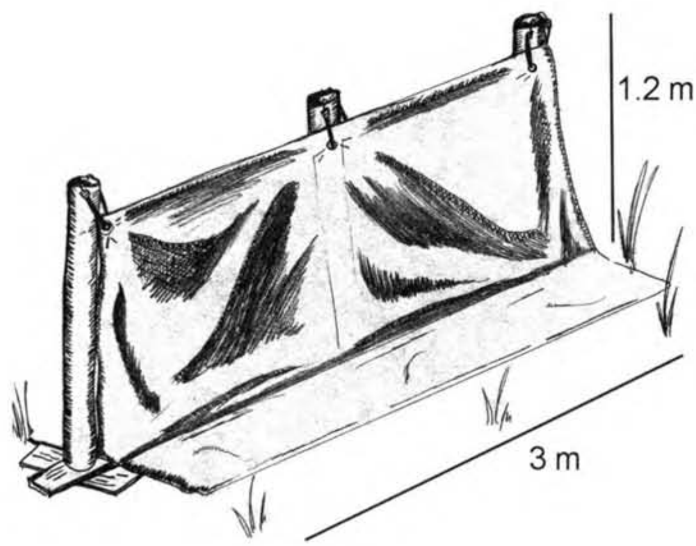

Fig. 1. Trapping structures were assembled from wood planks, stakes, silt fencing and PVC pipes to form a portable, non-invasive structure used to trap amphibians.

silt fencing, available commercially through construction suppliers (Enge 1997), was stapled to one side of the structure leaving a 30-cm flap at the bottom. PVC pipes were placed on the stakes and the drift fence was held taut by attaching small elastic cords from grommets to the PVC pipes (Fig. 1). We constructed 40 trapping structures at a cost of US $47.55 each, excluding the cost of minnow traps, and an average time of 0.3 h per structure.

Assembled trapping structures (~ 4.5 kg) were carried to the study site (100–300 m from road), along with bricks, chain, and PVC pipes (several trips are needed to get all supplies to sites). Two bricks were placed on each end of the trapping structures for stability against wind and water, and metal link chain (5-mm diameter) was draped along the flap of the drift fence to secure it to the uneven ground. Trapping structures were completed by placing one minnow trap at both ends of the drift fence (Fig. 2). Minnow traps were held snug against the fence with stakes where there was enough soil, and with rocks or bricks at other sites.

We sampled amphibians at two sites in ENP (Main Park Road and Context Road). Each site had five plots and each plot contained an array of four trapping structures arranged in an open square design for a total of 12 PVC pipes and eight minnow traps

Fig. 2. PVC pipes and collapsible minnow traps were used in combination to trap amphibians.

TABLE 1. Number of species captured using portable, non-invasive trapping structures at two sites in Everglades National Park.

Species	Main Park Road			Context Road		
	PVC Pipe	Minnow	Total	PVC Pipe	Minnow	Total
Oak Toad (*Bufo quercicus*)					1	1
Green Treefrog (*Hyla cinerea*)	197	1	198	746	1	747
Squirrel Treefrog (*Hyla squirella*)	802	2	804	239	2	241
Cuban Treefrog (*Osteopilus septentrionalis*)	3		3			
Southern Leopard Frog (*Rana sphenocephala*)		2	2		13	13
Green Anole (*Anolis carolinensis*)	31	13	44	107	11	118
Brown Anole (*Anolis sagrei*)		2	2			
Striped Mud Turtle (*Kinosternon baurii*)					1	1
Striped Crayfish Snake (*Regina alleni*)		1	1			
Common Garter Snake (*Thamnophis sirtalis*)					1	1
Total captures	1033	21	1054	1092	30	1122

per plot. Twenty trapping structures were used in each of the sites with a total of 60 PVC pipe refugia and 40 minnow traps per site. Sites were sampled monthly and each trap was checked on two consecutive days. Between trapping events, the elastic cords were unhooked, the drift fence was laid down, and minnow traps were closed.

We captured five amphibian species and five reptile species between July 2004 and August 2005; four were caught in PVC pipe refugia and nine in minnow traps (Table 1). No aquatic salamanders were caught using these trapping structures, and only two non-hylid anuran species were captured in the minnow traps (Table 1). We had 2,176 total captures and of those, 51 were from minnow traps and the remainder were from PVC pipe refugia (Table 1). Green Treefrogs (*Hyla cinerea*, N = 943), and Squirrel Treefrogs (*Hyla squirella*, N = 1041), captured in PVC pipes, accounted for the majority of captures. Cuban Treefrogs (*Osteopilus septentrionalis*), an introduced hylid frog species, were also captured three times in PVC pipes at the Main Park Road site. All animals captured were counted and released with no effort to mark them; therefore, the same individuals may have been captured on multiple dates.

The number of species and individuals captured in minnow traps was very low relative to Dalrymple (1988) who captured 695 individuals of 30 species of reptiles and amphibians in minnow traps in seasonally flooded prairie habitat in ENP. Differences in array design and construction, length of study, and amount of time traps were opened all may have contributed to the differences in the number of species and individuals trapped. Dalrymple (1988) trapped for 2.5 yrs and his traps were open 50% of the time. He used a three-array design in prairie habitat; each array consisted of four 15-m lengths of shade cloth that intersected to form an "X." These arrays were configured by attaching shade cloth to iron reinforcing bars that had been hammered into the limestone. Our five arrays at each site consisted of four 3-m non-invasive trapping structures that did not penetrate the limestone and were only opened for two nights per month for a total of 24 nights.

Corn (1994) recommends a drift fence design with three wings, each at least 5 m in length, radiating out from a central point and that funnel traps be placed in the middle of each array on either side. Our trapping structures could be made longer to meet these recommendations. A trapping structure 5 m in length may still be portable or two structures could be attached lengthwise to form a longer single structure. Alternatively, the trapping structure could be used with only PVC pipes, omitting the silt fence and funnel traps due to the success at capturing hylid frogs in PVC pipes and lack of success with the funnel traps. However, this design worked extremely well for capturing treefrog species and satisfied all requirements for use in protected areas.

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Radio Transmitter Attachment by Suturing for the Japanese Giant Salamander (*Andrias japonicus*)

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Methods for attaching radio transmitters to caudate amphibians are problematic (e.g., Blais 1996; Matsui 2003) because of their delicate skin, shape, and use of fossorial habitats and burrows. Available methods include surgical implantation (Blais 1996; Jehle and Arntzen 2000; Madison 1997; Madison and Farrand 1998; Stauffer et al. 1983), forced ingestion (Blais 1996; Schabetsberger et al. 2004), and suturing transmitters to animals (Blais 1996; Kakinoki 2000; Ota 1998). However, these methods have had limited use.

The Japanese Giant Salamander, *Andrias japonicus*, is a gigantic stream-dwelling salamander protected by the Japanese government (Matsui 2000). Radio telemetry can provide useful life history data for incorporation into conservation actions. Matsui (2003) surgically implanted transmitters subcutaneously into the hind limb of *A. japonicus*, but five of eight transmitters fell off within 16 days. A suturing attachment method was tested with eastern hellbenders, *Cryptobranchus a. alleganiensis*, where transmitters were attached to the keel or tip of animals' tails and remained attached for 1–8 weeks (Blais 1996). Kakinoki (2000) sutured transmitters to *A. japonicus* tails using nylon line and a pair of plastic washers, analogous to an ear-piercing. Eleven of 13 transmitters remained more than 100 days, and three lasted more than 10 months. However, he sutured only relatively large adults (68.2–86.2 cm TL, 2140–4160 g), and the usefulness of the method for smaller adults is unknown. In addition, damage to salamanders and the cause of transmitter loss have not been reported. We tested the suturing method on 18 adult *A. japonicus* of various sizes to examine transmitter retention period, damage to salamanders, and cause of transmitter removal.

Materials and Methods

Our study was conducted from July to November 2002 and in April 2003 at two sites in the Chugoku Mountains, western Honshu, Japan. The Tsuchiya River in Tottori Prefecture is relatively undisturbed with plentiful rock cover flowing through woodlands. The average stream width is approximately 5 m. The Ouchi River in Hiroshima Prefecture is more heavily disturbed with three dams on a 300-m reach of river. Our study reach partially runs through rice paddies and cement walls line the riverbanks to prevent erosion. Average stream width is approximately 3 m. Water depth in both rivers is less than 50 cm except in deep pools.

We used BD-2 (1.2 g or 1.8 g, 17 × 9 × 7 mm, 21 cm whip antenna, 9–16 week battery life) and PD-2 (3.5 g, 23 × 12 × 6 mm, 22 cm whip antenna, 6 month battery life) model transmitters (Holohil Systems Ltd., Ontario, Canada). The bottom edges of transmitters were embedded with a swivel or wire ring, used to connect to tail attachment assemblies (Fig. 1). Specifications for attachment assembly materials were as follows: polyethylene plastic washer (15–19 mm diameter × 1 mm thick, 0.3 g × 2); monofilament nylon line (0.78 mm diameter and 23 kg test fishing line for 30–39.9 cm TL salamanders, 1.17 mm diameter and 45 kg test fishing line for salamanders > 39.9 cm TL); and aluminum crimp sleeve (3.5 × 2.5 × 1 mm, two sleeves with nylon line 0.1 g, together for a total of 0.7 grams). Plastic washers were cut from a plastic container and sanded smooth. The inside dimensions of sleeves were 2.5 × 1.2 mm. Sleeves come with 7.3 mm lengths, but were cut to 1 mm length. In Japan, these sleeves are common in electronics shops and are available in saltwater fishing tackle shops in the U.S.A.

Salamanders were held without anesthesia in a halved PVC pipe along the stream bank while we attached transmitters. We covered

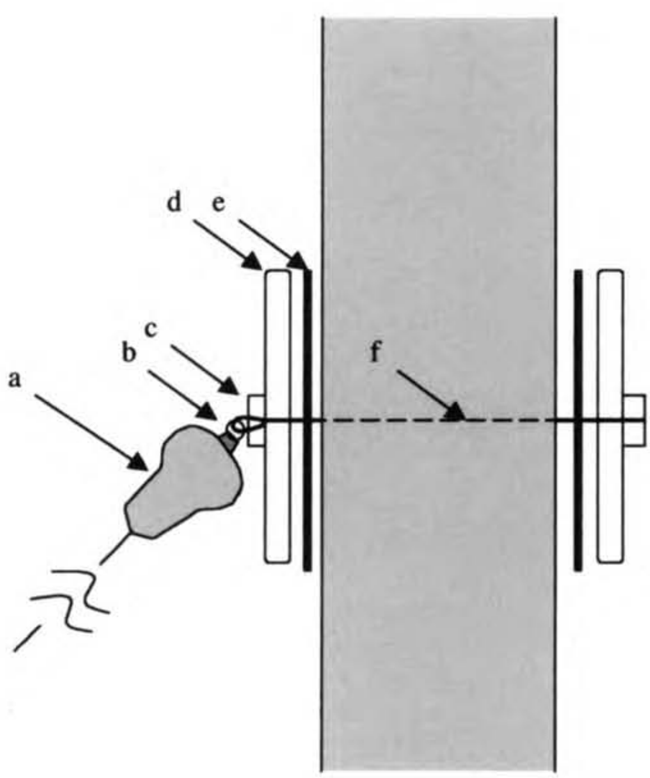

FIG. 1. Diagram of a completed radio transmitter attachment assembly in the upper portion of the tail of a Japanese Giant Salamander (shaded part of figure), including: a) radio transmitter; b) swivel or wire ring; c) aluminum crimp sleeve; d) polyethylene plastic washer; e) foam polyethylene cushion; and f) monofilament nylon line.

salamanders from head to mid-dorsum with a wet cotton bag or towel to keep them calm and wet (Tochimoto 1994). Attachment procedure was similar to Kakinoki (2000). In overview, the procedure entailed attaching a transmitter to a monofilament line with a small loop, then threading the line through the salamander's tail and fastening the line, transmitter, and two plastic washers to the tail using aluminum crimps (Fig. 1 and 2). Before the procedure, a 50 cm length of nylon line was superglued to a sewing needle (5 cm long, 1 mm thick) and sanded smooth. An end of nylon line was then passed through an aluminum crimp sleeve and the swivel ring of a transmitter and back through the aluminum crimp. The aluminum sleeve was then crimped tight on the line, thus creating a small loop in the nylon line around the swivel ring of the transmitter and crimped together (Fig. 1). The needle was then passed through a plastic washer. Needle and line were sterilized with 70% ethanol and, with washer and transmitter attached, were passed through the tail of the salamander. The device was attached at a location between 1/2 and 2/3 the length of the tail back from hind legs, and approximately 3/4 of the height of the tail at the point where the tail musculature and fin meet (Fig. 2). The needle was then passed through the second washer on the other side of the tail and through the second aluminum crimp sleeve. This sleeve was crimped tight on the nylon line and cut. There was approximately 5–10 mm slack between the salamander's tail and the plastic washers to prevent irritation by the washer. Tagged salamanders were released at the point of capture. With practice, the attachment procedure took two people approximately 5 minutes. We also tested foam polyethylene cushions (slightly larger than the resin washer, 1 mm thick) by inserting them between resin washers and one salamander's skin during attachment (Fig.1).

TABLE 1. Individual *A. japonicus* radio tracked in Tottori (Tsuchiya River) and Hiroshima (Ouchi River) prefectures, Japan. U = unknown.

Sal. ID	Location (River)	Sex	SVL/TL (mm)	Mass (g)	Transmitter type	Duration of retention (days)	Fate of transmitter
TY23	Tsuchiya	M	357/525	952	BD-2	123	Recovered
TY26	Tsuchiya	M	457/685	2160	BD-2	113	Battery death
TY43	Tsuchiya	M	376/547	1265	BD-2	120	Battery death
TY46	Tsuchiya	M	256/373	392	BD-2	73	Battery death
TY51	Tsuchiya	M	248/371	320	BD-2	74	Battery death
TY53	Tsuchiya	M	336/531	918	BD-2	83	Battery death
TY55	Tsuchiya	M	352/545	996	BD-2	67	Recovered
TY56	Tsuchiya	M	320/490	754	BD-2	77	Recovered
TY28	Tsuchiya	F	355/542	1065	BD-2	99	Recovered
TY28	Tsuchiya	F	—	1010	PD-2	185	Recovered
TY44	Tsuchiya	F	342/505	1095	BD-2	111	Battery death
TY47	Tsuchiya	F	375/575	1280	BD-2	22	Shed
TY42	Tsuchiya	U	250/375	372	BD-2	126	Battery death
OC22	Ouchi	M	525/775	3880	BD-2	112	Recovered
OC67	Ouchi	M	229/322	228	BD-2	39	Battery death
OC70	Ouchi	M	369/540	1350	BD-2	39	Shed
OC72	Ouchi	F	384/550	1225	BD-2	18	Shed
OC69	Ouchi	U	320/459	940	BD-2	10	Shed
OC71	Ouchi	U	282/437	628	BD-2	48	Shed

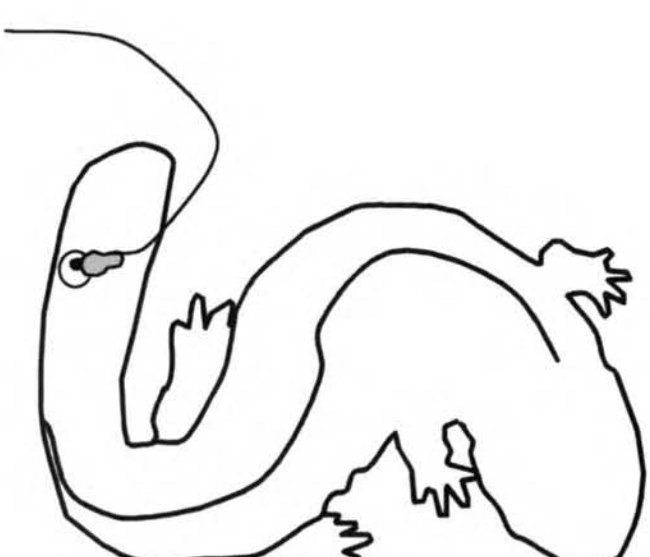

FIG. 2. Japanese Giant Salamander with radio transmitter and attachment assembly

In the Tsuchiya River, transmitters were attached to twelve individuals (Table 1; 8 males, 3 females, 1 unknown). Eleven of 12 individuals were tagged once and one was tagged twice using a total of one PD-2 and 12 BD-2 (8 large, 4 small) transmitters. Total salamander length (TL) ranged from 37.1–68.5 cm, while body mass was 320–2160 g. In the Ouchi River, large BD-2 transmitters were attached to six individuals once (Table 1; 3 males, 1 female, 2 unknown). Salamander TL ranged 32.2 –77.5 cm, while body mass was 228–3880 g. Transmitter packages weighed 1.9 g or 2.5 g (BD-2) and 4.2 g (PD-2), less than 1 % (0.1–0.8%) of the body mass of tracked salamanders.

We tracked salamanders with a 3-element Yagi or loop antenna (Antronics, Inc., Illinois, USA) and a model CE-12 receiver (Custom Electronics of Urbana Inc., Illinois, USA). We received transmitter signals with a 3-element Yagi antenna from about 100–130 m on a road above the stream. Under suboptimal tracking conditions, such as near stream bends, water gaps, or while wading in the stream, transmitter range was 40–50 m.

Results and Discussion

Transmitter retention period.—In the Tsuchiya River, the mean retention period was 97.9 days (SD = 37.7, range = 22–185). Twelve of 13 (92%) transmitters remained more than two months, one of 13 (8%) transmitters was shed in 22 days (Table 1). Five of the 13 (38%) transmitters were recovered but seven were lost because these salamanders settled in refuges such as deep cavities under rocks, artificial rock walls, or bank burrows just before battery death. In the Ouchi River, mean retention period was 44.3 days (SD = 33.0, range = 10–112). Of the six transmitters, four (67%) were shed within 2 months, one was retained for more than 2 months, and one was lost in artificial rock walls after 39 days (Table 1). Mean retention period differed between the Tsuchiya and Ouchi Rivers (Wilcoxon-Mann-Whitney test: $P = 0.018$). There was no correlation between retention period and TL at either site (Tsuchiya: $r = 0.01$, $N = 13$, $P = 0.97$; Ouchi: $r = 0.49$, $N = 6$, $P = 0.12$).

Cause of removal.—We confirmed five (Ouchi: 4, Tsuchiya: 1) cases of shed transmitters. In the Ouchi River, the first transmitter was entwined in grass roots in an undercut bank, and the assembly remained on the salamander's tail until it was recaptured a few days later. The second and third transmitters were recovered from beneath broken slabs of concrete. The fourth transmitter was found in a perched rice paddy on the ground where it converged with the stream. This transmitter did not catch on vegetation, but the transmitter's swivel ring was broken, possibly by a predator. In the Tsuchiya River, one transmitter was caught in accumulated twigs at the river's edge, and we recovered the assembly from the salamander after two weeks.

Mass change.—We assessed mass change between initial radio-tagging and recapture in five salamanders. Two males in the Tsuchiya River lost 14 g (1.9% of body mass) and 4 g (0.6%) after 77 and 67 days respectively. One male and female gained 40 g (1%) and 15 g (1.2%) after 112 days and 36 days in the Ouchi and Tsuchiya Rivers, respectively. A gravid female in the Tsuchiya first lost 55 g (5.2%) after 99 days and then regained 45 g (4.5%) after 185 days. We did not consider these changes to be significant because they were within mass changes observed in non-transmittered individuals (S. Okada, unpubl. data).

Injuries.—We observed two individuals with sores where the skin made contact with resin washers. These were in the Ouchi and Tsuchiya Rivers after 10 days and 22 days, respectively. The individual from the Tsuchiya had its attachment assembly removed and the salamander's injury had healed upon recapture in 16 days. In the Ouchi, another individual showed slight skin abrasion (about 5 mm diameter) at the point of contact with the plastic washer opposite of the transmitter after 112 days. It appeared that we had attached the transmitter assembly relatively tightly to injured individuals. In the one case where foam polyethylene cushions were used, the cushions were worn down to 0.5 mm after 185 days, but no sores were observed, therefore we recommend their use in the future. It is also possible that in situations where transmitters were recovered but the salamander was not observed injuries might have occurred.

Conclusion.— The suturing method was reliably effective for 2–4 mos. in our relatively short-term radiotelemetric study of multiple-sized adult *A. japonicus* in the Tsuchiya River. We anticipated that transmitters would snag on rocks. However it was not a problem in the Tsuchiya River even with plentiful rock cover in the stream. The Ouchi River, and areas of similar habitat, seem less suitable for the suturing method. The Ouchi River had various obstacles such as roots and broken concrete with sharp edges and most transmitters remained attached only approximately one month. Internal attachments such as surgical implantation or forced ingestion are likely more effective in these circumstances.

Our method was originally designed to minimize transmitter loss and salamander injury. However, future modifications such as thinner nylon line might prevent injuries such as skin sores because transmitters could be shed more easily when they become snagged. We also recommend attaching transmitters with approximately 10 mm slack between the washers and the salamander. Our suturing method is a viable option for researchers involved with *A. japonicus* telemetry because of its low cost, and ease of application. Although injuries occurred in at least three out of 18 individuals, our suturing method reduced injuries compared to a study of hellbenders using tail suturing (Blais 1996); attaching transmitters to tails with steel pins led to either chafing of skin or tearing and a subsequent hole in the tail following a few weeks in 11 of 12 salamanders (Blais 1996). Our method would also be applicable for other cryptobranchid species and large aquatic salamanders.

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Elastic Hair Bands: An Effective Marking Technique for Lizards in Mark-Recapture Studies

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Many studies of lizard species require individuals to be captured, marked, and then released. Commonly two methods are used to mark individuals: permanent marking via toe clipping (see Waichman 1992; Woodbury 1956), or temporary marking by painting unique color combinations of dots on the animal with nontoxic paint. Alternative techniques such as radio transmitters (e.g., Losos et al. 1990) and passive integrated transponder (PIT) tags may be difficult to place in small reptiles (Bloch and Irschick 2004), and can be expensive. A recently developed method is to sew unique combinations of small colored beads into the base of the tail or nape of the neck (e.g., Martins et al. 1998), but like toe clipping, this method is invasive and may not be appropriate for all types of field studies or species.

Toe clipping may negatively affect locomotor performance and survival in some lizards (Bloch and Irschick 2004). Likewise, temporary marks using paint may be lost quickly via skin shedding, reducing their long-term efficacy in observational studies. We used an alternative method to mark terrestrial lizards of small to moderate body size, which causes no injury, and facilitates long-term observation and identification of individuals in behavioral studies. We used elastic hair bands (available in hair accessory stores), which are available in a variety of colors and diameters and can be fitted to a lizard's neck to allow individual identification. The hair bands are made of silicone, which is nontoxic, unreactive, and water-resistant.

We marked adult *Tropidurus torquatus* (Iguania: Tropiduridae), a common species of open formations, with these elastic bands to estimate their home-range sizes. Our study occurred during portions of the reproductive (November 2004 to February 2005) and nonreproductive (from March to June 2005) seasons on a rocky outcrop approximately 60 × 90 m in the Toledos district, Juiz de Fora municipality, Minas Gerais State, Brazil (21°48'27.5"S, 43°35'31.7"W; 697 m elev., datum: WGS 84). During a four-day period each month, we collected lizards once with glue traps (Rodda et al. 2005), and then used sightings of the same individuals to estimate home range size. The diameter of the elastic hair bands varied from just over 15 mm for the smallest reproductive female to 25 mm for largest reproductive male, and each individual had up to two bands of different colors. Elastic hair bands did not appear to affect lizard movement and remained intact on lizards for three months or longer, allowing a satisfactory period of observation and data collection.

Adult male *T. torquatus* averaged larger snout–vent length (88.4 ± 11.8 mm; range = 70.6–117.7 mm; N = 42) than adult females (78.9 ± 9.4 mm; range = 65.2–95.0 mm; N = 60) (*t*-test; $t = -4.413$, $df = 101$, $P = 0.0001$). During the reproductive season 378 sightings were recorded for 48 lizards (29 females and 19 males) with hair bands, and in the nonreproductive season 510 sightings for 73 lizards (42 females and 31 males) were recorded. Mean number of sightings per individual during the reproductive and nonreproductive seasons was 5.3 and 7.9, respectively. Eleven females and eight males were sighted over eight months of study during which they were recaptured and their hair bands replaced because of wear and fading of their color. Twenty-one *T. torquatus* were recaptured that had lost parts digits on their forelegs and/or hind legs, which, had toe-clipping been used, would have resulted in misidentification of individuals, whereas hair bands allowed uninterrupted individual identification. Loss of toes can result from biting during territorial disputes (LBR, pers. observ.).

In our study of *T. torquatus* elastic hair bands proved effective, non-obtrusive, long-lasting, and inexpensive, but care must be taken to minimize the number and diameter of bands used to insure that injuries do not result. This simple technique should be applicable in mark-recapture studies of small to moderate-sized lizard species living in a variety of habitats, so long as the species has a distinct neck (i.e., head much larger than neck diameter) and coarse scales (e.g., most skinks could slip the band over their heads). Like any marking technique using color (e.g., nontoxic paint or colored beads), this method may also be unsuitable for studies of social status or mate choice if the focal species uses color for communication. We therefore recommend that investigators validate that the color-marking technique they choose does not interfere with the questions being asked of their study species.

Acknowledgments.—We thank M. Van Sluys, M. Kiefer, G. Colli, and C. Galdino for invaluable research suggestions, and L. Vitt and anonymous reviewers for helpful comments on a previous draft of the manuscript. This study was supported by a grant from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) to LBR. Research involving animals was in accord with the Ethical Principles of Animal Experimentation adopted by the Brazilian School of Animal Experimentation (COBEA), with approval of the Commission of Ethics in Animal Experimentation (CEEA) from the Research Rectory of Federal University of Juiz de Fora (Protocol 010/2005-CEEA), and under permission of IBAMA (Permit 261/05-NUFAS/MG and Process 02015.010660/05-88).

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NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 37, Number 1 (March 2006).

CAUDATA

AMBYSTOMA TIGRINUM MAVORTIUM (Barred Tiger Salamander). **EXTRALIMITAL POPULATIONS**. The natural range of *Ambystoma tigrinum mavortium* extends from central Nebraska to south Texas, USA (Conant and Collins 1991. Reptiles and Amphibians Eastern and Central North America, Houghton Mifflin Co., Boston, Massachusetts). The common practice of using Tiger Salamander larvae (water dogs) as fish bait has resulted in introductions of *A. t. mavortium* beyond its natural range (Petranka 1998. Salamanders of the United States and Canada, Smithsonian Press, Washington 587 pp.).

We report extralimital populations of *A. t. mavortium* from the unincorporated communities of Alpine and Ramona, San Diego Co., California. We consider both populations to be established because of the documentation of larvae (Alpine) or recently transformed individuals (Ramona). Specimen vouchers from the Alpine population have been deposited in the herpetological collection of the California Academy of Science, San Francisco, California (CAS). Vouchers were also sent to H. Bradley Shaffer, Department of Zoology, University of California, Davis, California, for genetic analysis.

On 6 February 1996, *A. t. mavortium* larvae (ca. 30 mm TL) were first detected in the vicinity of upper Chocolate Canyon in the unincorporated community of Alpine (R2E T15S Sec 29). Subsequent surveys resulted in additional observations of *A. t. mavortium* larvae: Spring 1996 (ca. 35 mm TL); 16 March 2001 (ca. 25 mm TL; CAS 233270); 28 March 2003 (ca. 17 mm TL; CAS 233721); 4 April 2003 (ca. 35 mm TL; CAS 233274); 4 May 2003 (ca. 43mm TL); April 2004; and 12 March 2005 (ca. 50mm TL; CAS 233723). Three of the larvae collected in 2003 were maintained in aquaria and photographed 25 months later to determine the pattern and coloration of individuals representing this population. Additional locality records of *A. t. mavortium* within the town of Alpine include a surface-active adult taken during Winter 1994 (R2E T15S Sec. 32), another on 12 January 2005 (R1E T16S Sec. 11), as well as the excavation of an adult from a residential garden in Spring 1999 (R2E T15S Sec. 33). Although no specimens were collected from these three additional locations, both surface-active individuals were photo documented. The Alpine population is now known to occupy an area of both the San Diego River watershed having been found in the area of upper Chocolate Canyon, and the Sweetwater River watershed, occurring in an unnamed drainage along Harbison Canyon Road.

Additional records of *A. t. mavortium* within San Diego Co. include three individuals captured within a few meters of the West Branch drainage located southeast of the unincorporated community of Ramona (R1W T13S Sec. 36). In Spring 2002, an adult was captured, and during Spring 2003, on separate dates, a recently transformed individual and an adult were captured. Individuals were photo documented prior to being released at the places of capture. This population also occurs within the San Diego River watershed.

Due to the limited amount of information, aspects of these populations such as source of introduction, length of time as an established population, population size, and the extent of their distribution remain unresolved.

This note provides source information for the *A. tigrinum* population of Alpine, San Diego Co., represented on the range map (extreme southwest portion of mainland California) in Stebbins (2003. Western Reptiles and Amphibians, 3rd. ed., Houghton Mifflin Co., Boston, Massachusetts), as referenced in Jennings (2004. An Annotated Check List of the Amphibians and Reptiles of California and Adjacent Waters, California Dept. Fish and Game 90[4]:161–213), and in Lemm (2006. Field Guide to Amphibians and Reptiles of the San Diego Region. University of California Press. Berkeley, California).

We extend our thanks to Mark R. Jennings for making useful comments on this manuscript, and Carlton Rochester, Drew Stokes, Gale Bustillos, and Yolaine Stout for providing additional information for Alpine locations, and Kyle Icke, Rick Roedell, and Jim Davidson for the Ramona location.

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AMBYSTOMA TIGRINUM TIGRINUM (Eastern Tiger Salamander). **BURROW DESCRIPTION.** Relatively little is known about burrows of the Eastern Tiger Salamander (Semlitsch 1983. Can. J. Zool. 61:616–620; Madison and Ferrand III 1998. Copeia 1998:402–410; Gruberg and Stirling 1972. Herpetol. Rev. 4:85–89). During winter 2005, we radio-instrumented four *A. t. tigrinum* as they exited a breeding wetland in southwest Georgia, USA. In all instances, animals were tracked to underground burrows with one or more visible entrances. The area and depth of burrows were measured when we attempted to recover the transmitters; measurements varied considerably among individuals.

One radio-tagged female was located in a burrow seven days after release. The burrow was adjacent to an agricultural field and firebreak, and was 6 m from the base of a large live oak, *Quercus virginiana*. The burrow meandered through an area ca. 0.5 × 0.50 m and reached a maximum depth of 0.30 m. Only one entrance was found; the burrow terminus was an elliptical cavity.

A tagged male was also located seven days after release. It spent two days in a shallow, branched burrow network. Total burrow length was ca. 4 m with a total area of 1.0 × 3.5 m. Although most of the tunnels were shallow, the burrow reached a maximum depth of 0.20 m. There was no tree canopy over the burrow system and


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Society for the Study of Amphibians and Reptiles

www.ssarherps.org

The Society for the Study of Amphibians and Reptiles, the largest international herpetological society, is a not-for-profit organization established to advance research, conservation, and education concerning amphibians and reptiles. Founded in 1958, SSAR is widely recognized today as having the most diverse society-sponsored program of services and publications for herpetologists. Membership is open to anyone with an interest in herpetology—professionals and serious amateurs alike—who wish to join with us to advance the goals of the Society.

All members of the SSAR are entitled to vote by mail ballot for Society officers, which allows overseas members to participate in determining the Society's activities; also, many international members attend the annual meetings and serve on editorial boards and committees.

Annual Dues and Subscriptions: Annual membership dues for the year 2007 in the Society for the Study of Amphibians and Reptiles are as follows: **REGULAR** membership US$60 (Student $30)—includes *Journal of Herpetology* and *Herpetological Review*; **PLENARY** membership US$80 (Student $45)—includes *JH*, *HR*, and annual subscription to the *Catalogue of American Amphibians and Reptiles*; **INSTITUTIONAL SUBSCRIPTION** $115—includes JH and HR. Additional fee for airmail postage outside USA $35 for one year. Additional membership categories available on the SSAR webpage: http://www.ssarherps.org/pages/membership.html.

All members and institutions receive the Society's primary technical publication, the *Journal of Herpetology*, and its news-journal, *Herpetological Review*; both are published four times per year. Members also receive pre-publication discounts on other Society publications, which are advertised in *Herpetological Review*.

Payment must be made in USA funds, payable to "SSAR," or by International Money Order, or with Visa or MasterCard (account number and expiration date must be provided). Payment should be sent to: Breck Bartholomew, SSAR Membership Office, P.O. Box 58517, Salt Lake City, Utah 84158, USA. Fax: (801) 453-0489; e-mail: ssar@herplit.com.

Future Annual Meetings

2007 — Saint Louis, Missouri, 11–16 July (with ASIH, HL)
2008 — Montreal, Canada (with ASIH, HL)
2009 — Portland, Oregon (with ASIH, HL)

About Our Cover: *Dicamptodon ensatus*

The Pacific Giant Salamanders (genus *Dicamptodon*), are a phylogenetically isolated group, assigned to their own family (Dicamptodontidae). For many years, *Dicamptodon* was thought to consist of but a single species (*D. ensatus*) occupying the humid coastal forests from central California to the Pacific Northwest. The first indication of greater diversity was the discovery and description in 1970 of *Dicamptodon copei*, a small, neotenic species restricted to western Washington and extreme northwestern Oregon (Nussbaum 1970. Copeia 1970:506–514). Later, allozyme studies by Daugherty et al. (1983. Copeia 1983:679–691) and Good (1989. Evolution 43:728–744) revealed that the formerly wide-ranging *D. ensatus* was comprised of three species-level groups: *D. aterrimus*, *ensatus*, and *tenebrosus*.

Our cover subject is an example of an adult *D. ensatus* (California Giant Salamander), the southernmost member of the group. This species occupies a small area of coastal California from the Santa Cruz Mountains north to southern Mendocino Co., closely associated with humid forests. Its range narrowly (by about 2.5 km) overlaps that of its northern relative *D. tenebrosus*, and hybrids between these two species are known (Good, *op. cit.*). This is one of the largest terrestrial salamanders, up to 304 mm TL. Adults are occasionally seen surface active on rainy nights, but more often can be observed at burrow entrances adjacent to small streams at night. Eggs, numbering 70–100 per female, are laid underground in running water, and attended by the female until hatching. The larval period ranges from 2–3 yrs. Paedomorphic individuals are known from the southern part of the range, and are associated with underground cave systems. Of the four species of *Dicamptodon*, *D. ensatus* is the only one known to emit bark-like vocalizations when roughly handled. Two thorough reviews of the natural history of this species have been published recently, and this account draws largely from those works: Fellers and Kuchta (2005. *In* Jones et al. [eds.], Amphibians of the Pacific Northwest, pp. 50–53. Seattle Audubon Society) and Bury (2005. *In* Lannoo [ed.], Amphibian Declines: The Conservation Status of United States Species, pp. 653–654. Univ. California Press, Berkeley).

Brian Freiermuth photographed the cover salamander in late February in California's Santa Cruz Mountains, the southern terminus of this species' range. The photo was taken using a Nikon D70 digital SLR camera with a 24mm fixed lens mounted on a Benbo Trekker tripod with wireless remote trigger. The image was recorded using natural light with fill flash (SB800) stopped down 2 exposures. A long exposure (4 seconds) captured movement of the stream. Brian is an avid naturalist and photographer. The majority of his coverage is herpetofauna, both wild and captive. Currently he works as an environmental consultant in the San Francisco Bay Area, performing a wide range of field studies. With an undergraduate degree in Earth Systems Science and Policy, he plans to return to school to seek a PhD in biology (with a focus on herpetology).

PHOTO BY KEVEN ANN COLGATE

SSAR BUSINESS

Open Letter to Membership

SSAR will celebrate its 50th Anniversary in 2007. Special activities will take place during the Joint Meeting of Ichthyologists and Herpetologists (JMIH) in St. Louis, 11–16 July. The major events associated with SSAR's Anniversary are scheduled for 13 July. These events feature a symposium organized by Jonathan Losos entitled "Herpetology in the Age of Genomics." Jim Murphy and Kraig Adler will be the Masters of Ceremonies for a special SSAR Banquet that evening. The SSAR/HL auction will follow the banquet. And, of course, everyone is invited to attend the Business meeting on July 15. A link to registration on our website (http:www.ssarherps.org) will be available in January. Registration can be for the entire meeting or only for the day of the SSAR celebration.

—Robin Andrews, SSAR President

Annual Report (2006) Grants-in-Herpetology Committee

An award in the amount of US $500 was made to each of the following individuals:

Conservation.—**Ricardo J. Torres-Cervantes**, Oklahoma State University. Project title: "Conservation and disease in the endangered aquatic Patagonian frog (*Atelognathus patagonicus*) and other Patagonian frogs."

Field Research.—**Dean A. Croshaw**, University of New Orleans/Savannah River Ecology Laboratory. Project title: "Polyandry in *Ambystoma talpoideum* and its consequences for individuals and populations."

Laboratory Research.—**Matthew Chatfield**, University of Michigan. Project title: "Hybrid zone dynamics between two species of salamanders in the genus *Plethodon*."

Travel.—**Ali M. Rabatsky**, University of Louisiana at Lafayette. Project title: "Evolutionary vestigialization of complex features using an island rattlesnake model."

International.—**Juan Carlos Jordån Arizmendi**, Universidad Nacional Mayor de San Marcos, Peru. Project title: "Resource partitioning among three sympatric *Ameiva* lizards (Sauria: Teiidae) in the Zona Reservada de Tumbes (Tumbes, Perú)."

2006 Grants-in-Herpetology Committee.—Chair: Erik R. Wild. Reviewers: Jeffrey Parmelee, Carol Spencer, Tod Reeder, James Austin, Chris Parkinson. SSAR congratulates the 2006 GIH recipients and thanks the committee members for their efforts.

Grants-in-Herpetology 2007 Proposals

Proposals are now being accepted for the 2007 SSAR Grants-in-Herpetology Program. This program is intended to provide financial support for deserving individuals or organizations involved in herpetological research, education, or conservation. Applica-

tion deadline is 28 February 2007. Grant application details are available at:

<http://www.ssarherps.org/pages/GIH.html>

Manuscript Review Service: An Update and Reminder

SSAR has a service for herpetological researchers, who wish to publish in English, but do not have English as their first language. As a society we offer some assistance to such authors in editing their manuscripts *before* they submit them for publication. This service has proven popular and we'd like to remind both authors and potential pre-submission reviewers about the program. Information about this service is posted at http://www.ssarherps.org/pages/presub.php

As a potential author, look over carefully what is mentioned at that website, and feel free to contact researchers listed at that site, if you feel they can help you with your manuscript. If you are already listed on the site as a potential reviewer, please confirm that the information there is current.

It would be nice to expand the list of potential reviewers. Therefore, if you are comfortable with your English skills and would like to be added to the list of potential reviewers, please consider doing so. The contact information and what is required to be a potential reviewer is provided at that website.

2006 Annual Meeting, New Orleans, Louisiana

The 49th annual meeting of SSAR took place from 12–17 July, 2006 at the Sheraton Hotel in New Orleans, Louisiana. SSAR members met with members of the American Elasmobranch Society (AES), the American Society of Ichthyologists and Herpetologists (ASIH), and The Herpetologists' League (HL). The meeting was co-hosted by the University of New Orleans (UNO), Southeastern Louisiana University (SELU), and Tulane University with local hosts Hank Bart, Bob Cashner, and Brian Crother.

A total of 1206 herpetologists and ichthyologists from 30 countries (including Argentina, Australia, Brazil, Costa Rica, Ecuador, Italy, Jamaica, Japan, Mexico, and New Zealand) attended the meeting. Approximately 530 of those present were students and around 590 papers and 280 posters were presented. Seven symposia, including one sponsored by SSAR (Amphibian and Reptile Use of Golf Courses, organized by Peter Paton and David Scott), were included in the meeting schedule.

SSAR extends thanks to the local co-hosts and other members of the Local Committee (especially the graduate students) for all of their hard work. We are once again very grateful to Sharon Brookshire and the staff of the Kansas State University Division of Continuing Education for a very smoothly-run meeting.

Social Programs and Resolutions

On the evening of 12 July, President Robin Andrews introduced Dr. Aaron Bauer (Villanova University) who gave this year's well-received SSAR President's Travelogue "Herps and Herping in India and Sri Lanka." Aaron continued the tradition of enjoyable and informative Travelogues. With around 1500 species of reptiles and amphibians in India and Sri Lanka, there are plenty of opportunities for study—even if some of them involve wearing a sarong and getting to a field site on the back of a camel! Many species of herps are poorly known in this part of the world. For example, in the Eastern Ghats of India, the leaf-toed gecko was first described in 1870 and then not observed again until 1985. As could be expected, geckos featured prominently in Aaron's presentation. We saw beautiful pictures of colonial golden geckos. Only the dominant males are golden and they appear to use cracks in boulders as resonating chambers for their vocalizations. In addition to lots of herp pictures, we also saw slides of people and places including impressive archeological sites and regions in eastern Sri Lanka that were devastated by the 2004 tsunami.

The next morning, the meeting officially began with a call to order by the local co-hosts. Bob Cashner on behalf of UNO welcomed us to the city and to the JMIH. An invitation to hold the 2006 meeting in New Orleans was offered in 2001. This was intended as the 10-year anniversary of the 1996 New Orleans meeting. Following Hurricanes Katrina and Rita, the local organizers and Meeting Planning Committee seriously considered other venues (including holding the meeting in Tampa again). Bob (whose home was flooded and was completely gutted recently in anticipation of renovation) recounted that, towards the end of 2005, they were "inundated" with letters of support from society members who wanted to hold the 2006 JMIH in New Orleans if at all possible. Brian Crother and Mary White (both from SELU) were key players in moving things forward and by December of last year it appeared that the New Orleans meeting would go ahead. The key to success, according to Bob, was that the three sponsoring universities worked together closely. Bob said that the city desperately needs conferences like this, both to support the local economy and to serve as "ambassadors" to help tell the story of what happened in New Orleans and of the current situation. Hank Bart (Tulane University) and Brian Crother echoed Bob's welcome and thanked members of the societies for their many well-wishes. Brian mentioned that Mary White, for all her efforts, should be considered a fourth co-host. Drs. Scott Cowen (President, Tulane University) and John Crain (Provost, SELU) then greeted the

President Andrews thanking Aaron Bauer for his presentation of the 2006 President's Travelogue "Herps and Herping in India and Sri Lanka." Photograph by Marion Preest.

From left to right Jim McGuire, Lisa Hazard, Brad Hollingsworth, Richard Etheridge, Ben Lowe, and Angelo Soto-Centeno waiting in the heat and humidity for the Group Photograph outside the Aquarium of the Americas. Photograph by Marion Preest.

meeting attendees and made introductory comments.

The warm welcome we received throughout the week from the co-hosts and meeting organizers, the hotel staff, and locals in restaurants, shops, and along the streets was unrivalled in my experience. If you missed this meeting, you really did miss something special! Many people at the meeting expressed a feeling of satisfaction and pride at being members of Societies that contributed (even if in a small way) to helping New Orleans get back on its feet. Mary White arranged an opportunity for those who could arrive a day early to assist with Habitat for Humanity's vast efforts in New Orleans. There is no shortage of work to be done! Bob Cashner, Hank Bart, and President Cowen all encouraged those at the meeting to take advantage of the "Hurricane Tours" being offered twice daily by Liz Sigler, Meg O'Connell, and Jim Grady (all from UNO). The tours quickly filled up following this encouragement and many were over-booked. The tour consisted of a 3-hour drive through a small part of the hardest hit areas of the city. Despite all the news coverage last August and September, I think all of us were struck by the magnitude of the damage and the vastness of the area affected (even though we only saw a minor fraction of it). Many people's memories of the 2006 JMIH will not be of papers attended or posters viewed, but of the devastation still so apparent almost a year after the 2005 hurricane season.

Following the call to order and welcomes on the first morning, the Plenary Sessions began. Daryl Frost (President, ASIH) introduced Dr. Lynne Parenti (Past-President, ASIH) who gave a presentation entitled "A Sense of Scale." This was followed by Dr. H. Carl Gerhardt, the Herpetologists' League Distinguished Herpetologist for 2006 who spoke on "Evolution and Mechanisms of Accoustic Communication in Frogs and Toads" and Dr. Robert A. Thomas from Loyola University who presented "How do Severe Storms affect the Herpetofauna? Louisiana is Alive and Croaking." A busy schedule of paper sessions and symposia began on the afternoon following the Plenary Session.

That evening the group photograph was taken outside on the steps of the Aquarium of the Americas. Following this, a reception was held in the Aquarium, which had only recently reopened following Hurricane Katrina.

In contrast with the previous two years, this year's Annual Picnic was not disrupted by weather and was held at the Audubon Zoo as planned. Attendees congregated on the patio area of the Swamp Exhibit and enjoyed good food, live music, and the heat and humidity of New Orleans outdoors in July.

Over $4,400 was raised at the Annual SSAR/HL Live Auction held on Sunday evening. SSAR uses these funds to support Student Travel Awards. Daryl Frost served as the auctioneer. The silent auction held throughout the meeting raised $462 (also used to support student travel).

The Annual Banquet was held in the Sheraton Hotel on 17 July with Larry Allen serving as the Master of Ceremonies. Past-Presidents of ASIH, SSAR, HL, and AES in attendance at the banquet were acknowledged. HL and ASIH presented a number of awards including the Storer and Stoye Student Awards and the H.S. Fitch Award to Whit Gibbons. Henry Mushinsky (Past President of SSAR) was informed of his election as President-Elect of ASIH. He will join the small but select group of herpetologists who have been President of SSAR, ASIH, and HL.

The following SSAR resolutions, prepared by Richard Wassersug (SSAR Resolutions Chair), were read:

Whereas, the following individuals have given freely of their time, energy, and expertise to SSAR, and

Whereas, because of their hard work and dedication, SSAR programs, projects, and goals have been advanced, and,

Whereas, SSAR is dependent on the generosity and tremendous efforts of its members and is grateful for their willingness to serve,

Therefore be it resolved that the Society for the Study of Amphibians and Reptiles offers its gratitude and sincere thanks for jobs well done to the following individuals:

Theodora Pinou, Treasurer (2001–2006); Brian Sullivan, Editor, *Journal of Herpetology* (2001–2005, now serving as Associate

SSAR officers (past, present, and future) Kirsten Nicholson, Robin Andrews, Roy McDiarmid, and Bob Aldridge enjoying the Temperature Lunch Special at the Palace Cafe. The cost of lunch ($9.17) was the high temperature achieved the previous day (91.7°F). Photograph by Marion Preest.

2007 Henri Seibert Student Award judges and winners. From left to right: Lora Smith (co-chair), Tracy Rittenhouse (winner, Conservation category), Elizabeth Harper (Honorable Mention, Ecology category), Julie Ray (winner, Evolution and Systematics category), Margaret Gunzburger (co-chair). (Photograph by Janalee Caldwell).

Editor to help with the editorship transition); Bill Parker, Managing Editor, *Journal of Herpetology* (1991–2005): Don Forester, Associate Editor, *Journal of Herpetology* (2002–2005); Andrew Price, Associate Editor, *Journal of Herpetology* (2005); Martin Whiting, Associate Editor, *Journal of Herpetology* (2002–2005); Erik Wild, Associate Editor, *Journal of Herpetology* (1997–2005); Steve Johnson, Associate Editor, *Herpetological Review* (2004–2005); Paul Stone, Associate Editor, *Herpetological Review* (2000–2005); Hidetoshi Ota, Geographic Distribution Section Editor, *Herpetological Review* (1996–2005); Hugo Alamillo, Copy Editor, *Herpetological Review* (2002–2006); Robert Gatten, Jr. Chair, Kennedy Award Committee (1988–2005, chair since 1999); Linda Ford, Chair, Resolutions Committee (2004); Marion Preest, Chair, Henri Seibert Awards Committee (2001–2005); Jack Sites, Member, Standard English and Scientific Names Committee; Chris Tracy, Nominations Committee (2004–2005).

The Banquet closed with thanks from Larry Allen to the Local Committee and conference organizers and an enthusiastic invitation to attend the 2007 Joint Meeting in St. Louis, Missouri (11–16 July).

Board Meeting and Business Meeting Summaries

Society President Robin Andrews called the Annual SSAR Board Meeting to order at 0805 h on 12 July 2006 in the Sheraton Hotel, New Orleans, Louisiana. In attendance were 7 members of the Board of Directors and 15 Editors, Committee Chairs, or members of the Society. Minutes of the 2005 Board of Directors Meeting (Tampa, Florida) were approved.

Annual reports for 2006/2007 were submitted by all officers, editors, and committee chairs. In her past year in office, President Andrews (with the assistance of the Secretary) reported revising the *SSAR Constitution* and updating *Organization, Functions, and Duties of the Officers, Editors, and Committees*. Both documents are now accessible via the SSAR website. She also wrote descriptions of the Society and of the *Journal of Herpetology* for the JSTOR website.

President Andrews appointed Richard Wassersug as Chair of the Resolutions Committee, Lynette Sievert as Chair of the Kennedy Award Committee, and Margaret Gunzburger and Lora Smith as co-Chairs of the Henri Seibert Award Committee. Thanks to Linda Ford, Bob Gatten, Jr, and Marion Preest who previously served in these positions. She wrote letters of thanks to the local committee who hosted the 2005 JMIH in Tampa and letters of congratulations to the winners of the Grants-in-Herpetology Awards. President Andrews suggested that the President's Fund (to which Presidents contribute $500 at the end of their term) be phased out after she steps down, however this proposal was not supported by the Board.

President Andrews attended several meetings in Tampa to discuss proposals by the Alliance Communications Group to publish *Journal of Herpetology*. She decided that the proposal to publish was not favorable, however a number of other services offered by the group were attractive. President Andrews noted in her report that SSAR is still searching for a permanent repository for its archives. The National Museum was raised as a possibility. President-Elect Roy McDiarmid will investigate this possibility. He requested that he be informed as to the volume of material needing archiving. Aaron Bauer was invited to present the President's Travelogue at the 2006 JMIH.

Treasurer, Theodora Pinou reported that during 2005, SSAR's expenses exceeded revenues resulting in an operating loss of $24,315. However, the Society realized investment income of $26,204 (a 4% return on investments) and received a grant of $33,600 and a donation of $4,776 that resulted in a net income of $40,265. Early in 2006, the portfolio of mutual fund investments was reshuffled to enhance income while maintaining the Society's investment objective of maximizing returns on investment while preserving the original principal amount of all restricted funds.

An overall decline in membership through 2005 may be partly explained by the availability of past SSAR publications through BioOne. Individual memberships however, increased in 2006 at least partly due to a concerted effort to contact members who had not renewed in recent years. Breck Bartholomew suggested that SSAR consider a membership drive in association with our 50th Anniversary Celebration in 2007. Dick Durtsche mentioned that he talks to members of his herpetology class about SSAR, points them in the direction of the website, and provides them with membership application forms.

Treasurer Pinou reported that SSAR received royalties of $10,006 (2004) and $12,426 (2005) from BioOne. Duties of the membership office were transferred from the Treasurer to the Publications Secretary's office in 2005.

Among her duties in the past year, Secretary Marion Preest reported that she wrote a summary of the 2005 Annual Meeting and compiled the Annual Report and prepared agendas for the Board and Business Meetings at the 2006 Annual Meeting. She responded to numerous emails regarding SSAR business and updated SSAR letterhead and various pages on the website.

Publications Secretary, Breck Bartholomew reported that income from sales of the Society's publications totaled $33,187. Members now receive a 10% discount on all SSAR publications and approximately a 20% discount for prepublication sales. Breck is investigating the possibility of having a distributor handle SSAR publications in Europe. Even with extra costs of shipping and han-

Steve Secor and Vic Hutchison enjoying the General Reception at the newly-reopened Aquarium of the Americas. Photograph by Marion Preest.

dling, he predicts the Society would still realize a profit.

Andy Price, Editor of *Catalogue of American Amphibians and Reptiles* (*CAAR*), reported that because of problems during the editorship transition, the 2005 account was delayed until February, 2006. It consisted of 20 accounts. The 2006 account (also 20 accounts) is expected this year. Andy is searching for new mapping software for account range maps. There was some discussion among those at the Board meeting of GIS systems and ArcView.

Kraig Adler (Editor) reported on the publication activities of *Contributions to Herpetology*. No books were published in 2005. "*Biology of the Reptilia*, Volume 20 (Morphology)," edited by Carl Gans, Abbot Gaunt, and Kraig Adler is anticipated for December 2006. Volume 21 (a complete bibliography of previous Volumes) will be the last in this series. Formatting has begun on "*Tasks and Problems Studying the Life of Reptiles in Zoos,*" by Hans-Günter Petzold. Publications beyond 2006 include "*Herpetological Time Travel Through the Zoo and Aquarium World*," by James B. Murphy, "*Contributions to the History of Herpetology*," Volume 2, "*Field Guide to Amphibians and Reptiles of the West Indies*," by S. Blair Hedges, and "*Lizards of Southern Africa*," edited by William R. Branch and Aaron Bauer. *Contributions to Herpetology* is a sequel to the 1989 volume issued at the First World Congress of Herpetology and will include biographies of leading herpetologists, an index to taxonomic authors, and doctoral lineages.

Editor of *Facsimile Reprints in Herpetology*, Aaron Bauer, reported that "*The Herpetological Contributions of Mario Giancinto Peracca*," edited by Franco Andreone and Elena Gavetti (with an English translation of the introduction) will be published in 2006. A donation has been received from the Societas Herpetologica Italica in support of this book. Planned for 2007 is "*Gray's Catalogues of the Specimens of Amphibians and Reptiles in the Collection of the British Museum.*" Aaron mentioned another organization publishing herpetological reprints. He does not view them as serious competition however as they are publishing facsimiles of mostly 20th century works.

John Moriarty (Editor, *Herpetological Circulars*) reported that "*Synopsis of Helminths Endoparasitic in Snakes of the United States and Canada*" has been printed and "*A Review of Marking Techniques for Amphibians and Reptiles*" is anticipated in late 2006. Two *Circulars* are planned for 2007 including "*The First Fifty Years – A History of SSAR.*" John suggests having this distributed *gratis* at the 2007 JMIH.

P. Steven Corn (former Editor, *Herpetological Conservation*) reported that Volume 2, "*Ecology, Conservation, and Status of Reptiles in Canada*," is at the page proofs stage and should be ready for publication in late September. Robin Jung and Joe Mitchell, current co-Editors of *Herpetological Conservation*, reported that they have received 52 submissions for Volume 3 "*Urban Herpetology: Ecology, Conservation and Management of Amphibians and Reptiles in Urban and Suburban Environments.*" These are in various stages of completion and revision. The editors plan to approach a publisher in early Fall, 2006. The U.S. Forest Service has provided a donation to assist with publication costs.

Herpetological Review Editor, Robert Hansen reported a 13% increase in the number of pages in *Herpetological Review* Volume 36 compared with Volume 35. To deal with a backlog of accepted natural history notes, more space was devoted to that section in Volume 36. The time lag for publication is now 3–9 months. The rate of new submissions appears to have leveled off. Most manuscripts are submitted and handled electronically. The SSAR Manuscript Review Service continues to be used. A Board member suggested that this service may need updating. Steve Johnson and Paul Stone (Associate Editors), Hidetoshi Ota (Geographic Distribution Section Editor), and Hugo Alamillo (Copy Editor) have resigned. New appointments include Brent Thomas, Indraneil Das, and Raul Diaz. There was discussion among the Board of increasing the amount of color used in *Herpetological Review*.

In 2005, the editorial office of *Journal of Herpetology* received 236 manuscripts (comparable with numbers received annually in the past 5 years). The rejection rate was approximately 60%. All manuscripts received since the beginning of 2006 have been submitted via AllenTrack and this appears to shorten the time for the review process. The median number of days to the first decision on a manuscript is now 32 days. Geoff Smith (Editor) has recom-

Lora Smith and Kirsten Nicholson—meeting burnout! Photograph by Marion Preest.

mended that the Copy Editing and Managing Editing duties be transferred to Allen Press. He provided a description of the services provided by Allen Press. The Board indicated that a decision regarding this should be made by Geoff. There was discussion among Board members of the Author Assistance Program offered by SSAR. It was suggested that a reference to this service be included in the *Instructions to Authors* for the *Journal of Herpetology* and also that editors should ask reviewers to take a more active role in editing manuscripts.

Geoff Smith took over as *JH* Editor in January 2006 and former Editor Brian Sullivan assumed a position as Associate Editor to help with the transition. Bill Parker stepped down as Managing Editor. Don Forester, Andy Price, Martin Whiting, and Erik Wild resigned as Associate Editors and Paul Andreadis, Sarah Bouchard, Tiffany Doan, Walter Meshaka, Matthew Parris, Gad Perry, and Fred Zaidan joined the staff as Associate Editors.

The 50th Anniversary of SSAR will be celebrated at the JMIH in St. Louis, Missouri, 11–16 July 2007. The "Committee on Celebration of the 50th Anniversary of SSAR" (Al Savitzky, Chair) met in Tampa in 2005 to discuss ideas for the celebration. The Joint Meeting Planning Committee will be asked to assist in elevating the profile of SSAR in St. Louis. Two specific ideas for the meeting have been discussed. The first is a symposium on molecular approaches to research on amphibians and reptiles, which provides a link to a symposium held during the 25th Anniversary. The Board voted and agreed unanimously to use the President's Fund to support this symposium and other activities proposed by the Committee. The second idea is a revival of the popular Herp Quiz, which has not been held for a number of years. The Committee met during the 2006 JMIH to discuss additional ideas and welcomes input from Society members. The Board discussed the possibility of a presentation of the history of the Society (focusing on the Society rather than on herpetology in general) possibly instead of the Travelogue or perhaps preceding the SSAR/HL live auction or an SSAR banquet.

Stephen Richter (Chair, Conservation Committee) reported that in 2005 the committee responded to various herpetological queries received from individuals and began forming connections with other herpetological conservation committees. They met with the ASIH Conservation Committee during the 2005 JMIH.

The Dean Metter Memorial Award screening committee (Joseph Beatty, Anne Maglia, and Brian Miller) received 10 proposals for the fourth Dean E. Metter Award. An award was made to Cybil Nicole Smith for her proposal "The Significance of the Distinctive Color Pattern and Behavior of Hatchling Great Plains Skinks (*Eumeces obsoletus*)." Ms. Smith is the first undergraduate to win this award.

Forty-six proposals for the Grants-in-Herpetology program (Erik Wild, Chair) were received in 2006 and awards of $500 were made in each of five categories (Conservation, Field Research, Laboratory Research, Travel, International). The Bibliographic Research category is no longer offered. The vast majority of proposals and letters of recommendation are now submitted electronically.

Marion Preest (Chair, Henri Seibert Awards Committee) reported that awards were made at the 2005 Tampa meeting in the following four categories: Ecology, Physiology/Morphology, Evolution/Systematics, and Conservation.

Catherine Bevier (Chair, Herpetological Education Committee) reported activation of the Herpetology Hotline question/answer page in November 2005. Approximately 50 inquiries were received in the first 6 months of operation. Some of these will be posted to a FAQ page. As requested at the 2005 Board meeting, the Committee is updating the International Grants Programs list on the website. The Board asked that the HEC update the "Careers in Herpetology" webpage.

Lynette Sievert (Chair, Kennedy Student Award Committee) reported that the winner of the 2006 Kennedy Student Award is Margaret Gunzburger for her paper: Gunzburger, M.S. and J. Travis. 2005. Critical Literature Review of the Evidence for Unpalatability of Amphibian Eggs and Larvae. *Journal of Herpetology* 39:547–571.

SSAR had previously agreed to meet as part of the JMIH in St. Louis in 2007 and Montreal in 2008. Henry Mushinsky (SSAR Rep., Meeting Planning Committee [MPC]) reported that the MPC had received and reviewed invitations for future joint meetings. The Board voted to approve meeting in Portland, Oregon in 2009, Providence, Rhode Island in 2010, and Minneapolis, Minnesota in 2011. As at previous Board meetings, there was some discussion of meeting with the World Congress of Herpetology (WCH). The consensus was that, given the prior planning (often several years in advance) now needed for JMIH, SSAR was unlikely to be able to make a commitment to meet with the WCH unless the Congress organizers began planning well in advance of a Congress. A suggestion was made that WCH be invited to participate in the 2009 or 2010 JMIH.

The 2006 JMIH was the first meeting subject to the limit of 700 oral presentations. However, because fewer than 700 abstracts were received, all those who wished to present oral papers were allowed to do so. Every symposium supported by at least one of the four societies was approved for the 2007 meeting. The Board was reminded of the new timetable and procedures for symposium approval.

No election was held in 2005. Kirsten Nicholson (Chair, Nominations Committee) reported that in 2006 the following positions need to be filled: President-Elect, Treasurer, Secretary, Regional Society Board Member, Conservation Board Member, and Regular Board Member (two positions). A new procedure will be implemented in 2006 to allow the Elector to track voters and to ensure confidentiality of votes. There was discussion of converting the Regional Society Board position to a Regular Board position, however, it was decided to retain this position as is for at least another term. It was recommended that the Regional Society Board member reach out to large, active local herpetological societies and encourage them to provide information about SSAR in their newsletters and websites.

Resolutions were read at the 2005 meeting in Tampa by Richard Wassersug thanking retiring members of SSAR for their service and acknowledging Janalee Caldwell and Laurie Vitt for their joint presentation of the SSAR President's Travelogue. Richard questioned whether SSAR should continue to make joint resolutions with ASIH. The Board stated that the Resolutions Chair need not contribute to the joint resolutions unless he/she wished.

Brian Crother (Chair, Standard English and Scientific Names Committee) reported that the committee is in the early stages of producing a new volume of standard English and scientific names. He questioned whether publishing the list as part of the *Herpeto-*

logical Circulars series created a static document and raised the possibility of issuing the next volume in both hard and electronic versions. The Board discussed creating an electronic "living" document, for example a pdf file that could be updated regularly. They decided that the Names Committee and John Moriarty (Editor, *Herp. Circulars*) should choose the appropriate format for the list. The consensus was that no restrictions should be placed on access to the list and that providing the list should be viewed as a service to the wider herpetological community.

Dawn Wilson reported that twenty applications were received for Student Travel Awards and ten awards ($200 each) were presented at the Business Meeting in Tampa. Very few applications were received for the 2006 meeting; Dawn attributed this partly to difficulties with advertising these awards on the meeting website. The possibility of emailing students and alerting them to the existence of the awards was raised.

The Web Oversight Committee (Anne Maglia, Chair) worked with the Relations with Herpetologists at Zoological Parks Committee to launch a new forum (see below). The site is being continually modified and updated and the Committee wishes to thank the webmaster Zack Walker for his hard work and dedication. Suggestions regarding the website are welcomed.

Recent activities of the Relations with Herpetologists at Zoological Parks Committee (Clay Garrett, Chair) include the launching of a committee web page and discussion forum. A bibliography of published contributions by zoo herpetologists will soon be accessible on the web forum. In 2006, the committee plans to explore the idea of a quarterly committee electronic newsletter.

In the past year, Al Savitzky attended both the American Institute of Biological Sciences (AIBS) and BioOne meetings. AIBS has a diverse array of programs and services available. Those of greatest interest to SSAR relate to education and public policy. For example, AIBS is heavily involved in defense of education concerning evolution in public schools and a Fall 2006 workshop organized by Marvalee Wake will cover the issue of macroevolution. AIBS is also concerned with building diversity in the workforce of professional biologists and has a Diversity Scholars Program offering funding for students of under-represented groups to present research at national meetings of member societies (such as SSAR). The public policy office continues to provide advice to lawmakers regarding issues of interest to organismal biologists and ecologists, e.g. funding at NSF, science education, environmental legislation, support of museum collections. AIBS has indicated a willingness to assist member societies with issuance of press releases. AIBS, in collaboration with several other scientific organizations, has designated 2009 as the "Year of Public Understanding of Science."

Al reported that BioOne has a new business model of providing replacement rather than supplemental income to society publishers. The size of the BioOne collection has increased, but cost per title has decreased. There is a very high renewal rate among academic library subscribers. BioOne is concerned about overseas distribution and is actively soliciting subscriptions in Europe and Asia. The full BioOne collection is available free to 80 developing countries. The preservation and archiving of electronic files is of concern, and BioOne has entered into agreements with several organizations and services (e.g. LOCKSS), which employ diverse technologies to archive web-distributed journal content. BioOne is planning to offer a second collection of journals beginning in 2007. Rather than expanding the current collection, this alternative will provide additional titles without diluting the current profit-sharing pool among BioOne publishers. BioOne is now able to handle non-standard issues of society journals. Open Access was once again a topic of discussion. The publishing community expects the U.S. government to mandate further open access publishing of federally funded research. Electronic only publication (no print copies) was also discussed.

Dick Durtsche (Symposium Proposals coordinator) received two proposals for symposia for 2007. The SSAR proposal for "Herpetology in the Age of Genomics" was approved by the Meeting Management committee however the SSAR/HL/ASIH proposal "Chemical Ecology" submitted by the ASIH Graduate Student committee was not approved.

After the annual reports were discussed, the Board turned to new business. Two representatives from Allen Press and Alliance Communications Group reviewed the services they could offer to SSAR including journal production, electronic publication, marketing, membership duties, etc. They could generate a restricted access online data base with a real-time directory that would allow members to pay subscriptions electronically, review their own accounts, access member information, etc. Members would be able to update their own mailing information and email addresses. If needed, Allen Press could provide financial and investment services including filing of necessary reports. President Andrews met with the Allen Press reps during the JMIH and a detailed proposal will be considered by the Board at a later date.

Journal of Herpetology became available through JSTOR in February, 2006. There was discussion of two options to make back issues available to all society members. With the *Per User Model*, SSAR would pay $7.50 per individual per yr for members without institutional access to JSTOR or BioOne. Assuming that requests would be few and that most would come from members in developing countries, President Andrews suggested that the society absorb these costs. With the *Usage Model*, JSTOR access would be provided to all members by bundling it with Allen Press membership services. Given our membership numbers, we would receive 180 free downloads and then pay $0.20 for each additional download up to a cap of $2,520 (plus associated Allen Press charges).

The family membership category needs to be reinstated (it appears to have been dropped in 2003 from the possible membership options). This would allow two or more members living at one address to receive one copy of the journals and each have voting rights and all other rights associated with membership.

Hardin Waddle is currently updating the much out-of-date list of officers, editors, and chairs on the website.

The SSAR 2007 budget was approved. There being no further business, the meeting was adjourned at 1345 h.

The Annual SSAR Business Meeting was called to order by President Andrews at 1603 h on 15 July. Approximately 34 SSAR members were in attendance. President Andrews summarized business dealt with at the Board Meeting on 12 July. Winners of the 2006 Kennedy Award, Henri Seibert Student Awards, Grants in Herpetology Awards, and Student Travel Awards were announced. The meeting was adjourned at 1730 h.

—Respectfully submitted by Marion Preest, SSAR Secretary

Metter Award Proposals Sought for 2007

Dean E. (Doc) Metter (1932–2001) was a long-time member of the biology faculty at the University of Missouri-Columbia, where he taught zoology, comparative anatomy, evolution, and herpetology. A believer in putting knowledge to the test in the field, Doc provided frequent opportunities for students to engage in fieldwork. In addition, he frequently assisted his graduate students as they ventured out to collect data.

Doc was a co-founder of the Bobby Witcher Society, the legacy of which is a scholarship fund. For many years, the interest earned served to reward outstanding herpetology students who intended to continue their education and seek a career in vertebrate biology. That fund now serves a similar purpose by honoring Doc's memory while helping to fund the SSAR-administered Dean E. Metter Memorial Award.

Application details are available from the SSAR website:

<http://www.ssarherps.org/pages/metter.php>

SSAR dues for 2007 must be paid no later than 31 December 2006, and proposals must be submitted (postmarked) by 28 February 2007. Proposals should be submitted electronically as email attachments (preferred) or by regular mail. Submit proposals or questions regarding application procedures to the Chair of the Metter Award Committee, Dr. Joseph J. Beatty (e-mail: beattyj@science.oregonstate.edu). Awards will be announced on or around 10 April 2007.

NEWSNOTES

Herpetological Research & Conservation in Ecuador

We are now accepting applications for participants in our Ecuadorian herpetofauna research program for 2007. Participants will gain hands-on experience in Herpetology and Conservation Ecology. We are studying the population ecology and community structure of reptiles and amphibians in imperiled western Ecuadorian ecosystems, which have dwindled to only 2–5% of their historic area. This rate of ecosystem decline, along with the high levels of biodiversity found in the region, prompted Conservation International to designate western Ecuador and parts of neighboring countries a "Conservation Hotspot"—an area in greatest need of study and conservation. We are exploring the last remaining fragments of disappearing forests. Data from our surveying and monitoring studies will lead to sound management decisions on the ground. Due to the high levels of endemism in the region, nearly every new site explored yields species previously unknown to science. In short, we want to find out what life exists there while there is still the chance, and to assist conservation planning in the region to make sure that as much as possible of the biodiversity found there can be saved.

In exchange for trip fees, participants receive all travel within Ecuador, training, room and board, and an experience to last a lifetime. Internships and course credit are available. We have dates available in January, May, and August of 2007. If you or anyone you know might be interested in participating, please see our Web site, www.ReptileResearch.org, for more details.

Slowinski Award Announced for 2006

The Center for North American Herpetology is pleased to announce that the recipient of The Joseph B. Slowinski Award for Excellence in Snake Systematics for 2006 is Todd A. Castoe, of the Department of Biology, University of Central Florida.

On 12 September 2001, the world lost one of its premier biologists, a loss that went virtually unnoticed in the wake of the tragedy that befell the United States the previous day. Joseph Bruno Slowinski, the 39-year old curator of amphibians, turtles, reptiles, and crocodilians at the California Academy of Sciences in San Francisco, died in the jungles of Burma from the bite of a venomous snake. Joe was bitten on 11 September and, despite heroic efforts to save his life by expedition companions and colleagues, succumbed to the effects of the bite the next day. Eventually, the world took notice, and numerous media outlets across the nation and throughout the world chronicled Joe Slowinski's exemplary career, cut so tragically short.

A distinguished committee, comprised of Frank Burbrink (City University of New York, Staten Island), Brian Crother (Southeastern Louisiana University, Hammond), and Robin Lawson (committee chair, California Academy of Sciences, San Francisco), have deemed the paper "Modeling Nucleotide Evolution at the Mesoscale: The Phylogeny of the Neotropical Pitvipers of the Porthidium Group (Viperidae: Crotalinae)" as the most distinguished paper on snake systematics to appear worldwide during 2005. The paper was co-authored with Mahmood M. Sasa and Christopher L. Parkinson, and was published in Volume 37 of *Molecular Phylogenetics and Evolution*.

As senior author of the paper, Todd Castoe becomes the fourth recipient of The Slowinski Award, and will receive a check from The Center for North American Herpetology for US $500 along with a commemorative memento in recognition of his achievement.

Ouachita Mountains Biological Station

The Ouachita Mountains Biological Station is located in the Ouachita Mountains of western Arkansas. The station consists of 380 acres, almost surrounded by the Ouachita National Forest. The terrain is rugged, and includes several springs and streams. Most of the habitat includes oak-hickory forest or mixed pine-deciduous forest. Several mountain tops with rocky outcrops and low flat wet areas are available. Three small ponds and an abandoned slate mine are on the property.

A well-lighted lecture/laboratory building with AC/heat, bathroom, and shower, can comfortably seat 24 at worktables. A small dormitory building has a kitchen, two bathrooms, shower, AC/heat and 10 beds (5 bunk beds). Four additional beds are available in other buildings. Other facilities include good potable water, a pavilion, and some trails for easy access to distant points. The station is available year-round. A web site with some photos is avail-

able at: www.lsus.edu/lsusmus/ombs/. The station is well-suited for small research or teaching groups.

To reserve space for your group contact:

Dr. Laurence M. Hardy
Ouachita Mountains Biological Station
Museum of Life Sciences
LSU in Shreveport
One University Place
Shreveport, Louisiana 71115-2399, USA
e-mail: lhardy@lsus.edu

Kansas Herpetological Society Annual Meeting

The Kansas Herpetological Society held its 33rd Annual Meeting at Fort Hays State University in Hayes, Kansas, on November 4–5, 2006. Over 100 participants attended scientific paper sessions presented by scientists and students from across the nation. Featured speakers were James L. Knight, curator of the South Carolina State Museum in Columbia, and Jerry D. Johnson, professor of biology at the University of Texas-El Paso. Both grew up in Salina, Kansas..

David Bender, student at Fort Hays State University, received the 2006 Howard K. Gloyd/Edward H. Taylor Scholarship, honoring the memory of two great biologists with strong ties to Kansas. The 2006 Alan H. Kamb Grant for Research on Kansas Snakes was made to George R. Pisani, Kansas Biological Survey. Henry S. Fitch, University of Kansas, Lawrence, was chosen as the ninth recipient of "The Suzanne L. & Joseph T. Collins Award for Excellence in Kansas Herpetology." Eugene D. Fleharty was installed as the eighth Distinguished Life Member of the Kansas Herpetological Society. Dr. Fleharty is Emeritus Curator of Herpetology at the Sternberg Museum of Natural History, Fort Hays State University. In 2007, the Society will meet at the Topeka Zoo, Topeka, Kansas.

MEETINGS

Meetings Calendar

Meeting announcement information should be sent directly to the Editor (rwh13@csufresno.edu) well in advance of the event.

18–19 January 2007—Declining Amphibian Populations Task Force, California-Nevada Working Group Annual Meeting, Las Vegas, Nevada, USA. Information: http://ice.ucdavis.edu/CANVDecliningAmphibians/DAPTF2007Announcement.htm.

6–8 February 2007—Workshop: Understanding Agriculture's Effects on Amphibians and Reptiles in a Changing World. Sponsored by U.S. Geological Survey's Amphibian Research and Monitoring Initiative, Partners in Amphibian and Reptile Conservation, the Natural Resources Conservation Service, Environment Canada, the Association of Fish and Wildlife Agencies, and Conservation International. St. Louis, Missouri, USA. Information: http://www.umesc.usgs.gov/ag_effects_workshop/workshop.html.

22–25 February 2007—Southeast Partners in Amphibian and Reptile Conservation, Annual Meeting, Chattanooga, Tennessee, USA. Information: http://www.separc.org/.

31 March–1 April 2007—Florida Herpetology Conference (including the 30th Annual All Florida Herpetology Event), Gainesville, Florida. Information: http://www.flmnh.ufl.edu/herpetology/herpsconference/afhc.htm.

16–20 April 2007—First Mediterranean Herpetological Congress, Marrakech, Morocco. Information available from the Congress website: www.ucam.ac.ma/cmh1.

14–18 April 2007—14th ARAV Conference, Association of Reptile and Amphibian Veterinarians, New Orleans, Louisiana, USA. Information: http://www.arav.org/.

20–23 June 2007—31st International Herpetological Symposium, Toronto, Canada. Information: http://www.kingsnake.com/ihs/.

11–16 July 2007—50th Annual Meeting, Society for the Study of Amphibians and Reptiles; 87th Annual Meeting, American Society of Ichthyologists and Herpetologists; 65th Annual Meeting, The Herpetologists' League. St. Louis, Missouri, USA. Information: http://www.dce.ksu.edu/jointmeeting/.

3–6 August 2007—5th Conference on the Biology of Plethodontid Salamanders: Symposium in Honor of David B. Wake. Instituto de Biologia, UNAM and ECOSUR, San Cristobal de la Casas, Chiapas, México. Information: http://www.ibiologia.unam.mx/barra/congresos/salamandra/salamandra.html.

CURRENT RESEARCH

The purpose of **Current Research** is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, **María del Rosario Castañeda** or **Michele Johnson**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can be found at: http://www.herplit.com/contents.

Behavioral Response To Social Cues Determined By Dispersal Status in Lizards

During and after dispersal, dispersing individuals face the costs of survival in unfamiliar habitats, and so they may differ from philopatric (non-dispersing) individuals in phenotypic traits that allow them to assess new habitat suitability quickly. To test this hypothesis, the authors examined behavioral responses of dispersing and non-dispersing yearling common lizards (*Lacerta vivipara*) to the presence of scent-marks from conspecific yearlings. Gravid females (N = 172) were captured from four natural populations and housed in the laboratory, where half were treated with corticosterone (a stress hormone) before they laid their eggs to determine if maternal stress affected dispersal. After hatching, juveniles (N = 816) were marked and released in either an unaltered

site or a site with manipulated (decreased) density, but not in the site of their mother's origin. One year later, 140 juveniles were recaptured and categorized as dispersers or non-dispersers and transferred to the laboratory where they were exposed to each of four conditions: 1) caged with no conspecific scent-marks, 2) caged with odor of one conspecific, 3) caged with odors of three conspecifics housed in isolation, and 4) caged with odors of three conspecifics housed communally. Results showed that morphometry did not differ among dispersers and non-dispersers, and that density, release site, maternal hormone treatment, and sex had no effect on response to the different conditions. However, dispersers spent more time trying to escape from scents from communally housed conspecifics than isolated scents, while the opposite was true for non-dispersers. The authors suggested that this may be an attempt of dispersers to avoid potential conflicts with other interacting individuals during the risky dispersal period. They concluded that while the environmental components measured did not affect dispersal-related behavior, dispersers are more sensitive to novel social cues.

ARAGÓN, P., S. MEYLAN, AND J. CLOBERT. 2006. Dispersal status-dependent response to the social environment in the Common Lizard, *Lacerta vivipara*. Functional Ecology 20:900–907.

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Genetic Differences and Plasticity Determine Diet Preferences in Tiger Snakes

Genotypic and phenotypic variation play major roles in food selection, and environmental variation and differences in dietary experience can result in behavioral plasticity in response to food. As these factors interact, it is difficult to determine their relative importance in feeding behavior. To address this question, the authors studied two disjunct populations of tiger snakes (*Notechis scutatus*) in Australia that occur in environments (mainland vs. island) with different prey availabilities. They tested feeding preferences among 6 types of prey (mouse, skink, silver gull, chicken, shearwater, and frog) in three groups of tiger snakes: wild-caught adults, neonates, and laboratory-reared juveniles. Results from these trials showed that adults ($N = 55$) from the two populations shared preferences for the same types of prey, regardless of their natural diet. Diet-naïve neonates ($N = 82$) showed interest in all prey types, but island neonates preferred gull chicks (the main prey of island adults) more than mainland neonates. Juveniles ($N = 15$) that were fed only mice until 8 months of age significantly preferred mice. The authors concluded that although the species has the potential for behavioral plasticity, the preferences shown by island snakes for prey no longer consumed by their population also indicate a strong genetic basis in feeding behavior for this species.

AUBRET, F., G. M. BURGHARDT, S. MAUMELAT, X. BONNET, AND D. BRADSHAW. 2006. Feeding preferences in two disjunct populations of tiger snakes, *Notechis scutatus* (Elapidae). Behavioral Ecology 17:716–725.

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New Phylogeny and Insights on Biogeographic Patterns of Ranid Frogs

Ranidae is one of the largest extant anuran families, with more than 1000 extant species and a nearly global distribution. However, there is no phylogenetic hypothesis for all major lineages in this group. The authors sequenced ~1570 bp of nuclear gene fragments (*Rag-1*, *Tyr*, and *Rhod*) and ~2100 bp of the mitochondrial genome from 104 species, including representatives of all ranid subfamilies. Parsimony, maximum likelihood and Bayesian analyses were performed to reconstruct the phylogeny, which was used in an attempt to reconstruct the early biogeographic history of the group. The phylogeny indicates that the monophyly of several previously recognized groups is rejected with high confidence. Further, the results of the biogeographic analyses indicate that plate tectonics have played an important role in determining the current distribution of ranids, as each major clade is associated with a single Gondwanan plate and their divergences fit the temporal break-up of the continents. The authors discuss several potential scenarios that would result in the current distribution of ranid frogs.

BOSSUYT, F., R. M. BROWN, D. M. HILLIS, D. C. CANNATELLA, AND M. C. MILINKOVITCH. 2006. Phylogeny and biogeography of a cosmopolitan frog radiation: late Cretaceous diversification resulted in continent-scale endemism in the family Ranidae. Systematic Biology 55:579–594.

Correspondence to: Franky Bossuyt, Unit of Ecology and Systematics, Vrije Universiteit Brussel, Pleinlaan 2, B-1050 Brussels, Belgium; e-mail: fbossuyt@vub.ac.be.

Turtle Navigation in Unfamiliar Habitats

Animals may use various orientation mechanisms to locate necessary resources, and different mechanisms are utilized in familiar and unfamiliar areas. Semiaquatic Eastern Painted Turtles (*Chyrsemys picta picta*) are ideal for studies of orientation, as they must travel through risky terrestrial habitat to reach suitable discrete patches of water. To determine whether turtles use an orientation mechanism in unfamiliar areas, the authors removed 60 adult turtles from their home lake and released them on land at five distances (100–2000 m) from an unfamiliar lake. To track paths of movement, each released turtle had a thread bobbin attached to its carapace, and fractal analysis was used to determine the tortuosity (the opposite of straightness) of the trails. Surprisingly, results showed that turtles walked in straight paths, indicating the use of some orientation mechanism, but did not orient towards water or in any single direction. The authors suggested that this implies that the turtles could not locate suitable aquatic habitats, even though they were most likely trying to reach them. They conclude that a compass mechanism (using either the sun or the earth's magnetic field) is the only mechanism that would produce these results, but that in unfamiliar areas the use of a compass without a mental map does not help them to locate water.

CALDWELL, I. R., AND V. O. NAMS. 2006. A compass without a map: tortuosity and orientation of eastern painted turtles (*Chrysemys picta picta*) released in unfamiliar territory. Canadian Journal of Zoology 84:1129–1137.

Correspondence to: Iain R. Caldwell, Project Seahorse, Fisheries Centre, University of British Columbia, 2202 Main Mall, Vancouver, BC V6T 1Z4, Canada; e-mail: i.caldwell@fisheries.ubc.ca.

Multiple Paternity Varies with Nesting Behavior in Sea Turtles

Mating systems can be affected by a number of behavioral, genetic, and demographic factors, all of which may differ between and within species. The authors studied two populations of Olive Ridley Sea Turtles (*Lepidochelys olivacea*) in Costa Rica to examine the frequency of multiple paternity in these populations, one of which displays mass nesting events (i.e., "arribada") and the other displays solitary nesting behavior. They used two highly polymorphic microsatellite markers to determine the number of paternal alleles occurring in hatchlings from the nests of 13 females (20–27 hatchlings per nest) in each of the two populations. Results indicated that multiple paternity is significantly higher for the arribada population (92%, the highest recorded for marine turtles) than the solitary nesters (30%), but analyses with six polymorphic microsatellite loci showed no genetic differentiation between the populations. The authors suggested that the difference in multiple paternity may be due to the differing abundances of individuals in the mating system between the two groups; the extremely large breeding assemblages that occur for the arribada population may cause mating with multiple individuals to be less energetically demanding, and therefore more frequent, than for the solitary nesters.

Jensen, M. P., A. Abreu-Grobois, J. Frydenberg, and V. Loeschcke. 2006. Microsatellites provide insight into contrasting mating patterns in arribada vs. non-arribada olive ridley sea turtle rookeries. Molecular Ecology 15:2567–2575.

Correspondence to: Michael P. Jensen, Applied Ecology Research Group, University of Canberra, ACT 2601, Australia; email: michael@mpj.eu.

Stress Hormone (But Not Androgens) Determine Male Calling Behavior in Toads

The expression of many sexually dimorphic traits is mediated by the effects of gonadal steroids (e.g., androgens). However, these effects can interact with those of stress hormones, including corticosterone (CORT). In this study, the authors investigated the relationship of androgens and CORT in male calling behavior in the Great Plains Toad (*Bufo cognatus*), a species that displays two male mating tactics: males may call to attract mates, or they may attempt to intercept females responding to calling males (a non-calling "satellite" strategy). First, they measured call parameters (i.e., call duration, frequency, amplitude) and hormone levels in callers with ($N = 24$) and without ($N = 35$) satellite males. They found that callers with and without satellites did not differ in call parameters or in their circulating androgen levels, but callers with satellites had lower CORT levels than callers without satellites. When males ($N = 5$) were experimentally treated with CORT, their call durations compared to a control group decreased over time, independent of their androgen levels. Further, in natural choruses CORT was generally negatively correlated with call duration. Finally, to test the prediction that females prefer longer calls (typical of males with low CORT and satellites), preference trials were performed. Twelve females were exposed to digitized broadcast calls of two different durations, and all preferred the longer calls. This is consistent with the hypothesis that satellites choose to associate with low CORT males to increase their mating opportunities. The authors also discuss potential mechanisms underlying the relationship between CORT, androgens, and satellite-caller associations.

Leary, C. J., A. M. Garcia, and R. Knapp. 2006. Stress hormone is implicated in satellite-caller associations and sexual selection in the Great Plains toad. American Naturalist 168:431–440.

Correspondence to: Christopher J. Leary, Department of Biology, University of Utah, Salt Lake City, Utah 84112 USA; e-mail: leary@biology.utah.edu.

Alternative Developmental Trajectories in Extinct Amphibians

Although metamorphosis is a trait widespread in extant amphibians, the evolutionary origin of these morphological transformations remains poorly understood. The recent discovery of fossils of adult specimens of *Apateon gracilis* (Branchiosauridae clade), revealed that individuals in this group (previously known only from larval specimens) underwent extensive morphological metamorphosis during development. This contrasts with other branchiosaurid species, in which development was neotenic: adult forms were merely an extension of the larval trajectory. In this study, the authors examined fossil material to describe the unique features of *A. gracilis* adults and to determine which features characterized the latest stages of development in this species. They discovered that *A. gracilis* experienced major proportional changes in cheek and posterior skull bones, and that up to 8 postlarval ontogenetic events occurred in a small window of developmental time. These results were compared to *A. caducus*, a neotenic branchiosaurid that has a larger body size but lacks the adult features of *A. gracilis*. The authors concluded that metamorphosis was likely correlated with habitat change (i.e., facultative) in Paleozoic branchiosaurids, and that the developmental pathways seen in extant amphibians were already established in this clade.

Schoch, R. R. and N. B. Fröbisch. 2006. Metamorphosis and neoteny: alternative pathways in an extinct amphibian clade. Evolution 60: 1467–1475.

Correspondence to: Rainer R. Schoch, Staatliches Museum für Naturkunde Stuttgart, Rosenstein 1-D-70191 Stuttgart, Germany; e-mail: schoch.smns@naturkundemuseum-bw.de.

Speciation in Plethodontid Salamanders

Many biologists struggle with the questions of how many species exist in a given taxon and how to diagnose those species. Using the general lineage species concept, the author examined two sympatric genera of plethodontid salamanders (*Ensatina* and *Batrachoseps*) in California with the goal of recognizing distinct evolutionary lineages that will likely remain distinct. After reviewing the decades of work on species relationships in *Ensatina*, a

well-known ring species complex, the author recommended that, despite its problems, the most appropriate taxonomy of this group is that of a polytypic species, and that adaptive divergence related to predator avoidance is the dominant force behind the differentiation among populations of this group. In contrast, a review of the work on *Batrachoseps* (the slender salamanders) led to the conclusion that this group includes approximately 20 differentiated species that represent a nonadaptive radiation, as their genetic diversification was not accompanied by ecological differentiation. The role of geography in the evolution of these groups was also discussed. The author concludes that careful analyses of the patterns and processes that lead to species formation will not resolve species controversies, but will continue to yield useful discussion.

WAKE, D. B. 2006. Problems with species: patterns and processes of species formation in salamanders. Annals of the Missouri Botanical Garden 93:8–23.

Correspondence to: David B. Wake, Department of Integrative Biology and Museum of Vertebrate Biology, University of California, Berkeley, California 94720-3160, USA; e-mail: wakelab@uclink.berkeley.edu.

How Many Species of Dinosaurs Existed?

Quantifying the species diversity in extinct animal groups is a current focus of paleontologists, but no study has yet attempted to determine the total taxonomic richness of both known and still undiscovered nonavian dinosaurs. Here, the authors applied a statistical method called the abundance-based coverage estimator (ACE) using previously published data to account for the deficiencies in the fossil record and to determine whether dinosaurs were declining prior to their ultimate extinction. They estimated the total "discoverable" diversity of dinosaurs to be 1844 genera, only 527 of which have currently been described. A logistic model predicted that 90% of this diversity will be known within 100–140 years. Estimated dinosaur diversity in the late Cretaceous remained steady (even though known diversity declined in this period), indicating that dinosaurs were not in decline in the 10 million years before extinction. This conclusion shows the importance of considering the incompleteness of the fossil record when analyzing fossil evidence. The authors also discussed factors that affect the relationship between true original dinosaur diversity and estimated discoverable diversity.

WANG, S. C., AND P. DODSON. 2006. Estimating the diversity of dinosaurs. PNAS 103:13601–13605.

Correspondence to: Steve C. Wang, Department of Mathematics and Statistics, Swarthmore College, 500 College Avenue, Swarthmore, PA 19081; email: scwang@swartmore.edu.

Insular Body Size Shifts in Rice Frogs

Island populations of reptiles, birds, and mammals have been shown to have different body sizes than their mainland counterparts, but no previous study has found insular size shifts in amphibians. The authors investigated populations of the Rice Frog (*Rana limnocharis*) on seven islands in the Zhoushan Archipelago and on the mainland of China (N > 17 females and 5–9 males per population), and found that island frogs were significantly larger than their mainland conspecifics in both breeding and non-breeding seasons. This insular body size increase was correlated with both increased population density and higher prey availability on islands. However, there was no relationship between body size on islands and variation in prey size, absence of other competing frog species, island size, or distance of islands from the mainland. The authors suggested that the increased density of rice frogs on islands is the result of increased resource availability, and the increased body size is due to the more intense intraspecific competition that occurs in high density populations. Further, they suggested that reduced predation on islands might also be responsible for the observed increased insular densities, and recommended further study to test this hypothesis.

WU, Z., Y. LI, AND B. R. MURRAY. 2006. Insular shifts in body size of rice frogs in the Zhoushan Archipealgo, China. Journal of Animal Ecology 75:1071–1080.

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OBITUARIES

Herpetological Review, 2006, 37(4), 396–398.

Margaret M. Stewart (1927–2006)

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On 2 August 2006, "Meg" Stewart, professor (emerita) of biology at the State University of New York at Albany (SUNY, University at Albany) and past president of the Society for the Study of Amphibians and Reptiles (SSAR), passed away peacefully at her home on the Helderberg Plateau in the Appalachian uplands of Albany County, New York, after a long battle with pancreatic cancer. Meg is survived by her husband, George E. Martin (Fig. 1A), her brother John M. Stewart, and several nieces and nephews. To those who may not have known Meg closely, the following quotation from a note written to us in the spring of 2005 (about a year before her death) demonstrates her love of the natural world and her optimistic view of life even as her own was in jeopardy. She said: "It is great to have sunshine and flowers; salamanders are breeding (have bred) in my pool and peepers are calling in our marshes. A little merlin sat in our yard all afternoon yesterday and our red fox walked across the yard at 3:00 pm. How could we ever leave this place?"

FIGS. 1A–C (LEFT TO RIGHT). A. Meg Stewart and her husband, George Martin (October 2004). Photo by Ariana N. Breisch. B. Meg with two of her Ph.D. students, Dan Townsend (left) and Larry Woolbright (right) in Puerto Rico in 1990. Unknown photographer. C. Stewart in the field in southwestern New York in 1957 with undergraduate assistant Gary Larson (center) and New York State Curator of Botany, Stanley J. Smith (right). Photo by Thomas H. Watthews.

Meg was well known to many in the herpetological community as she became the first female president of a major herpetological society anywhere in the world, assuming the elected position of president of SSAR in 1979. She was far from a figurehead officer in SSAR. Meg undertook seriously her assignment of leadership, having a personal agenda to reorganize the committee system within the society and to develop an operating manual for officers and editors that described in detail the roles of these positions (she said it was an unbelievable amount of work as she spent all summer writing letters). These operating procedures have provided a lasting foundation for the society, and the committees and chairs she appointed were similarly oriented toward productivity. This accomplishment, and her subsequent election to the presidency of the American Society of Ichthyologists and Herpetologists (ASIH) in 1996, solidifies her position among the well-known leaders in the major professional herpetological societies. In 2005, ASIH awarded her both the Robert K. Johnson Award for excellence in service to the society and the Henry S. Fitch Award for excellence in the study of amphibian and/or reptile biology.

By Meg's own admission, her society work caused her to sacrifice some momentum in working up her long-term data on tropical anurans. This work, as Powell and Henderson (1996) write, propelled her to prominence in tropical biology: "[She] and [her] coworkers (including A.S. Rand and F.H. Pough, and especially D.S. Townsend and L.L. Woolbright [Fig. 1B]), in a series of papers since 1979, have produced exquisitely detailed studies of *Eleutherodactylus coqui* on Puerto Rico. As a result, this particular frog is the best-known of all West Indian amphibians. Furthermore, Stewart's efforts pioneered the now-growing field of ecological studies on West Indian frogs." Meg herself summarized her early years in the Caribbean in a highly prescient natural history with an entertaining narrative of her research (Stewart 2003). Her field studies in the American tropics were preceded by her well-known study of the amphibian fauna in southeastern Africa conducted during a sabbatical leave in 1963–1964 and culminating in her monograph, *Amphibians of Malawi* (State University of New York Press, 1967), in which keys and line drawings (clearly executed by her own hand) of each species, and color photographs of many, are accompanied by full species accounts including records, range, size, general appearance, similar species, color pattern, body features, sexual dimorphism, variation, calls and calling time, breeding time, eggs, and habits and habitat. Thus reflecting Meg's detailed approach as a systematic naturalist, this work "...established her reputation in herpetology" (Langenheim 1996) and may form a baseline of data to evaluate the global extinction crisis affecting amphibians (Mendelson et al. 2006).

Meg was born on 6 February 1927 in rural Greensboro County, North Carolina, where she was raised with her older sister Josephine and brother John on a 100-acre truck farm that produced fruits, vegetables, eggs, and dairy products operated by her parents (with seemingly unending contributions of the children). She entered the Woman's College (now the University of North Carolina at Greensboro) and later the University of North Carolina at Chapel Hill, receiving her Bachelors and Masters degrees in 1948 and 1951, respectively. In June of 2006, the Epsilon chapter of Phi Beta Kappa at UNC-Greensboro elected her as an alumna member in recognition of an extraordinary career as a scientist and university professor. She was a laboratory instructor in biology and instructor in the Evening College of UNC-Greensboro for several years while an undergraduate student, and later taught briefly at Catawba College after receiving her Masters degree. Her doctoral dissertation (Cornell University, 1956) was on the natural history and development of the Northern Two-lined Salamander, *Eurycea bislineata*. A number of Meg's better known scientific papers are listed in an historical perspective that also outlines further aspects of her life's travels, travails, and triumphs (Brown and Breisch 2005).

Meg was initially appointed in 1956 to a full-time faculty position at the New York State College for Teachers at Albany (now the University at Albany) to which she devoted her full professional career. Her position was dedicated to field biology, but, as a woman, she accepted an entry-level salary 20% lower than comparable pay for men. She considered herself a vertebrate ecologist focusing on population and community ecology, and behavior of amphibians. One of her first major projects was a biological survey of the Allegany Indian Reservation and adjacent Allegany State Park (Stewart 1961) (Fig. 1C). Following her work in Africa, she focused her attention to the New World tropics, but she was quite

at home doing regional faunal surveys as well as conducting field studies of the local herpetofauna of the Adirondack Mountains in northern New York. For decades she devoted much of her natural history talents to the Albany Pine Bush, a glacial remnant pitch pine-sand plain community in and around the City of Albany. The latter "backyard" area served as a study site for her numerous class field trips, solidifying her extensive knowledge of the area's flora and fauna that led to her appointment to a state commission charged with management of the system. She was also active in the local chapter of The Nature Conservancy and supported a diversity of environmental causes, including providing expert testimony at hearings.

Numerous undergraduate and graduate students in her courses praised Meg's classroom abilities and field excursions. She was recognized officially as a Distinguished Teaching Professor in the Department of Biological Sciences at SUNY-Albany in 1977, one of about a dozen such select professors holding this prestigious title in the university. After her official retirement in 1997, she was reappointed to take on the rather arduous job of putting the finishing touches of organization on a new graduate program that she and several colleagues had earlier (in 1991) launched, the Biodiversity, Conservation, and Policy masters program (which accepted its first student in 1998). In 2003, she personally made a gift to endow the program through the establishment of the Margaret M. Stewart Graduate Scholarship (BCP program). Gifts in Meg's memory may be made to the University at Albany Foundation with notation to the above fund, and may be sent to Dr. Sorrell Chesin at the foundation, UAB-201, 1400 Washington Ave., Albany, New York 12222, USA.

Acknowledgments.—We are grateful to Kraig Adler for commenting on Meg's instrumental role in SSAR and other aspects of our summary of her life and legacy.

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Mendelson, J.R. III et al. [51 authors]. 2006. Confronting amphibian declines and extinctions. Science 313:48.

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Stewart, M. M. 1961. An ecological survey of amphibians, reptiles, and mammals of Allegany Indian Reservation and vicinity. *In* Biology of the Allegany Indian Reservation, pp. 63–98. New York State Mus. Bull. No. 383.

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J. Alan Holman (1931–2006)

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J. Alan Holman died suddenly of a heart attack on 12 August 2006 at his beloved fishing cabin at Fife Lake in northern Michigan, ending a remarkable and productive career in vertebrate paleontology and herpetology, and leaving family, friends, and colleagues with a profound sense of loss.

Al Holman, excavating microfossils near East Lake, Mackinac Co., Michigan, July 2002. Photograph by Phil Myers.

Al Holman was born in Indianapolis, Indiana, in 1931, and very early developed an intense interest in the natural world, and amphibians and reptiles in particular. He recalled as a child having a continuous and ever-changing menagerie of the local herpetofauna, and noted that the common species in the area then are now among the rarest, including the Kirtland's Snake (*Clonophis kirtlandii*) and the Cricket Frog (*Acris crepitans*), the latter being once so abundant that he often collected the little frogs as food for his snakes. Years afterward Al often lamented the obvious drastic decline in "herp" species and numbers over his lifetime. "What bothers me most," he would say, "is not that the rarer, more specialized species have become endangered or even disappeared—it's that the formerly common "generalist' species have now become rare—even in places that still seem to have habitat!" Al tried to do something about this situation, but his greatest contributions to science came in studying long-extinct amphibians and reptiles.

Al attended Franklin College in Indiana, receiving his Bachelor of Science degree in 1953. After a stint in the Navy, working as a medical corpsman, he then went on to graduate studies at the University of Florida, Gainesville, earning his MS degree in Biology in 1957, and his PhD in Systematics and Ecology in 1961. Al's doctorate advisor was Dr. Pierce Brodkorb, so not surprisingly his PhD thesis focused on fossil birds ("The osteology of living and fossil New World quail"). Another of his mentors at UF was Dr. Archie Carr, the famous marine turtle expert, who presumably encouraged Al's special life-long appreciation for all things chelonian.

Al began his teaching career at Samford University and then Illinois State University before coming to Michigan State University in 1967, where he had joint appointments in the Geology and Zoology Departments. He taught the undergraduate course in vertebrate paleontology, and later (after the retirement of friend and colleague Dr. Max Hensley) the herpetology course. He also be-

came the first curator of vertebrate paleontology at the MSU Museum. Over three decades, Al amassed a collection of nearly 3000 fossil specimens—mostly fossil fishes, amphibians, reptiles, and small mammals, but also a large mammoth skull he and colleagues collected in Kansas in 1971, now on display at the Museum. In addition, Al prepared and curated an impressive herpetological comparative osteological collection, presently containing over 4100 complete and partial skeletons. During his career, and after retirement, he described 53 new species, 22 genera, and one family of vertebrate fossils.

Al Holman focused his research on Cenozoic and Quaternary paleoherpetology in North America and Europe, and was a leading authority on New World fossil snakes. His studies on disharmonious Pleistocene "herp" faunas lent support for the Pleistocene Climatic Equability Hypothesis (in part, the idea that at times during the Pleistocene, winters were warmer and summers were milder in much of eastern and central North America than occurs today.) He also dabbled in "larger" animals at times, including devising a hypothesis that, post-glacially, mammoths and mastodons migrated to Michigan from other areas to partake of salt deposits in the central lower peninsula. Al enjoyed field work and for many years led expeditions of graduate students to many parts of the United States and Canada, and also worked with colleagues in the United Kingdom. Important fossil sites included sink holes in Florida, sand pits in Kansas and Nebraska, peat bogs in Michigan, and interglacial beds in Norfolk, England.

Al's research produced more than 300 publications, most of which were scholarly papers, but also a number of semi-popular and popular articles, along with eleven books. His productivity certainly did not decline after "official" retirement in 1997. His most recent book is "Fossil Salamanders of North America" (2006); other titles include "Fossil Frogs and Toads of North America" (2003), "In Quest of Great Lakes Ice Age Vertebrates" (2001), and "Fossil Snakes of North America" (2000). His concern for the conservation of living amphibians and reptiles was reflected in the production of three popular educational field guides on Michigan herps that we co-authored: "Michigan Snakes" (revised in 2006), "Michigan Turtles and Lizards" (1990, rev. 1997), and "Michigan Frogs, Toads, and Salamanders" (1992). In 2003, Al and his wife Margaret ("Peg") Holman (a respected archeologist who died in April 2006) co-authored a popular guide to Michigan's natural and human history—"The Michigan Roadside Naturalist." At least two additional book manuscripts were complete or nearly so, and are forthcoming.

Al Holman was foremost a dedicated educator. He chaired the committees of 21 graduate students at the masters and doctorate levels, and served on many others. His students knew him to be a kind and patient advisor, but with high expectations for academic achievement and communications skills. His colleagues knew Al as a reliable friend and confidant, ever willing to offer useful advice or assist with an academic question. A humble and often shy man, but with a droll wit and an uplifting sense of humor, Al's jokes could lighten the mood or break the tension at the driest or most acrimonious of staff meetings.

There can be no regrets for Al Holman's lifetime of contributions to his academic profession, his dedication and love for his family, and the well-earned respect of his colleagues and students. But we lament the untimely loss, and greatly miss his counsel and friendship.

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Warren J. Iliff (1936–2006)

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Warren Iliff served as Past-President of the Association of Zoos & Aquariums (formerly American Association of Zoological Parks and Aquariums) while he was director of the Dallas Zoo and Dallas Aquarium between 1984 and 1990. As president, his final position was to design and build the Aquarium of the Pacific in Long Beach, California. Photograph courtesy of the Aquarium of the Pacific.

When Warren Iliff arrived at the Dallas Zoo in Texas as director and my boss in 1984, the place was in shambles—lack of public support and declining attendance, indifferent city officials, an uninspired staff, and a barely functioning zoological society. Within months, he started to turn the place around through sheer energy, personal charm, boyish enthusiasm, and a strong commitment to conservation and research. Warren and his wife Ghislaine became treasured icons in the community. These were some of the best days at the zoo.

Warren was not a herpetologist but loved and supported herpetology. He secured funding for three research initiatives for the zoo herp staff and outside colleagues: 1) herpetofaunal survey of the Sierra de los Cuchumatanes in northwest Guatemala (with Jonathan A. Campbell and Edmund D. Brodie, Jr.); 2) Bushmaster study at La Selva, Costa Rica, developed by Harry W. Greene, which involved travel to that lovely setting by the entire staff; 3) analysis of Panther Chameleon biology in Madagascar (with Gary W. Ferguson, Jean-Baptiste Ramanamanjato, and Achille Raseliminana). Staff development was important to Warren so he made sure that monies were available for our staff, even when our budget was tight, to attend national and international herpetological meetings and training programs.

His memory was prodigious. Within a few months after arriving at the zoo, he knew the names of not only the entire zoo staff, members of the Dallas Zoological Society, and fellow workers in the City of Dallas, but the names of their spouses and children as well. Since he had total recall of our conversations, I could never put anything over on him.

Warren did not tolerate complacency and pushed me in directions that were to me unimaginable. Before he came to Dallas, our department essentially operated as an isolated fiefdom and we made little effort to interact with others in the zoo, our zoo visitors, or the broader zoo community. During my first annual evaluation, Warren made clear that in the future I would be judged in broader terms; no longer would my isolated and misanthropic way of doing things be accepted. Naturally, I was devastated and after several weeks of soul-searching, I concluded that he was right and

made an effort to change my approach; I became a more-well-rounded and better zoo professional as Warren would accept nothing less. It is rare that a new boss pushes a long-term employee in this way and unless it is done properly, it can be traumatic and destructive for both sides. Warren did it properly.

Warren was a caring director and the following anecdote underscores this point. Ghislaine and Warren hosted a series of parties at their home for the entire zoo and zociety staff, which numbered about 300 persons. These were not catered events—all of the food was prepared beforehand and served to all of the attendees by the hosts.

Our weekly staff meetings were energetic, unpredictable, and filled with mirth. Since Warren's mind was so fertile, the ideas would flow in an unquenchable torrent from his lips and we had to struggle mightily to keep up with the pace. Subjects ranged from the lack of viable conservation programs in zoos, which fishes breathe air, parental care in salamanders, ophiophobia in primates, cleanliness in the public restrooms (Warren wanted to put Gary Larsen cartoons in the stalls to occupy the patron), pro football, embryo transfer into surrogate mothers, collection and cryo-preservation of gametes and do or should zoos need the "frozen zoo," responsibilities of the press, animal welfare issues, lack of opportunities for minorities in our profession, global warming before it was fashionable, failed management strategies, zoo scandals, and so on—no topic was considered to be too delicate or sacrosanct. Often, we left these meetings so highly charged that we adjourned to the local pub to finish our discussions into the wee hours.

When Warren and I left the zoo, we kept in touch regularly. One remarkable characteristic of our conversations was that he rarely dwelled on his life but always wanted to know how my family and I were doing. He loved to talk about his friends and colleagues and explore the intricacies and challenges of the zoo business.

Many months ago, he was diagnosed with lung cancer and during the past several months was undergoing radiation and other treatments at a local hospital. Even during the last days of his illness, he inquired about my family and my well-being and I had to press him to talk about his condition and how he was doing.

I am sad to say that Warren passed away on 5 August 2006. When his condition deteriorated, he wanted to go home, and so spent his last few days with Ghislaine and brother Bernie in that place. The day before, he slipped into a coma but Ghislaine said that he was peaceful at the end.

Warren was a wonderful boss . . . challenging but not demanding. His presence in my life stretched me both intellectually and professionally. I will miss his wise counsel and friendship—and his infectious laugh so precious.

ZOO VIEW

I enjoyed reading Kevin Murphy's article about the Buffalo Zoo because it brought back memories of my earlier association with Director R. Marlin Perkins at the Lincoln Park Zoo in Chicago during the 1950s. Perkins was assuredly the most well-known zoo personality in the United States with his television shows "Zooparade" and "Mutual of Omaha's Wild Kingdom." The American Zoo and Aquarium Association issues an annual award called "Marlin Perkins Award for Excellence" to a zoo worker chosen for significant contributions to the profession.

During the 1950s when my parents occasionally decided that my collection of reptiles at home had to go, mostly due to untimely escapes, my herpetological treasures always went to the Lincoln Park Zoo. With heavy heart, I periodically carried my charges to the reptile building although I was already planning my next ploy to bring more herps home when my parents settled down and became resigned to my unusual interest. During these purges, I met R. Marlin Perkins, Edward Maruska, Gene Hartz, Ray Pawley, and Ed Almandarz. They subsequently spent hours explaining the intricacies of the zoo business, encouraging me to give it a try as a career. Since it was clear that I was ill-equipped to do anything else, their wise counsel prevailed. Marlin Perkins was the only dissenter; he insisted that the zoo business would thrust me into a life of insolvency, chaos, and frustration. Accurately predicting two out of three is not bad!

Although I mentioned this experience earlier (Card and Murphy 2000. Lineages and histories of zoo herpetologists in the United States. Herpetol. Circ. No. 27:1–44), it bears repeating as it was a defining moment of my life: "While a high school student, JBM was introduced to Perkins by Gene Hartz. JBM timidly knocked on his office door, entered cautiously and spent an unforgettable thirty minutes with him. Perkins told JBM that getting into the zoo business was the greatest mistake of his life. His frustrations were exacerbated by indifferent politicians, zoo workers, and personal friends who could not understand his passion for animals. Further, zoo finances were always unstable and his bosses were jealous of his TV fame. Finally, Perkins advised the impressionable lad that if he were stupid enough to embark on a career in zoo herpetology, fate would deal a cruel and unrelenting blow to his entire life. Perhaps he was right?"

R. Marlin Perkins and chimp. Undated photograph provided by Kraig Adler.

Later, when I was at the Dallas Zoo, Perkins came to visit and charmed all of the herpetological staff with his stories about zoo herpetology in the early days. One of the most memorable was his description of the near-fatal Gaboon Viper bite in 1928 at the St. Louis Zoo. His assistant, Moody Lentz, was holding the smallish snake as Perkins was trying to remove an eyecap; he was envenomated with one fang. This was before the days where a monovalent antivenin was available for this species so American pitviper polyvalent, followed by cobra serum and an additional one to counteract Fer-de-lance and other *Bothrops* venoms were used—Perkins nearly died. He concluded his anecdote by saying, ". . . that the doctors threw everything but the kitchen sink at me and I still survived!"

Rick Hudson in the Fort Worth Zoo's conservation department has been the prime force in the impressive and successful captive breeding/reintroduction program for the critically endangered Jamaican Iguana and other *Cyclura* species. Rick has published three chapters on translocation, headstarting and the role of zoos relative to West Indian iguanas in the book *Iguanas: Biology and Conservation* (2004. Alberts et al. [eds.]. Univ. California Press, Berkeley).

—James B. Murphy, Section Editor

Herpetological Review, 2006, 37(4), 401.

A Jewel of a House

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In 2005 the Buffalo Zoo renovated a little bit of history. The zoo closed down its Reptile House for seven months for some exciting improvements. Lead paint in the exhibit murals, threatening to become an animal health concern, was the impetus to start the project. The murals dated back to 1942 when the Reptile House was first opened. The Reptile House is part of the Main Building of the zoo which was a Works Project Administration (WPA) product, one of many building projects around the country. At the time the Reptile House was being built, R. Marlin Perkins, a renowned herpetologist, was curator at the Buffalo Zoo. Perkins took great pride in exhibiting reptiles in what at the time were considered very naturalistic exhibits. The murals depicted in the reptile exhibits helped boost the aesthetic and educational value of the individual exhibits and the reptile house in general.

In modern exhibits too, murals can add a great deal to the accurate exhibitry of the animal and facilitate attaining the goal of a truly natural looking exhibit. Visitors viewing a well done naturalistic exhibit can passively learn a great deal about an animal, just by observing the animal in its natural habitat.

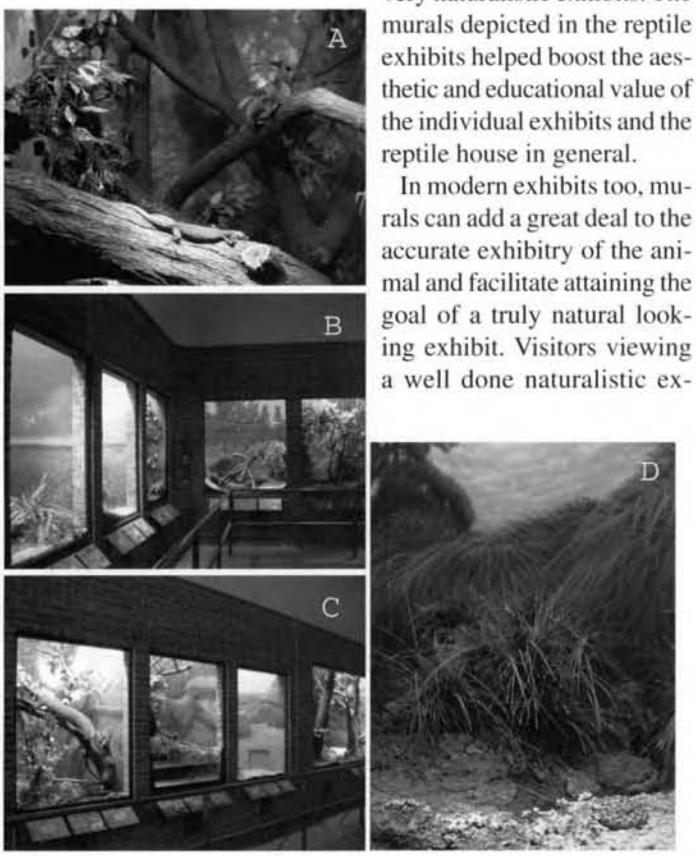

Fig. 1. A) Black Tree Monitor (*Varanus beccarii*) basking in its newly designed arboreal exhibit. Elevated, exterior nest box can be accessed by the lizards through the tree hole visible in mural. B) Exhibits showing graphics and a variety of habitats. Exhibit in center with pine tree houses Eastern Diamondback Rattlesnake (*Crotalus adamanteus*), Gopher Tortoise (*Gopherus polyphemus*), and Southern Fence Lizard (*Sceloporus undulatus undulatus*), one of several new mixed species exhibits in the house. C) Exhibits including Mata Mata Turtle (*Chelus fimbriatus*)/Emerald Tree Boa (*Corallus caninus*) display with underwater viewing. D) Mexican Lancehead Rattlesnake (*Crotalus polystictus*) exhibit created from photos of habitat near Atlacolmulco, Mexico.

Zoo staff had been trying to cope with the deteriorating murals for years. Lead abatement companies must be licensed and follow rigorous protocols in the removal process to prevent the release of super fine lead particles into the air. Due to the high costs of abatement, staff had been unable to appropriately remove any of the paint. Finally, a local labor union was contacted and an agreement was worked out with their abatement training school to use the Reptile House as a training facility.

Once the Perkins era murals were removed there was a tremendous amount of repair work done by zoo staff. Every wall of the 26 exhibits was patched, sanded, and primed. Each of the exhibits was originally built with hand-troweled concrete plaster walls that incorporated curved corners in the rear of the exhibits. These walls are very conducive to placing naturalistic props and the curved corners aid in mural continuity. In addition to the wall work, zoo staff spent numerous hours refurbishing the 1940s-vintage metal work that makes up the doors, doorframes, and shift doors assemblies. When Perkins designed the House he had the foresight to build a number of the enclosures with remotely operated shift cages as well as "peep" windows in all the keeper entry doors.

Once the prep work was done, photo references for each animal's habitat were painstakingly developed. Nationally renowned muralist David Rock used the photo references to create accurate, realistic murals. Each exhibit has a different habitat portrayed that seems to keep visitors engaged as they experience what the building has to offer. Once the initial murals were completed the project seemed to take on a life of its own. The zoo found the money to replace the majority of the badly etched glass fronts as well as for educational graphics throughout the building.

Exhibits were completed with three-dimensional props, misting systems, and new lighting schemes. Staff experimented with a number of new exhibitry techniques including an underwater view for a Mata Mata turtle exhibit.

In mid September 2005, the first exhibits were ready for their inhabitants. It was a very exciting time for staff. Special care had gone into re-building the exhibits and hiding the lights and misting systems. The animals in the exhibits now have more choice in terms of temperature and humidity gradients as well as how they can use the exhibit spatially. This was the first time since it opened that the Reptile House had been completely emptied and renovated. The house now looks fresh and new. There are a number of fascinating new species exhibited with special attention given to mixed species exhibits (Figs. 1A–D). As staff continues to strive for excellence at the Buffalo Zoo it seems likely that Marlin Perkins would be proud of this jewel that he started over 65 years ago. Zoo staff members certainly are.

Herpetological Review, 2006, 37(4), 402–403.

The International Iguana Foundation: Providing Critical Support to Endangered Iguanas

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When a group of iguana biologists and conservation professionals gathered in Fort Worth, Texas, in August 2001, it signaled the beginning of a new era for iguana conservation. The group convened to address the critical need to provide a reliable source of funding for iguana conservation, particularly to support ongoing recovery programs for some of the critically endangered iguanas of the genus *Cyclura*. Shortly thereafter, the International Iguana Foundation (IIF) was formally established as a registered nonprofit organization and with it, the futures of a number of endangered iguanas grew more secure.

The IIF is a diverse group of conservation professionals, combining years of experience with multidisciplinary expertise. With a governing board comprised of research scientists, zoo administrators, professional fund-raisers, field ecologists, captive managers, private breeders, and veterinarians, the IIF brings a uniquely broad perspective to iguana conservation. Currently the IIF has 14 board positions with individuals representing zoos and aquariums, corporations, wildlife trusts, and foundations. Largely U.S. based, the majority of Board members represent zoos that have made long-standing commitments to *Cyclura* conservation, including Audubon, Columbus, Fort Worth, Gladys Porter, Houston, Indianapolis, San Diego, Sedgwick County, Shedd Aquarium, Toledo, and the Wildlife Conservation Society. Disney's Animal Kingdom is our sole corporate partner, and Durrell Wildlife Conservation Trust (formerly Jersey) is our lone foreign member. However the IIF is currently making a strong push to recruit more participation from both Europe and Australia. The single private sector representative is the California-based International Reptile Conservation Foundation (IRCF), a relatively new nonprofit that publishes the journal IGUANA and that has been instrumental in developing the IIF's web site: <www.iguanafoundation.org>. The President of the IIF is Dr. Allison Alberts, newly appointed Director of Conservation & Science for the Zoological Society of San Diego, and an accomplished iguana research biologist with a remarkable body of published work to her credit.

The IIF mission is to ensure the survival of iguanas and their habitat through conservation, awareness, and scientific programs. This translates to one simple overarching goal: zero iguana extinctions.

The IIF's primary purpose is to raise the financial resources essential to implementing iguana conservation programs. Working in tandem with the Iguana Specialist Group (ISG) of the World Conservation Union (IUCN), the IIF provides critical support to initiatives prioritized in the ISG's Conservation Action Plan and in the various Species Recovery Plans drafted under that group's auspices. In addition, IIF works to generate public awareness of the many threats facing iguanas.

Prior to the formation of the IIF, the conservation of Caribbean rock iguanas was largely handled by the ISG. Formed as the West Indian Iguana Specialist Group in 1996, the group expanded its mandate to include all iguana species in 2000. The ISG did an admirable job of prioritizing and facilitating iguana conservation work, primarily in the West Indies. The group achieved remarkable success in terms of fund-raising and grant writing, matching resources with project needs, providing logistical support and scientific oversight to recovery programs, developing headstarting facilities, conducting field research and predator control and a host of other activities.

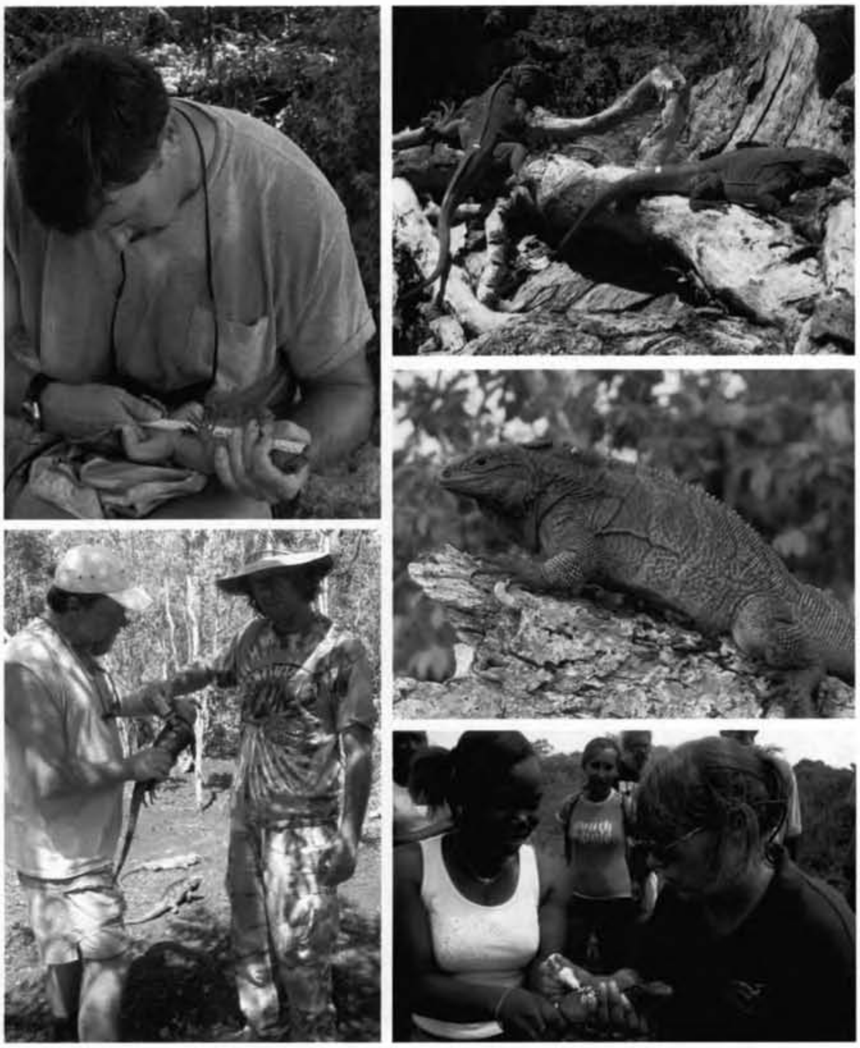
The strength of the ISG rests with their ability, through the international recognition that comes with IUCN affiliation, to forge working relationships with foreign governments, trusts and conservation NGOs (nongovernmental organizations). The ISG has developed a Species Recovery Plan (SRP) process. Since 2001, the group conducted workshops for the Grand Cayman Blue, Anegada Iguana, Ricord's Iguana, Turks and Caicos Iguana, Andros Iguana, and recently (and the first venture outside the Caribbean) the Fiji Crested Iguana. These SRP workshops are conducted in conjunction with the ISG annual meeting, where the group reviews the ever-changing list of priority species and projects. This list is made available to the IIF to use as they award funds and grants for projects.

Where the ISG is long on expertise, they are short on financial resources, which is where the IIF steps in. The close working relationship between these two groups is essential to ensure that the limited funds available for iguana conservation are used wisely and reflect the current prioritized needs. The strength of this process is that all decisions, both regarding funding (IIF) and species priorities (ISG) are made with consensus and under peer-review, which assures a broad and disciplined perspective.

Since its inception, the IIF has raised more than $484,000, primarily through direct board member annual contributions from supporting partners. The IIF also receives grants and public donations. Each supporting partner contributes from $2,500 to $10,000 annually; additionally, partners respond to requests for special project assistance or appeals for emergency needs such as those wrought by Hurricane Ivan in 2004 or the Blue Iguana extinction crisis of 2002.

The IIF applies for annual Disney Wildlife Conservation Fund (DWCF) grants that are earmarked for special large-project needs. Since 2002, the DWCF has been especially generous to the IIF, having awarded $68,750 for projects in Grand Cayman, Jamaica and the Turks and Caicos islands. The IIF has administered over $142,000 in grants from sources, including the Morris Animal Foundation (MAF), the SSC Sir Peter Scott Fund for Conservation Action, AZA's Conservation Endowment Fund, USFWS, and Conservation International. The largest of those, a $46,440 grant from MAF, funded medical evaluations on five *Cyclura* species, including pre-release health screening and establishing normal physiologic values on free-ranging animals.

The IIF is able to manage these conservation funds effectively because they have no overhead or paid employees. As one of the IIF's founding partners, the Fort Worth Zoo supports me to devote 40% of my salaried time to iguana conservation activities, including serving as the group's Executive Director. The zoo likewise supports the IIF's administrative office, one of two nonprofit rep-



From top left, clockwise: ▶ Glenn Gerber, PhD (San Diego Zoo CRES) collects data on a Stout Iguana, *Cyclura pinguis*, prior to being released in October 2004. ▶ The first group of 24 *C. pinguis* was released in October 2003, in two distinct habitat types on Anegada, BVI. In total, 101 iguanas have been repatriated from 2003 to 2006. ▶ A *C. pinguis* male, indicated by the red paint mark, rests on a dead tree following release on Anegada, October 2003. ▶ Kelly Bradley (Dallas Zoo), with help from a local Anegadan student, applies a white paint mark to a female iguana prior to release in 2005. Kelly successfully radio-tracked 72 iguanas on Anegada from 2003 to 2006 and obtained overall survivorship data of ~85%. ▶ Rick Hudson (Fort Worth Zoo) and Rick Van Veen (field coordinator for the Jamaican Iguana Recovery Team) apply a paint mark to a female *C. collei*, prior to release in the Hellshire Hills, February 2005. 67 *C. collei* have been repatriated since 1996.

tile conservation organizations (the Turtle Survival Alliance being the other) headquartered here, reflecting the zoo's strong tradition of commitment to herpetological conservation.

Conservation funds are allocated annually through a grants program. Since 2002, the IIF has awarded at total of $210,000 in four grant cycles to the following high priority projects: Blue Iguana Recovery Program, Grand Cayman; Jamaican Iguana Recovery Program; Anegada iguana research and conservation, British Virgin Islands; San Salvador Iguana translocation, Bahamas; St Lucia field research and conservation; Ricord's Iguana field research, Dominican Republic, Mona Iguana population monitoring and Fiji Crested Iguana field surveys.

The intent of the IIF is to address critical conservation needs, and three of the mainstays that fall into this category are the ongoing recovery programs for the Jamaican (*Cyclura collei*), Grand Cayman Blue (*C. lewisi*) and Anegada (*C. pinguis*) iguanas. All three are ranked Critically Endangered by the IUCN Red List and are considered conservation dependent; that is, the risk of extinction is too high to ignore the annual program needs. Intervention is necessary to offset the major threat, primarily high juvenile mortality associated with invasive feral predators. Not funding these programs is simply not an option. Therefore, the board recognizes that there will always be certain fixed costs associated with the grants program, however a solid proposal based on good science is still expected.

The IIF reached a major milestone in 2005: 100 individual iguanas of three species (Jamaica, Grand Cayman, and Anegada) returned to the wild with IIF funding since 2003. The October 2005 and 2006 releases of 24 and 29 Anegada iguanas respectively, surpasses that milestone, bringing to 224 the number of iguana repatriated to the wild with funding support from the IIF. In recent years the IIF has emerged as a major force for iguana conservation. And though the IIF has successfully raised a considerable amount of money, the group is constantly faced with worthy projects that are in serious need of financial support, but remain unfunded. Spiny-tailed iguanas of the *Ctenosaura melanosterna* complex fall into this category and will require considerable conservation funding in the coming years if they are to persist. Difficult choices have to be made. Such decisions are even more difficult with the realization that tried and tested conservation solutions exist for some of the highly endangered iguana species.

The expertise and techniques are available to help them; however, the pace of recovery is dictated by funding. For many species, rather than boldly forging ahead, the best that can be done is "holding the line" because of funding limitations. The IIF faces the challenge of reversing this situation, and to become better positioned financially to allow iguana conservation to move ahead at the pace that matches the need. For endangered iguanas worldwide, the IIF offers a fighting chance at survival.

The IIF is 501 c (3) nonprofit foundation registered in the State of Texas. Tax deductible (for U.S. taxpayers) contributions can be made with checks made payable to the IIF and sent to Rick Hudson, IIF, 1989 Colonial Parkway, Fort Worth, Texas 76110, USA, or on-line at <www.iguanafoundation.org> and click on contribute.

LETTERS TO THE EDITOR

Herpetological Review, 2006, 37(4), 404–405.

Amateurs, Professionals and Showmen: Taking Risks and Steve Irwin

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Some of us study animals to answer fundamental questions about their ecology, evolution and natural history, while others learn just enough about an animal's behavior to be dangerous to themselves, and sometimes to others. In Australia, prior to my departure in 1989, people who engaged in scientific studies of dangerous animals, the ones who sought to publish scientific papers, were few and virtually confined to universities, museums, or Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO). The professional field has grown since then, although the number of studies requiring "hands on" field work, particularly with highly venomous snakes, has not changed much. On the other hand, there was never a shortage of Australians who caught, kept, and often displayed dangerous animals.

The contrast between Australian scientific types and the lay public is perhaps exemplified by Banjo Patterson's poem, "Johnson's Antidote," that describes Johnson as a "free selector" (in this case a swagman, or an Aussie battler), always searching for a quick way to make a living, who witnessed a fight between a goanna and a venomous tiger snake. The goanna finally kills and eats the snake, surviving numerous bites ostensibly by nibbling the leaves of some plant. Johnson believes the plant harbors an antidote, and seeks the advice of a "scientific person" (actually a museum curator) for how to test it. The test shows the plant to be more deadly than the snake's venom, leaving the battler to battle on in search of fame and fortune.

As a "professional," finding populations of critters to study, especially if one was not born in Australia, required developing close relationships with "amateurs"—the risk-takers who handled those critters. They were the blokes (and Sheila's) who had read the popular accounts, traded husbandry notes, developed intense fascinations with particular species, applied what they knew to justify catching and handling them, and dreamed of one day finding their own "antidote," or running their own reptile park. And some did.

Joe Bredl, then owner of Bredl's Reptile Park near the riverland of South Australia, was a short, wiry man with a clipped white beard, a wonderful smile, and crisp Hungarian accent. Joe was quick to size me up as the new Curator of Reptiles at the South Australian Museum—and alas, a Yank! "Joe," I said, "where can we find some snakes?" "Oh, well it's too hot and dry mate," said Joe. The next day it rained—poured, rather—for several hours, and we caught lots of frogs, but no snakes. So I went back to Joe's park. "Joe," I asked, " where are the snakes hiding?" "Too, wet, mate," was Joe's reply. The front passed through and the humidity dropped, along with the temperature, so I asked once more, "Joe, any idea where we can find those snakes now?" "Too cold, mate, too cold." And that was my introduction to one of the most famous of the living "amateurs." I last heard Joe was bitten on the chest by an Inland Taipan or fierce snake, the world's most venomous terrestrial snake, while on a collecting trip. He nearly died. But being one of the few people to ever survive such an ordeal, Joe lavished in the publicity—he was now the stuff of legends, taking his place beside many other risk-takers.

"How many times have you been bitten?" the amateurs ask, when I tell them I've handled some ten thousand tiger snakes over the last 20 years. "None," I reply, "at least not envenomed." Their faces betray their skepticism and disbelief—one even blurts out, "Well, how can you call yourself a herpetologist, if you've never been bitten?" "Just lucky, I guess," shying away from the questions and not attempting to justify my apparent lack of experience. No credential—a childhood of catching snakes in the swamps behind my house in Louisiana, Bachelors, Masters, and Ph.D. degrees in herpetology, and postdoctoral experience in the biochemistry of snakes—nothing would impress them. Some know the risks of handling these highly venomous reptiles, but most, I think, only really understand (or learn to appreciate) the danger after they or a friend are bitten.

At a "show and tell" session, during a meeting of the Junior Herpetology Club of South Australia, a ten year old boy sat quietly with a knotted bag on his lap. When called on, he opened the bag, reached in, and took out a live, three-foot long taipan (the world's second most venomous terrestrial snake, and sometimes ranked as the worlds most dangerous). No one crowded around the young boy—all were too shocked to move. The snake seemed docile enough. "How long have you had that snake?" I asked, as calmly as I could. "Since it was a baby," he said. "I feed it mice by hand." Brian Miller, among the keenest of amateurs, and a close friend, grimaced at the comment. Just a few weeks before he'd told me about an incident in the cane fields of Queensland. "I saw this tail sticking out from between two railroad sleepers and I grabbed it," he said. "I thought it was a large whipsnake, but it was a taipan about four or five feet long. It doubled back, shot over my left shoulder and was gone in a second or so. I was so fortunate, as it could have bitten me thrice in the same amount of time." Brian congratulated the boy on the interesting snake he exhibited, and quietly asked that he put it back in the bag. Afterwards, we talked to him for over an hour about the dangers of handling such an unpredictable reptile. But the snake, apparently, was acquired legally, and after that night the boy never returned to the meetings.

Steve Irwin's first film on snakes was "The Ten Deadliest." Dr. Richard (Rick) Shine, of The University of Sydney, arguably one of the world's most scholarly herpetologists and an authority on Australian snakes, with over 500 refereed papers on amphibians and reptiles, reviewed the story line and videotape for Partridge Films. I also reviewed the materials. Rick and I agreed that Steve's handling abilities were cautious enough, but his dialog was meant for amateurs and lay people—handling snakes as gingerly as he did, examining them by holding their tails, and generally making a fuss over them, cooing about how mild their tempers were when "handled properly," were just a bit over the top. We scientific types take some twenty measurements, count numerous scales, examine for gender, reproductive condition and gut contents, draw blood

and venom samples, and mark, weigh, and photograph each individual. Using Steve's ideas, we would have given up the studies, or worked well into old age, to get enough data to finish our projects. But the part of Steve's film we found most objectionable, was the sight of him lying on the ground near a rat burrow, allowing a very large female inland taipan to approach and "lick" him on the cheek with her tongue flicks. That reminded me of the young boy with the taipan.

In spite of our objections, Steve's film was an instant success—particularly in the United States. Years later, a fellow herpetologist and keen field researcher told me that while trying to make a film on Eastern Diamond-backed Rattlesnakes in Georgia, he was notified of a recent snakebite victim, a young boy, just admitted to the local hospital. After the crisis was over, and the boy was interviewed, he was asked, "Why did you try to pick up that snake?" "I was just trying to be like the Crocodile Hunter," he replied.

Although my fascination with snakes has caused me to take many risks—most involved transport between islands in a rubber boat—I treated each snake as a research subject, with caution and a protocol for safety, as if each capture and handling was the first time. Over the years, I sensed that Steve Irwin, in spite of my reservations, perhaps subconsciously, did that, too. He most likely felt the same adrenalin rush and the same sense of accomplishment in collecting and displaying animals to the camera that I got from recording the data that, I hoped, would make my publications read and admired by my peers and the public. And, for a time, I eagerly accepted invitations of film crews from the ABC, the Cousteau Society, local and national television, and freelance cameramen working for the likes of David Attenborough, to make videos and television documentaries on tiger snakes. I even teamed up with Mark O'Shea on one of his 'big adventures,' and enjoyed it immensely. But all these were diversions from my real goal—to publish a book on the biology of these snakes—and that quest continues, today.

While in Australia in 2001, I also learned that Steve, the showman, was also Steve the conservationist, spending some of his earnings on the preservation of land for wildlife. This new perspective, related to me by an old friend at the South Australian Museum, changed my attitude toward Steve. Like most of his fans and detractors, I never knew him, personally. But, showmanship aside, conservation and land preservation for wildlife habitat, particularly in Australia, is admirable, no matter what the means are for doing it. My perspective changed. I began thinking more about the joy Steve displayed and how his work transferred wonderfully to his audiences. Wildlife expert, risk-taker, buffoon, comic, advocate, family man—he was all these things and more, and he projected his joy and enthusiasm for life into millions of homes.

I came to the conclusion there is a kinship among those of us who take risks with dangerous wildlife. Steve Irwin's death causes me to wonder how I survived all my years handling venomous snakes and to count my blessings. It also points, perhaps selfishly, toward a renewed sense of urgency to finish and publish my work, if for no one other than my wife, children, and grandchildren. When a person we all recognize dies, we may give pause to our daily chores and ask—what good have we actually contributed to humanity? Steve's impact will endure in his films. They will be seen by his wife and children, and remembered by all for a very long time.

Herpetological Review, 2006, 37(4), 405–406.

Comments on Maximum Length in the Moila Snake (*Malpolon moilensis*) and Length Dimorphism in the Montpellier Snake (*M. monspessulanus*)

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In the very interesting life history of the Moila Snake, *Malpolon moilensis* (Colubridae: Psammophiinae), as described by Gasperetti (1988), I was struck by the claim that Kramer and Schnurrenberger (1963) had recorded two female *M. moilensis* from Libya, of 1897 mm and 1899 mm total length. Kramer and Schnurrenberger (1963: 511–513) actually examined 19 specimens from Libya. Of these they indicated the length of only the longest one, a female of 910 mm (including tail 165 mm).

Gasperetti (1988: 253–257, 371 + appendix II) measured at least 47, and possibly as many as 144, Arabian *M. moilensis*, of which the longest was a female of 1213 mm (including tail 207 mm). Although he also mentioned a "non-measured"[*sic*], badly decomposed Arabian specimen "of over 1500 mm" (probably also in Gasperetti 1973), he seems to have excluded the possibility of the existence of Arabian specimens reaching 1900 mm, the size he ascribed to the Libyan specimens supposedly reported by Kramer and Schnurrenberger (1963). Despite his reservation regarding such large specimens, it appears that he mistook the collection numbers SK 1897 and SK 1898, listed by Kramer and Schnurrenberger (1963), for snake lengths in millimeters. A tiny additional error, possibly typographical, yielded the top record of 1899 mm. Apart from this, the distribution of *Malpolon moilensis*, correctly given by Kramer and Schnurrenberger (*op. cit.*) as extending from Mauritania and Morocco to Iran, was given by Gasperetti (1988), in his text and two maps, as extending only from Algeria to Iran. These errors were not present in Gasperetti's (1973) earlier treatment of *M. moilensis*, in which no Kramer and Schnurrenberger (*op. cit.*) specimens are mentioned either.

Unfortunately, Gasperetti's (1988) erroneous size record based on the SK-numbers has been repeated in the literature. In a study on biological diversity in Jordan, Disi (2002) stated that, according to Kramer and Schnurrenberger (1958[*sic*]), the two longest measured *Malpolon moilensis* are females from Libya of "189,7 cm and 189,9 cm total length." In another work (Disi et al. 2001), it is stated that there is a 190 cm maximum length for *M. moilensis* from Libya, with a list of thirteen "pertinent references." Among these Gasperetti (1988) is present but Kramer and Schnurrenberger (1963, or any other year) is not.

More erroneous statements on *Malpolon* sp. would have been avoided if Disi et al. (2001) had correctly interpreted the results of Kramer and Schnurrenberger's (1963) research; in particular, those results, subsequently corroborated by De Haan (1999, 2003), demonstrating that *M. monspessulanus* males grow much larger than females of the same age (maximum total length 230 cm vs. 140 cm), despite a lack of sexual dimorphism in tail length.

I hope that this letter will put an end to the repetition of errone-

ous lengths for the two *Malpolon* species, and will do justice to the excellent work on Libyan snakes by Kramer and Schnurrenberger (1963).

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POINTS OF VIEW

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Stability Restored to the Name *Phymaturus palluma*: A Response to Cei and Scolaro (2006)

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We initially prepared this article at the request of the editor in response to a manuscript submitted to this journal by J. M. Cei and A. J. Scolaro regarding the recent action of the International Commission on Zoological Nomenclature (ICZN), designating a type species for the iguanian lizard genus *Phymaturus*, and a neotype for the species *Phymaturus palluma* (ICZN 2005). However, the manuscript of Cei and Scolaro was subsequently withdrawn, and an expanded version recently appeared in the journal *Zootaxa* (Cei and Scolaro 2006). The following is brief history of this case, taken from our application to the ICZN (Etheridge and Savage 2003).

The genus *Phymaturus* (Gravenhorst 1837) has been used for over 150 years for a group of lizard species that occur in the cordilleras of central Chile and Argentina, and on several volcanic mesestas of Patagonian Argentina. Cei and Lescure (1985) determined that the type species of *Phymaturus*, *Lacerta palluma* Molina 1782, was misidentified by Gravenhorst (1837), and that Molina's description was actually based on a specimen of the teiid species *Callopistes maculatus*. Consequently, Cei and Lescure (1985) proposed replacing *Phymaturus palluma* with *Callopistes palluma*. Subsequently, Lescure and Cei (1991) proposed revalidation of the next available generic name, *Centrura* Bell (1843), for all species referred to *Phymaturus*, and replacement of the name *Centrura flagellifer* with *Phymaturus flagellifer*. Etheridge and Savage (2003) then applied to the ICZN, in the interest of nomenclatorial stability and universality, to use its plenary powers for the purpose of designating the holotype of *Centrura flagellifer* Bell 1843, as the neotype of *Lacerta palluma* 1782, and to place the names *Lacerta palluma* Molina 1782 and *Phymaturus* Gravenhorst 1837 on the Official List of Names in Zoology. Two years later our application was approved (ICZN 2005, Case 3225).

Cei and Scolaro (2006) argue that the decision of the ICZN was a mistake. They repeat the assertion of Cei and Lescure (1985) that the specimen upon which Molina (1782) based his description of *Lacerta palluma* was actually a specimen of the teiid lizard now known as *Callopistes maculatus*, and attribute the initial error of identification to Daudin (1802). The conclusions of Cei and Lescure (1985) were based on a detailed comparison of *Lacerta palluma*, as described by Molina (1782), with the characteristics described by Gravenhorst (1837) for *Phymaturus palluma*, and with those of *Callopistes maculatus*. We have made the same comparisons, and find their conclusion that Molina's specimen was probably a *Callopistes* to be convincing. Although we have never disputed this assertion, we believe the initial error was likely that of Gmelin (1788) and Meyer (1795) rather than Daudin (1802). Gmelin (1788), citing Molina (1782) listed *Lacerta pelluma* [sic] between *Lacerta cordylus* (Linnaeus 1758) (now *Cordylus cordylus*: Cordylidae) and *Lacerta stellio* (Linnaeus 1758) (now *Laudakia stellio*: Agamidae), both species having a spiny tail. Meyer (1795), citing Gmelin (1788) then placed *Lacerta pealuma* [sic] in the genus *Cordylus*, apparently because Linnaeus (1758), in his description of *Lacerta cordylus* used the term "*cauda verticillata*" (tail whorled), employed also by Molina (1782) in his description of *Lacerta palluma*. Because *Cordylus cordylus* is a lizard with a spinose tail, Meyer (1795) apparently incorrectly assumed the tail of Molina's species was also spinose. Subsequent authors appear to have perpetuated this error. Latreille (1801) and Daudin (1802) used the genus *Stellio* for *Lacerta palluma*, Cuvier (1829) used *Oplurus*, and Kaup (1826) used *Uracentron*, all genera characterized by a tail with whorls of spinose scales. It is not surprising, therefore, that when Gravenhorst (1837) was presented with a spiny-tailed lizard from Chile, he assumed it was Molina's *Lacerta palluma*. Thereafter, the name *Phymaturus palluma* was used consistently and universally until 1985. The revalidation of the next available name, *Centrura flagellifer* (Bell 1843) by Cei and Lescure (1985), and their subsequent proposal to again change the name to *Phymaturus flagellifer* (Lescure and Cei 1991) ushered in two decades of instability during which *Centrura flagellifer*, *Phymaturus flagellifer*, and *Phymaturus palluma* were used for the same species. Our sole objective in submitting this case to the ICZN (Etheridge and Savage 2003) was to bring an end to this instability once and for all.

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ARTICLES

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Alterations in Frog Assemblages After Hurricane Iris in Belize

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Hurricanes alter forest vegetation structure causing extensive defoliation, limb breakage, and uprooting of trees (Tanner et al. 1991). This reduction in canopy cover results in decreased humidity and increased light penetration and wind speeds, paralleling changes that occur locally in tree fall gaps (Hubbell and Foster 1986). Loss of canopy cover due to Hurricane Hugo in Puerto Rico resulted in increased temperatures near the forest floor and abundant growth of understory vegetation (Stewart 1995). Natural disturbances may stimulate vertebrates to respond in physiological, behavioral, or ecological manners (Karr and Freemark 1985). Habitat alterations can influence vertebrate species composition and population density (e.g., Reagan 1991; Woolbright 1991) through changes in predator-prey dynamics, food supply, and availability of retreat sites (Schoener et al. 2001). Such alterations can occur immediately and be long lasting (Waide 1991).

Few studies have quantified the response of animals to hurricanes. The densities of nectivorous and frugivorous birds (Askins and Ewert 1991; Lynch 1991; Waide 1991) and invertebrates such as phasmids and snails (Willig and Camilo 1991) were significantly reduced after hurricanes. The vertical microhabitat of *Anolis* species changed after Hurricane Hugo forcing three species to use habitat near ground level (Reagan 1991). The most detailed analyses of hurricane effects on an amphibian are those of Woolbright (1991, 1996) and Stewart (1995) on *Eleutherodactylus coqui* in Puerto Rico. One year following Hurricane Hugo, *Eleutherodactylus coqui* showed a fourfold increase in adult population size, likely because of an increase in retreat sites and decrease in predatory invertebrates (Woolbright 1991). A recent study (Vilella and Fogarty 2005) also reported an increase in the abundance of *E. coqui* but decreases in the abundance of two other eleutherodactylids after Hurricane Georges. Amphibians are sensitive to microhabitat changes and are considered indicators of ecosystem perturbation due to their unique life histories and physiologies (Blaustein and Wake 1995; Phillips 1990). Furthermore, pond-breeding species are influenced by vegetative changes occurring within ponds and surrounding terrestrial habitats (Semlitsch 2000). Therefore, pond-breeding frogs should be excellent model organisms to study the impact of hurricane disturbance.

Hurricane Iris (Class IV) struck southern Belize in October 2001. A 20-month study conducted prior to the hurricane (February 2000 to September 2001) examined the breeding phenology and habitat associations of frogs in several pond-breeding sites in the Bladen Natural Reserve (BNR; Hawley 2002). The availability of these pre-hurricane data presented a rare opportunity to examine the

effects of a hurricane on diverse anuran assemblages in multiple sites of different habitat types. Furthermore, predictions could be made regarding the response of anurans to changes in vegetation caused by Hurricane Iris. Hawley (2002) identified several species, including *Bufo valliceps*, *Hyla microcephala*, *Smilisca baudinii*, *Leptodactylus melanonotus*, *Rana berlandieri*, and *Rana vaillanti*, as common, habitat generalists, i.e., occurring within pine-savanna and forest habitats. In contrast, *Agalychnis callidryas*, *Hyla loquax*, *Hyla ebraccata*, *Gastrophryne elegans*, and *Rhinophrynus dorsalis* were specialists of forest habitat and *Hyla picta*, *Scinax staufferi*, and *Leptodactylus fragilis* were specialists of pine-savanna habitat. I expected habitat specialists, which are limited by particular physical and biological characteristics that occur within their range of habitat (Hutchinson 1957), to undergo more changes in their abundance and distributions than habitat generalists. For example, some hylids (e.g., *A. callidryas*) are confined to the forest because the canopy provides protection from high temperatures and low relative humidity that may be physiologically stressful. In contrast, other hylids (e.g., *H. picta* and *S. staufferi*) occur in areas with tall understory growth (Lee 1996), which serves as habitat for perching during the breeding season. If Hurricane Iris altered the quality of habitat for these species, I expected to observe changes in assemblage composition and their abundance at the study sites.

In this study, I compare frog species richness, composition, and abundance and canopy cover pre- and post-hurricane at six breeding sites. These pre-hurricane surveys in combination with post-hurricane surveys allow for changes in frog assemblages and vegetation structure to be assessed.

Methods

Study Sites.—I selected six study sites (each approximately 100 × 30 m) in the southeast portion of the BNR (16°33.124'N, 88°42.974'W) in the Toledo District of southern Belize in May 2000 (Hawley 2002; Fig. 1). Sites were selected based on their potential to serve as regular frog breeding ponds. Sites were located in primary tropical evergreen broadleaf lowland forest (F1–F4), short-grass savanna (S1), and transitional habitat (T1) (Meerman and Sabido 2001). F1 and F2 were located on a little-used, unpaved road between the Southern Highway and Bladen River and four sites (F3, F4, T1, and S1) were located off the road. Sites were a minimum of 100 m apart, with the most distant sites separated by 1.5 km (F1 and S1). I obtained daily precipitation and maximum and minimum temperatures for the years 2000–2002 from the Belize Foundation for Research and Environmental Education (BFREE), located ca. 750 m NE of site F1. The monthly maximum temperature was 32.28 ± 1.98°C (mean ± SD) and minimum temperature was 21.22 ± 2.83°C (mean ± SD) from 2000–2002 at BFREE. BNR is characterized by a distinct wet (May–October) and dry (November–April) seasonal cycle. Total annual precipitation was 2562 ± 66 mm (mean ± SD) from 2000 to 2002.

Anuran Surveys.—I conducted a minimum of six nocturnal audio surveys (Zimmerman 1994) in each site during June to August in 2000 and 2002 (Table 1). Survey effort was lower in 2001 with only two surveys conducted at some sites during the same time period. Surveys were conducted between 2000 h and 2400 h, corresponding to the time period of greatest frog vocalization, and survey duration was a minimum of ten minutes. I estimated the number of calling males of each species and noted it as an index of 1 to 4, standard in the Maya Forest Amphibian Monitoring Project (MayaMon) (Meyer 1999). A score of 1 indicates that 1–5 individuals were calling; 2 indicates 6–20 individuals; 3 indicates 21–50 individuals; and 4 indicates over 50 individuals. Surveys were conducted during a period of 2–5 days each month and a subset of sites were visited each night. The order in which sites were visited was varied on consecutive nights each month so that each was visited during different time periods.

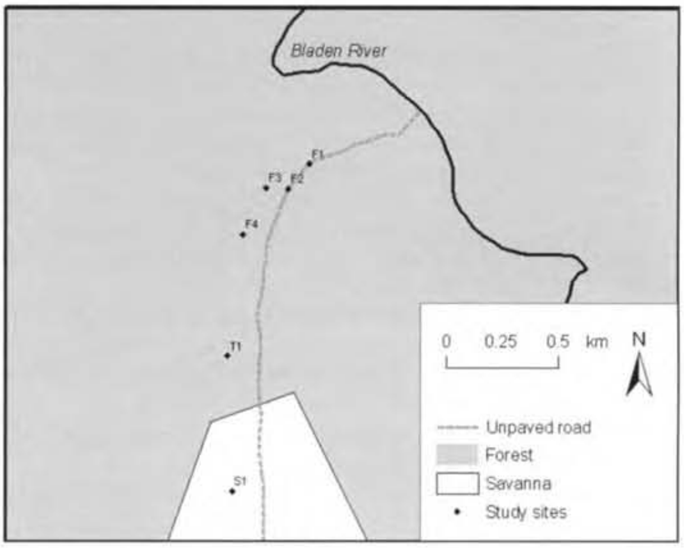

FIG. 1. Map of study sites in southern Belize. Detail of the Bladen Nature Reserve ecosystems was adapted from the Belize Ecosystems Map (Meerman and Sabido 2001).

Vegetation Structure.—I estimated percent canopy cover pre- (June–September 2001) and post- (June–August 2002) hurricane at each study site except T1. One plot (20 × 10 m) was established at the center of the pool in each site and divided into quadrats at 2 m intervals. Canopy cover was estimated using a sight tube divided into four equal parts with a string. At each 2 × 2 m quadrat intersection, I viewed through the tube upward and estimated the percent of canopy cover. A value of 0 to 3 was given, corresponding to 0–25, 26–50, 51–75, and >75% canopy cover.

Data Analysis.—I computed the total species richness in each site by pooling vocalization surveys from June to August each year. To represent the abundance of each species I used the highest value the calling index reached each year. Therefore, this value is an estimate of the largest size attained by the male breeding population of each species during the survey dates each year (Scott and Woodward 1994). I plotted species accumulation curves in each site during each year to examine how species richness changed with survey effort. When gamma diversity is low and species accumulation curves reach an asymptote, the curves are a satisfactory way to standardize effort among sites (Willott 2001). The curves reached asymptotes in two to six surveys; therefore, effort above six surveys did not reveal new species in any study site. If a minimum of six surveys is used to standardize effort among sites and years, then effort during 2001 was too low to offer a reliable comparison. However, years 2000 and 2002 can be compared to

examine how species richness, composition, and abundance varied pre- and post-hurricane. Throughout the remainder of the paper pre-hurricane will represent year 2000 and post-hurricane will represent year 2002 unless mentioned otherwise. I tested for a difference in species richness among sites pre- and post-hurricane using a Wilcoxon signed-ranks test for related samples, with sites as replicates. Then I tested for a difference in the number of sites each species occurred in pre- and post-hurricane with a Wilcoxon signed-ranks test for related samples, using species as replicates. Because of the possibility of a lack of independence among sites F1, F2, and F3 due to small inter-site distances, F2 was removed from statistical analyses.

Summary statistics were calculated for canopy cover in each site. I used a paired samples t-test to determine whether canopy cover differed pre- versus post-hurricane in each site.

Results

Frog Assemblages—Fourteen frog species of six families were observed during the study period (Table 1). Species richness increased at every site post-hurricane in comparison to pre-hurricane (Wilcoxon, $Z = -2.070$, $P = 0.038$). This trend remains even if additional survey effort is considered by pooling years 2000 and 2001 (Table 1). Furthermore, seven of 12 species were encountered in more sites post-hurricane; however, this difference was not significant (Wilcoxon, $Z = -1.552$, $P = 0.121$; Fig. 2). Of the seven species that increased in occurrence, four (*Hyla picta, Scinax staufferi, Smilisca baudinii,* and *Rana berlandieri*) were found in an additional two or three sites. In contrast, *Agalychnis callidryas* and *Leptodactylus melanonotus* were each encountered in one fewer site post-hurricane. The remaining species showed little (± 1 site) or no change in the number of sites they were detected in between time periods (Fig. 2).

The data suggest that the hurricane had neither an overall positive nor negative effect on the abundance of species (Table 1). In addition, no single species showed a consistent large increase or

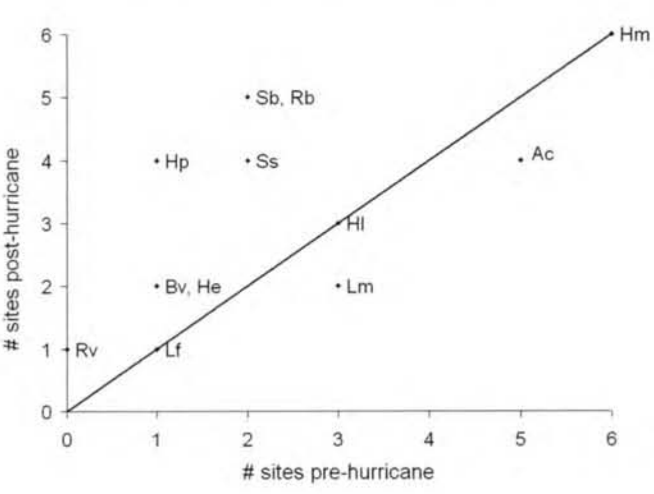

Fig. 2. The number of sites each species was detected in pre- and post-hurricane. Species abbreviations are the first letters of the genus and species names; see Table 1 for full names. The diagonal line represents no change in number of sites a species was detected in before versus after the hurricane.

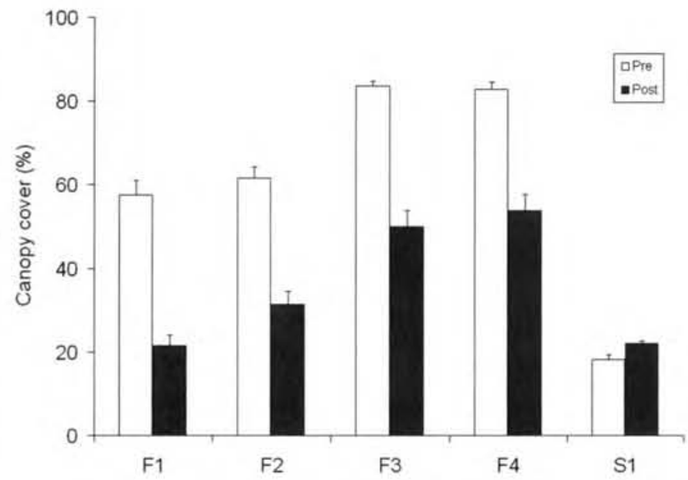

Fig. 3. Canopy cover (mean ± SE) pre- and post-hurricane at five study sites; each comparison between years was significant ($P < 0.05$) with paired samples t-tests.

decrease in abundance across multiple sites. However, fewer vocalizing *Agalychnis callidryas* were detected post-hurricane in several forest sites (Table 1). *Scinax staufferi* and *Hyla picta* were detected vocalizing post-hurricane in forest sites for the first time during the study period. In addition, the first observations of vocalizing *Smilisca baudinii* and *Rana berlandieri* at several sites occurred post-hurricane.

Vegetation Structure.—Canopy cover significantly decreased by approximately 30% (T-tests, $P < 0.001$) at all forest sites post-hurricane (Fig. 3). In contrast, there was a significant, albeit small, increase in canopy cover in the savanna site (S1) between time periods.

Discussion

The alteration of vegetation structure resulting from Hurricane Iris was typical of that found after other hurricanes of similar magnitude. Winds in excess of 224 km/h (Meerman 2001) caused uprooting of trees, limb breakage, and loss of canopy cover in the forest. Pine forest and savanna habitats are thought to have been the least affected by the hurricane (Meerman 2001). The results of this study support this idea, showing little change in canopy cover in the savanna site. However, alteration in the lowland forest structure resulted in a significant accumulation of debris on the forest floor (pers. obs.) and large openings in the canopy. These structural changes prompted the rapid growth of understory vegetation in several sites. Greater canopy openness has been positively correlated with increased light penetration, increased temperatures, and decreased ambient humidity on the forest floor (Hubbell and Foster 1986). Therefore, canopy cover can be viewed as a surrogate for these abiotic variables, which have a large influence on frog activity and distributions (Duellman and Trueb 1986; Pearman 1997). I propose that alterations in vegetation structure occasioned by Hurricane Iris caused some of the changes observed in frog occurrence and abundance during the study period. However, these structural changes were not so drastic as to cause significant population variation or the loss of anuran species in the study area during the study period.

TABLE 1. Species richness and abundance detected during vocalization surveys at each site from June to August in 2000 (00) and 2001 (01; Pre-hurricane) and 2002 (02; Post-hurricane). Numbers represent the maximum calling index reported in surveys during the time period at each site (1 = 1–5, 2 = 6–20, 3 = 21–50, and 4 = 50+ vocalizing individuals) and N = number of surveys during June to August each year at each site.

	F1		F2		F3		F4		T1		S1	
	Pre 00–01	Post 02	Pre 00–01	Post 02	Pre 00–01	Post 02	Pre 00–01	Post 02	Pre 00–01	Post 02	Pre 00–01	Post 02
Bufo valliceps				1						1—	2	
Agalychnis callidryas	2—2	1	2—2	1		2—	3—3	3		2—2	3	
Hyla ebraccata			—1	1			1—2	2				
Hyla loquax	2—2	1	2—2	2			2—2	2				
Hyla microcephala	2—2	2	4—3	3	2—	1	4—4	4	4—4	3	2—1	1
Hyla picta				1				1	1—1	1		1
Scinax staufferi		1		3					2—2	4	4—3	3
Smilisca baudinii	3—2	2	2—4	1		1				1		1
Rana berlandieri		1	1—1	1		1				2	1—	1
Rana vaillanti								1				
Leptodactylus fragilis											4—	1
Leptodactylus melanonotus			1—	1			2—		2—1	2		
Gastrophryne elegans									—1			
Rhinophrynus dorsalis							—1					
Total Species Richness	4—4	6	6—6	10	2—0	3	5—5	6	6—6	8	4—2	6
N	6—5	8	7—6	10	9—2	8	6—4	10	6—4	10	9—3	9

The most prominent changes in the frog assemblages after Hurricane Iris were increases in species richness and consequent changes in frog composition within those sites. However, no consistent trends across all species or all sites were found; frogs responded to the structural changes caused by the hurricane in species-specific manners. The increase in frog species richness at several sites was in part caused by an increase in the occurrence of *Scinax staufferi* and *Hyla picta* in forest sites after the hurricane. It is unlikely that these observations were an artifact of my sampling regime because they also were not observed in forest sites during surveys from June to August 2001. In contrast, post-hurricane, *S. staufferi* and *H. picta* were encountered in forest sites on several survey occasions. Both species were characterized as savanna habitat specialists within the study area prior to the hurricane by Hawley (2002). Typically, both breed in temporary pools in open areas, perching on emergent grasses and shrubs (Campbell 1998; Lee 1996). Post-hurricane, sites in the forest more closely resembled the vegetation structure of the savanna, with large openings in the canopy and greater understory vegetation growth. These structural changes may be responsible for the increased occurrence and abundance of *S. staufferi* and *H. picta* in forest sites post-hurricane. Increased understory vegetation cover in and around breeding ponds would provide additional perching sites for *S. staufferi* and *H. picta*.

Contrary to my expectations, most specialists of forest habitat did not undergo large changes in occurrence or abundance. *Agalychnis callidryas* showed small declines in abundance in several sites during the study period. *A. callidryas* is a canopy-dwelling species and is not found in sites without trees (Lee 1996); therefore, the reduction in its abundance in this study may be directly related to the loss of canopy cover in forest sites. Furthermore, increased temperatures and decreased relative humidity as a result of reduced canopy cover may cause physiological stress for *A. callidryas*, resulting in individuals moving to locations with more appropriate microhabitat conditions.

As expected, most species characterized as habitat generalists did not undergo large changes in occurrence or abundance. However, *Smilisca baudinii* and *Rana berlandieri* were detected in three additional sites post-hurricane. Unlike *S. staufferi* and *H. picta*, these observations do not suggest actual changes in the occurrence or abundance of these species because they were observed with regularity in many of the sites in surveys during months outside of the study period examined here (Hawley 2002). In addition, *S. baudinii* breeds explosively after heavy rains and therefore its presence at a site can be extremely variable. Three other species (*Gastrophryne elegans*, *Rhinophrynus dorsalis*, and *Bufo valliceps*) can be considered explosive breeders and consequently variation in the detection of these species among years can be attributed to this habit.

Although abiotic changes related to the hurricane were not directly measured in this study, the reduction of canopy cover suggests that changes in abiotic variables did occur as a result of the hurricane. Since it is well-known that anurans are sensitive to aspects of their physical environment (Duellman and Trueb 1986), it can be inferred that abiotic changes are at least partly responsible for the alterations in the composition of frog assemblages and the abundance of certain species observed here. Natural disturbance plays a large role in structuring temporal and spatial variation in communities (Sousa 1984). Some species disperse from habitats that are no longer suitable, while others specialize in colonizing newly disturbed habitats. Some of the patterns observed here are similar to those found in responses of birds to hurricane

disturbance. Waide (1991) reported that bird species that used a variety of habitats were pre-adapted to the environment of the post-hurricane forest in Puerto Rico. Moreover, an edge species, *Tiaris bicolor* (Black-faced Grassquit), colonized gaps in the forest post-hurricane (Waide 1991). Although frogs disperse on a much smaller scale than birds, movements of 500–700 m are within reason for frogs of a size similar to *Hyla picta* and *Scinax staufferi* (e.g., *Hyla regilla;* Reimchen 1991). The locations of the study sites along a natural gradient in canopy cover from savanna to forest may have facilitated the observation of small-scale changes in the local distribution of these species. These data suggest that natural disturbance events such as hurricanes may encourage species to temporarily occupy areas outside their usual habitat. Similar changes in the composition of frog assemblages may not have occurred in forested ponds more distant from the savanna-forest edge.

The findings here differ greatly from the large increase in abundance of *Eleutherodactylus coqui* observed one-year following Hurricane Hugo in Puerto Rico. However, *E. coqui* has direct development and inhabits leaf litter, making its life history much different from the species in this study. Overall, the results shown here demonstrate the resistance of pond-breeding frog assemblages to major changes in species composition and abundance as a result of hurricane disturbance. Habitat generalists and forest specialists underwent few changes in occurrence and abundance in the study sites. In contrast, two savanna specialists were encountered in forest sites subsequent to the hurricane. When examined with consideration of the natural history of each species, these changes in species composition and abundance appear to be related to alterations in vegetation structure caused by the hurricane. Every opportunity to study hurricane effects should be taken advantage of to gain a clearer understanding of the processes by which hurricane mediated changes in vegetation structure affect the species composition and dynamics of frog assemblages.

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Natural History and Color Variation of Two Species of *Gonatodes* (Gekkonidae) in Venezuela

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Geckos of the genus *Gonatodes* are small lizards measuring less than 130 mm total length. This genus contains 19 known species, all of which are Neotropical (Cole and Kok 2006; Kluge 2001; Powell and Henderson 2005), except *G. albogularis*, which was introduced to southern Florida, USA (Carr 1939). Eleven species of *Gonatodes* have been reported in Venezuela, and at least six more are being described (Barrio-Amorós and Brewer-Carías 2006; W. Schargel and G. Rivas, unpubl. data; C. Rivero-Blanco, pers. comm.). Most *Gonatodes* are arboreal; however, some could be accurately categorized as semi-arboreal or even terrestrial (e.g., *G. antillensis* and *G. albogularis bodinii* are mostly ground dwelling; Rivero-Blanco 1964). Other distinctive characteristics of these geckos are the round pupils and diurnal habits of most species (the exception being *G. antillensis*, the only species with oval pupils and mostly crepuscular or nocturnal habits). Aside from this information, the systematics, distribution, and biogeography of most species are poorly understood and merit comprehensive studies. Likewise, the natural history has only been studied in a few taxa (Duellman 1978; Murphy 1997; Quesnel et al. 2002; Rivas and Molina 2004; Seifan et al. 2002; Vitt et al. 1997, 2000). All taxa exhibit sexual dichromatism. In most cases, color-pattern differences between males and females are quite obvious. Yet, the coloration and pattern variation exhibited by males of many species is greater than previously reported and has been incompletely or poorly described.

Gonatodes ceciliae is endemic to the Península de Paria in extreme northeastern Venezuela and to the island of Trinidad (Rivero-Blanco 1979). It inhabits forested areas but little is known about its natural history. Limited data on its behavior and habitat were presented in the original description by Donoso-Barros (1966), and Murphy (1997) briefly described the natural history of populations in Trinidad. Rivero-Blanco (1979) described the Trinidadian population as a different subspecies; however, McBee et al. (1987) reported that *G. ceciliae* from the same locality (Simla, Arima Valley, Trinidad) had two different karyotypes, suggesting that there are two or more sympatric species.

Gonatodes vittatus is a common species known to occur in northern Colombia, northern Venezuela, and on the islands of Trinidad and Tobago, as well as many islands off the Venezuelan coast (e.g., Aruba, Curaçao, Los Roques, La Tortuga, Los Frailes, Isla de Margarita, Isla de Coche, Cubagua, and Los Testigos; Rivero-Blanco 1979). Although *G. vittatus* is a common species, little information has been reported about its natural history (e.g., Demeter and Marcelini 1981; Murphy 1997; Quesnel 1957; Roze 1964). Marcuzzi (1950) examined specimens from several localities in Venezuela and reported on their ecology and morphological and color variation. Although Marcuzzi (1950) provided an exhaustive description of the patterns of several specimens, most (if not all) of that information was based on preserved material. Moreover, Marcuzzi (1950) did not examine geckos from western Venezuela, thus the full spectrum of chromatic variation was incompletely documented. Later Rivero-Blanco (1979) provided a description of the species and additional information on its natural history.

Here we provide additional data on the natural history (distribution, habitat, behavior, reproduction, and predation) of these two species of *Gonatodes*, and describe color pattern variations in male *G. vittatus*.

All observations were made in the field. Illustrations were based on photographs taken of live geckos in the field. Illustrations were prepared using watercolor, ink, and color pencil. Collected geckoes were fixed in 10% formalin, transferred for preservation in 70% ethanol, and deposited in the herpetological collection of the Museo de Historia Natural La Salle (MHNLS), Caracas, and Museo de Biología, La Universidad del Zulia (MBLUZ), Maracaibo (Appendix).

Data for *Gonatodes ceciliae* were collected in deciduous, semideciduous, or cloud forest from four localities on the Península de Paria, Sucre: Locality 1) path between Puesto de Guarda Parques Las Melenas and Cerro Humo, southern versant of Península de Paria (10°39'N; 62°34'W; 700–800 m elev.), 1–2 June 2002; Locality 2) Guiria-Macuro road (10°39'N; 62°09'W; 15 m elev.), 3 June 2002; Locality 3) path between Macuro and Cerro Azul (10°40'N; 61°55'W; 400–600 m elev.), December 2003; Locality 4) Ensenada de Uquire, northern versant of Península de Paria (10°42'N; 61°58'W; 0 m elev.), August 1998.

Donoso-Barros (1966) noted that *Gonatodes ceciliae* is found beneath tree bark or in holes near the protruding buttresses of trees, and tends to inhabit houses. At Locality 1, eight individuals (seven males, one female) were found under rocks at 0900 h. When first discovered, these geckos remained motionless. Another female was found in the stump of a cut tree in the middle of a cleared patch of forest at midday. Nearby, a few geckos were found active on the forest floor at 2000 h during a full moon. In a neighboring forest patch, approximately 10 eggs were found at ground level under small stone slabs, in leaf-litter, and close to the base of a rocky wall. Donoso-Barros (1966) mentioned that *G. ceciliae* laid eggs in June in tree cavities and wall crevices. Here also we collected two species of snakes, *Liophis reginae zweifeli* and *Taeniophallus nebularis*, which are potential predators of *G. ceciliae*.

At Locality 2, *G. ceciliae* were found less than 0.5 m aboveground under fallen trees or logs or at the base of trees or palms. In one case a pair was found on the same trunk. This area had a strong marine influence, exemplified by the presence of terrestrial crabs (*Cardisoma* sp.), which are potential predators of *G. ceciliae* in that area. Three other species of geckoes inhabit the

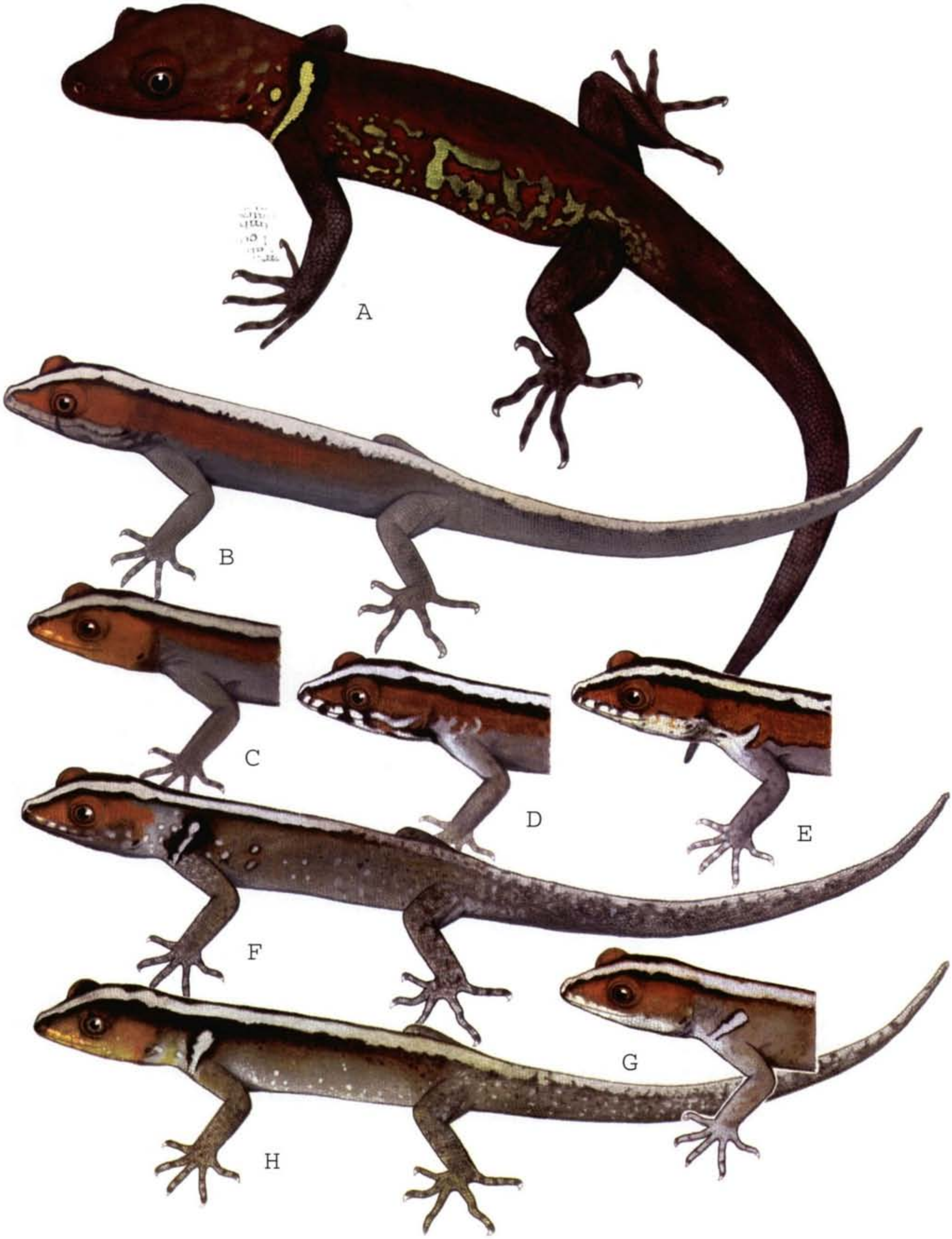

FIG. 1. Illustrations of adult male *Gonatodes* from Venezuela. (A) *G. ceciliae* Las Melenas, Península de Paria, estado Sucre; (B–H) *G. vitattus*: (B) Macuro, Península de Paria, estado Sucre; (C, D) Ocumare de la Costa, estado Aragua; (E) Sierra de Périja, estado Zulia; (F) Hacienda El Mirador, cerca de Casigua-El Cubo, estado Zulia; (G) La Azulita, estado Mérida; and (H) San Felipe, carretera entre Merida y Hacienda La Victoria, Sur del lago de Maracaibo, estado Merida.

area: the tiny *Sphaerodactylus molei*, which was found in a bromeliad on a tree trunk at this site (about 1.8 m above ground), *Thecadactylus rapicauda*, and *G. vittatus*.

Along a transect from near Macuro (40 m elev.) to midway to Cerro Azul at Locality 3, we observed *G. ceciliae* in a variety of microhabitats, but primarily in structures like water pipes and walls, as well as on an abandoned wooden cabin at 600 m elev., where the geckos were found on walls and beneath rocks. At a lower elevation (10 m elev.) near Macuro, we found *G. vittatus* in sympatry with *G. ceciliae* (always in association with human habitation and tree trunks in gardens) and the geckos *Hemidactylus palaichthus* and *T. rapicauda* (in association with an enclosed pool of water). At about 600 m, in a small cave in the rainforest, we found a communal nest site of *G. ceciliae* with the remains of hundreds of hatched eggs in an area of approximately 1 m^2. Communal nests are known for many other species of *Gonatodes* (Oda 2004; Quesnel 1957; Rivero-Blanco 1964), but this high density of eggs indicates the continued use of this nest for an extended period.

At Uquire (Locality 4), *G. ceciliae* was found at or near ground level in both abandoned and inhabited buildings (cabins, old houses). This species appears to show less of a preference for trees than other species of *Gonatodes*, although a single adult male was found about 1.5 m above ground. *Gonatodes vittatus* were observed at this locality as well.

Field data for *Gonatodes vittatus* were collected in the following localities: Turiamo and Ocumare de La Costa (Aragua); Guarenas, Urbanización El Placer, Prados Del Este (Miranda); Playa Guacuco, Isla de Margarita (Nueva Esparta). These localities varied from somewhat disturbed to residential or suburban and ranged in elevation from about 0–1000 m.

Males from several localities in the Distrito Capital and the states of Miranda, northern Aragua, northern Anzoategui, and Sucre (Península de Paria) exhibited the following coloration: Head and paravertebral areas of dorsum bright to dull orange, red-orange, or yellow-orange, with slightly lighter coloration on the sides of the head than on the body. Also, the orange in these areas sometimes varied in intensity, being somewhat darker or even brownish-orange in some specimens. Most variation among males in this region occurred in the color and pattern on the lips, chin, and throat. Some males had either uniformly yellow-orange or yellow-orange lips and throat with slightly darker but inconspicuous longitudinal stripes that converged midventrally. Others had bright white or pale gray lips, chin, and throat with distinct black stripes that started obliquely on the posterior supralabials (and/or below the eye) and extended to the throat where they formed a complex pattern that converged midventrally. However, the intensity, and especially the shape of these black stripes varied greatly. In a few individuals, the throat appeared black with oblique white stripes. In most individuals the stripes converged midventrally, but others had a more conspicuous vermiculate pattern, and still others had almost parallel stripes. A few males had uniformly gray lips and chin (clearly contrasting with the rest of the head), whereas the throat was whitish-gray with some longitudinally elongate black spots that converged midventrally. Dorsally, the orange coloration faded at different points along the body. In some specimens, this coloration reached the base of the tail but, more commonly, the orange faded immediately anterior to the insertion of the hind legs. All males examined had a distinct white vertebral stripe running longitudinally along their back, which extended from the tip of the snout to the tip of the tail. This stripe was usually well defined on the head and on the anterior portion of dorsum, but faded and became slightly darker posteriorly. This stripe occasionally had irregular margins and was usually narrower on the tail. A narrower black stripe paralleled the white stripe and was more distinct on the head and anterior part of the body before fading or, more frequently, fragmenting into irregular spots posteriorly. Black margins were usually not present on the tail or, when present, appeared as inconspicuous, short narrow lines. The rest of the dorsum, flanks, limbs, and tail were light gray or bluish-gray with no distinct markings, or were speckled with inconspicuous minute dark and light dots. In a male from Ocumare de La Costa, Aragua (Fig. 1C), the gray lateral color interrupted the orange area on the neck and touched the black stripes. A faint orange tint was present on the dorsal thighs of a few specimens. Digits had inconspicuous dark rings. The abdomen was generally as gray as the flanks; however, many individuals had a large black or blue-black area laterally extending from just anterior to the cloaca to the axilla along the flanks. In another male (Fig. 1D) from Aragua, the black color also extended onto parts of the chest, but most males lack these black areas.

A distinctive pattern was observed in males from Onia Ranch, near Vigia, Mérida State, South Maracaibo Lake Basin (SMLBa; Fig. 1H) and one from La Azulita, Mérida (SMLBb; Fig. 1G). This pattern may be restricted to individuals from these areas. At these localities the white vertebral stripe with black margins was distinct on the head and neck (also wider on this area). In the individual from Mérida and in one of the males from SMLBa (Fig. 1H), the vertebral stripe was less distinct on the back beyond the level of the arms, but remained more or less distinct to the tip of the tail. The specimen from SMLBb had an indistinct stripe that disappeared completely on the dorsal aspect of the last third of the tail (although this may be attributable to a regenerated tail). The black margins disappeared completely or faded on the back (beyond the level of the forelimbs) in all specimens but on the male from SMLBb, there were pairs of black, irregular, and inconspicuous spots along the vertebral stripe (pair on sacrum most distinct). The vertebral stripe was bordered instead by very narrow, irregular, and orange areas that disappeared midway along the back in the male from La Azulita, Mérida. The lips, chin, and throat of these individuals were uniformly white (or gray with darker stripes in one male from SMLBa; MBLUZ 828). A male photographed from the same general area had orange-yellow lips and chin. A black-bordered, oblique, white band was present just before the insertion of the arms and extended to the scapular area. The black margins of the humeral stripe in the specimen from SMLBa merged with the black margin of the vertebral stripe. The rest of the dorsum, tail, and limbs were slate-gray or brownish-gray with no distinct markings except for some inconspicuous orange smudges on the limbs and on the dorsum in the male from La Azulita. The other two individuals (SMLBa and SMLBb) had small, round, white spots or ocelli on the sides of the neck, flanks, and on the tail. The white ocelli near the axilla on the specimen from SMLBa had narrow and inconspicuous black margins. Digits had dark rings on a pale background in all specimens.

Two males from Aragua (Fig. 1C, D) matched in color and pat-

tern with the specimens from the Cordillera de la Costa Central and Península de Paria, but had an oblique, white and black-bordered stripe anterior to the insertion of the limbs that resembled the markings of males from SMLBa and La Azulita. Marcuzzi (1950) reported that this humeral stripe was observed in many males from Santa Ana, Península de Paraguana (Falcón), one male from La Cabrera, Lago de Valencia (Carabobo), and one male in Caracas (Distrito Capital). The white humeral stripe has not been observed in specimens east of Miranda state.

Gonatodes vittatus was observed in a wide variety of disturbed environments in or near human habitation, as has been reported other *Gonatodes* species including *G. albogularis*, *G. humeralis*, *G. siegliei*, and *G. taniae* (Oda 2004; Rivero-Blanco 1968, 1979), and *G. ceciliae* (this study). Most individuals were observed perched vertically on walls head down, and never far ($\leq$ 1.5 m) from hiding places such as vegetation, or holes and cracks in rock, brick, or cement. Other individuals were observed on rocks or in piles of trash. On the back porch of a house in Ocumare de la Costa (Aragua state), one male and two females were seen on logs lying on a cement floor and two other individuals were nearby. In less disturbed areas, *G. vittatus* was observed on shrubs, on the bases of tree trunks, or occasionally on the ground. When on tree trunks, geckos took refuge under loose bark or descended to shelter beneath vegetation or rocks at the base of the tree.

As is the case with other *Gonatodes* (Rivas and Molina 2004) we commonly observed this species in pairs or small groups, which were usually composed of a single male and one or two females. Juveniles were also occasionally found in the territories of adults, which is usually a wall or one or two trees (Roze 1964). We have observed adults (both sexes) with territories as small as 1–2 m^2. On a single stonewall ca. 4.5 × 2.5 m in Urbanización El Placer, Miranda, 26 individuals were counted in one afternoon.

Based on our observations, both males and females appear to be territorial, and we frequently observed individuals of both sexes chasing each other on walls. Territorial displays in males consisted of raising the head slightly and raising and waving the tail from side to side, movements also reported in other species of *Gonatodes* (Demeter and Marcelini 1981). Murphy (1997) noted that *G. vittatus* curls its tail in a "scorpion-like fashion," and reported a female displaying such posture toward a male right before the latter displaced the female from her station. We observed the 'tail-waving' display during presumably stressful situations or territorial interactions (see also Demeter and Marcelini 1981). Usually this display was followed by one individual chasing the other. No biting or other physical contact was observed.

Hemidactylus mabouia and *Thecadactylus rapicauda*, larger and more aggressive geckos, occur sympatrically with *G. vittatus* at numerous localities. No cases of predation by any of these geckos were observed, but Rivas et al. (2005) noted that populations of *G. vittatus* have decreased in number while populations of introduced *H. mabouia* have expanded in urban areas.

On the rocky slopes next to a small but heavily traveled road in Prados del Este, Caracas, a young Brown Vinesnake (*Oxybelis aeneus*, 580 mm total length) was observed preying on an adult male *G. vittatus* at 1130 h. The snake was perched on a small shrub overhanging the rock on which the gecko was moving. The gecko appeared not to notice when the snake slowly approached from above, suspending the anterior part of its body right above the lizard's body. After a short period during which the snake remained motionless, it struck suddenly at the middle of the lizard's body. The snake released its prey when handled and the gecko fled, showing no signs of physical damage or envenomation.

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APPENDIX

Specimens Examined (all from Venezuela)

Gonatodes ceciliae.— **SUCRE**: MHNLS 15541, 15727–15729, 17087. Las Melenas, Península de Paria, 700 m; MHNLS 16695, 15725–15726. Carretera Güiria-Macuro, Península de Paria, 20 m; MHNLS 18047–18049. Balneario Río Guayana, carretera Carupano-Güiria (10°35' N-62°56'W; 50 m).

Gonatodes vittatus.— **CARABOBO**: MHNLS 4991–4996. Punta Cabito, Lago de Valencia; **FALCÓN**: MHNLS 11877. Urbanización Ramón Luís Polanco, Punto Fijo; **MÉRIDA**: MBLUZ 828 (two specimens). Hacienda Onia, Sur del lago de Maracaibo, cerca del Vigía; **SUCRE**: MHNLS 9582–9588. Playa Colorada, 3 km de San Juan de las Galdonas, Península de Paria; **ZULIA**: MBLUZ 825. Hacienda El Mirador, municipio Jesús Maria Semprúm, cerca de Casigua-El Cubo.

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The Influence of Body Size and Trophic Morphology on the Size of Molluscan Prey of Female Texas Map Turtles (*Graptemys versa*)

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All 12 species of map turtles show sexual size and trophic dimorphism. Females are much larger than males and have wider heads, even as juveniles that overlap adult males in body size (Gibbons and Lovich 1990; Lindeman 2000a). The sexes occupy different feeding niches (Lindeman 2000a). Head width evolution is correlated with evolution of alveolar width in females, presumably because of dietary preferences for mollusks in many species (Lindeman and Sharkey 2001). For males, however, changes in head width and alveolar width are unrelated, probably because males are more insectivorous (Lindeman and Sharkey 2001). The 12 species of *Graptemys* are classified as megacephalic, mesocephalic, or microcephalic based on female head width relative to body size, which is related to the degree to which females rely exclusively on mollusks (Lindeman 2000a).

Body size influences the size of molluscan prey consumed by map turtles. Adult male and juvenile female *Graptemys ernsti* consumed mainly arthropods, whereas adult females consumed mainly mollusks (Shealy 1976). Large females ate Asian clams (*Corbicula* sp.) almost exclusively and maximum clam size increased with female body size (Shealy 1976). Lahanas (1982) found a strong positive correlation between carapace length of *Graptemys nigrinoda* and length of their mytilid mussel prey *Modiolus*.

The sister taxon to *Graptemys* is the Diamondback Terrapin (*Malaclemys terrapin*; Stephens and Wiens 2003). Female *M. terrapin* had wider heads and larger body sizes and consumed proportionally more large Periwinkle Snails (*Littorina irrorata*) than males (Tucker et al. 1995).

Many eastern North American rivers within the range of species of *Graptemys* began to be invaded by Asian clams (*Corbicula* spp.) in the 1950s (McMahon 1982) and *Corbicula* has become a prominent component in the diets of several map turtle species (Lindeman 2000b, 2006; Moll 1980; Shealy 1976; Shively and Vidrine 1984). The Texas Map Turtle (*Graptemys versa* Stejneger 1925) is endemic to the Colorado River drainage of central Texas. The diet of adult female *G. versa*, once varied with only a moderately heavy reliance on native sphaeriid clams, now consists almost exclusively of Asian clams (Lindeman 2006).

We tested the hypothesis that body size and trophic morphology of female *G. versa* determine the size of molluscan prey they consume. We also examined the correlation of variation in prey size with female body size to test the hypothesis that prey size is more variable in larger females because their trophic morphology enables them to consume larger prey. Finally, we tested the hypothesis that residual head width and residual alveolar width (after removal of the effect of body size) influence prey length. These last analyses have not been part of previous examinations of molluscan prey size in *Graptemys* spp. or *Malaclemys terrapin* (Lahanas 1982; Shealy 1976; Tucker et al. 1995) and further refine our understanding of morphological adaptations related to feeding in these turtles.

Samples of feces and stomach contents containing $\geq$ 1.0 ml of *Corbicula* shells that had been collected in 1998 and 1999 from *G. versa* from the South Llano River in south-central Texas were pooled by individual turtle for analysis. All samples came from female turtles, as males are considerably smaller than females on average, have narrower heads and alveolar surfaces, and consumed few *Corbicula* (Lindeman 2006). Complete dietary data are presented elsewhere (Lindeman 2006); here we focus on the size of *Corbicula*. Plastron length (PL), head width (HW), and alveolar width (AW) of the upper jaw of each turtle were recorded following Lindeman (2000a; measurements taken by PVL). Length of *Corbicula* was measured to the nearest 0.1 mm along the long axis of the shell with dial calipers (measurements taken by DC). Shell lengths of fragmented shells were estimated by extrapolation to missing parts of the shell when possible. Data were tested for normality using the Kolmogorov-Smirnov test and correlation analysis was used to analyze the relationships of overall mean, upper quartile mean, and maximum shell length with PL, HW, and AW. Upper quartile mean and maximum size were included

because the constraints of head and alveolar width on prey size may be important only for the largest prey taken. Data were log-transformed prior to analysis to assess allometry of prey size.

The coefficient of variation (CV) for shell length was determined for each sample and the correlation of arcsin-square root transformed CV with log(PL) was examined to determine whether larger females consumed shells of more variable sizes. Residuals analyses were conducted on log-transformed data to test whether overall mean, upper quartile mean, and maximum shell length were related to HW and AW after adjusting for female PL. These analyses tested the hypothesis that females of a given body size with wider-than-expected head or alveolar surfaces would consume larger clams than their body size alone would predict.

Fourteen samples, from female turtles ranging in size from 74–149 mm PL, contained 1.0 ml or more of *Corbicula* shells. Sample size of clam shells was log-transformed to achieve normality. Log-transformed data on clam shell size and turtle morphology were also found to be normally distributed in Kolmogorov-Smirnov tests (all $P > 0.50$). Samples contained 12–93 (mean = 35.9) clam shells for which length could be measured directly or estimated, with no

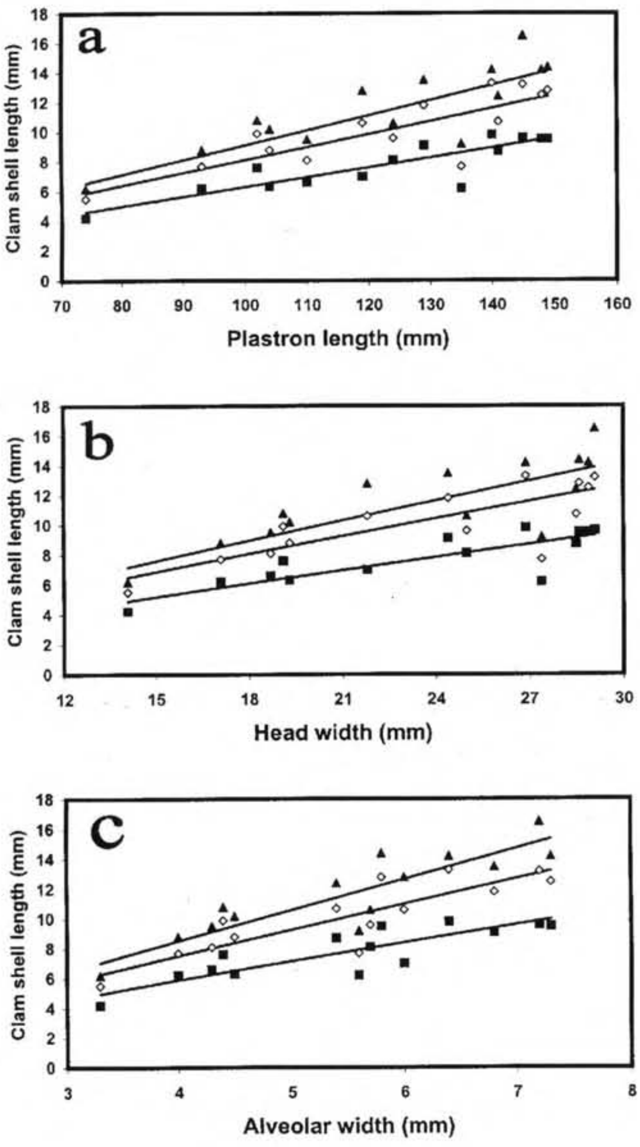

FIG. 1. Correlation of *Corbicula* shell length with measurements of (a) plastron length, (b) head width, and (c) alveolar width in female *Graptemys versa*. From top to bottom in each panel, lines represent back-transformed regressions of log-transformed maximum (triangles), upper quartile mean (diamonds), and overall mean (squares) shell length of *Corbicula* on log-transformed turtle body-size variables. All relationships were significant at $P < 0.001$.

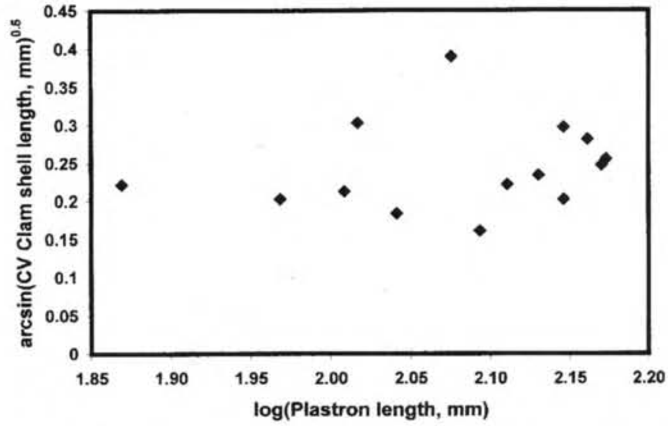

FIG. 2. Nonsignificant correlation of the arcsin-transformed coefficient of variation (CV) in clam shell length with female plastron length ($P = 0.53$, with the latter variable log-transformed for analysis).

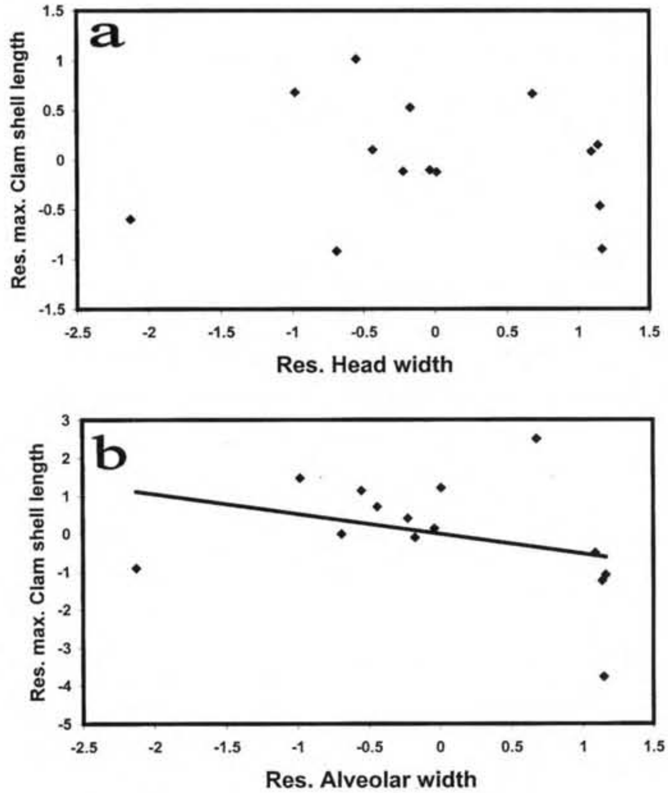

FIG. 3. Results of residual analyses testing (a) whether maximum shell length was related to head width (HW) after correction for both variables' log-log correlation with plastron length ($r = 0.335$, $P = 0.24$) and (b) whether maximum shell length was related to alveolar width (AW) after correction for both variables' log-log correlation with plastron length ($r = 0.575$, $P = 0.032$).

correlation found between plastron length and log-transformed sample size of clam shells (r = 0.013, P = 0.97). Log-transformed overall mean, upper quartile mean, and maximum shell length were all found to be strongly positively correlated with log-transformed turtle PL, HW, and AW (all $P < 0.001$; Table 1, Fig. 1). The relationships of clam shell length to turtle morphometric variables were not significantly different from isometry based on 95% confidence intervals on log-log slopes, as these all included the value of 1.00 that would be expected under isometry (Table 1).

TABLE 1. Results of correlation analyses relating length (mm) of *Corbicula* shells to morphometric data for 14 female *G. versa*. All data were log-transformed prior to analysis.

Independent variable (mm)	Dependent variable	r^2	Intercept	Slope (95% confidence interval)
Plastron length	Maximum	0.75	-1.22	1.09 (0.69–1.49)
	Upper quartile mean	0.72	-1.21	1.06 (0.64–1.48)
	Overall mean	0.77	-1.28	1.04 (0.68–1.40)
Head width	Maximum	0.67	-0.19	0.91 (0.51–1.31)
	Upper quartile mean	0.64	-0.21	0.89 (0.47–1.30)
	Overall mean	0.71	-0.32	0.88 (0.53–1.23)
Alveolar width	Maximum	0.80	0.34	0.98 (0.67–1.29)
	Upper quartile mean	0.76	0.31	0.94 (0.61–1.28)
	Overall mean	0.73	0.24	0.88 (0.54–1.22)

Coefficient of variation (arcsine-square root transformed) of clam shell length was not significantly correlated with log(PL) ($P = 0.53$; Fig. 2). Residuals analyses tested whether overall mean, upper quartile mean, or maximum clam shell lengths were related to residual HW after correction for both variables' correlation with plastron length; all had negative nonsignificant slopes (all $P \geq 0.20$; Fig. 3a). Residuals analyses testing the same relationships using residual AW all had positive correlation coefficients that were not significant for overall mean length ($P = 0.23$) and upper quartile mean length ($P = 0.101$), but significant for maximum shell length ($P = 0.032$; Fig. 3b).

Female *G. versa* have relatively wide heads and alveolar surfaces and their diet consists mainly of Asian clams (Lindeman 2000a, 2006). Plastron length, head width, and width of the alveolar surfaces of the upper jaw were all positively correlated with the size of Asian clams consumed. The lack of correlation between the coefficient of variation and plastron length may indicate that the larger female turtles preferentially take larger clams, which would provide more nutrition than smaller clams. Shealy (1976) found that the greatest ranges in *Corbicula* shell sizes ingested by *G. ernsti* were associated with large females but did not examine variance in shell sizes consumed.

The present study demonstrates that both body size and trophic morphology of map turtles influence the size of molluscan prey consumed and confirms the importance of trophic morphology in adapting these turtles to select molluscan prey (Lindeman 2000a; Lindeman and Sharkey 2001). The isometric relationship of prey size to turtle dimensions suggests a simple biomechanical relationship: enlarged body size, head width, and alveolar surface width allow larger prey to be consumed. In residuals analyses, female turtles with narrow alveolar surfaces relative to body size had relatively small maximum prey size and females with wide alveolar surfaces relative to body size had relatively large maximum prey size. Similar results were not obtained for upper quartile and mean shell sizes or for any residuals analyses using head width. Relative alveolar width may thus be more important than relative head width in determining the size of prey that can be ingested, with the constraint being greatest for maximum prey size.

Acknowledgments.—We thank T. Allen, L. Arkwright, D. Edwards, J. Lovell, and L. Lovell for their assistance in the field. The manuscript was reviewed by T. Tucker and D. Moll prior to submission for publication.

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sures 375 mm snout–vent length, 53 mm tail length, and has 25-25-19 scale rows, 197 ventrals, 36 subcaudals, eight spot rows at midbody, 41/42 body and 9/9 caudal spots at dorsal midline, and external pelvic spurs. A female specimen (CZACC 4.11995) collected from Marianao, Havana City Province measures 372 mm SVL, 52 mm tail length, and has 25-25-21 scale rows, 196 ventrals, 34 subcaudals, 10 spot rows at midbody, 58/61 body and 9/9 caudal spots at dorsal midline. The previously reported maximum SVL for this species is 327 mm (males) and 347 mm (females) (Hedges 2002. Bull. Nat. Hist. Mus. Lond. [Zool.] 68[2]:83–91). These new specimens also expand the known range of body spot counts at dorsal midline from 35–55 to 35-61 (Hedges, *op. cit.*).

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TROPIDOPHIS MORENOI (NCN). **SIZE RECORD.** Previously reported measurements for the two known specimens *T. morenoi* (Hedges et al. 2001. J. Herpetol. 35:615–617) are 295 mm snout–vent length (SVL) and 45 mm tail length (TL) (holotype CZACC 4.5492; Colecciones Zoológicas del Instituto de Ecología y Sistemática, La Habana, Ciudad de La Habana province, Cuba; ex-collection IB 2493 from ex-Instituto de Biología, Cuba) and 285 mm SVL and 44 mm TL (Paratype CZACC 4.5493; ex-collection IB 2942). The type locality of this species is Dolinas de Cueva de Humboldt, Caguanes, Villa Clara Province, Cuba (22°50'04"N, 80°12'02"W). This place belongs now to the Sancti Spíritus Province. An adult female *Tropidophis* (CZACC 4.12052) was collected by J. Salas (unknown date) from the same locality. It was identified by MD as *T. morenoi* on 20 January 2004, and is the first specimen of *T. morenoi* reported after the species description (Hedges et al., *op. cit.*). Measurements of this specimen are: 359 mm SVL and 57 mm TL, which exceeds the previous records by 64 mm SVL and 12 mm TL. Measurements of the head were not possible to determine because the head and neck are damaged. Other characters of color, scale counts, and measures conform to those of the type series.

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TROPIDOPHIS PARDALIS (NCN). **SIZE RECORD.** In July 1968, LVM collected a male *Tropidophis pardalis* from "La Catalina," Güines, Havana Province, Cuba. This specimen (CZACC 4.12042; Colecciones Zoológicas del Instituto de Ecología y Sistemática, Cuba) measures 284 mm snout–vent length, 38 mm tail length, and has 23-25-18 dorsal scale rows, 156 ventrals and 28 subcaudals, six spot rows at midbody, and 42/44 body spots at dorsal midline. A second male, collected by Julio Novo (date unknown) from Atabey, Playa, Havana City Province, Cuba (CZACC 4.8554), has 139 ventrals. A third male, collected by L. R. Hernández from Loma de la Esperanza, Sierra Morena, Villa Clara Province, Cuba on 26 May 1975 (CZACC 4.12012), has 160 ventrals. The previously reported maximum SVL for males of this species is 264 mm (Hedges 2002. Bull. Nat. Hist. Mus. Lond. [Zool.] 68[2]:83–91). The additional specimens expand the range of variation in ventral scale counts from 140–157 to 139–160 (Hedges, *op. cit.*).

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GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 37, Number 1 (March 2006). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extension reports unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA OPACUM (Marbled Salamander). USA: TENNESSEE: Hawkins Co.: Holston Army Ammunition Plant located in the Kingsport Quad (36°32'05"N., 82°36'51"W). 13 April 1996. Harvey Hammock and John E. Copeland. Austin Peay State University Museum of Zoology, APSU 18168. Verified by A. Floyd Scott. Adult specimen found beneath roots of fallen tree. New county record that extends the range of the species in Tennessee into the eastern portion of Hawkins Co. (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

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CRYPTOTRITON ADELOS (Sierra Juarez Moss Salamander). MÉXICO: OAXACA: Municipality of San Bernardino, Sierra Mazateca, Puerto Soledad (18°9'N, 96°59'W), 2065 m elev. 6 February 1993. Luis Canseco Márquez. Museo de Zoología, Facultad de Ciencias, UNAM (MZFC 13311). Municipality of Santa María Pápalo, Peña Verde (17°50'N, 96°47'W), 2805 m elev. 1 June 1999. Luis Canseco Márquez. Escuela de Biología, Universidad Autónoma de Puebla (EBUAP 1097). Both verified by D. B. Wake and M. García-Paris. MZFC 13311 is first record for the Sierra Mazateca and a range extension of ca. 94 km N from the type locality and EBUAP 1097 is the second record for the Sierra de Juárez (48 km N type locality) and bridges a gap between the type locality and the Sierra Mazateca record (Papenfuss and Wake 1987. Acta Zool. Mex. 21:1–16; as *Nototriton adelos*). Both specimens

were found in cloud forest.

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NOTOPHTHALMUS VIRIDESCENS LOUISIANENSIS (Central Newt). USA: TENNESSEE: CHESTER CO.: Henderson, Freed-Hardeman University Campus (35°26.082'N, 88°38.038'W). 16 March 2006. Timothy Harris. Verified by A. Floyd Scott. Austin Peay State University Museum of Zoology (APSU 18159, color photo). New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

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PHAEOGNATHUS HUBRICHTI (Red Hills Salamander). USA: ALABAMA: WILCOX CO.: N31.9054°, W87.2505°. 12 October 2005. M. Bailey and M. Van Fleet. Verified by Craig Guyer. Photograph voucher deposited in the Alabama Herp Atlas Project at Auburn University (AUM-AHAP-37294). Adults were observed at burrow openings on an east-facing slope in second-growth mesic deciduous forest. This record represents the northernmost locality for the species and is a new county record (Mount 1975. The Reptiles and Amphibians of Alabama. Alabama Agricultural Experiment Station, Auburn University, Alabama. 347 pp.). The monotypic genus *Phaeognathus* was presumed to be limited to portions of the Tallahatta and Hatchetigbee geologic formations in five Alabama counties (Schwaner and Mount 1970. Copeia 1970:571–573). However, our new locality lies within the older Nanafalia geologic formation (LaMoreaux and Toulmin 1960. Geologic Map of Wilcox County, Alabama. Geological Survey of Alabama Co. Report 4) and is 13.5 km NE of the nearest mapped Hatchetigbee or Tallahatta formation (Scott 1971. Geologic Map of Monroe County, Alabama. Geological Survey of Alabama, Special Map 101). Topography and the vegetative community at this locality are virtually identical to occupied *Phaeognathus* habitats to the south, suggesting the new site might represent a disjunct population.

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ANURA

BRACHYCEPHALUS EPHIPPIUM (Pumpkin Toadlet). BRAZIL: MINAS GERAIS: Municipality of Fervedouro: Mata do Pai Inácio, (20°46'S, 42°29'W, 1340 m elev.) Parque Estadual da Serra do Brigadeiro. December 2005. J. S. Dayrell, E. F. Oliveira, and R. N. Feio. Museu de Zoologia João Moojen de Oliveira, Universidade Federal de Viçosa, Minas Gerais, Brazil (MZUFV 6658–6662, 6671). Verified by J. P. Pombal-Jr. Published distribution for the species is Atlantic Forests in the states of Bahia, Espírito Santo, Rio de Janeiro, São Paulo, and Paraná, in eastern and southeastern Brazil (Pombal-Jr. 2001. Amphibia-Reptilia 22:179–185; Frost 2005. Amphibian Species of the World: An Online Reference. http://research.amnh.org/herpetology/amphibia). First state record and the most inland record for the species, extends its distribution 250 km NE from Nova Friburgo, RJ (Pombal-Jr., 2001, *op. cit.*).

Submited by **JUSSARA SANTOS DAYRELL, ELIANA FARIA DE OLIVEIRA, CARLA SANTANA CASSINI,** and **RENATO NEVES FEIO,** Museu de Zoologia João Moojen de Oliveira, Universidade Federal de Viçosa, 36571-00, Viçosa, MG, Brazil; e-mail jussaradayrell@gmail.com.

BUFO CAMERUNENSIS (Oban Toad). CENTRAL AFRICAN REPUBLIC: Ngotto Forest, Batouri River area (3°54'N, 17°2'E), bank of the Lobaye River, 445 m elev. This area consists of a mixed-species, semi-deciduous primary forest at the northern limit of the Guinea-Congolese rainforest. Between 25 November 1998 and 6 December 1999. P. Barrière. Verified by Alain Dubois. Muséum national d'Histoire naturelle, Paris (MNHN 2003.3380–3393). These 14 specimens (SVL 10–69 mm) were found dead in a pitfall trap used to collect terrestrial small mammals, during a long-term ecological and epidemiological survey within the Ecofac project (http://www.ecofac.org). First country record. Previously known from the forested areas of Guinea, Ivory Coast, Liberia, Nigeria, Cameroon, Equatorial Guinea, Bioko, Gabon, Republic of Congo, and Democratic Republic of Congo (Frost 2004. Amphibian Species of the World [online]. Ver. 3.0. American Museum of Natural History, New York; Frétey and Blanc 2000. Liste des Amphibiens d'Afrique centrale. Dossiers de l'ADIE, Série Biodiversité 2:1–39.).

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BUFO WOODHOUSII (Woodhouse's Toad). USA: CALIFORNIA: RIVERSIDE CO.: Taylor Ferry Site, Imperial Co. line, Colorado River, 25 September 2004 (LACM 155888). Additional specimens: LACM 155080, LACM 155890, LACM 155875 (verified by Kent Beaman, LACM) and EJR7295–7299 (verified by Eric Routman, San Francisco State University). These specimens, which support an older voucher from 1967 (LACM 37772), were collected from southern to northern Riverside Co. and fill the distribution gap of *B. woodhousii* along the lower Colorado River in California (Sullivan et al. 1996. Copeia 1996:274–280). This distribution is consistent with the relatively recent expansion of *B. woodhousii* to the southwest (Masta et al. 2003. Mol. Ecol. 12:1541–1554).

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CRYPTOTHYLAX GRESHOFFII (NCN). REPUBLIC OF CONGO: SANGHA: Mombongo, near Bomassa (02°12.50'N, 16°11.35'E), 72 m elev. 22 June 1997. Kate Jackson. Museum of Comparative Zoology, MCZ A-136000–2. Verified by José Rosado. Previously recorded in Angola, Cameroon, Central African Republic, Democratic Republic of Congo, Equatorial Guinea, and Gabon (de la Riva 1994. Rev. Esp. Herpetol. 82:123–139; IUCN et al. 2004. <www.globalamphibians.org>; Knoepffler 1966. Biol. Gab. 2:157–161; Laurent 1976. Ann. Mus. R. Afr. Centrale 213:1–67; Perret 1966. Zool. Jb. Syst. 8:289–464; Schiøtz 1999. Treefrogs of Africa. Edition Chimaira, Frankfurt am Main. 350 pp.). MCZ A–136000 (subadult, SVL 40.1 mm), 136001 (female; SVL 52.6 mm), and 136002 (male; SVL 45.0 mm) were collected between 2000–2200 h from vegetation ca. 1 m above the ground at the edge of the swamp at Mombongo. In life, specimens were rust colored; in ventral view, the belly and gular region were white with red arms and legs. Presence of this species in the Republic of Congo has been assumed but never documented. This is the first report of *Cryptothylax* from the Republic of Congo.

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HYLA SQUIRELLA (Squirrel Treefrog). USA: ALABAMA: CHAMBERS CO.: 5 km N of Waverly. UTM 16 632287E 36 27624N (WGS 84). 23 Aug 2005. Geoffrey G. Sorrell. Verified by Craig Guyer. AUM 37269. New county record (Mitchell and Lannoo 2005. *In* Lannoo [ed.], Amphibian Declines: The Conservation Status of United States Species, pp. 456–458. Univ. of California Press, Berkeley). The nearest record is from Lee Co., which neighbors Chambers Co. to the south. This specimen was collected from a roadside ditch along County Road 22 at ~2000 h. Approximately five other males were calling from the same location, which indicates presence of a breeding population.

Submitted by **GEOFFREY G. SORRELL**, Department of Biological Sciences, 331 Funchess Hall, Auburn University, Alabama 36849-5414, USA; e-mail: sorregg@auburn.edu.

HYPSIBOAS BECKERI (NCN). BRAZIL: MINAS GERAIS: SERRA DA PEDRA BRANCA: Pedralva Municipality (22°11'16.1"S, 45°23'23.5"W). 14 October 2005. V. G. D. Orrico and C. Luna-Dias. Herpetological Collection of the Departamento de Zoologia of Universidade Federal do Rio de Janeiro, Rio de Janeiro (ZUFRJ 9527, male and 9528, female). Verified by S. P. Carvalho-e-Silva. Previously known only from the type locality: Poços de Caldas, Minas Gerais (Caramaschi and Cruz 2004. Arq. Mus. Nac. Rio de Janeiro 62[3]:247–254). The new occurrence extends distribution 123 km ESE (straight line).

Submitted by **VICTOR GOYANNES DILL ORRICO** (e-mail: victordill@gmail.com) and **CYRO LUNA-DIAS NETO** (e-mail: cyroluna@gmail.com), Departamento de Zoologia, Universidade Federal do Rio de Janeiro, CP 68.044, CEP 21944-970, Cidade Universitária, Rio de Janeiro, Brazil.

LEPTOBRACHIUM MOUHOTI (NCN). VIETNAM: QUANG NAM PROVINCE: Ngoc Linh Mountain: Tra My District: Tra Don Commune (15°11.688'N, 108°2.413'E), 930 m elev. 10 March 1999. AMNH A-163651–163652 (15°11.507'N, 108°2.380'E), 960–990 m elev. 13 March 1999. AMNH A-163653 (15°10.698'N, 108°2.539'E), 1480 m elev. 20 March 1999. AMNH A-163649 (15°11.688'N, 108°2.539'E), 970 m elev. 22 March 1999. AMNH A-163650 (15°11.622'N, 108°2.212'E), 1020 m elev. 2 April 1999. AMNH A-163656–163657. Tra Tap Commune, near Thon 2 Village, stream (15°9.622'N, 108°2.427'E), 920–1060 m elev. 26–28 March 1999. AMNH A-163654–163655. All specimens collected by Nguyen Quang Truong. Verified by Bryan L. Stuart. This species is currently known only from the type locality in Mondolkiri Province, Cambodia (Stuart et al. 2006. Raffles Bull. Zool. 54[1]:129–155). This is the first record for Vietnam and extends the known range of this species by more than 300 km N from the southern Truong Son Mountains (Annamites) to the Central Truong Son. This also extends the elevational range of the species, as the type series was from 500–700 m.

Submitted by **RAOUL H. BAIN**, Center for Biodiversity and Conservation, American Museum of Natural History, Central Park West at 79th Street, New York, New York 10024, USA (e-mail: bain@amnh.org); and **NGUYEN QUANG TRUONG**, Department of Vertebrate Zoology, Institute of Ecology and Biological Resources, 18 Hoang Quoc Viet, Hanoi, Vietnam (e-mail: truong@iebr.vast.ac.vn).

LEPTOPELIS CALCARATUS (Efulen Forest Treefrog). CENTRAL AFRICAN REPUBLIC: Ngotto Forest, Batouri River area (03°54'N, 17°2'E), bank of the Lobaye River, 445 m elev. This area consists of a mixed-species, semi-deciduous primary forest at the northern limit of the Guinea-Congolese rainforest. Between 25 November 1998 and 6 December 1999. P. Barrière. Verified by Alain Dubois. Muséum national d'Histoire naturelle, Paris (MNHN 2003.3395). This specimen (SVL 48 mm) was found dead in a pitfall trap used to collect terrestrial small mammals, during a long-term ecological and epidemiological survey within the Ecofac project (http://www.ecofac.org). First country record. Previously known from the dense forested areas of Nigeria, Cameroon, Equatorial Guinea, Bioko, Gabon, and Democratic Republic of Congo (Frétey and Blanc 2000. Liste des Amphibiens d'Afrique centrale. Dossiers de l'ADIE, Série Biodiversité 2:1–39; Frost 2004. Amphibian Species of the World [online]. Ver. 3.0. American Museum of Natural History, New York).

Submitted by **THIERRY FRÉTEY**, Association Racine, 2 rue de la Cité, F-35360 Médréac, France (e-mail: fretey.thierry@wanadoo.fr); **PATRICK BARRIERE**, Laboratoire Ecobio: Ecosystèmes, Biodiversité et Evolution, UMR 6553-CNRS, Université de Rennes 1, Station Biologique, F-35380 Paimpont, France (e-mail: Patrick.Barriere@laposte.net); and **ANNEMARIE OHLER**, Muséum national d'Histoire naturelle, Département de Systématique et Evolution, USM 602 Taxinomie et collections (Reptiles et Amphibiens), 25 rue Cuvier, F-75005 Paris, France (e-mail: ohler@mnhn.fr).

LITHOBATES JOHNI (Moore's Frog). MÉXICO: PUEBLA: Municipality of Huehuetla: Río Tehuancate, under Tehuancate bridge, km 77 on Huehuetla-Zacapoaxtla Hwy (22°05'22.2"N, 97°36'36.4"W), 460 m elev. 7 June and 22 August 2003. Itzel Durán-Fuentes, Edmundo Pérez-Ramos, and Andrés A. Mendoza-Hernández. Verified by Luis Canseco-Márquez. Museo de Zool. "Alfonso L. Herrera," Fac. Cienc., UNAM (MZFC 17602–17607, 17609, 17611–17615). First record for Puebla, extending its known range ca. 145 km (airline) SE of Tehuatlán (Tehuetlán), Hidalgo (Webb 1988. Occ. Pap. Mus. Texas Tech Univ. [121]:1–15). The frogs were collected in and along the river situated in tropical semideciduous forest. The Global Amphibian Assessment (www.globalamphibians.org), accessed 27 February 2006, listed *L. johni* as an endangered species, although it was recently considered extinct by Hillis and Wilcox (2005. Mol. Phyl. Evol. 34:299–314). The above records and two others from Hidalgo (MZFC 14156–57) substantiate the viability of this species in east-central México.

Submitted by **ITZEL DURÁN-FUENTES, EDMUNDO PÉREZ-RAMOS,** and **ANDRÉS ALBERTO MENDOZA-HERNÁNDEZ,** Museo de Zoología, Facultad de Ciencias, UNAM, A.P. 70-399, México D.F. 04510, México (e-mail [IDF]: itzeldf@gmail.com).

PIPA PIPA (Surinam Toad). ECUADOR: PROVINCIA DE PASTAZA: Shiripuno River, Ñoneno area (01°05'S, 77°03'W, ca. 300 m elev.). 30 August 1997. J. -M. Touzet. Universidad San Francisco de Quito/Fund. Herpetológica Orcés, Quito (FHGO-USFQ 1650). Verified by Jean-Marc Touzet. *Pipa pipa* is a widely distributed species in the Amazonian basin from Venezuela to Bolivia and Brazil, the Guianas region and Trinidad (Frost 2002. Amphibian Species of the World: an Online Reference. V2.21 [15 July 2002] <http://research.amnh.org/herpetology/amphibia/index.html> [Accessed: 19 July 2004]). However, this aquatic frog has been reported from just three localities in Ecuador, in the provinces of Sucumbíos and Orellana (Duellman 1978. Misc. Publ. Univ. Kansas, Mus. Nat. Hist. 65. 352 pp.; Ron 2001. Anfibios de Parque Nacional Yasuní, Amazonía Ecuatoriana. Ver. 1.3 [2 March 2001]. Museo de Zoología, Pontificia Universidad Católica del Ecuador. Quito. <http://www.esb.utexas.edu/sron/ecuador/yasuni/esp/anfyas.htm> [Accessed: 19 July 2004]; Cisneros-Heredia 2003. *In* De la Torre and Reck [eds.], Ecología y Ambiente en el Ecuador. Mem. I Congreso de Ecología y Ambiente, Ecuador país megadiverso. CD. Universidad San Francisco de Quito, pp. 1–21). The specimen reported herein constitutes the first from the province of Pastaza and the westernmost record for the species, extending its range ca. 110 km ENE from previous localities in the province of Orellana, Ecuador (Yasuni Scientific Station and Tiputini Biodiversity Station; Ron, *op. cit.*; Cisneros-Heredia, *op. cit.*).

Submitted by **DIEGO F. CISNEROS-HEREDIA**, College of Biological and Environmental Sciences, Universidad San Francisco de Quito, Ave. Interoceánica y calle Diego de Robles, Campus Cumbayá, Edif. Maxwell, Casilla Postal 17-12-841, Quito, Ecuador; e-mail: diegofrancisco_cisneros@yahoo.com.

RANA AREOLATA (Crawfish Frog). USA: TENNESSEE: Gibson Co.: At the junction of Highway 425 and Milan Airport Road (UTM: 16S 0341238 3978775). 8 March 2006. Mandy Messer. Verified by A. Floyd Scott. Austin Peay State University Museum of Zoology (APSU 18162, color photo). New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

Submitted by **MANDY MESSER, LAURIE BENNIE,** and **BRIAN P. BUTTERFIELD,** Department of Biology, Freed-Hardeman University, Henderson, Tennessee 38340, USA (e-mail: bbutterfield@fhu.edu).

RANA PALUSTRIS (Pickerel Frog). USA: TENNESSEE: Wayne Co.: Along Highway 64 E of Clifton Junction (UTM: 16S 0410825 3905480). 13 March 2006. Mandy Messer. Verified by A. Floyd Scott. Austin Peay State University Museum of Zoology (APSU 18163, color photo). New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

Submitted by **MANDY MESSER, LAURIE BENNIE,** and **BRIAN P. BUTTERFIELD,** Department of Biology, Freed-Hardeman University, Henderson, Tennessee 38340, USA (e-mail: bbutterfield@fhu.edu).

RANA SYLVATICA (Wood Frog). USA: NORTH DAKOTA: McHenry Co.: 48°09'09.3"N, 100°55'03.8"W. 51 Street NW, Minot State University Applied Amphibian Field Ecology Lab, Schwabs Pond. 19 August 2005. Kenneth C Cabarle. Verified by Chris Beachy. Minot State University, Cyril Moore Science Center Research Collections (CMSCRCDF-2005-001). New record within McHenry Co. Adult individuals (N = 3) collected from pitfall traps at amphibian drift fence site, permanent pond in agricultural area. Adults appeared to be plentiful. This locality represents an extension within this county 120 km SW of the last recorded county record near Towner, North Dakota. The locality also extends collection records from a glacial basin eco-region to an adjacent glacial delta eco-region. This locality might expand the maximum southwestern distribution for the species with North Dakota (Redmer and Trauth 2005. *In* M. Lannoo [ed.], Amphibian Declines. The Conservation Status of United States Species, pp. 590–593. University of California Press, Berkeley and Los Angeles; Hoberg and Gause 1992. North Dakota Outdoors 55[1]:7–18.; and Johnson and Batie 1996. Surveys of Calling Amphibians in North Dakota. Jamestown, North Dakota: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/herps/amsurvey/amsurvey.htm (Version 16JUL97).

Special thanks to Minot State University and North Dakota INBRE for funding this research.

Submitted by **KENNETH C. CABARLE** (e-mail: kenneth.cabarle@minotstateu.edu), Department of Biology, Minot State University, 500 University Avenue West, Minot, North Dakota 58707, USA.

SCAPHIOPUS COUCHI (Couch's Spadefoot). USA: CALIFORNIA: Riverside Co.: 2 mi. SSE of Blythe, 33.5744°N, 114.5691°W, 13 August 1999. Tadpoles (MVZ 230247–50, verified by mtDNA sequencing, Paul Barber, Boston University); 1.2 mi. WNW of Palo Verde, 33.4345°N, 114.7481°W, 8 October 2004, toadlet

(LACM 155892). Additional specimens and photographs of adults: LACM 155877, 155887, 155889, LACM PC1417 and PC1418. Verified by Kent Beaman, Nat. Hist. Mus. of Los Angeles Co.) First county records (Glaser 1970. The Distribution of Amphibians and Reptiles in Riverside County, California. Riverside Museum Press, Riverside, California). These records are from extreme eastern Riverside County in and near the Palo Verde Valley, from the Imperial County border north to 20 miles NW of Blythe. This species has been presumed to occur in Riverside County, but documentation had been lacking.

Submitted by **DAVID M. GOODWARD**, 22430 Pico Street, Grand Terrace, California 92313, USA (e-mail: davegoodward@earthlink.net); **PAUL H. BARBER**, Boston University Marine Program, 7 MBL Street, Woods Hole, Massachusetts 02543, USA (e-mail:pbarber@bu.edu); and **DANIEL R. BUCHHOLZ**, Department of Biological Sciences, University of Cincinnati, Cincinnati, Ohio 45221-0006, USA.

SCINAX NASICUS (Lesser Snouted Treefrog). ARGENTINA: BUENOS AIRES: PARTIDO DE LA PLATA: Cattle farming pasture (34º59'05"S; 57º51'21"W), 8 January 2006. G. S. Natale. Museo de Ciencias Naturales de La Plata, Buenos Aires (MLP 3504–05, 3507, two adult males and one female). PARTIDO DE ARRECIFES: soy culture field (34º6'46"S; 60º8'20'"W), 8 January 2003. G. S. Natale. MLP 3506. All verified by L. Alcalde. Known distribution ranges from Bolivia (De la Riva et al. 2000. Rev. Esp. Herpetol. 14:19–164), to Brazil in Matto Grosso and "Cerrado" regions including Rio Grande do Sul (Giasson 2001. Herpetol. Rev. 32:273; Cechin et al. 2002. Herpetol. Rev. 33:222), Paraguay (Aquino et al. 1996. Colección de Flora y Fauna del Museo Nacional de Historia Natural del Paraguay. Romero. Editor. pp. 331–400), and Uruguay (Langone 1994. Ranas y Sapos del Uruguay, Reconocimiento y Aspectos Biologicos. Museo Damaso Antonio Larrañaga -Divulgación 5:1–123). In Argentina, it is widespread in the central and northern regions from Jujuy to northern Buenos Aires (Faivovich 1994. Herpetol. Rev. 25:75; Lavilla et al. [eds.] 2000. Categorización de los Anfibios y Reptiles de la República Argentina. Asociación Herpetológica Argentina. Tucumán Argentina. 97 pp.). La Plata is the southernmost known record and extends the range 200 km SE from Baradero (Faivovich, *op. cit.*). The record from Arrecifes extends the distribution 68 km to the west, out of the coastal zone proposed as a faunal filter by Gallardo (1974. Anfibios de los Alrededores de Buenos Aires. Edit. Univ. Eudeba/Lectores. 231 pp.).

Submitted by **GUILLERMO S. NATALE**, Centro de Investigaciones del Medio Ambiente, Departamento de Química, Facultad de Ciencias Exactas, UNLP, 47 y 115 (CP 1900), La Plata, Bs. As., Argentina, Becario CONICET (e-mail: gnatale@quimica.unlp.edu.ar); and **RAUL HERRERA,** 74 Nº 70 (CP 1900) La Plata, Bs. As. Argentina (e-mail: rherrera@lpsat.com).

ZACHAENUS CARVALHOI (Carvalho's Bug-eyed Frog). BRAZIL: MINAS GERAIS: Municipality of Pedra Dourada: Fazenda Floresta (20°47'S, 42°10'W, 1087 m elev.) Área de Proteção Ambiental Municipal Pedra Dourada. December 2005. J. S. Dayrell and C. P. Neves. Museu de Zoologia João Moojen de Oliveira, Universidade Federal de Viçosa, Viçosa, Minas Gerais (MZUFV 6730–6731). Verified by U. Caramaschi. First record outside the type locality: Municipality of Santa Tereza, Espírito Santo (Izecksohn 1982. Arq. Univ. Fed. Rural Rio de Janeiro 5[1]:7–11; Frost 2000. Amphibian Species of the World: An Online Reference. http://research.amnh.org/herpetology/amphibia), first state record, and the most inland record for the species. Extends southwestern range ca. 170 km airline.

Submitted by **JUSSARA SANTOS DAYRELL, CHARLENE DA PENHA NEVES, CARLA SANTANA CASSINI,** and **RENATO NEVES FEIO,** Museu de Zoologia João Moojen de Oliveira, Universidade Federal de Viçosa, 36571-00, Viçosa, MG, Brazil (e-mail: jussaradayrell@gmail.com).

LACERTILIA

AGAMA AGAMA AFRICANA (African Rainbow Lizard). USA: FLORIDA: LEE Co.: Sanibel Island, 5424 Shearwater Drive (26.46602°N, 82.1583°W, NAD83). 5 May 2006. Chris Lechowicz and Malcom Harpham. UF 146784 (photographic voucher). Verified by Kenneth L. Krysko. New county record and ca. 55 km S of the closest known population in Punta Gorda, Charlotte County (Enge et al. 2004. Florida Sci. 67:303–310). Adult male on wall of private residence.

Submitted by **CHRISTOPHER J. LECHOWICZ,** Sanibel-Captiva Conservation Foundation, P.O. Box 839, Sanibel, Florida 33957, USA; e-mail: clechowicz@sccf.org.

BACHIA HETEROPA ALLENI (Earless Worm Lizard). ST. VINCENT AND THE GRENADINES: Mustique Island and Union Island. 20 May 2005. Mark de Silva. MPM 33973–74. Verified by S. B. Hedges. Both are new island records, although the species is known from elsewhere on the Grenada Bank. The species occurs on Bequia and Canouan in the Grenadines and on Grenada (Schwartz and Henderson 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History. Univ. Florida Press, Gainesville, i-xvi+720 pp.).

Submitted by **ROBERT W. HENDERSON**, Section of Vertebrate Zoology, Milwaukee Public Museum, Milwaukee, Wisconsin 53233, USA (e-mail: rh@mpm.edu); and **ROBERT POWELL**, Department of Biology, Avila University, Kansas City, Missouri 64145, USA (e-mail: powellr@avila.edu).

GEHYRA MUTILATA (Mutilated Gecko). INDONESIA: KRAKATAU ISLANDS: Coastal forest, east shore, Panjang Island (06°05'S, 105°25'E). 2 April 2001. Mark O'Shea. Collected from under the bark of *Casuarina* tree. Rawlinson Krakatau Collection at Museum of Victoria, Melbourne, photographic voucher (NMV D 72413). Verified by Hidetoshi Ota.

The volcanic eruption of 27 August 1883 extinguished all life from Krakatau and the neighboring islands of Sertung and Panjang (Thornton 1996. The Destruction and Reassembly of an Island Ecosystem. Harvard Univ. Press, Cambridge, Massachusetts, xii + 346 pp.). All that remained of the original Krakatau was the southern half of Rakata volcano, a small outcrop to the north called Bootsmanrots, and the neighbouring islands of Panjang and Sertung, with a 200-m deep submarine caldera separating them. In 1930, a new island, Anak Krakatau, arose in the northern section of the Krakatau caldera.

Reptiles began to re-colonize the Krakatau Archipelago within six years of the eruption, by actively swimming, passively rafting, or through the agencies of man, although the rate of re-colonization has slowed markedly since the 1930s (Rawlinson et al. 1992. *In* Thornton [ed.], Krakatau—A Century of Change, pp. 225–231. GeoJournal 28[2]:81–302). To date, seven species of reptiles have re-colonized the Krakatau Archipelago from source populations in southern Sumatra and western Java, and from other islands in the Sunda Strait, Sebesi, and Paniatan (Thornton 1996, *op. cit.*; Thornton et al. 2002. Biol. J. Linn. Soc. 77[3]:275–317). Continued eruptions of Anak Krakatau make re-establishment of the flora and fauna a punctuated process.

Gehyra mutilata is a widely distributed species, found throughout the entire Indonesian archipelago, including Sumatra and Java (de Rooji 1915. The Reptiles of the Indo-Australian Archipelago Vol. I. Lacertilia, Chelonia, Emydosauria. E. J. Brill, Leiden. xiv + 382 pp.). It is also a highly successful colonizer of islands and continents outside its natural range (Lever 2003. Naturalized Reptiles and Amphibians of the World. Oxford Univ. Press, Oxford. xx + 318 pp.). Future biological surveys of Krakatau Islands should search the eastern forests of Panjang to confirm that this species has established a permanent population.

We thank YAP Films and Animal Planet for funding and support of the project "Return of the Reptiles" (OBA2) and wish to acknowledge the pioneering Krakatau fieldwork of SC's mentor, Prof. Ian W. B. Thornton, who passed away in 2002.

Submitted by **MARK O'SHEA**, School of Applied Sciences, University of Wolverhampton, Wolverhampton, WV1 1SB, England (e-mail: oshea@snakemos.demon.co.uk); and **SIMON COOK**, School of Science and Engineering, University of Ballarat, Mt Helen, Victoria, Australia 3353 (e-mail: simoncook67@yahoo.com.au).

HEMIDACTYLUS FRENATUS (Common House Gecko). MÉXICO: CHIAPAS: Municipality of Ocosingo: Frontera Corozal, Museo Regional de Frontera (16°49'16.6"N, 90°53'14.1"W), 101 m elev. 1 May 2004. Ricardo Paredes-León. Colección Nacional de Anfibios y Reptiles, Instituto de Biología, UNAM (CNAR-IBH 15663–65). Verified by Elisa Cabrera-Guzmán and Edmundo Pérez-Ramos. First record for the Lacandona region, extending its known range 140 km NW of Palenque, Chiapas (Lee 1996. The Amphibians and Reptiles of the Yucatán Peninsula. Comstock Publ. Assoc., Cornell Univ. Press, Ithaca, New York. 500 pp.). The specimens were collected at night on walls of the museum.

Submitted by **RICARDO PAREDES-LEÓN**, Colección Nacional de Ácaros, Instituto de Biología, UNAM, Ciudad Universitaria, México, D.F. 04510 (e-mail: skarabajo8@yahoo.com.mx); and **VÍCTOR-HUGO REYNOSO**, Colección Nacional de Anfibios y Reptiles, Instituto de Biología, UNAM, Ciudad Universitaria, México, D.F. 04510 (e-mail: vreynoso@ibunam.ibiologia.unam.mx).

NOROPS* (= *ANOLIS*) *SAGREI (Brown Anole). USA: SOUTH CAROLINA: ORANGEBURG CO.: Rest area on westbound I-26 at mile marker 152, ca. 3 km NW of the I-26/U.S. Rt. 301 jct. (33°28.849'N, 83°45.469'W). 07 June 2005. Florida State Museum of Natural History (UF 146016). Single adult male collected from landscaping vegetation adjacent to the main rest area building; one additional adult male observed on the building wall during an approx. 30 min. search of the grounds. COLLETON CO.: Rest area on northbound I-95 at mile marker 47, ca. 8 km NE of I-95/U.S. Rt. 21 jct. (32°48.164'N, 80°46.203'W). 30 June 2005. UF 146018. Single adult female collected from landscaping vegetation, relatively distant from rest area facilities and main parking; no other individuals observed. JASPER CO.: Welcome Center on northbound I-95, ca. 7 km NE of the Georgia-South Carolina border (32°15.962'N, 81°05.186'W). 30 June 2005. UF 146017. Single adult male collected from rocks bordering a water retention pond. Several adult males and females, approx. 10–15 total, were observed in various locations at this site in both May and June 2005. One small juvenile observed near the retention. All specimens verified by A. C. Echternacht. First records for South Carolina, extend range a maximum of 270 km N of Glynn County, Georgia record (Campbell 1996. Herpetol. Rev. 27:155–157). Jasper County lizards (ca. 125 km N of Glynn County record) might represent a recently established population. Dispersal to these rest areas is likely occurring via vehicular rafting (Campbell 1996, *op. cit.*; Godley et al. 1981. Herpetol. Rev. 12:84–86), though transport on ornamental vegetation is also a possibility at the Jasper and Colleton counties sites because cabbage palms from Florida nurseries were planted there in the mid-1990s and 2002, respectively, with possible replantings at later dates (South Carolina Department of Transportation, pers. comm.).

Submitted by **NATHAN W. TURNBOUGH**, Department of Ecology and Evolutionary Biology, University of Tennessee, 569 Dabney Hall, Knoxville, Tennessee 37996-4503, USA.

NOROPS SAGREI (Brown Anole). USA: TEXAS: HIDALGO CO.: City of La Joya, south shore of Walker Lake. 24 September 2005. Arianna McCoid. Texas Natural History Collection (TNHC) 64388. First specimen for this county. The species was listed as occurring in Hidalgo Co. (Dixon 2000. Amphibians and Reptiles of Texas. 2nd Ed. Texas A&M Univ. Press, 421 pp.) but apparently there is no corroborating specimen (*fide* J. Dixon, pers. comm.). The adult male specimen (53.4 mm SVL) was collected on the property of Mark and Rachel Medina; these homeowners had seen hatchlings of this species on their property this past summer. During the preceding two years the property had been landscaped with plants shipped directly from Florida and from local nurseries. BRAZORIA CO.: City of Alvin, 316 Windsor Square. 14 March 2006. M. J. McCoid. TNHC 64389. First specimen for this county (*op. cit.*). The adult male specimen (54.1 mm SVL) was collected at 1000 h. Several days prior to collection, a group of plants had been purchased from a Brazoria County nursery. Specimen identifications verified by Travis LaDuc.

Submitted by **MICHAEL JAMES McCOID**, Department of Pathology, University of Texas Medical Branch, 301 University Blvd., Galveston, Texas 77555-0609, USA; e-mail: mjmccoid@utmb.edu.

PODARCIS ERHARDII (Erhard's Wall Lizard). GREECE: ATTICA: Mount Parnitha (23°47'50"E, 38°10'02"N; 1160 m elev.). 17 October 2005. P. Pafilis. Natural History Museum of Crete (NHMC 80.3.51.1705–08, two males and two females). Verified by E. D. Valakos. The range includes diverse areas of mainland

and insular Greece. Believed to occur in Attica Prefecture (Wetstein 1953. Herpetologia Aegea, Sitzungsber. Osterr. Akad. Wiss. Math.-Naturwiss. K1., Wien 162[9–10]:42), no recent report of its presence exists. The finding represents the southernmost record of the species in mainland distribution, 40 km from Athens.

Submitted by **PANAYOTIS PAFILIS** and **CHRISA SIMOU**, Section of Animal Physiology, Department of Biology, University of Athens, 157–84, Panepistimiopolis, Ilisia, Athens, Greece (e-mail: ppafil@biol.uoa.gr).

TARENTOLA MAURITANICA. ARGENTINA: TUCUMÁN: San Miguel de Tucumán (26°49'50"S, 65°12'14"W). 26 February 2006. G. Ábalos. Herpetological collection Fundación Miguel Lillo, Tucumán, Argentina (FML 16982–16983). Verified by R. Montero. North African species introduced accidentally in South America (Achával and Olmos 1997. Anfibios y Reptiles del Uruguay. Pers. Edition, Montevideo 128 pp.). Previously known from Buenos Aires province, Argentina, and Montevideo, Uruguay (Castello and Gil Rivas 1980. Medicina 40:673–677; Achával and Gudynas 1983. Bol. Soc. Zool. Uruguay 1:7–10). First vouchered province record (previously mentioned without explanation by Freiberg 1977. El Mundo de los Saurios. Ed. Albatros, Buenos Aires, 104 pp.), extends known distribution in Argentina ca. 1300 km NW from the closest previous record in Buenos Aires.

Submitted by **MARÍA P. CABRERA** (e-mail: mpaucab@yahoo.com) and **CECILIA GUERRA** (e-mail: ceeciliaa@hotmail.com), Instituto de Herpetología, Fundación Miguel Lillo, Miguel Lillo 251, 4000 Tucumán, Argentina.

SERPENTES

ELAPSOIDEA TRAPEI (Trape's Garter Snake). MAURITANIA: GUIDIMAKA REGION: Precise locality not known, probably in the vicinity of Selibabi (15°09'N, 12°11'W). Audan. Entered in Muséum national d'Histoire naturelle, Paris in 1912 (MNHN 1912.0–447). Verified by Gernot Vogel. First record for Mauritania. Extends range 300 km north from the closest known locality at Bandafassi in southeastern Senegal (Trape and Mané 2004. Bull. Soc. Herpetol. France 109:5–34). This specimen was previously confused with *Elapsoidea semiannula moebiusi* (Broadley 1998. Afr. J. Herpetol. 47:13–23). *Elapsoidea trapei* is a recently described species that was known only from Senegal (Mané 1999. Bull. Soc. Herpetol. France 91:13–18).

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GYALOPION CANUM (Chihuahuan Hook-nosed Snake). MÉXICO: SONORA: Municipio de Yécora, 11.9 km (by Mex. Hwy 16) W Yécora (jct.) (28°21'45.2"N, 109°00'47.9"W), 1821 m elev. 6 August 2004. E. Enderson, K. Bonine, and R. Bezy. UAZ 56041-PSV. Verified by L. M. Hardy. This is the first record from the western slope of the Sierra Madre Occidental and extends the range 225 km SW from Colónia Juárez, Chihuahua, and 340 km S from Cananea, Sonora (Hardy 1975. J. Herpetol. 9:107–132; Tanner 1985. Great Basin Nat. 45:615–676). The snake was found DOR at 2205 h.

Submitted by **ERIK F. ENDERSON**, 2627 South Jaguar Road, Tucson, Arizona 85730, USA; **KEVIN E. BONINE**, Department of Ecology and Evolutionary Biology and School of Natural Resources, University of Arizona, Tucson, Arizona 85721, USA; and **ROBERT L. BEZY**, Natural History Museum of Los Angeles County, Los Angeles, California 90007, USA (e-mail: bezyr@theriver.com).

GYALOPION CANUM (Chihuahuan Hook-nosed Snake). USA: TEXAS: CROSBY CO.: Junction FM 261 and FM 3385 (33.4097°N, 101.097°W; WGS 1984). 20 May 2004. TNHC 64358. Verified by T. LaDuc. New county record (Dixon 2002. Amphibians and Reptiles of Texas. 2nd Ed. Texas A&M University Press, College Station, Texas. 421 pp.). The specimen expands the documented range of this species in northern Texas.

We thank J. R. Dixon, T. LaDuc, and E. Rickart for their assistance. All work was completed under TPWD Scientific Collection Permit SPR-1097-912 and IACUC 04-3D2AAE71.

Submitted by **JOHN D. McVAY**, Department of Biological Sciences, Texas Tech University, Lubbock, Texas 79409, USA (e-mail: john.mcvay@ttu.edu); and **M. R. J. FORSTNER**, Department of Biology, Texas State University at San Marcos, San Marcos, Texas 78666, USA.

HAEMORRHOIS DORRI (Boie's Racer). GUINEA: KINDIA DISTRICT: Kalekouré (09°55'N, 12°48'W). Between June and December 2004. Collector not recorded. Institut Pasteur de Guinée at Kindia (646–G). Verified by Youssouph Mané. First record for Guinea and first record for a wet savannah area of West Africa. Extends range 280 km S from the closest known locality at Bandafassi in southeastern Senegal (Trape and Mané 2004. Bull. Soc. Herpetol. France 109:5–34). This species is also known from southern Mauritania (Nickel 2001. Biodiversität Mauritanien, kommentierte liste zu den reell und potenziell in Mauritanien vorkommenden vertebraten, mit ausnahme des aves [Vögel]. Nouakchott, Mauritania, Project GIRNEM, GTZ), Mali, Burkina-Faso, Ghana, Togo, and Benin (Villiers and Condamin 2005. Les serpents de l'Ouest Africain, Institut Fondamental d'Afrique Noire, Initiations et Etudes Africaines n°2, 4ème édition, Dakar, 205 pp.; Trape and Mané 2006. Guide des serpents d'Afrique de l'Ouest soudano-sahélienne et saharienne, IRD éditions, Paris, *in press*).

Submitted by **JEAN-FRANCOIS TRAPE**, Institut de Recherche pour le Développement (IRD), Laboratoire de Paludologie et Zoologie médicale, B.P. 1386, Dakar, Sénégal (e-mail: Jean-Francois.Trape@ird.sn); and **CELLOU BALDE**, Institut Pasteur de Guinée, B.P. 146, Kindia, Guinée.

HYPSIGLENA TORQUATA (Nightsnake). USA: OKLAHOMA: ATOKA CO.: McGee Creek State Park, 26 km E of Atoka (UTM Zone 15 232969E 3802218N; NAD83). 30 April 2005. University of Oklahoma Herpetology Class. Verified by Laurie J. Vitt. Sam Noble Oklahoma Museum of Natural History (OMNH 41863). First county record and easternmost record for species in Oklahoma (Sievert and Sievert 2005. A Field Guide to Oklahoma's Amphibians and Reptiles. 2nd Ed. Okla. Dept. of Wildlife Conser-

vation. Norman, Oklahoma).

Submitted by **DOUGLAS FOX**, Oklahoma Biological Survey, 111 E. Chesapeake Street, Norman, Oklahoma 73019, USA; e-mail: dfox1@ou.edu.

IMANTODES GEMMISTRATUS (Central American Tree Snake). MÉXICO: SONORA: Municipio de Yécora, 32.8 km (by Mex. Hwy 16) W Yécora (jct.) (28°24.474'N, 109°06.747'W). 6 August 2004. E. Enderson, K. Bonine, and R. Bezy. UAZ 56042-PSV. Verified by G. Bradley. Extends the range 140 km N from Rancho Guirocoba and the vicinity of Alamos, Sonora (Schwalbe and Lowe 2000. *In* Robichaux and Yetman [eds.], The Tropical Deciduous Forest of Alamos. Univ. Arizona Press, Tucson, Arizona. 259 pp.; Zweifel 1959. Amer. Mus. Nov. 1961:1–18). The snake was found DOR at 2335 h.

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LAMPROPELTIS GETULA SPLENDIDA (Desert Kingsnake). USA. TEXAS: Lynn Co.: FM 400, 1 road mi NW junction FM 211. (33.3031°N, 101.7387°W; WGS 1984). 16 June 2005. TNHC 64359. Verified by T. LaDuc. New county record (Dixon 2002. Amphibians and Reptiles of Texas. 2nd Ed. Texas A&M University Press, College Station, Texas. 421 pp.).

We thank curators J. R. Dixon, T. LaDuc, and E. Rickart for their assistance. All work was completed under TPWD Scientific Collection Permit SPR-1097-912 and IACUC 04-3D2AAE71.

Submitted by **JOHN D. McVAY**, Department of Biological Sciences, Texas Tech University, Lubbock, Texas 79409, USA (e-mail: john.mcvay@ttu.edu); and **M. R. J. FORSTNER**, Department of Biology, Texas State University at San Marcos, San Marcos, Texas 78666, USA.

LIOPHOLIDOPHIS SEXLINEATUS (NCN). MADAGASCAR: ANTANANARIVO PROVINCE: Ankaratra Massif (19°20.532'S, 47°14.634'E; 2498 m elev.). 16 February 2006. Ylenia Chiari. Zoologische Staatssammlung München, Germany, ZCMV 2559. Another individual was collected nearby, by Miguel Vences, ZCMV 2561. The highest elevation recorded for this species and for any colubrid snake in Madagascar was 2110 m (Vences et al. 2002. Ital. J. Zool. 69:263–281). Specimens were identified on the basis of coloration and scale counts (Cadle 1996. Bull. Mus. Comp. Zool. 154:369–464): 17 dorsal, 150 ventral, 123 subcaudal, anal and all subcaudal scales but one divided for ZCMV 2559 and 17 dorsal, 136 ventral, 76 subcaudal, anal and all but three subcaudal scales divided for ZCMV 2561. Individuals observed during a sunny and warm day on the side of a rocky mountain path, one in the act of swallowing a frog (*Boophis microtympanum*). On the path nearby another individual of the same species was observed. It had been killed, probably by local people.

Submitted by **YLENIA CHIARI**, Zoological Museum of Amsterdam, Mauritskade 61, 1092 AD Amsterdam, The Netherlands (e-mail: yle@yleniachiari.it); **DINA MALALA RAVELONKASINA**, Départment de Biologie Animale, Faculté des Sciences, BP 906, Université d'Antananarivo, Antananarivo 101, Madagascar; and **EDWIGE FALIARISOA**, Départment de Biologie Animale, Faculté des Sciences, BP 906, Université d'Antananarivo, Antananarivo 101, Madagascar (e-mail: faliarisoaedwige@yahoo.fr).

NERODIA FASCIATA PICTIVENTRIS (Florida Watersnake). USA: CALIFORNIA: Los Angeles Co.: Harbor City: Kenneth Malloy Memorial Park: Machado Lake (aka Harbor Park Lake), along south lake margin at fishing dock 0.29 km (0.18 mi) NE of intersection of Vermont Ave and W. Anaheim St. A single dark-colored specimen (550 mm SVL). 3 April 2006. Collected by B. W. Trevett. LACM 161154 Verified by Jeffrey Seigel and Jeff Boundy. Allocation to ssp. *N. f. pictiventris* based on features of coloration and pattern. New state record for this subspecies. BWT photographed additional individuals and observed juveniles at same location. The presence of juveniles suggests that local reproduction is occurring at the site. Other records of *N. fasciata* in California include a reproducing population of *N. f. fasciata* in Sacramento Co. reported by Balfour and Stitt (2002. Herpetol. Rev. 33:150). Bury and Luckenbach (1976. Biol. Conserv. 10:1–14), give an account of a single individual of *Natrix* [=*Nerodia*] *fasciata* which they referred to as a "banded watersnake" and which was reportedly collected from a pond in "west Los Angeles" by a H. Campbell. The name "banded watersnake" is generally associated with *N. f. fasciata,* however, the true identity of the Campbell specimen has not been verified to our knowledge. Perhaps by coincidence, LACM has a specimen of *N. sipedon* with dark cross bands that was collected from El Dorado Park, Los Angeles Co., and dated September 1978 (LACM 109564). The LACM data sheet does not specify the city name for the *N. sipedon* specimen, but it is likely to be Long Beach, which has an El Dorado Park that contains a pond (and is located in west Los Angeles Co). Specimen LACM 109564 might therefore be the "banded watersnake" referred to by Bury and Luckenbach.

Submitted by **MICHAEL M. FULLER**, Department of Ecology and Evolutionary Biology, University of Tennessee, 1416 Circle Drive, Knoxville, Tennessee 37996, USA (e-mail: mmfuller@tiem.utk.edu); and **BRYCE W. TREVETT,** 6640 Abbottswood Drive, Rancho Palos Verdes, California 90275, USA (e-mail: rtrevett@hotmail.com).

RAMPHOTYPHLOPS BRAMINUS (Brahminy Blindsnake). MAURITANIA: TRARZA REGION: Nouakchott (18°05'N, 15°59'W). 22 August 2005. Hampâté Ba. Institut de Recherche pour le Développement at Dakar (IRD 181–MAU, IRD 182–MAU). Verified by Youssouph Mané. First record for Mauritania. Two specimens found together in a street. Extends range 440 km north from the closest known locality at Dakar, Senegal (Trape 1990. Bull. Soc. Herpetol. France 55:40–41).

Submitted by **JEAN-FRANCOIS TRAPE**, Institut de Recherche pour le Développement (IRD), Laboratoire de Paludologie et Zoologie médicale, B.P. 1386, Dakar, Sénégal (e-mail: Jean-Francois.Trape@ird.sn); and **HAMPATE BA**, Institut National de Recherche en Santé Publique (INRSP), B.P. 695, Nouakchott, Mauritanie.

STORERIA OCCIPITOMACULATA (Red-bellied Snake). USA: PENNSYLVANIA: York Co.: Dillsburg Quadrangle (40.10178°N, 077.09599°W). Tuckahoe Boy Scout Camp. 22 June 2004. J. D. Lindquist and E. D. Lindquist. State Museum of Pennsylvania, Section of Zoology and Botany (SMP-H2642). Verified by Walter Meshaka. Juvenile found under log in second growth dry oak-mixed hardwood forest. First record for county (Hulse et al. 2001. Amphibians and Reptiles of Pennsylvania & the Northeast. Cornell University Press. Ithaca, New York. 419 pp.).

Submitted by **JOSIAH D. LINDQUIST**, 602 Wingert Drive, Mechanicsburg, Pennsylvania 17055, USA; and **ERIK D. LINDQUIST**, Department of Biological Sciences, Messiah College, One College Avenue, Grantham, Pennsylvania 17027, USA.

THAMNODYNASTES SERTANEJO. BRAZIL: MINAS GERAIS: Municipality of Jaíba (15°12'S, 43°42'W). 09 March 1995. G. A. Cotta. Fundação Ezequiel Dias, Belo Horizonte, Minas Gerais, Brazil (FUNED 907). 22 July 1998. R. N. Feio and J. L. Pontes. Museu Nacional, Rio de Janeiro, Rio de Janeiro, Brazil (MNRJ 8048). Municipality of Jaíba, Mocambinho (14°48'S, 43°55'S). 20 August 1992. M. C. Brito-Pereira. Museu Nacional (MNRJ 8583). BAHIA: Municipality of Paulo Afonso, Usina Hidrelétrica Itaparica (09°21'S, 38°14'W). 30 January 1987. U. Simon. (FUNED 244). The species was previously known only from Municipality of Jaguarari, state of Bahia, and the Municipality of Exu, state of Pernambuco, Brazil (Bailey et al. 2005. Phyllomedusa 4[2]:83–101). First record from the state of Minas Gerais and (Jaíba), ca. 732 km southwest from the closest previous record (Bahia, Municipality of Jaguarari, Mine of Caraíba, 39°52'S, 09°51'W; Bailey et al., *op. cit.*), also the eastern limit of its distribution (Paulo Afonso), ca. 190 km east from the closest record (Jaguarari). All these localities are located in "Caatinga" biome.

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Range Extensions for Reptiles and Amphibians along the Northern Versant of Papua New Guinea

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The herpetofauna of New Guinea remains relatively poorly known, with 103 new species described since 2000, scores new species remaining to be described, and large parts of the island poorly surveyed. For those species already described, geographic ranges are poorly understood; for example, approximately 40% of frog species are still known only from their type localities. We have recently provided a significant number of new range extensions for the southeasternmost tip of New Guinea and adjacent islands (Kraus and Allison 2004; Kraus and Shea 2005), and Günther (2003a) has done the same for the western end of New Guinea. Here we present a similar list for the northern versant of Papua New Guinea. This portion of the island, north of the Central Dividing Range, consists of a series of independent mountain ranges (and their intervening depositional basins) that are the remnants of an arc of former islands sutured onto the northern margin of New Guinea over the past ten million years (Pigram and Davies 1987).

Below we provide range extensions based primarily on expeditions we conducted to the Bewani, Hunstein, and Torricelli mountains, but we supplement these with a few additional extensions from Mt. Shungol to the east of the Central Dividing Range and just south of the most recently sutured terrane (Finisterre) comprising the Huon Peninsula. For the sake of completeness, we also supplement our accounts for one species of *Callulops* and three species of *Litoria* with additional data from outside the northern versant of the island. All specimens are deposited in the Bernice P. Bishop Museum (BPBM). All coordinates use the AGD 66 datum.

Anura

Albericus brunhildae. EAST SEPIK PROV.: Hunstein Mts.: 1.3 km S & 2.3 km E Mt. Hunstein summit, 4.5226°S, 142.6748°E, 1000 m asl. 25 September–5 October 1989. A. Allison. BPBM 20884–902; WEST SEPIK PROV.: Bewani Mts.: Agpo Creek, 8.5 km N & 13 km E Utai, 3.312°S, 141.7°E, 1100 m asl. 28 September 1986. A. Allison. BPBM 20991–93; summit Mt. Menawa, 10.5 km N & 15.7 km E of Utai, 3.295°S, 141.723°E, 1920 m asl. 19–20 October 1986. A. Allison. BPBM 20994–98. First provincial records; previously known only from Adelbert Mts., 300 km to the E and 460 km to the SSE, respectively (Menzies 1999).

Asterophrys leucopus. EAST SEPIK PROV.: Hunstein Mts.: 1.3 km. S & 2.3 km E Mt. Hunstein summit, 4.5226°S, 142.6748°E, 1000 m asl. 30 September–2 October 1989. A. Allison. BPBM 16585–88; WEST SEPIK PROV.: Bewani Mts.: Agpo Creek, 8.5 km N & 13 km E Utai, 3.312°S, 141.7°E, 950 m asl. 26–28 Sep-

tember 1986. A. Allison. BPBM 14369, 14371–72; Agpo Creek, 8.5 km N & 14 km E of Utai, 3.309°S, 141.709°E, 1200 m asl. 22–23 October 1986. A. Allison. BPBM 14370, 14373. Range extensions of 100 km to the ENE and 175 km to the N, respectively, of Mt. Stolle (Richards et al. 1994).

Austrochaperina adamantina. WEST SEPIK PROV.: Bewani Mts.: vicinity Trefas Village, 5.9 km N & 7.3 km E Utai, 3.333°S, 141.651°E, 340 m asl. 23 October 1986. A. Allison. BPBM 14234. Previously known only from Mt. Nibo, Torricelli Mts., 70 km to the E (Zweifel 2000).

Austrochaperina aquilonia. WEST SEPIK PROV.: Bewani Mts.: Agpo Creek, 8.5 km N & 13 km E of Utai, 3.312°S, 141.7°E, 950 m asl. 28–29 September 1986. A. Allison. BPBM 14235–38; Agpo Creek, 8.5 km N & 14 km E of Utai, 3.309°S, 141.709°E, 1200 m asl. 22 October 1986. A. Allison. BPBM 14239. Previously known only from NE of Lumi, Torricelli Mts., ~70 km to the E (Zweifel 2000).

Austrochaperina basipalmata. WEST SEPIK PROV.: Bewani Mts.: Agpo Creek, 8.5 km N & 13 km E of Utai, 3.312°S, 141.7°E, 940–950 m asl. 24–27 September 1986. A. Allison. BPBM 14212, 14241–43; Agpo Creek, 8.5 km N & 14 km E of Utai, 3.309°S, 141.709°E, 1200 m asl. 6 October 1986. A. Engilis, Jr. BPBM 14213. Fills in 150 km range gap between localities in eastern Papua Prov., Indonesia and Torricelli Mts., PNG (Zweifel 2000).

Austrochaperina blumi. EAST SEPIK PROV.: Hunstein Mts.: 1.3 km. S & 2.3 km E Mt. Hunstein summit, 4.5226°S, 142.6748°E, 1000 m asl. 30 September–5 October 1989. A. Allison. BPBM 16581–84; WEST SEPIK PROV.: Bewani Mts.: Agpo Creek, 8.5 km N & 13 km E of Utai, 3.312°S, 141.7°E, 950 m asl. 20–27 September 1986. A. Allison. BPBM 14240, 14244–45; vicinity Trefas Village, 5.9 km N & 7.3 km E Utai, 3.333°S, 141.651°E, 340 m asl. 23 October 1986. A. Allison. BPBM 14246; Torricelli Mts.: 3.2 km SSE Mt. Sapau summit, 3.3933°S, 142.5283°E, 550 m asl. 20–26 May 2005. F. Kraus. BPBM 22653–58, 22661–63. Range extensions of 140 km to the NE, 220 km to the N, and 220 km to the NNE, respectively, of nearest locality near Telefomin (Zweifel 2000).

Austrochaperina parkeri. MOROBE PROV.: Along Dunch River 5.6 km NW summit Mt. Shungol, 6.8162°S, 146.6915°E, 750 m asl. 16–24 October 2003. F. Kraus and native collectors. BPBM 18385–90. Previously known only from type locality 35 km to the NNE on other side of Markham River (Zweifel 2000).

Austrochaperina septentrionalis. WEST SEPIK PROV.: Torricelli Mts.: 1.6 km SSW Mt. Sapau summit, 3.3807°S, 142.5155°E, 1120 m asl. 27 May 2005. I. Haguna. BPBM 22668–69. Previously known only from Bewani Mts. ~130 km to W (Allison and Kraus 2003).

Callulops personata. MOROBE PROV.: Along Dunch River 5.6 km NW summit Mt. Shungol, 6.8162°S, 146.6915°E, 750 m asl. 23 October 2003. F. Kraus & native collectors. BPBM 18504; E slope Bowutu Mts., 7.2960°S, 147.0929°E, 520–530 m asl. 29 March–1 April 2005. J. Anamiato. BPBM 23739–23740. First provincial records and range extensions of 520 km and 580 km to the SSE of Maprik (Zweifel 1972a).

Choerophryne longirostris. WEST SEPIK PROV.: Torricelli Mts.: 1.2 km S Mt. Sapau summit, 3.3773°S, 142.5180°E, 1120–1320 m asl. 27 May 2005. F. Kraus. BPBM 22672–76. Range extension of 120 km to the E from only known localities in Bewani Mts. (Kraus and Allison 2001).

Cophixalus balbus. EAST SEPIK PROV.: Hunstein Mts.: 1.3 km S & 2.3 km E Mt. Hunstein summit, 4.5226°S, 142.6748°E, 1000 m asl. 26 September – 2 October 1989. A. Allison. BPBM 16590–96; WEST SEPIK PROV.: Bewani Mts.: vicinity Trefas Village, 5.9 km N & 7.3 km E Utai, 3.333°S, 141.651°E, 320 m asl. 2 October 1986. A. Allison. BPBM 14382; Koske Creek, 4 km W Utai aerodrome, 3.393°S, 141.552°E, 210 m asl. 29 October 1986. A. Allison. BPBM 14383; Agpo Creek, 8.5 km N & 14 km E of Utai, 3.309°S, 141.709°E, 1200 m asl. 22 October 1986. A. Allison. BPBM 14384; 2 km W Utai Aerodrome, 3.391°S, 141.564°E, 210 m asl. 28 October 1986. A. Allison. BPBM 14392; Torricelli Mts.: 3.2 km SSE Mt. Sapau summit, 3.3933°S, 142.5283°E, 550 m asl. 20–25 May 2005. F. Kraus. BPBM 22690–701, 22706. First country records and range extensions of 760 km, 600 km, and 690 km, respectively, to the SSE of Yapen Island (Günther 2003b).

Lechriodus melanopyga. WEST SEPIK PROV.: Bewani Mts.: 2 km W Utai Aerodrome, 3.391°S, 141.564°E, 210 m asl. 28–30 October 1986. A. Allison. BPBM 14431–32; Utai Aerodrome, 3.389°S, 141.585°E, 210 m asl. 12 September 1986. A. Allison. BPBM 14433. Fills in 550 km range gap between Jayapura and Adelbert Mts. (Zweifel 1972b).

Lechriodus platyceps. WEST SEPIK PROV.: Bewani Mts.: Agpo Creek, 8.5 km N & 14 km E of Utai, 3.309°S, 141.709°E, 1200 m asl. 15–17 October 1986. A. Allison & A. Engilis, Jr. & A. Yaiko. BPBM 14434, 14438–39; Mt. Menawa, 9.4 km N & 14.1 km E of Utai, 3.302°S, 141.712°E, 1500 m asl. 7–16 October 1986. A. Engilis, Jr. & A. Yaiko. BPBM 14435, 14442–43; Mt. Menawa, 9.6 km N &14.2 km E of Utai, 3.301°S, 141.713°E, 1600 m asl. 15–21 October 1986. A. Allison, A. Engilis, Jr. & A. Yaiko. BPBM 14436, 14440; Mt. Menawa, 9.8 km N & 14.4 km E of Utai, 3.3°S, 141.714°E, 1700 m asl. 18 October 1986. A. Allison. BPBM 14437. First records for country and range extension of ~320 km to the E of Idenburg River (Zweifel 1972b).

Limnonectes grunniens. WEST SEPIK PROV.: Bewani Mts.: Koske Creek, 4 km W Utai aerodrome, 3.393°S, 141.552°E, 220 m asl. 30 October 1986. Native collector. BPBM 13406. First report from N of the Sepik River and range extension of ~90 km from nearest locality to the S (Menzies 1987).

Liophryne schlaginhaufeni. WEST SEPIK PROV.: Bewani Mts.: Agpo Creek, 8.5 km N & 14 km E of Utai, 3.309°S, 141.709°E, 1200 m asl. 1–22 October 1986. A. Allison, A. Engilis, Jr. & A. Yaiko. BPBM 14444, 14446, 14448, 14451, 14453, 16563; Agpo Creek, 8.5 km N & 13 km E of Utai, 3.312°S, 141.7°E, 950 m asl. 26–30 September 1986. A. Allison. BPBM 14445, 14447, 14449–50, 14454. Range extension of 80 km W of nearest locality at Mt. Nibo, Torricelli Mts. (Zweifel 2000).

Litoria exophthalmia. EAST SEPIK PROV.: Hunstein Mts.: Hunstein River, 8.7 km N & 9.8 km E summit Mt. Hunstein, 4.4321°S, 142.7414°E, 75 m asl. 16–17 September 1989. A. Allison. BPBM 16623–35; GULF PROV.: Kakoro, 7.846°S, 146.523°E, 70 m asl. 20 July 1982. A. Allison. BPBM 21533–38. New provincial records and range extensions of ~370 km to the NW and

~200 km to the SE, respectively, of only previously reported locality at Crater Mt., Chimbu Prov. (Tyler et al. 1986).

Litoria genimaculata. WEST SEPIK PROV.: Torricelli Mts.: 3.2 km SSE Mt. Sapau summit, 3.3933°S, 142.5283°E, 550 m asl. 18–24 May 2005. F. Kraus. BPBM 23223–42. First record for any north coast range (Menzies 1975; Tyler 1968).

Litoria iris. EAST SEPIK PROV.: Hunstein Mts.: 1.3 km. S & 2.3 km E Mt. Hunstein summit, 4.5226°S, 142.6748°E, 1000 m asl. 25 September–2 October 1989. A. Allison. BPBM 23505–06, 23508–11. First record for province and N of Central Dividing Range (Menzies 1993).

Litoria leucova. EAST SEPIK PROV.: Hunstein Mts.: 1.3 km S & 2.3 km E Mt. Hunstein summit, 4.5226°S, 142.6748°E, 1000 m asl. 2 October 1989. A. Allison. BPBM 23515–16. First provincial record and range extension 100 km NE of nearest locality in West Sepik Prov. (Johnston and Richards 1994).

Litoria micromembrana. EAST SEPIK PROV.: Hunstein Mts.: 1.3 km S & 2.3 km E Mt. Hunstein summit, 4.5226°S, 142.6748°E, 1000 m asl. 26 September–2 October 1989. A. Allison. BPBM 23507, 23512; CENTRAL PROV.: W flank Mt. Obree, 9.4606°S, 148.0282°E, 1800–2040 m asl. 4–7 February 2004. F. Kraus. BPBM 19250, 19378–80, 19383; 9.4601°S, 148.0304°E, 1800–2040 m asl. 4–7 February 2004. F. Kraus. BPBM 19252–53, 19381–82. First records for each province and each mountain range; East Sepik Province record extends range 130 km NE of known population at Telefomin; Central Province record extends range 420 km SE of record at Okapa (Tyler 1968).

Litoria modica. CENTRAL PROV.: 1.2 km E Woitape, 8.4568°S, 147.2620°E, 1620 m asl. 2 October 2003. F. Kraus. BPBM 18496; EAST SEPIK PROV.: Hunstein Mts.: 1.3 km S & 2.3 km E Mt. Hunstein summit, 4.5226°S, 142.6748°E, 1000 m asl. 30 September–2 October 1989. A. Allison. BPBM 23486–503; MOROBE PROV.: Along Dunch River 5.6 km NW summit Mt. Shungol, 6.8162°S, 146.6915°E, 750 m asl. 18 October 2003. F. Kraus. BPBM 18497–500; 5.35 km NW summit Mt. Shungol, 6.8188°S, 146.6933°E, 780 m asl. 21 October 2003. F. Kraus. BPBM 18501–02; WEST SEPIK PROV.: Bewani Mts.: Agpo Creek, 8.5 km N & 13 km E of Utai, 3.312°S, 141.7°E, 950 m asl. 20–27 September 1986. A. Allison. BPBM 14757–64, 14766–69; Agpo Creek, 8.5 km N &14 km E of Utai, 3.309°S, 141.709°E, 1135 m asl. 27 September 1986. A. Allison. BPBM 14765; Torricelli Mts.: 1.6 km SSW Mt. Sapau summit, 3.3807°S, 142.5155°E. 1050 m asl. 25 May 2005. F. Kraus. BPBM 23245. First records for each province and each mountain range (Tyler 1968; Global Amphibian Assessment 2006); Central Prov. record fills in a ~520 km gap between Central Dividing Range and southern end of Owen Stanley Mts. (Kraus and Allison 2004).

Litoria wollastoni. WEST SEPIK PROV.: Torricelli Mts.: 3.2 km SSE Mt. Sapau summit, 3.3933°S, 142.5283°E, 550 m asl. 20–24 May 2005. F. Kraus. BPBM 23222, 23246–48; 1.6 km SSW Mt. Sapau summit, 3.3807°S, 142.5155°E. 1050 m asl. 25–26 May 2005. Native collectors. BPBM 23249–50. First records for province and N of Central Dividing Range (Menzies and Zweifel 1974).

Nyctimystes pulchra. EAST SEPIK PROV.: Hunstein Mts.: 1.3 km S & 2.3 km E Mt. Hunstein summit, 4.5226°S, 142.6748°E, 1000 m asl. 5 October 1989. A. Allison. BPBM 17368; WEST SEPIK PROV.: Bewani Mts.: Agpo Creek, 8.5 km N & 13 km E of Utai, 3.312°S, 141.7°E, 950 m asl. 27 September 1986. A. Allison. BPBM 17369–70; vicinity Trefas Village, 5.9 km N & 7.3 km E Utai, 3.333°S, 141.651°E, 340 m asl. 24–25 October 1986. A. Allison. BPBM 17371–72. First records for each mountain range and first record for East Sepik Province; previously only reported from Torricelli Mts. and Huon Peninsula among the north coast ranges (Menzies 1975; Zweifel 1958).

Oreophryne biroi. WEST SEPIK PROV.: Bewani Mts.: vicinity Trefas Village, 5.9 km N & 7.3 km E Utai, 3.333°S, 141.651°E, 320 m asl. 2 October 1986. A. Allison. BPBM 14509–11. Fills in 200 km gap in range between Cyclops Mts. and Torricelli Mts. (Zweifel et al. 2003).

Oreophryne parkeri. WEST SEPIK PROV.: Bewani Mts.: vicinity Trefas Village, 5.9 km N & 7.3 km E Utai, 3.333°S, 141.651°E, 340 m asl. 24 October 1986. A. Allison. BPBM 23475–76; Torricelli Mts.: Parkop, 6.5 km S Mt. Sapau summit, 3.4246°S, 142.5187°E, 416 m asl. 14–15 May 2005. F. Kraus. BPBM 22781–84; 3.2 km SSE Mt. Sapau summit, 3.3933°S, 142.5283°E, 550 m asl. 18 May 2005. F. Kraus. BPBM 22785. Records fill in ~300 km gap between only two prior localities at Sentani, Papua Prov., and Matapau, West Sepik Prov. (Zweifel et al. 2003).

Platymantis cheesmanae. WEST SEPIK PROV.: Bewani Mts.: 2 km W Utai Aerodrome, 3.391°S, 141.564°E, 210 m asl. 28 October 1986. A. Allison. BPBM 12216–18. First record for country and range extension of 180 km E from only known locality in Cyclops Mts. (Zweifel 1969).

Rana jimiensis. WEST SEPIK PROV.: Torricelli Mts.: Parkop, 6.5 km S Mt. Sapau summit, 3.4246°S, 142.5187°E, 416 m asl. 14 May 2005. Native collector. BPBM 22831; 3.2 km SSE Mt. Sapau summit, 3.3933°S, 142.5283°E, 550 m asl. 18–28 May 2005. Native collectors. BPBM 22832–37, 22842; 1.6 km SSW Mt. Sapau summit, 3.3807°S, 142.5155°E. 1050 m asl. 25–26 May 2005. Native collectors. BPBM 22838–41. First records for north coast ranges and range extension of ~220 km NE of nearest reported locality near headwaters of Sepik River (Menzies 1987).

Rana volkerjane. WEST SEPIK PROV.: Bewani Mts.: Utai Aerodrome, 3.389°S, 141.585°E, 210 m asl. 12 September 1986. A. Allison. BPBM 13360; vicinity Trefas Village, 5.9 km N & 7.3 km E Utai, 3.333°S, 141.651°E, 320–340 m asl. 18 September – 24 October 1986. A. Allison. BPBM 13362–64, 13366, 13368–80, 13394–98, 13401; Menawa River, 8.4 km N & 11.4 km E of Utai, 3.312°S, 141.688°E, 560 m asl. 24 September 1986. A. Allison. BPBM 13391; Koske Creek, 4 km W Utai aerodrome, 3.393°S, 141.552°E, 220 m asl. 29 October 1986. A. Allison. BPBM 13404; Torricelli Mts.: Parkop, 6.5 km S Mt. Sapau summit, 3.4246°S, 142.5187°E, 416 m asl. 12–16 May 2005. Native collectors. BPBM 22810–15; 3.2 km SSE Mt. Sapau summit, 3.3933°S, 142.5283°E, 550 m asl. 18–23 May 2005. Native collectors. BPBM 22816–27; 1.6 km SSW Mt. Sapau summit, 3.3807°S, 142.5155°E. 1050 m asl. 25–26 May 2005. Native collector. BPBM 22828. First records for country and range extensions of 780 and 860 km, respectively, to the E of Wondiwoi Mts. (Günther 2003c).

Xenobatrachus tumulus. WEST SEPIK PROV.: Bewani Mts.: 2

km W Utai Aerodrome, 3.391ºS, 141.564ºE, 210 m asl. 28–29 October 1986. A. Allison. BPBM 14065–66; Torricelli Mts.: 3.2 km SSE Mt. Sapau summit, 3.3933ºS, 142.5283ºE, 550 m asl. 23 May 2005. Native collector. BPBM 22795. First records for province and range extensions of 450 km and 370 km, respectively, to the WNW from only known locality in Adelbert Mts. (Blum and Menzies 1988).

Xenorhina arboricola. WEST SEPIK PROV.: Torricelli Mts.: 1.6 km SSW Mt. Sapau summit, 3.3807ºS, 142.5155ºE, 1120 m asl. 27 May 2005. F. Kraus. BPBM 22796–97. Previously known only from Bewani Mts. and Hunstein Mts. ~130 km to the W and ~125 km to the SSE, respectively (Allison and Kraus 2000).

Lacertilia

Cyrtodactylus sermowaiensis. EAST SEPIK PROV.: Hunstein Mts.: Hunstein River, 8.7 km N & 9.8 km E summit Mt. Hunstein, 4.4321ºS, 142.7414ºE, 75 m asl. 18 September 1989. A. Allison. BPBM 17322. First record S of Sepik River and range extension of ~70 km to the SW of nearest locality north of that river (Bauer and Henle 1994).

Emoia irianensis. WEST SEPIK PROV.: Bewani Mts.: Agpo Creek, 8.5 km N & 14 km E of Utai, 3.309ºS, 141.709ºE, 1200 m asl. 29 September 1986. A. Allison. BPBM 13542; summit Mt. Menawa, 10.5 km N & 15.7 km E of Utai, 3.295ºS, 141.723ºE, 1920 m asl. 19–21 October 1986. A. Allison. BPBM 13544–51, 23062–63. First records for country and range extension of ~580 km to the ENE of the Wissel Lakes area (Brown 1991).

Emoia kordoana. EAST SEPIK PROV.: Hunstein Mts.: Hunstein River, 4.9 km N & 6.3 km E summit Mt. Hunstein, 4.4665ºS, 142.7108ºE, 100 m asl. 29 September 1989. A. Allison. BPBM 13478. First provincial record (Brown 1991).

Emoia oribata. EAST SEPIK PROV.: Hunstein Mts.: 0.7 km S & 6.3 km E summit Mt. Hunstein, 4.5181ºS, 142.7108ºE, 900 m asl. 24 September 1989. A. Allison. BPBM 13476; 1.3 km S & 2.3 km E Mt. Hunstein summit, 4.5226ºS, 142.6748ºE, 1000 m asl. 5 October 1989. A. Allison. BPBM 13477; WEST SEPIK PROV.: Bewani Mts.: vicinity Trefas Village, 5.9 km N & 7.3 km E Utai, 3.333ºS, 141.651ºE, 340 m asl. 23 October 1986. A. Allison. BPBM 13555. Hunstein records are first provincial records [Brown (1991) erroneously lists the Frieda River specimens BPBM 10590–93 as East Sepik Prov.; in actuality, they are just S of the border in West Sepik Prov.] and range extension of 100 km to the E of Frieda River; Bewani record is a range extension of 130 km to the N of Frieda River locality.

Emoia popei. EAST SEPIK PROV.: Hunstein Mts.: Hunstein River, 4.9 km N & 6.3 km E summit Mt. Hunstein, 4.4665ºS, 142.7108ºE, 100 m asl. 23 September 1989. A. Allison. BPBM 13471. Range extension of 180 km to the SSW from prior westernmost record at Marienberg (Brown 1991).

Gehyra oceanica. WEST SEPIK PROV.: Torricelli Mts.: Parkop, 6.5 km S Mt. Sapau summit, 3.4246ºS, 142.5187ºE, 416 m asl. 14 May 2005. Native collector. BPBM 23348; Sibilanga, 3.4488ºS, 142.4982ºE, 720 m asl. 31 May 2005. Native collector. BPBM 23349. Fills in ~670 km range gap between Jayapura and Madang (Bauer and Henle 1994).

Lipinia cheesmanae. EAST SEPIK PROV.: Hunstein Mts.: 1.3 km S & 2.3 km E Mt. Hunstein summit, 4.5226ºS, 142.6748°E, 1000 m asl. 26 September 1989. A. Allison. BPBM 12660. First record for country and range extension of 325 km E from the nearest known locality in Cyclops Mts. (Günther 2000).

Varanus doreanus. EAST SEPIK PROV.: Hunstein Mts.: 1.3 km S & 2.3 km E Mt. Hunstein summit, 4.5226ºS, 142.6748°E, 1000 m asl. 30 September 1989. A. Allison. BPBM 21464. First record for province and fills in ~1100 km range gap between Biak Island, Papua Prov., and Madang, Madang Prov. (Böhme et al. 1994).

Varanus jobiensis. EAST SEPIK PROV.: Hunstein Mts.: Hunstein River, 4.9 km N & 6.3 km E summit Mt. Hunstein, 4.4665ºS, 142.7108ºE, 100 m asl. 21–23 September 1989. A. Allison. BPBM 21462–63; WEST SEPIK PROV.: Bewani Mts.: vicinity Utai, 3.389ºS, 141.585ºE, 210 m asl. 14 September 1986. A. Allison. BPBM 23157. First records for each mountain range, first record for West Sepik Province, and each fills in ~800 km range gap between Marienburg, East Sepik Prov., and Yapen Island, Papua Prov. (Böhme et al. 1994).

Serpentes

Tropidonophis mcdowelli. EAST SEPIK PROV.: Hunstein Mts.: 1.3 km S & 2.3 km E Mt. Hunstein summit, 4.5226ºS, 142.6748°E, 1000 m asl. 5 October 1989. A. Allison. BPBM 18218. First record for province and range extension of 120 km to the SE of Mt. Nibo, Torricelli Mts. (Malnate and Underwood 1988).

Ramphotyphlops erycinus. WEST SEPIK PROV.: Torricelli Mts.: 3.2 km SSE Mt. Sapau summit, 3.3933ºS, 142.5283ºE, 550 m asl. 24–28 May 2005. F. Kraus. BPBM 23457–58. First record for province and fills in 730 km range gap between Toem, Papua Prov., and Awar, Madang Prov. (McDowell 1974).

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BOOK REVIEWS

Herpetological Review, 2006, 37(3), 368–373.

Giant Tortoises of the Indian Ocean. The Genus *Dipsochelys* Inhabiting the Seychelles Islands and the Extinct Giants of Madagascar and the Mascarenes, by Justin Gerlach. 2004. Edition Chimaira, Frankfurt am Main (www.chimaira.de), distributed in the USA by Zoo Book Sales, Lanesboro, Minnesota (www.zoobooksales.com). 207 pp. US $49.95. ISBN 3–930612–63–1.

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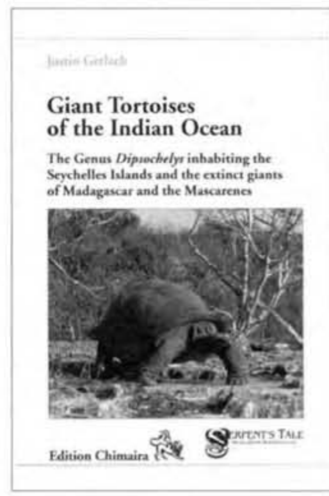

There is a rich, centuries-old tradition of natural history books by gentleman naturalists; and tomes on turtles and tortoises are particularly noteworthy in this genre. The volume under review, an extension of this custom, is attractively presented, with glossy paper, tight binding, and 188 figures, most of which are in color. Its eight chapters are: Introduction; Identification of the Indian Ocean giant tortoises and theories of their evolution; The morphology of giant tortoises; Taxonomy; Ecology; The discovery of Indian Ocean giant tortoises and their history; Conservation; and Bibliography. An enormous amount of historic, factual, theoretical, hypothetical, and speculative information is summarized in the book, presented together with a wealth of old, difficult-to-find text and photos. There is a table of contents, but no list of tables or figures, or even a general index—usual components for any scholarly tome as large and complex as this. And this raises a fundamental question: what is the objective of this publication? Will serious students—seeking much-needed scholarly treatment of Indian Ocean giant tortoises, with organized, up-to-date summaries and syntheses—find that it meets their needs and expectations? Or, is its cache of color photos and attractive presentation designed for an active hobbyist market, less concerned about seemingly pedantic details of the scientific debates, hypothesis testing, and the International Code of Zoological Nomenclature?

The book has an uneasy mix of styles, ranging from general, simplified stories of natural history to curt accounts of highly specialized analytical processes and terms—often with no explanation, background, or context for understanding the information presented or the issue under discussion. Numerous comments, claims, and arguments throughout the book raise basic concerns and distract from an easy read. Surely many of these contentious points of substance (not to mention the miscellaneous details of form including punctuation, grammar, redundancies, inconsisten-

cies, self-contradictions, incomplete citations and so on) could have been polished or mitigated had usual peer and editorial review processes been employed.[i] Only a sample of notable points is discussed herein.

The introduction sets the style for the volume; its three-and-a-half pages of text are accompanied by copious figures: in this case, ten, eight of which are in color. We are told that despite several in-depth works on the Galápagos tortoises, "their taxonomy remains highly confused" (p. 10). Yet, in treating the subject of the book, the Indian Ocean tortoises, the author simply states that there are two genera: "*Dipsochelys*" from the Madagascar to Seychelles, and *Cylindraspis* on the volcanic Mascarene islands. There is no mention in the introduction that the first name is promoted steadfastly by the author, despite its rejection in numerous peer-reviewed, scholarly studies by specialists knowledgeable of the taxonomic and nomenclatural issues (e.g., Crumly 1986; Pritchard 1986:532; Meylan and Auffenberg 1987:74; King and Burke 1989:70; Iverson 1992:249; Austin and Arnold 2001; Austin et al. 2002, 2003). These, and other, authors have argued, for decades, that the generic term *Aldabrachelys* is available and senior to "*Dipsochelys*," coined in 1982 by Roger Bour. Not only is "*Dipsochelys*" not widely used, especially in the scientific literature, but recently Bour has been co-author of peer-reviewed papers that employed the more usual *Aldabrachelys* (see Austin et al. 2002, 2003).

Near the end of the Introduction, the author states (p. 14) that "there are no external features which distinguish the three groups" [Galápagos, Mascarene, and Seychelles]—a claim with tremendous implications that is soon contradicted. Figures in the Introduction provide excellent images of heads of Aldabra, Mascarene, and Galápagos giant tortoises, clearly illustrating differences in head shape that many tortoise enthusiasts use to differentiate these three clades, and a distinguishing feature that has been well known for over a century (e.g., Gray 1872:3–4). In addition to several prominent personalities recognized by the author, other illustrations include a "phylogeny of recent tortoises" and a "world map of living and extinct giant tortoise distribution." It is remarkable that although several recent scientific studies directly applicable to questions of phylogeny are relatively easy to obtain (see below), the scheme proposed in this book is based on an unpublished thesis and one of three (which one is not identified) 2001 publications by the author that appeared in *Phelsuma*.[ii] The world map will disappoint tortoise aficionados who marvel at the gigantic size of living continental forms such as *Geochelone* [*Chelonoidis*] *denticulata* from northern South America (Pritchard 1986), *Geochelone* [*Centrochelys*] *sulcata* from northern Africa, and *Manouria emys* from Southeast Asia, not to mention scores of extinct gigantic forms (e.g., Auffenberg 1974) whose representation would have populated much of the apparently blank areas on the map. The closing of the Introduction states that "[i]n all cases the original literature has been tracked down to determine the real facts and separate them from the all too frequent myths that these animals seem to inspire." It is no mean feat to separate "real facts" from myths, especially when a writer is passionate about his topic.

Chapter Two, on identification and theories of evolution, begins with a candid appraisal of the problems: 18th and 19th century specimens without accurate localities; dubious original descriptions; confused type specimens, many described after having been transported from native lands; early diagnoses based on highly variable features and small sample sizes (commonly, just one specimen); and the less than careful use of taxonomic names. The summary of the intriguing early history of naming Indian Ocean tortoises is useful, and here the author explains some of the confusion and chaos in which the names of these chelonians are enmeshed. Curiously, he presents Schweigger's 1812 description for *T. gigantea* in French as if this were the original, and then gives an English translation. Schweigger (1812), as was common at that period, wrote in Latin (see also Duméril and Bibron 1834:416; Crumly 1986:238; Pritchard, 1986:522), but apparently Gerlach used Bour's (1984a:163) French translation, without explaining his source.

More importantly, a debatable logic is used in deciding which taxonomic names to reject and which to employ. The confusion regarding the generic name was mentioned above; the contention regarding the correct species appellation is more acute. A name that has been in regular usage for more than a century in hundreds of scientific publications about Aldabra tortoises—Schweiger's 1812 *Testudo gigantea* (Frazier 2006)—is rejected and replaced with Gray's 1831 *T. dussumieri*. But, this last name was clearly used by Gray (1831a:3, 1831b:9) only as a synonym to *T. indica*; and, hence, it is unavailable if one follows the International Code of Zoological Nomenclature (Art. 11.6; Frazier, *in prep.*). Moreover, another name, applied to a specimen of unknown origin, and with a transport history and final fate that reads like an adventure book, a name essentially forgotten for more than a century—*Testudo hololissa*—is recognized as a separate species. This is applied to specimens for which all available genetic information indicates that they are indistinguishable from the Aldabra tortoise (Palkovacs et al. 2002, 2003; Austin et al. 2003; Karanth et al. 2005; Noble, *in litt.* 10 August 2005).

Statements about ***results*** from studies of molecular genetics are generally consistent with the publications cited, but numerous matter-of-fact ***interpretations*** are subject to debate. The root of the dilemma lies with the author's conviction that since 1995 he has rediscovered at least two, near-extinct species of giant tortoises in the Seychelles, claims that have been made primarily in hobbyist and proprietary magazines (Gerlach and Canning 1995a,1995b, 1996:33, 1998a, 1998b:134; Gerlach 1997a:28, 1997b:71 ff., 1998a:31 ff., 1998b:4, 1999a:58, 1999b:9, 1999c:34, 1999d:496, 2001a:12, 2001b:127, 2002, 2003a:57, 2003b:8, 2005:938). These assertions have been substantiated by authoritative statements about proof of genetic differences between these so-called distinct species (Gerlach 1997a:28, 1997b:71 ff., 1998b:6, 2003a:59; Gerlach and Canning 1998b:134), allegations that were based on Les Noble's unpublished results of RAPDs research. However, these claims are inconsistent with what was found by the geneticist who did the work (Noble, *in litt.* 10 Aug. 2005, 24 Aug. 2005). Hence, it is refreshing that in his book Gerlach at last admits (p. 37) that "[r]ecent molecular analyses (Austin & Arnold 200 [sic.]; Austin et al. 2003; Palkovacs et al. 2002, 2003) have failed to locate any genetic differences between the living taxa or any genetic structuring of wild populations on Aldabra."

However, he goes on to contend (p. 37) that despite these recent, peer-reviewed publications that ***expressly*** investigated the question of specific differentiation "species differences are found in other molecular data." This bold claim is based on Cunningham's (2002) unpublished thesis which studied the cytochrome *b* gene (Cyt *b*) and the little-investigated nicotinamide adenine dinucle-

otide dehydrogenase subunit 4 gene (ND4). Her principal aim and methods were to "elucidate the inter-generic relationships among extant tortoises using two mitochondrial gene fragments"—***not*** to investigate species differences. She found no differences between individual Aldabra/Seychelles tortoises at the Cyt *b* site; and at the ND4 site the difference was "a maximum of 8bp [base pairs] in total and usually zero;" and it was unclear how to interpret this low level of differentiation, or indeed if it was due to artifacts (*in litt.* 3 August 2005). Hence, the author herself is not convinced that the molecular data alone support species differences in the six Aldabra/Seychelles tortoises that were sampled (*in litt.* 3 Aug. 2005, 7 Feb. 2006).

To explain the lack of genetic differences Gerlach (p. 30) argues that "*Dipsochelys* taxa are morphologically distinctive but appear to have diverged too recently to be fully reflected in the available molecular data." In his book he speculates that the granitic Seychelles were "colonized from Aldabra 15,000 years ago" (p. 39; in other publications he set the date at 18,000 years ago [Gerlach 2003a:58; Gerlach and Bour 2003:15]). He speculates even further that "[s]mall genetic changes within the last 3–7,000 years" may have given rise to the distinct species that he claims to have rediscovered. This possibility cannot be entirely ruled out, but given the available information on giant tortoises as well as other organisms, it is exceedingly unlikely.

Rather than employ the genetic research to test his hypotheses about morphological differences, the author decides that morphological differences are determinant, and he discounts widely held concerns about the remarkable intra-specific variability and plasticity of shell form, shape, and size. The earlier assertion in the book's introduction, that external features cannot be used to distinguish the three geographically separated clades of giant tortoises (Galápagos, Mascarenes, and Madagascar/Seychelles), taxa that are widely agreed upon, becomes even more noteworthy; for now we are told that external features can be used to distinguish species that are not generally accepted! Information derived from less-than obvious processes (like plots of eigenvectors) is presented with the scantiest of explanations (not to mention sample sizes that are inconsistent between text and legends; e.g., tables 1–2, figs. 13–14). Yet, these procedures (often based on debatable assumptions) form the basis for the author's selection of the species and names to be recognized. As has been pointed out elsewhere (Bour 2004), there are significant inconsistencies in the various hypothetical phylogenetic schemes presented (figs. 9, 36, 38).

The many details on morphology presented in the third chapter, particularly the comparative illustrations of various bony elements (figs. 44, 46–50), would have been considerably more valuable had they been accompanied by explanations not only of how the measurements were taken, but also the provenance, sex, size, etc. of the specimens measured and illustrated. Most hobbyists know that the size, shape, and relative proportions of a tortoise can be distorted—sometimes greatly—when it lives under certain conditions. Despite statements about allometric and isometric growth (pp. 41–45), much more information and analysis than is provided in the book is required to evaluate and understand these phenomena in the tortoises. Shapes and patterns of neural bones are notoriously variable in many chelonians (Pritchard 1988), so generalities about these features (p. 45) must be taken with great care, particularly when only small samples (e.g., two specimens per taxon) are available. Likewise, generalities about cranial morphology (p. 46), and suggestions about some tortoises having a "grinding action" during mastication—particularly when specimens are incomplete (and the samples on which the study is based are not explained)—need to be evaluated with caution. How much Crumly's (1982) seminal study of tortoise crania contributed to the book's description of giant tortoise skulls is not explained. Generalities about bony elements, and processes involved in their ontogeny, that are based on unspecified specimens, and evidently small numbers of specimens for species whose existence is not widely accepted in scholarly circles, must be considered with caution. In contrast to the lengthy details on bony elements to which the majority of the chapter on morphology is dedicated, the sections on skin, digestive system, penis, and heart are remarkably short and abbreviated. The intriguing question of gigantism is left to a couple of paragraphs.

The chapter on taxonomy occupies a quarter of the book. It begins with a reproduction of the fascinating cover from *The Illustrated London News* (ILN) of 5 July 1875, which shows two giant tortoises from the Seychelles. In his legend to this figure, the author determines that one of these tortoises was a female of one species and the other, a male of another species—a feat few people would attempt on the basis of just this old wood engraving.[iii] He lists six species in the genus "*Dipsochelys*," two of which are extinct species known from Madagascar. In addition to the Aldabra tortoise, called "*Dipsochelys dussumieri*" by the author, three other "species" are listed for the granitic Seychelles islands, of which he suggests one may be extinct. Additionally, five species of *Cylindraspis* are listed, this group being native to the Mascarene Islands. It is incredible that the binomial used most commonly in the hobbyist, and also scientific, publications for nearly fifty years to refer to the Aldabra giant tortoise—*Geochelone gigantea*—appears only a few times in the book, and is totally absent from the synonymy that is proposed (p. 67). This, and synonymies for other supposed species, is likely to greatly confuse the understanding of tortoise nomenclature and taxonomy.

The photographs of rarely seen type specimens are valuable, and a wealth of information is provided in the species synopses. However, it is bewildering that the nomenclature and taxonomy used in the book contradicts what has been used after careful research published recently in mainstream scientific journals (e.g., Austin and Arnold 2001; Palkovacs et al. 2002, 2003; Austin et al. 2002, 2003; Karanth et al. 2005)—even more so in that the author of the book is also a co-author on three of these peer-reviewed papers. Moreover, Roger Bour, an earlier proponent of resurrecting various names in disuse, and also author of the new name "*Dipsochelys arnoldi*" (Bour 1982) is a co-author of a recent study that concludes that only one species, *gigantea*, exists and has existed on Aldabra and the Seychelles (see Austin et al. 2003). Since the writings on giant tortoises by the early herpetological giants of the 18th, 19th and early 20th century, there has been a general realization that although species may be typified by certain external characteristics, there is still considerable intra-specific variability in skeletal, soft tissue, ecological, and behavioral characteristics (e.g., Rothschild 1915:428). In numerous parts of Gerlach's book, this general biological notion of the importance of intra-specific variability does not seem to be accepted. Indeed, as colleagues familiar with his work have observed, the author's rejec-

tion of recent findings from mainstream scientific research, even those with which he has collaborated as a co-author (e.g., Palkovacs et al. 2002, 2003; Karanth et al. 2005), suggests he has little faith in the scientific method, at least when the results contradict his conviction that he has rediscovered and saved the last remnants of two species of Seychelles tortoise (Gerlach 1998b).[iv]

While the tortoises of the Mascarenes are not the main subject matter of the book,[v] it is important to point out several anomalies. The claim that each of the three major Mascarene islands (Mauritius, Réunion, and Rodrigues) had two sympatric species of giant tortoises (p. 36, fig. 38) is a *faux pas* (that is corrected later on in the book). It contradicts recent scholarly research (Austin and Arnold 2001; Austin et al. 2002), which confirms two pairs of sympatric species, one on Mauritius and one on Rodrigues with but a single species on Réunion. The nomenclature and "phylogenetic scheme" presented for these animals (pp. 38, 99 ff.) are also at variance with recent studies published by various scholars in widely available professional journals (e.g., Austin and Arnold 2001; Austin et al. 2002). In the last named study, Roger Bour, author of *Cylindraspis borbonica* (1978), has accepted that his name is a junior synonym for *C. indica* Schneider, 1783, the extinct tortoise from Réunion. Yet, Gerlach's book lists only *C. borbonica* for the Réunion tortoise (p. 99), with no explanation of the other (older and available) names that have been applied (see Austin et al. 2002:284).

In summarizing the nomenclatural complexities involving giant tortoises, Bour (1984b:282–283) concluded that "[t]he peak of entanglement appeared with the publication of Lord Rothschild's (1915) work. But we willingly admit that this enthusiast did good both as a protectionist and popularizer." Perhaps he misjudged recent events. In the end, an enormous amount of time and effort has gone into debating what names to use for the giant tortoises of the Indian Ocean, a dubious situation this book will help sustain. "If all the time we all spend worrying about tortoise names were spent investigating their biology, they would be a very well studied group!" (Arnold *in litt.* 24 August 2005).

The chapter on ecology brings together much of the unique field work done on Aldabra Atoll over several decades, and the author rightly emphasizes the main limiting factors for tortoises on the Atoll: water, food, and shade. Yet, this chapter could be stronger. The narrative about shallow pools influenced by tidal ebb and flow (p. 119) confuses different types of phenomena affecting very different types of water bodies. Activity patterns of tortoises, at least on Aldabra and Curieuse, vary with size and sex of the animal, as well as with environmental conditions (Frazier 1972; Hambler 1994), so it is not clear how to interpret the book's generalized activity graphs—with no explanation of the individuals and conditions sampled (figs. 125–126; republished in Gerlach 2005). Thus, reported "differences in thermoregulatory behaviour between the three species of *Dipsochelys* giant tortoise" could be easily explained by differences in tortoise sizes and/or environmental conditions (e.g., Frazier 1972; Hambler 1994), but since these details are not provided one can only guess. The claim that "[r]egular basking behaviour has been observed in *D. arnoldi* only" contradicts extensive observations of giant tortoises on Aldabra (where the occurrence of "*Dipsochelys arnoldi*" has yet to be affirmed), and elsewhere, over periods of differing climatic conditions, where "basking" does occur, although not commonly. The descriptions of feeding are useful, although not without deficiencies. If the extensive work on wild tortoises on Aldabra is considered, it is clear that generalities about diet vary from place to place, from season to season, and between individuals, especially between different size classes (e.g., Frazier 1972; Gibson and Hamilton 1983). Hence, Gerlach's claims about species-specific differences in feeding behaviors (p. 139) need to be viewed within the context of the tremendous variation that occurs on just Aldabra. His interpretation that males mounted on other males are exhibiting conflict behavior (p. 135) is novel, and may be a gentlemanly way to avoid revealing that the extremely high libido in some male tortoises can result in them mounting just about anything, with just about any orientation (Frazier 1972). The concepts of "asocial" and "antisocial" behaviors (p. 135) are, despite the author's implications, very different.

Observations that age at maturity and reproductive effort vary with population density (pp. 138–139, 143) are critical, for they show yet again how plastic the biological features of these animals can be, with remarkable variation in physiology, growth, behavior, and morphology—all within individuals from the same population. Photos presented in support of species-specific differences in hatchling giant tortoises (figs. 145–147) are misleading, for the individuals shown are of different ages and sizes; the photo labeled as "*Dipsochelys arnoldi*" is comparable to some recently emerged hatchlings on Aldabra. Generalities about tortoises spending the first four years of their lives living in rock crevices (p. 147), while fascinating, do not tally with observations on Aldabra, nor with the fact that some of the areas on the Atoll with the highest density of tortoises are characterized by a pavement type of limestone, with a paucity of crevices (Grubb 1971). Speculation about rates of gene flow on Aldabra (p. 150, fig. 149) must be tempered with adequate studies; moreover, the displacement of animals in a dense population where successful reproduction is low is not the same as gene flow. Besides a number of points that are debatable, the order of ideas in this chapter is not always easy to follow.

As Bour (2004) explained, the chapter on history of giant tortoise discovery would seem more appropriate at the beginning of the book. In addition to the publications that Bour (2004) listed as missing from the historic treatment, a number of others could be added, including North-Coombes' (1991) intriguing account of early records from Rodrigues. Much of the historic information presented on the Seychelles seems to have come from Fauvel's (1909) impressive compilation of unpublished historic documents, although this detail is not mentioned in the book. The speculations about two sympatric tortoise species on the island of Mahé at the time of European discovery (pp. 162–163) are apparently supported primarily by the authors' intense conviction that he has rediscovered at least two species thought to have been extinct. The map depicting giant tortoise localities on Madagascar (fig. 157) is apparently, like several other parts of the book, based on the extensive research by Roger Bour. Unfortunately, it omits the northwestern localities (see Bour 1985: map 2, 1994:173, fig. 3), those that may be critical for explaining colonizations by these highly specialized tortoises onto the islands to the north (Austin et al. 2003).

The penultimate chapter on conservation is short, as Bour (2004) has pointed out. That captive rearing dominates its nine-and-a-

half pages, with enormous detail paid to tortoises in captive conditions, clearly shows the author's priorities. Yet, Gerlach himself admits that the long history of captive breeding has "played little part in conservation of Indian Ocean giants" (p. 179).

The final section, bibliography, brings together a useful compilation of sources of information on Indian Ocean giant tortoises from hobbyist magazines, unpublished theses and reports, old and hard-to-find writings, and also from the mainstream academic literature. The fact that several valuable publications were not included (Bour 2004) is not surprising given the vastness of the subject. Nonetheless, if the extensive scientific work done on Aldabra is to be considered, a number of scholarly publications would need to be included in a bibliography of Indian Ocean giant tortoises.

The bountiful color photos in the penultimate chapter, and throughout the book, are very effective in showing the beauty of the Seychelles and its wildlife, as well as providing an alluring travelogue style. Speculations on the origin and evolution of tortoises in the western Indian Ocean as well as other topics provide plenteous themes for years of careful research to test and tease apart the various assumptions and scenarios. Yet, assertions throughout the book, ranging from the stories of certain tectonic movements to variability in chromosomal base pairs, need to be evaluated on the basis of the best available information, not the author's passionate views regarding the creation of these captivating reptiles.

News that new species have been discovered, or "rediscovered," is routinely met with great interest. When combined with the need to save the animals from extinction, the topic takes on great public appeal, garnering support from diverse sectors, particularly the very dynamic community of tortoise breeders and hobbyists (e.g., Bruckers 1998; Devaux 1999), and often involving international celebrities, such as, in this case, Sir David Attenborough (Gerlach 2002). At one level there is an undeniable charm in being able to rediscover lost species and save them from extinction. However, the unrelenting insistence throughout the book to promote the existence of various living species of giant tortoise in the Seychelles flies in the face of diverse sources of scientific evidence and distracts from those contributions that the volume could make. Some conservationists in these incredible islands have pleaded for leaving the tortoises alone and getting on with other, more pressing priorities (Shah 2003).

As a continuation in the long line of popular literature on chelonians, this book is sure to be well-liked among the large, active community of herpetological enthusiasts,[vi] particularly tortoise aficionados. It may not fare so well in the scholarly community, where there is, early or late, a requirement for rigorous defense of claims and theoretical constructs, the clear separation of factual information from speculation, and theoretical discussion based on sources that have survived some form of academic review and critique. The book does make contributions, but tortoise students struggling to apply the scientific method may yet have to wait for that much-needed synopsis of Indian Ocean tortoises.

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Notes

[i] Several researchers have expressed similar concerns about other publications by the same author on subjects including birds, tortoises, terrapins, land snails, and plants of the Seychelles (e.g., Hambler 1997; Beaver, *in litt.* 8 August 2005; Mortimer, *in litt.* 31 July 2005; 26 Jan 2006).

[ii] *Phelsuma* is "the scientific journal of The Nature Protection Trust of Seychelles [NPTS]," an active NGO in the Seychelles established by Ron Gerlach, the author's artist father, and passionate conservationist who lives on the island of Silhouette, Seychelles (Devaux 1999:20). This serial has published 12 volumes and 147 articles since its inception in 1992, where J. Gerlach has a prodigious publishing record, with 34% of all articles authored either solely or jointly by him; his work load also includes the editorship of the journal (<http://members.aol.com/jstgerlach/phelsuma.htm>), as well as running the Indian Ocean Biodiversity Assessment (Gerlach 2004; <http://members.aol.com/jstgerlach/jg.htm>).

[iii] For information on 19th century illustrations in the ILN see http://www.ilnpictures.co.uk/showpage.asp?showdocumentid=192

[iv] The tortoises identified as "the last remaining individuals of two nearly extinct species" are popular attractions for tourists, some of whom take helicopter rides from the main island of Mahé to Silhouette to see the NPTS tortoise project and facilities (Devaux 1999:20). The NPTS also organizes tours to view the tortoises and terrapins of Seychelles and solicits funds for adopting various tortoises kept by the Trust (Gerlach 2002).

[v] Indeed, the book's title "*Giant Tortoises of the Indian Ocean. The Genus* Dipsochelys *inhabiting the Seychelles Islands and the extinct giants of Madagascar and the Mascarenes*" could be misunderstood to mean that the Mascarene tortoises are part of the genus "*Dipsochelys.*"

[vi] Indeed, this attractively produced book is the product of the very active hobbyist community in Germany.

Herpetological Review, 2006, 37(3), 374.

A Sheltered Life. The Unexpected History of the Giant Tortoise, by Paul Chambers. 2004. Oxford University Press, New York (www.oup.com) [originally published 2004 by John Murray, London]. xiv + 306 pp. Hardcover. US $19.95. ISBN 0-19-522396-9; ISBN-13 978-0-19-522396-5.

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The title of this gracefully written biological history belies the content of the book. The tortoises of the oceanic islands of the Pacific and Indian Oceans have hardly been sheltered from the rapacious predation of man. The author, Paul Chambers, is well aware of this devastating harvest. The title, of course, refers to the shell and its protective aspect prior to the arrival of humans. Similarly, he well recognizes the diversity of these insular giants, treating them as a single entity in the title because that is how sailors, colonists, and naturalists viewed them upon their first discovery and during the early centuries of tortoise-man interactions.

This book is not a conservation advocacy, although the conservation of giant tortoises is a core aspect of the narrative. It is impossible to discuss giant tortoises without examining man's rapacious behavior. This aspect of tortoise history is depressing reading, because all of us are aware of the outcome and can imagine the cruelty of harvesting and transport. Chambers presents the information factually, neither over- nor understating the extent and nature of tortoise harvesting. He reveals the stuttering start of tortoise conservation. Protection was a long time in arrival and remains in a fragile state in Aldabra and the Galápagos.

The narrative is organized into seven sections: Discovery; Inspiration; Decimation; Obsession; Pets; Recovery; In the Blood. Each section consists of two or more chapters. "Discovery" provides a history of the discovery of the giants by early navigators. "Inspiration" details the early taxonomic history of the giants. The focus, however, is the influence of the Galápagos tortoises on Darwin's developing thoughts on evolution. These chapters are delightful reading and most thought provoking, and I highly recommend them to anyone with slightest interest in Darwinian history. "Decimation" describes the decline and extinction of Indian Ocean tortoises and the impact of the whaling fleet on the Galápagos populations. Albert Günther and Walter Rothschild are the main figures in "Obsessions." I was aware of Günther's impact on giant tortoise taxonomy, but it was a delightful surprise to discover his crusading efforts to protect them, particularly the Indian Ocean ones. I share Chambers' assessment that his effort to establish breeding colonies outside a species' native habitat was misguided and not a viable solution to their conservation. Similarly, the current captive colonies of turtles and tortoises are equally misguided conservation efforts, serving the pet-keeper syndrome but not conservation of chelonians.

"Pets" examines the history of a few individual captive tortoises of exceptional longevity. Chambers' style here is polite and thorough investigative reporting. He also demonstrates that Darwin did not personally bring Galápagos tortoises home from his Beagle cruise. "Recovery" details 20th century attempts and successes in giant tortoise conservation. "In the Blood" examines current systematic and nomenclatural issues. Such matters are seldom of interest to laity or, for that matter, to most biologists. The telling here is thorough, yet a relaxed and honest report of recent (through 2003) scientific studies that reveal the survival of a single Indian Ocean giant (*Aldabrachelys gigantea*) and the persistence of a dozen-plus genetically distinct populations of Galápagos *Geochelone*.

I urge everyone with the slightest interest in tortoises and/or the history of biology to read Chambers' "A Sheltered Life." It offers a fascinating glimpse of Charles Darwin and the influence of tortoises on his development of evolutionary theory, revelations of Albert Günther as a conservationist, and many more aspects about giant tortoises.

Herpetological Review, 2006, 37(3), 374–376.

Amphibians of the Pacific Northwest, edited by Lawrence L. C. Jones, William P. Leonard, and Deanna H. Olsen. 2005. Seattle Audubon Society, Seattle, Washington (www.seattleaudubon.org). xii + 227 pp. Softcover. US $19.95. ISBN 0-914516-16-7.

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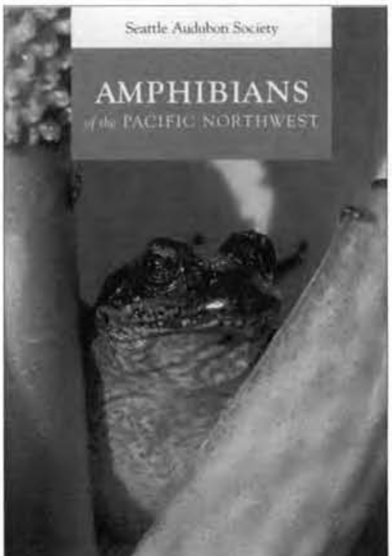

Field guides to the faunas of particular places tend to assort into two different models, largely depending on the number of species they encompass. The classic Peterson bird guides, for example, tend to have large numbers of small pictures, grouped many to a page, in order to cover the myriad species. Necessarily, these guides have only limited text that serves little else than to provide field characters for identification. There are lots of warblers. For smaller faunas in smaller regions than half a

continent, the Peterson approach would make for a pretty slim volume and thus the other model for a field guide or handbook is to devote several pages to each species and provide some depth and biology to the treatment. For the 47 species of amphibians in the Pacific Northwest of North America, this is the way to go and the result is a visually stunning photographic guide to the salamanders, newts, frogs and toads from Alaska to northern California west of the Rocky Mountains.

This guide is the successor to the 1993 "Amphibians of Washington and Oregon" by W.P. Leonard and co-authors. There are significant differences between the older book and the new, even though the layout and reliance on photographs is much the same. The geographic coverage is expanded, the number of species is expanded, the number of pages is expanded, and the number of authors is greatly expanded. There are flaws but the beauty of the illustrations will persuade anyone with a love for amphibians to get a copy.

The book's scope includes amphibians from Alaska, Yukon, British Columbia, Washington, Oregon, Idaho, western Montana, a small portion of extreme southwestern Alberta, and California north of Santa Cruz and west of the Siskyou Mountains. This constitutes a nicely definable biogeographic province with a fauna distinct from the drier American southwest, the central North America prairies, and most of the northern boreal forest. The maps, though, are a disappointment. The older book had an accurate rendering of the coastline of Washington and Oregon and showed county lines so that the extent of the blob distributions could be reasonably well located. The maps in the new book have an extremely vague and inaccurate portrayal of the coastline and only the state and provincial boundaries as landmarks. For all those many similarly stripy salamanders, knowing where you got it is the essential key to knowing what you've got but the maps make that very difficult. A few rivers at least would be valuable to help us get our bearings. These are not dot maps and the blobs are wrong some of the time. There are no records of Pacific Treefrogs in the Chilcotin and Nechako regions of British Columbia that lie west of the Fraser River. The Coastal Tailed Frog does not stop that far from the British Columbia-Alaska border. The Boreal Chorus frog has a much more extensive distribution in the Peace River district of northeast British Columbia than is depicted. The maps were compiled from maps published in other sources, which strikes me as having the unfortunate spin-off of perpetuating any errors those other maps might contain. Compounding this geographical vagueness, the locations of the photographs are identified only by state and county (there are so few photographs of animals from north of the 49th parallel that it's hardly worth the mention). I find this practice more annoying than helpful for I don't know where most of these counties are and there is no map to tell me.

The older book had five authors, the new has 33. Each section and species account in the new book has its own author or co-authors. Writing text for a popular guide is not at all the same as writing for the technical scientific literature. It is not surprising that some of the authors in this book demonstrate more adroitness than others. Deanna Olson's overview of frogs and toads is nicely balanced and appealingly written; David Darda turns a few good phrases in his overview of amphibians. Less successful are the piece on biogeographic patterns by Bruce and Gwendolyn Bury and the discussion of taxonomic and genetic diversity by Steven Wagner, both of which seem unable to package the information in a way that would engage and inform a lay reader. With talk of elements and regions and species names all in a row, the Burys' essay does not give much of a sense of why species are where they are so much as merely to point out where they happen to be. Wagner has an admittedly difficult task in explaining the arcane lore of modern taxonomic research but without knowing the histories of the usage of various names, it doesn't much make sense. Unless you knew that *Plethodon vandykei*, *Aneides ferreus*, *Rana aurora,* and *Rana pretiosa* each once were used to encompass populations that now are recognized as different species, there is nothing particularly interesting in *P. idahoensis*, *A. vagrans*, *R. draytonii,* or *R. luteiventris*. They are just names. Whether spadefoots are *Spea* or *Scaphiopus* makes no difference to identifying one if you catch it, and the issue confuses almost everybody. This applies likewise to the generic assignment of the Pacific Treefrog. Wagner evidently recommends *Hyla regilla* but the rest of the book uses *Pseudacris regilla*.

With so many authors each writing some small bit, unevenness in the quality of the writing is inevitable, but that's why we should have editors. Yet, noticeably and regrettably, repetitions and apparent contradictions appear throughout. This is especially a problem in the introductory sections about the biology of amphibians. "Anura" is defined as "without tail" on both page 6 and page 12. "Explosive breeding," which has long struck me as an unfortunate term conjuring images of frogs bursting apart, eggs flying everywhere, is defined on page 11, on page 12, and again in the glossary on page 222. Page 20 mentions chytridiomycetes and and oomycetes without defining them at all. They are fungi. *Saprolegnia* is in the glossary, defined as a fungus without mentioning that it is an oomycete. Page 6 says there are 15 species of frogs native to the region; page 12 says there are 17 species of frogs found in the region. This is true because two species are not native but there is the appearance of contradiction. Conservation concerns about amphibians are mentioned in a section on laws and conservation (pages 4 and 5), again on pages 8 and 13, and again in an essay on declining amphibian populations (pages 20 and 21). You'd think that the most interesting thing about amphibians is that there is progressively fewer of them. I tend to think that there are a great many interesting things about amphibians, including their morphology, behavior, physiology, sensory systems, and development, that could have had more wording devoted to them.

The amount of natural history knowledge and specific information in the species accounts is terrifically impressive but they, too, have their share of textual idiosyncracies. Some species lengths are given as TL, some as SVL and, for some frogs, SUL. Poor Reader has to use the glossary at the end to fathom that these are Total length, Snout-to-vent length, and Snout-to-urostyle length, respectively. Some, but not all, of the species accounts have interesting tidbits of information included, such as that spadefoots make people sneeze and Rocky Mountain Tailed Frogs swim by alternately kicking with their hind legs (Coastal Tailed Frogs do, too). Many, though, repeat taxonomic changes and items of conservation status mentioned elsewhere. There is no guide for what identifying characters to look for on the squirming animal you may have in hand, and there are no keys. The only diagrams showing field identifying characters are at the back of the book, along with

the glossary. I think this makes the book more difficult to use, especially when a species account suggests counting costal grooves between adpressed limbs and the only guides for what those may be are in the glossary.

Of all the species covered, I think the Wood Frog is the one hard done by. The photographs of adult Wood Frogs are all from the same county in Michigan, except for the tadpole which is from Tennessee. Wood Frogs from British Columbia, Yukon, and Alaska don't look like these. Wood Frogs from the northwest are mottled grey and black and have much shorter legs than those fine, uniformly light brown frogs from Michigan that do not even have the bold mid-dorsal stripe so common among northwestern individuals. Furthermore, Wood Frogs do not range so far south in British Columbia as is depicted on the map. All this may lead to even more confusion than there is already among records of Wood Frogs and Columbia Spotted Frogs in British Columbia. The species account also mentions the Wood Frog's famous freeze-tolerance but incorrectly states that it floods its cells with glucose. Glucose floods the extracellular fluid, serving initially as antifreeze and then as cryoprotectant once the extracellular fluid does freeze so that the cells do not dehydrate or suffer physical damage. I suppose this is less off the mark, though, than the text on page 13 implying that Wood Frogs freeze until spring thaw.

Nevertheless, the book is clearly intended to be used primarily as a picture key. It's the photographs that are its major attraction and the photographs are marvelous. These are many of the best photos of amphibians you are likely to find anywhere. Every species but one is illustrated with at least five photographs, and usually six, of stellar quality. Only the Scott Bar Salamander, *Plethodon asupak*, has only two photographs of it but the species is so new and so rare that to see any photographs of it at all is remarkable. All species with tadpoles or larvae have those illustrated, too. There are even photographs of egg masses for many species, mainly frogs. The work and diligence that went into compiling this set of photographs is truly commendable.

In most cases the photographs show much of the range of variation with the species. Oh, there are some peculiar choices of photographs, to be sure. Four photographs of transformed adult *Dicamptodon copei* are given although the species rarely transforms. Three very similar photographs of three very similarly red *Rana draytonii* are provided, which strikes me as odd because I have never found such vibrantly colored animals among any California Red-legged Frogs I've ever caught. The Tiger Salamanders at the top and bottom of page 39 look like the same individual. Likewise, there are two photographs of *Rhyacotriton cascadae* on page 59 on what must surely be the same rock and be perhaps the same individual. And the Wood Frogs are from Michigan.

However, the photography shows real skill and artistry. The animals are in natural settings and they look unstaged, notwithstanding the mild abuse needed to get a newt into its unken defensive posture. Take a look at the salamanders on page 145, or egg mass and tadpole on page 176, or the stunning shot of newt larvae about to hatch on page 80. Shots like these make this a beautiful book.

The *Amphibians of the Pacific Northwest* is a well produced and beautiful little book. It entices you just to look at the pictures and get a feeling for these animals. It might not prove to be the easiest of field guides for an amateur herpetologist but it is certainly worth having.

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Diamonds in the Marsh – A Natural History of the Diamondback Terrapin, by Barbara Brennessel. 2006. University Press of New England, Lebanon, New Hampshire (www.upne.com). xii + 219 pp., 16 pls. Hardcover. US $26.00. ISBN 1-58465-536-4.

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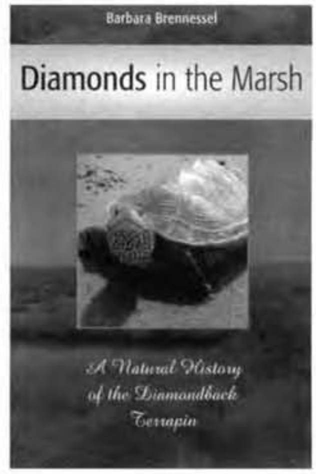

The April 2006 publication date of Barbara Brennessel's *Diamonds in the Marsh*, a treatise tackling the natural history of Diamondback Terrapins (*Malaclemys terrapin*), conveniently coincided with the passing of House Bill 4296 in the State of South Carolina on 15 March, 2006, prohibiting the commercial harvest of Diamondback Terrapins, and the passing of House Bill 980 in the State of Maryland on 21 March, 2006. Maryland's bill, originally written to prohibit the commercial harvest of terrapins altogether, instead passed with amendments requiring Maryland's Department of Natural Resources "to prepare a fishery management plan for diamondback terrapin [and...] adopt regulations governing terrapin resources and the catching of terrapin consistent with certain recommendations of the Maryland Diamondback Terrapin Task Force..." (MD HB980; March 21, 2006). Both Brennessel's book and the enactment of these two statutes regulating the harvest of terrapins are a boon—if not a blessing—for this species that once graced tables throughout the United States as the main ingredient in soups and stews.

Dating back to the 1500s, European colonists recognized and took advantage of terrapins in the New World, utilizing this bountiful supply of flesh (and eggs) as a food source not only for themselves, but also for servants, slaves, and pigs. Between the early 1800s and the 1850s, the demand for terrapin skyrocketed such that the price for a dozen large terrapins had risen from $4 to as much as $100 or more. Terrapin meat was shipped around the world to Paris, Berlin, and South America. By the early 1900s, however, the demand for terrapin waned as diamondback populations plummeted under the pressure of the overharvesting already underway (Brennessel 2006).

A comprehensive natural history such as *Diamonds in the Marsh* is an invaluable tool in the study and conservation of a species, and can provide a solid foundation for future research, conservation, and management decisions. Brennessel effectively pulls together the bulk of literature on the diamondback and communicates it to the reader in a generally clear, uncluttered fashion so as to make it not only a resource for researchers, but also an interesting read for reptile aficionados.

Chapter 1 covers everything one would expect in a species' natu-

ral history account, neatly presented. It is followed in Chapter 2 by a breakdown of the diamondback's range along the Atlantic and Gulf coasts, although this is organized in a muddled combination of terrapin populations, biogeographic regions, and/or states. This discussion of the diamondback's range is further complicated by the rudimentary map (Figure 1.9; p. 25) that offers little more than dashed lines demarcating the range of each subspecies overlain on a bare bones map of the coastal states from Massachusetts to Texas. There are no state names, oceans, bays, capes, state capitols, or major cities as reference points, making it difficult for those interested in orientating themselves with the lay of the land as they are introduced to the species' range.

In Chapters 3 and 4, Brennessel gives a thorough overview of the diamondback's reproductive cycle and first years of life, including sex ratios, sexual dimorphism, courtship and mating, nesting, nest site selection and construction, egg and clutch sizes, incubation, temperature-dependent sex determination, emergence, the so-called "lost years," and headstarting.

Chapter 5 offers a welcome respite from data-driven science. Here, the author and her readers have the opportunity to stretch their legs, and Brennessel does so with gusto. In the first ten-or-so pages, we're run through a gamut of legend and lore, from the tale of Brer Tarrypin of Uncle Remus fame to the Native North American's Great Turtle, followed by a discourse on the terrapin as a main course. We're peppered with recipes, presidential gossip, and accounts of its epicurean rise to fame and fall from grace, followed by accounts of other sources of mortality: predation, pollutants, bacteria, aquaculture, road mortality, and by-catch, to name a few.

Two omissions from this chapter are noteworthy, however. First, there is no mention of the Green Turtle (*Chelonia mydas*) or the Pacific Pond Turtle (*Clemmys marmorata*), two species that were extensively harvested simultaneously with the harvest of diamondbacks (Ernst et al. 1994) and that often appeared alongside the Diamondback Terrapin on menus (the Pacific Pond Turtle restricted to the Pacific Coast). True, the book's focus is on the Diamondback Terrapin, but a comparison between the harvests would have offered some perspective, especially given the fact that the harvest of Pacific Pond Turtles was likely inspired by the harvest of diamondbacks that by mid 1800s had been underway for more than a century. Second, there is no mention of the repeated (and failed) attempts to introduce diamondbacks to the West Coast (Smith 1895; State Board of Fish Commissioners of the State of California 1900;Taft 1944; Brown 1971; Jennings 2004) to supplement the waning supply of Pacific Pond Turtles in California in the late 1800s and early 1900s. These failed introductions show how truly influential the popularity of the Diamondback Terrapin was from coast to coast.

Brennessel's closing chapter soberly brings us back to the present, laying out not only what we have learned to date, but also how much more we need to learn for us to conserve these declining populations of Diamondback Terrapins. By-catch reduction devices and turtle exclusion devices have proven effective in excluding terrapins from crab pots, for example, but the regulations and incentives in place between states to require their use commercially or privately vary, if they exist at all. Additionally, the impacts of the commercial and private harvests on terrapins need to be considered in establishing and enforcing size limits, moratoria, and fishery management plans. These, however, are tricky roads not easily navigated.

As a resource for researchers, *Diamonds in the Marsh* is somewhat constrained by its design—likely a handicap necessary to attract the non-scientists. The table of contents requires a bit of intuition; Chapter 1, "A Decidedly Unique Creature," describes everything from the species' geographic variation to internal anatomy to taxonomy, whereas Chapter 5, "A Clear and Present Danger for the Most Celebrated of American Reptiles," covers Native American legends, the historical harvest of terrapin, natural predators, by-catch in crab pots, and pollutants (among other topics). Likewise, the index is somewhat bare. In flipping through the index, for example, one would not realize that there was any discussion of headstart programs for Pacific Pond Turtles or a retelling of the tale of Uncle Remus' Brer Tarrypin (there are).

Several gross errors are worth mentioning. The second half of the book is scattered with spelling and typographical errors (e.g. "aqualculture," or "habit" instead of "habitat") that should have been caught at the copyeditor's desk. But without question, my biggest complaint about *Diamonds in the Marsh* is its poor-quality photographs. Although most of the black-and-white photos are sharp or passably so, almost all of the color plates are either pixelated or grainy. Worse, even the photographs on the book jacket cover (front and back), as well as the frontispiece—all depicting the Diamondback Terrapin itself, no less—are visibly pixelated. Fortunately, William E. Davis' illustrations of diamondbacks—based on dead specimens, if I understand correctly—are nonetheless surprisingly and refreshingly life-like and expressive, penned with an eye for detail reminiscent of the herpetological plates found in Louis Agassiz's *Contributions to the Natural History of the United States of America* (1857). Their inclusion as chapter head pieces should be commended.

At times, Brennessel does allow her narratives to spill over, following tangents about the annoying resident insects to be found in the Atlantic salt marshes, or in stories and asides to the reader that seem either out-of-place or too familiar in what is, ultimately, a natural history of the Diamondback Terrapin. Still, she is effectively thorough in her coverage of the Diamondback Terrapin's natural history. Considering the broad readership she is appealing to, she keeps in-text citations to a respectable minimum to avoid cluttering up the narrative and, with a few exceptions, provides the necessary citations to direct inquiring minds in the right direction. Overall, Brennessel arrives at a good balance between writing for the scientist and writing for the general public.

When all is said and done, most of my criticisms are merely cosmetic. Brennessel accomplished what she set out to do—take on the arduous and daunting task of synthesizing the extant literature on Diamondback Terrapins and weave it into a natural history account that is both informative and inspirational. *Diamonds in the Marsh* does not fall short of this goal, and will no doubt inspire future generations of herpetologists to take an interest in the Diamondback Terrapin at a time when such help is needed most.

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North American Watersnakes, A Natural History, by J. Whitfield Gibbons and Michael E. Dorcas. The University of Oklahoma Press, Norman, Oklahoma (www.oupress.com). xxvi + 438 pp., 32 pp. plates. Hardcover. $49.95. ISBN 0-8061-3599-9.

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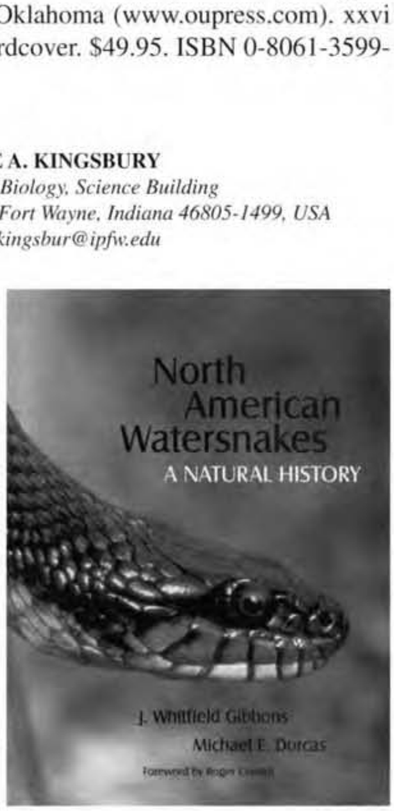

This is a comprehensive treatise on *Nerodia*, *Regina*, and *Seminatrix*, the watersnakes of Canada, the United States, Mexico, and Cuba. The genera covered in this publication were selected both because of systematic association and aquatic affiliation. Species such as the aquatic, but phylogenetically distant, *Faranica abacura* and *Agkistrodon piscivorus* were not covered, nor were any of the closely related but more terrestrial *Thamnophis*. The University of Oklahoma Press has also published an earlier volume, *The Garter Snakes* (Rossman et al. 1996), partly explaining the exclusion of the last of these genera from this volume.

Following the Introduction, the bulk of the book is divided into two sections. Part One, "Watersnake Biology," contains four brief chapters, each covering a broad topic. Chapter One is a brief overview of the taxonomy and systematics of the group. I would have liked to have seen more discussion of how these natricine genera are anchored among other colubrids. Instead, the authors directed more effort at explaining relationships between the species within the group. Included are a brief review of the relatedness of the genera in question to one another, and the justification for certain taxonomic decisions made in the book. Further details of relationships and of the taxonomic rationale employed are found in the individual accounts later in the text. This chapter also includes a table listing known fossil watersnakes.

Chapter Two is a review of techniques that have been employed to study watersnakes in the field. Chapter Three is an exploration of more general aspects of the biology of watersnakes, covering topics such as diet, parasites, body size, and reproduction. Finally, Chapter Four is a look at conservation issues involving the watersnakes. Snakes, as we know, are a group much maligned, but watersnakes are targeted with particular enthusiasm. Highlighted are the various efforts to glorify or justify the killing of watersnakes, including their purported competition with us for gamefish, or for being mistaken, no matter their true identity, for being "moccasins" – poisonous, and thus a great threat to all. This chapter also includes a tabular review of the legal status for those species listed at the state or federal levels.

Part Two includes species accounts for *Nerodia*, *Regina*, and *Seminatrix*. This section opens with range maps for each species, depicted by county, and color-coded to distinguish between sources of county record information. Precedence was given to museum records, but other records were included when these were not available. The maps do not convey any information about the most recent date that the species was observed, thus patterns of decline are not evident. However, the authors went to great pains to provide a source for all of the records they used (Appendix 3). Range maps are followed by keys for *Regina* and *Nerodia*, the two groups having more than one representative. Attractive color plates showing all of the species and subspecies are provided in the center of the book. Though small, they serve to illustrate the diversity and distinctiveness of this group of snakes.

Each of the species accounts begins with scientific name, the most widely used common name, and then a list of the subspecies. Sections regarding the identification, systematics and distribution of the species follow. "Description" details the morphological features defining the species and permits subspecies to be distinguished. "Taxonomy and Systematics" provides an overview of the taxonomic history of the species and details data bearing on both inter- and intraspecific relationships. A separate "Etymology" section addresses the origin of the specific and subspecific epithets and "Common Names" provides a thorough explanation of alternative common names. "Geographic Distribution" details the known range of the species, and sometimes the areas occupied by subspecies. "Fossil Record" summarizes the fossil records attributable to each taxon. The remaining sections relate to the biology of the species. Depending on the amount of published literature available for each species, different sections may be longer or shorter. "Habitat" characterizes wetland and upland requirements and includes particulars of habitat features needed for activities such as foraging and hibernation, as well as comments on seasonal activities as they relate to habitat use. Depending on the species and the extent to which they have been studied, the "Physiology and Behavior" section may contain details about such topics as thermal physiology, escape behavior, and ecdysis. Patterns of movement are provided in a distinct section, "Activity." What they eat and who eats them is covered in the sections "Diet and

Feeding" and "Predation, Parasitism, and Defense." Aspects of the growth of the individual, reproduction and population biology are each treated in separate sections. Each account closes with the more diverse sections: "Captive Maintenance"—addressing issues related to keeping the species in the laboratory, "Conservation"—highlighting concerns about threats to the species, and the closing section, "Questions and Comments," which provides the authors with a platform to raise research and conservation questions about the species. Both of the authors are well-established academic researchers, but have also shown a willingness to engage with natural resource agencies and the general public to promote conservation.

A final chapter, the Afterword, entitled "Research Opportunities with North American Watersnakes," offers a last examination of where the greatest research opportunities might lie for these taxa. Here the authors acknowledge details such as the taxonomic and systematic challenges remaining for these snakes, the research potential of these cooperative captives, and a plethora of other opportunities and questions. Clearly, though much is known, much remains to be explored.

Last but not least are the appendices and bibliography. Appendix 1 details the synonymies, type specimens, and localities for all of the species covered. Appendix 2 covers scutellation, and Appendix 3 provides a list of the verification sources, by county, for each species, for all of the records used in the figures and text. The first and last appendices should be particularly useful to researchers endeavoring to track down the details of distributions, or where to find a critical specimen. The last section of the book, the "Comprehensive Bibliography," is indeed comprehensive, as evidenced by the 80-some pages of citations. It provides a rich resource for reference hunters.

To conclude, Michael Dorcas and Whit Gibbons have done an excellent job. I would strongly recommend this work to the interested layperson, to students of herpetology, and to professionals seeking a worthy resource for further enlightenment. Gibbons and Dorcas were superbly thorough in their search for published and unpublished information. Their efforts to be as inclusive and current as possible are apparent, and I commend them.

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Amphibians and Reptiles of La Selva, Costa Rica, and the Caribbean Slope: A Comprehensive Guide, by Craig Guyer and Maureen A. Donnelly. 2005. University of California Press, Berkeley, California (www.ucpress.edu). viii + 299 pp. Softcover. US $24.95. ISBN 0-520-23759-5.

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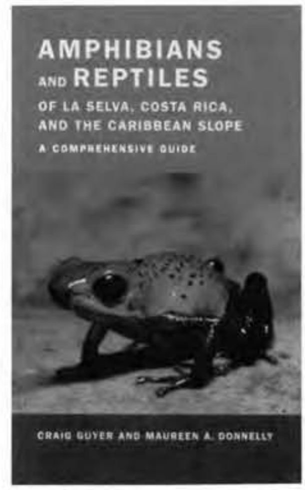

Over the years, the Central American country of Costa Rica has come to symbolize the biological promise of the American tropics. This feat has been due, in no small part, to the presence within this country's borders of one of the premier tropical field stations in the world, La Selva Biological Station, and its association with the lauded Organization for Tropical Studies. In fact, to quote Dr. Bruce Young, a former director of La Selva, in a 1998 videotape entitled "Costa Rica: Science in the Rainforest" (Turner Learning, Inc.), "Every time you pick up one of those picture books about the tropical rainforest, … much of that information came from La Selva." Given the importance of this field station to the conduct of tropical biological research and education, it is fitting that we now have a field guide to its herpetofauna and that of the surrounding Caribbean slope of Costa Rica. It is also fitting that this guide is authored by two herpetologists whose careers have been closely associated with La Selva: Craig Guyer, professor of biology at Auburn University in Alabama, and Maureen A. Donnelly, associate professor of biological sciences at Florida International University in Miami, Florida, who together have more than 40 years of field experience there.

This book joins two others recently published on the herpetofauna of Costa Rica. One is Jay Savage's definitive work on this subject, *The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Two Seas* (2002). The other is Twan Leenders' *A Guide to Amphibians and Reptiles of Costa Rica* (2001). A tempting question to consider is which book one might place in one of the two bags one can take on a flight to Costa Rica. First, however, let me review the Guyer-Donnelly book.

The main portion of the book consists of a 19-page introduction, an 82-page section on amphibians, a 136-page section on reptiles, and an 11-page section on additional species. Ancillary portions of the book comprise a field data sheet for amphibians and reptiles, a glossary, a literature cited section, and an index.

The introduction deals with a description of the book and its purpose, a discussion of the geography, climate, and vegetation of the station, a history of herpetological research at the station, and discussions of the diversity and conservation of the station's

herpetofauna.

The section on amphibians considers the 49 species recorded from La Selva, including one caecilian, three salamanders, and 45 anurans. Brief discussions of orders and families precede each group of species accounts. The species accounts provide an English vernacular name, the scientific name, other vernacular names, size, range-wide distribution, identifying features, sexual dimorphism, habitat, diet, reproduction, remarks (if pertinent), and a shaded map of the Costa Rican distribution. Dichotomous keys to orders, families, and species are also provided.

The section on reptiles deals with the 89 species known from the station, including five turtles, 25 lizards, 57 snakes, and two crocodilians. The organization of this section is the same as that for the amphibians, including the topics covered in the species accounts, and similar keys are also available.

The section on additional species provides comments on 11 amphibians and nine reptiles known to occur on the Costa Rican Caribbean slope, but not at La Selva. These accounts briefly consider their distribution in the country and general appearance. The glossary consists of 240 terms that may not be familiar to laypeople. The Literature Cited section contains 290 references to papers that appear in the body of the book. An index of 13 pages lists vernacular and scientific names of organisms dealt with in the book.

As is appropriate for a field guide, a series of color plates is divided into two groups, logically one of amphibians (76 plates) and the other of reptiles (131 plates), identified by use of vernacular names (although, for the benefit of herpetologists, it would be nice to have the scientific names accompany the common ones — there is certainly enough room on the page to do so). Illustrations, especially of a photographic nature and in color, are arguably the most important part of a field guide, most critically so if it is intended for laypeople, because it is this part of the field guide that will be examined initially in an attempt to identify what is in hand (or somewhere else, if venomous). So, the color plates in this book can be judged as to how well they allow correct identification by a first-time traveler to Costa Rica with zero herpetological knowledge. By this criterion, for the amphibians, I generally find the photographs arranged two to a page much better able to accomplish this need than are those arranged four to a page. Given that the pages are about 4 $^1/_2 \times 7\ ^1/_4$ inches in size, and that the photographs arranged four to a page have their legends occupying close to half the page width, many of the amphibian photographs are too small to do a very good job of identification. Beyond this, some of these small photographs were cropped too broadly, and therefore show more of the background than of the animal (e.g., plates 3, 8, 26, 31, 32, 34, 36, 39, 43, 48, 52, 61, 67, and 73). Another feature that detracts from the effectiveness of several of these photographs is the presence of human body parts in the frame. This is an unprofessional shorthand approach to dealing with difficult subjects (e.g., specimens of *Eleutherodactylus* that can leap amazing distances).

Some of these same issues also apply to the photographs of reptiles. Another problem most evident with these creatures is poor lighting and backgrounds that are too dark (e.g., plates 80, 87, 92, 98, 100, 105, and several others). Humans get in the picture again, in some cases, to the extent that there is more human than reptile being illustrated (e.g., plates 77, 97, 104, 106, 125, 142, 144, 166, 200, and some others). In response to the question about how well the photographs provided allow for correct identification alone, I have to conclude that, in many cases, they do not do so. As a consequence, the reader will have to resort to using the keys first, then the descriptions and, finally, try to use the photographs to confirm the identification.

The question then arises as to how good a job the keys and descriptions do in identification. For those familiar with the Central American herpetofauna, this job is most difficult when dealing with members of the speciose genera *Eleutherodactylus* (= *Craugastor* or *Eleutherodactylus* currently) among the anurans and *Norops* (= *Anolis* currently) among the lizards. Identifying colubrid snakes can sometimes prove taxing as well, simply because the number of species in the herpetofauna is relatively large. A cursory survey of the keys to these groups indicates that the authors have done an excellent job of constructing them, especially as they are primarily based on features of color and pattern, making them easier for laypeople to use. The descriptions (or identifying features) also do a very good job of securing the identification, once the creature has been "run through the keys." The deficiencies with the photographs could be materially ameliorated in the next edition by going to a two-per-page format and using some reasonable cropping. Some photographs, however, simply need to be replaced with ones that are properly lit and excuse humans as co-subjects.

In these days, when the concern about the decline of biodiversity around the world, but especially in the tropics, is reaching a fever pitch, books like this one can perform a vital function in educating people about this extremely serious problem. In this field guide, one has to look to the sections in the introduction on diversity and conservation to find this message, if it exists. These two sections comprise about five and one-half pages of the book. Although, by its title, one might expect the diversity section to deal with the importance of the diversity of the herpetofauna of La Selva, the discussion actually considers the reasons for the existence of this diversity (geological history, forest structure, and climate) and the sources for additions to the known herpetodiversity. The two-plus page section on conservation, however, does provide a brief, but well-reasoned and insightful discussion of the principal concerns about the persistence of the known herpetofauna of the station into the future. This discussion, moreover, is tantalizing enough to indicate that this subject deserves a full-fledged treatment of its own. To my knowledge, this has yet to be accomplished.

At the beginning of this review, I posed the question as to which of three books on the Costa Rican herpetofauna mentioned should go in the backpack for a trip to the popular destination. Savage's book is the definitive work on this subject and covers the entire country. It, however, is too bulky and heavy to horse around in a backpack. Twan Leenders' book is of an appropriate size and weight and covers the entire country, but not the entire herpetofauna. Guyer and Donnelly's book is also of appropriate size and weight, but covers only the herpetofauna of La Selva in detail and the rest of the Caribbean slope creatures in much less detail, leaving the central mountain spine and the Pacific slope herpetofauna out of consideration. My suggestion is to pack both the Leenders and Guyer-Donnelly books for a trip to any destination in Costa Rica. Another suggestion for a subsequent edition is that the 20 species of Caribbean slope animals be treated in the same detail as those

already recorded for La Selva and simply stipulate that these 20 forms may or may not be found eventually at the research station. This field guide serves several important functions and I am very pleased to see it now available. First, the La Selva Biological Station is host to a prestigious program in tropical biology that brings numerous students, faculty, and researchers to the American tropics from many places around the world, so this guide will be hugely useful as a supplemental textbook in a variety of courses. Second, the country of Costa Rica is a popular ecotourist destination, so this guide will be of interest to those tourists who wish to learn more about these two groups of vertebrates while "in country." Finally, Mesoamerica is an important "biodiversity hotspot" and, as such, it is important that the word get out as broadly as possible about the immense importance of the biological resources of this region. This book will assist in all these ways.

PUBLICATIONS RECEIVED

Encyklopedia Współczesnych Płazów i Gadów, by Piotr Sura. 2005. Wydawnictwo Fundacja, Nowy Sacz, Poland (www.wydawnictwo.sacz.com.pl). 544 pp. Hardcover. 85.00 zl (approx. US $27.00). ISBN 83-88887-60-2.

This Polish language encyclopedia of amphibians and reptiles is organized alphabetically by Polish vernacular names. The first part of the book, printed on glossy paper, is lavishly illustrated with hundreds of color photographs, maps (by Family), and line drawings. In addition to entries for individual taxa, there are accounts dealing with biological topics (e.g., hemipenis, mimicry), and even biographical entries (e.g., Cope, Mertens). Among the animals illustrated are some rarities and nearly all photos are of high quality. The second part of the book, beginning on page 273 is a 266-page systematic listing of amphibians and reptiles of the world. All currently recognized species are listed, along with their authors and dates of description. The book is rounded out by a literature section with more than 150 references, mostly covering higher order groups or faunal regions.

The Diversity of the Dumbara Mountains (The Knuckles Massif, Sri Lanka): With Special Reference to its Herpetofauna (Including Papers on Sri Lankan Herpetology), edited by Anslem de Silva. 2005. Lyriocephalus, Journal of the Amphibia and Reptile Research Organization of Sri Lanka (ARROS), Volume 6, Special Issue, available from A. de Silva, 15/1 Dolosbage Road, Gampola (CP), Sri Lanka. 382 pp. Softbound. US $40.00 (including airmail delivery; checks to K.A.L. de Silva). ISSN 1391-0833.

This special issue of the Sri Lankan journal *Lyriocephalus* contains 40 individual papers, the majority of which deal with aspects of the herpetology of the Knuckles Massif, a biologically diverse, forested range in Sri Lanka. The herpetological papers deal chiefly with different aspects of natural history, ecology, and parasitology, with an emphasis on lizards. Among the genera discussed are the endemic agamids *Lyriocephalus, Cophotis,* and *Ceratophora*, the skinks *Chalcidoseps*, *Nessia*, and *Lankascicnus*, *Cyrtodactylus* geckos, and uropeltid snakes. In addition, there are papers on the geology, climate, vegetation, malacology, archaeology, and ethnobiology of the Knuckles, and a 217-entry bibliography of publications devoted to the area. Another nine papers are general herpetological contributions relating to other aspects of Sri Lankan reptiles. The volume also includes a cumulative index to volumes 1–5 (1994–2004) of *Lyriocephalus*. This issue includes 17 color plates depicting many of the species of reptiles and amphibians from the Knuckles and otherwise illustrating the individual paper contributions. This volume will be a welcome addition to the libraries of those interested in the South Asian herpetofauna or tropical biodiversity in general.

Proceedings of the 3rd International Symposium on *Emys orbicularis*, edited by Uwe Fritz and Peter Havas. 2004. Biologia, Section Zoology, Volume 59, Supplement 14 (Slovak Academic Press, Ltd.; www.sappress.sk). iv + 209 pp. Softbound. ISSN 1335-6380.

This volume presents the proceedings of a symposium on the European Pond Turtle held in Kosice, Slovak Republic in 2002. The contributions are divided into the categories "Distribution and Habitat," "Natural History," and "Conservation and Management" and include data on populations from throughout the range of the species, from Spain and Portugal to Russia and Turkey. The information presented reveals a diversity of locality-specific ecological, demographic, and reproductive aspects of the biology of this endangered turtle across its broad distribution. Among the topics dealt with in individual papers are haplotype diversity in Germany, coexistence with *Mauremys leprosa* in Portgugal, survivorship in Poland, home range in France, Pleistocene, Holocene and historical records from the Czech Republic, and the effects of recreational fishing on *Emys* in France. The proceedings as a whole (presented entirely in English) offer the reader a well-rounded portrait of the biology of Europe's most important freshwater chelonian. This supplemental volume to the Slovak journal *Biologia* will be of interest to all those working on freshwater turtles, the European herpetofauna, or reptilian biology and conservation.

Snake, by Drake Stutesman. 2005. Reaktion Books Ltd., London (distributed in the USA and Canada by University of Chicago Press, Chicago, Illinois; www.press.uchicago.edu). 224 pp. Softcover. US $19.95. ISBN 1-86189-239-X.

This compact and well-illustrated book traces the symbolism of snakes through the ages. After a brief introduction to snakes for the novice, the book outlines the role and meaning of snakes in creation myths, their symbolism as creators, saviors, and demons, and the religious and symbolic significance of snake handling. The examples discussed and illustrated derive from a diversity of sources, from Paleolithic cultures to ancient Egypt and Mesoamerica, to Hindu traditions, to Greece and Rome, to modern Haiti and Kentucky. Another chapter discusses venomous snakes, venom, and snakebite beliefs and remedies, and two short chapters discuss the "Edible Snake" and "Pet Snake," emphasizing the meaning behind these respective uses of snakes by humans. A final chapter, "Vogue Snake," examines snakes in art,

fashion, film, and popular culture. The book closes with a timeline of snakes, a bibliography, a series of recipes involving snakes, a list of herpetological associations and websites, and an index. This idiosyncratic volume is difficult to describe, but is full of fascinating information, much of which will be new to most herpetologists. The illustrations, many in color, are especially intriguing, although purists will be disappointed that many classic herpetological plates are reproduced without reference to the works in which they appeared.

Ecological Consequences of Artificial Night Lighting, edited by Catherine Rich and Travis Longcore. 2006. Island Press, 1718 Connecticut Avenue, NW, Suite 300, Washington, DC 20009. xx + 458 pp. Softcover. US $29.95 (Cloth: $65.00). ISBN 1-55963-129-5 (Cloth: 1-55963-128-7).

This edited volume considers the effects of artificial light on all major groups of vertebrates, as well as insects, freshwater invertebrates, and plants. Four chapters totaling 114 pages, or one fourth of the book, are devoted to amphibians and reptiles. A chapter by Michael Salmon documents how artificial light impacts sea turtle nest site selection and orientation of hatchlings and discusses methods of light mitigation and comprehensive light management plans in place in parts of Florida. Gad Perry and Robert N. Fisher consider the effects of lights on lizards and snakes, which include both positive (enhanced or extended foraging) and negative (increased predation risk and decreased foraging success) aspects. They also review studies that indicate that photoperiod and/or light intensity may influence squamate behavior and that artificial light may affect interspecific interactions. Bryant W. Buchanan evaluates the effects of artificial night lighting on anuran aggregation, foraging, reproductive, antipredator, and photoperiodic behavior, egg and larval development, and tadpole behavior. In addition he outlines the consequences of spectral composition and illumination intensity on the visual system and on behavior. A final herpetological chapter by Sharon E. Wise and Buchanan deals with the behavioral and physiological responses of salamanders to artificial light including changes in territorial behavior, endocrine function, metabolic rates, activity, orientation, and homing. This book makes an important contribution to the understanding of the growing problem of light pollution and will be of interest to a broad range of herpetologists and other biologists, especially those whose organisms occupy urban and suburban habitats or other areas that experience significant artificial illumination.

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ARTICLES

TECHNIQUES

POINTS OF VIEW

RECENT POPULATION CHANGES

HERPETOLOGICAL HUSBANDRY

identify individuals in a population. For example, with 2–4 injection sites on our geckos (i.e., the near-transparent undersides of knee and elbow joints), a large number of unique color combinations was possible given the availability of five readily distinguishable VIE colors, and the experimenter's own injection-pattern variability. The greater effort and higher cost of elastomer, relative to the other surface-marking methods we tested, are outweighed by the longer retention time of the VIE.

Acknowledgements.—We thank R. McCord for anecdotal inspiration and B. Joslin for advice on capture locations and capture tactics. We also thank S. Nolan, M. Sessions, and B. Adelson for field companionship and assistance and K. Wright for loan of the heat lamp. We thank G. Rodda and an anonymous reviewer for their comments. Geckos were captured under Arizona Game and Fish Department collecting permit SP636712, issued to KEB. Geckos were marked under University of Arizona IACUC permit 03–023.

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POINTS OF VIEW

Herpetological Review, 2006, 37(3), 321–325.

The Evolution of Three Deviations from the Biphasic Anuran Life Cycle: Alternatives to Selection

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The origins of the diversity of breeding modes in anurans beg for more focused hypotheses, but no suggestion for the evolution of any grade of endotrophy (= development without a free-living, feeding tadpole *sensu* Altig and Johnston 1989) has received rigorous testing (e.g., Salthe and Duellman 1973). Direct development occurs in at least nine anuran families (Thibaudeau and Altig 1999), and other grades of endotrophy add to the list of deviations from the classical biphasic anuran life cycle. Selection has been proposed as the process by which these various reproductive modes arose (e.g., Downie 1993; Magnusson and Hero 1991). The prevalence of these breeding patterns in species rich, tropical assemblages has presumably been caused by selection for escaping crowded (i.e., competitors) and hostile (i.e., predators and abiotic factors) aquatic habitats (e.g., Duellman 1978). Yet, hundreds of species reproduce in aquatic sites in many habitats despite experiencing low and sporadic recruitment (e.g., Greenberg and Tanner 2005). Accordingly, we should not assume that any of these reproductive deviations afford vastly superior recruitment over the typical life cycle (e.g., Roberts 1994; Rödel et al. 2002), especially when egg survival is the only criterion that is commonly reported.

In the near absence of prevailing hypotheses that address the evolution of these various developmental modes (see Callery et al. 2001), we discuss an alternative to selection. We argue for a nonhierarchical approach in a system that suggests a hierarchical structure. Adhering to a hierarchical system oversimplifies a complicated process and inhibits finding a viable solution. Many broad questions need to be answered, and only after the collection of pertinent specimens and data can we eventually revisit the larger question of the evolution of divergent reproductive modes. We discuss three reproductive grades as examples that we propose have arisen independently by different genetic mechanisms, usually multiple times: arboreal eggs, nidicolous larvae (= variously modified, nonfeeding tadpoles usually confined to a "nest"), and direct developers (= froglet hatches from egg jellies). With an understanding of developmental biology increasing daily (e.g., Gilbert 2001; Raff 1996; Robert et al. 2001), discussions of competing hypotheses should help direct future studies.

We argue that those taxa that lay arboreal eggs over water and develop normally as tadpoles achieved those capabilities via se-

lective forces that coordinated two primary subjects: initially the calling behaviors of males and subsequently the ovipositional activities of females. If we assume that a male calling from the ground near a breeding site and laying eggs with a female in the adjacent water is the ancestral state, then males calling from elevated sites might be a first step in the evolution of arboreal oviposition. This move by the male was likely stimulated by selection for better spatial and acoustic resolution for mate choice in multispecies choruses. At least three variations in female activities can be recognized in what may be a logical progression: (1) a female goes to a male on an elevated perch and the amplexed pair returns to the water to oviposit (e.g., *Hyla avivoca* and *H. cinerea*; the female is not required to collect cloacal water for egg hydration), (2) a female goes to an elevated male and the amplexed pair returns to the water so that the female can gather cloacal water to hydrate eggs before returning to an elevated site for oviposition (e.g., *Pachymedusa dacnicolor*; Bagnara et al. 1986), and (3) a female goes to an elevated male and oviposits at an arboreal site (e.g., several dendrobatids and leptodactylids). In the third case, the female's actions prior to traveling to the male and/or the characteristics of the eggs must have evolved relative to the other two cases. In the absence of prior changes in eggs or development, we assert that none of these situations is a precursor to direct development. Analyses by Roberts (1994) showed that arboreal eggs evolved independently at least 10 times in Anura, that this mode evolved within lineages having both aquatic and terrestrial oviposition sites, and that it sometimes reverted to the presumed ancestral state. The hypothesis that this mode evolved in response to intense predation in aquatic systems was not supported (Roberts 1994).

We suggest that at least minor changes in egg energetics, egg jelly, and developmental trajectories must precede ovipositional changes for a pathway to lead to a total escape from the aquatic system. Developmental changes indicative of increased yolk density (e.g., Chipman et al. 1999) occur in numerous taxa, but we have little understanding of the relationships among ovum sizes, yolk gradients, or energy contents (Thibaudeau and Altig 1999; see Komoroski and Congdon 2001). Larger eggs result in larger larvae that maintain their size and growth advantages throughout their ontogeny (e.g., Dziminski and Alford 2005), but we have little idea which characteristics of a large egg promote these responses. A proportional increase in energy content is presumed, but this, and variations in other kinds of maternal provisioning, need verification among taxa representing diverse breeding modes.

Is the embryology of direct development more expensive than exotrophic development and is the increase in yolk in large, direct-developing eggs intended for embryological or posthatching development? Physical factors associated with being in air, energy sources and RNA transcripts provided by the mother during vitellogenesis, and provisioning of posthatchlings that are sometimes very small (e.g., hatchling *Sooglossus gardineri* are ca. 1 mm SVL; pers. observ.) are important factors to consider. Knowledge of the kinds and amounts of maternal provisioning of eggs from species that represent a number of reproductive modes are needed before we can start to understand the energetics of development. Changes in breeding mode likely occur only when a number of factors occur collaboratively, if not synergistically. For example, we reject the idea that arboreal foam nests involving numerous small eggs could be a precursor to direct development (Bossyut and Milinkovitch 2000). In this case, the eggs are out of water, but none of the other factors we consider required for the transition to direct development is present. This disagreement illustrates that we do not know enough about the probable sequence or many interactions of adults, ova, and development underlying such a transition in reproductive mode.

We suggest that the multiple occurrences of nidicoly represent independent truncations of normal development, but the specific benefits of these developmental modes remain unclear. Although nidicolous species likely share some of the presumed fitness benefits of arboreal eggs or direct development, we suggest that nidicoly has no developmental, genetic, or evolutionary associations with the other two modes. The details of a nidicolous ontogeny surely proceeds by patterns similar to typical larvae, whereas direct development involves a highly modified developmental pattern that does not involve developmental truncations, at least of similar kinds; nidicolous larvae likely are paedomorphic products of more modest regulatory changes (see below) while not violating metamorphic constraints required to recover a frog morphotype. If we knew which characters are affected to what degree and in what sequence or associations (see Thibaudeau and Altig 1999), then we would know the primacy of developmental occurrences, their developmental integration, and thus the relative degree of the truncation.

Direct development is different from the development of exotrophic tadpoles in a biphasic life cycle in many ways beyond the obvious developmental differences and the retention of a subtle, thyroid-based metamorphosis (Callery and Elinson 2000). Such differences include a precocial neural tube anatomy (Schlosser 2003), a different mode of abdominal wall formation (Elinson and Fang 1998), limb development in the absence of an apical ectodermal ridge (Richardson et al. 1998), and at least three types of tail development (i.e., small tails, with small fins, flexed ventrally, some myobatrachids (M. Anstis, pers. comm.); larger tails with large fins, flexed ventrally, some microhylids (pers. observ.); and larger tails with large fins, flexed laterally, some leptodactylids (Townsend and Stewart 1985). Admittedly our perspectives are myopic because most data are based on one species of *Eleutherodactylus*.

The unusual embryology (Elinson and Del Pino 1985), development (Wassersug and Duellman 1984), and unique bell gills of amphignathodontids (*sensu* Frost et al. 2006), although based largely on studies of one species of *Gastrotheca*, represent perhaps another form of endotrophy besides those discussed above. In no other genus is there a scattering of froglet-producing and tadpole-producing species. Wassersug and Duellman's (1984) suggestion that tadpoles are produced by some form of truncation of the froglet-producing program is debatable, but at least the reproductive diversity in this genus suggests that a variety of developmental programs can be switched rather easily, or often, among members of some lineages.

The primary alternative hypothesis for the origin of direct development is: although unknown selective pressures acted on prerequisites (e.g., ovum characteristics), the actual originations of direct development did not involve selection. The presumed switch from exotrophic tadpoles to direct development most likely occurred via major regulatory gene(s) deep within the developmen-

tal cascade, and the wide-ranging occurrences of direct development among families suggests that the genomes of all frogs contain the basic components of this developmental program. The origin of this novel embryogenesis must have been associated with a release from the developmental bias or constraint that governed the biphasic life cycle. There is no need to invoke gradual change via small multiple steps, each selected along the way. Instead there could have been a single, radical developmental change that bypassed the typical larval stage. Concomitant with that change, an independently evolved novel egg phenotype allowed the first direct developer to succeed, and selection would operate after the fact to maintain the novel embryogenesis. The release from the developmental bias can be viewed simply as the removal of barriers to developmental experimentation in contrast to some directional process. From this perspective, we should expect to find the various novel phenotypes that have subsequently evolved.

Did these genetic programs evolve in salientian (*sensu* Cannatella and Hillis 1993) life histories or are they even older? Direct development occurs in salamanders and caecilians, although the actual ramifications of it vary because of developmental patterns unique to each group. Drastic changes in structural genes were likely not required, thus the end product only allowed those taxa involved to expand into new reproductive niches. Viewing the morphologies of the three developmental deviations described above in a series from least-to-most modified (assuming we had the data to do this), would show the various potentials of developmental genetics but no corresponding phylogenetic affinities among grades. None of the three grades seemingly provides the requisite morphologies from which any of the other two could be derived.

Our proposal was generated from an observation and a presumption. Direct development has evolved numerous times (e.g., Marmayou et al. 2000 for a specific example) with many commonalities and differences across taxa. Conversely, the multiple occurrences of this developmental pattern based on successfully coordinated point mutations seem less plausible than being caused by basal regulatory changes (see above). The alternative, which cannot be resolved because of our paltry database, that the presumed similarities in morphology, behavior, and physiology of direct developers are produced by some unknown number of convergent genetic manipulations, seems equally unlikely because of the complexity of the many developmental changes.

If anuran development is capable of switching from exotrophic to endotrophic development by a yet unknown mechanism, perhaps the reverse occurs. Could the morphological oddities of exotrophic microhylid tadpoles (e.g., Wassersug 1989) be an example of an exotrophic tadpole with endotrophy in its ancestry? Thus, do all tadpoles have the same phylo-developmental history? Such initially outlandish scenarios gain credence in light of discussions (e.g., Chippindale et al. 2004; Mueller et al. 2004) that suggest developmental switches within lineages. Even though these particular cases involve salamanders wherein the direct developers are not nearly as divergent from typical cases as occurs in frogs, the genetic bases for such modifications are at least present in the genome of amphibians.

Other research fields may offer insights into the developmental patterns of direct development and its origins. For example, an exotrophic larva is immunocompetent, but it must reduce its immunocompetence by eradicating certain larval lymphocytes to avoid autoimmune responses when novel proteins appear at metamorphosis (Rollins-Smith 1998; Ruben et al. 1989). Direct development may be a means of avoiding metamorphic antigens without the hazards of immunosuppression. Model-based studies of metamorphic immunosuppression do not include information on direct developers. Also, if direct development involves upregulation of gene expressions, the energetic costs (Wagner 2005) may be an influential factor. Next, Galis et al. (2003) suggested that limb regeneration occurs readily in amphibians but not other tetrapods because the late development of the limbs removes a constraint of being associated with the development of the main body axis. If true, the patterns of limb regeneration (see Alvarado 2000; Brockes et al. 2001) in direct developers, whose limbs develop concurrently with the body axis, may more closely resemble the developmental patterns of reptiles. Last, certain marine invertebrates with varied developmental patterns have been studied in more detail than amphibians. For example, Strathman et al. (2002) noted that embryos that experience parental care develop more slowly than, in their case, free-living, planktonic forms. More informatively, these researchers suggested that slower development may permit compensation for less maternal investment of rate-limiting materials to the eggs and correction of developmental errors. This is the reverse of the common assumption (e.g., Dziminski and Alford 2005) that the large eggs of direct developers are better provisioned, and parental care was suggested as the equalizing factor.

The typically low species diversity among direct-developing lineages suggests that these developmental patterns are not entirely successful. The extant taxa could be the surviving members of larger assemblages in the past, but the fact that ca. 44% of the direct-developing taxa are not monophyletic with other direct-developing lineages suggests that selection did not produce the loss of the aquatic tadpole stage. Selection undoubtedly has maintained these lineages, but we argued above that the required embryological changes were not borne from selective forces per se. Species-rich exceptions may involve undetected developmental improvements over the clades with fewer species, or speciation in these lineages perhaps is not influenced by the success of their developmental modes.

Examples from the rapidly growing evolutionary and genetic literature give us a viewpoint from which to discuss new hypotheses. We do not propose actual mechanisms that may have been instrumental in the originations of any of the three developmental grades discussed here, but it is obvious that we are gaining access to relevant mechanisms that appear to give natural selection much more latitude to operate on a faster time scale. Arthur (2002) proposed the "biased embryo" hypothesis (i.e., the tendency for developmental systems to produce variant trajectories in some directions more readily than others) with four organismal levels of reprogramming that act as partners with selection. Fondon and Garner (2004) proposed that gene-associated tandem repeat expansions and contractions in *Hox*-family genes could promote rapid morphological change. Building on these studies, Ruden et al. (2005) hypothesized that stressors could be the trigger. Dehydration and thus ion balance, gas exchange, immunological factors, and changes in egg provisioning are possible options for stressors in the cases discussed here. The *Bmp*4 gene (Abzhanov et al. 2004; Albertson et al. 2005) is an interesting candidate for developmental adjustments in both direct-developing and typical amphibian

larvae.

Evolutionary and developmental geneticists should be aware that natural experiments in amphibian developmental patterns are awaiting explanations; there are frogs other than *Xenopus* that are strange in more interesting ways.

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RECENT POPULATION CHANGES

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The Status of Two Northern Leopard Frog Populations in Western Montana

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Since the 1970s the Northern Leopard Frog (*Rana pipiens*) has experienced significant declines in the western United States and Canada (Clarkson and Rorabough 1989; Corn and Fogelman 1984; Corn et al.1989; Hayes and Jennings 1986; Leonard et al. 1999; Orchard 1992; Roberts 1992; Wagner 1997). In western Montana, Northern Leopard Frogs were not detected at 31 historical sites and 1,324 non-historical sites, about half of which were considered suitable for *R. pipiens*, surveyed between 1997 and 2002 (Werner 2003). During these surveys, two extant, but previously unknown populations, known as the Foy Lakes and Meadow Chain-of-Lakes populations, were found (Fig. 1, Werner 2003). In 2002 to 2005, we initiated new, more intensive surveys of these two populations. Herein, we summarize their recent history (1995-2001), and from 2002–2005 surveys, we address their geographic range, approximate size, and level of reproduction.

MATERIALS AND METHODS

The Foy Lakes population is located in Flathead County, Montana, 2.2 km W of Kalispell, on a chain of four interconnected lakes (Fig. 1). The area covers about 7 km^2 and is located mostly on private lands with housing developments around some lakes. The presence of Northern Leopard Frogs at Foy Lakes was first made known to us in 1997. The closest historical record for this frog is at Smith Lake National Wildlife Refuge (NWR), approximately 8 km to the southwest in the same drainage, but the last observation of the frog at the refuge was in 1974. Surveys since 1993 failed to find frogs at the Smith Lake NWR or other nearby sites (Werner 2003).

The Meadow Chain-of-Lakes population (hereafter, "Chain-of-Lakes") is located 2.5 km S of Eureka in Lincoln County, Montana (Fig. 2). Chain-of-Lakes is situated on a timbered plateau ca. 125 m above the Tobacco River Valley. The area covers ca. 64 km^2 with numerous interconnecting lakes, ponds and wetlands except during dry years when smaller ponds and interconnecting waterways dry up. Historically, Northern Leopard Frogs were known from several lakes in the Tobacco River valley 10 km to the north, although no frogs were found at those sites in recent surveys (Werner 2003). We first observed Northern Leopard Frogs at Chain-of-Lakes in 1997.

We gathered background information prior to 2002 for the Foy Lakes and Chain-of-Lakes areas from unpublished surveys done by state and federal agencies, by the authors, or by other individuals. Most reports were of sporadic surveys made during the spring or summer, usually with an objective to determine species richness, and were conducted by individuals having a wide range of experience. Hence, direct comparisons to the 2002 to 2005 surveys were not possible, but the data are included here because they provide a historical record and point of reference for discussion.

Beginning in 2002, our goal was to survey all marshes, ponds, and lakes within the Foy Lakes and Chain-of-Lakes areas for 3–4

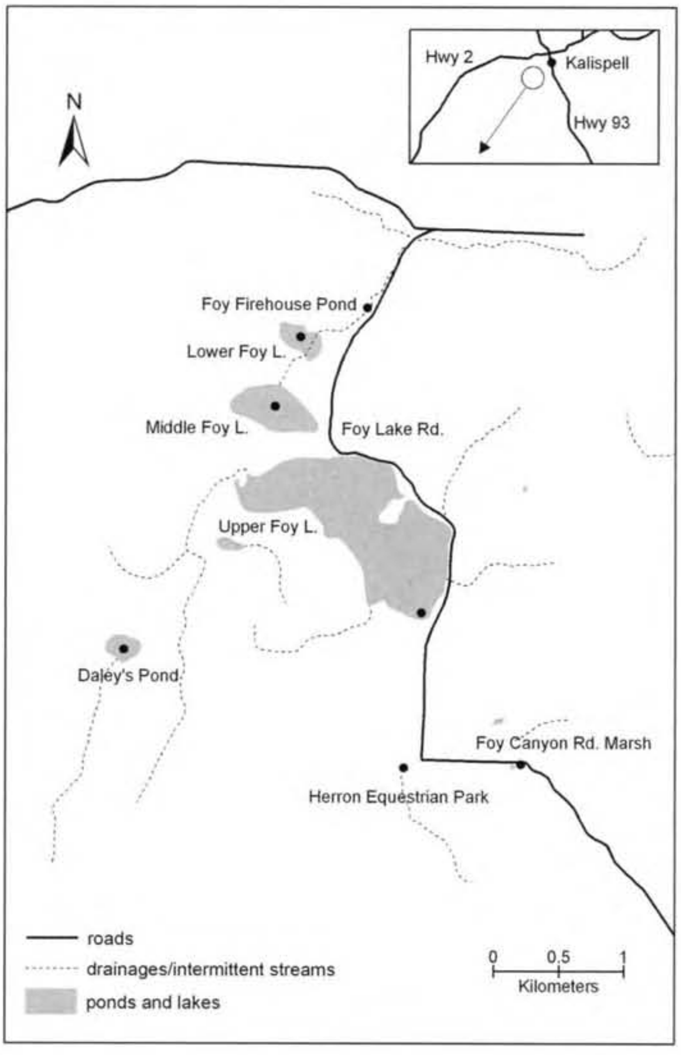

FIG. 1. Foy Lakes survey area in western Montana, USA.

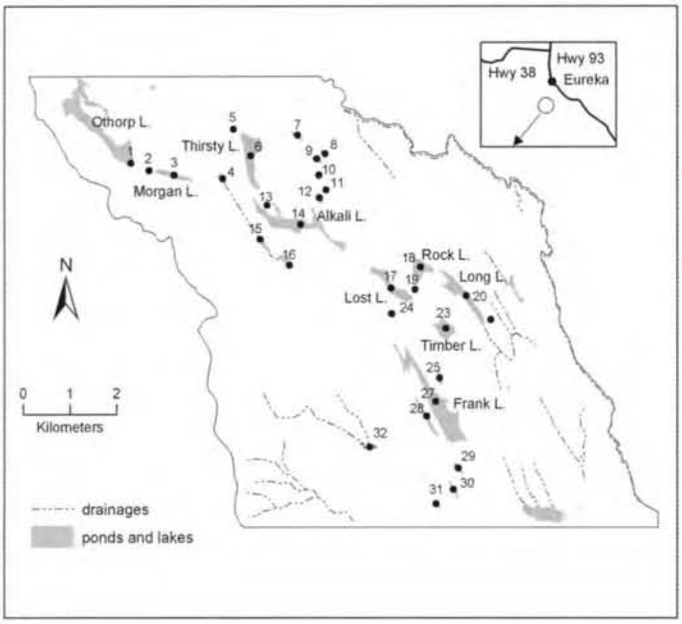

FIG. 2. Meadow Chain-of-Lakes survey area, Murphy Lake District, Kootenai National Forest, Montana, USA. Numbers correspond to survey sites listed in Table 4.

consecutive years. Within both areas, we designated each wetland type as a separate site. One to six people (usually two to four) undertook visual encounter surveys for 15 min to 3 h per site using methods described by Thoms et al. (1997) and in accord with the schedule below. For marshes, ponds, and small lakes, we surveyed the entire perimeter and dipnetted in the shallow water zone at regular intervals of about 3 m. The physical size of larger lakes and private ownership of shorelines in some instances, required that we be selective in choosing what areas to survey around larger lakes. Based on our previous experience in this area, we concluded that shorelines with steep, abrupt edges or rocky cliffs, and shorelines of open sand and gravel with no emergent vegetation, were not suitable leopard frog habitat, and hence we did not survey them. In the Foy Lakes area, about 50% of the total shoreline making up the Upper, Middle and Lower Foy lakes was not surveyed, with about 90% of the un-surveyed area being regarded as non-suitable habitat, and about 10% was likely suitable habitat but not accessible due to private ownership. In the Chain-of-Lakes area, about 15% of the large lake shoreline was not surveyed, 98% of the un-surveyed area was regarded as non-suitable habitat, and 2% was suitable habitat but inaccessible due to private ownership. Larger lakes with only a portion of their shoreline surveyed were noted. Surveys at larger lakes were conducted in the same manner as ponds and small lakes except for a more sporadic pattern of dipnetting in near-shore zones.

In 2002, we attempted to survey all sites three times, once in early spring during breeding, a second time in late June/early July when tadpoles should have been present, and again in late July/early August when new metamorphs should have been present. However, some smaller marshes and ponds dried up by June or July and all three surveys could not be completed. In 2003 and 2004, we surveyed the same sites unless they were dry, once in late June/early July and again in late July/early August. In 2005, we surveyed in late June only those sites where frogs had been seen previously. Marshes and ponds that dried each year were recorded. During each survey, we assumed frogs were counted only once, but this was not verified because frogs were not captured or marked. Consequently, we did not attempt to estimate population size.

In 2002, we also conducted auditory surveys at wetlands where Northern Leopard Frogs had been sighted in previous years' surveys. We did auditory surveys at night, playing a tape recording of Northern Leopard Frog calls while walking slowly around the periphery of ponds, or paddling a canoe slowly along the edge of larger lakes.

RESULTS

Foy Lakes Population.—In 14 surveys conducted between 1997 and 2001, observers reported Northern Leopard Frogs at five Foy Lakes sites (Table 1, Fig. 1). These early surveys reported only adults at four sites, but at the fifth site, Lower Foy Lake, 111 juveniles and 154 adults were seen in 1998, and 10 egg masses were observed during spring 2001. In a late summer survey, however, no tadpoles or metamorphs were seen at or near the oviposition site, and in 2002 no young frogs were observed, implying that the reproductive effort may have failed. The authors of these early reports distinguished juveniles from adults based on relative body size, but no body lengths were measured.

During 2002 to 2005, we conducted 39 surveys at seven sites involving 46 person-hrs of observation (Table 2). We conducted only limited surveys at three, Daley's Pond, Foy Canyon Rd marsh, and Herron Equestrian Park because they either dried up by early spring or in the case of Herron Equestrian Park, the wetland was altered as part of a renovation project (Table 2). Overall, we saw Northern Leopard Frogs at three sites (Foy Firehouse Pond, Lower Foy Lake, and Middle Foy Lake) with 0 to 12 frogs being observed per survey. Over all four years, the mean detection rate was 1.2 frogs per person-hr. We compared data among years at the two sites with the highest detection rates (Foy Firehouse Pond and Lower Foy Lake, Table 3). June data were chosen because they provided the most uniform survey conditions over all four years. Averaged together, the detection rate (frogs/person-hr) at these two sites was 2.3 in 2002, 5.3 in 2003, 2.0 in 2004, and 1.0 in 2005 with an overall mean of 3.1. Notable among all surveys was our August 2004 sighting of 3 metamorphs and 1 adult at Lower Foy Lake, and 4 metamorphs at Foy Firehouse Pond, indicating at least one successful egg-laying event. In 2005, 7 more metamorphs were seen at Lower Foy Lake, again indicating at least one successful egg-laying event. We saw no frogs at Herron Equestrian Park or Upper Foy Lake where adults were reported in 1997 and 1998 surveys.

Chain-of-Lakes Population.—In surveys conducted between 1995 and 2001, Northern Leopard frogs were seen at six sites (Table 4). Successful reproduction is supported at Chain-of-Lakes prior to 2002 as indicated by reports of juveniles at Leopard Ponds in 1995, 1997, and 1998, tadpoles at Rock Lake in 1996, juveniles at Summerville Lake in 1996, and juveniles at Timber Lake in 2000. Again, observers distinguished juveniles from adults based on relative body size, but no body measurements were actually made. An egg mass was seen at Leopard Ponds in 1997, but it could have been either from a Columbia Spotted Frog (*Rana luteiventris*) or

TABLE 1. Summary of 1997–2001 surveys conducted in the Foy Lakes area (UTM coordinates for Zone 11, NAD 83). "—" indicates site was not surveyed until 2002. E = Egg masses; J = Juveniles; A = Adults.

Site	Survey Years	No. Surveys	No. surveys detecting *R. pipiens*	Total No. Reported
Daley's Pond (694613mE, 5336976mN)	—			
Foy Canyon Rd. Marsh (697715mE, 52336341mN)	'98	1	0	0
Foy Firehouse Pond (696252mE, 5339697mN)	'98, '01	2	2	9A
Herron Equestrian Park (696785mE, 5336243mN)	'97, '98	3	2	2A
Lower Foy Lake (695764mE, 5339436mN)	'98, '99, '01	6	6	10E, 111J, 188A
Middle Foy Lake (695614mE, 5338898mN)	'98	1	1	15A
Upper Foy Lake, SE (696845mE, 5337430mN)	'98	1	1	10A
Totals:		14	12	10E, 111J, 224A

TABLE 2. Results of 2002–2005 surveys for the Northern Leopard Frog (*Rana pipiens*) in the Foy Lakes area, Montana, USA.

	2002		2003		2004		2005		2002–2005 Totals	
Site	No. Surveys	No. Frogs/ Person-Hr	No. Surveys	No. Frogs/ Person-Hr	No. Surveys	No. Frogs/ Person-Hr	No. Surveys	No. Frogs/ Person-Hr	No. of Surveys	No. Frogs/ Person-Hr
Daley's Pond	2[b]	0/2	0[b]	-	0[b]	-	0[b]	-	2	0/2 = 0.00
Foy Canyon Rd. Marsh	2[b]	0/2	1[b]	0/1	0[b]	-	0[b]	-	3	0/3 = 0.00
Foy Firehouse Pond	3	6/4	2	13/3	2	4[c]/2	1	0/1	8	23/10 = 2.30
Herron Equestrian Park	1[b]	0/1	1[b]	0/1	0[b]	-	0[b]	-	2	0/2 = 0.00
Lower Foy Lake[a]	3	4/5	2	12/3	2	4[d]/2	1	9[e]/2	8	29/12 = 2.42
Middle Foy Lake[a]	3	0/4	2	1/2	2	0/2	1	0/1	8	1/9 = 0.11
Upper Foy Lake, SE[a]	3	0/3	2	0/2	2	0/2	1	0/1	8	0/8 = 0.00
Yearly Totals	17	10/21	10	26/12	8	8/8	4	9/5	39	53/46 = 1.15
No. of Frogs/Hr. Search		= 0.48		= 2.17		= 1.00		= 1.8		

[a] Large lake where only a portion of the shoreline was surveyed; see text for explanation.
[b] Number of surveys limited due to wetland drying up, or in the case of the Herron Equestrian Park, a human caused alteration in the drainage.
[c] All 4 frogs were metamorphs
[d] Includes 1 adult and 3 metamorphs
[e] Includes 2 adults and 7 metamorphs

TABLE 3. Survey results from June, 2002–2005 at the two sites with the highest detection rates of Northern Leopard Frogs (*Rana pipiens*) in Foy Lakes and Meadow Chain-of-Lakes, Montana, USA. Site numbers at Chain-of-Lakes correspond to those shown in Fig. 2.

Site	2002 No. Frogs/ Person-Hr	2003 No. Frogs/ Person-Hr	2004 No. Frogs/ Person-Hr	2005 No. Frogs/ Person-Hr	2002–2005 Total No. Frogs/ Person-Hr
Foy Lakes					
Foy Firehouse Pond	5/1	9/2	0/1	0/1	14/5
Lower Foy Lake	2/2	12/2	4/1	2/1	20/6
Total (Average)	(2.33)	(5.25)	(2.00)	(1.00)	(3.09)
Chain-of-Lakes					
No. 3 Morgan Lake	2/4	1/6	0/4	0/5	3/19
No. 23 Timber Lake	2/5	1/4	0/5	0/5	3/19
Total (Average)	(0.44)	(0.20)	(0.00)	(0.00)	(0.16)

the Northern Leopard Frog. Observers reported adult frogs at two other sites, Frank Lake in 1996 and 1998, and Heather Pond in 1996, 1998, and 1999. All six sites are within a 4 km^2 area.

From 2002 to 2005, we conducted 168 surveys at 30 sites involving 724 person-hrs of observation. Limited surveys at 7 of 30 sites were conducted due to wetland drying, or on a few occasions, temporarily being unable to access a wetland on private land (Table 5). During the 2002 and 2003 surveys, we saw only 1 or 2 adult frogs per survey at Hayes Pond, Morgan Lake, Othorp Lake, Frank Lake, Summerville Lake, and Timber Lake, but no frogs at these sites during the 2004 and 2005 surveys (Table 5). The first three sites, Hayes Pond, Morgan and Othorp Lakes had not been surveyed prior to 2002; the last three sites were known to have frogs present before 2002 (Table 4). Also, we did not see frogs at Rock Lake or Heather Pond where they had been reported prior to 2002. We saw 0.02 frogs/person-hr averaged over all four years. When considering only the June 2002 to 2005 surveys at the two sites with the highest detection rates (Morgan Lake and Timber Lake), and combining the results, we saw detection rates ranging from 0 to 0.4 frogs/person-hr (Table 3). We saw no eggs, tadpoles, or metamorphs at any of the 30 sites during the 2002 to 2005 surveys.

Discussion

Despite using similar survey methods, it is difficult to compare

Table 4. Summary of 1995–2001 surveys conducted in the Meadow Chain-of-Lakes area, Murphy Lake District, Kootenai National Forest, Montana, USA (UTM coordinates for NAD 83). Site numbers correspond to those shown in Fig. 2. "—" indicates site was not surveyed until 2002. E? = egg mass present but uncertain whether it was from *R. pipiens* or *R. luteiventris*; T = Tadpoles; J = Juveniles; A = Adults.

Site	Survey Years	No. Surveys	No. surveys detecting *R. pipiens*	Total No. Frogs Reported
No. 1 Othorp Lake (640059mE, 5412216mN)	—			
No. 2 Moroth Pond (640459mE, 5412052mN)	—			
No. 3 Morgan Lake (640983mE, 5411967mN)	'98	1	0	0
No. 4 Turtle Lake (642032mE, 5411880mN)	'01	1	0	0
No. 5 Thirsty Lake Pond (642256mE, 5412902mN)	—			
No. 6 Thirsty Lake (642647mE, 5412287mN)	'96	1	0	0
No. 7 Pond 7 (643639mE, 5412780mN)	'98, '99	2	0	0
No. 8 Moose Pond (655208mE, 5412398mN)	'96, '98, '99	4	0	0
No. 9 Pond 9 (644037mE, 5412278mN)	—			
No. 10 State Pond 10 (644087mE, 5411987mN)	'96, '00	2	0	0
No. 11 State Pond 11 (644227mE, 5411660mN)	—			
No. 12 State Pond 12 (644101mE, 5411472mN)	—			
No. 13 Alkthir Pond (642964mE, 5411322mN)	—			
No. 14 Alkali Lake (5410968mN, 643543mE)	'95, '96, '99, '00	4	0	0
No. 15 Stoeckly Marsh (642831mE, 5410598mN)	—			
No. 16 Stoekly Lake (643459mE, 5410059mN)	—			
No. 17 Lost Lake (645492mE, 5409817mN)	'95, '96, '00, '01	4	0	0
No. 18 Rock Lake (646202mE, 5410112mN)	'95–'01	7	2	>50T, 3A
No. 19 Leopard Ponds (646060Em, 5409680Nm)	'95–'01	14	8	1E?, 18J 17A
No. 20 Long Lake (647043Em, 5409554Nm)	'01	1	0	0
No. 22 Nichols Pond (647733Em, 5408919Nm)	—			
No. 23 Timber Lake (646774Em, 5497671Nm)	'00, '01	5	4	16J, 8A
No. 24 Heather Pond (645643Em, 5409056Nm)	'96–'01	9	6	6A
No. 25 Hayes Pond (646649Em, 5407706Nm)	—			
No. 27 Frank Lake (646718Em, 5407170Nm)	'95, '96, '98–'01	6	3	6A
No. 28 Summerville Lake (646271Em, 5407017Nm)	'96, '98–'01	7	2	>13J, 11A
No. 29 Pond 29 (647058Em, 5405810Nm)	—			
No. 30 Toad Farm Pond (646945Em, 5405373Nm)	01	1	0	0
No. 31 Sec 19 Pond (646583Em, 5405070Nm)	98, '99, '01	3	0	0
No. 32 Marsh 32 (645181Em, 5406263Nm)	—			
Totals:		70	25	1E?, >50T 47J, 51A

TABLE 5. Results of 2002–2005 surveys for the Northern Leopard Frogs (*Rana pipiens*) in the Meadow Chain-of-Lakes area, Murphy Lake District, Kootenai National Forest, Montana, USA. UTM's for each site are given in Table 3. Site numbers correspond to those shown in Fig. 2.

	2002		2003		2004		2005		2002–2005 Totals	
Site	No. Surveys	No. Frogs/ Person-Hr	No. Surveys	No. Frogs/ Person-Hr	No. Surveys	No. Frogs/ Person-Hr	No. Surveys	No. Frogs/ Person-Hr	No. Surveys	No. Frogs/ Person-Hr
No. 1 Othorp Lake[a]	3	1/12	2	0/9	2	0/8	0	—	7	1/29 = 0.03
No. 2 Moroth Pond	3	0/9	2	0/5	1[b]	0/1	0	—	6	0/15 = 0
No. 3 Morgan Lake	3	2/17	2	1/17	2	0/9	1	0/5	8	3/48 = 0.06
No. 4 Turtle Lake	3	0/10	1	0/6	2	0/5	0	—	6	0/21 = 0
No. 5 Thirsty Lake Pond	1[b]	0/1	0[b]	—	1[b]	0/1	0	—	2	0/2 = 0
No. 6 Thirsty Lake	3	0/16	1	0/9	2	0/16	0	—	6	0/41 = 0
No. 7 Pond 7	2	0/4	1[b]	0/1	0[b]	—	0	—	3	0/5 = 0
No. 8 Moose Pond	3	0/7	1[b]	0/5	2	0/7	0	—	6	0/19 = 0
No. 9 Pond 9	2[b]	0/9	0[b]	—	0[b]	—	0	—	2	0/9 = 0
No. 10 State Pond 10	3	0/17	1[b]	0/1	1[b]	0/5	0	—	5	0/23 = 0
No. 11 State Pond 11	2[b]	0/11	1[b]	0/2	1[b]	0/2	0	—	4	0/15 = 0
No. 12 State Pond 12	3	0/13	1[b]	0/4	0[b]	—	0	—	4	0/17 = 0
No. 13 Alkthir Pond	2	0/6	0[a]	—	1[b]	0/1	0	—	3	0/7 = 0
No. 14 Alkali Lake	3	0/26	2	0/18	2	0/17	0	—	7	0/61 = 0
No. 15 Stoeckly Marsh	3	0/17	2	0/9	1[b]	0/5	0	—	6	0/31 = 0
No. 16 Stoekly Lake[a]	3	0/11	2	0/9	2	0/5	0	—	7	0/25 = 0
No. 17 Lost Lake[a]	3	0/36	2	0/5	2	0/14	1	0/2	8	0/57 = 0
No. 18 Rock Lake	3	0/35	2	0/12	2	0/7	1	0/4	8	0/58 = 0
No. 19 Leopard Ponds	3	0/7	2	0/6	1[b]	0/2	1	0/3	7	0/18 = 0
No. 20 Long Lake	3	0/28	2	0/15	2	0/9	1	0/6	8	0/58 = 0
No. 22 Nichols Pond	1[b]	0/1	0[b]	—	0[b]	—	0	—	1	0/1 = 0
No. 23 Timber Lake	3	2/17	2	2/3	2	0/7	1	0/5	8	4/32 = 0.13
No. 24 Heather Pond	3	0/10	2	0/4	1[b]	0/1	0	—	6	0/15 = 0
No. 25 Hayes Pond	3	2/3	1[b]	0/2	1	0/1	0	—	5	2/6 = 0.33
No. 27 Frank Lake[a]	3	0/15	2	1/20	2	0/10	1	0/2	8	1/47 = 0.02
No. 28 Summerville Lake[a]	3	1/10	2	0/12	2	0/8	1	0/2	8	1/32 = 0.03
No. 29 Pond 29	3	0/3	1[b]	0/1	0[b]	—	0	—	4	0/4 = 0
No. 30 Toad Farm Pond	3	0/5	2	0/7	2	0/3	0	—	7	0/15 = 0
No. 31 Sec 19 Pond	3	0/4	1[b]	0/1	0[b]	—	0	—	4	0/5 = 0
No. 32 Marsh 32	1[b]	0/1	1[b]	0/2	2	0/5	0	—	4	0/8 = 0
Yearly Totals	80	8/361 = 0.02	41	4/185 = 0.02	39	0/149 = 0	8	0/29 = 0	168	12/724 = 0.02

[a] Large lake where only a portion of the shoreline was surveyed; see text for explanation.
[b] Number of surveys limited due to wetland drying up, or temporarily unable to gain access from private owner at the time of surveying.

the Foy Lakes and Chain-of-Lakes populations directly. Chain-of-Lakes covers nine times the area of Foy Lakes and habitat differs between these locations. Further, we conducted 168 surveys in 724 hours at 30 Chain-of-Lakes sites, and only 39 surveys in 46 hours at seven Foy Lakes sites. Nevertheless, frogs were encountered more frequently at Foy Lakes than Chain-of-Lakes, but detection rates were relatively low at either location.

The existing Foy Lakes population appears to be centered at Lower Foy Lake and Foy Firehouse Pond (Fig. 1). June data at these two sites showed more frogs were present in 2003 (21) than in other years (7 in 2002, 4 in 2004, and 2 in 2005; Table 3). The most significant observation may be the presence of metamorphs in both 2004 and 2005. The last time eggs were observed at either site was at Lower Foy Lake in spring 2001, but no metamorphs were seen afterwards. The last year juveniles were observed at Lower Foy Lake was 1998. Since only a few metamorphs were seen in 2004 (3) and 2005 (7), it is possible that only a single egg-laying event occurred each year. The distance between Lower Foy Lake and Foy Firehouse Pond is 0.4 km so it is possible that metamorphs at both locations originated from the same oviposition site. Given the four year survey period and extensive surveys covering 90% or more of suitable habitat, the Foy Lakes population within the wetlands appears to be very small, consisting mostly of adults, and showing limited reproduction from 2002 to 2005. The results from all or any one survey provide only a partial picture of the total population present at that time, and given unknowns regarding dispersal, the total size and age distribution of the Foy Lakes population remains unknown.

At Chain-of-Lakes, our original impression was that the existing population was centered at Timber Lake because all previous

observations had come from that area (Fig. 2). However, our 2002 and 2003 surveys showed frogs present in the northwest corner at Othorp and Morgan Lakes. Further evidence for a more widespread distribution came in 2005 when 3 adult frogs and possibly tadpoles (they could have been Columbia Spotted Frog) were seen 8 km to the west of Othorp Lake, at Phills Lake, which was out of our survey area. A previous survey at Phills Lake in 2001 was negative for Northern Leopard Frogs. The current situation at Chain-of-Lakes is difficult to assess. Certain indicators of population success seem to show a downward decline (no evidence of reproduction at any sites during the 2002 to 2005 surveys, a total absence of frogs in 2004 and 2005 at sites they had been seen at in 2002, 2003, or earlier, and overall the low number of frogs seen). Still, there are wetlands surrounding Chain-of-Lakes that could be harboring frogs (e.g., Phills Lake). Additional surveys over a larger areas is warranted before conclusions can be drawn regarding the status of the Northern leopard Frog at Chain-of-Lakes.

There is evidence that the chytrid fungus (*Batrachochytrium dendrobatidis*) is a factor in the decline of some amphibians in the western United States (Bradley et al. 2002; Carey et al. 1999, 2003; Davidson et al. 2003; Muths et al. 2003; Ouellet et al. 2005). One of six animals from Foy Lakes tested positive for chytrid fungus in 2004 (PCR assay; Pisces Molecular LLC, 2200 Central Avenue, Suite F, Boulder, Colorado 80301-2841, USA). No animals have been tested at Chain-of-Lakes. Given the small number of frogs observed and their fragmented distribution, it is possible that the Foy Lakes and Chain-of-Lakes populations may be remnants of larger populations that have succumbed to fungal infections. Given the close proximity of Foy Lakes to the Smith Lake NWR, and the latter's extensive wetlands and historical records, re-surveys and fungal testing at the refuge would seem advisable. Northern Leopard Frogs may have been overlooked in earlier surveys because of small numbers. Similarly, re-surveys of sites in the Tobacco River Valley are warranted now that we know frogs occupy the nearby Chain-of-Lakes.

At this point, prognosis for survival of the two populations is uncertain. The Confederated Salish and Kootenai Tribes Wildlife Management Program on the Flathead Indian Reservation, 130 km to the south of Foy Lakes, is currently involved in a Northern Leopard Frog reintroduction project. Hopefully the success of this project, a rebound from one or both of the remaining populations in our study area, or perhaps discovery of other unknown populations will contribute to the persistence of the Northern Leopard Frog in western Montana.

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A Simple Method for Housing *Xenopus* During Oviposition and Obtaining Eggs for Use in FETAX

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The Frog Embryo Teratogenesis Assay – *Xenopus* (FETAX) is a 96-hr whole embryo teratogenesis test useful for detecting developmental toxicants in the environment (Bantle et al. 1994). The versatility of FETAX allows it to be used in screening pure and complex mixtures, toxicity reduction assays, determining structure-activity relationships, examining metabolism of teratogens, and investigating mechanisms of teratogenesis at the molecular and cellular levels (Bantle 1995). Adult *Xenopus* are generally easy to maintain in captivity and can be bred effectively using human chorionic gonadotropin (HCG). Standardized methods for general housing of adults have been developed (ASTM 1991). These standards recommend a 12 h day/12 h night photoperiod, water temperature should be 23°C, and densities of four to six frogs per 1800 cm^2 of water surface area. The sides of aquaria are to be at least 30 cm high and opaque with the water depth 7–14 cm.

During oviposition ASTM (1991) recommends use of 10–20 L glass aquaria fitted with 1-cm mesh suspended about 3 cm from the substrate. This allows the eggs to fall through the mesh where adults will be unlikely to ingest or damage them until removal by the investigator. Recommended mesh is currently nylon or plastic. Using glass aquaria can be dangerous as these can easily break and develop leaks during handling. It is also possible for the frogs to get under the mesh and drown, or damage and ingest eggs.

The standards provide for a second method in which the frogs are housed in two plastic dish pans at least 38 cm × 38 cm (1444 cm^2). These are stacked inside each other. The uppermost pan should be manually perforated with holes using a 1.5 cm cork-borer or other similar device. This is somewhat better than using aquaria. There is little risk of breakage and the frogs cannot become trapped in the egg chamber. Drilling the holes can be an arduous task and hole-placement must be done carefully to avoid extensive plastic bridges where eggs can attach themselves and later be destroyed.

The Rayburn laboratory has determined that sifting cat litter boxes (Fig. 1) provide a safe, effective alternative to either of the previous methods for housing *Xenopus* during oviposition. These containers have served well for breeding over 100 frogs in the last five years. Sifting cat litter boxes can be purchased at discount stores for around US $6.00. These containers are opaque and made of plastic, per ASTM (1991) recommendations and leak-proof. Each set comes with two pans, a sifting grate, and an open lid (Fig. 1).

The pans have a base area of 1260 cm^2 (30 × 42 cm), 184 cm^2 smaller than the ASTM (1991) standard. Each pan is 9 cm deep, allowing a water depth of around 7–8 cm, within the standard recommendations. One of these pans serves as the base housing the frogs. The sifting mechanism, intended for use to remove cat feces from the litter, is seated inside the base tray. The base of the sifting mechanism is composed of a plastic grate with consistent 1 × 2 cm holes. The grate provides adequate safe passageway for the majority of eggs to fall through. The space between the top of the grate and the bottom of the base-pan is sufficient (1–2 cm) to protect eggs from the adults. The lid provided with this kit (Fig. 1) sits on top of the base-pan. It projects 7 cm above the base pan. When the second pan is inverted and placed on top of the "lid," it provides an effective cover to prevent escapes and light penetration. Maintaining a dark environment is important to encourage these frogs to oviposit. The current model of sifting litter box has holes drilled on either side so that the whole assembly could be locked or otherwise fastened together to avoid escape or tampering. If similar models do not have these holes they would be easy to install with a small drill or cork-borer.

The eggs will stick to the bottom pan and can be easily removed using an inverted plastic petri dish to scrape them from the base. Eggs that stick to the grate can be removed in two ways. The first method is to use forceps or probes to remove eggs from the grate manually. This takes quite a bit of time. The second method in-

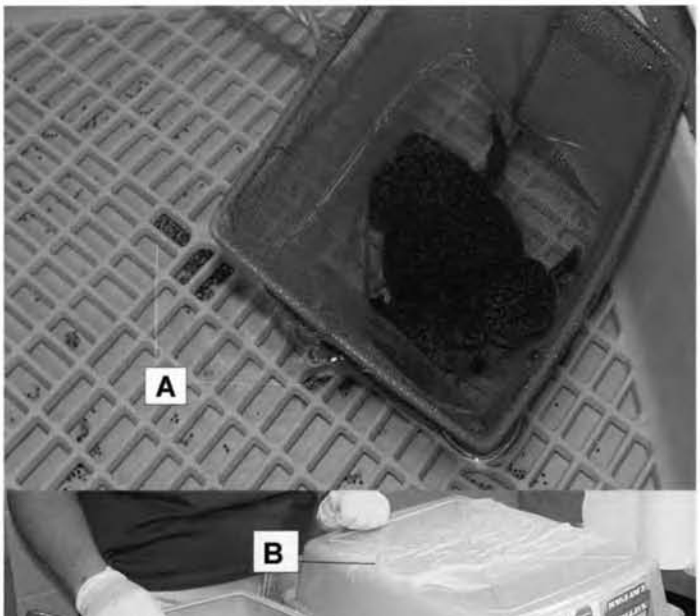

Fig. 1. Sifting cat litter boxes in use as oviposition chambers for obtaining eggs from *Xenopus* for use in FETAX: A) eggs beneath grate; B) cover pan; C) clamping lid; D) base pan.

volves using a dilute L-Cysteine solution. Drain water from the assembly until it is just covering the grate. Then add about 100 ml of 2% L-Cysteine (CAS #52-90-4, ASTM 1991). Gently stir or rotate the assembly (60 rpm on a rotary shaker). Embryos will fall from the grate into the bottom of the assembly in 20–60 minutes. Embryos will still have an inner jelly coat present. These embryos can be removed to a flask and dejellied using normal FETAX procedures except the time will be much shorter.

We recommend this technique to researchers for housing *Xenopus* during oviposition. The quantity and quality of eggs collected using this method is as good as with any of the standardized techniques, but without the problems outlined above. This method will recover 100% of eggs laid with little difficulty. There is little opportunity for adults to damage the eggs once they are laid, and this method provides a safe housing arrangement for adults during this period. This method might also be useful with other species of amphibians, especially those that lay dispersed eggs clutches.

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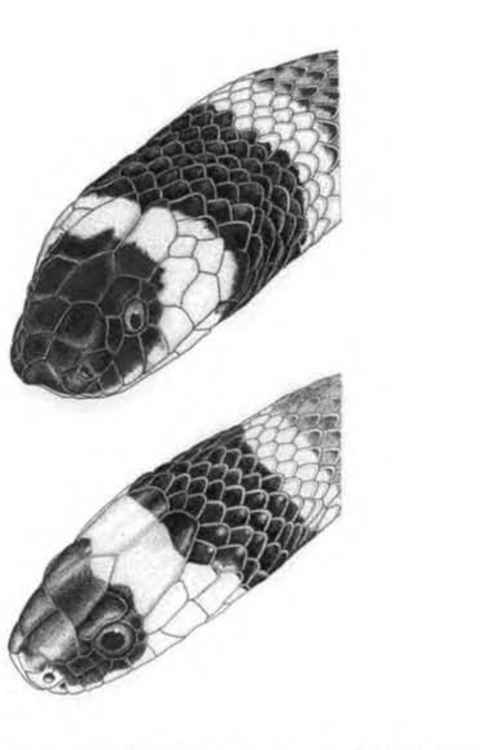

Upper: *Micrurus diastema* (UMRC 84-5), 657 mm SVL. México: Yucatán. Lower: *Urotheca elapoides* (USNM 319777), 230 mm SVL. Belize: Columbia Forest Reserve. Illustrations by Julian C. Lee.

NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 37, Number 1 (March 2006).

CAUDATA

PLETHODON HUBRICHTI (Peaks of Otter Salamander). **REPRODUCTION**. On 26 May 2005, while conducting a mark-recapture study in the contact zone for *Plethodon hubrichti* and *P. cinereus*, we discovered a *P. hubrichti* egg cluster under a rock imbedded in the soil. This is the first time a nest has been seen for this species (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Inst. Press, Washington, D.C. 587 pp.). Our study site (10 m × 10 m) is located near Onion Mountain, Bedford County, Virginia (USA). The egg cluster was attached to the top of a small cavity in the soil beneath the rock. Ten eggs were visible (2–3 additional eggs were likely in the center of the cluster but could not be seen without disturbing it) and the diameter of each of three eggs was 5.5 mm. Because the site was examined previously on 20 May 2005, it is likely the eggs were laid between 20–26 May. A brooding female was found attending the eggs during the initial and three subsequent site visits. She consistently retreated deeper into the crevice upon removal of the cover rock. On 7 July 2005, embryos with clearly visible eyes were moving within the eggs. Hatchlings were discovered clustered around the remains of the egg mass during a site check on 30 July 2005. Additional neonates were seen (N = 12) elsewhere on our site on 19 August 2005. It is likely that other nests were located either under large rocks that we could not move or below ground, since a total of 79 adult *P. hubrichti* had been marked on our site that year. The egg number and size, as well as the behavior of the brooding female, are similar to those noted for *P. cinereus* (Petranka, *op. cit.*). All neonates observed in this and another long-term study on timbering impacts (Reichenbach and Sattler, pers. obs., N = 126) were noted to be dark brownish-gray in coloring, bearing no distinct marks or color spots. This is in contrast to the description in Petranka (*op. cit.*), which states "hatchlings have a distinct dorsal stripe consisting of reddish spots." We have also noted that the characteristic brassy flecking on the dorsum of this species appears when the animals are ca. 25 mm SVL.

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ANURA

ATELOPUS VARIUS (Variable Harlequin Frog) and ***ATELOPUS ZETEKI*** (Panamanian Golden Frog). **ECTOPARASITES**. *Atelopus varius* and *Atelopus zeteki* are critically endangered (IUCN, Conservation International, and NatureServe. 2004. Global Amphibian Assessment. www.globalamphibians.org 4 April 2005) species known from premontane and lower montane wet forests and rainforests of the Atlantic and Pacific versants of the cordilleras of Costa Rica and Panama (Savage 2002. The Amphibians and Reptiles of Costa Rica. Univ. Chicago Press, Chicago, Illinois. 934 pp.; Dunn 1933. Occas. Pap. Boston Soc. Nat.

Hist. 8:65–79). Here we report the first observations of parasitism of *A. varius* and *A. zeteki* by ticks of the genus *Amblyomma*.

During monitoring studies of *A. zeteki* and *A. varius* in the Provinces of Panamá and Coclé, , ticks of the genus *Amblyomma* were observed parasitizing two female *A. zeteki* and one male and one female *A. varius*. These frogs were also observed to have numerous circular, raised scars on the venter, and less often on the dorsum, presumably due to previous tick infestation. An additional five females and one male *A. zeteki* were observed with similar scars but were not harboring ticks at the time. Three of these ticks were identified by RGR as larval (2) and nymphal (1) life stages of the genus *Amblyomma*. However, as none of these ticks were adult, identification to species was not possible and these specimens shall hereafter be referred to as *Amblyomma* sp.

The observations of ticks on *A. zeteki* were made by CLR and NEK in December 2004 and January 2005 (early dry season) during peak breeding activity, when the sex ratio was strongly male biased (ca. 1.8:1, CLR unpubl. data). However, of the seven frogs of this population observed with ticks and/or tick scars, six were female, indicating that the incidence of ectoparasitism by *Amblyomma* sp. on *A. zeteki* is likely higher for females than for males. This pattern could be produced if females and males are associated with different microhabitats outside the breeding season, or have different home ranges, or if females are longer lived than males and thus are exposed to ticks over a longer period of time. However, we have insufficient data to properly test these hypotheses. In contrast, in observations of two individual *A. varius* made by EJG in December 2002, one was male (four ticks on venter) and the other was female (35 ticks over all surfaces of the body). We have no information on sex ratio or the prevalence of scars at this site although scarred individuals were seen. It should be noted that many Neotropical amblyommines, especially the ubiquitous *Amblyomma cajennense*, are extremely abundant as immatures during the dry season, when a great range of hosts may be frequently and heavily attacked (Fairchild et al. 1966. *In* Wenzel and Tipton [eds.], Ectoparasites of Panama, pp. 167–219. Field Mus. Nat. Hist., Chicago, Illinois). Also, preimaginal tick populations are typically overdispersed (clumped), so that the odds of encountering them are not the same for all members of a host population (Robbins et al. 1998. J. Parasitol. 84:1303–1305).

The presence of numerous (up to 50) scars, presumably from previous infestation, on individual frogs suggests that ectoparasitism by *Amblyomma* sp. does not always cause mortality in *A. varius* and *A. zeteki*. However, six of the nine tick-infested and/or scarred frogs, when compared to a regression of weight against length (SVL), hereafter body condition, were found to be among the lowest 10% of the expected body condition distribution for their respective populations, indicating that tick infestation may carry a fitness cost for these frogs. The two other females and one male were among the middle 50% in body condition; however, these three individuals were also the smallest in body size (and therefore likely the youngest) and less extensively scarred than the other four females, which could account for their relatively good health.

Amphibian hosts of both ticks are chiefly true toads of the genus *Bufo*, especially the widely introduced Cane Toad, *B. marinus*, although *A. dissimile* has been collected from *B. fustiger* and *B. schneideri* (Cerny 1967. Wiad. Parazyt. 13: 533–537; Walton 1946. J. Parasitol. 32 [sect. 2, supp.]:18–19), while *A. rotundatum* has been reported from *B. arenarum* and *B. granulosus* (Díaz-Ungría 1957. Rev. Sanid. Asist. Soc. 22:457–467). *Atelopus* spp. are also members of the Bufonidae, but to our knowledge, this is the first report of parasitism by ticks of the genus *Amblyomma* on another bufonid genus.

We thank the Autoridad Nacional del Ambiente (ANAM) of Panama for permission to study *A. varius* and *A. zeteki* as well as the Smithsonian Tropical Research Institute (STRI) in Panama for logistical support. This work was completed with applicable federal and international permits and in compliance with guidelines of the Institutional Animal Care and Use Committee (IACUC #8831, University of Michigan).

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BUFO A. AMERICANUS (Eastern American Toad). **LEUCISM.** Leucism is an autosomal recessive gene mutation in which animals lack functional melanophores and xanthrophores and possess minimal iridophores. The skin appears solid white with no pattern, but pigmentation is retained in the eyes (Bechtel 1995. Reptile and Amphibian Variants: Colors, Patterns, and Scales. Krieger Publ. Co., Malabar, Florida. 206 pp.). Complete albinos, partial albinos, and leucistic specimens have been observed for many species of North American amphibians and reptiles (Brame 1962. Abhandl. Und Ber. für Naturk. Und Vorgesch. 11:65–81; Drykacz 1981. SSAR Herpetol. Circ. 11. 31 pp.; Harris 1970. Bull. Maryland Herpetol. Soc. 6:21–27; Hensley 1959. Publ. Mus. Michigan St. Univ. 1, 159 pp.).

A leucistic adult female *Bufo a. americanus* (SVL 61 mm) was discovered in a partially wooded area near Sylva, Jackson County, North Carolina (35°22.5'N, 83°13.5'W) on 12 Oct 2004. It was subsequently transported to the Highlands Biological Station in Highlands, Macon County, North Carolina where it continues to survive in captivity. Although the eyes are dark, the skin of this individual is translucent white, and internal organs are clearly visible when it is backlit. Several photographs of this specimen were taken and are on file at HBS.

Although *B. americanus* is well-studied and widely distributed, I have found reports of abnormal pigmentation in this species only from central Kentucky (L. Hafley, pers. comm.) and northern Virginia (Bulmer 1975. Virginia Herpetol. Soc. Bull. 78:7). Similar appearing specimens of *B. fowleri* have been collected from Wake County, North Carolina in 1965 (NCSM 3884; Palmer and Braswell 1980. Brimleyana 3:49–52), and from Randolph County, North Carolina in 2005 (A. Braswell, pers. comm.), but to my knowledge this is the first record of leucism in *B. americanus* from west-

ern North Carolina.

I thank Alvin Braswell of the North Carolina Museum of Natural Sciences for his assistance.

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BUFO BERGI (NCN). **REPRODUCTION**. *Bufo bergi* is associated with the flood plains of the Paraná and Paraguay rivers in northern Corrientes, eastern Chaco, Formosa, and northern and eastern Santa Fe, Argentina, and in adjacent southern Paraguay (Frost 2004. http://research.amnh.org/herpetology/amphibia/index.html). Few data are available to describe the reproductive traits of *B. bergi*. Fifteen individuals were captured in rice field habitat in Estancia La Norah (27°47'S, 58°46'W), 30 km S of Corrientes City, Corrientes Province, Argentina. Males (N = 10) were collected between 1 Nov 2001 and 5 Nov 2003; females (N = 5) were collected between 14 Oct 1999 and 19 Nov 2003. Specimens were captured in roadside ditches between 1800 and 2000 h, preserved in 10% formalin, and deposited at CECOAL (Centro de Ecología Aplicada del Litoral). Males measured: 33.3–40.5 mm SVL (mean 36.6; SD 2.4; CV 6.6%), body mass (BM) was 3.7–8.5 g (mean 6.2; SD 1.5; CV 24.9%); testes mass was less than 0.01 g. Testes were white in color and somewhat cylindrical in form. Females measured: 33.1–43.1 mm SVL (mean 40.4; SD 4.7; CV 11.6%), net body mass (BM) (body mass – ovary mass) was 5.1–9.8 g (mean 6.9; SD 2.0; CV 29.2%); ovary mass (OM) was 0.46–1.5 g (mean 0.7; SD 0.46; CV 62.5%); ovarian complement (OC) (number of mature ova) was 1043–2490 (mean 1751.8; SD 435.5; CV 24.9%); mature ova diameter (OD) was 0.30–0.7 mm (mean 0.5; SD 0.06; CV $\text{mean}_{[5\ \text{females}]}$ 11.17%; SD_{CV} = 2.2%; N = 500); reproductive effort (RE) (ovary mass/body mass %) was 4.7–19% (mean 10.7%; SD 5.4%; CV 50.1%); ovarian size factor (OSF) ($[_{mean}OC * {}_{mean}OD] / {}_{mean}SVL_{\text{gravid females}}$) (Duellman and Crump 1974. Occas. Pap. Mus. Nat. Hist. Univ. Kansas. 23:1–40) was 18. Ova were dark pigmented.

The differences in SVL and BM (net body mass for females) between males and gravid females were not significant (SVL [Mann-Whitney *U*-Test = 38.00; p = 0.11]; BM [Mann-Whitney *U*-Test = 29.00; p = 0.62]). *Bufo bergi* is an explosive breeder with breeding activity lasting one to a few days, with synchronous arrival of males and females. Table 1 summarizes the morphometric and reproductive features of males and females used in this study.

We thank Marta I. Duré for help with laboratory and fieldwork and CONICET for funding this study.

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Table 1. Length, weight, and reproductive data for 10 male and 5 female *Bufo bergi* from 30 km S of Corrientes City, Corrientes Province, Argentina. SVL = mean snout–vent length ± 1 SD; BM = mean body mass ± 1 SD (net body mass for females); OM = ovary mass ± 1 SD; OC = mean ovarian complement (number of mature ova) ± 1 SD; OD = mean ova diameter ± 1 SD; RE = mean reproductive effort ± 1 SD; OSF = ovarian size factor ([OC * OD] / SVL).

Sex	N	SVL (mm)	BM (g)	OM (g)	OC	OD (mm)	RE (%)	OSE
Female	5	40.42 ± 4.69	6.89 ± 2.01	0.73 ± 0.46	1751.80 ± 435.50	0.50 ± 0.06	10.76 ± 4.39	18.00
Male	10	36.57 ± 2.41	6.16 ± 1.53	—	—	—	—	—

BUFO BERGI (NCN). **DIET**. *Bufo bergi* occurs in the floodplains of the Paraná and Paraguay rivers in northern Corrientes, eastern Chaco, Formosa, and northern and eastern Santa Fe, Argentina, and in adjacent southern Paraguay (Frost 2004. http://research.amnh.org/herpetology/amphibia/index.html). Little is known of the diet of this species. In Corrientes, it utilizes terrestrial and temporary pool habitat during the reproductive season. We analyzed stomach contents of 10 specimens (females: 41.26 ± 2.9 mm SVL, N = 3; males: 36.8 ± 2.29 mm SVL, N = 7) collected 15 km NW of Corrientes (27°28'S, 58°50'W), Corrientes, Argentina, between January 2001 and October 2002. The diet showed a marked predominance of ants in number (81.3%) and volume (48.9%). Table 1 summarizes data obtained by analysis of the stomach content. The values of diversity (Shannon Index, using natural logarithm) and niche amplitude (Levins index) were 0.63 and 1.46.

Table 1. Prey consumed by *Bufo bergi* (N = 10) from Corrientes, Argentina.

	N	%Total	Vol. (mm^3)	% Vol.	Freq.
INSECTA					
Coleoptera	37	13.8	373.1	42.9	8
Hemiptera	3	1.1	11.8	1.4	3
Hymenoptera (ants)	218	81.3	425.5	48.9	8
Homoptera	1	0.4	6.4	0.7	1
Larvae	8	2.9	52.2	6	4
ARACHNIDA					
Araneida	1	0.3	0.09	0.01	1
TOTAL	**268**	**100**	**869**	**100**	

Due to the low number of specimens available, we used a non-parametric test (Spearman Rank Correlation) for analysis of morphology and diet. We observed a positive and significant correlation between SVL and mouth width (rs = 0.76; p = 0.010); mouth width was also correlated with prey volume (rs = 0.63, p = 0.05). The number of ingested prey was not correlated with predator SVL (rs = 0.18, p = 0.61).

Data from specimens examined during this study suggest *Bufo bergi* is a generalized predator, actively foraging preferentially for ants.

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BUFO HOUSTONENSIS (Houston Toad). **JUVENILE DISPERSAL.** *Bufo houstonensis* is an endangered anuran endemic to central-east Texas. While its breeding behavior has been well documented (Hillis et al. 1984. J. Herpetol. 18:56–72; Price 2003. Texas Parks and Wildlife Dept. Rep. 03-0401), the little published information concerning the juvenile life stages focuses mainly on predation (Freed and Neitman 1988. Texas J. Sci. 40:454–456), coloration (Mays and Freed 1985. Herpetol. Rev. 16:108–109), and growth (Greuter and Forstner 2003. Herpetol. Rev. 34:355–356; Quinn and Mengden 1984 Southwest. Nat. 29:189–195).

A Houston Toad egg string was surrounded with an aluminum flashing enclosure during Spring 2004 at the Griffith League Ranch (GLR) in Bastrop County, Texas, USA to monitor post-metamorphic behavior. Upon emergence, 993 individuals were captured and a single toe was clipped to identify the cohort year. The flashing was removed and 100 individuals were dusted with inert fluorescent powder (Radiant Color, T1 pigment) and released as a single group at the point of emergence. Fluorescent pigment was successfully used to track adult *Pelobates fuscus* (Eggert 2002. Herpetol. J. 12:69–74) and the same technique was applied in tracking juvenile Houston Toad dispersal. Toadlets were monitored immediately following release to determine if the pigment caused any malaise, and normal activity was observed. Metamorphs were located with a UV light (Raytech, Raytector-V Portable UV Light) for two consecutive nights and observed during the early morning hours of the day following their pigment-marked release. Metamorph locations were marked with marking flags; the area was left as undisturbed as possible, and the dispersal pattern was not analyzed until after the metamorphs left the pond's edge. It was our intention to follow the juveniles for a longer period, but during the afternoon of the third day, GLR received over 25 mm of rain. We believe this resulted in the pigment powder washing off of the toads as well as washing away trackways from the preceding night's dispersal.

We released the pigment-marked individuals at the point of emergence at the pond's edge. The tracks from individual metamorphs were not distinguishable within 0.5 m of the release site due to the large amount of powder deposited in a small area. However, tracks could easily be distinguished beyond the initial confused area of powder marks. When dispersing from the pond's edge metamorphs did not move in a straight line, but in a seeming random pattern that may have been foraging or shade seeking behavior. The majority of the pigment-marked individuals retreated into the water after release, which is normal behavior for post-metamorphic *B. houstonensis* (Greuter 2003. Unpubl. MS. Thesis, Texas State Univ. San Marcos, Texas. 80 pp.). We were able to track 15 individuals over two days. Within 48 hours after emergence, 8 of the *B. houstonensis* metamorphs had dispersed at least 4 m from the pond's edge. Mean dispersal distance was 3.24 m (range 0.7 m–5.13 m; median distance 3.43 m; N = 15) from the release point. The majority of the individuals (N = 12) were found buried under grass or sedge tussocks. The dispersal pattern did not increase in diameter from 24–48 h after marking. After the rainfall event, no pigment-marked metamorphs were relocated, however, toe-clipped individuals were quickly located, so we assumed the pigment washed off during the rainfall.

During this study, metamorphs did not show any ill effects due to the powder. Using this method was an easy, efficient, and cost effective way to track post-metamorphic juveniles. Nighttime observations of the movements of pigment-marked juveniles were easily monitored using UV light. Metamorphs were also observable during the day as the powder is highly visible, allowing us to observe toadlets without disrupting the point of emergence. We could visually track the individuals during day using binoculars from a distance of 3 m without difficulty. This is particularly relevant given the concentration of individuals at the pond's edge during the emergence period and the consequent care required to prevent accidental mortalities when trying to observe the behavior of these juveniles. We did not observe direct foraging during day or night surveys. Individuals appeared to be moving between shaded cover (daylight) or moving from one resting area to the next (night time). The technique does have an inherent weakness in very wet or rainy areas.

This study was conducted under permits issued to MRJF (USFWS: TE039544-1, TPWD: SPR-0102-191, and TXSTATE-IACUC: HGVMAD-02 and 5Qrs45-02).

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COPHIXALIS SAXATILIS (Black Mountain Microhylid). **PREDATION.** The family Microhylidae is a large group of anurans occurring throughout the tropical and warm temperate regions of the World. In Australia they are confined to the wet forests of north-eastern Queensland and the drier monsoonal forests of Arnhem Land (Cogger 2000. Reptiles and Amphibians of Australia. Reed Publishing, Sydney, Australia. 808 pp.). Here I report predation of the rare microhylid *Cophixalis saxatilis* by the Northern Tree Snake (*Denrelaphis calligaster*). *Cophixalis saxatilis* is a large microhylid (40 mm SUL) restricted to the 6 km^2 gigantic black boulder jumble habitat of Black Mountain. While conducting fieldwork in the early evening (1800–1930 h EST) on Black Mountain (21–26 Nov 2000) I observed numerous *C. saxatilis* active and jumping among the exposed boulders at various locations. While walking along the edge of the mountain I observed a large Northern Tree Snake (*D. calligaster*; ca. 0.9 m TL) following an adult male *C. saxatilis* (ca. SUL 35 mm). After following the frog for ca. 4.5 m the frog stopped near the entrance of a rock crevice, apparently unaware of the snake's presence. As the snake approached the stationary frog it adopted a posture characteristic of this species before striking the frog. Upon being seized the frog emitted an audible squawk and struggled and kicked vigorously for over 10 minutes. During this time the snake chewed continuously and adjusted the position of the frog within its mouth, while the frog appeared to struggle less. After about 20 minutes the frog's body had been consumed and was visible as a bulge in the snake's body. Afterwards the snake

moved into a refuge under a large boulder along the edge of the mountain where it was no longer visible. The habitat occupied by *C. saxatilis* consists predominantly of a mosaic of boulder jumbles that may prevent the access of many of the typical terrestrial frog predators (i.e., snakes). Thus, apart from avian predators much of this habitat may represent a safe harbor and where the possibility of predation is restricted to the habitat edges.

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CROSSODACTYLUS CARAMASCHII (NCN). **MORTALITY.** *Crossodactylus caramaschii* is a diurnal, stream dwelling anuran found at the Serra de Paranapiacaba, state of São Paulo, southeastern Brazil (Bastos and Pombal 1995. Copeia 1995:436–439). The species calls from emergent rocks in forest streams, where their eggs are laid and the tadpoles develop. During Sept 2003 in the municipality of Apiaí (24°33'45"S, 48°48'45"W; 925 m elev.) in the Atlantic Forest of the state of São Paulo, Brazil, five dead or moribund *C. caramaschii* were collected. These frogs were found recently dead on the rocks of the stream (N = 2) or were heard calling and died shortly after collection (N = 3). This situation is similar to the pattern reported from localities where local extinctions have been associated with infection by the chytrid fungus *Batrachochytrium dendrobatidis*, which causes chytridiomycosis (Berger et al. 1998. Proc. Nat. Acad. Sci. USA 95:9031–9036). Clinical signs of amphibian chytridiomycosis include abnormal posture, lethargy, and loss of righting reflex (Daszak et al. 1998. Emerg. Infect. Dis. 5[6]:735–748). The first record of *B. dendrobatidis* in Brazil was reported from Serra da Mantiqueira in *Hylodes magalhaesi* (Leptodactylidae), a diurnal, stream dwelling frog closely related to *Crossodactylus* (Carnaval et al. 2005. Froglog 70:3). Although the dead or moribund *C. caramaschii* collected were not tested for the presence of *B. dendrobatidis*, the pattern of death observed suggests infection by this fungus. Therefore, *B. dendrobatidis* might be more widespread in Brazil than reported.

Identification of these frogs was verified by Vanessa K. Verdade, and four were catalogued at the Museu de Zoologia da Universidade de São Paulo (MZUSP 133906–133909).

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DENDROPHRYNISCUS MINUTUS (Amazonian Tiny Tree Toad). **PREDATION**. On 3 Feb 2005 between 1300 and 1330 h, I observed predation involving a toad, a spider, and a group of ants in the forest litter next to a stream in the Reserva Florestal Adolpho Ducke (02°55'N, 59°59'W), Central Amazon, Amazonas, Brazil. While taking photos of an adult *Dendrophryniscus minutus* (SVL 15.8 mm) on the forest litter, it jumped about 30 cm and when in landed it was immediately attacked by a spider (*Ancylometes rufus*; 9.0 mm cephalothorax and abdomen length). The spider bit it on the dorsal region, and quickly moved away. The toad stayed motionless during the attack; it tried to move afterward but fell with its ventral region up, stretching and slowly contracting its hind and front legs. The spider came back shortly and grasped one of the toad's hind legs. After about two minutes an adult ant (*Megalomyrmex* cf. *balzani*; 8.2 mm) attacked the spider and tried to pull the toad away by one of the front legs. In less than two minutes five more adult ants of the same species attacked the spider which then abandoned the toad. The ants touched the toad for a few seconds but rejected it and followed in the spider's direction. The ants found, attacked, and immobilized the spider quickly. The toad, free of predators, but under the toxin's effect, tried to jump but was disoriented and still partially paralyzed.

The small diurnal bufonid *D. minutus* is an inhabitant of primary forest associated with leaf litter (Rodriguez and Duellman 1994. Publ. Nat. Hist. Mus., Univ. Kansas, 80 pp.). *Ancylometes rufus* is a terrestrial pisaurid spider that lives in the tropical forests of South America. They are most abundant next to streams and natural ponds and often feed on frogs (Menin et al. 2005. Phyllomedusa 4:39–47), tadpoles, and small fishes (Höfer and Brescovit 2000. Insect Syst. Evol. 31:323–360). Predation of toads by ants has been reported (Thomas and Allen 1997. Herpetol. Rev. 28:40–41; Zuffi 2001. Herpetol. Rev. 32:100–101; Fritz et al. 1981. Biotropica 13:158–159). Predation of adult *D. minutus* by adult *A. rufus* has been reported (Menin et al., *op. cit.*). Predation on amphibians by *A. rufus* can be common due to the abundance of this species in Amazonian forests and the large diversity of frogs in the different microhabitats occupied by this spider.

I thank Marcelo Menin and Karl Mokross for reviewing this note, Clarissa S. Azevedo and Thiago J. Izzo for identification of spider and ant, and José Tavares for assistance with fieldwork.

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ELEUTHERODACTYLUS DIASTEMA (Common Tink Frog). **REPRODUCTION**. The genus *Eleutherodactylus* comprises a large number of poorly known tropical frogs that demonstrate direct development of terrestrial eggs and often exhibit parental care. Reproduction has been described for very few *Eleutherodactylus*, and for most species there are no data available on clutch size or parental care (Townsend 1996. *In* Powell and Henderson [eds.], Contributions to West Indian Herpetology, a Tribute to Albert Schwartz, pp. 229–239. SSAR Contrib. Herpetol. Vol. 12. Ithaca, New York). For those species for which information is available, data are often derived from one or two observations, and quite often these observations are contradictory (Townsend, *op. cit.*).

Eleutherodactylus diastema is a common frog of humid forests that ranges from Nicaragua to Panama and belongs to the subgenus *Eleutherodactylus* and the *martinicensis* series (Savage 2002. The Amphibians and Reptiles of Costa Rica. Univ. Chicago Press, Chicago, Illinois, 934 pp.). Dunn (1937. Copeia 1937:163–167) described one clutch of *E. diastema* from "Tablazo," Costa Rica and suggested male parental care. Ovaska and Rand (2001. J. Herpetol. 35:44–50) reported observations of five clutches from Barro Colorado Island, Panama, and suggested the species does

not demonstrate parental care. Here I provide an additional observation of reproduction in *E. diastema* from a lowland wet forest in Costa Rica.

At ca. 2130 h on 19 July 2005, I observed a female *E. diastema* in mature primary forest at La Selva Biological Station in the lowlands of northeast Costa Rica. I detected a nearby male calling from beneath a coiled fallen leaf in leaf-litter ca. 10 cm above the forest floor and within the buttress of a large tree. The female approached the calling male and disappeared behind the fallen leaf. I did not disturb the leaf-litter to continue observation.

I examined the site where the male was located at ca. 1030 h on 20 July 2005. There was a clutch of 11 spherical eggs (each ca. 6 mm in diameter) deposited in a small oblong (ca. 20 × 10 mm) mass attached to a dead leaf and concealed behind additional dead leaves. The clutch was located ca. 10 cm above ground level at the location where the calling male was observed the previous evening. Individual eggs were ca. 6 mm in diameter and uniformly off-white in color. The uniformly off-white coloration of the eggs and absence of visible embryos suggest that the clutch was newly laid. I observed no parent in a casual search of an area within a 50 cm radius of the clutch. The clutch was examined again at ca. 2100 h on 20 July, ca. 0940 h on 21 July, and ca. 0944 h on 22 July. On each observation, I counted the eggs and casually searched the immediate area in a radius of ca. 50 cm for the presence of any adult *E. diastema*. For each of these observations, all 11 eggs remained intact; none were predated or showed any indication of fungal infection or desiccation. I detected no adult *E. diastema* within the search area on any encounter.

This observation generally agrees with other observations of clutch size and courtship behavior for this species. This observation agrees with Ovaska and Rand's (*op. cit.*) observation of lack of parental care for populations in Panama, but not that of Dunn (*op. cit.*). Because *E. diastema* likely represents a complex of species (Savage, *op. cit.*), it is possible either that the mode of parental care varies within this species, or that variation in the mode of parental care varies among the species in a cryptic complex.

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HYLA ALBOPUNCTATA (Spotted Tree Frog), ***H. MULTIFASCIATA*** (Many-banded Tree Trog), ***BARYCHOLOS TERNETZI*** (Savage's Goiás Frog), ***EPIPEDOBATES FLAVOPICTUS*** (Cerrado Poison Frog). **PREDATION.** The venomous wandering spider, *Phoneutria nigriventer*, and the fishing spider, *Anclyometes* sp., are common to the Cerrado biome of Central Brazil. Wandering spiders are widely foraging nocturnal predators while fishing spiders nocturnally and diurnally frequent waterside habitats, where they hunt for prey. These behaviors bring both spiders into contact with nocturnal amphibians. The venom of *P. nigriventer* may be potent in small vertebrates; a two-year old boy was bitten on the toe at one of our field sites and died three days later. Through herpetological inventories of this region of Cerrado since 1995, we have observed *P. nigriventer* feeding on a number of anurans, and *Anclyometes* sp. feeding on one frog. Our considerations of spiders as potentially significant predators of frogs in the Cerrado of Brazil began on 15 May 1990 (2000 h) when we observed *Anclyometes* sp. feeding on the dendrobatid frog, *Epipedobates flavopictus*. The observation was made near the town of Minaçu, along the Castelão River, State of Goiás, Brazil. The spider attacked the frog while it moved along the edge of a pool of water, biting it and holding on. Within minutes the frog was dead. Five minutes later, the spider dragged the frog into a crack between large boulders whereafter observations could not continue. On 10 July (beginning at 2200 h) and 12 July (beginning at 2330 h) 1998, we observed two *P. nigriventer* each feeding on recently captured *Epipedobates flavopictus*. Both frogs were still alive when observations began and no significant portion of either had been consumed. The locality lies along an unnamed road connecting the town of Minaçu and the Serra da Mesa hydroelectric power plant, Tocantins River, State of Goiás, Brazil. Observations were made along a drainage associated with "Club Elita," a social club off the unnamed road. In the same ravine on 18 July 1998 (2015 h) a species of mygalomorph spider (*Nhandu cerradensis*; Theraphosidae), was also observed feeding on *E. flavopictus*. The toxic alkaloids of this anuran apparently do not affect spiders or are tolerable enough to render the frog an appropriate prey species. All three observations of predation events at Club Elita occurred along a small drainage in a steep granitic ravine. All frogs were entirely consumed in less than three hours. On 13 July 1998 (beginning at 2230 h), at the same locality as with the *E. flavopictus*, we observed *P. nigriventer* feeding on a leptodactylid frog, *Barycholos ternetzi*. The frog was dead at the initiation of the observation and a significant portion of its abdomen had been consumed. After two hours of feeding, the spider abandoned the two legs of the frog, all that remained. On 16 July 1998 (beginning at 2130 h), we observed *P. nigriventer* feeding on a hylid frog, *Hyla multifasciata*, in the same locality as with the *Epipedobates* and the *Barycholos*. The frog had been recently captured and was alive at the initiation of the observations. Three hours later, the half of the frog that remained (head and arms) was abandoned by the spider. On 15 January 2004 (beginning at 1000 h) we observed *P. nigriventer* feeding on another hylid frog, *Hyla albopunctata*, at Ponte de Pedra hydroelectric power plant, right bank of the Corrente River, State of Mato Grosso, Brazil (Fig. 1).

FIG. 1. The venomous wandering spider, *Phoneutria nigriventer*, feeding on *Hyla albopunctata* in Central Brazil. Photo by I.J.T.

The habitat lies exactly on the ecotone between the Cerrado and Pantanal. We were drawn to the predation event through audible "scream-like" vocalizations emitted by the frog. This event differs from the others in that it occurred during the day, unusual behavior for the spider. At the initiation of observations, the frog was still alive and completely whole. In eight hours of feeding, only the legs of the frog remained and the spider abandoned them.

We thank Rick West for assistance in spider identification.

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MELANOPHRYNISCUS CUPREUSCAPULARIS (NCN). **DIET**. *Melanophryniscus cupreuscapularis* is found in areas surrounding the type locality, in northeastern Corrientes, Argentina (Frost 2004. http://research.amnh.org/herpetology/amphibia/index.html). The species is primarily terrestrial although during the reproductive season it is found in temporary pools in groups of up to 10 individuals. Males vocalize while hidden in vegetation or floating on the surface of the water. Diet of this species has not been reported.

Twenty individuals were collected 15 km NW of Corrientes (27°28'S, 58°50'W), Corrientes, Argentina between July 1997 and April 1999. Twelve individuals contained identifiable prey items (female: 22.08 ± 1.81 mm SVL, N = 5; males: 21.82 ± 0.76 mm SVL, N = 7). Ants were the predominant prey in number (66.2%) and volume (85.8%), although beetles were found in the highest frequency. Table 1 summarizes data obtained by analysis of the stomach content. The values of diversity (Shannon Index, using natural logarithm) and niche amplitude (Levins index) for this species were 1.15 and 2.13.

We used a non-parametric test (Spearman Rank Correlation) for analysis of morphology and diet. We observed a positive and significant correlation between SVL and mouth width ($r^2 = 0.68$; $p = 0.015$); the number of prey ingested was significantly correlated with predator SVL ($r^2 = 0.76$, $p = 0.004$). Mouth width was not correlated with prey volume ($r^2 = 0.063$, $p = 0.84$).

Data from specimens examined during this study suggest *Melanophryniscus cupreuscapularis* is a generalized predator, actively foraging preferentially for ants.

TABLE 1. Prey consumed by *Melanophryniscus cupreuscapularis* (N = 12) from Corrientes, Argentina.

	N	%Total	Vol. (mm^3)	% Vol.	Freq.
INSECTA					
Coleoptera	7	2.7	3.9	4.2	6
Hemiptera	2	0.8	1.03	1.1	2
Hymenoptera (ants)	174	66.2	80.9	85.8	5
Isoptera	2	0.8	0.7	0.7	1
Homoptera	15	5.7	1.9	2.0	3
Larva	2	0.7	0.3	0.3	2
Collembola	25	9.5	5.3	5.6	4
ARACHNIDA					
Araneida	1	0.4	0.04	0.04	1
Acarina	35	13.3	0.3	0.3	2
TOTAL	**263**	**100**	**94.4**	**100**	

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PHRYNOHYAS VENULOSA (Veined Treefrog). **DIET**. *Phrynohyas venulosa* has a wide distribution in Central and South America, ranging from the lowlands of Mexico to the Amazon Basin of Colombia, Ecuador, Peru, Venezuela, and Brazil; the Guianas, Brazil, Paraguay, Trinidad, and Tobago (Frost 2004. http://research.amnh.org/herpetology/amphibia/index.html). In Argentina, *P. venulosa* occurs in Jujuy, Salta, Formosa, Chaco, Corrientes, and Entre Ríos y Misiones (Cei 1980. Amphibians of Argentina. Monitore Zoologico Italiano MS). We examined the stomach contents of 20 specimens collected 15 km NW of Corrientes (27°28'S, 58°50'W), Corrientes, Argentina, between February 1994 and March 1999. Only 35% (N = 7) had identifiable stomach contents (males: 64.4 ± 16.3 mm SVL, N = 3; females: 76.6 ± 5.7 mm SVL, N = 4).

Ants were the predominant prey in number and beetles were better represented volumetrically. Table 1 summarizes data obtained by analysis of the stomach contents. The values of diversity (Shannon Index, using natural logarithm) and niche amplitude (Levins index) for this species were 1.15 and 2.08.

Due to the low number of specimens with identifiable prey we used a non-parametric test (Spearman Rank Correlation) for analysis of morphology and diet. A positive and significant correlation exists between SVL and mouth width ($r^2 = 0.85$; $p = 0.01$). The number of prey ingested was not correlated with predator SVL (rs

TABLE 1. Prey consumed by *Phrynohyas venulosa* (N = 7) from Corrientes, Argentina.

	N	%Total	Vol. (mm^3)	% Vol.	Freq.
INSECTA					
Coleoptera	4	10.8	738.8	35.3	1
Hemiptera	2	5.4	428.2	20.5	2
Hymenoptera (ants)	25	67.6	96.0	4.6	3
Hymenoptera (excl. ants)	1	2.7	1.5	0.07	1
Larvae	1	2.7	88.5	4.2	1
Orthoptera	3	8.1	726.6	34.7	2
ARACHNIDA					
Araneida	1	2.7	11.4	0.5	1
TOTAL	37	100	2091	100	

= 0.05, p = 0.90) and mouth width was not correlated with prey volume ($r^2 = 0.53$, $p = 0.21$).

Phrynohyas venulosa is an arboreal frog with low mobility. Based on diet and observed behavior of the specimens examined in this study it should be considered a generalized predator with a "sit-and-wait" strategy for obtaining prey.

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RANA HECKSCHERI (River Frog). **PREDATION.** Few predators have been reported for *Rana heckscheri*. Allen (1938. Copeia 1938:50), Fogarty and Hetrick (1973. Auk 90:268–280), and Brown (1979. Brimleyana 1:113–124) reported Banded Water Snakes (*Nerodia fasciata*), Cattle Egrets (*Bubulcus ibis*), and a Rainbow Snake (*Farancia e. erytrogramma*) as predators of *R. heckscheri* tadpoles. Juvenile and adult *R. heckscheri* are reported to have toxic skin secretions (Ashton and Ashton 1988. Handbook of Reptiles and Amphibians of Florida—Part Three: The Amphibians. Windward Publishing, Inc., Miami, Florida. 191 pp.; Bartlett and Bartlett 1999. A Field Guide to Florida Reptiles and Amphibians. Gulf Publishing Co., Houston, Texas. 280 pp.), and Behler and King (1985. The Audubon Society Field Guide to North American Reptiles and Amphibians. Alfred A. Knopf, New York, 743 pp.) reported that "water snakes and indigo snakes become violently ill" after ingesting recent metamorphs.

On 3 Sept. 2005, we observed an adult female *N. fasciata* (ca. 850 mm TL) exhibiting what might best be described as a combination of active foraging and ambush behavior in the shallows of Old Levi Mill Lake (Poinsett State Park, ca. 10.6 km WNW of Pinewood, Sumter Co., South Carolina, USA). Recently transformed juvenile *R. heckscheri* were abundant along the lake's edges, and we saw several in the snake's immediate vicinity. We observed the snake for several minutes on multiple occasions during mid-day and early afternoon, but did not see it capture prey. At 1554 h, we captured and handled the snake, and it regurgitated a juvenile *R. heckscheri* (52 mm SVL, 14.0 g). We released the snake and deposited the frog in the North Carolina State Museum of Natural Sciences (NCSM 68547). To our knowledge, this represents the first report of natural predation on non-larval *R. heckscheri*.

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TESTUDINES

ACTINEMYS MARMORATA (Pacific Pond Turtle). **SIZE**. To date the largest *Actinemys marmorata* reported was a male from Marin County, California, with a straight-line carapace length (SCL) of 223 mm and a plastron length (PL) of 193 mm (Fidenci 2005. Herpetol. Rev. 36:440). Here we report the measurements of three large *A. marmorata* captured from California Central Valley slough habitats adjacent to the Sacramento River, near Hamilton City (California, USA). Male #1: SCL = 241 mm; PL = 216 mm; carapace width at 8th marginal (CW) = 176 mm; shell height (SH) = 90 mm; mass = 1923 g. Male #2: SCL = 226 mm; PL = 210 mm; CW = 175 mm; SH = 74 mm; mass = 1402 g. Male #3: SCL = 223; PL = 209 mm; CW = 170 mm; SH = 83 mm; mass = 1564 g. All turtles were individually marked with filed notches in the marginal scutes and released at their capture sites. These captures represent the largest *A. marmorata* yet recorded within their range. All measurements were confirmed by John S. Campbell.

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ACTINEMYS MARMORATA (Pacific Pond Turtle). **REFUGIA**. Pacific Pond Turtles are known to be shy and to escape quickly into deep pools when disturbed (Ernst et al. 1994. Turtles of the Unites States and Canada, Smithsonian Institution Press, Washington D.C. 578 pp.). They are reported to utilize undercut banks and submerged structures (i.e., rocks, logs, vegetation, etc.) as refugia (Holland 1996. Herpetol. Rev. 27:198–199; Reese and Welsh 1998. J. Wildl. Manage. 62:842–853). Holland (*op. cit.*) also reported an atypical instance of refugia use in an upland habitat. However, little else has been reported about upland or aquatic refugia by this species. Here I report the use of rodent burrows and aquatic silt loads as refugia by *A. marmorata*.

Beginning in Fall 2002, an effort was made to remove Bullfrogs (*Rana catesbeiana*) from a portion of Kellogg Creek in the Los Vaqueros watershed, in eastern Contra Costa County, ca. 57 km E of San Francisco, California (USA). Bullfrog removal was conducted to increase habitat suitability for the California Red-legged Frog (*R. draytonii*) and *A. marmorata*. Portions of the creek were isolated using sand bags and wire mesh fencing. These sections were then drained. Native fauna was removed during draining and placed in adjacent sections of creek—upstream of the area being drained.

Fifty-six *A. marmorata* were encountered during the draining phase of the project. Turtles were found free-swimming in shallow pools, attempting to move upstream or downstream, or were found buried in the bottom sediment of drained pools. On three separate days, turtles were also found within the burrows of Beaver (*Castor canadensis*) and Muskrat (*Ondatra zibethicus*) located in the bank of the creek.

We frequently observed turtles (ca. 30% of captures) utilizing bottom silt as refugia from our capture. As water levels were lowered, turtles moved to the bottom of pools where they appeared to "swim" into loose bottom silt. Although turtles were not visually detectable, they could be located by raking through the silt with both hands. Frequently turtles were found < 0.5 m into the silt. On one occasion 3 turtles were found deep (ca. 0.7–0.9 m) within an inactive earthen burrow made by a Beaver. A fourth was found ca. 0.3 m within a different Beaver burrow, and a fifth turtle was found ca. 0.3 m within a potentially active Muskrat burrow.

Holland (*op. cit.*) reported that *A. marmorata* typically use inaccessible microsites as refugia, including under logs, rocks, cut banks, within vegetation, and occasionally in substrate. During the work on Kellogg Creek, it appeared that turtles regularly sought refuge in bottom silt loads of natural pools and those created by Beavers. They also utilized large-rodent burrows, perhaps in response to the draining of pools where turtles were present.

Beavers provide suitable open-water habitat for *A. marmorata* when the two species are sympatric. However, Beavers might also provide refugia within their abandoned burrows, and also by piling loose silt at the base of their dams.

I thank Mary Shea and the Contra Costa Water District for support and assistance with this investigation.

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CARETTA CARETTA (Loggerhead Seaturtle). **PREDATION.** Hatchling seaturtles have a large number of documented predators (Dodd 1988. U.S. Fish. Wildl. Serv., Biol. Rep. 88 [14], 110 pp.; Stancick 1995. *In* Bjorndal [ed.], Biology and Conservation of Sea Turtles, 2nd ed., pp. 139–152. Smithsonian Institution Press]. However, seaturtle predation by anuran amphibians is apparently unreported. Here, we document the predation of *Caretta caretta* hatchlings by the Cururu Toad (*Bufo jimi* Steveaux 2002), observed on two different occasions at the District of Arembepe, City of Camaçari, Bahia, Northeast Brazil (12°45'42.8"S, 38°10'05.5"W). Projeto TAMAR-IBAMA (the Brazilian National Sea Turtle Conservation Program) maintains a field station in this area. Some seaturtle nests are transferred to an open hatchery, which consists of a 130 m^2 area, surrounded by a fence, fully exposed to sun and rain, and located at the suprashore zone, at the vegetation line. Extensive wetlands are located very close to the sandy beach. Inside the fence, each nest receives an individual screen fence, where recently emerged hatchlings are temporarily retained and then released after data collection. Occasionally some of the hatchlings escape from the protective screens.On several occasions the presence of *Bufo jimi* inside the hatchery was noted, never more than one specimen at a time. In February 2003, attempted predation on *C. caretta* hatchlings by *B. jimi* was observed, when over 20 hatchlings of *C. caretta* and *Eretmochelys imbricata* escaped from the protective screens and dispersed through the hatchery. A toad, using a sit-and-wait strategy, was observed attempting to capture several turtle hatchlings. It initially appeared to have no success in swallowing them; all the captured hatchlings were released after the ingestion attempts and no successful predation was observed. However, the *B. jimi* specimen was then captured and sacrificed; necropsy and examination of stomach contents revealed a *C. caretta* hatchling with a straight-line carapace length of 46 mm. In January 2004, another *B. jimi* specimen was found inside the hatchery, beside one of the nests, where there was a retained *C. caretta* hatchling. This time there were no dispersed turtle hatchlings in the hatchery. This toad was also captured and sacrificed and necropsy revealed one *C. caretta* hatchling in the stomach (no measurements were possible due to carapace damage caused by digestion).

The *B. jimi* specimens were deposited at Museu Nacional do Rio de Janeiro (MNRJ 30804) and Museu de Biologia Mello Leitão (MBML 3670); the ingested *C. caretta* were deposited at Museu de Biologia Mello Leitão (MBML 1706-07).We are grateful to Ulisses Caramaschi for the identification of MNRJ 3804 specimen, and Célio F. B. Haddad, Luciano S. Soares, and Gustave G. Lopez for reviewing the manuscript. Projeto TAMAR-IBAMA is co-managed by Fundação Pró-TAMAR and is officially sponsored by PETROBRAS.

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CHELONIA MYDAS AGASSIZII (East Pacific Green Seaturtle). **MALE NESTING.** The Green Seaturtle is the most common marine turtle species in the Galapagos Islands and the only species that nests in the archipelago. Nesting activity is concentrated between the months of December and May (Green 1994. *In* Schroeder and Wilheinghon [compilers], Proc. of the 13th Symp. on Sea Turtle Biology and Conservation. NOAA Tech. Mem. NMFS - SEFSC - 314:65– 68; Zárate and Dutton 2002. *In* Danulat and Edgar [eds.], Reserva Marina de Galápagos. Línea Base de la Biodiversidad, pp. 305–323. Fundación Charles Darwin/Servicio Parque Nacional Galápagos, Santa Cruz, Galápagos, Ecuador). The most important nesting beaches are Quinta Playa (Isabela Island), Bahía Barahona (Isabela Island), Las Bachas (Santa Cruz Island), and Las Salinas (Seymour Island). A monitoring program at these sites was established during nesting seasons during 2002–2005 and recorded 2756, 1913, 1569, and 724 nesting females, respectively ((Zárate et al. 2003. *In* Seminoff [compiler], Proceedings of the 22nd Annual Symposium on Sea Turtle Biology and Conservation, pp. 70–73. NOAA Tech. Memo. NMFS-SEFSC – 503 [Quinta Playa]; and Zárate, unpubl. data).

On 16 December 2004 and 21 February 2005 I observed apparent nesting behavior by male turtles, one at Bahía Barahona (Turtle 1, ID: GF497/GF440) and one at Las Salinas (Turtle 2, ID: LB772/LB773), respectively. These individuals were classified as males based on their tail length (TL: measured from the tip of the tail to the trailing edge of the carapace) and its prehensile character (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Inst. Press, Washington, DC. 578 pp.). Both had tails longer than 20 cm, a male character (Wibbels 1999. *In* Eckert et al. [eds.], Research and Management Techniques for the Conservation of Sea Turtles, pp. 139–143. IUCN/SSC Marine Turtle Specialist Group Publ. No. 4). Turtle 1 was observed for about 1 h and 10 min; turtle 2 was observed for 45 min before it returned to the sea. Curved carapace lengths of Turtle 1 and Turtle 2 were 87.3 cm and 100.0 cm, respectively, whereas the TLs were 31.0 cm and 24.0 cm.

Both males were encountered while they were digging a body pit with their front flippers. Turtle 1 was observed excavating an egg chamber; its behavior was nearly identical to that of females observed during the same behavioral sequence. The completed egg chamber measured ca. 60 cm deep and 18 cm wide, and upon completion Turtle 1 remained in a laying position for 20 min prior to covering the egg chamber. Neither male was observed on a second occasion.

This is the first documented record of nesting behavior by male *C. mydas* in the Galapagos Islands, although similar observations have been made elsewhere (P. Pritchard, pers. comm. to S. Troeng). Cases are reported from Tortuguero National Park, Costa Rica (Troeng 2000. Chelon. Cons. Biol. 3:749–750) and Suriname (J. Schulz, pers. comm. to P. Pritchard). Explanations suggested for this phenomenon include possible endocrine disruption in males resulting in behavioral change (Troeng 2000, *op. cit.*) or intersexuality, as records in nature of individuals showing gonadal characteristics of both sexes occasionally occur (Limpus et al. 1994. Mem. Queensland Mus. 35:139–154). However, specific analyses on a case by case basis will be needed to identify precise causes for this behavior.

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CHRYSEMYS PICTA BELLII **(Western Painted Turtle). DENSITY AND BIOMASS.** From 28 May to 29 June 2005 we trapped *Chrysemys picta bellii* in a 0.71 ha spring fed, human-made pond (maximum depth ca. 2 m), ca. 200 m from Blue Creek, 16.9 km NNE of the junction of Highways 27 and 26 in Oshkosh, Garden County, Nebraska, USA (see also Iverson et al. 2000. Herpetol. Rev. 31:238). The turtles were caught using four 15-m fyke nets (183 cm depth, 2.5 cm mesh, with 90 cm diameter hoop traps on each end) baited daily with fresh pieces of carp. We captured and marked a total of 106 *C. p. bellii* (34 females and 8 males > 150 mm carapace length; 29 females and 13 males 110–150 mm; and 22 others < 110 mm; range 84–190 mm carapace length and 70–840 g body mass), having a composite mass of 38.87 kg, a density of 149 turtles/ha, and a standing crop biomass of 54.7 kg/ha.

Although estimates of standing crop biomass are available for *C. picta* in New York (15.7–91.3 kg/ha; Zweifel 1989. Amer. Mus. Novitates 2952:1–55), Pennsylvania (4.3–106.4 kg/ha; Ernst 1971. J. Herpetol. 5:151–160; 1976. J. Herpetol. 10:25–33), Michigan (4.6–73.6 kg/ha; Iverson 1982. Oecologia 55:69–76; Congdon et al. 1986. Amer. Midl. Nat. 115:165–173), and Indiana (11.2 kg/ha; Wade and Gifford 1965. Proc. Indiana Acad. Sci. 74:371–374; Iverson 1982, *op. cit.*), these are the first measurements reported for the western subspecies *C. p. belli*, and for the western two-thirds of the species range. These data suggest that despite the much larger body size of *C. p. bellii*, and the low aquatic turtle species richness at this site and over most of its range, density and biomass are apparently similar to those of eastern populations.

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EMYDOIDEA BLANDINGII **(Blanding's Turtle). DOUBLE-CLUTCHING.** Female Blanding's Turtles are generally believed to nest only once per season (M.J. Pappas et al. 2000. Chelonian Conservation and Biology 3[4]: 557-568; Standing, K.L. et al. 2000. Chelonian Conservation and Biology 3[4]: 637-642). Here, we report an observation of a female Blanding's Turtle in Minnesota that nested twice during the 2003 nesting season.

Adult female Blanding's Turtles were radio-tracked during the 2003 activity season at Elm Creek Park Reserve, Hennepin County, Minnesota, USA, during a multi-year study of habitat use and movement patterns of turtles in this population. During the evening of 7 June, female 2040 was observed beginning a nesting foray (the earliest such foray by this turtle in four monitored nesting seasons). At 2145 h on 9 June she was observed from a distance in a sparsely vegetated area occasionally used for nesting by other Blanding's Turtles. At this time she did not appear to be actively digging, and the researcher left the area to avoid disturbing her. The researcher returned at 2215 h and found a skunk eating an egg at the spot at which the turtle had been observed earlier. The skunk was chased away, and a nest containing intact eggs was found at this location. Female 2040 was sitting nearby in tall grass. By 11 June, this turtle had returned to her home wetland.

On 26 June, female 2040 was again observed traveling on land. On 29 June, she was found covering what appeared to be a completed nest at 2015 h. This nest was opened by the researcher to confirm completion, and eleven eggs were found. Female 2040 had returned to her original wetland by 4 July.

Although these field observations strongly suggested that female 2040 had laid both clutches of eggs, she had not actually been seen during any stage of the construction of the 9 June nest. To confirm that this nest had indeed been constructed by female 2040, a maternity test was conducted by comparing the genotypes of the hatchlings collected from both nests to that of female 2040 using microsatellite DNA. Tissue samples were collected from the hatchlings and the adult female by snipping off the distal 2 mm of the tail. DNA was extracted using a 5% solution of Chelex resin and PCR was amplified as described by Osentoski et al. (Molecular Ecology Notes 2: 147-149). Microsatellites at three loci were sized and visualized using GENESCAN analysis software v.3.1 (ABI Prism) at the Advanced Genetics Analysis Center, University of Minnesota.

One allele per locus in each hatchling genotype was identical to female 2040's genotype at each locus, which strongly supports the conclusion that female 2040 nested twice during 2003. Additionally, at all three loci tested, no more than three alleles were detected among all hatchlings from the two clutches, and the complement of alleles detected at any given locus was identical between the two clutches. Not only do these data support the conclusion that female 2040 laid both clutches, but both of these clutches also appear to have been sired by the same male.

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TERRAPENE, T. CAROLINA, T. C. BAURI, T. C. MAJOR (American Box Turtles, Eastern Box Turtle, Florida Box Turtle, Gulf Coast Box Turtle). **MAXIMUM SIZE.** Although box turtles of the genus Terrapene reached and even exceeded 300 mm maximum carapace length (CL) during the Plio-Pleistocene (Auffenberg 1958. Bull. Florida State Mus. 3:53–92; Milstead 1969. Bull. Florida State Mus. 14:1–113; assigned to *T. carolina putnami*), very few individuals exceed 200 mm today. The largest modern box turtles recorded were two male *T. c. major* from St. Vincent Island, Franklin County, Florida, with reported carapace lengths of 216 and 210 mm (Auffenberg, *op. cit.*; specimens said to have been skeletonized, apparently unavailable). This note provides measurements for a substantially larger living *Terrapene* (male *T. c. major*), the largest known Recent female (*T. c. major*), and the largest recorded Florida Box Turtle (*T. c. bauri*, male). Measurements of additional large turtles are also included (Table 1) because of their potential value to studies of allometric growth in the genus.

In the living collection of Brechtel (BB) is a massive male *Terrapene carolina* (R-553; UF 143641, 2 color transparencies) with a CL of 235 mm, plastron length (PL) of 217 mm, carapace width (CW) of 179 mm, and body mass of 2.1 kg; additional measurements are provided in Table 1. Although provenance of the turtle is uncertain, its morphology and coloration are clearly consistent with *T. c. major* and highly reminiscent of turtles from the region of the Apalachicola lowlands of western Florida. The carapace is strongly flared posteriorly and dark black-brown in color, with light yellow radiating spots on the costals; the plastron, head, and legs are also dark black-brown. The CL of 235 mm exceeds Auffenberg's largest reported specimen by 19 mm.

A second large male (R-561; UF 144571, three digital color photographs), collected in 2003 in the Apalachicola National Forest, Liberty County, Florida, was given to M. Aresco, who measured, photographed, and released it; its CL of 213 mm is only 3 mm shy of Auffenberg's (1958) previous record. The carapace was black with a yellow keel, the plastron yellow, and jaws white.

The largest recorded female *Terrapene* is an adult female *T. c. carolina* from New York (Table 1; Cook et al. 1972. Int. Turt. Tort. Soc. J. 6:8–17), with a CL of 198 mm, PL of ca. 186 mm (sum of anterior and posterior plastral lobe lengths of 76 and 110 mm, respectively), CW of 146 mm, and body mass of 1.395 kg. DRJ collected a very large female *T. c. major* (R-554; UF 143642, 3 color transparencies; currently maintained alive) crossing a Leon County, Florida, road in 2003. Both ends of the carapace had been truncated (by an estimated 3–5 mm anteriorly and 5–8 mm posteriorly) by old, well-healed injuries reminiscent of turtles injured by mowing (G. Guyot, pers. comm.) or possible chewing by a vertebrate predator. Nonetheless, her PL (204 mm), CW (154 mm), and body mass (1.59 kg) all substantially exceed corresponding measurements of the giant New York female. The shell height of 104 mm may also be a record for any modern representative (of either sex) of the species. Her coloration of yellow streaks and spots on a brown carapace, yellow plastron, and mostly brown head and feet are typical of many *T. c. major*.

Although Dodd (2001. North American Box Turtles: a Natural History. Univ. Oklahoma Press, Norman. 231 pp.) gave 166 mm as the record size CL for *T. c. bauri*, Pritchard (1980. Chelonologica 1:113–123) documented a much larger male (Chelonia Research Institute PCHP 1440, Lee County, Florida) that measured 187 mm CL and 138 mm CW; the CRI collection includes a second large male (PCHP 6147) of 183 mm CL. In BB's living collection are several large males, including one (R-557, now in DRJ living collection; UF 143643, 3 color transparencies) with a CL of 190 mm and CW of 144 mm. Additional measurements of this record male are given in Table 1, along with measurements of two other large living males (R-562, 563) that exceed the maximum size given by Dodd (*op. cit.*). Although their provenances are uncertain, the first and third stem from a rescued private collection in the Florida Keys, Monroe County, and the second is believed to have originated in Marion County, north-central Florida. The relatively flat shell and flared peripherals of the largest are consistent with *T. c. bauri* from the Florida Keys (Auffenberg, *op. cit.*). All three have black carapaces with narrow, radiating yellow lines as typify *T. c. bauri*. The throat of the largest male is colored by a deep blue iridescence.

Although some of our data are drawn from captive animals, we believe that most or all of their growth to record sizes was achieved prior to captivity. Even if otherwise, this note documents the genetic potential of *Terrapene carolina* to achieve larger sizes than

TABLE 1. Measurements, sex, and subspecific identities of six *Terrapene carolina* measured alive during 2003-2004; mass in g, all other measurements in mm. CL, carapace length; PL, plastron length; CW, carapace width; SH, shell height; APLL, anterior plastron lobe length; APLW, anterior plastron lobe width; PPLL, posterior plastron lobe length; PPLW, posterior plastron lobe width. Measurements of CL and PL are maximum.

ID no.	R-553	R-561	R-554	R-557	R-562	R-563	Cook et al. (1972)
subspecies	*major*	*major*	*major*	*bauri*	*bauri*	*bauri*	*carolina*
sex	M	M	F	M	M	M	F
mass	2100	-	1590	1040	894	796	1395
CL	235	213	>189	190	173	174	198
PL	217	197	204	172	160	165	~186
CW	179	157	154	144	132	128	146
SH	99	96	104	82	81	73	82
APLL	88	80	81	73	64	71	76
APLW	109	95	103	80	85	79	100
PPLL	128	118	123	97	93	93	110
PPLW	132	116	113	105	104	93	116

currently realized.

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TRACHEMYS SCRIPTA SCRIPTA (Yellow-bellied Slider). **FIRE ANTS AND NEST FAILURE.** On 29 June 2005 I witnessed a female *Trachemys scripta scripta* attempting to nest on the banks of a 10 acre pond in Lancaster, South Carolina, USA. This turtle was part of a previous study and she had been marked and her plastron length (19 cm) recorded. Initial observation revealed that she had already excavated a nest hole and deposited one egg, but fire ants (*Solenopsis geminata*) were attacking her. During the attack she swiped her face with her front claws and retracted her head; she also gasped and bit at the ants in an attempt to remove them. The attack lasted for about five minutes more when she abandoned the nest without covering the one egg. Upon entering the water she thrashed about in an apparent attempt to remove the ants. Ants were observed entering the nest and attacking the egg. On subsequent trips to the pond I did not see the egg or evidence of additional nesting attempts.

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CROCODYLIA

CAIMAN CROCODILUS YACARE (Pantanal Caiman). **AESTIVATION**. Under conditions of water stress, some crocodilians aestivate for months in mud or holes (e.g., *Crocodylus niloticus*: Guggisberg 1972. Crocodiles: Their Natural History, Folklore and Conservation. Davies and Charles, Redwood Press Limited. 195 pp.; *Caiman crocodilus crocodilus*: Staton and Dixon 1975. Mem. Soc. Cienc. Nat. La Salle 35:237–266; *Crocodylus porosus*: Magnusson and Taylor 1979. Copeia 1979:478–480; *Crocodylus palustris*: Whitaker and Whitaker 1984. J. Bombay Nat. Hist. Soc. 81:297–317; *Crocodylus johnstoni*: Walsh 1989. Aust. Zool. 25:68–70). In response to disturbance, *Caiman crocodilus yacare* are known to leave pools to bury themselves under leaf litter in forested sites or in the mud around lakes (Campos et al. 2003. Copeia 2003:628–634), but published observations are lacking for caiman engaging in seasonal aestivation. Hence, here we report data on aestivating behavior by *C. crocodilus yacare* in the Brazilian Pantanal.

Observations on *C. crocodilus yacare* terrestrial activity were made at Campo Dora Ranch, an area with seasonal rivers; and Nhumirim Ranch, an area with many isolated lakes, in the Pantanal of Nhecolândia (Campos et al. 2003, *op. cit.*). This area experiences pronounced dry (August–December) and wet (January–May) seasons. Over 70 days beginning August 1993, we monitored 13 caiman (11 females, 2 males) using radiotelemetry; 7 in Campo Dora Ranch and 6 in Nhumirim Ranch. Radios were attached with nylon line to the last pair of double tail crests (*fide* Munoz and Thorbjarnarson 2000. J. Herpetol. 34:397–403). Each caiman was located 13 times at intervals averaging 5.5 days; and whether they were in the water or on land was noted.

Of the 13 caiman monitored during the dry season, we found 4 aestivating in either leaf litter or mud on different occasions (Table 1). For the four individuals that were aestivating (all females), the proportion of time that each was found buried varied from 0 to ca. 60% (Table 1). Whether aestivating Pantanal *C. crocodilus yacare* are responding to dry conditions, lack of food, or both is unclear (see Schmidt-Nielsen 1975. Animal Physiology. Cambridge University Press, 699 pp.). In the Pantanal, aestivating caiman without radio transmitters are almost impossible to detect because they typically do not respond to disturbance; we found only one non-radioed caiman buried in mud along a river margin, and this individual also did not respond to disturbance. Moreover, if any caiman aestivated over an interval shorter than our sampling resolution, this pattern would have gone unrecorded. Recognizing the frequency and seasonality of aestivation behavior is important because ignoring it can result in underestimating population size from direct counts, such as those used in the Venezuelan management program (Thorbjarnorson 1991. *In* Robinson and Redford [eds.], Neotropical Wildlife Use and Conservation, pp. 217–235. University of Chicago Press, Chicago, Illinois) and aerial survey program in the Pantanal (Coutinho and Campos 1996. J. Trop. Ecol. 12:741–747; Mourão et al. 2000. Biol. Conserv. 92:175–183). Our data provide only a preliminary glimpse of the aestivation pattern of some *C. crocodilus yacare* females over a relatively short seasonal interval; more resolved surveys over the entire seasonal range will be required to fully understand aestivation in *C. crocodilus yacare*.

This study is part of a doctoral dissertation by ZC submitted to the Federal University of Minas Gerais under the supervision of Gustavo Fonseca and WM, and was financed by Embrapa Pantanal, WWF-USA, Fundação O Boticário, and Conservation Interna-

TABLE 1. Size, sex, and aestivation habitat data for radio-telemetered *Caiman crocodilus yacare* in the Brazilian Pantanal. Percentage of time found in the aestivation habitats indicated is a function of the 13 times animals were located at intervals averaging 5.5 days.

Area Type	SVL (cm)	Mass (kg)	Sex	Habitat (%) Mud	Forest Litter
Lake	78.5	11.0	F	0.0	0.0
Lake	70.0	9.0	F	17.1	42.8
Lake	75.0	11.0	F	0.0	0.0
Lake	67.0	9.0	F	0.0	0.0
Lake	78.5	9.0	F	30.0	0.0
Lake	79.0	9.0	F	0.0	0.0
River	102.0	24.0	M	0.0	0.0
River	81.0	12.0	M	0.0	0.0
River	84.0	14.0	F	31.4	0.0
River	80.5	12.0	F	0.0	0.0
River	79.0	11.5	F	21.4	18.6

tional-Brasil. The Brazilian Environmental Agency (Ibama) provided permits to capture caiman. We thank Francisco (in memoriam), Procópio, Vandir and José Augusto for indispensable field assistance.

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LACERTILIA

ANOLIS CAROLINENSIS CAROLINENSIS (Northern Green Anole). **BEHAVIOR**. *Anolis carolinensis*, among the best-studied anoline lizards, is arboreal and generally uses any type of forested habitat and can be found in vegetation around urban and suburban areas (Mount 1975. Reptiles and Amphibians of Alabama. Auburn University Experiment Station, Auburn, Alabama. 347 pp.), hardwood hammocks and freshwater marshes, and coastal marshes (Bartlet 2006. Louisiana Coastal Marshes online at: http://www.uvm.edu/~jbarlet/nr260/animal%20life/animallifefinal.htm; Clark 1976. The Sanibel Report: Formulation of a Comprehensive Plan Based on Natural Systems, online at: http://www.worldpolicy.org/globalrights/environment/report/chapter4.html; Florida National Parks & Monuments Association 1996. Reptiles and Amphibians of Everglades National Park, online at: http://www.fiu.edu/~glades/education/reptilebr.htm). Although *A. carolinensis* has been described in these publications as using vegetation around water or in wetland situations, to our knowledge, use of floating mats of rooted vegetation is unreported. Hence, here we describe an observation of *A. carolinensis* using a floating mat of alligatorweed (*Alternanthera philoxeroides*) in central Alabama.

On 10 October 2005, ARG observed an adult (ca. 6.5 cm SVL, sex undetermined) *A. c. carolinensis* walking on an *A. philoxeroides* mat growing in shallow water along the shore of Beaver Lake in Oak Mountain State Park, Pelham (33°19'00"N, 86°35'50"W; datum: WGS84; elev. 55 m). The next day, both authors observed another adult (ca. 6.5 cm SVL, sex undetermined) in a different area of the lake performing the same behavior. The second animal readily ran across the surface of the mat, under the overhanging roots of a pine growing on the shoreline, and up the trunk of the tree. It was captured and positively identified by the senior author, and released at the point of capture.

Why these *A. a. carolinensis* performed this behavior is unclear. Alligatorweed presents a floating mat that can become interwoven, dense with leaves forming a nearly continuous mat, which can easily support the weight of *A. a. carolinensis* without sinking (in this case, many leaves on the stems were missing and the plants were somewhat brown which was likely due to the onset of cooler weather). The lizards may have been venturing onto the alligatorweed to capture invertebrates lurking on the plants and water surface.

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ASPIDOSCELIS EXSANGUIS (Chihuahuan Spotted Whiptail) ×***ASPIDOSCELIS SEXLINEATA VIRIDIS*** (Prairie Racerunner). **REPRODUCTIVE POTENTIAL.** Triploid parthenogenetic *Aspidoscelis exsanguis* (nomenclature based on Reeder et al. 2002. Am. Mus. Novitat. 3365:1–61), derived from a 2-stage hybridization sequence involving 3 gonochoristic species (Good and Wright 1984. Experientia 40:1012–1014), is syntopic with *A. sexlineata viridis* on the east side of Sumner Lake, Sumner Lake State Park, De Baca County, New Mexico (34°36'N, 104°24'W, WGS84; elev. 1311 m). On 2 July 1998, JMW collected a male lizard (University of Arkansas Department of Zoology = UADZ 6241) at this site with the basic striped and spotted adult dorsal color pattern of all-female *A. exsanguis*; however, such a male can only be a tetraploid hybrid resulting from a haploid sperm of *A. sexlineata viridis* ($1n = 23$) fertilizing the unreduced egg of an *A. exsanguis* ($3n = 69$). *Aspidoscelis exsanguis* has been identified as a participant in two other hybridizations. Neaves (1971. Breviora 381:1–25) described the karyotype of a female *A. exsanguis* × *A. inornata*, and Taylor et al. (1989. J. Herpetol. 23:202–205) identified a male hybrid as having been fathered by either an *A. inornata* or *A. marmorata* (= *tigris*) male. Here, we detail the morphological and histological examination of the Sumner Lake *A. exsanguis* × *A. sexlineata viridis* hybrid.

Based on Walker et al. (1989. Copeia 1989:1059–1064) and Taylor et al. (2001. Am. Mus. Novitat. 3345:1–65), JMW described the gross reproductive morphology of the preserved hybrid. Based on Goldberg and Beaman (2003. Herpetol. Rev. 34:143), SRG histologically examined the left testis and left epididymis of the hybrid and assessed its previous reproductive functionality.

The preserved hybrid was 62 mm SVL (mass unavailable). Compared to male *A. sexlineata viridis* of similar age, its testes (mean dimensions of both = ca. 4 × 6 mm), epididymides, and hemipenes were of expected size and structure. Histology of the left testis indicated that the hybrid was undergoing early spermiogenesis. As reported for other teiid lizards (Lowe and Goldberg 1966. J. Morph. 119:277–281), a circumtesticular tunic 1–3 Leydig cells thick surrounded the left testis. Clusters of metamorphosing spermatids were present and tails of spermatozoa projected into the lumina of the seminiferous tubules. Sperm were also present in the sectioned epididymis.

This *A. exsanguis* × *A. sexlineata viridis* hybrid seemed capable of inseminating females of *A. exsanguis*, *A. sexlineata viridis*, and/or *A. tesselata* at the Sumner Lake site, but we do not necessarily infer that its presumed diploid sperm ($2n = 46$) could have contributed to production of either fertile or infertile polyploid hybrids. Nevertheless, the hybrid likely would have interfered with normal reproduction in females of these three species should any of them have been inseminated. Taylor et al. (2001, *op. cit.*) provided indirect histological evidence that the more numerous triploid hybrid males of *A. tesselata* × *A. marmorata* (N = 12) collected at Arroyo del Macho, Chaves County, New Mexico, may have inseminated congeneric females at this site.

Collection of UADZ 6241 was made under authority of permit 1850 issued to J. E. Cordes (Subpermittee JMW) in 1998 by the New Mexico Department of Game and Fish. Access to Sumner Lake State Park for this purpose also required a Special Use permit granted to JMW in 1998 from the Energy, Minerals and Natural Resources Department, New Mexico State Park and Recreation Division.

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ASPIDOSCELIS LINEATISSIMA (Twelve-lined Whiptail). **DIET**. The genus *Aspidoscelis* includes among the most important insectivorous lizards (Bostic 1966. Herpetologica 22:81–90; Paulissen 1987. Southwest. Nat. 32:395–397; Anderson 1993. *In* Wright and Vitt [eds.], Biology of Whiptail Lizards (Genus *Cnemidophorus*), pp. 83–116. Oklahoma Mus. Nat. Hist., Norman; Eifler and Eifler 1998. J. Herpetol. 32:24–33; Gadsden and Palacios-Orona 2000. Act. Zool. Mex. 79:61–76; Vitt and Pianka 2004. *In* Pérez-Mellado, Riera and Perera [eds.], The Biology of Lacertid Lizards, pp. 139–157. Evolutionary and Ecological Perspectives. Institut Menorquí d'Estudis, Recerca). Although *Aspidoscelis* diet is generally described as consisting of insects, the food habits of *A. lineatissima* are unknown.

On 6 May 2004 (dry season), MAGR captured an adult male of *A. lineatissima* (86 mm SVL, 12.5 g, 19°31'35.3"N, 105°04'06.6"W, datum: WGS84; 15 m elev) at Reserva de la Biosfera Chamela-Cuixmala (19°22'03"–25'11"N, 104°56'13"–03'25"W). Dominant vegetation is tropical dry forest with a wet season occurring July–October and a dry season November-June. Examination of its stomach contents revealed a partially digested snake, *Conophis vittatus* (90 mm SVL, 0.75 g). The head of the *C. vittatus* was totally digested but the rest of the body was intact.

Conophis vittatus, a terrestrial oviparous snake that occurs along the Pacific coast of México, is diurnal (Ramírez-Bautista 1994. Cuaderno 23. pp. 72–73. UNAM, México), and hence, would have opportunity to be found by *A. lineatissima*. This represents the first record of any *Aspidoscelis* feeding on *Conophis vittatus*.

Méndez-de la Cruz Fausto verified the identity of the snake. The *A. lineatissima* (IBH 14905) and *Conophis vittatus* (IBH 13905) were deposited in Colección Nacional de Herpetología, Instituto de Biología, Universidad Nacional Autónoma de México.

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COLOPUS WAHLBERGII (Wahlberg's Kalahari Gecko). **ENDOPARASITES.** *Colopus wahlbergii* occurs in sandy plains with scattered vegetation and ranges from the Kalahari region of Botswana, extending into the Republic of South Africa, Namibia and southwest Zimbabwe (Branch 1998. Field Guide to Snakes and other Reptiles of Southern Africa, Ralph Curtis Books, Sanibel Island, Florida. 399 pp.). Adults measure between 45-61 mm SVL (Branch, *op. cit.*). To our knowledge, no reports of endoparasites exist for *C. wahlbergii*. The purpose of this note is to report a species of Cestoda, *Oochoristica truncata* and a species of Nematoda, *Spauligodon smithi* in *C. wahlbergii*.

Coelomic cavities and small and large intestines of 20 *C. wahlbergii* (mean SVL = 50.6 mm ± 4.4 SD, range: 40-58 mm) from Botswana, Kgalagadi District, 11 km S Tsabong, (26°08'S, 22°28'E, datum: WGS72; elev. 960 m) collected in 1970 were borrowed from the herpetology collection of the Natural History Museum of Los Angeles County (LACM 116407, 116410-116413, 116421, 116423-116424, 116428, 116430, 116436-116437, 116440, 116448, 116454, 116458, 116464, 116466, 116471, 116477), Los Angeles, California and examined for helminths. Stomachs were unavailable for examination. One female (LACM 116423) contained three cestodes in the small intestine. One male (LACM 116424) contained 6 nematodes (4 males, 2 females) in the large intestine. Cestodes were regressively stained in hematoxylin, mounted in Canada Balsam, studied as whole mounts and identified as *Oochoristica truncata*. Nematodes were cleared in a drop of concentrated glycerol on a glass slide, cover-slipped, and identified as *Spauligodon smithi*. They were deposited in the United States National Parasite Collection, Beltsville, Maryland: *Oochoristica truncata* USNPC (97451); *Spauligodon smithi* USNPC (97452).

Oochoristica truncata is widespread in Africa where it is known from agamid, chameleonid, corydalid, gekkonid, scincid lizards and boid and colubrid snakes (Goldberg and Bursey 2004. Afr. Zool. 39:111-114). *Oochoristica* utilize an intermediate host; infection is through the host's diet (Conn 1985. J. Parasit. 71:10-16). *Spauligodon smithi* is previously known from the gekkonid *Ptenopus garrulus* (Goldberg and Bursey 2002. Afr. Zool. 37:43-46) and lacertid *Nucras tessellata* (Goldberg and Bursey 2004. Afr. Zool. 39:111-114. *Spauligodon smithi* has a direct life cycle with no intermediate host; infection occurs through the ingestion of eggs (Anderson 2000. Nematode Parasites of Vertebrates: Their Development and Transmission, CABI Publishing, Wallingford, U.K. 650 pp.). *Colopus wahlbergii* is a new host record for *O. truncata* and *S. smithi*.

We thank Christine Thacker (LACM) for permission to examine specimens and Sean Kark and Nicholas Scott (Whittier College) for assistance with dissections.

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LEIOCEPHALUS PSAMMODROMUS (Turks and Caicos Curly-tail Lizard). **NECROPHAGY**. Despite their abundance and distribution throughout the Caribbean, relatively little is known about the natural history of lizards in the genus *Leiocephalus*. In particular, few reports exist on their diets. Here, we report on an observation of necrophagy in *L. psammodromus* from the Turks and Caicos Islands.

At 0950 h on 12 March 1974, JBI observed a male *L. psammodromus* (91 mm SVL) consuming a dead *Anolis scriptus* on the southwest portion of Pine Cay (21°54'N, 72°06'W, datum: WGS84; elev. 1.5 m). The observation was made in the rocky coppice vegetation zone of the island ("SW Blind" site; Iverson 1979: Bull. Florida State Mus., Biol. Sci. 24:175–358). The anole had been regurgitated by a *Cyclura carinata* at 1345 h the previous

day, and thus had been dead for at least 20 h.

Previous reports of the diets for some *Leiocephalus* have reported saurophagy (e.g., *L. barahonensis*: Micco et al. 1997: Herpetol. Nat. Hist. 5:147–156; *L. carinatus*: Schoener et al. 1982: Oecologia 53:160–169; *L. cubensis*: Schwartz and Henderson 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History. Univ. Florida Press, Gainesville; *L. macropus*: Fong and Del Castillo 2002. Herpetol. Rev. 33:205–206; *L. schreibersi*: Jenssen et al. 1989. Anim. Behav. 38:1054–1061); however, this appears to be the first observation of *Leiocephalus* eating dead lizards. Our observation suggests that *L. psammodromus*, and perhaps other species, may be opportunistic scavengers as well as predators.

The *L. psammodromus* (UF32893) was deposited in the herpetological collection at the Florida State Museum, University of Florida.

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PHRYNOSOMA MCALLII (Flat-tailed Horned Lizard). **HIBERNATION**. Based on a study of captive animals in laboratory and outdoor enclosures, *P. mcallii* have been described as obligate hibernators, with a date of entry into hibernation varying from October to December (Mayhew 1965. Comp. Biochem. Physiol. 16:103–119). As part of a study to determine the effects of off-highway vehicle use on *P. mcallii*, in which a treatment of off-highway vehicles was applied to sites in November or December of 2004 (Grant 2005. MSc Thesis, Colorado State Univ., Fort Collins, Colorado. 84 pp.; online at: http://www.warnercnr.colostate.edu/~doherty), we followed 36 *P. mcallii* equipped with radio-transmitters into hibernation.

Lizards were at four study sites in the Colorado Desert, a subsection of the Sonoran Desert, in southern California. Twelve lizards were on East Mesa of the Imperial Valley (32°49'20"N, 115°15'10"W, datum: NAD83; elev. 10–15 m), 2 lizards on the Navy Parachute Range of West Mesa of the Imperial Valley (32°51'30"N, 115°46'20"W, datum: NAD83; elev. -5 to -10 m), 12 lizards were at Ocotillo Wells State Vehicle Recreation Area near Squaw Peak (33°10'50"N, 116°07'05"W, datum: NAD83; elev. 55–65 m), and 10 lizards were also at Ocotillo Wells State Vehicle Recreation Area a few miles north on the Pole Line Road (33°09'50"N, 115°59'30"W, datum: NAD83; elev. 25–65 m). A lizard was defined as hibernating if it was in a typical hibernation burrow (see below).

As in the captive study, free-ranging *P. mcallii* began hibernation from early October to late December. However, two lizards were never observed hibernating, although one of these was seen digging a burrow on 20 December. Five additional lizards abandoned their first hibernation burrows and moved to new hibernation burrows before we applied the experimental treatment in late November–December. These five *P. mcallii* moved < 10 m before digging a new burrow. Another two lizards were observed in a hibernation burrow at least once, but were on the surface and not in hibernation burrows when the treatment was applied to these areas in late December. *Phrynosoma mcallii* may be obligate hibernators, but their behavior seems variable.

Typical hibernation burrows were shallow and the entrance was plugged with substrate, whereas non-hibernation burrows, used daily in the summer, are not plugged and usually much longer and deeper. Upon excavation from a hibernation burrow, a lizard was usually (80% of the time [N = 27]) facing outward rather than into the burrow. We recorded hibernation depth (measured to the center of a lizard's dorsum) for 31 lizards. Median depth was 5.0 cm; mean depth was 6.0 cm (SE = 0.6, range 2–17). Only two lizards hibernated at depths > 10 cm. Summer burrows have been reported as being typically 70–80 cm long and 25–30 cm deep (Young and Young 2000. Final report: scientific study of the flat-tailed horned lizard, *Phrynosoma mcallii*. U.S. Dept. of Navy Contracts N68711-95-LT-C0032, N68711-95-LT-C0035. 72 pp.; Online at: http://bioweb.usu.edu/flattailweb).

We hypothesized that lizard mass might affect the date that lizards enter into hibernation. For 24 *P. mcallii* for which we measured their mass within 5 days of October 1, we regressed mass on date of entry into hibernation (Fig. 1). Because lizards were not relocated every week, date of entry into hibernation could only be resolved to within an 11–day interval. The middle date of that interval was estimated to be the hibernation date. This regression has a significant (non-zero) slope (β) of -4.3 (95% CI: -2.6 and -6.0; P = 0.000025). These results indicate that the smaller *P. mcallii* are, the more they delay hibernation, perhaps either to continue to grow or gain fat reserves for hibernation. Larger pre-hibernation mass has been found to be correlated with increased hibernation survivorship in other reptiles (e.g., *Thamnophis elegans*; Bronikowski 2000. Evolution 54:1760–1767).

We have few data for juvenile *P. mcallii* (< 65 mm SVL) because they were too small to carry radio-transmitters. On 18 November, we observed a juvenile (44 mm SVL) *P. mcallii* surface active, but we also found another juvenile (45 mm SVL) in a burrow with a plugged entrance, facing out, i.e. in typical hibernation position. On the warm days of 15 and 20 December, we observed 3 active juvenile *P. mcallii* (40–42 mm SVL); one was next to an

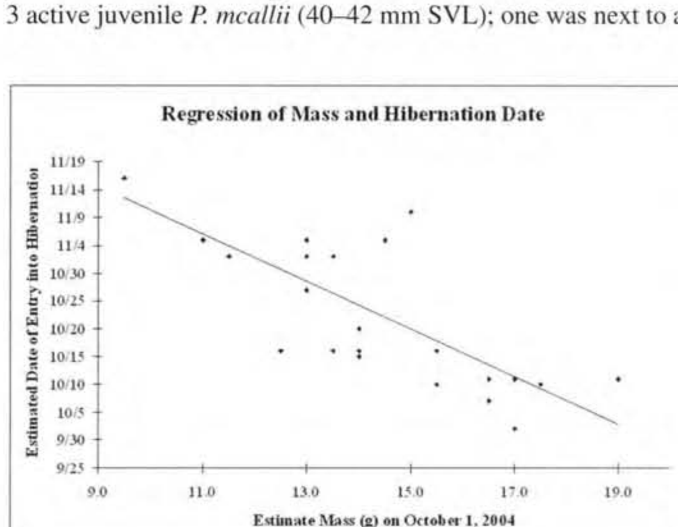

FIG. 1. Estimated mass on 1 October 2004 and estimated hibernation date of 24 *Phrynosoma mcallii* on three sites in southern California in 2004. The regression line of a linear estimate of the relationship between mass on 1 October 2004 and the estimated date of entry into hibernation (see text for details).

ant colony. It has been hypothesized that juveniles may not hibernate or that they hibernate for only a short time because they can reach reproductive size the following summer (Young and Young, *op. cit.*; Muth and Fisher 1992. Development of baseline data and procedures for monitoring populations of the flat-tailed horned lizard, *Phrynosoma mcallii*. Contract Report FG9268 to the Calif. Dept. Fish and Game, Sacramento, California.). Our observations suggest that juveniles can also be flexible in their hibernation habits.

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PHRYNOSOMA TAURUS (Mexican Horned Lizard). **DEFENSIVE BEHAVIOR.** As horned lizards (genus *Phrynosoma*) are potential prey for many animals, they need effective defenses. Recently, field encounters between humans and each of several species of *Phrynosoma* were combined with controlled encounters with predators and literature records to determine which of the 13 currently recognized *Phrynosoma* species (including *P. taurus*) exhibit the anti-predator blood-squirting behavior (Sherbrooke and Middendorf 2001. Copeia 2001:519–527). Sherbrooke and colleagues (2004. Herpetol. Rev. 35:345–347) indicated that the only literature report of blood squiring in *P. taurus* was based on a misidentification of the species not based on personal observation (see Ruthling 1919. Copeia [72]:67–68). Thus, they concluded that the report of blood squirting by *P. taurus* was erroneous. We provide an observation of blood-squirting behavior in *P. taurus* that may require reconsideration of their conclusion.

In May 2005, while walking on a trail toward Sierra de Monteflor in Zoquiapan Boca de Los Ríos within the Biosphere Reserve of Tehuacan-Cuicatlan, Oaxaca, México, UOGV collected a male *Phrynosoma taurus* (80 mm SVL) at (17°36'38.3"N, 96°49'23.5"W, datum: WGS84; elev. 1374 m). The lizard was found while walking on a trail in an oak forest. When captured, the animal displayed the blood-squirting defensive behavior by ejecting blood from the sinus of the left eye. Execution of the behavior was rapid and occurred within 7 sec of handling. This record confirms the presence of blood-squirting behavior in *P. taurus*, and represents the first record of this behavior in response to a field encounter with humans.

Because the *P. taurus* occurred in a Biosphere Reserve, we photographed the animal for a voucher and then released it. The color slide voucher (MZFC 1598) was deposited in the herpetological collection of Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, México.

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TUPINAMBIS MERIANAE (Tegu). **DIET**. The seven recognized species of tegu (genus *Tupinambis*) occur over a broad range habitats from forest to grassland. As adults, tegus are usually assumed to prey largely on small vertebrates and invertebrates (Zug et al. 2001. Herpetology: An Introductory Biology of Amphibians and Reptiles, 2nd edition. Academic Press, London. 630 pp.). However, dietary studies indicate that they are opportunistic omnivores that scavenge and include vegetable matter in their diets (Sazima and Haddad 1992. *In* Morellato [ed.], Historia Natural da Serra do Japi, pp. 212–235. Unicamp Press, Brazil). Here, we describe an unusual attempted predation event by *T. merianae* from southeastern Brazil.

At 1130 h on 30 December 2005, we observed an adult (ca. 50.0 cm SVL) *Tupinambis merianae* biting a juvenile (30.0 cm total length) armadillo (*Dasypus novemcinctus*) on Anchieta Island in the southeastern coast of Brazil (23°32'27.2"S, 45°03'57.1"W, datum: WGS84; elev. 6 m). The armadillo had a bruise on his dorsum (Fig. 1) that had an offal-like smell.

The predation attempt likely failed because the thickest part of the armadillo appeared to be too large to be swallowed. The offal-like smell from the armadillo's bruise may have triggered the predatory attempt, as scavenging on dead animals has been reported for *T. merianae* (Haddad and Sazima, *loc. cit.*).

FIG. 1. *Dasypus novemcinctus* with a bruise on the dorsum prior to its sustaining a predation attempt by *Tupinambis merianae*.

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UROSTROPHUS VAUTIERI (NCN). **SKIN SHEDDING.** For many reptiles, ecdysis can make them temporarily more vulnerable to predation or can reduce their ability to feed. Lizards often rub their old skin on the substrate using their forelegs, hindlegs, mouth, and tail in what appears to be a series of creeping movements (Sousa et al. 2000. Revista Brasiliera Zool. 17:225–228). Ecdysis in most lizards involves loss of patches of skin, whereas ecdysis in snakes and some lizards (e.g., anguids) involves loss of the entire skin in one piece (Smith 1946. Handbook of Lizards: Lizards of the United States and of Canada. Comstock Publishing Co., New York. 557 pp.; Zug 1993. Herpetology: An Introductory Biology of Amphibians and Reptiles. Academic Press, San Diego, California. 527 pp.; Borges 1999. Serpentes Peçonhentas Brasileiras: Manual de Identificação, Prevenção e Procedimentos em Caso de Acidentes. Editora Atheneu, São Paulo. 148 pp.). Complete shed skins of snakes and anguids can often be used to identify species. We describe, for the first time, behavior of the leiosaurid lizard *U. vautieri* during a shedding event.

A single *U. vautieri* (95 mm SVL, 2.7 g) was captured in a pitfall trap on 26 September 2000, in a forest patch next to CBR - Centro de Biologia da Reprodução (Center of Reproduction Biology) at the Campus of Universidade Federal de Juiz de Fora – UFJF (21°46'50.5"S, 43°22'30.3"W, datum: WGS84; elev. 948 m). The lizard was maintained and observed in a terrarium (110 × 40 × 40 cm), enriched with a substrate of sand, rocks, dry leaves, and branches of different diameters distributed in different positions to provide perches. Mealworm larvae (*Tenebrio* sp.) were offered as food. Shedding behaviors were recorded and photographed.

At 0900 h on 3 October 2000, LBR found the *U. vautieri* in the initial stages of shedding its skin. Ecdysis began with a splitting of skin around the eyes and a dorsal split in skin extending from the back of the head to the distal portion of the posterior torso. During this process, the lizard kept crawling and rubbing its skin on a leaning branch with the back of its torso until the old dorsal skin was entirely removed. However, old skin still remained attached to its head, neck, limbs, and tail. The skin fragments remaining on the head were rubbed off on the branch and the lizard ate the detached pieces. Next, the lizard crawled up and down on the branch, which detached all skin on limbs and the belly. While it rubbed its skin on the branch, the lizard searched its body for detached skin, and, at 1–2 minute intervals, it swallowed pieces that had been removed. To remove the skin remaining on its tail, the lizard bit the skin at the base of the tail and pulled on it. It then detached its old skin from the base to the end of its tail by turning its body in circular movements. The entire shedding process required ca. 40 min.

The shedding skin process in *U. vautieri* we observed was similar to that observed by Sousa et al. (*op. cit.*) for *Enyalius perditus* and *E. bilineatus* of the same family. In *E. perditus*, however, the lizard's initial skin detachment, occurred transversely on the dorsal part of the head, between the tympana.

The *U. vautieri* (CH-UFJF 051) was deposited in the herpetological collection of Universidade Federal de Juiz de Fora, Juiz de Fora City. We thank Laurie J. Vitt and reviewers for helpful comments on a first draft of the manuscript.

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VARANUS EREMIUS (Rusty Desert Monitor). **ENDOPARASITES.** *Varanus eremius* is a small (adults ca. 50 cm total length) monitor known from central coastal regions of Western Australia to desert areas of South Australia and the Northern Territory (Cogger 1996. Reptiles & Amphibians of Australia, 6th ed., Ralph Curtis Publications, Sanibel Island, Florida. 808 pp.). Two previous reports of helminths for *V. eremius* exist: both reported larvae assigned to the nematode family Physalopteridae (Jones 1995. Aust. J. Zool. 43:141–164; Jones 1995. J. Wild. Dis. 31:299–306). The purpose of this note is to report one species of Cestoda and two species of Nematoda in *V. eremius*.

Coelomic cavities and small and large intestines of 20 *V. eremius* (mean SVL = 124 mm ± 12.4 SD, range: 105–1148 mm) from Western Australia collected between 119°05'E to 123°55'E and 26°14'S to 28°27'S, datum: AGD66; elev. ca. 465 m during 1966–1968 in the herpetology collection of the Natural History Museum of Los Angeles County (LACM 54088–54091, 54094, 54096–54099, 54112, 54115–54116, 54119–54120, 54123–54124, 54126–54127, 54129–54130) were examined for helminths. Stomachs were unavailable for examination. Cestodes were regressively stained in hematoxylin, mounted in Canada balsam, studied as whole mounts and identified as *Acanthotaenia gracilis* (prevalence: infected lizards/lizards examined × 100 = 35%; mean intensity: mean number of helminths per infected lizard ± SD = 2.1 ± 1.2). Nematodes were cleared in a drop of concentrated glycerol on a glass slide, cover-slipped, and identified as *Kreisiella lesueurii* (prevalence: 15%, mean intensity: 5.3 ± 4.5) and *Maxvachonia brygooi* (prevalence: 40%, mean intensity: 6.8 ± 7.6). Helminths were deposited in the United States National Parasite Collection, Beltsville, Maryland: *Acanthotaenia gracilis* USNPC (97447); *Kreisiella lesueurii* USNPC (97448); *Maxvachonia brygooi* USNPC (97449).

Beddard (1913. Proc. Zool. Soc. London 1913:4–36) described *Acanthotaenia gracilis* from a *Varanus varius* collected in Australia. *Varanus eremius* is the second host reported to harbor this cestode. To our knowledge, the life cycles of species of *Acanthotaenia* are unstudied. *Kreisiella lesueurii* is known from Australian scincids and agamids (Goldberg and Bursey 2000. Trans. Roy. Soc. S. Aust. 124:127–133). *Maxvachonia brygooi* is known from Australian scincids, agamids and a varanid (Goldberg and Bursey, *op. cit.*). *Kreisiella leseueurii* is a member of the Physalopteridae which typically utilize insect intermediate hosts; *M. brygooi* belongs to the Cosmocercidae in which infection results from ingesting eggs (Anderson 2000. Nematode Parasites of Vertebrates: Their Development and Transmission, CABI Publishing, Wallingford, United Kingdom. 650 pp.). *Varanus eremius* repre-

sents a new host record for *Acanthotaenia gracilis*, *Kreisiella lesueurii* and *Maxvachonia brygooi*.

We thank Christine Thacker (LACM) for permission to examine *V. eremius*, and Dustin Goto and Sean Kark (Whittier College) for assistance with dissections.

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XENOSAURUS RECTOCOLLARIS (Pallid Knob-scaled Lizard). **PARENTAL CARE**. Parental care is infrequent in reptiles (Wesolowski 1994. Am. Nat. 143:39–58), although it exists in some lizards (Somma 1987. Great Basin Nat.47:536–537). In *Xenosaurus newmanorum*, an association between females and neonates exists that may indicate parental care (Lemos-Espinal et al. 1997. Herpetol. Rev. 28:22), but no observations of similar behavior exist in other *Xenosaurus*. Hence, we report observations implying parental care in the rock-crevice dwelling *X. rectocollaris* (Ballinger et al. 1995. Biotropica 27:128–132), a species endemic to the Biosphere Tehuacán-Cuicatlán Reserve that inhabits arid zones with little vegetation at elevations up to 2000 m (Lemos-Espinal et al. 1996. Herpetol. Nat. Hist. 4:151–154).

During a mark-recapture study of this species in 2004, we observed nine occasions where a female and one or two neonates occupied one crevice. The first occasion occurred on 7 April. In a crevice 8 mm wide × 150 mm deep, and 39 mm above the ground, we observed a female (89 mm SVL) with a juvenile (54 mm SVL). On 8 April 2004, we observed two more associations; one was in a crevice 11 mm wide × 145 mm deep, and 300 mm above the ground that contained a female (102 mm SVL) and one juvenile (57 mm SVL). The other was in a crevice 8 mm wide × 100 mm deep, and 220 mm above the ground, and contained a female (100 mm SVL) with one juvenile (63 mm SVL).

On 7 May 2004, we observed a female (102 mm SVL) with two juveniles (52 and 51 mm SVL) in a crevice 9 mm wide × 91 mm deep, and 100 mm above the ground, The females and juveniles marked in April were still in their same crevices.

In mid-July 2004, a female (105 mm SVL) was found with a juvenile (60 mm SVL) in a crevice 8 mm wide × 160 mm deep at ground level. Lizards marked in April and May were still inside their same crevices.

On 17 September 2004, we found a gravid female (100 mm SVL) with two juveniles (51 and 65 mm SVL, respectively) in a crevice 10 mm wide × 200 mm deep, and 240 mm above the ground. The next day, we observed three associations: a female (103 mm SVL) with a juvenile (50 mm SVL) in a crevice 8 mm wide × 170 mm deep at ground level; a female (87 mm SVL) and a juvenile (47 mm SVL) in a second crevice 10 mm wide × 650 mm deep, and 1500 mm above the ground; and a female (103 mm SVL) and a juvenile (51 mm SVL) in a third crevice 21 mm wide × 160 mm deep at ground level. The animals noted in previous months were still in the same positions as before.

In all instances, juveniles were innermost in their crevices. The outermost position of the females may have been a protective behavior, or simply due to the size differential of the crevices. Manipulative study will be necessary to determine whether these associations really reflect parental care.

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SERPENTES

ALSOPHIS CANTHERIGERUS (Jubo, Jubo de Sabana, Jubo Sabanero). **SIZE RECORD.** On 25 June 1926, Charles T. Ramsden collected a female *Alsophis cantherigerus* from San Carlos, Guantánamo Province, Cuba. This specimen (CTR without number; "Charles T. Ramsden" historic collection deposited at Instituto de Ecología y Sistemática, Cuba) was determined as *A. c. pepei* by MD on 3 March 2005. It measures 1333 mm snout–vent length, 480 mm tail length (tail incomplete), and according to Ramsden's notes, there were 58 eggs in the oviducts. The previously reported maximum SVL for this species was 1220 mm (Schwartz and Henderson 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History. Univ. Florida Press, Gainesville, xvi + 720 pp.). Novo and Arazoza (1986. Rep. Inv. 30:1–15) reported maximum clutch size for this species as 24 eggs for a female measuring 1160 mm SVL, and noted a positive correlation between clutch size and SVL.

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BOIRUNA MACULATA (Mussurana, Víbora luta, Mamona). **PREY AND PREDATION BEHAVIOR.** *Boiruna maculata* has a large distribution in southern South America, from Mendoza, southwestern Argentina to southern Bolivia, western Mato Grosso do Sul and southern Goiás, and southern Brazil. It is also found in Paraguay and Uruguay (Achával and Olmos 1997. Anfibios y Reptiles del Uruguay. Olmos Editor. Montevideo, Uruguay. 128 pp.; Giraudo and Scrocchi 2002. Smithson. Herpetol. Infor. Serv. 132, 53 pp.; Zaher 1996. Boll. Mus. Reg. Sc. Nat. Torino 14[2]:289–337). Because of its distribution, coloration, food habits, and myths about its behavior, the species is one of the best known in the region.

In spite of this, here we describe a previously unreported behavior and prey species. On 10 January 2004 at 0030 h, while conducting a herpetological survey in the Reserva Ecológica El Bagual (26°10'53"S, 58°56'39"W; datum WGS84, Formosa, Argentina, we observed an adult bird, known locally as a "Zorzal colorado" (*Turdus rufiventris,* Turdidae), fall from its nest in an "Espina Corona" tree (*Gleditsia amorphoides*) at 1.5 m above

ground. We observed a male *Boiruna maculata* (SVL 1298 mm; 525 g; herpetological collection Fundación Miguel Lillo, Tucumán, Argentina, FML 15421) climb the tree and eat one of the three chicks (45.0 g; 39.5 g, and 40.3 g; ca. 9 days old) in the nest.

On 18 November 1996, another *B. maculata* was captured during the morning, resting in a nest of "Boyero ala amarilla" (*Cacicus chrysopterus,* Icteridae) that was hanging at the end of a thin branch of a "Guayacán" (*Caesalpinia paraguayensis*) at 3.5 m from the ground and 5 m from the trunk; the snake regurgitated two chicks and in the nest we found two others, one dead and another alive (estimated age and weight of the chicks: 16–18 days; 30–34 g). Another snake from the same locality (FML 11560, female, SVL 1180 mm) contains a slightly digested chick (86 g, 160 mm TL; estimated age 7 days) of "Chajá" (*Chauna torquata,* Anhimidae) in its stomach.

Previous reports about the feeding habits of *Boiruna maculata* mention snakes, lizards, mice, and fishes in the diet (see Carreira Vidal 2002. Alimentación de los Ofidios de Uruguay, Monografías de Herpetología, Vol. 6. Asociación Herpetológica Española. Barcelona, España, 126 pp. and literature cited therein). Our observations indicate that *B. maculata*, at least at this locality, habitually feeds on nestling birds, and climbs trees in search of nests and chicks, in spite of its stout body and relatively short tail—a body form typical of ground-dwelling species.

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BUNGARUS MULTICINCTUS MULTICINCTUS (Many-Banded Krait). **DIET**. *Bungarus m. multicinctus* mainly feeds on fish, frogs, skinks, snakes, and mice (Mao 1993. Common Terrestrial Venomous Snakes of Taiwan. National Museum of Natural Science Spec. Publ. No. 5). Larger *B. m. multicinctus* tend to be more ophiophagous (Mao 1970. Herpetologica.26:45–48), with the following species recorded as prey: *B. m. multicinctus*, *Enhydris plumbea*, *Ramphotyphlops braminus*, *Cyclophiops major*, *Trimeresurus stejnegeri*, *Xenochrophis piscator* (Lin et al. 1995. NOW 3[2]:19–21 [in Chinese]; Mao 1970, *op. cit.*; Mao, pers. obs.).

At 1955 h on 5 May 2005, in Da-jiou-shi Experimental Forest, National Ilan University, northern Taiwan, we observed a male *B. m. multicinctus* (ca. 110 cm total length) subduing a Taiwanese Habu (*Protobothrops mucrosquamatus*) (ca. 65 cm total length) on the roadside of the forest nursery trail (24°47'11"N, 121°40'39"E; 254 m elev.). The air temperature was 22.6°C and the relative humidity was 68%.

When attacked, the *P. mucrosquamatus* bit the *B. multicinctus* on its back. Because a drop of blood was visible on the dorsal scales, we assume that the fang penetrated the skin of the *B. multicinctus*. However, we observed no changes in the behavior of the *B. multicinctus*. After the *P. mucrosquamatus* stopped struggling, the *B. multicinctus* started to swallow it headfirst. At 2115 h the prey was completely swallowed, and the *B. multicinctus* moved to a nearby bamboo bush. To our knowledge, this is the first report of *P. mucrosquamatus* being preyed upon by a *B. m. multicinctus*.

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CROTALUS INTERMEDIUS GLOYDI (Oaxacan Small-headed Rattlesnake). **DIET.** *Crotalus intermedius* is a small, montane species known to prey only on lizards. Klauber (1972. Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind. 2nd ed. Univ. California Press, Berkeley, California. 1533 pp.) found two large lizards (unidentified species) and lizard scales in three specimens of *C. i. intermedius*, and a lizard (unidentified species) and lizard scales in 12 *C. i. omiltemanus*. Campbell and Armstrong (1979. Herpetologica 34:304–317) reported finding *Sceloporus* scales in the scats of 18 *C. i. omiltemanus* from Guerrero and *Sceloporus* remains in the stomachs of several *C. i. gloydi* from Oaxaca. Campbell and Lamar (2004. Venomous Reptiles of the Western Hemisphere. Cornell Univ. Press, Ithaca, New York. 870 pp.) further reported finding *S. formosus* and *S. mucronatus* in the stomachs of *C. i. omiltemanus* from Guerrero.

On 25 June 2005 Boone Hallberg presented us with a collection of preserved reptiles from his property ca. 3 km E of Ixtlán de Juárez in Oaxaca, Mexico. Among these specimens was a juvenile *C. i. gloydi* with a noticeable bulge in its stomach. Upon dissection we found that the snake (SVL 225 mm, mass 9 g) had ingested a large mouse (*Reithrodontomys fulvescens helvolus*; snout

FIG. 1. Juvenile *Crotalus intermedius gloydi* and the prey item (*Reithrodontomys fulvescens helvolus*) it consumed; the approximate prey/predator mass ratio was 1.4.

to rump length 80 mm, tail length 72 mm, mass 13 g) head-first. The approximate prey/predator mass ratio was 1.4. The snake and the mouse were accessioned together in the herpetological collection of the Instituto Tecnológico Agropecuario de Hidalgo (ITAH 1331).

We thank Boone Hallberg for donating the specimen and for allowing us access to his property; Steve Mackessy, Mike Torrocco, Griselda Quijano, Arisay Melo, and Ray Queen for assistance in the field; and Javier Rodríguez and Jonathan Campbell for reviewing the manuscript. Research and collecting were conducted under the authority of SEMARNAT scientific research permits OFICIO NÚM/SGPA/DGVS/02100 issued to FMQ and RWB.

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GEOPHIS HOFFMANNI (Hoffmann's Earth Snake). **REPRODUCTION.** *Geophis hoffmanni* is known from eastern Honduras to central Panama and Costa Rica (Savage 2002. The Amphibians and Reptiles of Costa Rica. A Herpetofauna Between Two Continents Between Two Seas, Univ. Chicago Press, Chicago, Illinois, 934 pp). There are reports of clutches of up to five eggs (numbers of individual clutches not given) from November and December in Solórzano (2004. Snakes of Costa Rica. Distribution, Taxonomy, and Natural History, Instituto Nacional de Biodiversidad, INBio, Santo Domingo de Heredia, Costa Rica, 791 pp.). The purpose of this note is to report additional clutch sizes by month for *G. hoffmanni* from Costa Rica.

I examined ten females (mean snout–vent length, SVL = 225 mm ± 17 SD, range: 201–255 mm) from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California: LACM: 151179, 151188, 151202–151204, 151215, 151216, 151221, 151232, 151233. Nine *G. hoffmanni* were from San José Province one was from Heredia Province. They were collected 1963, 1966, 1983. The left ovary was removed, dehydrated in ethanol and embedded in paraffin. Histological sections were cut at 5 μm and stained with Harris' hematoxylin followed by eosin counterstain. Enlarged ovarian follicles (> 8 mm length) or oviductal eggs were counted; no histology was done on them.

Eight of the ten females contained enlarged follicles or oviductal eggs and were from: June (N= 1), August (N = 1), September (N = 1), October (N = 1), November (N = 4). Mean clutch size (N = 8) was 2.6 ± 0.52 SD, range: 2–3. One female from November was undergoing yolk deposition (= secondary vitellogenesis *sensu* Aldridge 1979. Herpetologica 35:256–261) for a subsequent clutch and another from November was not undergoing yolk deposition. The smallest reproductively active female (3 oviductal eggs) measured 201 mm SVL (LACM 151215) and was from June. The presence of reproductively active females over a six month period (including December from Solórzano, *op. cit.*) indicates a prolonged ovarian cycle with the likelihood of multiple egg clutches produced in the same year. *Geophis brachycephalus* from Costa Rica produced egg clutches during January, February, July, August, October, November (Sasa 1993. Rev. Biol. Trop. 41:295-297) also indicating an extended ovarian cycle.

I thank C. Thacker (LACM) for permission to examine specimens. Specimens are from the CRE collection donated by J.M. Savage to LACM.

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GEOPHIS SEMIDOLIATUS (Coral Earth Snake). **REPRODUCTION.** *Geophis semidoliatus* is known from Veracruz and Puebla, Mexico (Downs 1967. Misc. Publ. Mus. Zool. Univ. Michigan 131:1–193; Canseco-Marquez et al. 2000. Herpetol. Rev. 31:259–163). To my knowledge, there is no published information on its reproduction. The purpose of this note is to provide information on the reproductive cycle of *G. semidoliatus* based on a histological examination of gonads from museum specimens.

I examined ten females (mean snout-vent length, SVL = 256 mm ± 12 SD, range: 237–277 mm), seven males (SVL = 222 mm ± 19 SD, range: 190–241 mm) and three neonates (SVL = 114 mm ± 5 SD, range: 108–118 mm) from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California: LACM 2547, 122136, 122203–122207, 122212, 122213, 122217, 122221, 122224, 122226, 122228–122230, 122275, 122277–122279. All *G. semidoliatus* were from Veracruz, Mexico and were collected in 1969, 1971, or 1972. The left testis and vas deferens or ovary was removed, dehydrated in ethanol and embedded in paraffin. Histological sections were cut at 5 μm and stained with Harris' hematoxylin followed by eosin counterstain. Enlarged ovarian follicles (> 8 mm length) or oviductal eggs were counted; no histology was done on them.

Spermiogenesis was in progress in the seven males examined. The vas deferens from each male contained sperm. All were from July. The smallest male measured 190 mm SVL. The ten females were all reproductively active (enlarged follicles or oviductal eggs) and were from: July (N = 6), August (N = 1), September (N = 2), October (N = 1). One July female with oviductal eggs (LACM 122224) was undergoing concurrent yolk deposition (= secondary yolk deposition *sensu* Aldridge 1979. Herpetologica 35:256–261) for a subsequent clutch indicating *G., semidoliatus* may produce more than one clutch in the same year. Mean clutch size (enlarged ovarian follicles or oviductal eggs was 2.1 ± 0.7 SD, range: 1–3 eggs). These are the first clutch sizes reported for *G. semidoliatus.* The smallest reproductively active female measured 237 mm SVL (enlarged ovarian follicles). Three presumably neonates were collected during summer: LACM 122279, SVL = 108 mm and LACM 122226, SVL = 118 both from July and LACM 122136, SVL =115 from August.

I thank C. Thacker (LACM) for permission to examine specimens.

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HETERODON PLATIRHINOS (Eastern Hognose Snake). **ROAD CROSSING BEHAVIOR**. The effect of roads on the ecology and movement patterns of animals is of great interest to ecologists and conservationists (Forman and Alexander. 1998, Ann. Rev. Ecol. Syst. 29:207–231; Forman et al, 2003, Road Ecology: Science and Solutions, Island Press, Washington, D.C.). Recent work on snakes demonstrates that roads might have significant effects on their movements (Shine et al. 2004. Ecology and Society 9:9). Furthermore, different species of snakes may respond differently to roads (Andrews 2003. Proc. Int. Conf. Ecol. Trans., pp. 649–651; Andrews and Gibbons 2005. Copeia 2005:772–782).

In the course of accumulating over 1700 observations while radiotracking 16 *Heterodon platirhinos* daily over four years (Plummer and Mills 2000. J. Herpetol. 34:565–575), we observed 61 cases among four snakes that approached within 5 m of a lightly used 5 m wide paved asphalt road. In each case, we recorded the snake's location the following day and classified the interim movement as a 1) road crossing; 2) a move away from the road (snake reversed its direction of travel); or 3) a move parallel to the road. Three snakes approached the road 27 times but avoided crossing (Table 1). One male snake (HP6) appeared to move randomly after approaching the road, crossing it in 25% of cases. Eight of his nine crossings resulted from moving to and from a hibernaculum on the side of the road opposite from its home range (Plummer 2002. Herpetol. Rev. 33:89–90) and occurred at two specific locations on the road. Among all snakes, only 15% of the 61 road approaches were followed by crossings. Our telemetric data suggest that *H. platirhinos* is sensitive to the presence of paved roads and that moving individuals typically avoid crossing them; however, some individuals might be compelled to cross when moving to and from hibernating sites (Bonnett et al. 1999. Biol. Cons. 89:39–50). The overall 85% avoidance rate we found is similar to the 80% road avoidance rate observed for *H. platirhinos* by Andrews and Gibbons (*op. cit.*). Plummer and Mills (*op. cit.*) found that resident *H. platirhinos* moved about 120 m per day within unusually large (50 ha) home ranges, probably creating regular opportunities for road crossings on the study area. That crossings did in fact occur is evidenced by HP6 and by two road-killed untracked *H. platirhinos* observed over four years of daily observations.

TABLE 1. Number of responses of *Heterodon platirhinos* after approaching a paved asphalt road. Responses were classified as road crossings, movements away from the road, and movements parallel to the road.

Snake	Sex	No. approaches	No. crosses	No. away	No. parallel
HP1	F	6	0	3	3
HP6	M	34	9	9	16
HP10	F	16	0	1	15
HP13	M	5	0	2	3
Total		61	9 (14.8%)	15 (24.6%)	37 (60.7%)

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HETERODON PLATIRHINOS (Eastern Hognose Snake). **REGURGITATION OF PREY.** The death-feigning behavior of snakes in the North American genus *Heterodon* has long been recognized (Edgren. 1955. Herpetologica. 11:105–117). On 11 September 2005, in the Adirondack foothills of northwestern Saratoga County, New York, USA, JB encountered an active neonate *H. platirhinos* (ca. 11.4 cm TL). During an attempt to move the snake, it responded by hissing, hooding, and writhing. As the snake entered the death-feigning phase, it regurgitated a partially digested red eft (land stage of *Notophthalmus viridescens*). After the death-feigning phase was completed, the snake retreated. Although predation on *N. viridescens* by *H. platirhinos* has been reported (Uhler et al. 1939. Trans. N. Am. Wildl. Conf. 4:605–622), we are unaware of reports indicating predation frequency. Tetradotoxin (TTX) and its analogues occur in many terrestrial and marine animals and have been detected in salamanders of the genera *Taricha*, *Notophthalmus*, *Cynops*, *Ambystoma*, *Triturus*, and *Paramesotriton* (Yamashita and Mebs 2001. Toxicon 39:1261–1263). Brodie et al. (1974. Copeia 1974:506–511) found that the aposematically pigmented red eft stage of *N. viridescens* contained concentrations of TTX approximately ten times the levels of the aquatic adult stage. Further observations are needed to determine if *Heterodon platirhinos* frequently predate red efts in the referenced area.

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HETERODON PLATIRHINOS (Eastern Hognose Snake). **ENVENOMATION AND PREY SURVIVAL.** Whether or not colubrid snakes of the genus *Heterodon* are at all venomous has been questioned, but mostly supported since the idea was first proposed by Ditmars (1912. Zoologica 1:204) upon observation of microscopic grooves along the rear fangs. Later, evidence was provided through personal experiences and observations of envenomation by *Heterodon*, first by Bragg (1960. Herpetologica 16:121–124) and later by Grogan (1974. Herpetologica 30:248–249) and Morris (1985. Herpetologica 41:361–363). Each author described swelling and pain at the site of the wound. Hill and Mackessy (1997. Toxicon 35:671–678; and 2000. Toxicon 38:1663–1687; see also Mackessy 2002. J. Toxicol.-Toxin Rev. 21:43–83 for an extensive review of toxicity of colubrid salivas) used molecular techniques to quantify the toxicity and enzymatic activity in venoms of several species of colubrid snakes (including subspecies within *H. nasicus*). However, experimental evidence supporting toxicity of *Heterodon* saliva is limited. In one study, fluid from the salivary glands of *H. platirhinos* was injected into mice (none died), anurans (15 of 17 died; including *Bufo fowlerii,* 8 of 10 died), and one *Ambystoma laterale* (which did not die) (McAlister 1963. Herpetologica 19:132–137). Additionally, Young (1992. Toxicon 30:775–779) showed that application of *H. platirhinos*

Duvernoy's gland secretion caused pronounced reduction of muscle twitch amplitude during frog (*Rana pipiens*) neuromuscular preparations, but in guinea pig and rat tissue preparations effects were considerably less. Injection of Duvernoy's gland secretion into mice caused initial hyperactivity and later lethargy. We avoid use of the word "venom" to refer to any components of saliva for reasons discussed by Kardong (1982. Mem. Inst. Butantan 46:105–188). While some of these accounts demonstrate the toxicity of *Heterodon* saliva, there is little evidence demonstrating its efficacy and use as an applied means of subduing or killing prey in the wild. Furthermore, some authors have proposed that *Heterodon* snakes use their rear fangs for "popping" toads (Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Inst. Press, Washington, DC, 680 pp.). This too remains largely unobserved in the field and is purely speculative.

Herein, we provide evidence that challenges the efficacy of the toxic capacity and fang-mediated puncturing ability in *Heterodon*. Our observations indicate that these physiological attributes may not function as reliable predatory mechanisms.

During a telemetry study of *H. platirhinos* at the Brookhaven National Laboratory, Upton, Suffolk County, New York, USA (40°52'20"N, 72°52'04"W) one of us (SEG) recorded mass and length for one of the snakes in our study at 1500 h on 22 July 2004. The snake (SVL = 730 mm, 399 g), clearly disturbed by these activities, regurgitated a live *Scaphiopus holbrookii* (SVL = 32.0 mm, 2.6 g). The toad was rinsed with water and placed in a secure enclosure where it lived for 42 days before it was released at the location of its collection. The toad appeared healthy and ate well on a diet of crickets while in captivity. The toad did not appear to show any detrimental effects as a result of being swallowed by the snake. Again, on 31 May 2005, one of us (JAF) observed a different *H. platirhinos* (SVL = 538 mm, 224 g) regurgitate a live adult *Bufo fowleri* (SVL = 50.4 mm, 19.1 g). The toad appeared completely healthy and was kept under observation for 12 h before being released. Two other reports of live regurgitation were observed by Wendy Finn (pers. comm.) during her participation as a technician on this study. One observation occurred on 23 June 2005 and involved a snake (SVL = 505 mm, 114 g) regurgitating an undetermined anuran species that quickly escaped. The final observation occurred on 7 July 2005 and involved the same snake from 31 May 2005 regurgitating another *B. fowleri* (SVL = 58 mm, 25 g). This toad was kept in observation for five days and then released. Thus, three snakes in total were observed regurgitating live anurans indicating that this is not a unique event confined to a single individual, but rather an occurrence that might happen regularly. As such, these findings suggest limitations to the overall efficacy of the predatory mechanisms that have been attributed to this species, specifically mildly venomous saliva and prey-puncturing rear fangs.

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LEPTOTYPHLOPS TENELLUS (Guyana Blindsnake). **PREDATION.** Hawks of the genus *Micrastur* are known to generally feed upon birds and insects (Robinson 1994. Biotropica 26:443–458). *M. ruficollis* is, however, also reported to feed on *Anolis* and other mainly arboreal lizards such as *Laemanctus* and *Corytophanes*, as well as larger actively foraging terrestrial lizards of the genus *Ameiva* (Thorstrom 2000. J. Raptor Res. 34:196–202). Additionally, snakes form the bulk of the diet for *M. gilvicollis* (del Hoyo and Sargatal 1994. Handbook of the Birds of the World, vol. 2. Lynx Edicions, Barcelona, 638 pp.). However, none of the *Micrastur* species has been reported to feed on small semi-fossorial or leaf-litter dwelling snakes or lizards. On 24 November 2005 an adult female *M. gilvicollis* (YPM ORN 101439) was collected by Jorge de Leon from the environs around Augustus Creek near the northern rim of Tafelberg Plateau, Sipaliwini District, Suriname. During specimen preparation two reptiles were removed from the stomach, *Leptotyphlops tenellus* (YPM R15355) and a gymnopthalmid lizard *Iphisa elegans* (YPM R15358). *Leptotyphlops* burrows and *Iphisa* forages under leaf-litter (Dixon 1974. Herpetologica 30:133–139; Hahn 1979. Cat. Amer. Amphib. Rept. 230:1–4) Robinson (*op. cit.*) and del Hoyo and Sargatal (*op. cit.*) report that *M. gilvicollis* has been observed following ants through the forest, but that generally it attacks from concealed perches in the understory. It has not previously been reported to feed on prey species that are mostly hidden from view beneath leaf litter. We present evidence that fossorial and semi-fossorial squamates are also taken by *M. gilvicollis* and suspect that such prey are probably encountered during ant-foraging behavior.

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PROTOBOTHROPS MUCROSQUAMATUS (Taiwanese Habu). **STOMACH CONTENTS.** *Protobothrops mucrosquamatus* is a dietary generalist, mainly feeding on frogs (*Rana limnocharis, R. longicrus*), snakes (*Amphiesma stolatum, A. sauteri*), birds, rodents (*Mus formosanus, Rattus losea, R. norvegicus, R. coxinga*), shrews (*Suncus murinus*; Mao 1970. Herpetologica 26:45–48), and white mice under laboratory conditions (Kuntz 1963. Snakes of Taiwan. U.S. Naval Medical Research Unit No. 2). Small mammals (rodents and insectivores) seem to be its principal prey (Mao, *op. cit.*), and we have observed these snakes ambushing bats in dark crevices and caves.

At 2245 h, on 10 May 2005, in Da-jiou-shi Experimental Forest (DEF; 254 m, 24°47'11"N, 121°40'39"E), National Ilan University (NIU), northern Taiwan, a female *P. mucrosquamatus* (330 mm snout–vent length, 75 mm tail length) was observed moving along a concrete barrier. The snake had a greatly enlarged midbody, which affected its mobility. Upon palpation, the snake regurgitated a Long-tailed Shrew (*Crocidura kurodai*), with a body

length, tail length, and body mass of 63 mm, 54 mm, and 6.5 g, respectively. The snake was then released where found.

Long-tailed Shrews and Tanaka Grey Shrews (*C. attenuata*) are sympatric and abundant in DEF (Mao, in prep.). On many occasions, we have observed shrews along the concrete barrier at night. Based on our observations, *Trimeresurus stejnegeri* (Bamboo Vipers) regularly ambush along the concrete barrier, and on some occasions, *P. mucrosquamatus* and *Bungarus multicinctus* (Many-banded Kraits) have been encountered. It seems probable that this artificial structure concentrates local prey species in a linear fashion and thereby offers a better opportunity for successful predation. To our knowledge, this is the first report of a *P. mucrosquamatus* preying on *C. kurodai*.

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PSEUDABLABES AGASSIZII (Burrowing Night Snake). **REPRODUCTION**. The monotypic genus *Pseudablabes* is endemic to the Neotropics, occurring from central Brazil to northwestern Argentina and Uruguay (Peters and Orejas-Miranda 1970. Catalogue of the Neotropical Squamata: Part I Snakes, Smithsonian Institution Press, Washington, D.C. 347 pp.). Information regarding this species is restricted to a few studies on morphology, habitat use, diel activity, diet, feeding behavior, reproduction, and seasonal activity. Our knowledge of clutch and egg characteristics is limited (see Marques et al., Herpetol. J., *in press*). Here, we provide data on clutch size, volume and mass of eggs, size of hatchlings, and incubation time for eggs from a wild-caught *P. agassizii*. The female was collected during the faunal rescue for the Hydroelectric Usine of Queimado (16°12'S, 47°19'W), on the frontier of Minas Gerais and Goiás states, and Distrito Federal, including the municipalities of Unaí, Cabeceira Grande (MG), Formosa, Cristalina (GO), and Região Administrativa de Paranoá (DF). UHE Queimado was built on the Preto River, São Francisco basin, where the most representative local macrohabitat is the Cerrado *sensu lato* (Rizzini 1979. Tratado de Fitogeografia do Brasil, Vol. 2, Editora da Universidade de São Paulo, São Paulo, 374 pp.). The gravid female was collected in the morning of 19 October 2003 (316 mm SVL, 103 mm TL; 149 mm head length; 0.65 mm head height; 0.66 mm head width, and 144 g total mass). She was kept in a ventilated wooden collection box (40 × 20 × 20 cm), at room temperature (varied approximately between 20–34°C night/day). The substrate was lined with soil and leaf litter. At 0700 h on 21 October 2003, we found nine eggs, adhered to one another, in the corner of the box (Fig. 1). The eggs were similar in size (mean length 19.07 mm ± 0.59 SD; mean width 11.45 mm ± 0.05 SD; Table 1). The eggs were moved to an artificial incubator, a plastic box (40 × 20 × 15 cm) with a clip lid. The substrate consisted on a 6 cm layer of vermiculite. The box was heated at night by two 40-W lamps. The temperature inside the box, measured twice a day with a mercury thermometer, varied between 26–31°C. Substrate moisture was also monitored, and when necessary, water was sprayed on the inner side of the box. Two days after oviposition, one egg dehydrated and was discarded. Hatching began on the morning of 16 December 2003 and continued to 18 December.

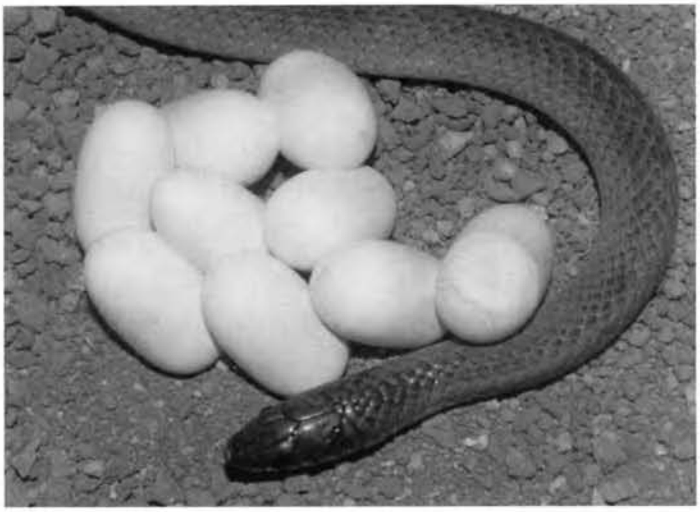

FIG. 1. Female *Pseudablabes agassizii* and its eggs (Minas Gerais, Brazil).

TABLE 1. Measurements of female and hatchlings of *Pseudablabes agassizii* at Minas Gerais, Brazil. EL = Egg length; EW = Egg width; SVL = Snout–vent length; TL = Tail length; BM = Body mass. Complementary measurements for hatchlings were taken in laboratory: HL = Head length; HH = Head height; HW = Head width.

Egg number	EL (mm)	EW (mm)	Hatching date	SVL (mm)	TL (mm)	HL (mm)	HH (mm)	HW (mm)	BM (g)	UFMG collection
1	18.0	11.0	16/12/2003	99.2	27.7	7.8	3.35	3.75	1.0	1550
2	19.0	12.0	16/12/2003	101.3	28.8	8.4	3.4	3.95	1.0	1549
3	19.2	10.7	16/12/2003	102	35.3	—	—	—	1.0	—
4	18.6	11.0	16/12/2003	100.2	28.6	7.6	3.0	3.7	1.0	1548
5	19.4	11.8	16/12/2003	107.3	30.3	—	—	—	1.01	—
6	19.4	11.5	16/12/2003	104	30.3	—	—	—	1.01	—
7	20.0	11.6	17/12/2003	108.3	31.7	—	—	—	1.01	—
8	19.0	12.0	16/12/2003	100.4	30.3	—	—	—	1.01	—
Female				316	103.2	14.9	6.5	6.55	144	1547

Mean hatchling SVL was 102.84 mm ± 3.39 SD; TL 30.37 mm ± 2.35 SD; Mass 1.005 g ± 0.005 SD (Table 1). Five hatchlings were released in the field on 17 December 2003, and the others, as well as the female, were deposited in the herpetological collection of Universidade Federal de Minas Gerais (UFMG 1547–1550). The period of egg incubation of *P. agassizii* in captivity was 57–59 days. The female was collected in October, which corresponds to the beginning of the local rainy season (Galvão and Nimer 1965. *In* IBGE [ed.], Geografia do Brasil-Grande Região Leste, Vol. 5, pp. 91–139. Rio de Janeiro, Brazil). Our results are consistent with Marques et al. (*op. cit.*), in that egg-laying occurs mainly during the rainy season, and that *P. agassizii* produces small clutches compared to related species, likely owing to its small adult size.

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THAMNOPHIS HAMMONDII (Two-striped Gartersnake). **DIET.** *Thamnophis hammondii* ranges from central California, USA, to southern Baja California Sur, México (Grismer 2002. Amphibians and Reptiles of Baja California. Univ. California Press, Berkeley. 399 pp.; Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Books, Washington, D.C. 668 pp.); little is known about the feeding ecology of this largely aquatic snake in the southern edge of its distribution.

At 2334 h on 17 August 2005, we captured a female *T. hammondii* (CIBNOR 0659: 522 mm SVL, 138 mm TL; 77.8 g [without prey item]) on Arroyo Las Ánimas, San Pedro de la Presa Oasis, Municipio de La Paz, Baja California Sur, México (24°51'00.8"N, 110°59'30.4"W) that had eaten an adult female *Bufo punctatus* (Red-spotted Toad; CIBNOR 0660: 62 mm SVL; 18.6 g) rump first. The prey was in excellent condition; only the skin in the cloacal region was partially torn. A second female *T. hammondii* (CIBNOR 0657: 341 mm SVL, 87 mm TL; 18.6 g [without prey item]) from the same locality regurgitated a partially digested *Tilapia* cf. *T. zilli* (Redbelly Tilapia, Cichlidae). The fish was swallowed headfirst and the anterior half of the specimen had been digested; the fish remains weighed 0.42 g. On the same night, we saw a third *T. hammondii* traveling along rocks on the same section of the arroyo. The snake was following a similar route to that used by a *Peromyscus* sp. (Deer Mice) a moment earlier, perhaps an indication that the *T. hammondii* may have been trailing the rodent.

Our observations support the assertions that *T. hammondii* forages in and near the water, its prey include anurans and fishes, and although primarily a diurnal species, can be active at night during the summer (Grismer 2002, *op. cit.*; Ernst and Ernst 2003, *op. cit.*). The snakes and their prey were deposited in the herpetological collection of the Centro de Investigaciones Biológicas del Noroeste (CIBNOR), La Paz, Baja California Sur, México.

We thank José Abelino Cota, Yahirí Rodríguez, Armando Tejas, and Carmen D. Ortiz for field assistance, Lucía Campos for help identifying the fish remains, and Harry W. Greene for comments on the manuscript.

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THAMNOPHIS VALIDUS CELAENO (Cape Gartersnake, Mexican Pacific Lowlands Gartersnake). **DIET.** *Thamnophis validus celaeno* is the only subspecies of the Mexican Pacific Lowlands Garter Snake that occurs in Baja California, where apparently is confined to water systems in the Cape Region of the peninsula (Rossman et al. 1996. The Garter Snakes: Evolution and Ecology. Univ. Oklahoma Press, Norman. 332 pp.; Grismer 2002. Amphibians and Reptiles of Baja California. Univ. California Press, Berkeley. 399 pp.).

On the afternoon of 22 August 2005, we caught a female *T. v. celaeno* (CIBNOR 0697: 348 mm SVL, 105 mm TL; 21.9 g [without prey item]) in a concrete irrigation canal on Cañada de San Bernardo, Rancho Boca de la Sierra, Reserva de la Biosfera Sierra de la Laguna, Municipio de Los Cabos, Baja California Sur, México (23°23'05.3"N, 109°49'06.1"W). The snake had eaten a *Bufo punctatus* (Red-spotted Toad; CIBNOR 0698) rump first. The posterior part of the toad, including the hind limbs, had been digested. The prey remains measured 51 mm in length and weighed 6.1 g. A second snake from the same locality had eaten another adult *B. punctatus* rump first. These records confirm that *B. punctatus* is an important trophic resource for *T. v. celaeno* (Conant 1969. Bull. Amer. Mus. Nat. Hist. 142:1–140; de Queiroz et al. 2001. Copeia 2001:1034–1042). The snakes and their prey were deposited in the herpetological collection of the Centro de Investigaciones Biológicas del Noroeste (CIBNOR), La Paz, Baja California Sur, México.

We thank José Abelino Cota and Israel Guerrero for field assistance, and Harry W. Greene for comments on the manuscript.

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TROPIDOPHIS MACULATUS (NCN). **SIZE RECORD.** On 31 January 1981, Mercedes Reyes collected a male *Tropidophis maculatus* from 5th Ave., between 112 and 114, Playa, Havana City Province, Cuba. This specimen (CZACC 4.11988; Colecciones Zoológicas del Instituto de Ecología y Sistemática, Cuba) mea-

sures 375 mm snout–vent length, 53 mm tail length, and has 25-25-19 scale rows, 197 ventrals, 36 subcaudals, eight spot rows at midbody, 41/42 body and 9/9 caudal spots at dorsal midline, and external pelvic spurs. A female specimen (CZACC 4.11995) collected from Marianao, Havana City Province measures 372 mm SVL, 52 mm tail length, and has 25-25-21 scale rows, 196 ventrals, 34 subcaudals, 10 spot rows at midbody, 58/61 body and 9/9 caudal spots at dorsal midline. The previously reported maximum SVL for this species is 327 mm (males) and 347 mm (females) (Hedges 2002. Bull. Nat. Hist. Mus. Lond. [Zool.] 68[2]:83–91). These new specimens also expand the known range of body spot counts at dorsal midline from 35–55 to 35-61 (Hedges, *op. cit.*).

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TROPIDOPHIS MORENOI (NCN). **SIZE RECORD.** Previously reported measurements for the two known specimens *T. morenoi* (Hedges et al. 2001. J. Herpetol. 35:615–617) are 295 mm snout–vent length (SVL) and 45 mm tail length (TL) (holotype CZACC 4.5492; Colecciones Zoológicas del Instituto de Ecología y Sistemática, La Habana, Ciudad de La Habana province, Cuba; ex-collection IB 2493 from ex-Instituto de Biología, Cuba) and 285 mm SVL and 44 mm TL (Paratype CZACC 4.5493; ex-collection IB 2942). The type locality of this species is Dolinas de Cueva de Humboldt, Caguanes, Villa Clara Province, Cuba (22°50'04"N, 80°12'02"W). This place belongs now to the Sancti Spíritus Province. An adult female *Tropidophis* (CZACC 4.12052) was collected by J. Salas (unknown date) from the same locality. It was identified by MD as *T. morenoi* on 20 January 2004, and is the first specimen of *T. morenoi* reported after the species description (Hedges et al., *op. cit.*). Measurements of this specimen are: 359 mm SVL and 57 mm TL, which exceeds the previous records by 64 mm SVL and 12 mm TL. Measurements of the head were not possible to determine because the head and neck are damaged. Other characters of color, scale counts, and measures conform to those of the type series.

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TROPIDOPHIS PARDALIS (NCN). **SIZE RECORD.** In July 1968, LVM collected a male *Tropidophis pardalis* from "La Catalina," Güines, Havana Province, Cuba. This specimen (CZACC 4.12042; Colecciones Zoológicas del Instituto de Ecología y Sistemática, Cuba) measures 284 mm snout–vent length, 38 mm tail length, and has 23-25-18 dorsal scale rows, 156 ventrals and 28 subcaudals, six spot rows at midbody, and 42/44 body spots at dorsal midline. A second male, collected by Julio Novo (date unknown) from Atabey, Playa, Havana City Province, Cuba (CZACC 4.8554), has 139 ventrals. A third male, collected by L. R. Hernández from Loma de la Esperanza, Sierra Morena, Villa Clara Province, Cuba on 26 May 1975 (CZACC 4.12012), has 160 ventrals. The previously reported maximum SVL for males of this species is 264 mm (Hedges 2002. Bull. Nat. Hist. Mus. Lond. [Zool.] 68[2]:83–91). The additional specimens expand the range of variation in ventral scale counts from 140–157 to 139–160 (Hedges, *op. cit.*).

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GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 37, Number 1 (March 2006). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extension reports unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA OPACUM (Marbled Salamander). USA: TENNESSEE: Hawkins Co.: Holston Army Ammunition Plant located in the Kingsport Quad (36°32'05"N., 82°36'51"W). 13 April 1996. Harvey Hammock and John E. Copeland. Austin Peay State University Museum of Zoology, APSU 18168. Verified by A. Floyd Scott. Adult specimen found beneath roots of fallen tree. New county record that extends the range of the species in Tennessee into the eastern portion of Hawkins Co. (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

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CRYPTOTRITON ADELOS (Sierra Juarez Moss Salamander). MÉXICO: OAXACA: Municipality of San Bernardino, Sierra Mazateca, Puerto Soledad (18°9'N, 96°59'W), 2065 m elev. 6 February 1993. Luis Canseco Márquez. Museo de Zoología, Facultad de Ciencias, UNAM (MZFC 13311). Municipality of Santa María Pápalo, Peña Verde (17°50'N, 96°47'W), 2805 m elev. 1 June 1999. Luis Canseco Márquez. Escuela de Biología, Universidad Autónoma de Puebla (EBUAP 1097). Both verified by D. B. Wake and M. García-Paris. MZFC 13311 is first record for the Sierra Mazateca and a range extension of ca. 94 km N from the type locality and EBUAP 1097 is the second record for the Sierra de Juárez (48 km N type locality) and bridges a gap between the type locality and the Sierra Mazateca record (Papenfuss and Wake 1987. Acta Zool. Mex. 21:1–16; as *Nototriton adelos*). Both specimens

Desmognathus brimleyorum, and a comparison with other desmognathine salamanders. J. Zool. 243:21–27.

APPENDIX 1. Collection data for specimens examined.

Species	Museum No. (ASUMZ)	Date of collection (mm/dd/yy)	SVL (mm)	County
P. albagula	22419	4/17/98	70	Crawford
P. albagula	15887	4/14/90	72	Crawford
P. albagula	15464	3/13/90	71	Newton
P. albagula	22756	5/27/98	72	Polk
P. albagula	19201*	9/22/93	62	Pike
P. ouachitae	22762	5/27/98	56	Polk
P. ouachitae	24016	4/15/00	60	Polk
D. brimleyorum	22397	3/27/98	68	Montgomery
D. brimleyorum	21840	5/11/97	76	Polk
D. brimleyorum	22523	4/18/98	84	Polk
D. brimleyorum	21749	4/19/97	85	Polk
D. brimleyorum	23156	4/16/99	79	Logan
D. brimleyorum	3561**	8/15/80	89	Polk

*Animal collected during non-reproductive season.

**Animal collected during non-reproductive season; skin only excised from dorsal trunk region.

Herpetological Review, 2006, 37(3), 284–288.

Reproductive Ecology of *Atelopus zeteki* and Comparisons to Other Members of the Genus

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The Panamanian Golden Frog, *Atelopus zeteki* Dunn (Anura: Bufonidae), is a taxon of concern endemic to the Coclé and Panamá Provinces of Panama (Dunn 1933; Savage 1972), principally inhabiting lowland rainforest (Savage 1972) on the Pacific cordilleran slope. Bufonidae are among four families of amphibians containing more "rapidly declining" species than the average (Stuart et al. 2004), and of 34 species of amphibians which have gone extinct since 1500 (Stuart et al. 2004), three were in the genus *Atelopus* (IUCN et al. 2004). In addition, of 77 described species of *Atelopus* (Frost 2004), 61 (82%) are listed as Critically Endangered (IUCN et al. 2004), and it has been suggested that this is the first example of a species-rich lineage being so uniformly imperiled (Lötters et al. 2004). In particular, *Atelopus zeteki* is listed as Critically Endangered (IUCN et al. 2004) and given the highest level of protection by the Convention on International Trade in Endangered Species (CITES I). Development of conservation strategies and long-term monitoring programs for threatened species is contingent upon understanding species' life histories. As basic biological and ecological information is lacking for many *Atelopus* species, collection of such data may be crucial for conservation efforts.

Relatively little is known about the reproductive ecology of *Atelopus* frogs (Lötters 1996). While breeding phenology usually varies somewhat among species and populations depending upon local climatic conditions, limited data suggest that *Atelopus* breeding generally occurs at the beginning of the dry season (Lötters 1996, Savage 2002). *Atelopus* oviposit in cryptic locations, attaching their eggs to the undersides of rocks in swiftly flowing streams generally during periods of low water flow (Savage 1972, Lötters 1996). Previous descriptions of egg-laying and clutch characteristics come principally from captive or dissected animals. The few reported field observations of egg masses or oviposition sites provide limited data on clutch sizes, ovum diameter, and/or oviposition site characteristics in *A. flavescens* (Lescure 1981) and *A. franciscus* (Boistel et al. 2005) from French Guyana, and *A. muisca* (Rueda-Almonacid and Hoyos 1991) from Colombia. To our knowledge, no published information from the field or laboratory exists on the reproductive ecology of *A. zeteki*. Our objectives were to describe the clutches and oviposition sites of *A. zeteki* and compare their reproductive ecology with that of other *Atelopus* species.

Materials and Methods.—In 10–16 December 2004 and 8–15 December 2005, we conducted surveys for *Atelopus zeteki* in Panamá Province, Panama, in a small stream ca. 5–15 m in width with steep rocky slopes. We searched for *A. zeteki* egg masses by overturning rocky substrates and submerged woody debris and examining accumulations of leaf litter within the stream channel along a 200 m reach. These searches were conducted in conjunction with surveys for adult *A. zeteki* along the stream margins and on exposed rocks and small islands within the stream. All frogs were marked by toe-clipping. When clutches were found, we counted the number of eggs per clutch and measured the diameters of at least 20 eggs, randomly chosen, from each of three clutches. Embryo developmental stages were estimated (Gosner 1960). To characterize the microhabitat at oviposition sites, we measured overstory canopy closure using a concave spherical densiometer (only in 2005), size of substrate (Platts et al. 1983) to which an egg mass was attached, predominant size of surrounding substrate (visually estimated within a 1 m^2 area centered on the oviposition substrate), water depth at the location of the clutch (only in 2004), distance of oviposition substrate to wetted edge, wetted width of stream at each oviposition site, stream velocity (m/s) near each egg mass, and instream habitat type (e.g., pool or riffle, Platts et al. 1983). Stream velocity at oviposition sites was estimated by determining the time it took for a floating object to travel a 1 m stream segment centered on the location of an egg mass. Velocity was calculated as the distance traveled divided by the time elapsed. In addition, we measured the distance between clutches within each year. In 2004, we measured general habitat conditions for five of the variables along the stream reach and

compared these with microhabitat characteristics at oviposition sites using Student's t-tests. Canopy closure was measured at the beginning and every 10 m along the reach within one m of the stream margin and averaged. We visually estimated the proportion of the surface of the streambed made up of cobble, gravel, pebble, sand, and silt (after Platts et al. 1983) within 20 randomly located 1-m wide bands that bisected the reach. Water depth was measured at three equidistant points across the width of the stream at 20 randomly selected locations along the 200 m reach. Depth measurements were averaged. We determined mean wetted width from measurements at 20 randomly selected locations along the reach. Stream velocity was measured within one meter of the margin at 20 randomly selected locations along the reach and averaged.

Results.—Over two breeding seasons, we found 17 clutches of eggs of *A. zeteki* within the 200 m-long reach and one clutch upstream of the reach. In 2004, we found 41 amplectant pairs, 208 single frogs, and seven clutches of eggs of *A. zeteki* during five surveys over a seven-day period. In 2005, we found four pairs, 166 individuals, and 11 clutches in five surveys over eight days. Each intact clutch appeared to contain a single strand of small, cream-colored eggs attached to a rocky substrate in the stream (Table 1). Strands were attached to the substrate and then wrapped back up on themselves creating two or more layers of eggs in a loose, elongated mass (Fig. 1). In 2004, most of the clutches found

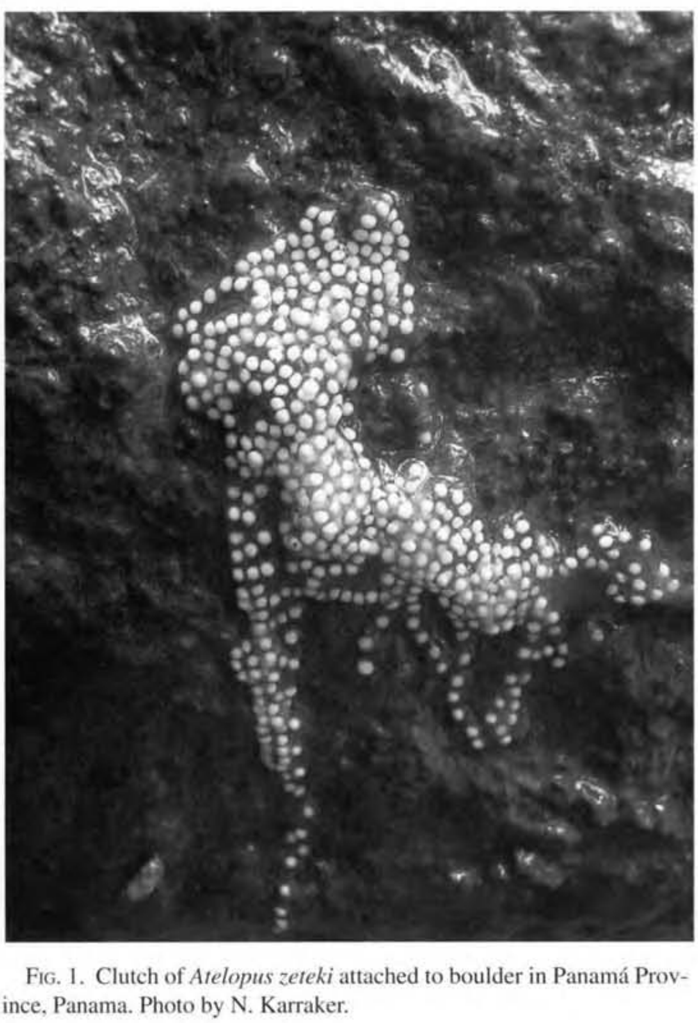

FIG. 1. Clutch of *Atelopus zeteki* attached to boulder in Panamá Province, Panama. Photo by N. Karraker.

appeared to have been recently oviposited, but in 2005 many of the clutches had begun hatching or had already hatched. Accurate counts of clutch size were made for five clutches in 2004 and four in 2005. Mean clutch size was 370 ± 137 (SD) (N = 9; Table 1). Eggs ranged in developmental stage from cleavage to hatching. We were unable to determine the duration of embryonic development in the field. But in captivity, the embryonic period of *A. zeteki* ranged 7–11 days at 22.0°C and averaged 8.9 ± 1.3 days (N = 9) (Detroit Zoo, unpubl. data).

Embryos averaged 1.8 ± 0.2 mm in diameter (range 1.4–2.5 mm, N = 60). Mean water temperature at oviposition sites was 23.4 ± 0.8°C (N = 15). On 11 December 2004, pH of the stream was 7.8. Six clutches were attached on the top, one on the side, and 11 on the undersides of substrates. All but one clutch were attached to cobble- or boulder-sized substrates (Table 1). All clutches but one were found within 2 m of the stream margin and were evenly distributed between riffle and run habitats. Percent canopy closure was lower (t = 2.04, $P = 0.050$) above oviposition sites at 93.1 ± 5.8 (range 85–100; N = 9), while the average for the reach was 96.9 ± 1.9 (range 91–99; N = 21). Sand was the predominant substrate type around oviposition sites for 15 of 18 (83%) clutches, while the proportions of surface substrates overall within the reach were 36% cobble, 31% sand, 20% pebble, 6% gravel, and 7% silt (N = 20). Water depth at oviposition sites averaged 16.5 ± 15.7 cm (range 1–44; N = 6), and was lower (t = 2.44, $P = 0.022$) than the average depth for the reach of 30.8 ± 11.0 cm (range 17–63; N = 20). Mean wetted width of the stream at oviposition sites was 9.9 ± 3.7 m (range 6.1–18.7; N = 15), and was higher (t = 2.94, $P = 0.006$) than the reach average of 7.7 ± 2.1 m (range 4.2–11.8; N = 20). Mean stream velocity at oviposition sites was 0.34 ± 0.15 m/s (range 0.10–0.50; N =15), and comparable (t = 0.74, $P = 0.463$) to the average for the reach of 0.37 ± 0.10 m/s (range 0.23–0.50; N = 20). Two clutches were separated from others by 22 m each, but the mean nearest neighbor distance between all other clutches within the reach was 1.1 ± 1.3 m (N = 15). Two clutches were found attached to the underside of the same boulder, 11 and 12 cm apart, in 2004 and 2005, respectively. In 2005, we found two clutches attached 12 cm apart on the underside of another boulder. Aside from the single clutch found upstream of the reach, all clutches in both years were located within a 25-m reach of stream.

Seven clutches were no longer submerged under water when found and one appeared to be covered by a white fungus. It had rained heavily in the area just prior to surveys each year, so presumably these exposed clutches were oviposited when the water level was higher in the stream.

Discussion.—We observed eggs of *Atelopus zeteki* in December 2004 and 2005, which marks the transition between rainy and dry seasons in most years. We observed amplectant pairs as early as 8 December in 2005 and as late as 25 January in 2004. Surveys of this site, associated with a separate study on population dynamics, in February, March, July, and August yielded no amplectant pairs. Small, but well-developed, larvae were observed in the stream in mid-December 2005, but no metamorphs or subadults were found, indicating that the breeding season probably begins in late November or early December and continues into January. Further evidence comes from observations made on 4 December 2003, in which no adults were observed along the stream, but males

TABLE 1. Clutch sizes, developmental stages (after Gosner 1960), and characteristics of oviposition sites of *Atelopus zeteki* observed in Panamá Province, Panama. Substrate size categories: silt (<0.06 mm), sand (0.06 to 2 mm), gravel (2 to 64 mm), cobble (64 to 256 mm), boulder (256 to 4096 mm), and bedrock (>4096 mm), as measured across the longest diameter (Platts et al. 1983). Habitat types follow Platts et al. (1983). — Indicates data were not collected. [1]Indicates clutches for which accurate counts could not be made. [2]Indicates clutches in which all other eggs appeared to have hatched.

Clutch size	Stage of development	Canopy closure	Water temp. (°C)	Substrate type	Surrounding substrate type	Distance from stream margin (cm)	Water depth (cm)	Habitat type	Stream flow (m/s)	Wetted width (m)
327	cleavage	—	24.2	cobble, boulder	sand	0	10	riffle	0.20	6.9
256	cleavage	—	22.5	bedrock	sand	0	44	run	0.10	10.4
243	cleavage	—	22.5	cobble	sand	0	1	run	0.10	10.6
no count[1]	hatching	—	22.5	boulder	gravel, cobble	77	10	run	0.33	8.8
202	cleavage	—	22.5	cobble	cobble, boulder	0	8	run	0.33	8.9
72[1]	hatching	—	22.5	boulder	sand	76	26	run	0.33	15.7
481	neurulation	—	22.5	boulder	sand	76	26	run	0.33	15.7
48[1]	none evident	99	23.2	boulder	sand	92	—	run	0.25	18.7
465	hatching	100	23.6	boulder	sand	55	—	run	0.50	14.8
623	organogenesis	100	23.6	boulder	sand	67	—	run	0.50	14.8
416	hatching	96	23.6	boulder	sand	54	—	riffle	0.50	8.9
318	none evident	97	23.1	boulder	sand	35	—	riffle	0.50	6.1
~83[1]	none evident	94	23.1	boulder	sand	57	—	riffle	0.50	6.1
~50[1]	neurulation	88	24.4	boulder	sand	127	—	riffle	0.20	10.4
~150[1]	none evident	88	24.4	boulder	sand	115	—	riffle	0.20	10.4
3[2]	hatched	85	24.4	boulder	sand	34	—	riffle	0.50	8.2
11[2]	hatched	85	24.4	boulder	sand	66	—	riffle	0.50	8.2
0[2]	hatched	94	24.4	boulder	gravel	269	—	riffle	0.33	6.6

TABLE 2. Clutch sizes and ova diameters of *Atelopus*. — indicates data were not available.

Species	N	Mean clutch size (SD)	Mean ovum diameter (mm)	Method of determination	Source
A. carbonerensis	1	279	1.5	Dissection	La Marca 1984
A. chiriquiensis	1	364	2.05	Oviposited in captivity	Lindquist and Swihart 1997
A. chiriquiensis	14	370 (108)	—	Dissection	UMMZ[1] 147970–72, 147974–79, 14985, 14987
A. cruciger	1	271	1.5–1.6	Oviposited in captivity	Mebs 1980
A. flavescens	1	—	1.5–1.7	Field observation	Lescure 1981
A. franciscus	>1	~250	—	Field observation	Boistel et al. 2005
A. gracilis	1	350	0.8	Dissection	McDiarmid 1971
A. ignescens	1	372	1.3	Dissection	McDiarmid 1971
A. muisca	1	69	~2.0	Field observation	Rueda-Almonacid and Hoyos 1991
A. sernai	1	220	—	Dissection	Ruíz-Carranza and Osorno-Muñoz 1994
A. subornatus	1	189	1.8–2.2	Dissection	Lynch 1986
A. varius	1	910	1.0	Dissection	McDiarmid 1971
A. varius	1	—	1.6	Oviposited in captivity	Starrett 1967
A. varius	3	723 (26)	—	Dissection	UMMZ[1] 147973, 147980, 147988
A. zeteki	9	370 (137)	1.8	Field observation	This study

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were heard calling at the forest edge, approximately 50 m upslope of the stream, and in damp wooded ditches that extended up into the adjacent clearing. No females were observed on that date, but on 12 December, 10 amplectant pairs were found by the stream (K. Zippel, pers. comm.). Hundreds of metamorphs were observed along the stream on 27 April 2002 (K. Zippel, pers. comm.). Oviposition in *A. chiriquensis*, another Panamanian species, probably occurs during the dry season as amplectant pairs were collected in February (Lindquist and Swihart 1997). Egg masses of *A. franciscus* from French Guyana were found in late April or early May (Boistel et al. 2005). In the same country, a clutch of *A. flavescens* eggs was found in July (Lescure 1981). In late October, a clutch of *A. muisca* was reported in Colombia (Rueda-Almonacid and Hoyos 1991). In *A. varius* in Costa Rica, breeding is estimated to begin in October and continue into early December (Crump 1988). These examples demonstrate the tremendous variation in timing of oviposition within this genus, which may be related to climatic differences between regions.

To our knowledge no clutches of *A. zeteki* have been previously reported, but descriptions of eggs and oviposition sites exist for other *Atelopus* species (Table 2). There appears to be much intraspecific variation in *Atelopus* clutch sizes. Fourteen clutches of *A. chiriquiensis* ranged from 170–603 eggs. We found that five clutches of *A. zeteki* ranged in size from 202–623 eggs. There is also interspecific variation in *Atelopus* ranging from 69 eggs in one clutch of *A. muisca* (Rueda-Almonacid and Hoyos 1991) to one of *A. varius* containing 910 eggs (McDiarmid 1971). In addition, ovum diameter varies widely in the genus, with 0.8 mm for *A. gracilis* (McDiarmid 1971) to 2.2 mm for *A. subornatus* (Lynch 1986). Ovum diameter in *A. zeteki* averaged 1.8 mm.

Duration of embryonic development has not been previously reported for *A. zeteki*. The duration of 7–11 days at 22°C reported here is comparable to the short periods described for other species of *Atelopus*. In the laboratory, eggs of *A. cruciger* hatched in three to four days at 20°C (Mebs 1980). Embryos of *A. varius* took six days to hatch in captivity (Starrett 1967), although no water temperature data were given. It appears from these limited data that the embryonic period in *Atelopus* may be relatively short.

Within our sampled reach, *A. zeteki* oviposited in wider stream sections, along shallow margins, and in fast water habitats with slightly lower canopy closure. In our study area, all clutches were attached to rocky substrates and 83% were attached to larger substrates, boulders, and bedrock. As eggs are laid during the transition between wet and dry seasons, selection of larger substrates for oviposition may reduce the risk of eggs being washed downstream in late rainy season storms, particularly in relatively confined channels such as the one in which the clutches were located. Eggs in four clutches were hatching when found. In each instance, as the rock was turned over, larvae were unable to adhere to the rock, indicating that the ventral sucking disc (Starrett 1967) characteristic of *Atelopus* either had not yet developed or does not function at hatching. Larvae slid from the remnants of the egg mass into the substrate below. It is notable that the larvae were similar in color to sand in the study area, which was the predominant substrate surrounding all but three of the clutches.

Females may select oviposition sites due to several factors including microhabitat characteristics, relative predation risk, and proximity to calling males. Although we searched 200 m of stream, 16 of 18 clutches were found within an average of 1.1 m of another clutch. Three pairs of these clutches, each pair at different development stages, were attached within 12 cm of each other on the underside of a boulder. This distribution of egg masses suggests that important locations for oviposition may be present along the stream and that communal oviposition occurs in *A. zeteki*. Communal oviposition has not been previously reported for any *Atelopus*. Communal oviposition occurs when the benefits of communal reproduction outweigh the losses to individual reproduction, females have limited clutch sizes, and suitable oviposition sites are uncommon (Robertson et al. 1998). Communal oviposition sites of *A. zeteki* may increase an individual's fitness by reducing the predation risk for a single clutch of eggs and distributing the risk among multiple clutches. The number of suitable locations for egg-laying in the vicinity of the oviposition sites reported here for *A. zeteki* is not known. However, the locations used may represent sites that are relatively stable from high flow events, during the breeding period, within those streams.

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A Synopsis of Bioacoustic Studies of Anuran Amphibians of Borneo

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We summarize information on acoustics recorded from the anuran amphibians of Borneo. Currently, 154 species of frogs and toads (Amphibia: Anura) are known from Borneo (Das 2005; Das and Haas 2005; Inger and Stuebing 2005). The five species of Ichthyophiidae known from Borneo presumably do not call. The quality of acoustic information of Bornean amphibians reported in the literature varies significantly. In this review, we scored call data from 0–5, where 0 = unknown; 1 = abbreviated, onomatopoeic or verbal description; 2 = analytical description only, no sonogram/oscillogram; 3 = sonogram/oscillogram only, no analytical description; 4 = sonogram/oscillogram and analytical description; and 5 = recording on a CD. In the context of this review, "analytical description" refers to an explicit summary of important call characters, such as fundamental frequency, dominant frequency, and call rate. The respective references cited are in chronological order. We report whether descriptions are based on extralimital samples; all other references pertain to Borneo, and where possible, the locality of recording is mentioned.

In total, the calls of 101 species of anuran amphibians (65.6%) known from Borneo are described in the literature. The list includes calls of several species that have been described exclusively from extralimital areas (including India, Nepal, Thailand, and the Malay Peninsula). At least in some cases (e.g., *Fejervarya limnocharis* and *F. cancrivora*), the extralimital calls refer to nonconspecific cryptic species. In a manuscript under preparation, we will describe the calls of three additional species: *Bufo quadriporcatus*, *Leptolalax maurus* and *Microhyla borneensis* (Sukumaran et al., in prep.).

Species with unknown calls include the sole Bornean representative of Bombinatoridae (*Barbourula kalimantanensis*, an endemic of Kalimantan, Indonesia); 15 species of Bufonidae; four species of Megophryidae; 12 species of Microhylidae; 12 species of Ranidae; and nine species of Rhacophoridae. A number of familiar species from the family Ranidae have unknown calls, or have calls inadequately described in the literature. This may be due to the logistical difficulty in getting reliable recordings due to either calling behavior (such as short, sporadic calls; call shyness; or long periods between calls) or environment (e.g., high ambient noise levels in the stream habitat characteristic of many such ranids). In addition, males of some members of the genus *Limnonectes* lack vocal sacs, resulting in their characterization in the past as 'voiceless frogs' (e.g., Emerson and Inger 1992; Emerson and Berrigan 1993; Emerson et al. 1993; Emerson and Voris 1992). However, further observations have since established that females of some of these 'voiceless frogs' do indeed vocalize (see, for instance, Emerson 1992; Inger and Stuebing 2005; Matsui 1995).

Even when call descriptions are available, these may be in an abbreviated form (descriptive or onomatopoeic), lacking sonograms or oscillograms, and thereby not available for analysis. When descriptive accounts of calls are excluded, only 75 species (48.7% of the fauna) of Bornean frog calls have been analyzed. In many cases, no vouchers are listed, sometimes making identification of the species concerned uncertain.

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TABLE 1. Checklist of anuran amphibians of Borneo, annotated with status information on bioacoustics and their sources. Status of descriptions: 0 = unknown; 1 = abbreviated, onomatopoeic or verbal description; 2 = analytical description only, no sonogram/oscillogram; 3 = sonogram/oscillogram only, no analytical description; and 4 = sonogram/oscillogram and analytical description.

	Status of description
Bombinatoridae	
Barbourula kalimantanensis	0
Bufonidae	
Ansonia albomaculata	1 (Inger and Stuebing, 2005)
Ansonia anotis	0
Ansonia fuliginea	0
Ansonia guibei	0
Ansonia hanitschi	1 (Inger and Stuebing, 2005); 4 (Malkmus et al., 2002: from Sungei Liwago, Gunung Kinabalu National Park, Sabah)
Ansonia latidisca	0
Ansonia leptopus	1 (Inger and Stuebing, 2005); 4 (Inger and Dring, 1988: from Kalabakan, Nanga Tekalit and Gunung Mulu National Park, both in Sarawak)
Ansonia longidigita	1 (Inger and Stuebing, 2005); 4 (Inger and Dring, 1988: from Gunung Mulu National Park, Sarawak; Malkmus et al., 2002: from Sungei Langanan, Gunung Kinabalu National Park, Sabah)
Ansonia minuta	0
Ansonia platysoma	1, 4 (Malkmus et al., 2002: from Sungei Wariu, Gunung Kinabalu National Park, Sabah)
Ansonia spinulifer	4 (Matsui, 1982b: from Sungei Muruk near Long Bawan, in East Kalimantan: as *Ansonia leptopus*; corrected to *Ansonia spinulifer* by the author via hand-written corrections in a reprint given to the authors)
Ansonia torrentis	4 (Dring, 1983b: from Gunung Mulu National Park, Sarawak)
Bufo asper	1 (Inger and Stuebing, 2005); 4 (Grosjean and Dubois, 2001: from Khao Chong, Thailand)
Bufo divergens	1 (Malkmus et al., 2002; Inger and Stuebing, 2005)
Bufo juxtasper	1 (Malkmus et al., 2002; Inger and Stuebing, 2005); 4 (Matsui, 1982a: from Ranau, Sabah)
Bufo melanostictus	1 (Daniel, 2002: India); 4 (Mou and Zhao, 1992: from China; Kanamadi et al., 1995b: from India; Roy et al., 1998: from India; Grosjean and Dubois, 2001: from India, Nepal, and Thailand); 5 (McKay and Case, 2005: from Bali, Indonesia)
Bufo quadriporcatus	4 (Sukumaran et al., in prep: from Sama Jaya Nature Reserve, Sarawak)
Leptophryne borbonica	0
Pedostibes everetti	0
Pedostibes hosii	1 (Dring, 1979: from Sungei Kelebang, Gunung Lawit, Peninsular Malaysia; Inger and Stuebing, 2005)
Pedostibes maculatus	0
Pedostibes rugosus	0
Pelophryne api	4 (Dring, 1983b: from Gunung Api and Bukit Pala, Gunung Mulu National Park, Sarawak)
Pelophryne brevipes	0
Pelophryne exigua	0
Pelophryne guentheri	0
Pelophryne macrotis	0
Pelophryne misera	1 (Inger and Stuebing, 2005); 4 (Malkmus et al., 2002: from Sungei Liwago, Kinabalu National Park, Sabah)
Pelophryne rhopophilus	0
Pelophryne signata	0
Pseudobufo subasper	1 (Kiew, 1972: from Tasek Bera, Peninsular Malaysia; Lim and Ng, 1992: from Peninsular Malaysia)
Megophryidae	
Leptobrachella baluensis	1, 4 (Dring, 1983a: from Gunung Mulu National Park, Sarawak)
Leptobrachella brevicrus	1, 4 (Dring, 1983a: from Gunung Mulu National Park, Sarawak)
Leptobrachella mjobergi	1, 4 (Dring, 1983a: from Gunung Mulu National Park, Sarawak; tentatively assigned to *Leptobrachella mjobergi*)
Leptobrachella parva	1, 4 (Dring, 1983a; Malkmus et al., 2002: from Gunung Mulu, Fourth Division, Sarawak)
Leptobrachella palmata	0
Leptobrachella serasanae	0
Leptobrachium abbotti	1 (Inger and Stuebing, 2005); 4 (Malkmus et al., 2002: from Sungei Kipungit, Gunung Kinabalu, Sabah)
Leptobrachium gunungense	4 (Malkmus et al., 1996b; 2002: from Sungei Carson, Gunung Kinabalu National Park, Sabah; comparisons with that of *Leptobrachium montanum*)
Leptobrachium hendricksoni	0
Leptobrachium montanum	1 (Inger and Stuebing, 2005); 4 (Malkmus, 1996; Malkmus et al., 2002: from Gunung Kinabalu National Park Headquarters, Sabah; compared with that of *Leptobrachium gunungense*)
Leptobrachium nigrops	1 (Kiew, 1972: from Tasek Bera, Peninsular Malaysia)
Leptolalax arayai	4 (Matsui, 1997: from Gunung Kinabalu National Park Headquarters, Sabah; Malkmus et al., 2002: from Silau-Silau, Gunung Kinabalu National Park, Sabah); also, as *Leptolalax gracilis* by Malkmus and Riede (1993)
Leptolalax dringi	4 (Matsui, 1997; Malkmus et al., 2002: from Gunung Mulu National Park, Sarawak)
Leptolalax gracilis	4 (Matsui, 1997: from Gunung Serapi, Matang, Sarawak; Camp Two, Gunung Mulu National Park, Sarawak; comparison made between audio data from these recordings by Malkmus and Riede, 1993). However, the identity of the individual from latter locality is tentative, as its call structure varies significantly from other documentations of *gracilis* calls
Leptolalax hamidi	4 (Matsui, 1997: from Bukit Lanjak, Sarawak)
Leptolalax maurus	4 (Sukumaran et al., in prep.: from Sungei Mesilau, Gunung Kinabalu National Park, Sabah)
Leptolalax pictus	4 (Malkmus and Riede, 1993: from Sungei Langanan, Gunung Kinabalu National Park, Sabah; compared with that of *Leptolalax gracilis;* Malkmus et al., 2002: from Sungei Kipungit, Gunung Kinabalu National Park, Sabah)
Megophrys baluensis	4 (Malkmus and Riede, 1996c: from Sungei Liwago, Gunung Kinabalu National Park, Sabah; Malkmus et al., 2002: from Sungei Lanaga, Gunung Kinabalu National Park, Sabah)

TABLE 1. Continued.

	Status of description
Megophrys edwardinae	0
Megophrus kobayashii	4 (Malkmus and Matsui, 1997; Malkmus et al., 2002: from Gunung Kinabalu National Park Headquarters, Sabah)
Megophrys nasuta	1 (Dring, 1979: from Sungei Kelebang, Gunung Lawit, Peninsular Malaysia; Inger and Stuebing, 2005); 1, 4 (Malkmus et al., 2002: from Poring, Gunung Kinabalu National Park, Sarawak)
Microhylidae	
Calluella brooksi	0
Calluella flava	0
Calluella smithi	0
Chaperina fusca	1 (Inger and Stuebing, 2005); 1, 4 (Malkmus et al., 2002: from Sayap, Gunung Kinabalu National Park, Sabah)
Gastrophrynoides borneensis	0
Kalophrynus baluensis	1 (Inger and Stuebing, 2005); 4 (Malkmus and Riede, 1996c; Malkmus et al., 2002: from Gunung Kinabalu National Park Headquarters; Sabah); 3 (Malkmus, 1994)
Kalophrynus eok	1 (Das and Haas, 2003: from Long Re, Sarawak)
Kalophrynus heterochirus	0
Kalophynus intermedius	0
Kalophrynus nubicola	4 (Dring, 1983b: from Gunung Mulu National Park, Sarawak; three distinct call types were identified, which may be attributable to genetic variation as well as environmental factors)
Kalophrynus pleurostigma	4 (Matsui, 1996: from Sepilok, Sabah, and Niah, Sarawak; with comparison with calls of *Kalophrynus interlineatus*); 4 (Malkmus et al., 2002: from Sepilok, Sabah)
Kalophrynus punctatus	0
Kalophrynus subterrestris	0
Kaloula baleata	1 (Inger and Stuebing, 2005); 4 (Malkmus et al., 2002: from Poring, Gunung Kinabalu National Park, Sabah); 5 (McKay and Case, 2005: from Bali, Indonesia)
Kaloula pulchra	1 (Inger and Stuebing, 2005); 3 (Heyer, 1971: from Thailand)
Metaphrynella sundana	1 (Inger and Stuebing, 2005); 3 (Matsui et al., 1996; Lardner and bin Lakim, 2002: from Poring, Sabah); 4 (Hoffmann, 2000; Malkmus et al., 2002; Lardner and bin Lakim, 2004: from Poring, Sabah). Also, discussion of possible acoustic convergence with *Tympanophyllum* sp. (Orthoptera: Tettigoniidae) in Malkmus (1995)
Microhyla berdmorei	0
Microhyla borneensis	4 (Sukumaran et al., in prep: from Kubah National Park, Sarawak)
Microhyla maculifera	0
Microhyla perparva	0
Microhyla petrigena	0
Ranidae	
Fejervarya cancrivora	4 (Matsui, 1982b: from Tarakan, East Kalimantan)
Fejervarya limnocharis	1 (Kiew, 1972: from Tasek Bera, Peninsular Malaysia; Inger and Stuebing, 2005); 2 (Dring, 1979: from Sungei Kelebang, Gunung Lawit, Peninsular Malaysia); 4 (Dubois, 1975: from Nepal; Mou and Zhao, 1992: from China; Kanamadi et al., 1995a: from India; Roy and Elepfandt, 1993; Roy, 1994; Roy et al., 1995; 1998: from northeast India; Malkmus et al., 2002: from Peninsular Malaysia); 5 (McKay and Case, 2005: from Bali, Indonesia)
Hoplobatrachus sinensis	1 (Inger and Stuebing, 2005)
Huia cavitympanum	1 (Inger and Stuebing, 2005)
Ingerana baluensis	1 (Malkmus et al., 2002)
Limnonectes asperata	0
Limnonectes finchi	1 (Malkmus et al., 2002; Inger and Stuebing, 2005)
Limnonectes ibanorum	0
Limnonectes ingeri	0
Limnonectes kenepaiensis	0
Limnonectes kuhlii	1 (Inger and Stuebing, 2005); 3 (Tsuji, 2004: from Taiwan, Republic of China); 4 (Malkmus et al., 2002)
Limnonectes laticeps	1, 2 (Dring, 1979: from Sungei Kelebang, Gunung Lawit, Peninsular Malaysia)
Limnonectes leporinus	1 (Emerson, 1992: from Sabah: as *Rana blythi*)
Limnonectes malesianus	0
Limnonectes palavanensis	1 (Inger and Stuebing, 2005); 4 (Malkmus et al., 2002: from Gunung Mulu National Park, Sarawak)
Limnnectes paramacrodon	0
Limnonectes rhacodus	0
Meristogenys amoropalamus	0
Meristogenys jerboa	4 (Matsui et al., 1993: from Gunung Serapi, Matang, Sarawak)
Meristogenys kinabaluensis	1 (Malkmus et al., 2002)
Meristogenys macrophthalmus	0
Meristogenys orphocnemis	4 (Malkmus et al., 2002: from Sungei Kepungit, Poring, Gunung Kinabalu National Park, Sabah)
Meristgenys phaeomerus	1 (Inger and Stuebing, 2005)
Meristogenys poecilus	0
Meristogenys whiteheadi	0
Occidozyga baluensis	1 (Inger and Stuebing, 2005); 4 (Malkmus et al., 2002: from Gunung Mulu National Park, Sarawak)
Occidozyga laevis	1 (Alcala, 1962: from Negros, Philippines); 3 (Malkmus et al., 2002); 4 (Alcala et al., 1986: from Luzon, Philippines); 5 (McKay and Case, 2005: from Bali, Indonesia)

TABLE 1. Continued.

	Status of description
Rana baramica	1 (Arak, 1984: from Ulu Gombak, Selangor, Peninsular Malaysia; Inger and Stuebing, 2005); 1, 2 (Dring, 1979: from Sungei Kelebang, Gunung Lawit, Peninsular Malaysia); 2 (Matsui, 1993); 4 (Leong et al., 2003: from Semantan and Niah, Sarawak, and Kuala Lumpur and Templer's Park, Peninsular Malaysia, with particular attention to distinguish from calls of *Rana laterimaculata*)
Rana erythraea	1 (Malkmus et al., 2002; Inger and Stuebing, 2005); 3 (Arak, 1984: from Ulu Gombak, Selangor, Peninsular Malaysia; 4 (Alcala et al., 1986: from Negros, Philippines). The record of Roy et al., 1995 (from northeast India) are here considered to be based on one or more non-conspecific individuals, as their Fig. 1A, purported to be this species, is actually *Polypedates maculatus*; while Fig. 2A is an indeterminate species of *Rana* (of the *Sylvirana* group).
Rana glandulosa	1 (Inger and Stuebing, 2005); 2 (Matsui, 1993); 4 (Sanchez-Herraiz et al., 1995: from Gunung Mulu National Park and Bako National Park, both in Sarawak)
Rana hosii	1 (Arak, 1984: from Ulu Gombak, Selangor, Peninsular Malaysia; 2 (Malkmus et al., 2002; Matsui, 1993); 4 (Matsui, 1982b: from Bawan River, East Kalimantan)
Rana laterimaculata	1 (Arak, 1984: from Ulu Gombak, Selangor, Peninsular Malaysia: as *Rana cryptica* nomen nudum); 4 (Leong et al., 2003: from Semantan and Niah, Sarawak, and Kuala Lumpur and Templer's Park, both in Peninsular Malaysia, with particular attention to distinguish from calls of *Rana baramica*)
Rana luctuosa	1 (Malkmus et al., 2002; Inger and Stuebing, 2005); 2 (Matsui, 1993)
Rana nicobariensis	1 (Kiew, 1972: from Tasek Bera, Peninsular Malaysia; Inger and Stuebing, 2005); 2 (Matsui, 1993); 3 (Arak, 1984: from Ulu Gombak, Selangor, Peninsular Malaysia; 4 (Matsui, 1982a: from Ranau, Sabah: as *Rana erythraea*, fide hand-corrected reprint received from M. Matsui; Malkmus et al., 2002: from Poring, Gunung Kinabalu National Park, Sabah); 5 (McKay and Case, 2005: from Bali, Indonesia). Also, 4 (Matsui, 1982b: from Long Bawan, East Kalimantan, compares the Ranau, Sabah, population, as *Rana erythraea*)
Rana picturata	Due to the confusion between *Rana picturata* Boulenger, 1920 and *Rana signata* (Günther, 1872) (and possibly others within the complex), it is difficult to treat call attributions as reported in literature with any degree of confidence. Malkmus et al. (2002) discuss the conflicting call descriptions that result from the confusion over the species complex and provide a sonogram of a call attributed to *Rana signata* and *Rana picturata*. Sonograms and analysis of calls of individuals identified as *Rana signata* from Gunung Mulu National Park and Bako National Park, Sarawak given in Sanchez-Herraiz et al. (1995). Inger and Stuebing (2005) provide a description of a call attributed to *Rana picturata*
Rana raniceps	1 (Inger and Stuebing, 2005; Malkmus et al., 2002: as *Rana chalconota*); 2 (Matsui, 1993: as *Rana chalconota*)
Rana signata	2 (Dring, 1979: from Gunung Lawit, Peninsular Malaysia; 2 (Matsui, 1993). See also comments under *Rana picturata*
Staurois guttatus	1 (Malkmus et al., 2002; Inger and Stuebing, 2005: as *Staurois natator*)
Staurois latopalmatus	1 (Davison, 1984: from Kuala Temawai, Brunei Darussalam; Malkmus et al. 2002; Inger and Stuebing, 2005); 4 (Hödel and Amézquita, 2001: from Danum Valley, Sabah)
Staurois parvus	0
Staurois tuberilinguis	1 (Inger and Stuebing, 2005); 4 (Malkmus et al., 2002: from Sungei Liwago, Gunung Kinabalu National Park, Sabah)
Rhacophoridae	
Nyctixalus pictus	1, 4 (Matsui, 1996: from the Park Headquarters, Gunung Mulu National Park, Sarawak; Malkmus et al., 2002: from Sungei Liwago, Gunung Kinabalu National Park, Sabah)
Philautus acutus	4 (Dring, 1987: from Gunung Mulu National Park, Sarawak)
Philautus amoeanus	4 (Malkmus and Riede, 1996a; Malkmus et al., 2002: from Pondok Ubah, Gunung Kinabalu National Park, Sabah)
Philautus aurantium	4 (Malkmus and Riede, 1996b, compared with *Philautus gunungensis*).
Philautus bunitus	1, 4 (Malkmus and Riede, 1996a; Malkmus et al., 2002: from Sungei Liwago, Gunung Kinabalu National Park, Sabah)
Philautus disgregus	0
Philautus erythropthalmus	0
Philautus gunungensis	4 (Malkmus and Riede, 1996b; Malkmus et al., 2002: from Silau-Silau, Gunung Kinabalu National Park, Sabah)
Philautus hosii	1 (Dring, 1987: from Gunung Mulu National Park, Sarawak; Inger and Stuebing, 2005)
Philautus ingeri	1 (Dring, 1987: from Gunung Mulu National Park, Sarawak; Malkmus et al., 2002; Inger and Stuebing, 2005)
Philautus kerangae	4 (Dring, 1987: from Gunung Mulu National Park, Sarawak)
Philautus longicrus	1 (Malkmus et al., 2002)
Philautus mjobergi	1, 4 (Malkmus et al., 2002: from Sungei Silau-Silau, Gunung Kinabalu National Park, Sabah; 4 (Dring, 1987: from Gunung Mulu National Park, Sarawak). Also, sonograms and comparison with call of *Philautus saueri* in Malkmus and Riede, 1996a)
Philautus petersi	1 (Inger and Stuebing, 2005); 4 (Dring, 1987: from Gunung Mulu National Park, Sarawak; Malkmus and Riede, 1996a; Hoffmann, 1998: from Sayap, Gunung Kinabalu National Park, Sabah; Malkmus et al., 2002: from Sungei Liwago, Gunung Kinabalu National Park, Sabah)
Philautus refugii	0
Philautus saueri	1, 4 (Malkmus and Riede, 1996a: Malkmus et al., 2002: from Pakka Cave, Gunung Kinabalu National Park, Sabah; comparative analysis with call of *Philautus mjobergi* in Malkmus and Riede, 1996a)
Philautus tectus	1 (Dring, 1987: from Gunung Mulu National Park, Sarawak)
Philautus umbra	1 (Dring, 1987: from Gunung Mulu National Park, Sarawak)
Polypedates chlorophthalmus	0
Polypedates colletti	1 (Inger and Stuebing, 2005)
Polypedates leucomystax	1 (Kiew, 1972: from Tasek Bera, Peninsular Malaysia; Inger and Stuebing, 2005); 4 (Matsui, 1982a: from Ranau, Sabah; Brzoska et al., 1986: from Negros, Philippines; Sanchez-Herraiz et al., 1995: from Gunung Mulu National Park and Bako National Park, both in Sarawak; Narins et al., 1998: from Ulu Gombak, Peninsular Malaysia; Roy et al., 1998: from India; Trépanier et al., 1999: from Vietnam); 5 (McKay and Case, 2005: from Bali, Indonesia)
Polypedates macrotis	1 (Inger and Stuebing, 2005); 4 (Matsui, 1982b; Malkmus et al., 2002: from Long Api, East Kalimantan)
Polypedates otilophus	1 (Inger and Stuebing, 2005; Malkmus et al., 2002)
Rhacophorus angulirostris	1 (Inger and Stuebing, 2005); 1, 2 (Malkmus et al., 2002)

TABLE 1. Continued.

	Status of description
Rhacophorus appendiculatus	1 (Inger and Stuebing, 2005); 2 (Dring, 1979: from Sungei Kelebang, Gunung Lawit, Peninsular Malaysia); 4 (Malkmus et al., 2002: from Danum Valley, Sabah; Hopkins et al., in prep.: from Sepilok, Sabah)
Rhacophorus baluensis	1 (Inger and Stuebing, 2005); 1, 4 (Malkmus et al., 2002: from Gunung Mulu National Park, Sarawak)
Rhacophorus cyanopunctatus	1, 2 (Dring, 1979: from Sungei Kelebang, Gunung Lawit, Peninsular Malaysia); 3 (Malkmus et al., 2002, provided analysis of Dring's 1979 data)
Rhacophorus dulitensis	1 (Malkmus et al., 2002; Inger and Stuebing, 2005)
Rhacophorus everetti	1 (Malkmus et al., 2002; Inger and Stuebing, 2005)
Rhacophorus fasciatus	0
Rhacophorus gadingensis	0
Rhacophorus gauni	1 (Malkmus et al., 2002; Inger and Stuebing, 2005)
Rhacophorus harrissoni	0
Rhacophorus kajau	4 (Dring, 1983b: from Gunung Mulu National Park, Sarawak; compared with calls of *Rhacophorus appendiculatus* by Heyer (1971)
Rhacophorus nigropalmatus	1 (Grandison, 1972: from Gunung Benom, Peninsular Malaysia)
Rhacophorus pardalis	1 (Alcala, 1962: from Negros, Philippines; Malkmus et al., 2002; Inger and Stuebing, 2005)
Rhacophorus reinwardtii	1 (Grandison, 1972: from Gunung Benom, Peninsular Malaysia; Inger and Stuebing, 2005); 3 (Dring, 1979: from Sungei Kelebang, Gunung Lawit, Peninsular Malaysia; identified as '*Rhacophorus* cf. *reinwardti*')
Rhacophorus rufipes	0
Theloderma horridum	0

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Shell Color Variation of Midland Painted Turtles (*Chrysemys picta marginata*) Living in Habitats with Variable Substrate Colors

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In reptiles, skin pigmentation can be important in crypsis, communication, and thermoregulation (Cooper and Greenberg 1992). Patterns of melanism of skin and shells of freshwater turtles can be described as permanent (heavy pigmentation of the shell throughout life), seasonal (changes in melanin distribution during sexual cycles), senile reticulate (melanization of some areas in some old individuals within the population), and ontogenetic (increases or decreases in skin melanin content with age, Lovich et al. 1990). Under laboratory conditions, melanin content of the skin of some side-neck turtles increases when turtles are maintained on dark-colored backgrounds when compared to those maintained on light-colored backgrounds (Banks 1986; Woolley 1957). Such phenotypic plasticity (Alpert and Simms 2002) in melanin content in dorsal skin may facilitate background color convergence in a turtle species that resides in different habitats with variable substrate colors (Lovich et al. 1990). Background color convergence may reduce predation rates (Cooper and Greenberg 1992) or make turtles more effective predators because they are less easily detected by prey (Green and Leberg 2005). To date, little information exists on how integument color varies among populations of freshwater turtles residing in environments with different substrate colors. Such studies might generate insights into the ecological

and evolutionary importance of pigmentation in freshwater turtles.

Painted Turtles (*Chrysemys picta*) are a North American emydid that occupy a range of freshwater habitats and therefore are ideal for assessing inter-population variation in shell color. The carapace of *Chrysemys picta* ranges from olive to black (Ernst et al. 1994), and sexual dimorphism in shell color is not apparent other than the reticulate melanism that may develop on the carapaces of some older male individuals (MacCulloch 1981; Smith et al. 1969). The plastron tends to lack dark pigment at the margins but may have more centrally-located dark pigment. We studied shell color within and among populations of wild-caught Midland Painted Turtles (*Chrysemys picta marginata*) of the Beaver Island Archipelago using photographic digital and spectrometric techniques in the laboratory. We compared the degree of shell darkness (intensity) among populations residing in black-substrate inland swamps, marshes, and lakes, as well as in the relatively light-colored sand and algae covered substrates of Lake Michigan bays. We focused on the carapace ground color because it is the largest dorsal region that would be viewed against the substrate by picine or avian predators (Stuart-Fox et al. 2004). Although background color convergence would presumably be most important to small, juvenile turtles that would be most vulnerable to predation, our data set included mainly sub-adult or adult turtles. Color change, however, has been shown to occur in adult individuals (Banks 1986; Woolley 1957) and therefore background color convergence might be manifested in all ages and sizes of turtles. If background color convergence occurs, then turtles from environments with dark-bottomed substrates would be expected to have darker carapaces than individuals from light-colored substrates of Lake Michigan harbors.

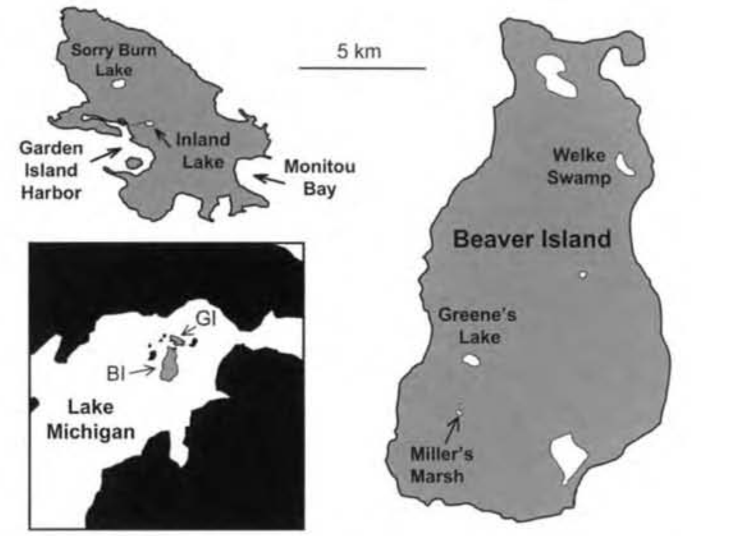

FIG. 1. Map of study sites on Garden Island (GI) and Beaver Island (BI) and the location of the Beaver Island Archipelago in northern Lake Michigan between the Upper and Lower Peninsulas of Michigan (inset).

MATERIALS AND METHODS

Study sites and collection of turtles.—We collected turtles during June and July in 2000–2003 by hand or using baited hoop nets, fyke nets, and basking traps. We selected study sites where the substrate of the bottom was relatively uniform throughout the habitat and avoided sampling from populations living in habitats with heterogeneous bottom substrates (e.g., with sandy, muck, and leaf-covered mosaics). We collected turtles from three inland sites on Beaver Island (45°36'N, 85°35'W, Fig. 1). Miller's Marsh and Greene's Lake are relatively small bodies of water with dark muck bottoms and clumps of water lilies (*Nuphar* sp. or *Nymphaea* sp.), cattails (*Typha latifolia*), and various *Potamogeton* species. Welke Swamp is an inland cedar swamp of northeastern Beaver Island that is mainly a black muck-bottomed habitat with some submerged aquatic vegetation. Inland sites on Garden Island (45°47'N, 85°30'W) included Sorry Burn Lake and Garden Island Inland Lake that were both dark muck-bottomed lakes and surrounded by floating vegetation mats. Lake Michigan harbor sites included Monitou Bay and Garden Island Harbor that were both relatively shallow bays (< 5 m maximum depth) associated with Lake Michigan. Although these Lake Michigan habitats were heterogeneous in that they had rock or soft bottoms, a thin layer of light brown to green-yellow algae covered each type of substrate giving the substrate a relatively uniform color. Large stands of aquatic vegetation were present, mainly wild celery (*Vallisneria americana*) and coontail (*Ceratophyllum demersum*).

Photographic digital images.—We obtained JPEG images (1600 × 1200 pixels) of turtles collected during 2000 (ca. 90%) and 2001 (ca. 10%). A Nikon Coolpics 800 digital camera was placed on a camera stand equipped with four 60-watt soft-light incandescent bulbs. Turtle shells were rinsed with tap water, dried completely and then placed horizontally in a restraining device such that the top of the carapace was relatively level and 20 cm below the camera lens. Lights were adjusted such that they shined from anterior and posterior locations with ray angles that were at about 30° to the perpendicular of the carapace or plastron. The camera was set to accommodate incandescent light at f 3.5 at 1/60 sec and macro settings were employed although no zoom was used. To provide a color standard, a 2 × 4 cm gray card was placed on the turtle's shell at a location that was off-center within the field of view. We used a personal computer equipped with Image-Pro Express 4.0 software to determine intensity values of carapaces and plastrons from the JPEG images, which was measured as pixel counts of 8-bit values that ranged between 0 (black) and 255 (white). Intensity, or brightness, is a dimensionless variable that measures the relative reflectance of an object where low values represent dark color and high values represent light color (Cooper and Greenberg 1992). The third vertebral scute of the carapace was used to represent the carapace as it was relatively flat which eliminated glare. Using the geometric shape function of the software program, we formed a rectangle that enclosed a majority of the area of the third vertebral scute and determined intensity for that area. While the ventrally-located plastron would not be expected to vary in color as a function of substrate color, we measured intensity of the left abdominal scute of the plastron for comparison with the carapace. We restricted our measurements to a rectangular area of the lateral region of the abdominal scute of the plastron because it lacked black pigment allowing us to evaluate variation in relative darkness between the plastron and carapace. We also took intensity readings from the gray cards in each image of the carapace and plastron. Most turtles that were less than 50 mm could not be used because the curvature of the carapace of these individuals caused

noticeable glare. Also, we collected only one individual that was less than 120 mm at the Lake Michigan habitats (Garden Island Harbor and Monitou Bay). Turtles whose shells were greatly flaking or that were opaque because they were in the advanced stages of scale sloughing were also excluded from the data set.

Spectrometric analysis of shell color.—To assess color quality in terms of reflected wavelengths and intensity, we used a spectrometric technique on turtles from three of the seven populations that were studied using the JPEG digital image technique (Garden Island Harbor, Miller's Marsh, and Welke Swamp which represented carapace intensity extremes and an intermediate shell color). Reflectance spectra of turtle carapaces were obtained in the laboratory under standardized conditions (June and July, 2002 and 2003) using a reflectance probe (Ocean Optics R-400) connected to a deuterium-halogen lamp (Ocean Optics) of an Ocean Optics USB 2000 portable spectrometer, and a notebook computer running Ocean Optics OOI Base 32 software. Subjects were placed at a fixed distance of 0.5 cm from the probe and reflectance of the shell surface was sampled at 30° from the perpendicular. A white standard (Labsphere Spectral WS-1) was scanned and dark current removed from the signal immediately before a reading was taken. Our data included wavelengths that spanned both the visible and ultraviolet spectra (330–700 nm). We included a portion of the UV spectrum as some potential fish predators may have visual systems that are UV-sensitive (Bowmaker 1991; Yokoyama and Yokoyama 1996). Intensity was measured as the total area under the spectral curve between 330–700 nm where the median % reflectance of each 20-nm increment was determined and summed per spectral reading (Macedonia et al. 2003).

Statistical analyses.—Carapace and plastron intensities as determined by JPEG and spectrometric techniques were approximately normally distributed and so were analyzed by ANOVA. *Post hoc* tests were conducted using least squares means multiple t-tests. Alpha values for all tests were 0.05.

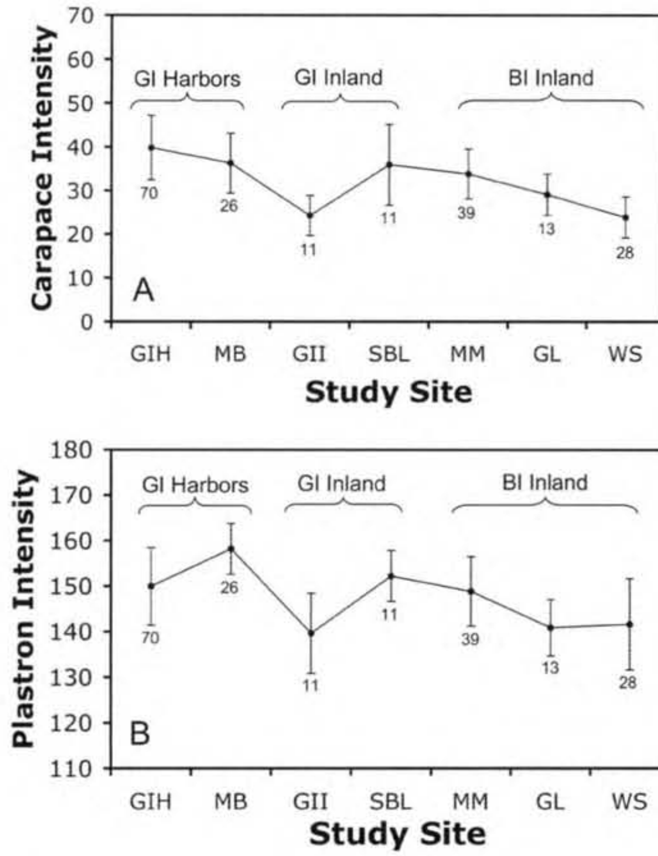

FIG. 2. Mean intensity values for (A) the third vertebral scute and (B) the lateral margin of the left abdominal scute of *Chrysemys picta* from seven different locations on Beaver and Garden Islands. Vertical lines are ± 1 SD and sample sizes are shown below.

RESULTS

Photographic digital images.—Intensities of the third vertebral scute and its associated gray card were not correlated ($P > 0.05$ in all correlations) indicating that variation in lighting conditions among JPEG images was minimal. Within a site, intensity of the third vertebral scute of the carapace (carapace intensity or CI) was not correlated with carapace length ($P > 0.05$ in all cases) nor did it vary between male and female turtles ($P > 0.05$ in all cases). Therefore, we combined juveniles, males, and females into single data sets that represented individuals from each study site. There were significant differences in CI among sites (model: $F_{6,191} = 26.7$, $P < 0.0001$, $R^2 = 0.46$, Fig. 2A and Fig. 3A–C). Least squares (LS) means multiple t-tests indicated that turtles from Garden Island Harbor (a light-substrate Lake Michigan harbor habitat) were lighter (i. e. had greater LS mean CI values) than turtles from other localities, and turtles from Welke Swamp and Garden Island Inland Lake (dark-substrate inland habitats) were darker than turtles from all other populations ($P < 0.05$ in all comparisons). Mean intensity of the third vertebral scute of turtles from Monitou Bay (a light-substrate Lake Michigan harbor habitat), Sorry Burn Lake, and Miller's Marsh (both inland habitats with dark substrates) were not significantly different from one another ($P > 0.05$ in each case) and each had greater LS mean intensity than turtles from the dark substrate, inland Greene's Lake ($P < 0.05$ in all comparisons). Therefore, although mean carapace intensity was highest (lightest in color) and lowest (darkest in color) in environments with light and dark substrates respectively, mean carapace intensity was intermediate in some populations that had either light or dark substrates.

Within populations, plastron intensity (PI) was not affected by gender or body size, and gender and body size data were combined within sites for analyses among sites. There was significant variation in PI among sites ($F_{6,191} = 13.9$, $R^2 = 0.31$)(Fig. 2B and Fig. 3D–F). Turtles from Monitou Bay had significantly greater LS mean PI than turtles from other populations ($P < 0.005$ in all cases). Plastrons of turtles from Sorry Burn Lake, Garden Island Harbor, and Miller's Marsh were similar in intensity ($P > 0.05$ in all comparisons) and each had greater LS mean PI than turtles from Welke Swamp, Greene's Lake, and Garden Island Inland Lake which were all statistically indistinguishable from one another.

We did not notice any obvious dark staining by exogenous factors (e.g., tannins) of the shell within any population, particularly on the plastron where it would be most evident because of its light color (Fig. 3D–F). Within sites, PI and CI were not correlated ($P > 0.05$ in all regressions) as would be expected if an exogenous factor affected intensity values of the shell. When PI is regressed on CI, a slope of approximately one would be expected if exogenous

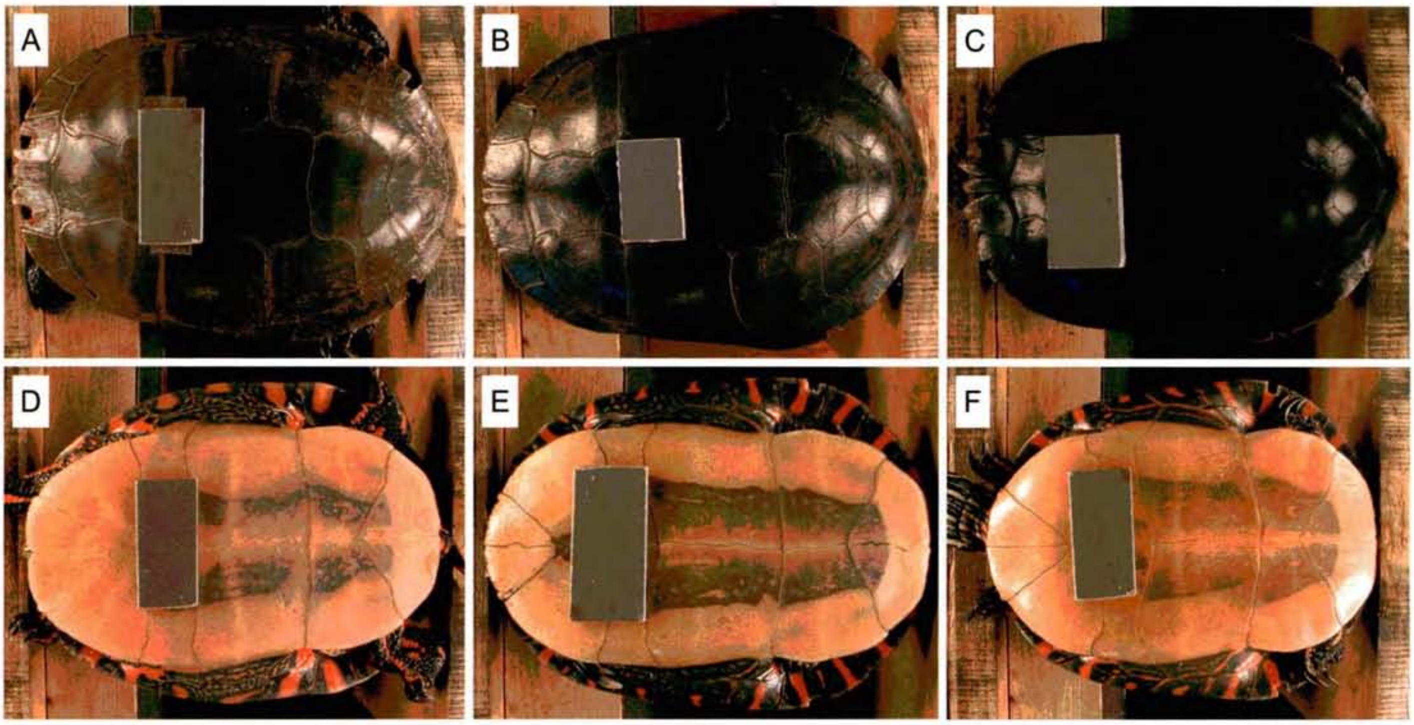

FIG. 3. Dorsal views of *Chrysemys picta* carapaces that represent mean intensity values from (A) Garden Island Harbor (light-shelled extreme), (B) Miller's Marsh (intermediate value), and (C) Welke Swamp (dark-shelled extreme) and ventral views of plastrons that represent mean intensity values from (D) Monitou Bay (light-shelled extreme), (E) Miller's Marsh (intermediate value), and (F) Welke Swamp (dark-shelled extreme).

factors, which would affect both the plastron and carapace in a similar way, affect shell color. Overall, PI was significantly but weakly related to CI (PI = 135.32 + 0.40CI, $F_{1,195} = 26.7$, $P < 0.0001$, $R^2 = 0.13$) but by a slope much less than unity ($t = 4.0$, $P < 0.0001$). A regression of the difference between PI and CI (PI - CI) on CI was significant (PI - CI = 135 - 0.61CI, $F_{1,195} = 62.9$, $P < 0.0001$, $R^2 = 0.26$) indicating that over a range of carapace intensities, dark carapaces diverged greatly from plastrons which would not be expected if exogenous factors were affecting both carapaces and plastrons.

Spectrometric analysis of shell color.—There was significant variation among all sites (Garden Island Harbor, Miller's Marsh, and Welke Swamp) in mean intensity of the third vertebral scute ($F_{2,51} = 27.0$, $P < 0.0001$, $R^2 = 0.54$). Least square mean intensity, expressed as percent reflectance, was highest at Garden Island Harbor (a light-substrate Lake Michigan harbor habitat), lowest at Welke Swamp, and intermediate at Miller's Marsh which were both inland habitats with dark substrates ($P < 0.05$ in all comparisons, Fig. 4A).

Mean intensity of the third vertebral scute, as determined from JPEG images on the same turtles that were used in the spectral analysis, varied significantly among sites ($F_{2,51} = 10.6$, $P < 0.0001$, $R^2 = 29$). Least square mean CI was greater at Garden Island Harbor than at Miller's Marsh and Welke Swamp ($P < 0.05$ in both comparisons, Fig. 4B). Intensities as determined by spectroscopy and from JPEG images were positively correlated ($r = 0.61$, $P < 0.0001$).

Mean percent reflectance of wavelengths between 330–700 nm for Garden Island Harbor, Miller's Marsh, and Welke Swamp are shown in Fig. 5. The elevation of the lines indicates differences in intensity where Garden Island Harbor turtles had the lighest shells and Welke Swamp turtles had the darkest shells. Turtles from Miller's Marsh and Welke Swamp had similar shaped curves with slight increases between 500–600 nm. Carapaces from Garden Island Harbor had lines that diverged from Miller's Marsh and Welke Swamp in the green region of the spectrum.

DISCUSSION

Using both digital image and spectrometric techniques, we detected variation in the degree of carapace darkness of *Chrysemys picta* shells among populations of the Beaver Island Archipelago. Turtles that resided in Lake Michigan harbor habitats with light-colored substrates either had relatively light carapace ground color (Garden Island Harbor) or were intermediate in the degree of darkness (Monitou Bay). In turtles from inland habitats with dark-colored substrates, turtles had either relatively dark-colored carapaces (Garden Island Inland Lake, Greene's Lake, Welke Swamp) or carapaces that were intermediate in the degree of darkness (Sorry Burn Lake and Miller's Marsh). Therefore, our prediction that turtles would show background color convergence in their respective environments seemed valid for some localities but not for others.

Pigmentation patterns of reptile integuments result from differential distribution and activity of epidermal or dermal melanophores or melanocytes that work together with other types of chromatophores to determine color quality (Cooper and Greenberg 1992). Lovich et al. (1990) suggested that in *Trachemys scripta* morphological color (long-term or permanent darkening of the integument) variation might result from hormone-mediated sup-

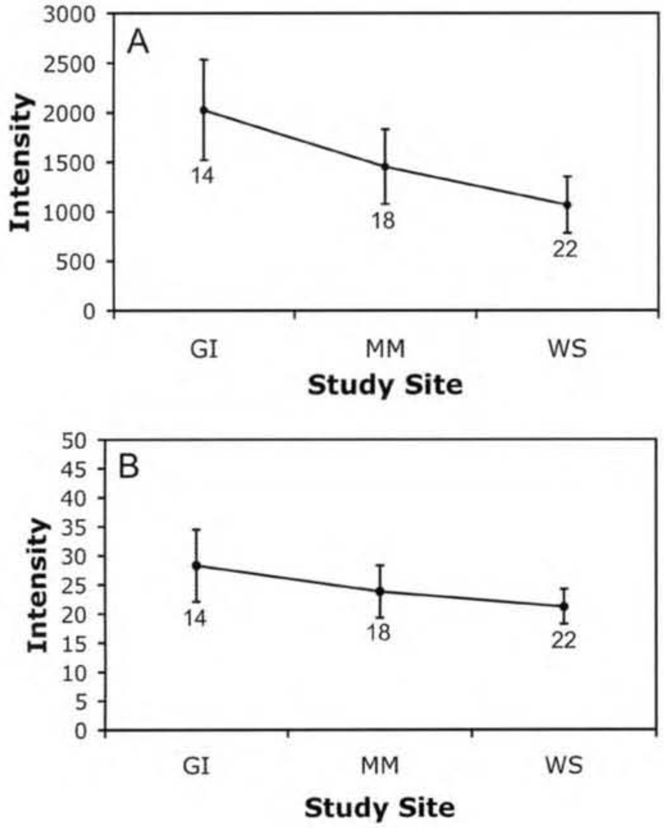

FIG. 4. Mean intensity values for the third vertebral scute of *Chrysemys picta* as determined by (A) spectrometry and (B) JPEG digital analysis for three localities. Vertical bars are ±1 SD and samples sizes are shown below.

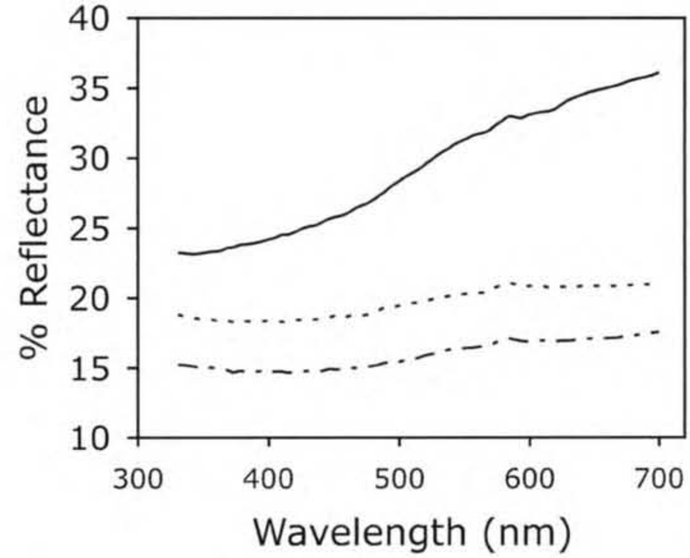

FIG. 5. Mean percent reflectance in wavelengths between 330 and 700 nm for the third vertebral scute of *Chrysemys picta* carapaces from Garden Island Harbor (solid line), Miller's Marsh (dashed line), and Welke Swamp (dot-dash line).

pression of dermal melanophores in light-colored individuals and enhancement of epidermal melanophores in melanistic individuals. A similar mechanism would presumably be operating in the closely-related *Chrysemys picta*. In our study, relatively unpigmented regions of the plastron also varied among populations in roughly the same way as that of the carapace. Such a pattern might represent plastron chromatophore activity that parallels melanophore activity of the carapace. While we cannot discount the influence of exogenous factors (e.g., tannins) on the degree of shell darkening among populations, the degree of carapace darkness strongly diverged from the plastron in dark individuals indicating that most variation in carapace darkness was due to pigment differences between individuals.

Whether the differences in carapace color among the *Chrysemys picta* populations of this study represented phenotypically plastic responses to variations in environmental conditions among habitats or fixed genetic differentiation within populations remains to be determined. Short-term increases in melanin content in the skin can be induced by dark substrate colors in some turtle species (Banks 1986; Woolley 1957) and a similar mechanism of shell color determination may exist in *C. picta*. Assuming that such plasticity would require visual input where melanin deposition is inversely related to substrate light reflection, variables such as water clarity or water depth might affect light conditions independent of substrate color (Marshall et al. 2003; Yokoyama and Yokoyama 1996). Therefore, intermediate carapace color in environments with either dark or light substrates might occur if there is variation in light transmission through water. Alternatively, it is possible that light or dark-colored turtles migrated from habitats with light or dark-colored substrates respectively to habitats with dark and light-colored substrates respectively. As a result, patterns of shell color relative to substrate color could be confounded. It is certainly possible that turtles could migrate between the dark-bottomed inland and light-bottomed Lake Michigan harbor habitats of Garden and Beaver Islands, especially through creeks and cedar swamps. However, long-distance movements away from Miller's Marsh, an inland dark-bottomed habitat on Beaver Island and with turtles with an intermediate degree of shell darkness, are not known to occur (Rowe 2003). While we cannot rule out dietary influences on color variation, we know of no instances where variation in dietary composition has been shown to cause variation in pigmentation of reptiles. Furthermore, we presume that variation in deposition of melanin, a pigment that is not directly derived from the diet (Cooper and Greenberg 1992), is primarily responsible for variation in shell intensity among individuals and populations of *Chrysemys picta*. In some reptiles, short-term darkening of the integument might be associated with enhancing heat absorption under cool conditions (Parker 1998; Pearson 1977). It is unlikely that thermal conditions of the environments of our populations had any influence on color determination as the Lake Michigan habitats, where turtles were light in color, tend to have cooler water temperatures than more inland sites (Rowe 2003; Rowe and Bowen 2005).

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Mannophryne trinitatis (Anura: Dendrobatidae) is a Trinidadian Single-Island Endemic

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Garman (1887) described *Phyllobates trinitatis* based exclusively on specimens from the island of Trinidad. This species was most recently transferred into the genus *Mannophryne* by La Marca (1992) after having been placed into *Prostherapis* and *Colostethus* by previous authors (*Prostherapis*—Mole and Urich 1894, Rivero 1961; *Colostethus*—Edwards 1971, Rivero 1990). It is a commonly encountered inhabitant of streams running through forests in the Northern Range and the Central Hills of Trinidad (Kenny 1969; Murphy 1997). The species description was apparently based on 20 Trinidadian specimens according to a comment at the end of the original description (Garman 1887), although not all of them may now be extant. Even though the type series (Table 1) came from Trinidad, the specific epithet *trinitatis* has also consistently been applied to coastal Venezuelan populations of rocket frogs (under the generic names *Prostherapis, Colostethus,* and *Mannophryne*) since at least the 1920s (e.g., Lutz 1927). The exception for identification of such populations as *M. trinitatis* has been the description of readily distinguishable new species (e.g., *Prostherapis neblina* Test, *P. riveroi* Donoso-Barros, *Colostethus guatopoensis* Dixon and Rivero-Blanco, *C. oblitteratus* Rivero) and the resurrection of *P. herminae* from synonymy by La Marca (1984, 1994). All other rocket frog populations throughout the

Table 1. Syntypes of *Mannophryne trinitatis* in the collections of The Natural History Museum, London (BMNH), the University of Michigan Museum of Zoology (UMMZ), and the Museum of Comparative Zoology, Harvard University (MCZ). Eight additional syntypes may exist according to Garman (1887).

Specimen number	Comments
BMNH 1947.2.14.23–24	—
MCZ A-2181	nine specimens, collected on 4 June 1879, examined by HK
UMMZ 47218	—

Venezuelan coastal range have been rather serendipitously assigned to *M. trinitatis* even after indications that this may be unwarranted.

In the early 1960s, Rivero (1961) already intimated that Venezuelan populations of *M. trinitatis* should be considered distinct from *M. trinitatis* at the species level but fell short of providing a name and a species diagnosis. In his unpublished dissertation, Edwards (1974) proposed the manuscript name "*praecia*" for a population at Cerro Azul in the Península de Paria, but this name is not available since the dissertation was never published. The distinction of Venezuelan populations was again revisited by La Marca (1994), who provided a detailed redescription of *M. trinitatis* based on Trinidadian material. Despite of the differences noted between Venezuelan and Trinidadian specimens, La Marca (1994) initiated no taxonomic change. In his online database, Frost (2004) shows the distribution of *M. trinitatis* as restricted to Trinidad. This restriction first appeared online in the version of the database posted in 2000, but without analysis or further explanation. Kaiser et al. (2003) described inconsistencies between rocket frogs from Trinidad (referred to as *M. trinitatis*) and Venezuela (referred to as *M.* cf. *trinitatis*) at the chromosomal level, providing a data set independent of the morphological information to confirm the assertion that Trinidadian and Venezuelan populations, at least from the Caracas area, are distinct.

We believe that the combined morphological and chromosomal evidence now clearly supports the hypothesis that the distribution of *M. trinitatis* includes only the island of Trinidad. Even though the information posted on the webpage for *M. trinitatis* in Frost's (2004) *Amphibian Species of the World* database indicates that the species is restricted to Trinidad, and has done so since an earlier version in 2000, this information has not entered the literary mainstream. We presume that this may be because *Amphibian Species of the World* is an online-only reference that does not provide the data used to arrive at the decision to restrict the distribution of the species. As a consequence, authors have continued to report *M. trinitatis* from Venezuela (e.g., Barrio-Amorós 1998, 2004; Manzanilla and La Marca 2005). The proper application of the name *M. trinitatis* to the correct populations is of considerable importance, not only from the point of taxonomy or biogeography, but especially since isolated populations in Venezuela have been given the IUCN Red List status of vulnerable (IUCN et al. 2004).

Unfortunately, there is no name available that could be applied to the coastal Venezuelan populations of these commonly encountered rocket frogs. Populations throughout the Venezuelan Cordillera de la Costa and other coastal habitats, however, require additional sampling and further study to ascertain how many species have been hiding under the improperly applied name *M. trinitatis* for the better part of a century.

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TECHNIQUES

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Subcutaneous Movements of Visible Implant Elastomers in Wood Frogs (*Rana sylvatica*)

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Concerns about declines in amphibian populations have increased the need for long-term studies of amphibians (McCoy 1994). These studies often require methods of marking that are readily applied, safe for the organism, and allow reliable identification (Nace 1982). Marks should: 1) not effect mortality rates or behavior; 2) allow identification of individuals; 3) be permanent; and 4) be easily interpreted (Ricker 1956). Toe clipping is commonly used to mark amphibians but may alter feeding behavior, reduce potential for weight gain, cause infection, and toes may regenerate (Clarke 1972; Davis and Ovaska 2001; Ferner 1979; Golay and Durrer 1994). Passive Integrated Transponders (PIT) tags are useful in marking amphibians for long-term studies, however the process of tagging can be time-consuming, materials are expensive, and some animals may be too small for the technique (Ireland et al. 2003; Ott and Scott 1999). Visible Implant Elastomers (VIE; see Anholt et al. 1998; Bailey 2004; Davis and Ovaska 2001; Marold 2001; Nauwelaerts et al. 2000) are long lasting and allow many individuals to be marked (Northwest Marine Technology 2000). Several colors, which fluoresce under blue light, can be injected at various body locations, providing hundreds of unique marks. Another subcutaneous marking technique, alpha numeric fluorescent tags, may have similar advantages over traditional methods (Buchan et al. 2005).

Retention of VIE marks has been studied in *Rana esculenta* (Nauwelaerts et al. 2000), *Plethodon vehiculum* (Davis and Ovaska 2001), *Eurycea bislineata* (Bailey 2004; Marold 2001), and *Desmognathus fuscus* (Marold 2001). Although these studies found that marks were retained, further information is needed on the potential subcutaneous movements of marks away from their original locations. In a laboratory study, Marold (2001) used 14 mark locations on *Eurycea bislineata* and found marks in the mid-body region were easily confused with those in surrounding locations. Davis and Ovaska (2001) marked *Plethodon vehiculum* on six ventral surfaces and noted that 13 of 69 (19%) individuals were difficult to identify due to subcutaneous movements of marks. Bailey (2004) found that observers misidentified *E. b. wilderae* on 39 of 300 (13%) occasions. Our study objectives were to: 1) determine if subcutaneous movement of marks varied depending on where in the body they were applied; and 2) identify optimal regions for marking wood frogs (*Rana sylvatica*).

Twenty-four (23 males and 1 female) adult *Rana sylvatica* were collected on 29 January 2001 at a breeding pond in Madison County, Kentucky, USA. In the laboratory, five frogs were placed into each of four tanks, with four frogs in an additional tank. Each 37.9 L tank contained pebble and soil substrate and a water dish. Tanks were watered daily to ensure moist conditions and temperature was maintained at 20°C. Frogs were inspected for mortality and infection daily and were fed crickets weekly.

Each frog was marked in two regions of the body by injecting VIE under the skin. Six injection sites were tested: the centers of the dorsal and ventral aspects of the forelimb, mid-body, and hindlimb (Fig. 1). Borders of each body region were defined by proximal ends of the limbs and dorso-ventral midlines of the body (Fig. 1). Frogs were not anesthetized and were hand-held during injections. Individuals in each tank were marked in the same combination of body regions, including: tank 1 - ventral surfaces of the mid-body and hindlimb; tank 2 - ventral surfaces of the mid-body and forelimb; tank 3 - dorsal surfaces of the mid-body and hindlimb; tank 4 - dorsal surfaces of the mid-body and forelimb, and; tank 5 - contained one individual from each of the four marked groups.

Frogs were marked on 1 February 2001, and positions of VIE were monitored weekly until 2 March 2001. Marks were inspected using a flashlight with blue light emitting diodes, while wearing

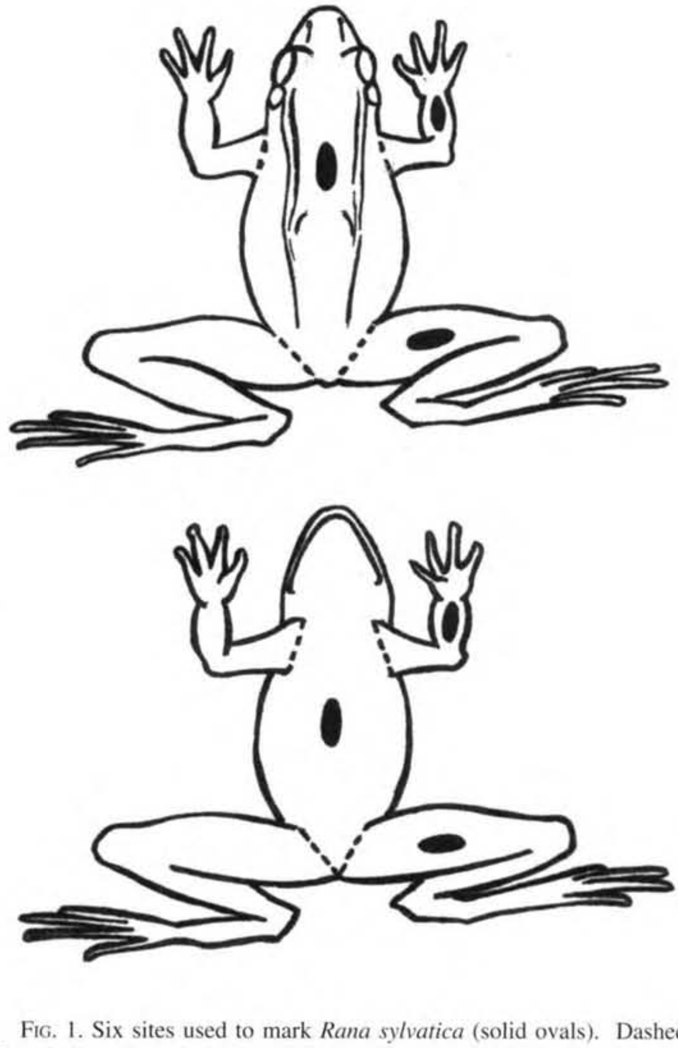

FIG. 1. Six sites used to mark *Rana sylvatica* (solid ovals). Dashed lines indicate boundaries between dorsal and ventral forelimbs, midbody, and hindlimbs.

TABLE 1. Percentages of Visible Implant Elastomer marks that exhibited subcutaneous movements out of assigned body regions (N) in captive *Rana sylvatica*.

	Forelimb (12)	Midbody (24)	Hindlimb (12)	Overall (48)
Dorsal	17	0	0	6
Ventral	0	100	33	44
Overall	8	50	17	—

filter glasses (Northwest Marine Technology) that only permitted green, yellow, orange, and red colors to be viewed. Positions of marks were scored as '0' if they were within defined borders of the marked region, or '1' if they were outside of or touched the borders of the marked region (Fig. 1). Effects of location (forelimb, mid-body, or hindlimb) and aspect (dorsal or ventral) on fidelity of marks to defined body regions were determined at the end of week four using two Chi-square contingency tables at $\alpha = 0.05$ (Zar 1999; SPSS 13.0). A multi-dimensional contingency table was not used because average expected frequencies were < 6 (Zar 1999).

Fifteen of 48 marks (31%) exhibited subcutaneous movements. Movements of marks occurred non-randomly with respect to location ($\chi^2 = 8.05$, $P < 0.018$, d. f. = 2) and aspect ($\chi^2 = 16.39$, $P < 0.001$, d. f. = 1). Marks on limbs and the dorsal aspect showed fewer subcutaneous movements than mid-body and ventral marks (Table 1). Although we did not test for an interaction between location and aspect, marks in some body regions showed relatively high percentages of subcutaneous movements. Specifically, all marks on the ventral mid-body exhibited subcutaneous movements; whereas, all marks on dorsal mid-body and hindlimb, and ventral forelimb remained in defined regions (Table 1). No injuries, infections, or mortalies occurred over the one-month study.

Our results indicate that Visual Implant Elastomers may not be useful in the dorsal forelimb, ventral midbody, and ventral hindlimb of *Rana sylvatica*. Researchers that assign marks in these regions may misinterpret mark combinations. Other regions (dorsal midbody and hindlimb, and ventral forelimb) may be more suitable for marking ranids. Several factors may have contributed to differential mark fidelity, including: how deeply marks were injected, degree of connectivity between skin and underlying muscle, abrasion with substrate, and handling by researchers (frogs were restrained by grasping the mid-body and hindlimbs). On several occasions, we observed that marks moved as a result of handling. Northwest Marine Technologies (2000) recommended handling specimens with care for at least ten days after tagging. If specimens are handled excessively before elastomers cure, marks may be forced out the needle wound (Northwest Marine Technology 2000). Loss of marks did not occur during our study, although subcutaneous movements of elastomers were observed within the first week after injection. On two occasions, marks appeared to be lost when they moved behind dark pigment; the marks became visible again after moving to areas with lighter pigmentation. Additionally, we had difficulty differentiating between red and orange marks, particularly when they were behind pigmented areas.

Our study was limited to four weeks under laboratory conditions; long-term field studies may be needed to determine the overall efficacy of using VIE for marking ranids. Conditions or behaviors in the field (e.g., amplexus, burrowing, or abrasion with substrate) also may result in differential mark movement. Likewise, movement of marks behind dark pigment may increase chances of misinterpreting colors or failing to detect marks. Unfortunately, except for the ventral forelimb, regions with the highest mark fidelity also had the darkest pigmentation (i.e., dorsal regions). Conceivably, other subcutaneous marking methods (alpha numeric fluorescent tags) may suffer from similar problems. We recommend that researchers avoid applying marks in neighboring body regions or those with low mark fidelity. In some cases, it may be necessary to avoid marking densely pigmented regions.

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Marking Amphibians with Alpha Numeric Fluorescent Tags: Caecilians Lead the Way

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Buchan et al. (2005) considered their testing of alphanumeric fluorescent tags (VIAlpha tags) to mark frogs and salamanders to be a first for amphibians. However, previously we reported the successful use of these tags in the Indian caecilian *Gegeneophis ramaswamii* in both the laboratory (Measey et al. 2001) and field (Measey et al. 2003a). Our aims here are to compare use of VIAlpha tags in different amphibians now that they have been tested in representatives of all three orders, and to draw attention to other recent progress in caecilian ecology.

Measey et al. (2001, 2003a) both made incisions and inserted VIAlpha tags using only the manufacturer's supplied injector. Buchan et al. (2005) made incisions with a blood lance and used the injector only to deliver the tags. On a subsequent visit to the study site reported by Measey et al. (2003a), we also used a blade (scalpel) to make the initial incision in *G. ramaswamii*, obviating the need to resharpen the injector. This reduced tagging time from up to 5 mins (Measey et al. 2001) to less than 1 min per individual. This is still longer than that reported for frogs and salamanders by Buchan et al. (2005), perhaps because caecilians have annulated bodies with a tighter connection between the skin and external muscular sheath (Nussbaum and Naylor 1982).

Buchan et al. (2005) did not anaesthetize frogs and salamanders, whereas Measey et al. (2001: table 1) asserted that inserting tags into caecilians requires anaesthesia. Restraining caecilians in the hand is difficult so that tagging precision is impractical without anaesthesia, something that might also be expected for some salamanders. Unlike Buchan et al. (2005), we did not sterilize equipment before tagging each individual at our site, but we recognize that this represents best practice. Equipment should also be sterilized before use in other sites to prevent spread of pathogens (e.g., Fellers et al. 1994).

Caecilian biology in general remains much less known than for frogs and salamanders (Gower and Wilkinson 2005). Despite this, much progress has been made recently in quantitative caecilian ecology, including studies of abundance (Measey 2004; Measey et al. 2003a, b), condition (Measey and Gower 2005), niche separation (Gower et al. 2004), diet (Jones et al. 2006; Kupfer et al. 2005a; Measey et al. 2004), and life history (Kupfer et al. 2004, 2005b; Malonza and Measey 2005).

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Effects of Tricaine Methanesulfonate (MS-222) Concentration on Anesthetization and Recovery in Four Plethodontid Salamanders

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Tricaine methanesulfonate (also known as MS-222, Tricaine, Metacaine, or ethyl *m*-amino-benzoate methanesulfonate) is a commonly used anesthetic for fish and amphibians. Previous research has shown that the pH of MS-222 solutions has an effect on anesthetic efficacy and physiological functions (Letcher 1992; Lowe 2004; Ohr 1975a,b; Robinson and Scadding 1983). Current recommendations are to buffer solutions of MS-222 to a neutral pH (Crawshaw 1993; Robinson and Scadding 1983; Ohr 1975a). MS-222 solutions can be buffered using $NaHCO_3$ (sodium bicarbonate; Cooper 2003), aqueous buffers such as dihydrogen potassium phosphate and sodium hydroxide (Lowe 2004), or can be titrated with NaOH (Ohr 1975a). Although MS-222 is widely used and the benefits of buffering solutions are well known, few studies elaborate on the effects of its concentration on amphibian anesthetization and subsequent recovery time (see Letcher 1992; Robinson and Scadding 1983). We assessed the effects of MS-222 (Sigma, catalogue number A5040-25G) concentration in aqueous solutions on the time to anesthetization and recovery. Four species of semi-aquatic, stream-breeding salamanders (*Desmognathus monticola*, *D. ocoee*, *D. quadramaculatus*, and *Eurycea wilderae*) were tested at three different concentrations (500 mg/L, 1000 mg/L, and 2000 mg/L).

Materials and Methods.—We used 45 salamanders per species for this experiment. Animals were housed with moist paper towels in plastic Gladware™ containers (15.5 × 15.5 × 5 cm) within an environmental chamber on a 12/12 light cycle at 20°C and 75% humidity. Depending upon the species and size of the salamanders, 2–10 animals were kept together in the same container. No salamander was held in the environmental chamber for more than 72 h prior to testing. Fifteen salamanders per species were tested at each of three experimental concentrations (500 mg/L, 1000 mg/L, and 2000 mg/L) of MS-222. Salamanders were tested only once, at one concentration to ensure independence between replicates. After testing, all salamanders were returned to the environmental chamber for at least 24 h before being returned to their stream of capture. Solutions were made using 0.250 g, 0.5 g, and 1.0 g of MS-222 dissolved in 500 ml of distilled water. Solutions had an instantaneous pH of 3.9–2.8, and were neutralized with varying amounts of sodium bicarbonate (0.4 g for 500 mg/L to 0.93 g for 2000 mg/L), added in small amounts while monitoring the pH with a pH meter (Oakton Instruments, product # 35624-33). Solutions were buffered to a pH of approximately 6.5 as the pH would continue to rise throughout testing.

To test the effects of concentration, salamanders were submerged in the MS-222 solution and the time to complete anesthetization was recorded. An animal was deemed anesthetized (the induction time, Robinson and Scadding 1982) when unable to right itself and reflexive and voluntary responses to gentle pinching of the limbs and tail with forceps ceased. Salamanders were then rinsed in pure distilled water and laid in a shallow dissecting tray with distilled water (partially submerging the animal). Salamanders were monitored with gentle pinching of the limbs until a response was detected. Two to three salamanders were tested in the MS-222 solution at a time, being replaced by others after induction. Solution mixtures were used repeatedly until the pH rose above 8. There was a 45 minute cut-off for induction, after which animals were removed from the MS-222 solution and omitted from the data set. The mean body mass, mean pH, mean temperature, mean induction time, mean time to recovery, and all standard errors were calculated. Analyses of covariance (ANCOVA, SPSS v.13) were run for each MS-222 concentration, comparing species to induction and recovery time, with mass as the covariate. All factors were log transformed. Tukey-Kramer's multiple comparisons tests were run to identify significant species differences based on induction and recovery times.

Results.—Induction time generally decreased and time to recovery increased with increasing MS-222 concentration (Table 1). The smaller salamanders, *D. ocoee* and *E. wilderae*, closely followed this pattern with little variation. The larger two species, *D. quadramaculatus* and *D. monticola*, exhibited the most variation in both induction and recovery times. Most notably, *D. quadramaculatus* had a substantially longer recovery time at 1000 mg/L than either the 500 or 2000 mg/L concentrations. It was found that species differences were highly significant ($P<0.001$) at all concentrations for both induction and recovery times. Tukey-Kramer's multiple comparisons showed extreme variability in species differences both between concentrations and between induction and recovery times. The covariate mass was significant for both the 500 and 2000 mg/L concentrations ($F_{1,57} = 6.39$, $P = 0.014$; $F_{1,54} = 7.84$, $P = 0.007$ respectively). Contrary to the low and high concentrations, mass was not significant in the 1000 mg/L concentration ($F_{1,59} = 0.095$, $P = 0.760$). Mass was also not significant in relation to recovery time for any MS-222 concentration, though was nearly significant in the anomalous 1000 mg/L concentration ($F_{1,59} = 3.62$, $P = 0.062$). We had 100% survival of all tested salamanders at all concentrations and no abnormal behavior or visible external impairments were incurred as a result of testing. The temperature of aqueous MS-222 solutions was held constant (mean temperature = 26.9°C, SE = 0.061, N = 173) and the pH was kept neutral (mean pH = 7.15, SE = 0.020, N = 173).

Discussion.—Increasing the concentration of MS-222 in a neutral solution led to shorter induction times and longer recovery times. These results correspond to those found by Robinson and Scadding (1983) and Letcher (1992). As concentration increased, variation in induction time within species generally decreased, while variation in recovery time generally increased. The larger salamander species, *D. quadramaculatus* and *D. monticola*, generally took longer to reach complete induction than the smaller *D. ocoee* and *E. wilderae* (Table 1). *Desmognathus monticola* was the most anomalous species tested, showing no consistent pattern between concentrations, and many individuals did not become inducted within the 45 minute cut-off (note sample sizes in Table 1). For its size, *D. ocoee* reached induction more slowly and re-

TABLE 1. Mean and standard error (±SE) estimates of body mass (g), induction time (min), time to recovery (min), pH, and temperature (°C) for each species in each MS-222 concentration (mg/L).

	Mass	Induction	Recovery	pH	Temperature
D. quadramaculatus					
500 (N = 14)	9.35 (±1.13)	14.04 (±2.19)	12.64 (±2.14)	7.29 (±0.10)	26.43 (±0.14)
1000 (N = 15)	9.71 (±1.09)	6.03 (±0.37)	21.99 (±1.02)	7.30 (±0.09)	27.00 (±0.00)
2000 (N = 15)	11.06 (±1.41)	3.10 (±0.18)	18.65 (±2.38)	6.88 (±0.02)	28.00 (±0.00)
D. monticola					
500 (N = 14)	3.46 (±0.50)	7.82 (±0.76)	6.95 (±0.74)	7.00 (±0.06)	26.43 (±0.23)
1000 (N = 15)	3.77 (±0.57)	5.13 (±0.82)	8.33 (±0.91)	7.11 (±0.06)	26.93 (±0.27)
2000 (N = 10)	4.61 (±0.57)	8.29 (±1.77)	7.43 (±0.95)	7.13 (±0.08)	27.00 (±0.33)
D. ocoee					
500 (N = 15)	0.82 (±0.99)	12.73 (±1.86)	3.67 (±0.24)	7.00 (±0.00)	26.00 (±0.00)
1000 (N = 15)	0.83 (±0.12)	4.60 (±0.27)	6.96 (±0.35)	7.30 (±0.00)	27.00 (±0.00)
2000 (N = 15)	0.67 (±0.09)	2.35 (±0.08)	9.72 (±0.78)	7.35 (±0.00)	28.00 (±0.00)
E. wilderae					
500 (N = 15)	0.61 (±0.10)	4.70 (±0.31)	8.50 (±0.36)	7.14 (±0.02)	26.60 (±0.13)
1000 (N = 15)	0.59 (±0.10)	2.36 (±0.12)	14.12 (±0.56)	7.35 (±0.09)	27.00 (±0.00)
2000 (N = 15)	0.71 (±0.07)	1.90 (±0.13)	21.54 (±1.15)	6.91 (±0.00)	26.00 (±0.00)

covered faster than expected in 500 mg/L. *Desmognathus quadramaculatus* also exhibited unexpected variation in its recovery time in the 1000 mg/L concentration.

Contrary to Lowe (2004), mass played a significant role in time to induction in two of the three concentrations (500 and 2000 mg/L), although mass was not significant in time to recovery in any concentration. But in accordance to Lowe (2004), species differences were most significant (P<0.001) and present in all concentrations for both induction and recovery times, but the inconsistency of significant differences between species attests to the variability within this system. The latter may be indicative of a phylogenetic variation (Lowe 2004), but other factors influencing the induction and recovery times of salamanders may include the time since last feeding, age, sex, and reproductive status.

It was our goal to provide information for practical and efficient use of MS-222. Researchers should choose the most appropriate concentration for their needs of handling or operating upon salamanders. At 1000 and 2000 mg/L induction times for all species were 6 minutes or less, making recovery time the most important consideration when selecting a concentration in which to anesthetize salamanders. If longer recovery times are required, animals can be left in MS-222 solutions for an extended period of time beyond the time of last response with no fatal effects (Robinson and Scadding 1983; pers. obs.), although this has not been explicitly tested. Higher concentrations of MS-222 may cause some physiological stress (Robinson and Scadding 1983) and should be avoided if possible.

Although all of these salamander species share similar life history characteristics and three are congeners, extensive variation was present. Preliminary testing of species' responses to MS-222 is recommended. For more control over the pH of a solution, we also recommend following buffering procedures described by Lowe (2004) or Robinson and Scadding (1983). Further, for extended anesthetization, intraceolomic injection may be preferred (Letcher 1992).

Acknowledgments.—All procedures were approved by the University of Missouri Animal Care and Use Committee (protocol #3951). Salamanders were collected under USFS permit number HIG 6493. We thank Highlands Biological Station for laboratory facilities, and Tim Altnether and John Crawford for assistance in collection of salamanders. Valued comments were provided by John Crawford, Andrew Cox, Thomas Pauley, Jason Lowe, and Deanna Olson.

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Feasibility of Using Plastron Markings in Young Wood Turtles (*Glyptemys insculpta*) as a Technique for Identifying Individuals

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Being able to recognize individual animals is important in studies of behavior, movements, social structure, population and density estimates, growth rates, as well as survival and mortality estimates. According to Godley et al. (1999) these parameters are essential for the conservation and management of threatened or endangered species.

Traditionally, shell notching has been the main method of marking turtles for identification of individuals (Cagle 1939). In recent years, use of PIT (Passive Integrated Transponder) tags has gained popularity (Godley et al. 1999). While use of PIT tags is non-mutilating, it is still invasive and tags can be too large to implant in hatchlings (Buhlmann and Tuberville 1998) or small juveniles. Similarly, notching an adult turtle's carapace can be relatively quick and easy, but notching hatchlings and juveniles is more difficult and can cause serious shell fractures (Cagle 1939).

The use of natural markings as a means to identify individuals is growing, especially where the animal being studied is secretive (Karanth 1995; Karanth and Nichols 1998), where tag loss is reportedly high (McDonald and Dutton 1996) or where traditional methods of capture to obtain information are not feasible due to threat of harm to the animal (Bretagnolle et al. 1994; Stevick et al. 2001). Some studies of turtle populations have used photocopies or digital photographs of turtle plastron markings as a means of identifying individuals (Janzen et al. 2000a; Janzen et al. 2000b; Kolbe and Janzen 2001).

In order for natural markings to be of value to long-term population studies, it is crucial that they are stable over time and change very little throughout an animal's life (Vincent et al. 2001); the probability of correctly identifying an individual decreases if the pattern changes over time. Hatchling Wood Turtles (*Glyptemys insculpta)* do not hatch with their characteristic black plastron patterns. Instead, the plastrons of newly hatched Wood Turtles are a tawny brown with darker brown flecking. The purpose of this study was to determine if the plastral markings of Wood Turtles change as hatchlings mature and to evaluate the use of digital photographs of plastron markings as a non-mutilating, non-invasive technique for the identification of individuals.

This study was carried out from February 2004 to February 2005 with a group of 24 captive Wood Turtles that hatched in the late summer of 2003. These turtles are part of a head-starting program run by the Ontario Ministry of Natural Resources and the Kawartha Turtle Trauma Centre, in Peterborough, Ontario. Hatchlings were housed in large Rubbermaid containers and separated out according to clutch; clutches were not mixed. In total, there were five separate tanks, one with three turtles (W4), one with eight turtles (W1), one with five turtles (W3b) and two with four turtles each (W2, W3a).

In order to track mortality, weight gain and growth of the hatchlings, volunteers caring for the Wood Turtles had to be able to recognize the individual turtles. Initially, a non-toxic, formaldehyde-free nail polish was painted on the turtles' marginal scutes in individual patterns according to Cagle (1939). Starting in February 2004, digital photographs were taken of each turtle's plastron and a photograph was also taken of the carapace if the turtle had any noteworthy abnormalities. Digital photographs were used primarily for identifying individuals (with the nail polish markings becoming the back-up to the photographs) until the volunteers began to notice that the plastron markings were changing, making identification by the photographs alone more difficult. Photographs of plastron patterns were updated in April, August, and November 2004, with the final set being taken in February 2005. Photographs were used as back up for the nail polish markings as well as to determine the extent to which the patterns changed over time. All photographs were edited in Adobe Photoshop CS to make them the same size, and contrast levels were adjusted; no other alterations of the photographs or the plastron markings were made (Fig. 1).

In order to determine if the plastron patterns changed over time as the turtles grew, 10 volunteers were shown a catalogue of photographs of the turtles and then asked to find the match for a picture taken at a later time. Pictures of 10 turtles were chosen at random from 24 possibilities and these were the ones used for this part of the study. The catalogue represented turtles that had been photographed at a previous time and the pictures of the turtles given to the volunteer were more recent shots of the catalogued turtles. All ten of the 'baby photographs' were laid out in front of the volunteers; they were then given one photo at a time of the pictures that were taken at a later date to match to the earlier photograph. This was repeated until each volunteer had attempted to match all ten turtles to their 'baby' pictures. Volunteers were provided with a best case scenario: the turtles they were given were included in the catalogue of the ten pictures. Volunteers were not timed, to avoid adding pressure. Volunteers were not told if they had chosen correctly or incorrectly to avoid matches being made by a process of elimination.

The first trial involved photographs taken in February 2004, when the turtles were 6 months old, and photographs taken in February 2005, when they were 18 months old. The second trial was conducted in the same manner as the first trial, but used the photographs taken at 12 months of age to compare to those taken at 18 months.

In the first trial the rate of success for correctly matching a picture of the plastron pattern of a test Wood Turtle to the same turtle taken a year earlier was only 29%. There were three instances in the first trial where the volunteers were unable to pick any of the pictures in the catalogue as the one they had in their hand. For the second trial when the catalogue turtles were a year old and the test photos were of 18 month old individuals, the rate of success for correctly matching the turtles was increased to 67%. Volunteer experience ranged from no experience with turtles to being experienced with handling turtles on a regular basis. Seven volunteers mismatched siblings from clutch W4 in at least one of the two trials.

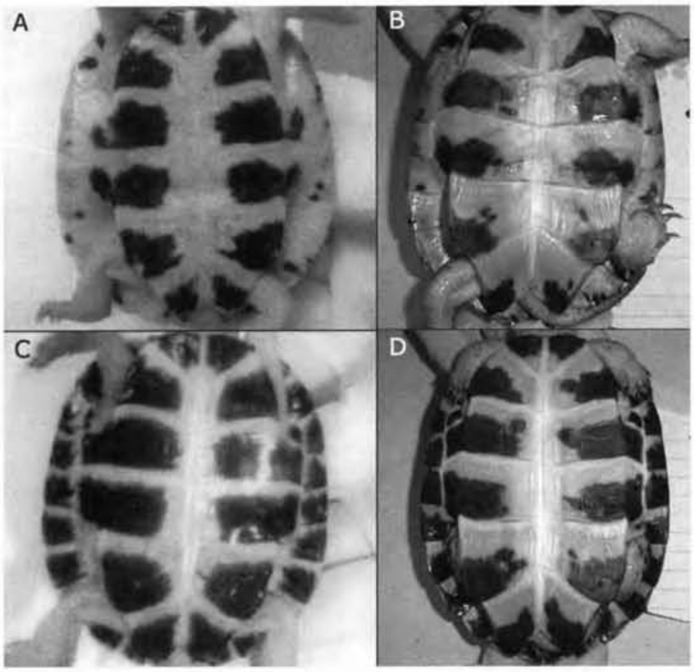

FIG. 1. Digital photographs of the plastrons of juvenile *Glyptemys insculpta*. a) Turtle W1.6 in February 2004 and b) in February 2005. c) Turtle W3.2a in February 2004 and d) in February 2005.

The stability of natural markings over time is essential if they are going to be used for long-term population studies (Vincent et al. 2001); the probability of correctly identifying an individual decreases if the pattern changes over time. Many naturally distinctive markings remain relatively unchanged over an animal's life and prove to be a reliable source of identification. McDonald and Dutton (1996) photographed the pineal (pink) spots of nesting leatherback marine turtles (*Dermochelys coriacea*) to develop life history profiles and size estimates of nesting populations. They discovered that for leatherbacks, photo-identification was a more reliable means of recognizing individuals than was the use of flipper tags. A high success rate with using natural markings has also been found for spotted salamanders (Loafman 1991), tigers, manatees, and many other animals (Karanth and Nichols 1998; Langtimm et al. 1998).

This study looked at the stability of plastron markings in the endangered Wood Turtle (*G. insculpta*) and evaluated the feasibility of using the plastron markings as a means of identifying very young individuals as an alternative to notching or toe clipping. The volunteers matching the plastron patterns on pictures that were taken a year apart had a great deal of difficulty in doing so; the average percentage of correct matches in the first trial was 29%. Volunteers frequently commented on how difficult it was to match pictures taken in February 2005 to those taken in February 2004. A frequent error made during matching was the mistaking of clutch mates for one another as it was found that they often resembled each other in patterning. In the second trial, volunteers still commented on how difficult it was to match the correct picture to one taken 6 months previously, despite a doubling in the rate of successful matches. The rate of success for correctly matching a test turtle from February 2005 to catalogued pictures that were taken in August of 2004 was 67%. The higher success rate in the second trial suggests that markings become more stable as Wood Turtles mature. For other species, including the Box Turtle, the plastron markings appear to become set for life once a turtle reaches subadult size (C. Swarth, pers. comm.).

The purpose of this study was to determine if the plastron patterns of Wood Turtles changed as hatchlings grew and to determine if the plastron markings could be used as a means to identify individual hatchlings over time. The appeal of this technique is that it is less invasive and mutilating than either filing or cutting notches into the marginal scutes or toe clipping. Unfortunately, it does not appear as though the use of plastron markings will be a useful stand-alone technique in the field for identifying individual hatchlings over time; the markings are too unstable and change too much while the turtles are growing.

Acknowledgments.—We thank all the volunteers who helped take the pictures and those who took the time to match plastron photos: Tara De Blois, Steve Sharpe, Regina Varrin, Toby Wells, Malcolm Shepard, Kearsley Schieder-Wethy, Dawn Fidler, Lauren Hughes, and Anne Kidd. We thank all the researchers, zoologists, and herpetologists who took the time to answer our emails and share their findings (published and unpublished) and especially to the volunteers at the Kawartha Turtle Trauma Centre. Thanks also to Erica Nol for comments on the manuscript. Care of the turtles was covered by Ontario Ministry of Natural Resources Authorization to Keep Specially Protected and Game Wildlife in Captivity permit #1026097.

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A Note on Effective Basking Trap Size

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Basking traps are an effective means of capturing many species of turtles and commonly used in field research (Gibbons 1990; Lindeman 2000; McKenna 2001). However, there is little published information about the relative efficacy of different basking trap sizes. Practical considerations of costs, handling and storage favor smaller traps but we suspected that larger traps were more effective in capturing turtles. Thus we modified a basking trap design that was developed by McKenna (2001), to include both large and small versions for tests in a field study.

All traps were made of a floating, square frame with a mesh basket suspended underneath the frame. Small traps were constructed of 5.1 cm diameter polyvinyl chloride (PVC) pipe, joined with PVC elbows to form a 0.71×0.71 m floating frame. Large traps were constructed of 10.2 cm diameter PVC pipe, joined with PVC elbows to form a 0.93×0.93 m floating frame. Frames pipes were packed with buoyant, closed-cell plastic foam. Baskets had depths ≥ 18 cm and were made of plastic, garden mesh fencing (5.08×5.08 cm) attached to the floating frames with plastic cable-ties. Ramps were constructed from plastic (polyethylene) landscaping lattice, cut into rectangles of the same width and approximately half the length of the traps, and attached on two, opposite sides of the floating frames with cable ties. Ramps extended from the top of the frames into the surrounding water on the outside of each trap. Turtles climb up the ramps to bask and are trapped when they fall or jump inside the floating frame.

We conducted our field test of trap size in the Ottawa National Wildlife Refuge, Ottawa County, Ohio, USA (41°37'N, 83°12'W). The refuge consists of diked marshes separated by deeper channels used to control water levels. Ten traps of each size were set in both marshes and channels, and checked about every third weekday between April 26 and July 21, for an average total of 44 trapping days per trap. A total of 191 turtles were captured (*Chrysemys picta*: 97 female adults, 38 male adults, 2 juveniles; *Graptemys geographica*: 32 female adults, 15 male adults, 5 juveniles; *Trachymus scripta elegans*: 2 males), including 51 recaptures (*C. picta*: 25 female adults and 6 male adults; *G. geographica*: 7 female adults, 11 male adults, and 1 juvenile; *T. s. elegans*: 1 male).

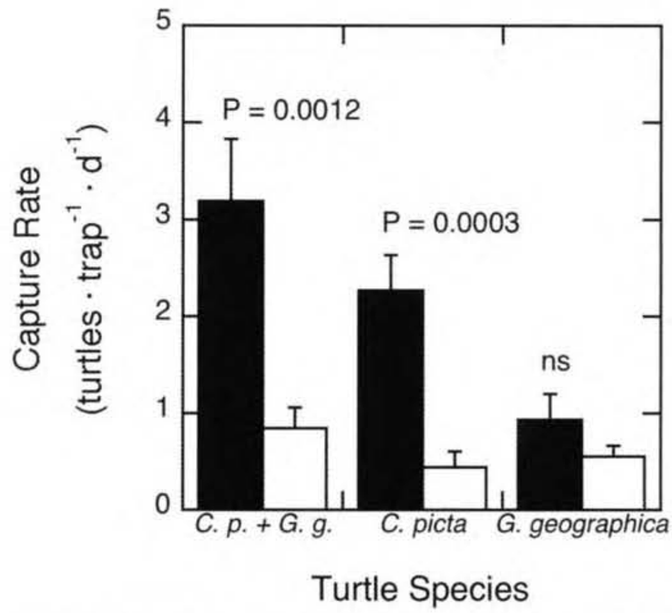

FIG. 1. Trap success for large (black bars) and small (white bars) traps evaluated with Wilcoxon Sign Rank tests for *Chrysemys picta*, *Graptemys geographica*, and both species combined. Error bars represent one standard deviation.

We estimated trapping success as the number of turtles captured per trap per day (turtles • trap^{-1} • day^{-1}) to correct for variations in trapping periods for individual traps, due to occasional drift or wind damage. A Wilcoxon Sign-Rank test used this measure of daily trap success as the dependent variable for comparing mean capture rates for the two trap sizes (SAS version 8.0). Large-framed traps caught significantly more turtles than small-framed traps (Fig. 1) for *C. picta* ($P = 0.003$), and for both species combined ($P = 0.012$), but not for *G. geographica*. Hence, the convenience and monetary savings of small traps is offset by a reduction in their apparent capture effectiveness for at least some species.

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The Relative Efficiency of Basking and Hoop Traps for Painted Turtles (*Chrysemys picta*)

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Trap efficiency, the rate at which a trap catches animals (Novak 1987), is an important factor when gathering quantitative data such as relative abundance. Different techniques may catch individuals at different rates making comparisons across studies difficult or impossible (Heyer et al. 1994). Different trap types may also capture classes of individuals at different rates and lead to an over or under representation of animals of a specific age, size or gender (Frazer et al. 1990; Koper and Brooks 1998; Ream and Ream 1966). Increasing trap efficiency is an important way to increase the precision of population size estimates from mark-recapture data. The precision of population size estimates is increased as a higher proportion of the population is captured and marked (Seber 1982) which will be achieved more readily using a maximally efficient trapping method. Efficient trapping is also important to researchers trying to maximize return for their effort in terms of time and money (Morton et al. 1988).

Several methods exist for trapping aquatic turtles but there have been few studies comparing the relative efficiency and practicality of different trap types. The two trap styles commonly used to capture aquatic turtles are basking traps and hoop traps. Basking traps, as the name suggests, take advantage of the basking behavior of turtles. There are several basking trap designs and most consist of a basking platform with a net or wire basket attached underneath. Turtles are captured in the net after leaving the platform. Hoop traps consist of a cylindrical frame covered in mesh; turtles, attracted by bait, enter the trap through a submerged, funnel-shaped opening. Lagler (1943) claimed that hoop traps were "the most efficient and practical kind of trap for turtles" although he offered no evidence for this claim. Basking traps have been shown to be more effective than hoop traps in capturing Map Turtles (*Graptemys geographica*) and Painted Turtles (*Chrysemys picta*) although both studies examined only single populations (Browne and Hecnar 2005; McKenna 2001). In this paper, I present a comparison of the relative efficiency of basking and hoop traps for catching Painted Turtles in 10 central Minnesota lakes over a two-year period.

Basking traps used for this study were modeled after traps used by local commercial turtle harvesters (Fig. 1). Traps consisted of a wood frame, 60 × 60 cm at the base, with a net basket underneath. Strips of styrofoam were attached to the bottom of the wood frame for buoyancy. The net basket, attached to the wood frame, was ca. 90 cm deep, 122 cm in circumference, and had 3.8 cm square mesh (Memphis Net and Twine, Tennessee, USA). The sides of the trap were sloped inward to facilitate entry and prevent escape. A cross board was attached to the top of the trap to provide additional basking area and to increase the probability of turtles entering the trap. Hoop traps, made by Memphis Net and Twine, contained a single opening and were 72 cm in diameter with 3.8 cm square mesh. Canned sardines packed in soybean oil were used as bait.

I trapped *C. picta* in 10 central Minnesota lakes that ranged in size from 6 to 64 ha. Trapping was conducted from 26 June to 31 August 2001 and 13 May to 30 August 2002. Basking traps and hoop traps were set simultaneously on each lake for 1–5 days at a time. Traps were typically checked and emptied every day (N = 95 days, range = 17–48 h/trap set, median = 24 h). Each lake was sampled at least seven times during the study (Table 1). Traps were set where turtles were observed to be most abundant which was near the shoreline, adjacent to cattails and other emergent

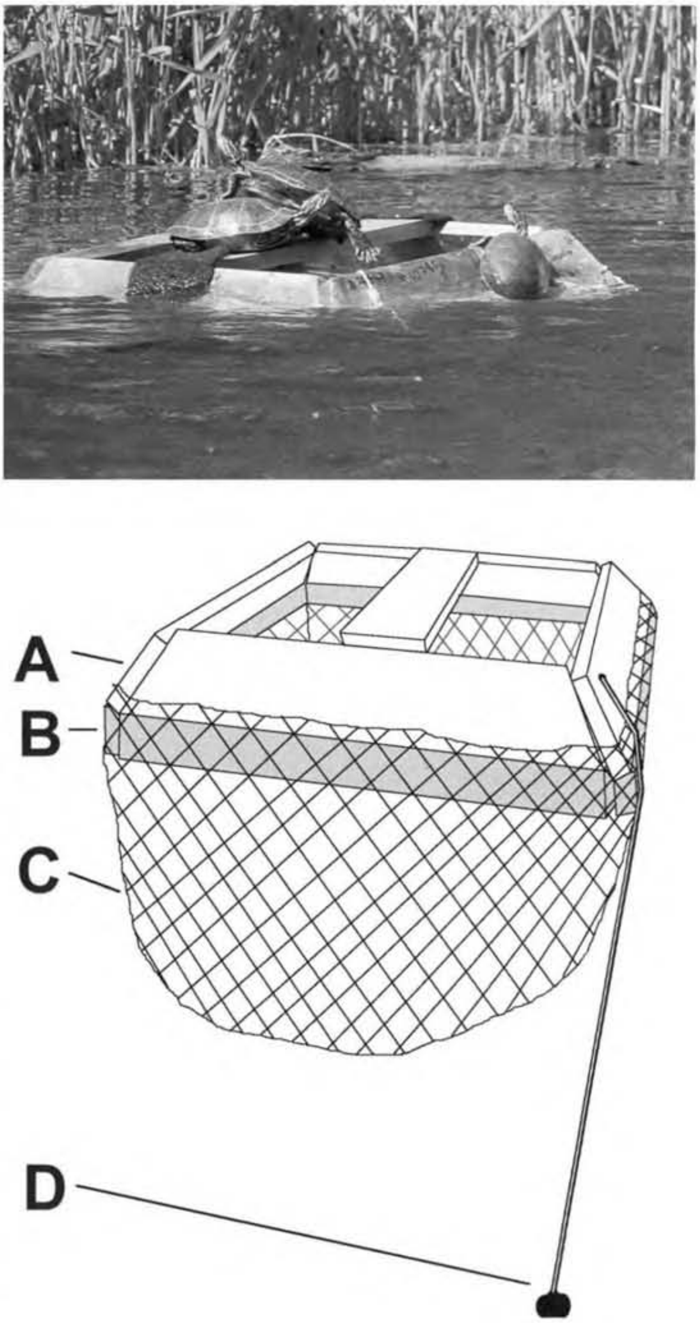

FIG. 1. Top: Painted Turtles (*Chrysemys picta*) on a basking trap in central Minnesota. Bottom: Basking trap design used in this study. A - wood frame; B - foam floats; C - net basket; D - anchor.

TABLE 1. Data summary comparing the mean catch-per-unit-effort (CPUE) of Painted Turtles (*Chrysemys picta*) captured in each lake for hoop and basking traps. Effort is measured in trap-hours. The number of traps is shown as the mean and the minimum and maximum number of traps used to sample each lake.

		Hoop Traps					Basking Traps				
Lake	# of samples	# of traps mean (min, max)	Total effort	Males/ trap-hr	Females/ trap-hr	Juveniles/ trap-hr	# of traps mean (min, max)	Total effort	Males/ trap-hr	Females/ trap-hr	Juveniles/ trap-hr
Bjorkland	8	4, (4,4)	870	0.0081	0.0000	0.0000	6, (4,10)	1370	0.0482	0.0216	0.0133
Gemini East	9	2.4, (0,5)	415	0.0037	0.0037	0.0000	5.9, (4,10)	1222	0.0158	0.0132	0.0155
Gemini West	9	2.8, (1,5)	748	0.0204	0.0139	0.0000	5.8, (3,9)	1518	0.0226	0.0149	0.0017
Half Moon	9	4.6, (3,7)	967	0.0335	0.0112	0.0000	8.8, (5,13)	1796	0.0188	0.0076	0.0052
Henschien	7	5, (4,6)	777	0.0195	0.0061	0.0000	12.3, (10, 15)	1927	0.0320	0.0076	0.0131
Lake 21	7	6, (5,9)	952	0.0065	0.0021	0.0009	11, (9,14)	1786	0.0593	0.0294	0.0230
Maria	17	7.3, (2,11)	3013	0.0417	0.0116	0.0005	15.5, (8,25)	6521	0.0944	0.0442	0.0186
Sagatagan	9	5.2, (4,7)	1175	0.0161	0.0074	0.0000	9, (4,16)	2139	0.0193	0.0083	0.0006
Spurzem	12	4.8, (2,9)	1560	0.0280	0.0051	0.0004	13.5, (6,24)	4188	0.0188	0.0050	0.0066
Stump	8	4.4, (2,6)	936	0.0101	0.0027	0.0005	10.1, (4,16)	2089	0.0211	0.0102	0.0070

vegetation, in May and June, and out from shore near floating mats of vegetation in July and August. Traps were also set near sites where *C. picta* were observed basking. Trap efficiency was quantified as catch-per-unit-effort (CPUE) with effort measured as trap-hours, the number of traps on a lake multiplied by the number of hours set. CPUE was calculated for both trap styles for every sample.

I recorded trap style, sex, and straight-line carapace length for every turtle captured. Front claw length and position of the cloaca relative to the rear edge of the carapace was used to classify each turtle as male or female. Juveniles were animals with no discernable secondary sex characteristics and a carapace length less than 10 cm (Ernst and Ernst 1973).

Two statistical analyses were conducted to determine whether catch differences between basking traps and hoop traps were significantly different. The first analysis tested the difference of mean CPUE for basking traps and hoop traps for every sample using a nonparametric Wilcoxon rank sum test for independent groups. A nonparametric test was used because mean CPUE was not normally distributed. The nonparametric analysis compared the relationship between the number of turtles captured and trap style, but it did not take into account the numerous environmental, seasonal, and gender-based factors that are thought to influence trapping success in painted turtles. The second statistical analysis, therefore, included several independent variables in a multiple linear regression model. Effort was analyzed as an independent variable because CPUE data were not normally distributed even after transformation. Independently examining variables that make up a ratio is one way to overcome normality problems (Sokal and Rohlf 1995). Catch data, the number of turtles captured in each sample, were transformed ($\ln[n+1]$) to better fit a normal distribution. Normal quantile plots were inspected *a posteriori* to verify that residuals were normally distributed. The following linear regression model was used to analyze catch data: catch = trap style + lake + month + effort + sex + residual. Trap style was a categorical variable that identified traps as a floating basking trap or submerged hoop trap; lake was a categorical variable that accounted for the numerous individual differences of each lake such as area, productivity, and suitable nesting habitat; month was a categorical variable that accounted for seasonal differences in trappability; effort was measured as trap-hours, the number of traps multiplied by the number of hours they were set; and sex categorized turtles as males, females, and juveniles.

Possible seasonal and gender biases of the two trap types were also explored. I used a series of Chi-square goodness of fit tests to determine if male: female sex ratios differed significantly from 1:1 for each month for both trap types for each lake. The 1:1 sex ratio was chosen as an arbitrary reference point and was not meant to imply a 1:1 sex ratio actually exists in the populations under study. Statistical analyses were conducted using JMP IN Version 4.0.4 (Sall et al. 2001).

I marked 1690 *C. picta* and subsequently recaptured 426 *C. picta* (total captures = 2116). I captured 238 males, 72 females, and 5 juveniles in hoop traps (total = 315) and 1081 males, 464 females, and 256 juveniles in basking traps (total = 1801). Basking traps had a significantly higher CPUE than hoop traps ($\chi^2 = 79.3626$, df = 1, $P < 0.0001$) with a mean CPUE of 0.068 turtles per trap-hour in basking traps compared to 0.029 turtles per trap-hour in hoop

TABLE 2. Significance tests of the multiple linear regression comparing the number of Painted Turtles (*Chrysemys picta*) captured to individual lake effects (lake), seasonal effects (month), effort measured as trap hours (TH), trap style (either basking traps or hoop trap), and sex (male, female, or juvenile).

Source	*df*	Sum of Squares	F	*P*
Lake	9	42.596	9.24	< 0.0001
Month	3	2.654	1.73	0.1603
Effort (TH)	1	5.860	11.44	0.0008
Trap Style	1	49.298	96.24	< 0.0001
Sex	2	65.785	64.22	< 0.0001

TABLE 3. Results of the chi-square goodness of fit tests that examined whether Painted Turtle (*Chrysemys picta*) male: female sex ratios differed significantly from 1:1 for each month and lake for both basking traps and hoop traps. An asterisk notes samples that differed significantly from 1:1.

		Hoop Traps				Basking Traps			
Lake	Month	Males	Females	χ^2	*P*	Males	Females	χ^2	*P*
Maria	May	41	12	15.87	0.0001*	383	143	109.51	0.0001*
Spurzem	May	1	0	1.00	0.3173	15	2	9.94	0.0016*
Gemini East	June	0	0	N/A	N/A	12	6	2.00	0.1573
Gemini West	June	2	2	0	1	2	2	0	1
Henschien	June	1	0	1.00	0.3173	18	9	3.00	0.0833
Lake 21	June	1	1	0	1	7	11	0.89	0.3458
Sagatagan	June	6	6	0	1	6	8	0.29	0.593
Spurzem	June	3	1	1.00	0.3173	16	1	13.24	0.0003*
Stump	June	0	0	N/A	N/A	24	13	3.27	0.0705*
Bjorkland	July	3	0	3.00	0.0833	25	9	7.53	0.0061*
Gemini East	July	1	1	0	1	2	1	0.33	0.5637
Gemini West	July	0	0	N/A	N/A	2	0	2.00	0.1573
Half Moon	July	1	0	1.00	0.3173	3	2	0.20	0.6547
Henschien	July	0	0	N/A	N/A	14	5	4.26	0.0389*
Lake 21	July	2	1	0.33	0.5637	33	15	6.75	0.0094*
Maria	July	23	10	5.12	0.0236*	88	44	14.67	0.0001*
Sagatagan	July	7	3	1.60	0.2059	0	1	1.00	0.3173
Spurzem	July	9	2	4.45	0.0348*	16	10	1.38	0.2393
Stump	July	1	0	1.00	0.3173	3	1	1.00	0.3173
Bjorkland	August	1	0	3.00	0.0833	24	14	2.63	0.1048
Gemini East	August	1	1	0	1	6	8	0.29	0.593
Gemini West	August	0	0	N/A	N/A	18	14	0.50	0.4795
Half Moon	August	20	7	6.26	0.0124*	27	9	9.00	0.0027*
Henschien	August	12	4	4.00	0.0455*	30	1	27.13	0.0001*
Lake 21	August	3	0	3.00	0.0833	84	31	24.43	0.0001*
Maria	August	33	9	13.71	0.0002*	150	84	18.62	0.0001*
Sagatagan	August	9	1	6.40	0.0114*	40	9	19.61	0.0001*
Spurzem	August	24	3	16.33	0.0001*	20	7	6.26	0.0124*
Stump	August	13	3	6.25	0.0124*	15	6	3.86	0.0495*

traps. Basking traps caught more turtles per trap-hour in each age and sex class than hoop traps in most lakes (Table 1). The multiple linear regression analysis found the number of turtles captured was significantly correlated to trap effort, individual lake, turtle gender and age, and trap style, and the number of turtles captured was not correlated with the seasonal variable, month (Table 2).

Both trap types caught more males than females and basking traps caught substantially more juvenile *C. picta* than hoop traps. Male: female sex ratios differed significantly from 1:1 for both trap types consistently in several lakes, particularly Lake Maria (Table 3). Male: female sex ratios also differed from 1:1 in most populations during August. Because not all populations were sampled every month it was not possible to statistically compare seasonal differences in sex ratio across all lakes.

The basking trap design presented in this paper was substantially more efficient than hoop traps for catching *C. picta*, particularly juveniles. Basking traps captured twice as many turtles as hoop traps. The results presented here agree with other comparisons between basking traps and hoop traps in basking turtles (Browne and Hecnar 2005; McKenna 2001). The applicability of these results across the range of *C. picta* is unknown because sampling by either hoop trap or basking trap depends on the behavior of turtles, and geographic variation in behavior is common (Foster and Endler 1999). With this in mind, researchers wanting to maximize the return for their effort, particularly for mark-recapture studies, should consider the use of basking traps for capturing *C. picta*.

Four of the five variables examined in the multiple linear regression contributed to overall trap efficiency. The first variable was effort. Simply increasing the amount of time or the number of traps used increased the number of turtles captured. The second variable contributing to trap efficiency was differences between lakes. Environmental factors such as lake size, productivity, the availability of nesting areas, and proximity to roads can influence

the relative abundance of turtles in the sampled population which should be related to hoop trap and basking trap efficiency (Cagle and Cheney 1950; Seber 1982). Operating under the assumption that the number of turtles caught was proportional to the effort used to catch them (Seber 1982), traps should be more efficient in lakes with abundant turtle populations. Bury (1979) and Zweifel (1989) noted large differences in population density between different *C. picta* populations with some populations having an order of magnitude more turtles per unit area than other populations. The CPUE of both hoop traps and basking traps differed significantly between lakes and was consistent with expected variation related to differences in the relative abundance of *C. picta* in different populations.

The third variable contributing to trap efficiency was sex. Significantly more males than females were captured in both trap types. The high capture rates of males implied: 1) the populations were male biased; 2) both trap types were male biased; or 3) a combination of a male biased population and trap bias. The consistent male capture bias in Lake Maria for both trap styles in every month suggests an actual male bias in that population. Several authors have suggested that hoop traps were male biased because of the attraction of males to captured females (Cagle and Cheney 1950; Frazer et al. 1990; Ream and Ream 1966, Vogt 1979). Because the ratio of males: females was roughly the same between trap styles basking traps were no more or less biased toward capturing males than hoop traps. Basking traps captured a larger proportion of juveniles than hoop traps suggesting that juveniles were either not as attracted to the bait as adults or that juveniles could more easily escape from hoop traps. It is also possible that juveniles were over-represented in basking traps. Because of their size, juveniles gain and lose heat more quickly than adult turtles (Lefevre and Brooks 1995) and may need to bask more frequently, resulting in more frequent captures in basking traps.

The fourth variable contributing to trap efficiency was the trap style. I observed both *C. picta* and *Chelydra serpentina* escaping from set hoop traps during this study, an occurrence also reported by Frazer et al. (1990). The decreased efficiency of hoop traps may have been related to the inability to retain captured turtles and not to differences in the attraction to the traps although these factors could not be separated here.

Hoop trap and basking trap efficiency are affected by the trap's ability to attract turtles (Novak 1987). Turtles can be attracted to traps for several reasons such as the need to bask on basking traps (Plummer 1979) and the bait in hoop traps (Cagle and Cheney 1950). My results may have been influenced by the choice of bait used, as some baits may be more effective at attracting *C. picta* than others (Jensen 1998), although Ernst (1965) found canned sardines, the bait used in this study, to be the most effective for trapping painted turtles. Male turtles may also be attracted to traps containing females and trap efficiency should increase for male turtles during periods of mate-searching activity (Cagle and Cheney 1950; Frazer et al. 1990; Thomas et al. 1999, Vogt 1979). The increased male capture bias during August was likely a result of mate searching behavior as copulation in *C. picta* most often occurs in the fall (Gist et al. 1990).

The ability to detect differences in basking trap efficiency, based on the seasonal and reproductive energy requirements of *C. picta*, was not confirmed here. Basking trap efficiency should increase as the need to bask increases. The primary purpose of basking is thermoregulation (Boyer 1965) and turtles bask more or less based on seasonal and reproductive energy requirements (Krawchuk and Brooks 1998; Lefevre and Brooks 1995; Ream and Ream 1966; Thomas et al. 1999). Egg development and nesting in females and mate-searching and spermatogenesis in males are energetically demanding and correlated with increased basking (Krawchuk and Brooks 1998; Thomas et al. 1999). Detecting differences in male basking behavior due to differing energy requirements was confounded by the possibility of male turtles being attracted to females already in the traps. Furthermore, monthly differences in the CPUE of male turtles were observed in both trap types and could have been related to mate-searching behavior. Additional work with a different experimental design would be needed to tease apart the influence of these behaviors on trap efficiency.

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Noninvasive Sampling Methods for Genotyping Amphibians: New Application for Conservation Genetics

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Amphibian species and populations are declining all over the world (Houlahan et al. 2000; Stuart et al. 2004). Hence, conservation of biodiversity is a globally crucial topic. Genetic characters are essential in order to promote conservation of biodiversity, because they contain much information about populations and species, such as intrinsic variability, population structure, historical patterns of gene flow, and phylogenetic relationships (Avise 2000). By using such information, we can define conservation units for each animal, and monitor genetic diversity.

As a genetic method, protein electrophoresis has been widely used in animals. This method requires fresh materials such as blood or other tissues (e.g., muscle, liver). DNA methods also have become popular since the polymerase chain reaction (PCR) was introduced in the late 1980s (Mullis and Faloona 1987; Saiki et al. 1985). PCR-based genotyping methods have highly progressed, and enable us to use a variety of materials including a small number of cells. These materials include hair, feces, urine, and buccal cells in mammals, feathers and eggshells in birds, and scales and fins in fishes (reviewed by Morin and Woodruff 1996).

In amphibians, both protein and DNA analyses have generally used materials obtained by sacrificing individuals. Therefore, sampling might have a serious impact on declining populations and species. Consequently, it is essential to establish sampling methods that avoid irreversible damage or viability reduction. Conservation genetic surveys should not contribute to the problem they seek to alleviate.

There are several studies that describe sampling methods without physical damage (Davis et al. 2002; Pidancier et al. 2003). Davis et al. (2002) used epidermis as DNA source material. Pidancier et al. (2003) used oral mucosa. In addition to these two materials, we employed molted skin and feces, and investigated four points: 1) collecting cells from oral mucosa, epidermis, molted skin, and fecal samples; 2) extracting DNA from each sample; 3) risk of contamination; 4) practicality of these methods. Materials were collected from Urodela and Anura in previous studies and Gymnophiona in the present study to include three orders of amphibians.

METHODS

Sampling.—Four families (Typhlonectidae, Hynobiidae, Salamandridae, and Rhacophoridae) belonging to three orders of amphibians were tested. Samples were collected from one individual each of the Cayenne Caecilian (*Typhlonectes compressicauda*), the Hokkaido (Yezo) Salamander (*Hynobius retardatus*) and the Japanese Fire-bellied Newt (*Cynops pyrrhogaster*), and three individuals of the Forest GreenTreefrog (*Rhacophorus arboreus*). The oral mucosa (buccal cells), and epidermis and molted skin (epidermal cells) in Gymnophiona and Caudata, and the oral mucosa (buccal cells), epidermis (epidermal cells), and feces (intestinal cells) in Anura were used as genetic source material. Each surface of mouth cavity, skin, and feces was scrubbed off with sterilized cotton swabs. In order to open the mouth for collecting buccal cells, we used a sterilized toothpick. Each sample was shaken off a cotton swab in 1.5 ml tubes filled with 0.6 ml of TNE buffer (10 mM Tris-HCl [pH 7.5], 100 mM NaCl, 1 mM EDTA-2Na [pH 8.0]). A section of molted skin cut with sterilized scissors was thoroughly washed with TNE buffer, and soaked in 1.5 ml tubes filled with 0.6 ml of TNE buffer. To confirm whether or not the DNA sequences obtained from each sample actually represented the target ones, a liver sample of the tested individual, removed in fully anesthetized condition with acetone chloroform, was sequenced.

Cell staining.—We ascertained the existence of cells scrubbed off from each animal by placing the cotton swab on a glass slide, dried in air, and fixed with May-Grunwald stain solution. They were washed with water, stained with Giemsa solution, and washed again with water. After drying, they were examined with a microscope.

Genotyping.—All samples preserved in TNE buffer were treated with 30 µl of 10% sodium dodecyl sulfate (pH 7.2), and digested with proteinase K (final concentration: 0.5 mg/ml) at 37°C for 15 hours. Proteins were removed with a standard phenol chloroform extraction, followed by ethanol precipitation (Sambrook et al. 1989), and DNA was resuspended in 100 µl of TE buffer (10 mM Tris-HCl [pH 7.5], 1 mM EDTA-2Na [pH 8.0]). The concentration of DNA in all extracts was measured using spectrophotometer.

PCRs were performed on a TaKaRa PCR Thermal Cycler 480, with 3 µl of DNA solution and 0.9 units of Expand High Fidelity PCR System enzyme mix (Roche Diagnostics GmbH) in the total 21.8 µl of a reaction mixture contained 2.5 µl of 10X Expand HF buffer with 15 mM $MgCl_2$ (Roche Diagnostics GmbH), 4 mM dNTPs, 25 pmoles of a mixture of a forward and reverse primer, 1

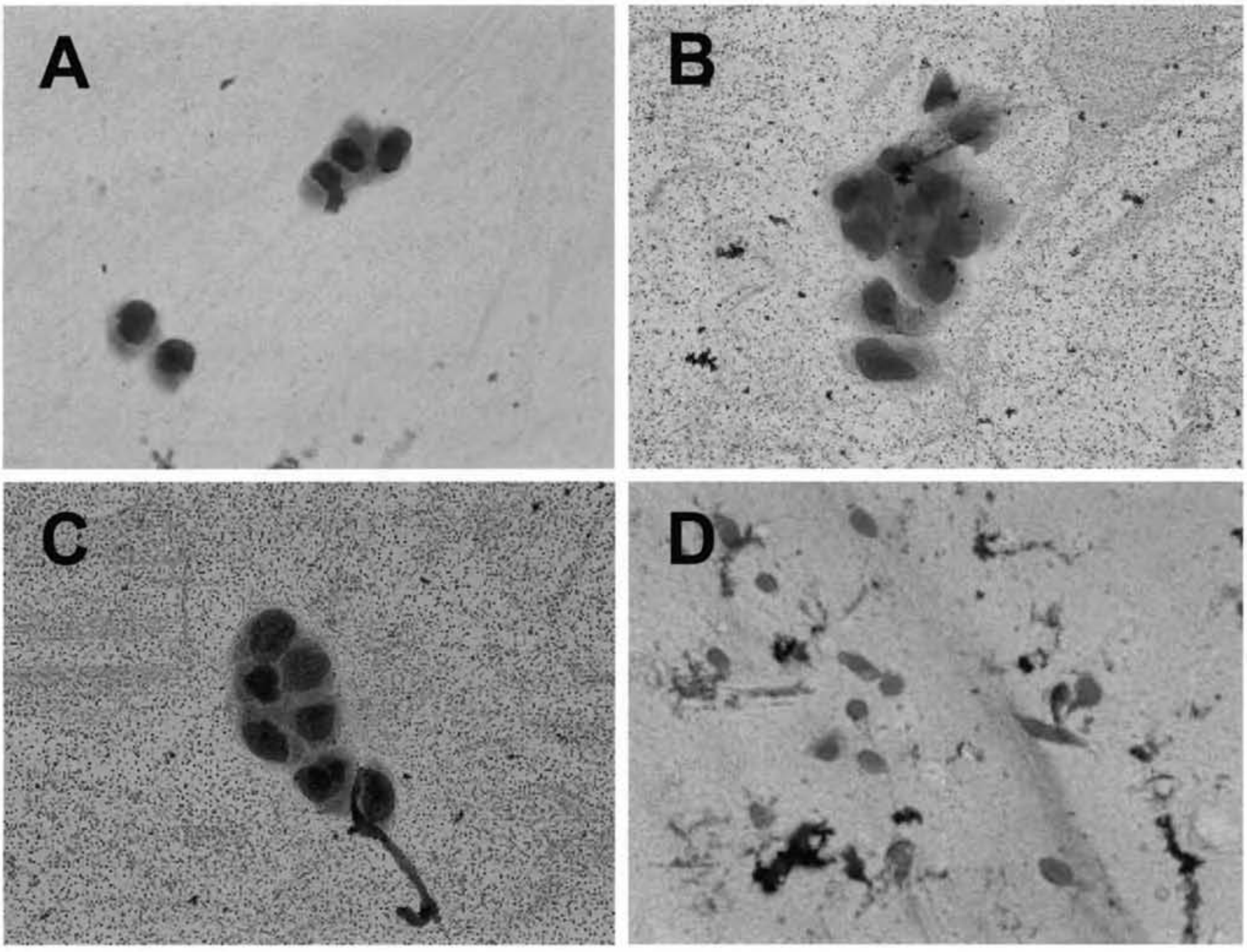

FIG. 1. Buccal cells stained by May-Grunwald Giemsa method: A) Cayenne Caecilian (*Typhlonectes compressicauda*); B) Hokkaido (Yezo) Salamander (*Hynobius retardatus*); C) Japanese Fire-bellied Newt (*Cynops pyrrhogaster*); D) Forest Green Treefrog (*Rhacophorus arboreus*). These cells were observed in all samples.

TABLE 1. Results of PCR in all samples: A) Cayenne Caecilian (*Typhlonectes compressicauda*); B) Hokkaido (Yezo) Salamander (*Hynobius retardatus*); C) Japanese Fire-bellied Newt (*Cynops pyrrhogaster*); D) Forest Green Treefrog (*Rhacophorus arboreus*). A successful PCR is indicated by "yes" and failure by "no." In a case of DNA from molted skin of the *C. pyrrhogaster*, PCRs succeeded by dilution of the quatity of DNA into one third (from 3 µl to 1 µl).

	oral mucosa	superficial skin	molted skin	feces
A	yes	yes	yes	—
B	yes	yes	yes	—
C	yes	yes	no	—
D	yes	yes	—	yes

µl of dimethylsulfoxide (DMSO). The primers used were L2606 (5'-CTGACCGTGCAAAGGTAGCGTAATCACT-3') and H3056 (5'-CTCCGGTCTGAACTCAGATCACGTAGG-3')(Hedges et al. 1993) for the 16S rRNA gene of mitochondrial DNA (mtDNA) for Gymnophiona and Urodela, and L14850 (5'-TATCTTCATTATGAAACTTTGGGTC-3') and H15548 (5'-AACAGAAAATATCATTCTGGCTTAAT-3') newly designed for mtDNA cytochrome *b* gene in Anura. The numbering system followed the human sequence (Anderson et al. 1981). A template-free sample was used as a negative control. The PCR profiles consisted of 10 min denaturation at 94°C, and then 35 cycles of 1 min denaturation at 94°C, 2 min annealing at 45°C, and 3 min extension at 72°C, and a final hold of 5 min extension at 72°C. The specific DNA fragments were separated by electrophoresis using 3% NuSieve GTG (BioWhittaker Molecular Applications) agarose gel. A gel containing specific DNA fragments was cut out. Double stranded DNA products for sequencing were purified from the gel by using EASYTRAP™ Ver.2 (TaKaRa).

Thermo Sequenase Cycle Sequencing Kit (USB Corporation) was used for sequencing reaction. Sequencing products were separated on a 5.5% Long Ranger (BioWhittaker Molecular Applications) gel by using a LI-COR 4200S-1 DNA sequencer, and their sequences were subsequently optimized by eye. Sequences were aligned and compared with GENETYX-WIN (ver.4, Software Development Co., Ltd. 1999).

RESULTS

The presence of cells in oral mucosa, epidermis, molted skin, and feces specimens was assessed by cell staining method. Buccal cells could always be observed sufficiently in all samples (Fig. 1), while numbers of cells from epidermis and feces were small.

The concentration of DNA in the molted skin samples from *Typhlonectes compressicauda* and *Cynops pyrrhogaster* showed 0.24 µg/µl and 0.12 µg/µl, respectively, but the others could not be measured. That is, they were under detectable limits. The presence of DNA extracted from each sample was ascertained by PCR. Firstly, PCR product was observed in all samples except a case of molted skin of the *C. pyrrhogaster* (Table 1). The DNA solution extracted from molted skin of the *C. pyrrhogaster* showed brown color instead of usually colorless DNA solutions. In this case, PCR product was observed by dilution of the quantity of DNA into one third: from 3 µl to 1 µl. On the other hand, DNA extracted from buccal cells of *Rhacophorus arboreus* was amplified in large quantities. The amplification was achieved even in a case where the quantity of DNA was diluted into 1/100 (Fig. 2). Finally, PCR products could be obtained from all samples except the negative controls.

All nucleotides between forward and reverse primers were sequenced in all samples. Base sequences were 431 base pairs (bp), 465bp, 454 bp of the 16S rRNA gene in *Typhlonectes compressicauda*, *Hynobius retardatus*, and *Cynops pyrrhogaster*, respectively, and 697 bp for the cytochrome *b* gene in *Rhacophorus arboreus*. Base sequence of different isolates from the same individual were consistent and identical to the sequence of DNA extracted from liver. No evidence of contamination among isolates was detected.

DISCUSSION

The previous genetic surveys in amphibians have employed protein analyses that have usually used materials like blood and tissues. Similarly, mitochondrial DNA analyses have used muscle and liver, even when coupled with PCR methods, and a few researchers used eggs and embryos (e.g., Yang et al. 1994). All of these methods require lethal sampling. Previous non-lethal sampling methods include tail-tip tissues in live newts (Arntzen and Wallis 1991), toe-tip tissues in live frogs (Gonser and Collura 1996), and tadpole tails (Zeisset et al. 2000).

Toe-clipping was introduced more than a half century ago (Bogert 1947), and has been commonly used to identify individu-

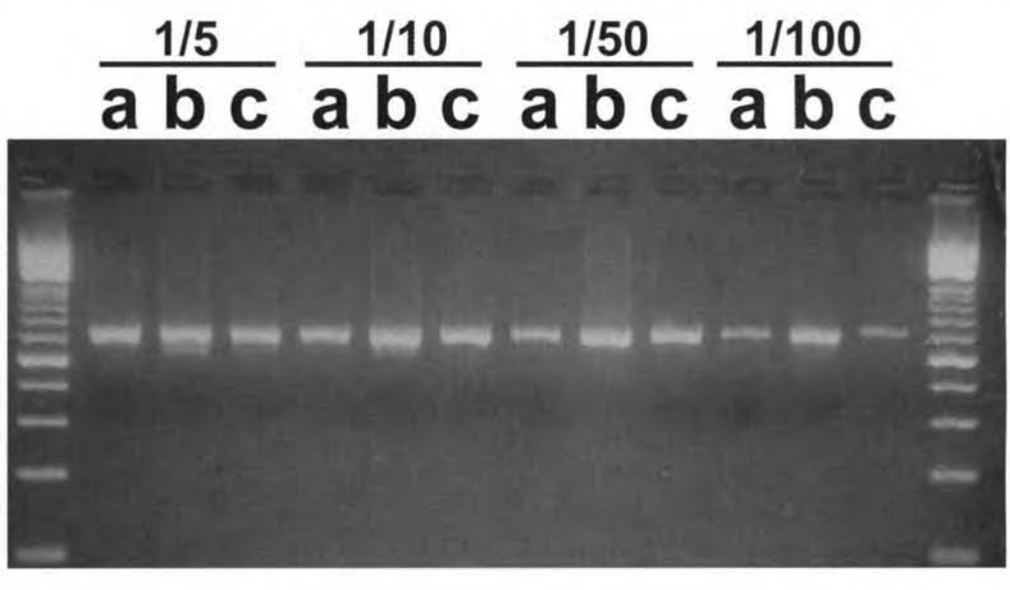

FIG. 2. Electrophenogram of PCRs using DNA extracted from buccal cells of three Forest Green Treefrogs (*Rhacophorus arboreus*). Small letters (a–c) denote individual frog samples. From left to right, dilutions of DNA were 1/5, 1/10, 1/50, and 1/100. The amplification was clearly confirmed even at 1/100.

als in the field (Donnelly et al. 1994). This is very convenient for individual recognition, and clipped toe-tip is available for age determination (e.g., Francillon-Vieillot et al. 1990) as well as genetic analysis. However, negative effects on survival have been shown in Anura (e.g., Clarke 1972; Golay and Durrer 1994). Further, Arntzen et al. (1999) demonstrated that the tail-clipping—as generally used for marking and to obtain material for molecular analyses in Caudata—affected growth in *Triturus cristatus*, although not survival. Recently, McCarthy and Parris (2004) indicated that the estimated decline in return rate of 4–11% for each toe clipped assumed that the adverse effects are independent of the total number of toes clipped. For these several reasons, amphibian biologists should use noninvasive methods to collect DNA resources.

In the present study, we tried several sampling methods that would minimize impacts to individuals. We collected the oral mucosa (buccal cells), epidermis and molted skin (epidermal cells), and feces (intestinal cells) from four families (Typhlonectidae, Hynobiidae, Salamandridae, and Rhacophoridae) representing three orders of amphibians. Many buccal cells were obtained especially from *Rhacophorus arboreus*. Theoretically, more than 3,000 PCRs are possible in this case. The body size (snout–vent length; SVL) of this frog is relatively large, 57 mm SVL on average in males and 72 mm SVL on average in females (Maeda and Matsui 1999). Hence, surface area sampled with a cotton swab was wide. Therefore, it is suggested that buccal cells can be obtained effectively from animals with a large body size and large mouth cavity. Although there is a difference in efficiency among species, these methods must be able to be widely applied to amphibians.

Epidermal sampling seems most convenient as Davis et al. (2002) reported. But as a practical matter, this method requires caution to prevent contamination by researcher because we catch animals by hand. It may be difficult to find either molted skin or feces except in captivity. Additionally, in cases where amphibians eat other amphibians, there is a possibility that the feces contain DNA from both. However, most of the cells ingested by animals are digested and destroyed. DNA in the cell is fragmented by deoxyribonuclease. That is, in feces, DNA from other amphibians has already been fragmented. On the other hand, cells on the "surface" of feces have been in quite recent contact with the intestinal wall, so that they contain DNA in better condition for PCR. In the field, these three sampling methods may not be practical in all cases. Buccal cells have few risks of contamination because researchers seldom directly touch the mouth cavity. However, when buccal cells are collected without anesthetizing the animal, it may be necessary to provide additional restraint to minimize risk of injury to the animal. Notably, we were able to collect buccal cells easily from *Salamandrella keyserlingii* anesthetized by MS-222 (Tanaka-Ueno, pers. obs.). Where the appropriate training is available, it may be better to anesthetize specimens in order to make sampling easy and improve animal welfare. Considering the quantity of DNA included in each sample, the risk of contamination, and practicability in the field, the best sampling method may be swabbing buccal cells from oral mucosa.

Buccal cell collection can minimize physical impact to animals and may enable us to acquire genetic information without reducing survivorship of endangered species. This noninvasive sampling method is convenient and reliable, and is therefore well suited not only for sensitive species but also animal welfare in general.

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A Device for Excluding Predators from Pitfall Traps

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Pitfall trapping is a common technique for sampling small vertebrates (Jenkins et al. 2003; Sutton et al. 1999). As with most live trapping methods, trapped animals might incur mortality through desiccation (Jenkins et al. 2003), drowning (Aubry and Stringer 2000), starvation (Yunger et al. 1992), exposure (Padget-Flohr and Jennings 2001), and increased predation risks (Dodd and Scott 1994). However, most studies rarely mention predation and typically only attempt to mitigate the other problems. Only anecdotal evidence of predation is mentioned and mainly deals with predation within the pitfalls (Jenkins et al. 2003) or disturbances to pitfall covers (Sutton et al. 1999). We present a device to reduce predation of animals captured in pitfall traps. Our design provides an alternative to cover boards that are often employed in drift fence studies as anti-predatory mechanisms (Phillips et al. 2002) and is unique in its ability to capture a wide array of small vertebrates, including frogs and toads, while providing secure protection from larger vertebrate predators. We devised predatory exclusion devices (PEDs) in response to increased predator activity (scat, tracks, and disturbance) observed along specific drift fence arrays. Our ultimate goal was to design an inexpensive and time-efficient exclusion device that would reduce predation risks to captured animals in pitfall traps without jeopardizing capture rates of target species.

We operated eighteen terrestrial drift fences year-round and checked them daily at the Griffith League Ranch in north-central Texas, Bastrop County. Our study was part of a long-term study of the endangered Houston Toad (*Bufo houstonensis*). Arrays were either linear or Y-shaped (Bury and Corn 1987) and erected using aluminum flashing (Gibbons and Semlitsch 1981) with 39 19-L buckets distributed among the fences. Only pitfall traps known to have captured adult Houston Toads during previous survey periods were outfitted with PEDs. Eleven of 18 arrays captured *B. houstonensis* among 34 pitfalls. We outfitted 32 PEDs to the terminal pitfalls of the 11 arrays.

PEDs had a cover-board, two strips, four posts, cable ties, and binder clips. We built 40.64 × 40.64 × 1.27 cm cover boards from treated plywood. Each board had four 5.0 cm holes drilled 1.27 cm from each corner and a 30.48 × 1.27 cm gap center cut so the cover board seated at the fence's end. Strips measured 7.62 × 40.64 × 1.27 cm and had two 1.27 cm holes drilled at each end at 1.27 cm from the end. We cut re-bar (1.27 cm) into 60.96 cm lengths for the posts (Fig. 1). For assembly, we first drove the posts 40.64 cm into the ground and oriented the strips parallel to the fence at 10.16 cm high. Second, we cinched cable ties on the posts above and below the strips then placed the cover board snugly on top of the strips. Lastly, we secured the cover board to the strips with two large binder clips. Our design enabled animals to crawl or

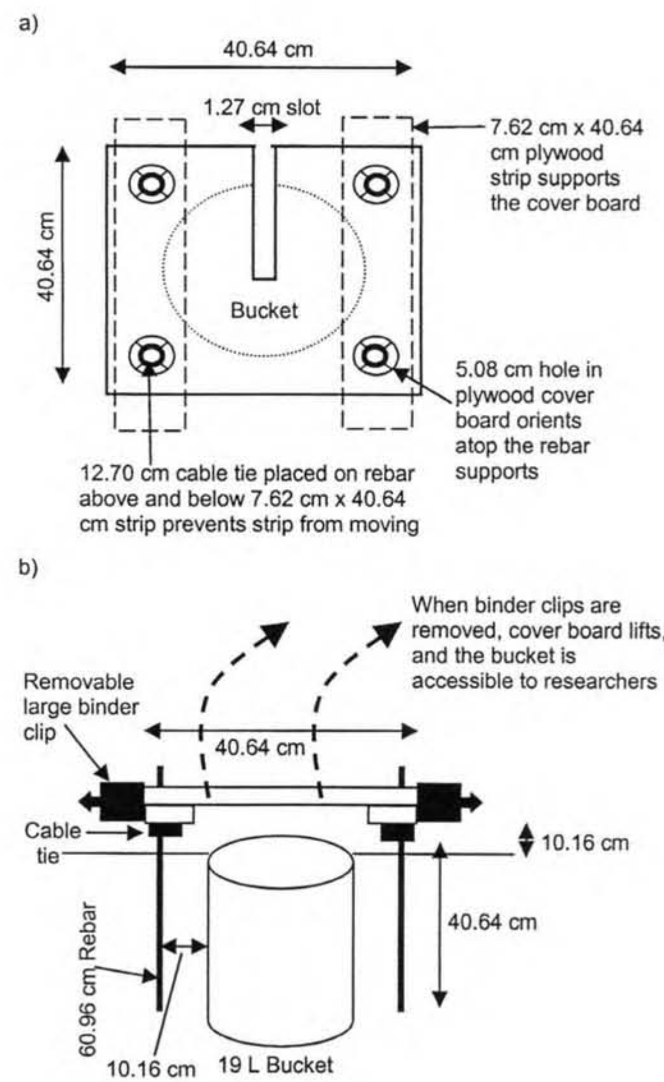

FIG. 1. Detailed drawing of a Predator Exclusion Device illustrating its general operation and an aerial view (a) plus a lateral view (b) of the PED with pitfall trap.

hop underneath the PED thus preventing larger vertebrate predators from reaching the pitfalls' bottom.

Creating a PED secure enough to deter predators yet still readily removed by the researchers was an important goal. With such a large trapping regime, checking each trap, especially on wet spring days with dozens of captures, might take anywhere from a few minutes to several hours. We estimated removal of PEDs added approximately one minute to check each pitfall. Beyond the labor, drift fences can be expensive creating problems in short-term studies with smaller budgets (Malone and Laurencio 2004). We estimated the costs for wood, cable ties, re-bar, and binder clips at approximately US \$5.00 per PED. An added benefit is preventing injury to unaware livestock and personnel, a concern when conducting studies on sites with high activity.

During an eight-month test, all PEDs remained intact with no damage or disturbance. Most importantly, the presence of PEDs did not affect the capture of the target species, the endangered Houston Toad. The proportion of *B. houstonensis* caught in unprotected pitfalls out of total captures from 2003 did not significantly differ from the proportion of *B. houstonensis* caught in PED protected pitfalls during the 2004 season (95% CI P_1-P_2 = -0.0947 < P_1-P_2 < 0.1227) indicating that capture success was not affected by the presence of the PEDs. The same pattern was observed in captures of the Southern Leopard Frog *Rana sphenocephala*, whose proportional captures in protected and unprotected pitfall traps did not significantly differ among the 2003 and 2004 seasons (95% CI P_1-P_2 = -0.0145 < P_1-P_2 < 0.1325). However, a majority of these frogs were juveniles, large adult ranids may be excluded from PED protected pitfalls due to the height limitation of the device.

Three months into the study we documented failed predation attempts at ten pitfalls having PEDs using ten Deercam® motion sensor cameras. Cameras recorded predators entering pitfalls without PEDs and attempting, but failing to enter pitfalls with PEDs (specifically *Procyon lotor*). Despite the PEDs' effectiveness, agile predators (e.g., snakes) can still enter pitfalls and consume animals. Our PEDs provide an inexpensive solution to predation from larger vertebrates. Although alternatives to pitfall trapping that also help limit predation in herpetofaunal studies exist, these techniques are often limited in taxon sampling and even increase other mortality factors such as desiccation (Jenkins et al. 2003; Lohoefener and Wolfe 1984). We think our technique provides an inexpensive and unbiased tool that will aid in reducing predation associated with pitfall trapping for other studies.

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An Improved Blood Sampling Technique for Hatchling Emydid Turtles

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Blood sampling is useful for the study of behavior, ecology, and physiology. It is a minimally invasive method of obtaining tissue that allows, for example, genetic, toxicological, and stable isotope analyses. Various techniques for obtaining blood from turtles have been described (Avery and Vitt 1984; Bennett 1986; Owens and Ruiz 1980; Rogers and Booth 2004; Wibbels et al. 1998; reviewed by Kutchling 1999). Most published techniques apply to adult turtles, with the exception of Bennett (1986) and Wibbels et al. (1998) who described blood sampling from the dorsal cervical sinus and the subcarapacial vein of hatchling sea turtles. We are unaware of a blood-sampling technique for hatchling emydid turtles, which are smaller (usually < 10 g) than cheloniid hatchlings (≈ 20 g). Although we found the technique reported by Wibbels et al. (1998) to be useful on smaller emydid hatchlings, we successfully used an alternative technique that we believe is more appropriate and less detrimental. Here we describe this technique, report our success, and discuss its advantages over the previously described techniques.

In summer 2005, we collected 34 gravid female Common Map Turtles (*Graptemys geographica*) at a nesting site in Lake Opinicon (100 km S of Ottawa, Ontario) and induced oviposition with oxytocin (10 IU/kg) (Ewert and Legler 1978). We incubated eggs in the laboratory at 29°C and we obtained blood on all hatchlings (N = 338) to determine paternity. Hatchlings weighed 4.7–10.3 g (mean = 7.5, S.D. = 1.1 g). We collected between 0.03 and 0.05 ml of blood with a 0.5 ml insulin syringe (B-D U-100) fitted with a 13 mm long (28.5 ga) needle. We obtained blood from the coccygeal vein, which runs along the dorsal midline of the tail (Fig. 1). The venipuncture site was between the cloaca and the base of the tail, along the dorsal midline (common map turtles have a yellow stripe running along that midline). The needle was directed cranioventrally at a 45° angle and inserted approximately 2 mm deep between two adjacent vertebrae. If the needle went deeper than 2 mm, it meant that the needle was beside the vertebrae and no blood could be obtained. As soon as the opening of the needle was in the skin, the plunger of the syringe was withdrawn gently (up to the 0.2 ml mark) to create a vacuum. Care was taken not to apply excessive negative pressure to prevent collapse of the vein (Rogers and Booth 2004). If blood did not appear in the syringe immediately, we slowly rotated the syringe and/or gently increased or decreased the angle until blood was withdrawn into the syringe. If an insufficient amount of blood was obtained on the first try, we made a second attempt a few mm closer to the base of the tail. If no blood was obtained on the second attempt, however, we sampled the subcarapacial vein (a branch of the external jugular according to Rogers and Booth (2004)) as described by Wibbels et al. (1998) to avoid damaging the tail blood vessels. For 248 of the 338 samples taken, we recorded the presence of extracellular fluid, the number of attempts (up to two), and the volume of blood taken in each attempt.

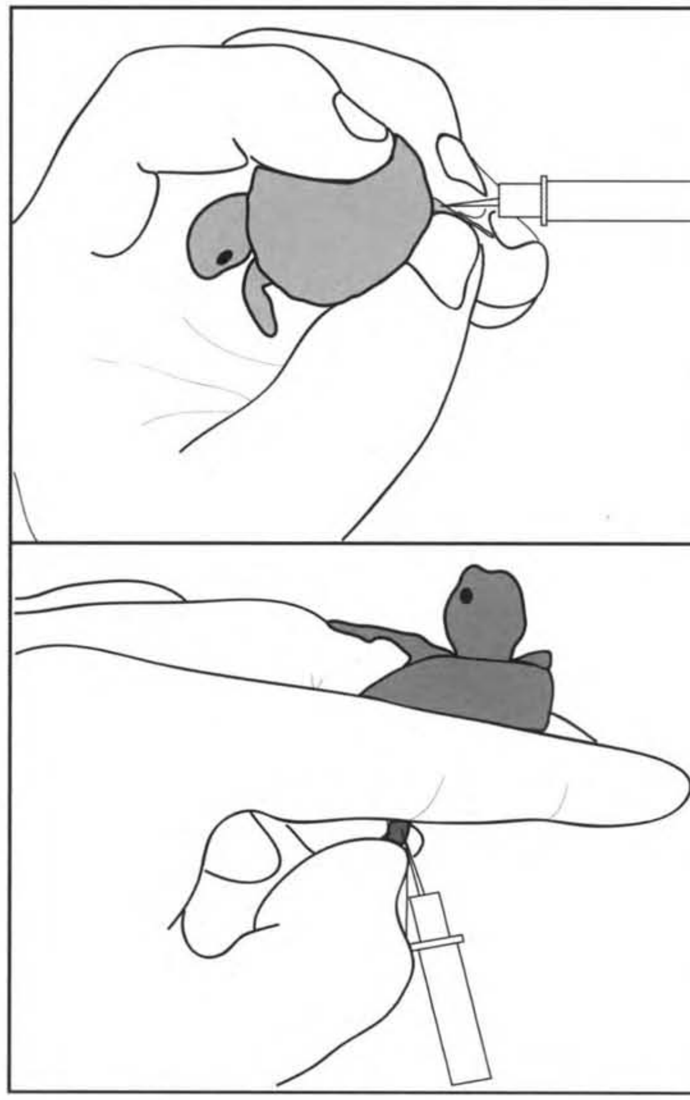

Fig. 1. Two ways of handling hatchling turtles for sampling blood from the coccygeal vein.

In a maximum of two attempts, we were successful in taking at least 0.03 ml (mean = 0.047 ml) of blood from the coccygeal vein for 83% of the hatchlings. For the remaining 17% of the hatchlings, we obtained the blood from the subcarapacial vein (also in a maximum of two attempts). Our success at obtaining blood from the coccygeal vein was independent of hatchling size (logistic regression with carapace length as the independent variable: $\chi^2 = 0.0012$, $P = 0.97$). This result suggests that the technique is practicable on hatchlings of smaller species, such as Painted Turtles (*Chrysemys picta*) or Spotted Turtles (*Clemmys guttata*) that overlap in size with the smaller hatchlings of Common Map Turtle (Ernst 1994). However, this technique may be difficult to apply on species with relatively short tails.

We noted the presence of extracellular fluid or lymph in 16% of the samples from the coccygeal vein, but in 75% of those samples

it was estimated to be ≤ 0.01 ml. In the samples from the subcarapacial vein, extracellular fluid or lymph was noted in 58% of the samples and exceeded 0.01 ml in 86% of those samples. Extracellular fluid and lymph are undesirable in blood samples for both genetic analysis and haematological studies (Lopez-Olvera et al. 2003). We released most turtles 1–3 weeks after blood sampling and none died or showed signs of weakness while in captivity. Another 120 hatchlings were kept in the laboratory for more than a month and none died.

We believe that the coccygeal vein should be preferred over the subcarapacial vein for venipuncture in hatchlings for three reasons. First, bleeding never occurred when we sampled from the coccygeal vein, whereas occasional bleeding occurred when we took blood from the subcarapacial vein. The subcarapacial vein is more likely to produce abundant bleeding because it is a larger vessel. Second, we obtained extracellular fluid more often and in greater amounts when we used the subcarapacial vein. Finally, vital organs are less likely to be injured when blood is taken from the dorsal side of the tail rather than from the head and neck regions.

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Retention Rates of Surface and Implantable Marking Methods in the Mediterranean House Gecko (*Hemidactylus turcicus*), with Notes on Capture Methods and Rates of Skin Shedding

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Many ecological studies of amphibians and reptiles commonly use toe clipping to permanently mark small species. However, researchers have noted deleterious effects on locomotion and even survival caused by toe clipping (Bloch and Irschick 2004; Clarke 1972; Dodd 1993). Alternatives to toe clipping include implantable and surface-marking techniques, yet the former requires the species of interest to have transparent or semi-transparent skin, and the latter may be highly susceptible to wear or loss by shedding.

The Mediterranean House Gecko (*Hemidactylus turcicus*) is an introduced species that is found in association with human habitation in many regions of the United States (Selcer 1986), including Tucson, Arizona where we conducted our study. In our experience, simple surface-marking techniques (permanent marker, correction fluid, etc.) are inadequate for monitoring individual *H. turcicus* because these lizards shed frequently. Our goal was to provide a permanent marking technique for individual *H. turcicus* for periods in excess of 2 wk to facilitate population monitoring.

Based on our observations, the variation in dorsal patterns is not readily distinguishable among individual *H. turcicus*. For small species like *H. turcicus* (SVL = 44–59 mm; body mass = 2.1 g), external tags are often not appropriate. However, internal microtagging has been used successfully in a number of studies (e.g., Buckley et al. 1994 for fish). Here, we use implantable elastomer tags (Northwest Marine Technology: Shaw Island, Washington) to mark small geckos. This method uses a two-part silicone-based material mixed immediately before use, which is injected subcutaneously. Injected as a liquid, it soon cures into a pliable, biocompatible solid that remains visible under translucent skin. In *H. turcicus* the best tagging area was the ventral skin surrounding the leg joints because the dorsal surface has a darker, leopard-like pattern. Tag visibility can be enhanced by fluorescing the marker with a blue-light LED or UV light. A single color kit, including the injector, a 5-cc tube of elastomer, mixing supplies, blue LED flashlight with amber glasses, carrying case, and instructions costs U.S. $215, although more complicated kits cost significantly more. These implantable microtags have been used in ecological studies of crustaceans (e.g., Godin et al. 1995), fish (e.g., Goldsmith et al. 2003), amphibians (e.g., Pfennig and Murphy 2000), and reptiles (e.g., Losos et al. 2004).

Capture Methods.—Our preferred method involved a clear "cup" (we used half of a clear plastic water bottle, approximately 8-cm diam) and a thin, hand-sized manila card. The geckos were found mostly in small groups (usually three or four) surrounding the illuminated radii of porch lights of houses. Individuals were wary, and would dash for recesses and holes very quickly if startled. Using the plastic container, it was possible to slowly enclose geckos without immediately startling them. We then slid the card underneath the cup along the wall and the gecko was captured. Spotting individuals proved difficult without using additional light; however, a flashlight usually startled them. Using a dimmer flashlight or simply reflecting the porch light with the manila card provided sufficient light and did not startle the geckos.

Shedding Observations.—We kept 16 geckos in a glass terrarium ($60 \times 30 \times 40$ cm). Geckos were provided with simulated porch light in the form of a 100-W overhead incandescent bulb, which provided both heat and a nighttime light source. Geckos were exposed to sunlight through the windows of the lab during the day. Inside their terraria, geckos were provided with a refugium (egg crate cardboard). *Hemidactylus turcicus* live in groups under similar conditions (e.g., porch lights) on houses and apartment buildings (Davis 1974; Selcer 1986). Each day we fed the geckos small crickets (*Acheta domesticus*) and mealworms (larval *Tenebrio molitor*) and misted them with water. During a 2-wk observation period, five of the 16 geckos shed including one individual that was observed abrading its loose layer of skin against a rough surface. These observations reinforced our impression that shedding would limit the utility of simple surface-marking methods in the field.

Retention Rates of Various Marking Methods.—After the initial 2 wk of observation, each gecko was assigned to one of six groups. Two terraria ($60 \times 30 \times 40$ cm) were placed end-to-end lengthwise with two walls (5-mm foam board held in place with silicon) that divided each tank into three cells. Each cell contained a refugium (made of the same foam board) on one wall, accessible by small holes that provided shelter and darkness (as well as abrasion for shedding). The floor of each terrarium was covered in aquarium rock and artificial plants, which provided cover for ground foraging and another surface to aid in shedding. Two 100-W incandescent lamps were suspended just above the terraria to provide an evenly distributed light and heat source (close enough to simulate porch lights, but with shade provided by refugia). Seven more recently captured geckos were randomly assigned to the four treatments with the original 16 geckos. Thus, we had a total of 23 individuals, four placed in each of five compartments and three individuals in the last compartment (similar to the group sizes observed at porch lights in the field). Without marking any of them, we fed the geckos and allowed them to acclimate to the experimental conditions for 2 d.

We marked individual *H. turcicus* using one of three methods. The first method involved placing a raised cyanoacrylate superglue dot (SGD) on the back, measuring ca. 0.5 cm diam. The second method involved gluing an elastomer alphanumeric tag (ANT: Northwest Marine Technology's VI Alpha Tags, adhered with the same superglue) on the back to create a more visible external marking for comparison with SGD. The third method involved injecting a visible implant elastomer (VIE) into a leg. Geckos were held by hand and the hind leg was extended so the VIE could be injected into the ventral knee joint with a 1-ml syringe.

TABLE 1. Calendar of shedding for 12 *Hemidactylus turcicus* with two surface-marking methods (SGD = superglue dot and ANT = alphanumeric tag). Geckos were marked on day 0. Numbers are the cumulative number of animals that had completely shed and lost their surface mark. Numbers in brackets are the number of individuals that escaped or died.

Marking Treatment	Day 3	4	5	7	8	10	13	15
SGD	0	0	1	2	3	3	5 [1]	5 [1]
ANT	0	1	1	2	2	3	5	5

Geckos were distributed into the enclosures such that there was an individual marked by each method in each of the six cells. In all but the last compartment (which contained only three geckos), one gecko was left unmarked as a control. The experiment commenced with 23 geckos: six individuals marked with SGDs, six with ANTs, six with VIEs, and five unmarked controls. By feeding the geckos ad libitum, providing them adequate light and heat, and misting them with water, they were expected to achieve high levels of activity, thus providing a vigorous test of each marking method for 2 wk.

By day 15, all but one SGD gecko had shed its skin and therefore its mark. The sixth SGD-marked individual died while shedding. Over the same time period all but one ANT gecko shed its skin and mark. Each VIE gecko retained its mark for the 2-wk duration. Three individuals escaped their terrarium near the end of the experiment, but these were animals that had either been unmarked or shed their mark before escaping. A summary of shedding records and mark retention among geckos in our study is presented in Table 1. Over the course of the 2-wk study, all implanted specimens were easily distinguished upon capture, but the surface marks were consistently shed. As early as day four there were visible signs of wear to surface marks; two SGD geckos were beginning to shed, with raised skin surrounding the glue spot, but the glue itself was retained. Our results indicate that Mediterranean House Geckos might shed as often as every 2 wk under favorable conditions. Our experiment was not designed to determine if external marking promotes shedding, however, our results are suggestive of this and this warrants further testing.

For studies of *H. turcicus*, a more permanent marking method (compared to surface methods) is necessary for observation periods exceeding a few days. Toe clipping is one such alternative, but this technique has proved harmful to *Bufo fowleri* (Clarke 1972) and *Aspidoscelis* [*Cnemidophorus*] *sexlineata* (Dodd 1993). More recently, toe clipping has been shown to reduce the clinging ability of pad-bearing arboreal lizards by 40% and 60% with two and four toes removed, respectively (Bloch and Irschick 2004). The primarily scansorial locomotion of *H. turcicus* warrants consideration for the well being of their toes.

Visible implant elastomer had a minimal impact on survival, growth, health, or behavior of reef fishes (Buckley et al. 1994). Likewise, we did not observe obvious reductions in activity or locomotor performance as a result of implanting elastomer under the left knee of six *H. turcicus*. Elastomer can be used on very small animals (Marold [2001] successfully injected larval salamanders < 2 cm SVL) and, by color-coding, can be readily used to

identify individuals in a population. For example, with 2–4 injection sites on our geckos (i.e., the near-transparent undersides of knee and elbow joints), a large number of unique color combinations was possible given the availability of five readily distinguishable VIE colors, and the experimenter's own injection-pattern variability. The greater effort and higher cost of elastomer, relative to the other surface-marking methods we tested, are outweighed by the longer retention time of the VIE.

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POINTS OF VIEW

Herpetological Review, 2006, 37(3), 321–325.

The Evolution of Three Deviations from the Biphasic Anuran Life Cycle: Alternatives to Selection

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The origins of the diversity of breeding modes in anurans beg for more focused hypotheses, but no suggestion for the evolution of any grade of endotrophy (= development without a free-living, feeding tadpole *sensu* Altig and Johnston 1989) has received rigorous testing (e.g., Salthe and Duellman 1973). Direct development occurs in at least nine anuran families (Thibaudeau and Altig 1999), and other grades of endotrophy add to the list of deviations from the classical biphasic anuran life cycle. Selection has been proposed as the process by which these various reproductive modes arose (e.g., Downie 1993; Magnusson and Hero 1991). The prevalence of these breeding patterns in species rich, tropical assemblages has presumably been caused by selection for escaping crowded (i.e., competitors) and hostile (i.e., predators and abiotic factors) aquatic habitats (e.g., Duellman 1978). Yet, hundreds of species reproduce in aquatic sites in many habitats despite experiencing low and sporadic recruitment (e.g., Greenberg and Tanner 2005). Accordingly, we should not assume that any of these reproductive deviations afford vastly superior recruitment over the typical life cycle (e.g., Roberts 1994; Rödel et al. 2002), especially when egg survival is the only criterion that is commonly reported.

In the near absence of prevailing hypotheses that address the evolution of these various developmental modes (see Callery et al. 2001), we discuss an alternative to selection. We argue for a nonhierarchical approach in a system that suggests a hierarchical structure. Adhering to a hierarchical system oversimplifies a complicated process and inhibits finding a viable solution. Many broad questions need to be answered, and only after the collection of pertinent specimens and data can we eventually revisit the larger question of the evolution of divergent reproductive modes. We discuss three reproductive grades as examples that we propose have arisen independently by different genetic mechanisms, usually multiple times: arboreal eggs, nidicolous larvae (= variously modified, nonfeeding tadpoles usually confined to a "nest"), and direct developers (= froglet hatches from egg jellies). With an understanding of developmental biology increasing daily (e.g., Gilbert 2001; Raff 1996; Robert et al. 2001), discussions of competing hypotheses should help direct future studies.

We argue that those taxa that lay arboreal eggs over water and develop normally as tadpoles achieved those capabilities via se-


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SOCIETY FOR THE STUDY OF AMPHIBIANS AND REPTILES

www.ssarherps.org

The Society for the Study of Amphibians and Reptiles, the largest international herpetological society, is a not-for-profit organization established to advance research, conservation, and education concerning amphibians and reptiles. Founded in 1958, SSAR is widely recognized today as having the most diverse society-sponsored program of services and publications for herpetologists. Membership is open to anyone with an interest in herpetology—professionals and serious amateurs alike—who wish to join with us to advance the goals of the Society.

All members of the SSAR are entitled to vote by mail ballot for Society officers, which allows overseas members to participate in determining the Society's activities; also, many international members attend the annual meetings and serve on editorial boards and committees.

ANNUAL DUES AND SUBSCRIPTIONS: Annual membership dues for the year 2006 in the Society for the Study of Amphibians and Reptiles are as follows: **REGULAR** membership US$60 (Student $30)—includes *Journal of Herpetology* and *Herpetological Review*; **PLENARY** membership US$80 (Student $45)—includes *JH*, *HR*, and annual subscription to the *Catalogue of American Amphibians and Reptiles*; **INSTITUTIONAL SUBSCRIPTION** $115—includes JH and HR. Additional fee for airmail postage outside USA $35 for one year. Additional membership categories available on the SSAR webpage: http://www.ssarherps.org/pages/membership.html.

All members and institutions receive the Society's primary technical publication, the *Journal of Herpetology*, and its news-journal, *Herpetological Review*; both are published four times per year. Members also receive pre-publication discounts on other Society publications, which are advertised in *Herpetological Review*.

Payment must be made in USA funds, payable to "SSAR," or by International Money Order, or with VISA or MasterCard (account number and expiration date must be provided). Payment should be sent to: Breck Bartholomew, SSAR Membership Office, P.O. Box 58517, Salt Lake City, Utah 84158, USA. Fax: (801) 453-0489; e-mail: ssar@herplit.com.

Future Annual Meetings

2007 — Saint Louis, Missouri, 11–16 July (with ASIH, HL)
2008 — Montreal, Canada (with ASIH, HL)
2009 — Portland, Oregon (with ASIH, HL)

About Our Cover: *Acanthocercus atricollis*

East Africa's Blue-headed Tree Agamas, with their bright blue heads, live in savanna, woodland, and forest clearings, often in association with human settlements. This species can be found over much of the African continent, from Ethiopia to South Africa. Diurnal and arboreal, much of their time is spent on the trunks of big trees, sometimes on rocks and termite hills. The vividly colored, broad-headed males are strongly territorial, defending territories from elevated vantage points. Home ranges of males are markedly larger than those of females. Ants are their favored food, although a wide range of insects and other arthropods are eaten. Females lay 4–15 eggs, which undergo an incubation period of about 90 days. Hatchlings, which are 70–80 mm total length, grow rapidly and achieve sexual maturity in their second year.

The cover subject, a male *Acanthocercus atricollis*, was photographed just outside of Isasha National Park during the Exo Terra 2005 Ugandan Expedition. This eleven-person, fifteen-day expedition successfully studied the local herpetofauna. Other notable lizard species documented on this trip included *Chamaeleo xenorhinus*, *Chamaeleo johnstoni*, and *C. adolfifrederici*.

The cover photo was taken by **Michael D. Kern**, an exotic wildlife photographer living in Palo Alto, California. As winner of the 2005 Exo Terra Nactus Award, Kern was invited to be the official photographer of the Ugandan Expedition. His work has been published in several leading reptile and photographic magazines as well as nationally in many newspapers. To see more of Kern's photography, including additional images from the expedition (such as the aforementioned species of *Chamaeleo*), visit www.thegardensofeden.org. To learn more about Exo Terra and the 2005 Uganda Expedition visit www.exo-terra.com.

SSAR BUSINESS

Kennedy Student Award Committee Annual Report, 2006

The Kennedy Award Committee (Carl Anthony, Bill Lutterschmidt, Terry Schwaner, Wayne VanDevender, Lynnette Sievert, Chair) has completed its work for Volume 39 of the *Journal of Herpetology*. The Committee has selected "Critical Literature Review of the Evidence for Unpalatability of Amphibian Eggs and Larvae" by Margaret S. Gunzburger (Joseph Travis, coauthor; Vol. 39: 547–571). The Kennedy Award carries with it a cash prize of US $200 or the winner's selection of any SSAR publications valued at twice that amount. The Committee was impressed with the high quality of a number of the eligible papers.

The committee invites all student members of the Society to submit their work to the *Journal*, and encourages regular members who supervise the work of students to draw this award to the attention of those students.

Seibert Award Winners for 2006 Announced

The fifteenth annual Seibert Awards were presented at the 49th Annual Meeting of the SSAR in New Orleans, Louisiana July 12–17, 2006. These awards are named in honor of Henri C. Seibert, an early and tireless supporter of SSAR, serving as an officer for over 20 years. In recognition of outstanding student presentations at the annual meeting, a single award is given in each of four categories: Morphology & Physiology (7 presentations), Evolution & Systematics (5 presentations), Ecology (18 presentations), and Conservation (12 presentations). All winners will receive a check for US $200 from SSAR and a book from University of California Press compliments of Chuck Crumly.

The Winners—Morphology & Physiology: **Raymond A. Hernandez** (coauthors Stephen M. Secor and Robert E. Espinoza), California State University, Northridge, "Can omnivores be dietary specialists? Adaptability of gut form and function in an omnivorous lizard." Evolution & Systematics: **Julie Ray** (coauthor Richard B. King), Old Dominion University, "Long term perspective of Lake Erie Watersnake color polymorphism." Ecology: **Kurt J. Regester** (coauthors Matt R. Whiles and Karen R. Lips), Southern Illinois University, "Trophic basis of production and energy flow associated with emergence among assemblages of larval ambystomatid salamanders in forested ponds in southern Illinois." Conservation: **Tracy A.G. Rittenhouse** (coauthor Raymond D. Semlitsch), University of Missouri-Columbia, "Defining terrestrial habitat use and summer refuge sites of wood frogs in oak-hickory forests."

Honorable Mention—Evolution & Systematics: **Allyson Modra** (coauthor Ronald L. Gutberlet, Jr.), University of Texas at Tyler, "Phylogeny of *Bothrops*, *Bothriopsis*, and *Bothrocophias* species from morphological data (Serpentes: Viperidae: Crotalinae)." Ecology: **Elizabeth B. Harper**, University of Missouri-Columbia, "Density dependence in the terrestrial life history stage of two anurans." Conservation: **Natalie Hyslop** (coauthors J. Michael

Myers and Robert J. Cooper), University of Georgia, "Home range, movements, and survival of the threatened Eastern Indigo Snake (*Drymarchon couperi*) in southeastern Georgia."

The judges for 2006 were Lora Smith (Jones Ecological Research Center, Newton, Georgia), Margaret Gunzburger (US Geological Survey, Gainesville, Florida), Christopher Sheil (John Carroll University, University Heights, Ohio), Fredrick Janzen (Iowa State University, Ames, Iowa), John Maerz (University of Georgia, Athens, Georgia), Patrick Owen (Ohio State University, Lima, Ohio), Matthew Aresco (Nokuse Plantation, Bruce, Florida), Stephen Corn (US Geological Survey, Missoula, Montana), Marion Preest (Claremont College, Claremont, California), and Kirstin Nicholson (Washington State University in St. Louis).

NEWSNOTES

Declining Amphibian Populations Task Force Transition

Effective mid-2006, the Declining Amphibian Populations Task Force (DAPTF) became part of the World Conservation Union (IUCN) Amphibian Specialist Group (ASG). This merger will continue and expand the DAPTF's mission as an organization devoted to amphibian research and conservation. DAPTF's familiar newsletter, *Froglog*, will continue on a bimonthly basis. Electronic versions of back issues, as well as information for contributors, can be found at the DAPTF website:

http://www.open.ac.uk/daptf/froglog/

MEETINGS

Meetings Calendar

Meeting announcement information should be sent directly to the Editor (rwh13@csufresno.edu) well in advance of the event.

4–5 November 2006—33rd Annual Meeting, Kansas Herpetological Society, hosted by Fort Hays State University, Hays, Kansas, USA. Information: http://www.cnah.org/khs/AnnualMeetingInfo.html

6–9 November 2006—9th Reunión Nacional de Herpetología México, hosted by the Mexican Herpetological Society. Universidad Autónoma de Nuevo León, Monterrey, Nuevo León, México. Information: http://www.sociedadherpetologicamexicana.com/.

24–27 November 2006—Herpetological Association of Africa 8th Conference. Potchefstroom campus of the North-West University, South Africa. Information available from the conference website: www.wits.ac.za/haa/2006conf.htm.

6–8 February 2007—Workshop: Understanding Agriculture's Effects on Amphibians and Reptiles in a Changing World. Sponsored by U.S. Geological Survey's Amphibian Research and Monitoring Initiative, Partners in Amphibian and Reptile Conservation, the Natural Resources Conservation Service, Environment Canada, the Association of Fish and Wildlife Agencies, and Conservation International. St. Louis, Missouri, USA. Information: http://www.umesc.usgs.gov/ag_effects_workshop/workshop.html.

16–20 April 2007—First Mediterranean Herpetological Congress, Marrakech, Morocco. Information available from the Congress website: www.ucam.ac.ma/cmh1.

20–23 June 2007—31st International Herpetological Symposium, Toronto, Canada. Information: http://www.kingsnake.com/ihs/.

CURRENT RESEARCH

The purpose of **Current Research** is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, **María del Rosario Castañeda** or **Michele Johnson**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can be found at: http://www.herplit.com/contents.

A New Cretaceous Terrestrial Snake: Implications for the Origin of Snakes

A new fossil snake (*Najash rionegrina* sp. nov.) is described from the Upper Cretaceous period of Patagonia in Argentina, representing the first limbed snake from a fully terrestrial deposit. *Najash* has a sacrum supporting the pelvic girdle, functional hindlimbs outside the ribcage and several features associated with a surface-dwelling or subterranean lifestyle. Previously described fossil snakes with fully formed limbs, *Haasiophis, Pachyrachis* and *Eudopophis*, from the Tethyan coasts of Northern Gondwana, were considered the most primitive snakes and the 'transitional link' between extant snakes and the Mosasauroidea, an extinct group of marine lizards, supporting the hypothesis of a marine origin of snakes. However, *Haasiophis, Pachyrachis* and *Eudopophis* also show other features typical of more advanced macrostomatan snakes (boas, pythons and colubroids) contradicting their basal position and questioning their relevance in the origin of snakes. A phylogenetic analysis of 119 characters coded for 18 relevant taxa, including all relevant fossils, shows *Najash* as the most primitive snake known and all other snake fossils closely related to more advanced recent forms. These results support the hypothesis of a terrestrial origin of snakes.

Apesteguía, S. and H. Zaher. 2006. A Cretaceous terrestrial snake with robust hindlimbs and a sacrum. Nature 440:1037–1040.

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Captive Breeding and Potential Fitness Loss in a Reintroduced Species

Captive breeding has become an important conservation tool for some endangered species. Because captive populations are founded by a small number of individuals, the resulting loss of fitness due to inbreeding is usually impossible to avoid. Additional concerns result from the absence of natural selection and the rapid adaptation to captivity environments (stable, unchanging environments without predators). The authors examined whether defenses induced by predators in *Alytes muletensis*, the Mallorcan midwife toad, were maintained in populations after several generations in captive breeding. Tadpole induced responses to natural predators (the snake *Natrix maura* and the frog *Rana perezi*) under laboratory conditions include elongation of the tail, shallower tail fins, and faster development. Morphological measurements and developmental stage were compared between 1) a natural population (founder) and a reintroduced population (descendant) with common ancestry, and 2) short-term (3–8 generations) and long-term (9–12 generation) captive populations with different ancestors. Tadpoles from both founder and descendant populations showed induced changes to chemical predator cues in tail shape, with no significant difference between the two. Significant differences between short-term vs. long-term captive populations were found only in the lower tail fin, and despite no significant differences in other measurements, short-term population shape variation was stronger. Genetic variation was also studied using microsatellite DNA analysis, comparing heterozygosity and allelic richness among populations. Results suggest that relatively high levels of heterozygosity and important fitness attributes can be maintained for a few generations in captivity, but in long-term captive populations these start to decline and might have a detrimental effect in reintroduction programs.

Kraaijeveld-Smit, F. J. L., R. A. Griffiths, R. D. Moore, and T. J. C. Beebee. 2006. Captive breeding and the fitness of reintroduced species: a test of the responses to predators in a threatened amphibian. Journal of Applied Ecology 43:360–365.

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Deviation from the Frequency-Dependant Selection Model of Batesian Mimicry in Poison Frogs

In Batesian mimicry a palatable species mimics the warning signal of a toxic model to deceive and avoid predation. The mimetic advantage is frequency dependant, as a considerable increase of mimics result in predators learning to ignore the warning. Where more than one model species is available, theory predicts 1) the evolution of polymorphism, so mimics diverge in appearance and are allowed to increase in abundance and maintain the warning signal in low frequency, 2) the evolution of an intermediate phenotype between model species, or 3) a mimetic resemblance to the most highly abundant and/or noxious model. The authors studied a mimicry system composed of two parapatric models (*Epipedobates bilinguis* and *E. parvulus*) that share a similar warning coloration and one mimic (*Allobates zaparo*) that is geographically dimorphic resembling each warning signal where the model is parapatric. Where the two models co-occur, *A. zaparo* resembles only one of the models (*E. bilinguis*), contradicting predictions 1 and 2. The authors used toxicity assays, field abundance measurements, and predator learning experiences to investigate the mechanisms related to this atypical case. In the area where both models occur, *Epipedobates parvulus* was significantly more abundant than *E. bilinguis*. Further, *E. bilinguis* was less toxic than *E. parvulus*. Contrary to expectations, in co-occurring areas *A. zaparo* resembles the least abundant and less toxic model. Predator-learning trials with chickens were conducted to study the psychological 'stimulus generalization' model. Predators educated with the more toxic *E. parvulus* avoided mimics of both models; however, predators educated with the less toxic model only avoided models from their learning experience. Therefore, in the area of overlap, mimics of *E. bilinguis* (the less toxic and less abundant model) received protection generated from both models. The authors suggest the resemblance of *A. zaparo* to the less abundant, less toxic model is stimulus-controlled predator generalization of learned avoidance. Alternative explanations for this pattern are also discussed.

Darst, C. R. and M. E. Cummings. 2006. Predator learning favours mimicry of a less-toxic model in poison frogs. Nature 440: 208–211.

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Morphological and Functional Convergence in Herbivorous Lizards

Food capturing and acquisition requirements common to all herbivores provide similar selective pressures that could lead to convergence. The author studied functional and morphological convergence of herbivorous lizards using geometric morphometric techniques and simple functional models. Three questions were addressed: 1) do herbivorous lizards show evidence of convergence in skull and lower jaw morphology? If so, 2) what is the morphospace pattern associated with this convergence? and 3) is it possible to predict the direction of the convergence based on functional models? Relative warp (RW) analysis and a new metric of convergence (multidimensional convergence index, MCI), coupled with a resampling procedure to test for significance, were applied to digitized landmarks of adult skull and lower jaw photographs in lateral view (555 species, 13 families). Three different patterns that could be considered evidence of convergence were tested: 1) occupation of the same area of morphospace, 2) occupation of different areas of morphospace, but putative convergent taxa closer to each other than to relatives, and 3) parallel change of putatively convergent taxa away from their relatives. To test if it is possible to predict the direction of the convergence using functional models, the author compared the mechanical advantages (MA) between herbivores and carnivores, calculated from the lower jaw landmark coordinates and plotted onto warp plots. Results support a morphological convergence among herbivorous lizard skulls, based on a pattern that shows deviations of the herbivores away from their carnivore relatives and towards a common area

of morphospace (second pattern of convergence). In the lower jaws, though no overlap in morphospace occurs, there is a convergent function that can be predicted using a lever model, where herbivores tend to show higher values of MA, supporting the idea that different changes in morphology can result in the same change in function. Finally, the author highlights the importance and the advantages of incorporating functional and morphological perspectives into the same question.

STAYTON, C. T. 2006. Testing hypotheses of convergence with multivariate data: morphological and functional convergence among herbivorous lizards. Evolution 60:824–841.

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Complex Ornament Evolution In Agamid Lizards

The expression of exaggerated physical features or ornaments in males, used in reproductive displays and aggressive encounters has been regarded as the result of sexual selection. However, the presence of these structures in many females remains a tricky question. Two main hypotheses have been postulated to explain the mutual ornamentation: 1) genetic correlation between sexes, and 2) sexual selection on females as well as males. The former case predicts simultaneous evolutionary gain of ornaments in both sexes, followed by an eventual secondary loss, while in the latter, the historical appearance of the ornaments does not have to occur in concert in both sexes. Using comparative analyses, the authors examined the relative contribution of each hypothesis in the mutual ornamentation of agamid lizards. On a composite phylogenetic tree, linear parsimony was used to reconstruct transitions between monomorphism and dimorphism, and for each sex separately, the gain or loss of ornaments. The Phylogenetic General Least Squares (PGLS) regression model was used to establish if type of shelter used to avoid predators might influence the number of ornaments. Results show a complex history of evolutionary transitions between no ornamentation, mutual ornamentation and dimorphism in agamids for most ornament types studied, supporting the role of both genetic correlation and sexual selection on females. The total number of ornaments exhibited by both males and females was negatively associated with burrowing behavior. Interestingly, and contrary to predictions of the genetic correlation hypothesis, the authors found that males have experienced more evolutionary losses than females for several ornament types and discuss different explanations for this pattern, including risk of predation, type of shelter used, and changes in the dynamics of natural selection (shift in direction of sexual selection, founder effect and genetic drift).

ORD, T. J., AND D. STUART-FOX. 2006. Ornament evolution in dragon lizards: multiple gains and widespread losses reveal a complex history of evolutionary change. Journal of Evolutionary Biology 19:797–808.

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Report of the Amphibian Chytrid Fungus in Costa Rica Prior to Population Declines

The recent decline and extinction of amphibian populations from apparently protected and undisturbed areas is an alarming global trend. Population declines in Costa Rica, mostly in the mid and high elevations, have been linked to climate change and outbreaks of the amphibian fungus *Batrachochytrium dendrobatidis*. The authors studied the presence of the fungus in specimens collected at the Braulio Carrillo National Park (BCNP, 100–2600 m), in 1986 prior to well-documented declines in the area. Histological cuts from the pelvic patch of 202 specimens representing 30 species were examined. For comparison, 18 specimens from 5 species were collected in 2002 from the lower portion of the study area to establish if the chytrid fungus is currently present in lower areas, where no declines have been reported. The authors compared the infection status of host species with altitude (as a temperature indicator), reproductive mode, and current population status. Results show that the chytrid fungus was present in the BCNP in almost all altitudes in 1986, not only in species that have disappeared from the area, but also on those that have persisted as well. Furthermore it was present in the few species that can still be found in high altitudes, where the highest declines have been reported. Species of all reproductive modes were infected, except the direct developing species that inhabit streams. As it is not restricted to species strongly associated to aquatic habitats, the authors suggest the pathogen can survive in moist floors and can be picked up from the ground. In the 2002 survey three out of the five species included were infected, but all five are common and with no signs of population decline.

This study does not support the hypothesis that chytrid infections would occur only in species and sites where subsequent population declines occurred, though the authors do not deny the association between the fungus presence and population declines and highlight the role other factors might be playing in the amphibian population declines.

PUSCHENDORF, R., F. BOLAÑOS, AND G. CHAVES. 2006. The amphibian chytrid fungus along an altitudinal transect before the first reported declines in Costa Rica. Biological Conservation 132:136–142.

Correspondence to: Robert Puschendorf, Amphibian Disease Ecology Group, School of Tropical Biology, James Cook University, Townsville, Queensland 4811, Australia; e-mail: Robert.Puschendorf@jcu.edu.au.

Habitat Microstructure Predicts the Developmental Life History of *Eurycea* Salamanders

Phenotypic plasticity, the ability to express alternate phenotypes, allows populations to colonize and survive in variable environments. The plethodontid salamander *Eurycea tynerensis*, restricted to the Ozark Plateau of south-central North America, comprises both strictly aquatic paedomorphic populations and more terrestrial metamorphic populations. Populations typically display only one life history mode. The authors tested the relationship between environmental conditions (streambed sediment) and life history (paedomorphic/metamorphic) using independent contrasts and Markov Chain Monte Carlo randomizations to test the significance

of regression results. Sediment particle size, type (clastic or chert) and degree of sorting (a measure of uniformity of particle sizes in the substrate, poor sorting = containing multiple size classes) were highly correlated with life-history mode. Paedomorphic populations were present in streams with well-sorted, large chert particles while metamorphic populations were present in streams with poorly sorted, clastic small material as sandstone or siltstone. All correlations were positive and significant. The authors suggest the streambed material composed by deposits of large gravel creates a loose streambed that allows access to subsurface water in dry months, allowing paedomorphic forms to survive, while streambeds composed of more heterogeneous, densely packed clastic sediments leave no subterranean refuge when water surface dries forcing the exploitation of more terrestrial habitats. These results suggest local microhabitat conditions have a major role in phenotypic expression. However, the authors point out that despite the strong correlations with streambed composition, other factors such as nutrient abundance, persistence of underground water, or availability of suitable surrounding habitat can be playing an important role in determining life history mode in *E. tynerensis*.

Bonett, R. M., and P. T. Chippindale. 2006. Streambed microstructure predicts evolution of development and life history mode in the plethodontid salamander *Eurycea tynerensis*. BioMed Central Biology 4:6.

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Comparison of Species Delimitation Methods Using the *Sceloporus grammicus* Complex

Accurate delimitation of species is a recurrent issue in biology, given that species are the basic unit of analysis in several areas. Recently, a series of methods have been proposed to identify and delimit species, but few studies have compared the results of different methods over the same group. The authors used the *Sceloporus grammicus* complex, composed by at least 8 chromosome races (7 of them morphologically distinguishable) to test genetic distance, character-based and tree based methods for delimiting species. Allozyme, morphology and molecular data from the literature was reanalyzed to determine hypothetical evolutionary species (HES) according to the evolutionary (ESC) and general lineage (GLC) species concepts. The authors tested if the four HES established a priori were recovered under different methods and different types of data (chromosome and allozyme). The methods applied were: 1) Highton (2000) genetic distance, 2) the character-based, Doyle (1995) multilocus field for recombination (mlFFR) and Davis and Nixon (1992) population aggregation analysis (PAA), and 3) Wiens and Penkrot (2002) tree-based method. A total of 662 lizards were included, from 55 localities, representing all chromosome races. Results showed Doyle's mlFFR had low resolution and poor ability to identify distinct lineages. Highton's genetic distance, Davis and Nixon's PAA and Wiens and Penkrot's tree based method recovered all four HES with different degrees of support. However, no single method strongly identified all four HES lineages, though no significant discordance was found between methods. The authors discuss the ability of each method to discriminate among different HES with the types of data used, and conclude that given the complexity of the group in question the results are encouraging regarding the applicability and accuracy of these three methods in delimiting species.

Marshall, J. C., E. Arévalo, E. Benavides, J. L. Sites, and J. W. Sites, Jr. 2006. Delimiting species: comparing methods for Mendelian characters using lizards of the *Sceloporus grammicus* (Squamata: Phrynosomatidae) complex. Evolution 60:1050–1065.

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The Origins of Egg Eating in Snakes

Major dietary shifts often begin with the incorporation of novel food items as a minor component of the diet. However, initial stages of diet specialization are usually overlooked because they are not associated with major phenotypic changes. To study the origins of egg eating in snakes, the authors used comparative methods to test if egg eating is more likely to arise in lineages that already include squamates (lizards and snakes) or birds in their diets. This association is expected for two reasons: 1) the occurrence correlation, when a novel food is more likely to be encountered if its density is correlated with a particular food already part of the diet, and 2) the specific feeding predisposition, when traits that facilitate feeding on some food already in the diet might facilitate feeding on the novel food. Quantitative data on snake diet, including 200 species, was taken from the literature and unpublished data from one of the authors. Data on habitat and maximum size was also considered, as these variables are associated with the probability of finding squamate or bird eggs (terrestrial, arboreal, aquatic) and the capability of ingesting them (gape size). Concentrated changes test and a Bayesian estimation of character evolution based on stochastic models were applied on a supertree including all species of interest. Analyses were conducted including all the taxa, and also excluding species highly unlikely to find the eggs or corresponding animals (i.e., aquatic species) and those probably unable to eat them (i.e., small species). In addition, character mapping was used to infer whether the egg specialists arose from lineages that ate the corresponding animals. Results support the hypothesis that feeding on the corresponding animals is correlated with the inclusion of eggs in the diet and all the ancestors of egg specialist species fed on the corresponding animals. The authors discuss the results under the correlated occurrence and specific feeding predisposition explanations and emphasize specialization of egg eating can be related not only to the availability and density of the resource, but to the historical constraints the evolutionary path to specialization entail.

de Queiroz, A., and J. A. Rodríguez-Robles. 2006. Historical contingency and animal diets: the origins of egg eating in snakes. The American Naturalist 167:684–694.

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OBITUARIES

Herpetological Review, 2006, 37(3), 262.

Marcos Di Bernardo
1963–2006

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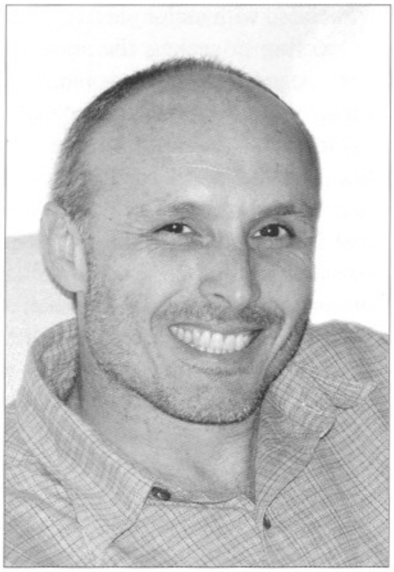

Marcos Di Bernardo in the early 2000s.

Marcos Di Bernardo, a prominent Brazilian herpetologist and professor of zoology at the Catholic Pontifical University of Rio Grande do Sul (PUCRS), Brazil, passed away on 16 June 2006 at age 42 in Porto Alegre, following a two-year battle against cancer. Marcos was born 4 November 1963 in Bento Gonçalves, Rio Grande do Sul State, to Ayres Italvino Di Bernardo and Elisa Velenti Di Bernardo. He lived with his family in Bento Gonçalves until finishing high school and then moved to Porto Alegre to attend University and become trained as a biologist.

Marcos entered the same university in which he eventually became a professor in March 1981, and graduated with a degree in Biological Sciences in 1985. A few years later Marcos enrolled in the graduate school at the same university and received a M.Sc. degree in 1991 with a thesis on a cladistic analysis of a group of xenodotine snakes and the resurrection of *Echinanthera* Cope, 1894. In 1986 Marcos accepted his first position as a biologist, as Assistant Researcher in the Museum of Sciences and Technology of PUCRS (MCP). At MCP Marcos was a student of Thales de Lema, who guided his first steps in the field of herpetology. Together with Thales, Marcos constructed an important collection of amphibians and reptiles at MCP that today includes more than 26,000 specimens, mainly from South America. In March 1994, Marcos entered the graduate program of the State University of São Paulo (UNESP) at Rio Claro, under Ivan Sazima. He received his Ph.D. degree from UNESP in 1998 with a dissertation on the natural history of a community of snakes in the Araucaria Plateau in southern Brazil.

In March 2001, Marcos accepted the position of Adjunct Professor at the Catholic Pontifical University of Rio Grande do Sul, where he taught undergraduate courses on the zoology of tetrapods, amphibians, and biodiversity, and graduate courses in herpetology and the natural history of reptiles. During the last several years Marcos was very active in university life, serving in many university committees, teaching, and directing 13 master theses and nine doctoral dissertations. His important contributions to Brazilian herpetology include 46 peer-reviewed papers, one book, and six book chapters published during his career, most of those on natural history and taxonomy of reptiles and amphibians, and several papers co-authored with his former graduate students. He was a gifted photographer and produced thousands of wonderful images of reptiles and amphibians over the courses of many years. Marcos had a deep interest in biodiversity studies, publishing original descriptions of two new species of snake, *Echinanthera cephalomaculata* Di Bernardo, 1994 and *E. cephalostriata* Di Bernardo, 1996, and two new species of frog, *Elachistocleis erythrogaster* Kwet & Di Bernardo, 1998 and *Melanophryniscus admirabilis* Di Bernardo, Maneyro & Grillo, 2006.

In the early 1990's Marcos met Thales de Lema's graduate student Silvia Rodrigues Machado, whom he married in 5 November 1995. Tragically, Silvia died very young of a cerebral aneurism in July 2002, leaving Marcos and their daughter Camila Di Bernardo, then only three years old. Silvia's cousin and Camila's godmother Carla Nogueira assumed much of Camila's care and eventually married Marcos. Carla came to reestablish family happiness, with enormous dedication and love. This passage would have been much more painful without Carla.

Marcos was a successful field and laboratory herpetologist who loved snakes and other reptiles. He was an excellent and dedicated teacher, beloved by his students, and several times elected as Honored Teacher in graduation ceremonies. Marcos had a rare combination of virtues: he was generous without being spendthrift, was proud without being arrogant, was humble without being simple, and was serious without losing the joy of life. The happiness and the peace that he transmitted to all around him earned the affection of adults and children, as well as prominent personalities and those of more modest backgrounds. This way, he built friendship and respect everywhere he traveled. He was righteous in his beliefs, and lived to high standards, both in his personal life and in his academic and professional life. It was always a pleasure interact with him. He is now resting after the glorious fight that nobody emerges from as winner. Thankfully he will be remembered not for this final battle, but for living his life with the kind of dignity that distinguishes great men.

A devoted husband and father, Marcos is survived by his only daughter Camila and his wife Carla, and will be forever remembered with the most vivid and happy memories by those colleagues and friends that he cultivated during his life. Marcos, we all will miss you!

Acknowledgements.—We thank G. M. F. Pontes, who provided assistance in finding proper dates and helped in searching photographs, and J. S. Albert for reviewing the manuscript.

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Daniel Robert Sutherland 1952–2006

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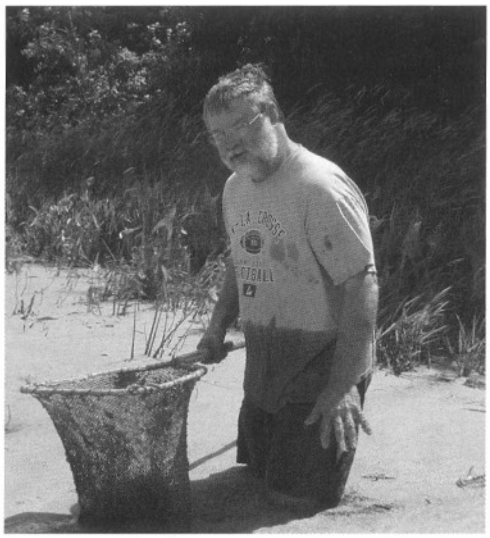


Dan Sutherland, pictured here, as those who worked with him in the field will remember him most fondly: slopping through wetlands, wearing shorts (never hip-waders), soaking wet, and covered in muck. This picture was taken at an amphibian malformation "hotspot" in Eden Prairie, Minnestoa. Photo courtesy of Pieter Johnson.

Daniel Robert Sutherland, Ph.D., passed away suddenly and unexpectedly on May 26, 2006 in La Crosse, Wisconsin. He was 54. He is survived, in part, by his wife of 22 years, Becky A. Lasee, Ph.D., and daughter, Alyssa (age 13).

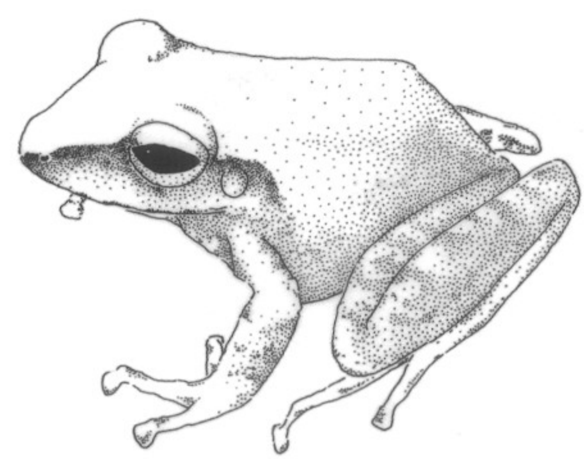
Dan was born on March 26, 1952 in Vermillion, South Dakota to Robert and Vida (Floy). He attended high school in Wayne, Nebraska, where he achieved notable success on the football field, and graduated in 1970. Dan went on to receive his undergraduate degree in biology from Wayne State College (Nebraska) in 1974, and his master's degree in zoology from the University of North Dakota in 1976; his thesis was entitled *"An Analysis of the Piscine Parasitofauna of Four North Dakota Streams."* Upon finishing his master's research, Dan began doctoral work in zoology at Iowa State University under Professor Martin Ulmer. He completed his dissertation (*"Life Cycle and Host-Parasite Relationships of* Khawia iowensis, *Calentine and Ulmer, 1961* [*Cestoidea: Caryophyllidea*]") in 1981 and, after teaching for a year at the University of Wisconsin-Eau Claire, took a post-doctoral position at the University of Wisconsin-Madison. Dan went on to become a professor of biology at Wartburg College (Iowa) from 1987–1993. He then joined the biology faculty at the University of Wisconsin-La Crosse where he remained until his passing.

Although educated and trained as a fish parasitologist, Dan's significant contributions to herpetology are well known to those in the field of amphibian malformations. As an expert in aquatic animal health, Dan was initially drawn to the phenomenon of "deformed frogs" in the mid-1990s after it was suggested that a trematode could disrupt normal development in metamorphosing amphibians. Not long afterwards, he became heavily involved in researching the platyhelminth species *Ribeiroia ondatrae*, a parasite that has been shown to elicit amphibian malformations in both laboratory and field settings. For the past decade, Dan tirelessly collected and dissected thousands of anurans in an attempt to better understand this parasite and its effects on amphibians, quickly becoming a nationally known authority on the subject. Amphibian researchers from throughout North America would annually send field-collected anurans to him for dissection and proper identification of the parasites they contained.

He co-authored a number of important scientific papers on the subject and his research was featured in William Souder's book, *A Plague of Frogs: The Horrifying True Story* (2000), and Dan recently wrote an authoritative chapter on anuran parasites in *Declining Amphibians: The Conservation Status of United States Species* (2005).

Although an outstanding scientist and researcher, Dan will be most affectionately remembered for the passion with which he taught. Having mentored hundreds of undergraduate and graduate students (including me) throughout his professional career, Dan excelled at getting the best out of his students. Well known for his gregarious, affable personality and highly respected on campus, word quickly spread each semester among students registering for classes to "take Sutherland" for introductory biology, parasitology, anatomy and physiology, and aquatic animal health. Dan's love of field biology became apparent when he taught, as all of his parasitology students were taken to nearby wetlands to go "froggin'" and collect their own specimens to analyze in lab, something they all enjoyed. His ability to tell stories, jokes, and his good-natured ribbing of students was also legendary, quickly endearing him to those enrolled in his courses.

Dan will be deeply missed by those who considered him a colleague, a teacher, a mentor, and, most importantly, a dear friend.



Eleutherodactylus longirostris(Leptodactylidae). Colombia: Río Yurumanguí, Valle del Cauca, along Pacific Coast. Illustration by Fernando Vargas Salinas.

ZOO VIEW

When I started in the zoo business in 1965, one of the persons I met a few years later was reptile keeper Ron Goellner from the St. Louis Zoo. A few years later, he was promoted to curator, a position he held until 1995. Since then, Ron was Director of Animal Collections. Some months ago, I learned that Ron was ill and sadly, he passed away on 26 February 2006. An expanded tribute to Ron will appear in *Herpetological Review* by two of his friends and colleagues, Jeff Ettling and Charles Hoessle. Ron was the creator of the Zoo's Center for Hellbender Conservation, now renamed the Ron Goellner Center for Hellbender Conservation. Donations can be sent to the St. Louis Zoo Foundation, P.O. Box 790290, St. Louis, Missouri 63179-0290, USA. Include a note directing funds to the Hellbender Center.

—James B. Murphy, Section Editor

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Herpetology at the Fort Worth Zoo: A 45-Year History

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The Early Years

In late summer of 1953, members of the Fort Worth Zoological Association, notably Kirk Johnson, Amon G. Carter Jr., and Park Director Hamilton Hittson, began searching for a professional zoologist for the position of Curator of the Fort Worth Zoo. Although the search committee considered numerous candidates, it was a young chap, merely 23 years old, who piqued their interest. His name was Lawrence Curtis. Curtis, who had earned two natural science degrees from Southern Methodist University, had been working at the Dallas Aquarium for seven years, and was also gainfully employed as General Curator of the Dallas Zoo. Assistant Park Director James Brown frequently visited the Dallas facility and had been very impressed with Curtis. So on the recommendation of Brown, Hittson attempted to recruit Curtis for the position of Curator of the Fort Worth Zoo.

Curtis thoughtfully weighed the merits of each institution. He knew that Dallas was municipally supported and had no immediate plans for capital improvements, whereas the Fort Worth Zoo was supported by a strong association intent on expanding their facilities. Further lured by an increase in salary and the promise of free residence, Curtis accepted the position.

Shortly after joining the staff, he began developing a master plan, which would become the basic design of the modern Fort Worth Zoo. One of his primary goals was to add indoor facilities, for at that time the Zoo was basically a summer attraction. Curtis had a great interest in ichthyology and rather quickly sold the Zoological Association members on the value of a new aquarium. In December of 1953, Amon G. Carter Jr., presented the Zoological Association with a check for $50,000, and shortly thereafter, construction on the new aquarium began. It was named the Record Aquarium, in honor of James R. Record, dynamic Managing Editor of the *Fort Worth Star Telegram*. In two-and-half years the aquarium had drawn more than twice as many visitors as the population of Fort Worth, and had grossed $150,000, much of which was used to finance additional Zoo construction.

The following five years were busy ones for Curtis. He petitioned the Park Board for numerous improvements that included moated exhibits and a Great Ape House. In November of 1958, Curtis initiated a project that would bring the Zoo acclaim for decades. He appeared before the Park Board to announce that the Zoological Association wished to build a reptile house. After receiving authorization to proceed, Curtis flew to New York, Philadelphia, and Washington, D.C. to evaluate various herpetological facilities.

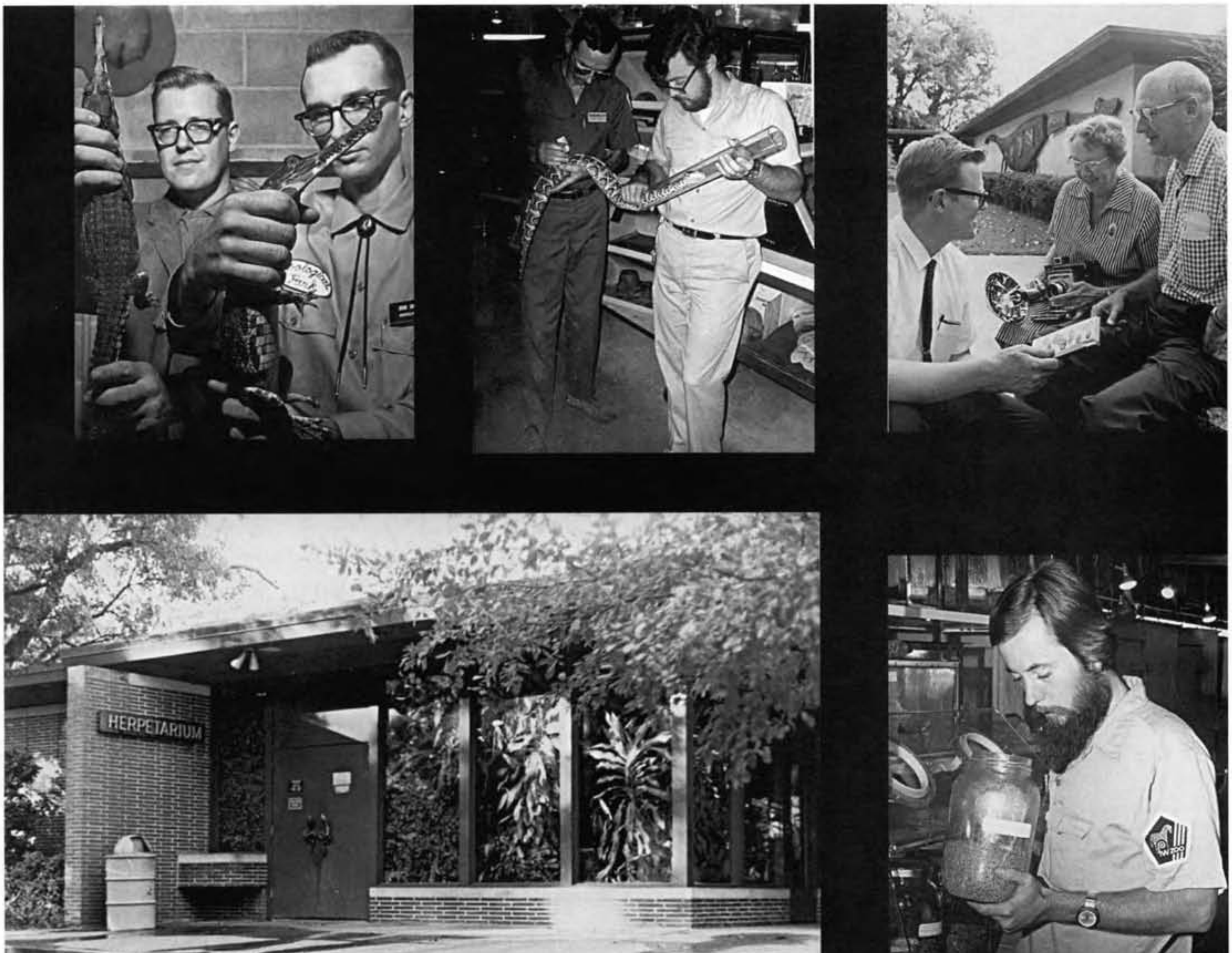
Herpetarium Construction.—In the spring of 1959, Curtis presented Herpetarium plans for final approval. The building was to measure 117 x 55 feet and cost approximately $80,000, including stocking expense (ca. 200 species). The Park Board unanimously approved the proposal, whereupon the Zoological Association received a $93,000 loan co-signed by Amon Carter Jr. The loan was to be repaid by admission fees of 10 cents for children and 20 cents for adults.

The Herpetarium was completed in the summer of 1960 and was the fourth indoor exhibit to open in less than six years. Boasting the largest exhibit of reptiles and amphibians in the world (with 175 vivaria), the facility also included a Zoo hospital and quarantine room. Then contemporary features, such as refrigerated air, operational skylights, temperature controlled water, switch operated emergency alarms, and state-of-the-art service facilities, made this Herpetarium a true marvel. Innovative exhibits such as a display of giant snakes with curved non-reflective glass (creating the illusion of an open-fronted exhibit) were especially popular attractions. The main public area included five exhibit halls covering various geographic regions and another area that was devoted exclusively to amphibians. There were also special exhibits teaching the identification of native venomous snakes and treatment for snakebite.

Staff

Lawrence Curtis had a passion for herpetology that rivaled his interest in ichthyology. In the 1950s he authored papers in numerous journals such as *Copeia*, *Herpetologica*, and the *Texas Journal of Science*. He also contributed regularly to *International Zoo Yearbook*. Over the years he held many board positions including Vice President of the Texas Herpetological Society and President of the American Association of Zoological Parks and Aquariums (now AZA – American Zoo and Aquarium Association).

Curtis was one of the first herpetologists to keep an up-to-date catalogue on antivenin. During the summer of 1966, a young boy—the victim of a rattlesnake bite—was saved after receiving antivenin treatment. Curtis consulted his antivenin catalogue and coordinated the serum shipment to Texas via the US Air Force. Before the year's end, he aided several other people from various states. In recognition of his services he received several awards from the American Aviation Association and the Press Club of Fort Worth. Further, Fort Worth Mayor Willard Barr proclaimed August 15, 1966, as "Lawrence Curtis Day."



Top Row (L to R) — Lawrence Curtis and J. P. Jones; J. P. Jones and Jonathan Campbell; Lawrence Curtis and Roger and Isabel Conant; *Middle Row* — Herpetarium as it appeared shortly after construction; Bern Tryon; *Bottom Row* — David Blody; George Ledvina; Rick Hudson.

After leaving the Fort Worth Zoo, Curtis became Director of the Oklahoma City Zoo in 1970—a position he held for 15 years. In later years he served as a consultant for various zoos and aquaria around the world, and he recently lived in Saudi Arabia where he worked as Director of the Riyadh Zoological Gardens. He presently lives in Oklahoma.

The first Supervisor of the Herpetarium was John M. Mehrtens. He was partly responsible for the quality design of many exhibits in the Herpetarium. Over the years he traveled to many locations, securing animals for display. Mehrtens is probably best known for his book *Living Snakes of the World in Color* (Sterling Publishing, 1987).

Joseph Laszlo, well known internationally for his significant contributions to our understanding of captive management, furthered his career at the Fort Worth Zoo under John Mehrtens. Joe was a colorful character to say the least. He was always eager to talk herpetology and he pursued his interests with unbridled passion. Joe was promoted to Assistant Supervisor in the mid 1960s, and later worked at the Houston Zoo before accepting the position of Supervisor at the San Antonio Zoo in the early 1970s.

John P. Jones was hired as Supervisor in the late 1960s—a position he held for many years. J. P. was a talented man who understood the art of exhibit design, graphic display, and the science of animal husbandry. Moreover, he led a fine crew of young men, some of whom would go on to make significant contributions to herpetology.

Contemporary with Jones was a young stalwart named Jonathan Campbell. Campbell was Assistant Supervisor at the time and had already begun to blaze a herpetological path of accomplishment that would prove difficult to follow. Back in those days he traveled frequently to Mexico and Guatemala with various colleagues, bringing home all manner of reptiles and amphibians—many of them new to science. Campbell left the department in the early 1970s to pursue his master's degree under William Pyburn at the University of Texas at Arlington. Afterwards he wrapped up his graduate studies at the University of Kansas, under William Duellman, where he earned his PhD in 1983. Some of Campbell's early publications covered husbandry techniques and behavioral observations in captivity. He subsequently produced a wave of manuscripts and books that included myriad new species descriptions and taxonomic revisions, mostly on Latin American herps. Campbell now holds a professorship at the University of Texas at Arlington where he is also Chair of the Biology Department and Director of the Amphibian and Reptile Research Diversity Center.

Bern Tryon joined the department in the mid-1970s as Assistant Supervisor. Modeled in the Carl Kauffeld tradition, Bern was another zoo herpetologist who bridged captive management with academic pursuits. He published many peer-reviewed papers on topics such as breeding and rearing bog turtles and captive reproduction of West African dwarf crocodiles, a paper widely regarded as one of the classic studies on crocodilian reproductive behavior. His paper entitled *How to Incubate Reptile Eggs* stands today as the standard cited reference on this topic. Bern's publications helped advance the state of chelonian husbandry, but two of his enduring passions during this time were developing breeding techniques for Arizona Ridge-nosed Rattlesnakes and Gray-banded Kingsnakes. Bern presently lives in Tennessee where he serves as Director of Animal Collection—Herpetology at the Knoxville Zoo.

One of the hallmarks of the Fort Worth Zoo's Herpetarium was the naturalistic quality of the exhibits. The departmental personnel began using live plants to enhance exhibits at a time when this practice was considered anathema (or before this practice became vogue). When it came to quality in herpetological exhibitry, one keeper stood head and hands above the rest—Fort Worth-raised David Heckard. Lead keeper in the department until 1981, David brought an attention to detail for exhibits that was unequaled. David went on to manage the Herp Department at the Abilene Zoo in Texas for many years before moving to San Diego Zoo's Wild Animal Park where he is presently employed.

Certainly one of the more colorful and intense curators in the department's history was Dave Blody. Dave had an unparalleled passion for the "herp of the moment." The result of his addiction was a burgeoning collection that stretched the resources of the department. Dave's primary husbandry interests included arboreal crotalids, boids, and varanids. He was particularly adept at making the drafty and poorly insulated Herpetarium work to his advantage by shuffling animals to appropriate niches, thus inducing many of his charges to reproduce. Perhaps his legacy will be that he oversaw the transformation of an aging and deteriorating facility into a showcase for rare herp species that attracted legions of reptile enthusiasts and became world renowned for successfully breeding difficult-to-manage species.

Rick Hudson was hired in 1980 as Assistant Curator. A Virginia native with degrees in biology and veterinary technology, Rick arrived at a time when the mystique of Texas zoo herpetology was at its peak and the collection in Dallas across the river to the east was earning its highest accolades. Fueled by a competitive spirit to excel, Rick was at once Dave Blody's "partner in crime" and together they built a reproductive program rivaled only by the Dallas menagerie.

Early on Rick became involved in the emerging AZA conservation programs for reptiles, founding and chairing the Lizard Advisory Group for more than ten years. This led to the development of the Rock Iguana Species Survival Plan (SSP) and the Jamaican Iguana Recovery Program, which received the AZA's International Conservation Award in 2000. For years he has worked tirelessly on this project and has played an integral role in the survival of the species. Expanding on this work to include the conservation of other Caribbean iguanids, Rick helped organize the IUCN Iguana Specialist Group, now in its 10th year, which he currently co-chairs. In this capacity, he devotes 50% of his time to traveling, doing fieldwork, building head-start facilities, and organizing reintroduction and recovery programs. To fund and support these efforts, he helped create the International Iguana Foundation in 2001 and serves as the Executive Director. He has long had a special interest in crocodilians and chelonians, and in 2001 organized an international workshop to address the Asian Turtle Crisis. That led to the formation of the IUCN Turtle Survival Alliance that he co-chairs, which raises funds, conducts workshops, and administers conservation programs in five Asian countries. Rick worked in the Herpetarium until 2000, whereupon he became one of the zoo's Conservation Biologists.

Jack Cover, a native of Baltimore, Maryland, was hired as Lead Keeper in the early 1980s. Jack worked at the Fort Worth Zoo for several years where he made significant contributions to the overall program. Jack was a great exhibit artist, published numerous

papers, and was particularly adept at enticing animals under his care to reproduce. Jack left the Fort Worth Zoo in the late 1980s to take a position at the National Aquarium at Baltimore, where he presently serves as General Curator.

Other former staff members worthy of mention are: Johnny Banks, Steve Boyd, Kelly Bradley, Amy Bridegam, Gary Carl, Chris Davis, Steve Dobbs, Ricky Green, Norm Haskell, Terry Hulsey, Randy Johnson, Tim Jones, George Ledvina, Tommy Logan, Doug Mehaffey, Steve Meyers, Ken Morgan, Nate Nelson, Norman Nunley, Rick Reed, Jeff Ross, John Simmons, Marc Spataro, Mike Stewart, Earl Turner, and Mark Wanner.

Currently the department has eight staff members: Curator Diane Barber, Lead Keeper Matt Vaughan, and keepers Grant Ashmore, Andrew Brinker, Mike Doss, Andrea Floyd, and Stephen Hammack.

Captive Reproduction

During the late 1970s and early 1980s herpetologists were finally beginning to grasp the fundamentals of husbandry science—made possible by pioneering studies on sex determination, thermoregulation, hibernation, habitat selection, UV light requirements, social behavior, etc.

The Fort Worth Zoo Herp Department has always had an impressive collection and a staff motivated to provide their animals with the environmental/social conditions necessary to reproduce. In 1988 the department was awarded the prestigious AZA Edward H. Bean award for their breeding program for five species of arboreal boids. Over the years staff elicited reproduction in more than 220 species (crocodilians, 6 species; chelonians, 25 species; lizards, 58 species; snakes, 120 species; anurans, 15 species) resulting in the production of more than 6000 offspring.

Conservation

Staff members at the Fort Worth Zoo have a rich history of involvement in conservation projects. In 1993 the Zoo established a Conservation Department to more actively participate in global programs aimed at habitat protection and species conservation. Although the members have an interest in many non-herp programs, reptile and amphibian projects have always been, and continue to be, an integral part of their overall conservation vision. Herpetology staff is actively involved in the Conservation Department's programs and also pursue projects independently. The following is a brief summary of ongoing herp projects.

Anegada Iguana, *Cyclura pinguis*

In an effort to save *Cyclura pinguis*, the World Conservation Union (IUCN) Iguana Specialist Group, along with the British Virgin Islands National Parks Trust, initiated a head-start program to bolster the wild population until many of the problems facing the iguanas could be minimized or removed. This project is partially funded and managed by staff at Dallas Zoo, with staff from the Fort Worth Zoo providing field support and nutrition studies. The San Diego Zoo's Center for Research of Endangered Species (CRES) also has an active role in this program.

Puerto Rican Crested Toad, *Peltophryne lemur*

In an effort to save this species from extinction, a Species Survival Plan (SSP) was created in 1984. The SSP goals include island-wide education and outreach, research, the protection of existing habitat, and the creation of new ponds. A reintroduction program is a large component of the recovery plan for this species. Each year, captive toads from zoos and aquaria in the United States and Canada are reproduced, and tadpoles are sent to Puerto Rico for repatriation.

In late 2006 program participants will begin a nutritional/dietary analysis of wild tadpoles, and continue a hydrology study on the remaining breeding pond and release sites. Zoo veterinarians will initiate a health assessment study on Marine Toads that are sympatric with the Crested Toad.

SSP Partners are American Zoo and Aquarium Association, Puerto Rican Department of Natural Ecological Resources, U.S. Fish and Wildlife Service (USFWS), University of Puerto Rico, Juan Rivero Zoo, and citizens of Puerto Rico.

Chiricahua Leopard Frog, *Rana chiricahuensis*

Listed as threatened without critical habitat, the Chiricahua Leopard Frog is in decline in many locales across its range. The Fort Worth Zoo has set up a head-start facility where adult frogs from select populations will be bred and resulting tadpoles returned to the field for repatriation.

Partners are USFWS, New Mexico Game and Fish Department, Arizona Game and Fish Department, and Turner Endangered Species Fund.

Jamaican Iguanas, *Cyclura collei*

Shortly after the rediscovery of the Jamaican Iguana in 1990, the Durrell Wildlife Conservation Trust funded initial field work and began to establish husbandry protocols. Subsequently the Fort Worth Zoo began raising funds to further support field research. To formulate a consensus, conservation, and recovery strategy, the Zoo organized a Population and Habitat Viability Assessment workshop in Kingston. Conservation actions were focused on reversing high juvenile mortality due to mongoose predation and called for collection of hatchlings for an expanded head-start program at the Hope Zoo, increased field research, predator control, and an eventual restocking program. In 1994 a team from the Fort Worth Zoo constructed an iguana management and head-start facility, and by 1996 the first pilot releases of iguanas had occurred. Since then the Zoo has conducted nutritional studies, coordinated genetic research, and performed veterinary health assessments. Training of Hope Zoo staff has been ongoing, both in Jamaica and in the U.S. The reintroduction program continues today and since 1996, 76 sub-adult Jamaican Iguanas have been successfully repatriated to the wild in order to boost the remnant population surviving in the Hellshire Hills. In 2002 a milestone was reached when a released iguana appeared at one of two known nesting sites and laid eggs, evidence that head-started iguanas were becoming integrated with the wild population. Today the Jamaican Iguana is recognized as one of the world's leading conservation success stories, and reinforces the concept that captive populations, when properly managed, can be highly relevant to conservation.

Future Plans

Following tradition, the Herp Staff will continue to showcase a diverse collection and focus on the captive reproduction of rare or little-known species. With conservation and in-house research playing an increasing role in the department's master plan, staff members will further expand their ties with the academic herp commu-

nity to more broadly define and address issues of importance.

As the department nears its 50th anniversary, staff are completing plans and raising funds for a new state-of-the-art herpetarium. This improved facility will provide increased off-exhibit holding space, as well as a more dynamic public display that presents naturalistic exhibits with an educational theme of conservation and stewardship.

Acknowledgments.—Numerous people provided information and materials for this manuscript. Some of the information regarding the early history of the Zoo and Herp Department was gleaned from newspaper clippings from the Fort Worth Star Telegram, and an unpublished master's thesis written by Texas Christian University graduate student Paul Pearce in 1969. For various courtesies I thank Diane Barber, David Blody, Margaret Hobart, Rick Hudson, James B. Murphy, Lyndsay Nantz, Tracy Sturrock, Tarren Wagener, Bob Wiese, and members of the Fort Worth Zoo Herp staff.

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Dragons and Humans

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". . . THAT HE HAD RECEIVED INFORMATION FROM THE INHABITANTS OF THAT ISLAND, THAT IN THE NEIGHBOURHOOD OF LABOEAN BADJO, AND ON THE ISLAND OF KOMODO OCCURED [SIC] A VARANUS SPECIES OF AN UNUSUAL SIZE. THEY CALLED THE ANIMAL 'BOEAJA DARAT' (LAND CROCODILE)."—P. A. OUWENS (1912)

"THE PUBLIC SEES THE KOMODO DRAGON, WITH ITS AWESOME MORPHOLOGY AND UNSETTLING FEEDING BEHAVIORS, AS A COMBINATION OF CROCODILIAN, LIZARD, AND DINOSAUR - A CREATURE THAT MERCILESSLY TRACKS AND DEVOURS ITS PREY. THIS AMALGAMATION OF FEAR, RESPECT, AND ADORATION HAS DRIVEN THE RESEARCH MACHINE FOR MANY YEARS."—KURT AUFFENBERG AND WALTER AUFFENBERG (2002)

"HOWEVER, THOUGH BURDEN (1928) STATED THAT THERE IS NO INDICATION ORAS WILL ATTACK MAN, SOME INDIVIDUALS ARE DECIDEDLY AGGRESSIVE, AND ATTACKS ON HUMANS HAVE OCCURRED ON SEVERAL OF THE ISLANDS . . . ORAS WERE INVOLVED IN TWO DEATHS ON KOMODO."—WALTER AUFFENBERG (1981:320)

"ACCOUNTS OF HUMANS BEING KILLED OR INJURED BY KOMODO DRAGONS HAVE BEEN DOCUMENTED ONLY IN LOCAL CASUALTY RECORDS OF THE MANGGARAI PROVINCE IN WESTERN FLORES ISLAND."—DENNIS R. KING, ERIC R. PIANKA, AND BRIAN GREEN (2002)

In 1926, the first living Komodo Dragons (*Varanus komodoensis*), known as "Oras" in Indonesia, were placed on exhibit in New York's Bronx Zoo (Fig. 1) and the Amsterdam Zoo (Fig. 2), but the effort to display them in New York was less than satisfactory. W. Douglas Burden (1927) painted this gloomy picture, "After watching these great carnivores in the wilderness of romantic Komodo, it was painful to see the broken-spirited beasts that barely had strength to drag themselves from one end of their cage to the other. Surely, it is not all a matter of diet and a change of climate. Perhaps, as in the case of many mammals, *Varanus komodoensis*, in order to survive, demands the freedom of his rugged mountains." In 1934, a dragon on display at the Smithsonian's National Zoological Park (NZP) lived only two years after capture by the Griswold-Harkness expedition (Fig. 3). Five dragons were exhibited at NZP over a forty-year span, the average longevity being five years and the maximum being 12 years (Fig. 4). Because the largest specimens were generally captured, dragons at other North American and European zoos fared poorly as well (see Flower 1937; Jones 1965; Rookmaaker 1975), no doubt due to the fact that adult animals often have difficulty adjusting to captivity. Dragons rarely lived beyond five years in captivity, and most did not survive the first few months. Zoo visitors were excited about viewing these huge, carnivorous lizards, so collecting expeditions to Komodo were mounted to secure specimens for display until World War II brought collecting to an end for many years.

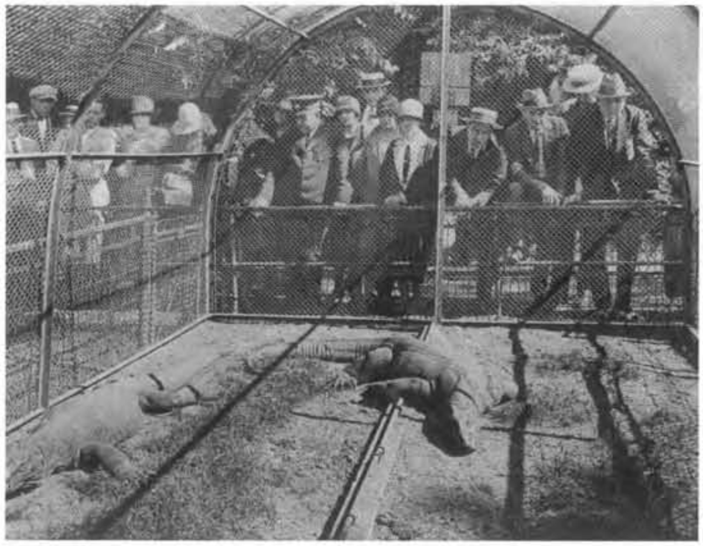

FIG. 1. Komodo dragon exhibit at Bronx Zoo (Wildlife Conservation Society). Undated photograph but possibly in the early 1930s. Credit: photograph courtesy of Wildlife Conservation Society, headquartered at Bronx Zoo.

FIG. 2. Komodo dragon with keeper at Natura Artis Magistra in Amsterdam photographed between 1926 and 1931. Komodo dragons were added to the collection in 1926. Five years later, 12 eggs were laid in a hole and protected by the female. Note tortoise in back right corner of exhibit. Credit: provided by Eugène Bruins, Natura Artis Magistra Archives.

At the London Zoo, several intriguing reports on dragon behavior seemed to contradict the belief that dragons were always dangerous to man and were delicate captives. Hill (1946) mentioned a dragon at the Zoo pushing a shovel over the stones in his cage... "and the more noise he can make with it, the more it seems to please him." Curator of Reptiles Joan Beauchamp Procter (1928) discussed tractability and tameness, "The dragon, whose name is Sumbawa, walked around a very long table, and without paying attention to the audience ate a large fowl, several eggs, and a pigeon from her hand, allowing itself to be scratched and patted even when swallowing the fowl with enormous gulps, treatment

FIG. 3. Keeper Roy Jennier next to "Xomo," the first Komodo dragon at Smithsonian National Zoological Park. This lizard was collected by Griswold-Harkness expedition in 1934, cost $780 at that time, and lived two years. Hot water pipes in rockwork provided heat. This image was duplicated in color on a postcard for sale. Photograph courtesy of Smithsonian National Zoological Park Photo Archives.

which even dogs will not always permit." and "She [at death proved to be a male] would tear a pig to pieces but can be trusted with children." Sumbawa was the host at children's tea-parties a few weeks after arrival at the Zoo and was perfectly tame with all the guests. Procter (1928–1929) included a photograph of a two-year-old child standing next to Sumbawa (Fig. 5) and examined dragon behavior, "The question of the ferocity of these lizards is, perhaps, the most misunderstood of all. All the lizards of the genus *Varanus* are savage, predatory, and highly strung, and they use their teeth, claws and slashing tails with great effect, as I have personal cause to know. At the Zoo we consider any large monitor more dangerous to deal with than a crocodile twice its size. But, allowing for this, *V. komodoensis* is the gentlest, most intelligent, and most tractable of them all. This is comparing them with speci-

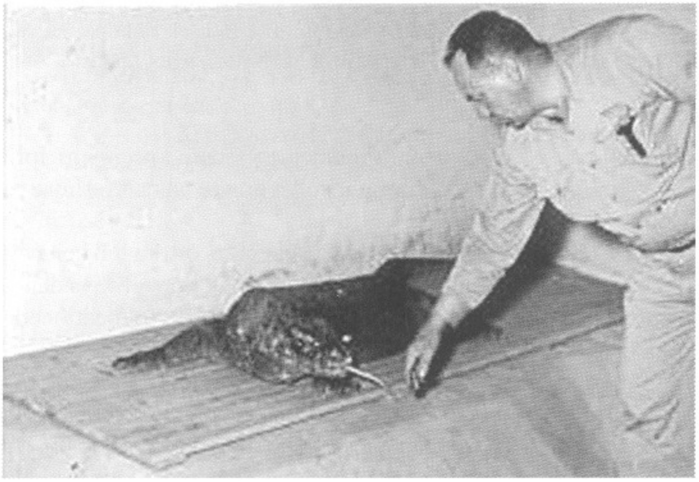

FIG. 4. Supervisor of reptiles Jack DePrato and dragon named Kalana at Smithsonian National Zoological Park in late 1960s. Photograph courtesy of Smithsonian National Zoological Park Photo Archives.

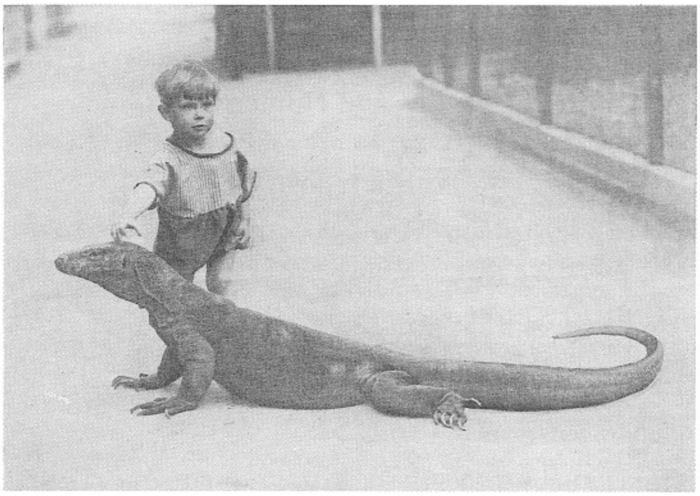

FIG. 5. Photograph by F. W. Wood of Sumbawa standing next to two-year-old child from Joan Procter's article "Dragons that are alive to-day," published in Wonders of Animal Life in 1928–1929. Photograph courtesy of Kraig Adler.

mens only half their weight of species such as *niloticus, albigularis, bengalensis, salvator, nebulosus, varius*, and so on. It is quite true that they are very nervous, and also that they could no doubt kill one if they wished, or give a terrible bite when taking food from the hand greedily, but there is no vice in them." Sumbawa accompanied Procter on strolls through the Zoo during her inspections, ". . . investigating everything which might be of interest." The lizard responded to the voice of its keeper or curator, but disliked having its tympanum touched. There is a photograph of keeper Arthur Budd with Sumbawa in 1928 (Zuckerman 1976); the scar on the lizard's neck was caused by a crocodile bite. Peter Chalmers Mitchell, Secretary of the Society from 1902 to 1935, concluded in 1929, ". . . the better conditions for the reptiles themselves and the feeding and handling of them has made some unexpected creatures docile. Notable instances are the Komodo dragons, which are as tame as dogs and even seem to show affection."

Robert Mertens from the Senckenberg Museum in Frankfurt, Germany acquired two dragons from Mr. H. R. Rookmaaker on Flores (Mertens 1930; see also Rookmaaker 1975). Mertens (translated from German) described the affair, "The next day we met the zoologically very interested assistant-resident of Flores, Mr. Rookmaaker, who immediately showed his willingness to support our expedition in any way. I was especially pleased when Mr. Rookmaaker agreed to comply with my request to get me a Komodo monitor for the Senckenberg-Museum. As the Island of Komodo had been thoroughly investigated the previous year by the American Burden-expedition, it would hardly have served any purpose to visit the Island by ourselves, as a visit to Komodo would have cost a lot of time and money. Mr. Rookmaaker showed great kindness by sending a small expedition of natives from Laboean Badjo, on the West coast of Flores, to the Island Rintja—in between Komodo and Flores—to catch a *Varanus komodoensis* for me; I would then travel to Reo, on the North coast of West-Flores, to collect this valuable animal that would be transported there from Laboean Badjo . . . As the larger *Varanus komodoensis* still persisted in refusing to take food, we decided to kill the animal, in order to prepare the skin and skeleton in a leisurely manner. After

we had tried in vain to kill the animal with chloroform [Mertens uses the term 'chloroformieren'] I reached for the needle and after an injection of 5 ccm nicotin and 10 ccm sublimate it died within a few minutes. The smaller specimen on the other hand quickly decided to start feeding: chicken eggs, chicken entrails, and veal were taken regularly. Mr. Rookmaaker now kindly gave us this lively specimen for the Frankfurt Zoo, while he courteously donated the larger specimen to the Senckenberg-Museum." There is a picture of the live dragon with a rope around its pelvic area. In 1942, curator Gustav Lederer described the habits of this tame dragon named Bübchen which lived at the Frankfurt Zoo between 1927–1944. It was taken on long walks through the zoo by the director. The dragon was in excellent health up to its death from an Allied bombing raid in which the Aquarium was demolished, thus living 16 years, 8 months, and 21 days. In Lederer's 1942 paper, there is a photograph of a woman with this large dragon. Some reptiles can recognize their keeper and are able to distinguish him from other persons. At Frankfurt, the dragon knew the veterinarian after the second treatment and could no longer be persuaded to leave its hiding place as soon as the vet appeared. The lizard even recognized the operating table and fled from it (Lederer 1931). Keeper Albert Schick allowed zoo visitors to interact with a dragon outdoors at the Frankfurt a. M. Zoo (Figs. 6, 7).

Two dragons from Rintja arrived at the Berlin Aquarium in 1927—"Max and Moritz"—presumably named after the characters from a famous old German book for children (Sachs 1927; Jones 1985; Fig. 8). Moritz lived until 1944. There is another photograph of a Berlin dragon with its keeper in a publication by Klingelhöffer (1957:247). Jürgen Lange (1989) reported on a pair of dragons from Flores which arrived at the Aquarium during May 1984, "During the first two months after their arrival both the monitors were aggressive toward visitors so viewing was restricted to the narrow sides of the terrarium and the public prohibited from touching the glass. Since then, however, they have become very tame and show no fear of their keeper."

The first dragons arrived at the Antwerp Zoo in 1930 but these lizards lived only a few years. Seven years later, other dragons began arriving at the Zoo but these varanids also lived a short time. In 1959, Walter Van Den Bergh published two interesting photographs. One pictures the chief guardian of reptiles, J. Van Gorp, next to two large dragons which became tame only a few days after arrival. The other photo shows a dragon being held by its forelegs in an upright position.

In 1937, the only zoo in Indonesia to have dragons was Surabaya. Two years later, on occasion of the 75th anniversary of the then-Dutch Zoo of Batavia (Jakarta), a book was published: "Bataviasche Planten- en Dierentuin 1864–1939" with photographs of the dragons in that old zoo and also a special chapter dedicated to them. There is an account of an expedition that would fulfill an old wish of the Zoo's board—to offer some of these dragons for sale to other zoos. The Ministry of Economic Affairs supported an expedition to collect lizards for Rotterdam, Antwerp, Rome, Edinburgh, Washington, and Philadelphia zoos. They left for Laboen Badjo in early June 1937 and decided to catch dragons by using wooden traps. The traps were baited with deer and pig meat. Only one young dragon was caught but the traps attracted a lot of very skinny dogs so they switched to the methods used by the natives—using wire traps—something they initially had wanted to avoid because of potential damage to the monitors. There is no mention on how many were caught or whether any were shipped

FIG. 6. Photograph of Komodo Dragon at Frankfurt Zoo with keeper Albert Schick during early 1960s. Photograph courtesy of Hans-Dieter Philippen and Gerard Visser.

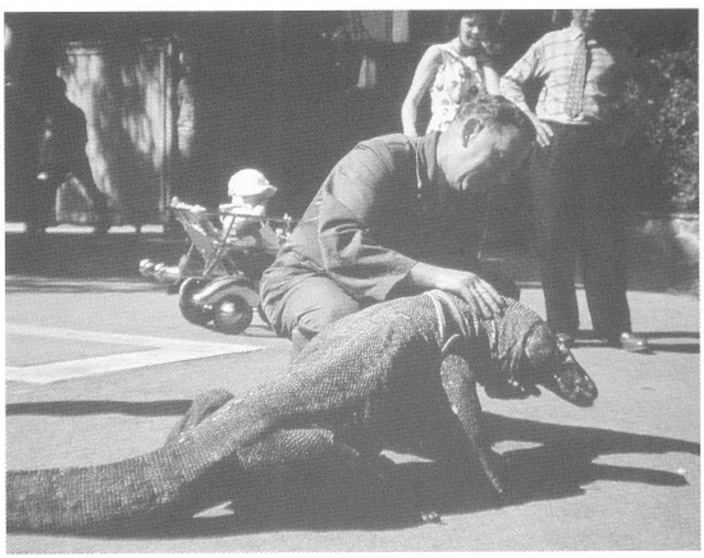

FIG. 7. This adult Komodo Dragon, with keeper Albert Schick, was allowed to walk among zoo visitors at Frankfurt a. M. Zoo in Germany. When the lizard arrived at the zoo in 1958, it measured 2.5 m. Photograph by R. Faust, courtesy of Christian Schmidt.

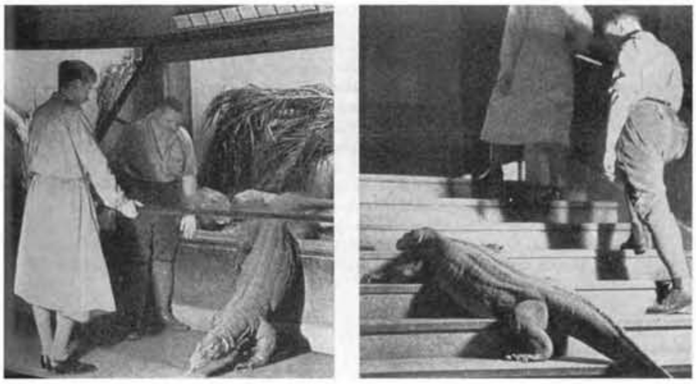

FIG. 8. Moritz, an adult male Komodo Dragon at the Berlin Aquarium. Two dragons from Rintja arrived at the Aquarium in 1927 and Moritz lived until 1944. The other dragon (Max) died shortly after arrival. Moritz is climbing out of his terrarium in the Aquarium and following his keeper like a dog. Photograph courtesy of Archive Zoo-Aquarium Berlin.

FIG. 9. Kraken with Trooper Walsh during one of the experimental trials to determine play behavior at Smithsonian National Zoological Park in 1999.

FIG. 10. Keeper Rob Lewis records Kraken's behaviors during experimental trials to determine play behavior at Smithsonian National Zoological Park in 1999. Photograph by Trooper Walsh.

FIG. 11. Kraken begs pizza from a familiar volunteer at Smithsonian National Zoological Park, 1998. Photograph by Trooper Walsh.

to foreign zoos.

In the National Geographic School Bulletin published on 10 October 1960, a cover photo said to be taken at the Rotterdam Zoo shows a young child walking with a large dragon controlled by a rope harness around its body.

Until recent decades, captive dragons have not been thoroughly investigated, due to lack of success in maintaining viable populations. At the NZP in 1995, a young female named Kraken, approximately 2.5 m in total length and hatched at the Zoo three years earlier, usually exhibited playlike behavior—removing a

FIG. 12. Kraken investigates unfamiliar visitor at Smithsonian National Zoological Park, 1998. Photograph by Trooper Walsh.

handkerchief or notebook from keeper Trooper Walsh's pocket, scraping his shoes with her forearm, playing tug of war with a plastic cup, interacting with empty cardboard boxes, as well as pieces of cloth and scarves (Fig. 9). Kraken stood on her hind legs, directed tongue flicks to Walsh's face, rested her head on his shoulder, and closed her eyes. Kraken carried frisbees, shoes, plastic toy action figures for children, and other objects around in her mouth but made no attempt to swallow them (Fig. 10). The lizard stuck its head into a plastic bucket, raised her anterior trunk so that the container covered her head and walked around the exhibit. The dragon placed her snout inside a shoe, lifted it off the substrate, and moved throughout the cage. When Walsh whistled, Kraken turned her head toward the source of the sound. Kraken could discriminate between prey and non-prey; she would gently take a rat offered with tongs and never showed an inclination to bite Walsh. See Burghardt et al. (2002) for an initial behavioral inventory and quantitative analysis of the trials with Kraken.

Not all dragons are placid toward humans, however. Walter Auffenberg (1995, pers. comm.) told us about a large rogue dragon (later identified as # 34) tracking his fifteen-year-old son Kurt and field assistant Putra Sastrawan during his study on Komodo Island. Kurt and Putra took a small trail from the base camp to work in Poreng, a pass over the mountain ridge that separates the northern and southern watersheds of the island. People used this trail to go to Sabita, a village on the northeast coast. This dragon entered their tent, tore apart articles of clothing, and carried off a soiled handkerchief. When they returned to base camp the next day, # 34 walked up to the house, laid its chin on the deck and watched them. Kurt recognized # 34 and suspected that the lizard had tracked them which was confirmed when they returned to the trail the next day; the dragon's tail drag was superimposed over their footprints. Remarkably, this dragon had tracked Kurt and Putra from Poreng back to the base camp, a distance of several kilometers. Walter interpreted this as a potential predatory episode. Of the 55 hatchlings produced by the NZP female between 1992–1995, at least two were aggressive toward humans at hatching and remained so through adulthood.

FIG. 13. Ultrasonography of dragon at London Zoo in 2005. Photograph courtesy of Richard Gibson, Zoological Society of London.

There are a number of research projects currently running or recently completed at several zoos. At the Dallas Zoo, Curator Ruston Hartdegen and associates have discovered that a dragon could discriminate between its permanent keeper, another reptile keeper who had less contact with the dragon, and a keeper from another animal department. The dragon was calm with the familiar caretaker, nervous around the less-familiar reptile keeper, and displayed defensive behavior to the keeper from another animal department (R. Hartdegen, pers. comm.). Kraken at NZP exhibited the same responses toward familiar and unfamiliar persons (Figs. 11, 12).

At the London and Houston zoos, ultrasonography without anesthesia is used to determine sex and assess reproductive condition on dragons; the dragons remain calm during the procedure (Fig. 13).

In London, a large male dragon (named Raja) was in a restraint box for target training (Fig. 14). Dragons are trained to associate a target on a stick with a food reward. The target is moved into and out of the restraint crate so that the dragons become comfortable entering this restricted space, which facilitates moving them. This interesting example of operant conditioning used food as the initial cue—then the reward frequency was gradually reduced, using

FIG. 14. Large male dragon named Raja in restraint box for targeted operant training to allow bleeding, nail clipping, physical examination, and other procedures requiring handling. Photograph courtesy of Richard Gibson, Zoological Society of London.

FIG. 15. Dolly Ellerbrock and dragon named No-Name at Pittsburgh Zoo. This enormous male dragon is called "No" by the staff and comes to them when called. No-Name hatched at Smithsonian National Zoological Park in 1993 and now measures approximately 3 m in total length and weighs ca. 82 kg. Photograph by Herb Ellerbrock, Pittsburgh Zoo.

a clicker (sound producing device) as a bridge between the target and reward (R. Gibson, pers. comm.).

At the Pittsburgh Zoo, a study was initiated to test a dragon's spatial memory by examining whether dragons use proximal (nearby) or distal (far away) visual cues to remember the location of a food reward hidden in the lizard's exhibit. Preliminary results support the hypothesis that a dragon used proximal cues to remember the location of the food and additional experiments are underway to determine if a dragon can use distal cues in other circumstances (H. Ellerbrock, pers. comm.; Fig. 15).

Dragons will prove to be interesting subjects for future behavioral studies. What we have presented here is mostly anecdotal, but systematic studies to further examine the causes for these unexpected responses by dragons toward humans will be fruitful. But why are humans motivated to interact with dragons and why are these lizards often personalized? It seems as though large reptiles in zoos, especially dragons, are often given pet names but this rarely occurs with smaller ones. Retired NZP curator Dale Marcellini offered an interesting observation—perhaps the size and shape of dragons (and other reptiles such as crocodilians) which are somewhat similar to humans may be the main reason that humans pay more attention to these large reptiles and, as a consequence, may well initiate interactions with them. In an attempt to dominate all animals, some humans may specifically focus attention on large, possibly dangerous reptiles even when there are potential risks. In other cases, humans motivated to understand why reptiles operate the way they do may concentrate on dragons and other gargantuan reptiles. Detailed comparative studies with small reptiles and humans would be very enlightening.

There are examples of habituation ("tameness") in dragons in the wild, wild dragons brought into captivity, and those hatched in captivity. In a series of arresting photographs in her 1992 book called "Les Dragons de Komodo," Nicole Viloteau is interacting with two large wild dragons and one image shows her pulling out a gigantic dragon's tongue and kissing its tip.

In our combined experience working with living reptiles for nearly 90 years, no other species has interacted with humans like Komodo Dragons—these lizards are something special. Noted varanid biologist Eric Pianka put it this way: "Varanid lizards differ from other lizards in several ways. They have more aerobic capacity and greater metabolic scope, most varanids range over larger areas, and they are much more intelligent than other lizards. If you doubt this, go to a zoo that has a Komodo Dragon, make eye contact, and look into its eyes. You will be impressed with the way it looks back at you!"

Acknowledgments.—We dedicate this contribution to Gerard Visser, Curator of Fishes and Reptiles at the Rotterdam Zoo in the Netherlands. He is Co-Chair of the European Amphibian and Reptile Taxon Advisory Group and EEP-coordinator for Komodo Dragons. Gerard has had a positive impact throughout his professional life on studying and conserving dragons.

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Marvin L. Jones, retired registrar at the San Diego Zoo, died after suffering a massive heart attack on 4 April 2006. We consulted Marvin regularly about the history of dragons in zoos and aquariums during preparation of this manuscript, our last conversation occurring two days before his death. His knowledge of zoo history was encyclopedic and he was always willing to share his knowledge with his colleagues. He will be missed.

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ARTICLES

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A Neotype for the Aldabra Tortoise, *Testudo gigantea* Schweigger, 1812

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Statement of the problem: nomenclatural instability and confusion

Ever since their discovery by Europeans, giant tortoises of the western Indian Ocean have been at the center of taxonomic debates (Chambers 2004; Crumly 1988). Two clades are now recognized from this region (Arnold 1979): *Cylindraspis* spp., the extinct Mascarene tortoises, and *Aldabrachelys* from the Seychelles-Aldabra-Madagascar region (SAM). During nearly two centuries, no fewer than five generic names, and 13 epithets have been applied to the giant tortoises of SAM, with nearly 30 binomial combinations. Yet, recent genetic research indicates that despite this plethora of names there are but three distinguishable congeneric species in SAM: two fossil forms from Madagascar, and one living taxon, the Aldabra Tortoise (Austin et al. 2003; Karanth et al. 2005; Le et al. 2006; Palkovacs et al. 2002, 2003).

In the eye of this taxonomic tempest is the Aldabra Tortoise. Over the past two decades there has been growing confusion about which scientific name to apply to the giant tortoise that lives on Aldabra Atoll. During this period at least four generic names (*Aldabrachelys*, "*Dipsochelys*," *Geochelone*, and *Testudo*) and three epithets ("*dussumieri*," *elephantina*, and *gigantea*) have been used for this tortoise, with no fewer than six binomial combinations. This nomenclatural uncertainty affects not only the two fossil species on Madagascar, but also ongoing debates about giant tortoises from other islands in the Comores and Republic of Seychelles.

The contemporary surfeit of names for the Aldabra Tortoise stems from three issues: evolving opinions on the intergeneric relationships of land tortoises (Testudinidae), enhanced understanding of the taxonomic relationships of the nominal species that lives on Aldabra and Seychelles, and varying interpretations of how to deal with Schweigger's (1812) description of *Testudo gigantea*, for which there is no known type specimen.

With regard to the question of intergeneric relationships, ever since Loveridge and Williams' (1957:220 ff.) seminal study, the Linnean genus *Testudo* has generally been restricted to certain Old World, non-gigantic species, although as late as 1996 *Testudo gigantea* was still in use (e.g., Blaszkiewitz 1996). Loveridge and Williams (p. 225) proposed the subgenus *Aldabrachelys* for grouping the Aldabra tortoise and other closely related species within *Geochelone* Fitzinger, 1835. "*Dipsochelys*" was coined by Bour (1982) to replace *Aldabrachelys* (see below) as the genus for the Aldabra tortoise and its close relatives. Today the use of

Aldabrachelys (or "*Dipsochelys*") as a full generic name, instead of *Geochelone*, comes from the generally accepted conclusion that *Geochelone* (*s. lat.*) is not monophyletic but that its subgenera are monophyletic, although there are divergent views (see Austin et al. 2003:1415; Caccone et al. 1999:6; Crumly 1982:232; 1985:117; Crumly and Sánchez-Villagra 2004; Gaffney and Meylan 1988:210; Le et al. 2006; Meylan and Auffenberg 1987:74; Meylan and Sterrer 2000:68; Palkovacs et al. 2002:224).

From no later than 1877 until at least 1915 more than one species of giant tortoise was thought to live on Aldabra Atoll. Some of the better known works that reported various species to be sympatric on Aldabra, are Günther (1877:10): *elephantina*, *daudinii*, *hololissa*, and *ponderosa*; Boulenger (1889:167–169): *elephantina*, *daudinii*, *hololissa*, and *gigantea* (with *ponderosa* regarded as a junior synonym to *elephantina*); Rothschild (1897): *gigantea* and *daudini* [*sic*] (with *elephantina*, *hololissa*, and *ponderosa* regarded as junior synonyms of *gigantea*); and Rothschild (1915:425–427): *daudinii* and *elephantina* (with *gigantea* on some other island in Seychelles, and *hololissa* regarded as a junior synonym of *gigantea*, and *ponderosa* regarded as a hybrid of *elephantina* and *gigantea*).

Since 1950 most workers have agreed that just one species of giant tortoise, *gigantea*, lives on Aldabra and the Seychelles (e.g., Mertens and Wermuth 1955:377–378; Wermuth and Mertens 1961:204, 1977:84; Williams 1950:520, 551; 1952:557). However, in the last two decades there have been renewed claims that as many as four species of giant tortoise are living, or have lived, on Aldabra and Seychelles islands (e.g., Bour 1985a:54 ff, 1985b:60 ff., 1988:403; Gerlach 2004); these assertions have been contradicted by recent molecular genetic work (Austin et al. 2003; Karanth et al. 2005; Le et al. 2006; Palkovacs et al. 2002, 2003). Questions about intergeneric relationships and multiple species on Aldabra and Seychelles are beyond the scope of this paper. Here I evaluate only the nomenclatural status of Schweigger's (1812) name, *Testudo gigantea*.

Origin and early use of *Testudo gigantea* Schweigger

In 1812 *Testudo gigantea* was described by Schweigger in two places (page 327 and pages 362–363) in a monograph that was republished partially two years later (1814) (see Bour 1984a:162; Loveridge and Williams 1957:533). According to Schweigger (1812:327), the specimen upon which his description was based, from the royal collection of Lisbon, was examined in a museum in Paris (although not specifically stated, it was later assumed that this specimen was in the Muséum National d'Histoire Naturelle, Paris; see Bour 1984a:162; Crumly 1986:238; Pritchard 1986:522). It has been questioned if Schweigger "specially indicated" a type (Pritchard 1986:522; Rothschild 1915:430), for it was not customary at that time to do so. Nonetheless, the single specimen that Schweigger described is *ipso facto* the holotype, and it has been lost since at least the beginning of the 20th Century (Bour 1984a:162; Crumly 1986:238–239; Rothschild 1915:430). The "habitat" of *T. gigantea* was listed by Schweigger (1812) as "Brasilia." Certain other species described by Schweigger (1812), with erroneous localities, are recognized today (Crumly 1988:2; Pritchard 1986:531).

Between 1831 and 1881 numerous authors referred to *T. gigantea* in varying ways showing that there was considerable confusion about the taxonomy and zoogeography of giant tortoises, and this species in particular. *T. gigantea* was placed within the complex synonymy of *Testudo indica*, a species regarded by Gray (1831a:3, 1831b:9) as highly variable and found in many parts of the tropical world. Later, Gray (1844:5–6, 1855:5–6) placed *T. gigantea* within the synonymy of *Testudo indica*, but simultaneously listed it as "T. gigantea *Schweig.?*" (or "T. gigantea *Schweigger*?") in the synonymy of *Testudo tabulata*. Duméril and Bibron (1835:114, 120, 121, 123) and Duméril and Duméril (1851:5) recognized *T. gigantea* Schweigger as a separate species, of unknown "*patria*," but noted that it resembled closely *T. elephantina*, a species known from the region of the Mozambique Channel, including Aldabra and other islands. Gray (1869:171, 1870:7) made cautionary remarks about the risks of "determining species without the examination of all the parts of the animal, the skull as well as the thorax" raising the possibility that *gigantea*, as well as eight other nominal species of giant tortoise, might not be distinct species. Günther (1877:22 fn.) commented that *T. gigantea* may be the same species as *T. elephantina*, the latter known to live on Aldabra. Other interpretations during this fifty-year period include listing *Testudo gigantea* Schweigger under *Testudo tabulata* (Temminck and Schlegel 1835:69), a synonym of *Geochelone* (*Chelonoidis*) *denticulata* Linneaus 1766, from South America; and using the name *Scapia gigantea* Schweigger (Gray 1872:3, 8) as a new combination based upon a specimen of *Manouria emys* Schlegel and Müller, 1844, a species known from Southeast Asia.

Establishment of *Testudo gigantea* Schweigger as the Aldabra Tortoise

Hubrecht (1881:43) was the earliest author known to explicitly list the locality of *T. gigantea* Schweigger as Aldabra, "the chief dwelling place of the closely allied *Testudo elephantina*." He raised the question if these are distinct species, or "merely varieties of the same species." Boulenger, in his seminal catalogue (1889:168) listed the locality of *T. gigantea* Schweigger as Aldabra, along with *elephantina* and two other nominal species. He later (1894:305) referred to "the true *Testudo gigantea* of Schweigger" having earlier indicated that a fossil form from Madagascar is "most nearly allied to *Testudo gigantea* of the Aldabra Islands" (1893:581).

From 1881 until present, *T. gigantea* has been applied to the Aldabra Tortoise, with varying opinions on the number of other giant tortoise species on this atoll and elsewhere in the Seychelles islands. As many as seven different species have been recognized at one time from the Aldabra and Seychelles area (Rothschild 1915), and as many as four species were thought to occur on Aldabra by Günther (1877:10) and Boulenger (1889:167–169).

Rothschild (1897:407) recognized *T. gigantea* Schweigger as the oldest name for the Aldabra Tortoise, and established *elephantina* and *ponderosa* as subspecies, or "casual aberrations of *T. gigantea*;" he also recognized *T. daudini*. By 1950 *T. gigantea* was the only species of Indian Ocean giant tortoise mentioned in Williams' comparative study (1950:520, 536, 552), and later Williams (1952:557 fn.) drew attention to the fact that "*T. gigantea* is the oldest name" for the Aldabra Tortoise. In 1957 Loveridge and Williams (1957:225) designated *T. gigantea* Schweigger, as the type species of their new subgenus *Aldabrachelys*. Apart from the Aldabra Tortoise and the extinct Madagascar *grandidieri*, the only other species that they specifically included in their new subgenus

was *T. sumeiri* [*sic*], a name applied to a gigantic specimen of confused origin but generally thought to come from the Seychelles. Mertens and Wermuth (1955:377–378) and Wermuth and Mertens (1961:204) listed only one species from the Aldabra and Seychelles area: *Testudo gigantea* Schweigger, 1812, with three subspecies: *T. g. gigantea* from Mahé, *T. g. daudinii* from Aldabra's south island, and *T. g. elephantina* from Aldabra's north island. Other major taxonomic studies of testudines that continued to recognize *T. gigantea* as the only species from Aldabra include Auffenberg (1974:142) and Wermuth and Mertens (1977:84). Moreover, scores of authors in more than a hundred papers in a wide variety of scientific publications have also referred to the species of the Aldabra tortoise as *gigantea* (Gerlach 2001:23 tab. 1; Stimson, in Pritchard 1986:522).

Varying opinions on the established nomenclatural system

In 1982 Bour stated that Schweigger's type description of *T. gigantea* applied "*incontestablement*" [unquestionably] to an extinct Mascarene tortoise, now known as *Cylindraspis indica* (Schneider, 1783). Though acknowledging that *gigantea* had been used for decades, including by himself (e.g., Bour 1979:1225, 1980:543, 544, 1981:120), Bour concluded that the name could not be applied to the Aldabra Tortoise and decided it was a junior synonym of *T. indica* Schneider, 1783. He then revived Duméril and Bibron's (1835) name, *T. elephantina* for the Aldabra Tortoise. Bour further concluded that *Aldabrachelys* (Loveridge and Williams 1957: 225 "Type species: *Testudo gigantea* Schweigger") was not available for the Aldabra Tortoise, but a junior synonym of *Cylindraspis* Fitzinger, 1835. On the basis of these decisions, Bour erected a new genus "*Dipsochelys*" for the giant tortoises of the Seychelles-Aldabra-Madagascar region. He later published more extensive arguments along these same lines (Bour 1984a, b); in all cases his evidence was based solely on Schweigger's (1812) description.

Pritchard (1986) agreed with Bour that Schweigger had not described an Aldabra Tortoise. However, he concluded that the 1812 description applied to the South American *Geochelone* (*Chelonoidis*) *denticulata*. Like Bour, Pritchard developed intricate arguments for reinterpreting the original description. His strongest point was an assertion that "there is persuasive circumstantial evidence that the specimen indeed came from Brazil" (1986:528). While his reinterpretation is compelling, a careful reading of Pritchard's arguments reveals that they are replete with qualifiers and caveats (for example in regard to the reliability of type localities from that era, Schweigger's two recognizable descriptions of *denticulata* listed the species as native to Virginia [Crumly 1988:2; Pritchard 1986:531]; see Rasmussen and Prys-Jones [2003] for a detailed discussion on the complexities of interpreting locality data from 19th Century ornithological specimens). Moreover, Pritchard stated that Schweigger did not designate type specimens, indicating that no type specimen for *T. gigantea* will ever be located. While Pritchard agreed with Bour that *gigantea* should be replaced by *elephantina*, he argued that *Aldabrachelys* should be maintained as per his interpretation of the rules and recommendations of the International Commission of Zoological Nomenclature (ICZN). He admitted that "invalidation of the familiar epithet *gigantea* represents a rather profound upheaval," reporting that this name was well established during the past fifty years of publications (1986:522, 531).

Crumly (1986) adopted a conservative approach to these nomenclatural dilemmas, explaining that Schweigger's (1812) description was not easy to interpret, and observing that *gigantea* was the established name for the Aldabra Tortoise. Given that the priority of the ICZN is to maintain stability and universality, he saw no reason to cause instability in a system that was established and widely used by a diversity of researchers and publications, and he reasoned that both *gigantea* and *Aldabrachelys* are valid and should be retained.

In their taxonomic review published for the Association of Systematics Collections, King and Burke (1989:70) decided to follow Pritchard (1986), as did Broadley and Howell (1991:8) in their checklist and synoptic keys. However, numerous specialists in chelonian systematics have continued to use *gigantea* for the Aldabra Tortoise, employing either *Geochelone* or *Aldabrachelys* as the generic name (e.g., Austin and Arnold 2001:2515; Austin et al. 2002:281, 2003:1417; Crumly 1988:2; Crumly and Sánchez-Villagra 2004:136, tab. 2; Ernst and Barbour 1989:250; Iverson 1992:249; Meylan and Auffenberg 1986:303, 1987:76; Meylan and Sterrer 2000:52; Zug et al. 2001:44 ff.).

A major proponent of name change for the Aldabra Tortoise and rejection of the established nomenclatural system has been Gerlach (e.g., Gerlach 1997, 2001, 2004; Gerlach and Canning 1995; see Frazier 2006 for details), who argued for the use of "*Dipsochelys dussumieri*" for the Aldabra Tortoise, thereby rejecting Bour (1984a:171 fn. 1, 1984b:282) and Pritchard's (1986:532) arguments that Gray's (1831) *T. dussumieri* is a *nomen oblitum*. In fact, Gray (1831a:3, 1831b:9, 1844:5, 1855:6), as well as Temminck and Schlegel (1835:75), clearly used "*Test. dussumieri*" only as a synonym for *Testudo indica* Schneider, 1783; hence, *T. dussumieri* is an unavailable name (ICZN Art. 11.6; Frazier, *in prep.*). Gerlach (2001:23 tab. 1) has presented a summary of names used in tortoise publications that clearly shows that *gigantea* is the established name for the Aldabra Tortoise.

Bour, in proposing the invalidation of *gigantea*, admitted to being "embarrassed to run counter to an apparently satisfying system" (1984b:281), but it is unclear what name he now prefers for the Aldabra Tortoise. Recently he has coauthored publications that have used *Aldabrachelys gigantea* (Austin et al. 2002, 2003). Yet, he has also been a coauthor of a paper in which "*Dipsochelys dussumieri*" was used for the Aldabra Tortoise (Gerlach and Bour 2003). In his review of Gerlach's (2004) popular book, Bour (2004) wrote: "[t]he author [Gerlach] has chosen to use a generic name, *Dipsochelys*, and a specific name, *dussumieri*, which are not absolutely unequivocal."

Possible disadvantages from the continued use of *Testudo gigantea* Schweigger

The only possible problem that has been mentioned for the continued use of *gigantea* for the Aldabra Tortoise is Pritchard's remark (1986:532) that the same species name was used by Grandidier (1868a, b) for an extinct giant tortoise from Madagascar, *Emys gigantea*. However, this junior homonym of *T. gigantea* Schweigger was purposely replaced by Vaillant (1885:876) with *T. grandidieri* (see also Boulenger 1894:305). Hence, *Emys gigantea* has long since been supplanted by *T. grandidieri*, with widespread and continuous use, including by Pritchard himself

(Pritchard and Trebbau 1984:198). The only way that this homonym could cause a problem would be to invalidate Vaillant's established designation and try to supplant it with Grandidier's long disused name—a proposition that would only cause more chaos and instability and contravene ICZN Article 59.1 (1999).

Summary of the contemporary situation regarding *Testudo gigantea* Schweigger

The above discussion clearly shows that there is not only general instability and chaos regarding the valid name of the Aldabra Tortoise, but the major proponents (Bour 1982, 1984a, b; Gerlach 2001; Pritchard 1986) for "invalidating" *gigantea* have admitted that this action causes upheaval in an established nomenclatural system, thereby negating the ICZN objectives of stability, priority, and universality. Other specialists of chelonian taxonomy and systematics have chosen to reject the claim that Schweigger's (1812) *T. gigantea* is not valid (see above). As mentioned earlier, Rothschild (1915) and Bour (1982) reported that the type specimen is lost. Although other workers (e.g., Arnold, Gerlach, Pritchard) have examined type material of giant tortoises in the Muséum National d'Histoire Naturelle, Paris, with special attention to old types, there is no evidence that Schweigger's (1812) type is extant. Consequently, while scholars may continue to reinterpret Schweigger's (1812) description, there can be no unequivocal determination, for this type specimen is lost.

Designation of the neotype for *Testudo gigantea* Schweigger, 1812

To clarify the situation and stabilize the name for the Aldabra Tortoise, I designate USNM 269962, an adult male from Dune Patates, South Island, Aldabra Atoll, Republic of Seychelles, as the neotype of *Testudo gigantea* Schweigger, 1812. This specimen at the National Museum of Natural History, Smithsonian Institution, consists of a skull, mandible, articulated carapace and plastron, scutes (most of which are attached to the shell), postcranial skeleton, and fragments of skin. Skull measurements (mm) are: basicranial length = 110; maximum length = 123; maximum width = 82.9. Shell measurements (cm) are: straight carapace length = 82.4, curved carapace length = 116.2; straight width of 3rd vertebral = 28.0, curved width of 3rd vertebral = 30.1; and plastron length = 65.0 (see Grubb [1971:330] for a description of methods for measuring Aldabra Tortoise shells). There is a conspicuous nuchal scute; and the fourth vertebral has an epoxy-filled circle where a titanium disk was once attached (see Gaymer 1973). This neotype is a specimen of the nominal species *Testudo gigantea* Schweigger, which has recently been defined and diagnosed thoroughly as *Aldabrachelys gigantea* by Arnold (1979:138), as *Geochelone gigantea* by Crumly (1982:218 ff., 1985:124) and Crumly and Sánchez-Villagra (2004:Table 2. ff.), and as "*Dipsochelys elephantina*" by Bour (1994:19–25, 93 ff.). As Loveridge and Williams (1957:225) noted when erecting the subgenus *Aldabrachelys*, this taxon is characterized by having the external naris higher than wide.

The status of *Aldabrachelys* Loveridge and Williams, 1957

As summarized above, Bour (1982:117, 1984a:170, 1984b:282) stated that Loveridge and Williams' (1957:225) subgeneric name *Aldabrachelys* is a junior synonym for *Cylindraspis* Fitzinger, 1835, and is thus not valid for the Aldabra Tortoise. Nonetheless, various authors have reasoned that without a ruling by the ICZN, *Aldabrachelys* continues to be available for the Aldabra Tortoise (Crumly 1986:240; King and Burke 1989:70; Meylan and Auffenberg 1987:74; Pritchard 1986:532). Bour (1994:136–137) contended that these authors were in error, and he stated that he will continue to use "*Dipsochelys*" for the generic name of the Aldabra Tortoise until a "hypothetical decision" is taken by the Commission. It is unclear if he ever submitted a proposal to the Commission, and as Bour (1994:137) admitted, the Commission has not offered an opinion on the status of the purported misidentified type specimen of *Aldabrachelys*. Hence, Loveridge and Williams' (1957) name continues to be available for the Aldabra Tortoise and closely allied species. In any case, *Dipsochelys* Bour, 1982, is a subjective junior synonym and not a valid name for the Aldabra Tortoise. Moreover, the designation of a neotype for the type species (*Testudo gigantea* Schweigger) of the genus *Aldabrachelys* Loveridge and Williams (1957) removes the nomenclatural confusion associated with the generic name of the Aldabra Tortoise. *Aldabrachelys* stands as the valid generic name for *Aldabrachelys gigantea* and other closely allied species (*A. abrupta*, *A. grandidieri*, and *A. laetoliensis*) whenever these species are regarded as generically distinct from other taxa of giant tortoises.

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Histology and Histochemistry of Caudal Courtship Glands in Three Arkansas Plethodontid Salamanders

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Breeding behavior in plethodontid salamanders is comprised of several stages that employ tactile, chemical, and possibly visual stimulation (Verrell 1997). Certain integumentary glands called caudal courtship glands, located at the dorsal base of the tail in some male plethodontid salamanders, presumably produce pheromones and are of special interest concerning courtship and mating behavior (Sever 1989). Caudal courtship glands were first reported and histologically described in plethodontids by Noble (1929), who called them "hedonic" glands. Arnold (1977) later renamed them "courtship" glands and suggested these glands be referred to by their anatomical position (hence the name "caudal" courtship glands; Staub and Paladin 1997). Courtship glands may play a pivotal role in reproduction by pheromonally influencing female receptivity during mating (Sever 2003), and thereby influencing individual mating success.

Caudal courtship glands produce secretions during the breeding season (Sever 1989, 2003). During the mating season some male plethodontids (e.g., *Plethodon jacksoni* = *Plethodon wehrlei*—Newman 1954; *Eurycea multiplicata*—Noble 1929) exhibit an elevated ridge or protuberance at the dorsal base of the tail within which caudal courtship glands have been found (Hamlett et al. 1998; Sever 1989; Trauth et al. 1993). The secretions produced by these glands are thought to aid in eliciting the "tail-straddling walk," which is a courtship component unique to plethodontids (Arnold 1977). During this walk the female places her snout directly above the glands on the tail base of the male. Her nasolabial grooves are believed to transfer chemicals from these glands to her vomeronasal organs (Houck and Sever 1994) where pheromonal stimulation presumably maintains the female's interest while the male deposits a spermatophore on the substrate. The female then may pick up the spermatophore with her cloacal lips, essentially completing the tail-straddling walk. Since spermatophore deposition is dependent upon the female being in the tail-straddling position (Houck and Reagan 1990) and because pheromonal secretions from the caudal courtship glands presumably increase the likelihood that the female will remain in this position, these glands would increase success in male insemination of a female. Although sexual dimorphism and hypertrophy during the breeding season provide compelling evidence of a courtship function for these glands (Sever 2003), functional tests have not been performed.

Caudal courtship glands are known in *Desmognathus, Eurycea*, and *Plethodon* (Sever 2003). Histological evidence also exists for several species of *Eurycea* (Hamlett et al. 1998; Noble 1929; Sever

TABLE 1. Staining properties of various epidermal glands of *Plethodon albagula*, *Desmognathus brimleyorum*, and *Plethodon ouachitae*. Negative reaction (-), weak positive reaction (+), strong positive reaction (+++).

Species	Gland type	H&E	Pollak trichrome	Alcian blue	PAS	Secretion type
P. albagula	Caudal courtship	Basophilic	Greenish-blue	-	+	Granular
P. albagula	Mucous	Basophilic	no reaction	+++	+	Fibrous
P. albagula	Granular	Eosinophilic	Reddish-brown	-	-	Granular
P. ouachitae	Caudal courtship	Eosinophilic	Purple-red	-	+	Granular
P. ouachitae	Mucous	Basophilic	no reaction	+++	+	Fibrous
P. ouachitae	Granular	Eosinophilic	Orange-brown	-	_	Granular
D. brimleyorum	Caudal courtship	Eosinophilic	dark purple	-	+	Granular
D. brimleyorum	Mucous	Basophilic	no reaction	+++	+	Fibrous
D. brimleyorum	Granular	Eosinophilic	Orange-brown	-	_	Granular

1985, 1989; Trauth et al. 1993), *Plethodon cinereus* (Houck and Sever 1994; Noble 1929), *Plethodon jordani* (Noble 1929) and several desmognathines (e.g., *Desmognathus phoca* = *Desmognathus monticola*; *Desmognathus fuscus fuscus* = *Desmognathus auriculatus*; *Desmognathus fuscus carolinensis* = *Desmognathus ochrophaeus*—see Noble 1929). Herein, we report the presence of these glands in three additional species of salamanders in the two plethodontid subfamilies: Desmognathinae (*Desmognathus brimleyorum*, the Ouachita Dusky Salamander) and Plethodontinae (*Plethodon albagula*, the Western Slimy Salamander, and *P. ouachitae*, the Rich Mountain Salamander). In addition, our study provides the first histological detail describing caudal courtship glands in a desmognathine salamander.

Methods.—Male specimens were collected from Polk, Montgomery, Crawford, Newton, Logan, and Pike counties in Arkansas (Appendix 1; *P. albagula*, N = 5; *P. ouachitae*, N = 2; *D. brimleyorum*, N = 6). They are deposited in the Arkansas State University Herpetological Museum. The majority of voucher specimens were collected during the spring months (from Mar–May; N = 11). Early spring appears to be the optimal breeding season for these species (Taylor et al. 1990; Trauth et al. 1990), although little is actually known about the mating season in Arkansas. Specimens collected during this period were examined because caudal courtship glands are known to hypertrophy during the breeding season in other species (Sever 1989), thus indicating that they may serve some function related to mating. For comparison, some animals were collected from the non-reproductive season (N = 2). The snout–vent length (SVL) of each specimen was measured from the tip of the snout to the anterior margin of the vent.

Histological examination was performed using routine histological methods (Presnell and Schreibman 1997). Skin was excised from the dorsal base of the tail of preserved specimens and compared to patches of skin excised from the trunk region just

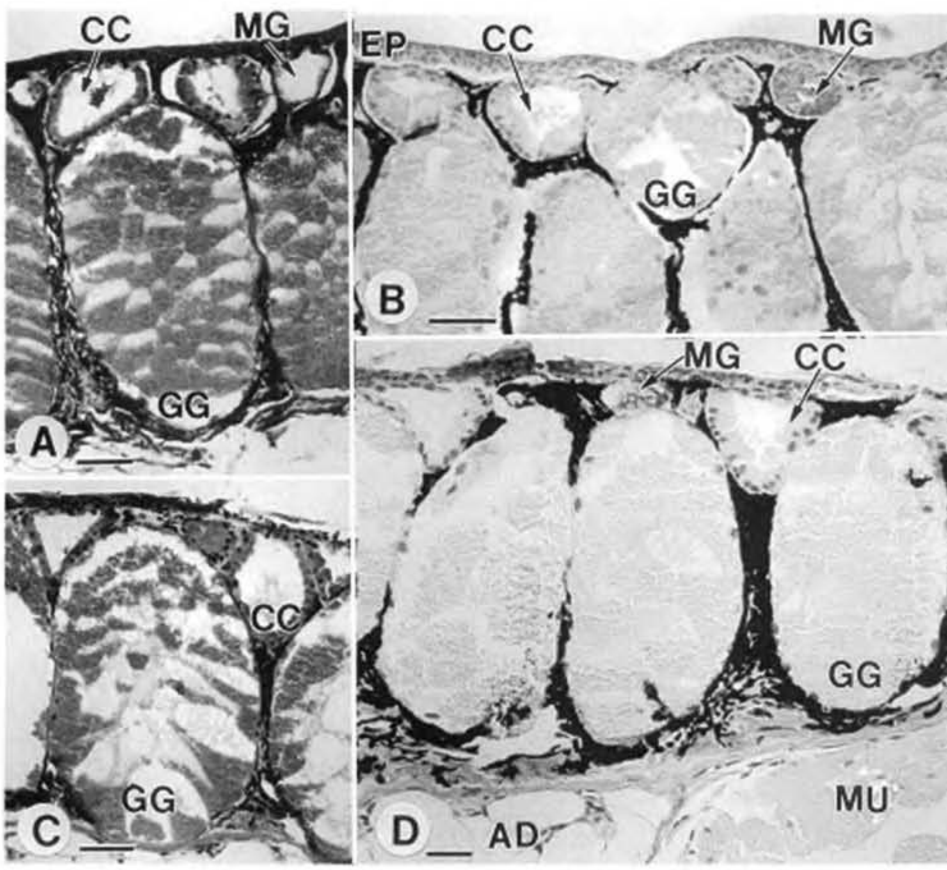

FIG. 1. A. Caudal courtship, granular, and mucous glands of *Plethodon albagula* stained with Pollak trichrome; dark areas below the epidermis represent melanophores; scale bar = 100 µm. B. Caudal courtship, granular, and mucous glands of *Plethodon albagula* stained with alcian blue; scale bar = 100 µm. C. Caudal courtship and granular glands of *Plethodon ouachitae* stained with Pollak trichrome; scale bar = 100 µm. D. Caudal courtship, granular, and mucous glands of *Plethodon ouachitae* stained with alcian blue; scale bar = 100 µm. Adipose tissue (AD), caudal courtship glands (CC), epidermis (EP), granular glands (GG), mucous glands (MG), muscle (MU).

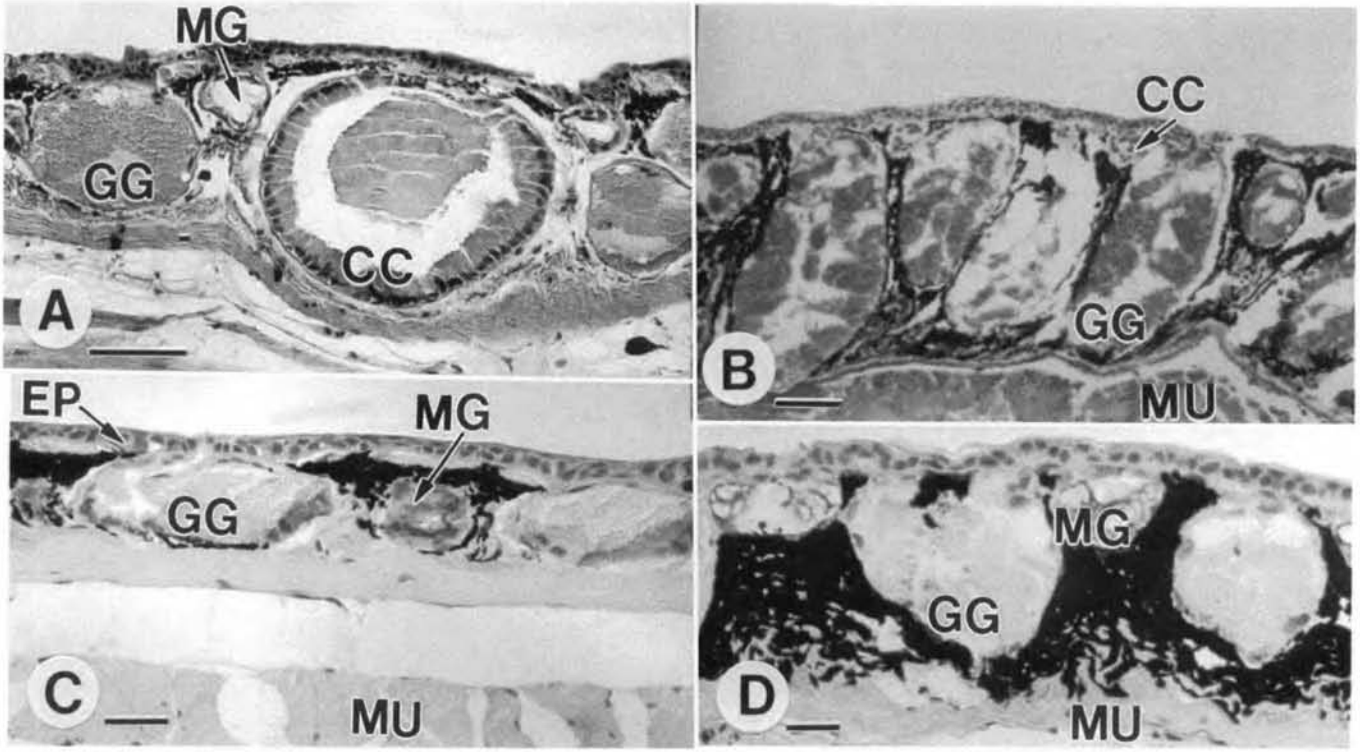

FIG. 2. A. Caudal courtship, granular, and mucous glands of *Desmogathus brimleyorum* stained with H & E; scale bar = 100 µm. B. Caudal courtship and granular glands present outside of the breeding season of *Plethodon albagula* stained with Pollak trichrome; scale bar = 100 µm. C. Granular and mucous glands present in the dorsal trunk region of *Desmognathus brimleyorum* stained with alcian blue; scale bar = 50 µm. D. Granular and mucous glands present in the dorsal trunk region of *Plethodon ouachitae* stained with alcian blue; scale bar = 100 µm. Adipose tissue (AD), caudal courtship glands (CC), epidermis (EP), granular glands (GG), mucous glands (MG), muscle (MU).

anterior to the hind legs. Tissue samples were dehydrated in a graded series of ethanol solutions, cleared in xylene, infiltrated and embedded in paraffin, and serially sectioned into ribbons 8 µm thick. Serial ribbons were mounted on glass slides using Haupt's adhesive.

Tissues were stained or treated with four histological stains: hematoxylin and eosin (H & E), alcian blue 8GX (pH 2.5), Pollak trichrome, and periodic acid-Schiff reagent (PAS). General cytology was revealed by using H & E, and alcian blue indicated the presence of carboxylated glycosaminoglycans. Pollak trichrome revealed connective tissue and mucins (common in glandular secretions) and was expected to stain elastin red, fibrin and calcium purple, collagen and mucus blue green. Neutral carbohydrates, mucopolysaccharides, mucoproteins, glycoproteins, and other carbohydrate-protein substances were reveal by PAS (Presnell and Schreibman 1997). Collectively, these stains and reactions revealed the presence of caudal courtship glands and allowed for differentiation among all glands present in the epidermis (caudal courtship, granular, and mucous glands; see Sever 1989). Tissues were examined and photographed using a compound light microscope at 100× magnification.

Caudal courtship glands are, in part, defined by their staining properties. They are known to have an eosinophilic reaction with H&E, a negative reaction with alcian blue, a positive reaction with PAS, and mixed reactions (more than one color evident) with Pollak trichrome (Hamlett et al. 1998; Sever 1989; Trauth et al. 1993). These glands are also defined by their anatomical location on the dorsal tail base.

Results.—Plethodon albagula (mean SVL = 71 ± 0.96 mm; range 62–72 mm), *P. ouachitae* (mean SVL = 58 ± 2.8 mm; range 56–60 mm), and *D. brimleyorum* (mean SVL = 78 ± 6.9 mm; range 76–89 mm) possessed caudal courtship glands in the skin at the dorsal base of their tails. No male specimen examined in this study lacked caudal courtship glands. These glands contain serous secretions and differ in staining properties (Table 1) from granular and mucous glands also located in this region (Fig. 1).

The epithelium of caudal courtship glands in *P. albagula, P. ouachitae*, and *D. brimleyorum* was simple columnar, and nuclei were arranged basally in each gland cell (Figs.1A, 1C, and 2A). Epithelia of mucous and granular glands were modified low simple columnar that almost appeared squamous-like (Figs. 1A, 1D, and 2A).

Caudal courtship glands of *P. albagula* (Fig. 1B), *P. ouachitae* (Fig. 1D) and *D. brimleyorum* exhibited secretions with no reaction to alcian blue and a slightly positive reaction to PAS (Table 1). Caudal courtship glands of *P. albagula* produced secretions that were slightly basophilic with H & E. In *P. ouachitae* and *D. brimleyorum* (Fig. 2A), secretions of caudal courtship glands appeared slightly eosinophilic with H & E. With Pollak trichrome, secretions of *P. albagula, P. ouachitae*, and *D. brimelyorum* stained dark red (*D. brimleyorum* secretions often additionally contained a blue-green component), and epithelia stained blue-green with dark red nuclei (Fig. 1A,1C).

During the breeding season, caudal courtship glands in the tail base region of *P. ouachitae* varied in shape, including triangular, barrel-shaped, or spherical configurations, presumably due to

squeezing from the surrounding hypertrophied granular glands (Figs. 1C and 1D). Caudal courtship glands were spherical in *D. brimleyorum* (Fig. 2A) and spherical or ovoid in *P. albagula* (Figs. 1A and 1B). There was no consistent difference in shape between pre-secretory, secretory, and post-secretory stages.

Granular glands, mucous glands, and caudal courtship glands of specimens of *P. albagula* collected outside the breeding season appeared extremely small relative to their size in specimens examined within the breeding season; moreover, they appeared to be fewer in overall number (Fig. 2B). Courtship glands were rarely observed or were absent in sections of the skin taken from the trunk region of the body (Figs. 2C and 2D).

Discussion.—Although no female plethodontids were examined in this study, we conclude that the glands examined are caudal courtship glands based on staining property similarities between the glands in the present study and glands described by Sever (1989), Trauth et al. (1993), and Hamlett et al. (1998). We predict that these glands will be absent in female plethodontids. The absence or extreme reduction in caudal courtship glands size in specimens collected outside of the breeding season compared with those from specimens collected within the breeding season also supports their classification as courtship glands. The absence of these glands in the trunk region provides additional evidence that they may play a role in the tail-straddling walk stage of courtship.

Staining of caudal courtship glands in *P. albagula* differed from *Eurycea longicauda melanopleura* and *E. lucifuga* in that Trauth et al. (1993) and Hamlett et al. (1998) found the latter two species to appear eosinophilic with H & E. Our study revealed them as basophilic. Caudal courtship gland secretions in *P. ouachitae* and *D. brimleyorum* stained similarly to those in *E. l. melanopleura* and *E. lucifuga* (eosinophilic). Staining properties of caudal courtship glands in *P. albagula, P. ouachitae,* and *D. brimleyorum,* agreed with those in *E. lucifuga* and *E. l. melanopleura*, when PAS, alcian blue, and Pollak trichrome were employed.

All staining properties of glands in *D. brimleyorum* and *P. ouachitae* match those found by Sever (1989) in the *Eurycea bislineata* complex. He reported that caudal courtship glands are eosinophilic. Our results for *P. albagula* differ; a basophilic reaction is indicated. Agreement of staining properties resulting from PAS and alcian blue in our study with Sever (1989) suggests that secretions of caudal courtship glands *in P. albagula, P. ouachitae,* and *D. brimelyorum* are also likely mucoproteins.

Staining with Pollak trichrome indicated the possible presence of elastin (red), fibrin and calcium (purple), and collagen and mucus (blue-green) in caudal courtship glands (Presnell and Schreibman 1997). Positive reactions of caudal courtship glands with PAS and negative reactions of these glands with alcian blue may indicate the presence of a neutral carbohydrate (Hecker et al. 2003).

Courtship glands can occur in areas other than the dorsal tail base (Noble 1929; Thurow 1968), although they are normally concentrated at the tail base. In *D. brimleyorum*, the large caudal courtship glands occupied such an overall high volume during the breeding season that they displaced the adjacent mucous glands in the tail base region.

Our study has revealed the existence of caudal courtship glands in three additional plethodontid species and includes the first detailed histological description of these glands in a desmognathine salamander. Knowledge of the presence of caudal courtship glands is useful because pheromones produced by these glands probably increase female receptivity and, therefore, male mating success. Although overall understanding of the role of glandular secretions and their relationship to salamander behavior in plethodontid salamanders remains insufficient, female receptivity and the probability of insemination are known to increase markedly due to the effects of courtship glands (e.g., mental glands; Houck and Reagan 1990). Further investigations of caudal courtship glands will undoubtedly shed more light on this remarkable method of sexual communication in salamanders.

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APPENDIX 1. Collection data for specimens examined.

Species	Museum No. (ASUMZ)	Date of collection (mm/dd/yy)	SVL (mm)	County
P. albagula	22419	4/17/98	70	Crawford
P. albagula	15887	4/14/90	72	Crawford
P. albagula	15464	3/13/90	71	Newton
P. albagula	22756	5/27/98	72	Polk
P. albagula	19201*	9/22/93	62	Pike
P. ouachitae	22762	5/27/98	56	Polk
P. ouachitae	24016	4/15/00	60	Polk
D. brimleyorum	22397	3/27/98	68	Montgomery
D. brimleyorum	21840	5/11/97	76	Polk
D. brimleyorum	22523	4/18/98	84	Polk
D. brimleyorum	21749	4/19/97	85	Polk
D. brimleyorum	23156	4/16/99	79	Logan
D. brimleyorum	3561**	8/15/80	89	Polk

*Animal collected during non-reproductive season.
**Animal collected during non-reproductive season; skin only excised from dorsal trunk region.

Herpetological Review, 2006, 37(3), 284–288.

Reproductive Ecology of *Atelopus zeteki* and Comparisons to Other Members of the Genus

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The Panamanian Golden Frog, *Atelopus zeteki* Dunn (Anura: Bufonidae), is a taxon of concern endemic to the Coclé and Panamá Provinces of Panama (Dunn 1933; Savage 1972), principally inhabiting lowland rainforest (Savage 1972) on the Pacific cordilleran slope. Bufonidae are among four families of amphibians containing more "rapidly declining" species than the average (Stuart et al. 2004), and of 34 species of amphibians which have gone extinct since 1500 (Stuart et al. 2004), three were in the genus *Atelopus* (IUCN et al. 2004). In addition, of 77 described species of *Atelopus* (Frost 2004), 61 (82%) are listed as Critically Endangered (IUCN et al. 2004), and it has been suggested that this is the first example of a species-rich lineage being so uniformly imperiled (Lötters et al. 2004). In particular, *Atelopus zeteki* is listed as Critically Endangered (IUCN et al. 2004) and given the highest level of protection by the Convention on International Trade in Endangered Species (CITES I). Development of conservation strategies and long-term monitoring programs for threatened species is contingent upon understanding species' life histories. As basic biological and ecological information is lacking for many *Atelopus* species, collection of such data may be crucial for conservation efforts.

Relatively little is known about the reproductive ecology of *Atelopus* frogs (Lötters 1996). While breeding phenology usually varies somewhat among species and populations depending upon local climatic conditions, limited data suggest that *Atelopus* breeding generally occurs at the beginning of the dry season (Lötters 1996, Savage 2002). *Atelopus* oviposit in cryptic locations, attaching their eggs to the undersides of rocks in swiftly flowing streams generally during periods of low water flow (Savage 1972, Lötters 1996). Previous descriptions of egg-laying and clutch characteristics come principally from captive or dissected animals. The few reported field observations of egg masses or oviposition sites provide limited data on clutch sizes, ovum diameter, and/or oviposition site characteristics in *A. flavescens* (Lescure 1981) and *A. franciscus* (Boistel et al. 2005) from French Guyana, and *A. muisca* (Rueda-Almonacid and Hoyos 1991) from Colombia. To our knowledge, no published information from the field or laboratory exists on the reproductive ecology of *A. zeteki.* Our objectives were to describe the clutches and oviposition sites of *A. zeteki* and compare their reproductive ecology with that of other *Atelopus* species.

Materials and Methods.—In 10–16 December 2004 and 8–15 December 2005, we conducted surveys for *Atelopus zeteki* in Panamá Province, Panama, in a small stream ca. 5–15 m in width with steep rocky slopes. We searched for *A. zeteki* egg masses by overturning rocky substrates and submerged woody debris and examining accumulations of leaf litter within the stream channel along a 200 m reach. These searches were conducted in conjunction with surveys for adult *A. zeteki* along the stream margins and on exposed rocks and small islands within the stream. All frogs were marked by toe-clipping. When clutches were found, we counted the number of eggs per clutch and measured the diameters of at least 20 eggs, randomly chosen, from each of three clutches. Embryo developmental stages were estimated (Gosner 1960). To characterize the microhabitat at oviposition sites, we measured overstory canopy closure using a concave spherical densiometer (only in 2005), size of substrate (Platts et al. 1983) to which an egg mass was attached, predominant size of surrounding substrate (visually estimated within a 1 m^2 area centered on the oviposition substrate), water depth at the location of the clutch (only in 2004), distance of oviposition substrate to wetted edge, wetted width of stream at each oviposition site, stream velocity (m/s) near each egg mass, and instream habitat type (e.g., pool or riffle, Platts et al. 1983). Stream velocity at oviposition sites was estimated by determining the time it took for a floating object to travel a 1 m stream segment centered on the location of an egg mass. Velocity was calculated as the distance traveled divided by the time elapsed. In addition, we measured the distance between clutches within each year. In 2004, we measured general habitat conditions for five of the variables along the stream reach and

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UROTHECA DECIPIENS (Collared Glass-tailed Snake). **DIET**. *Urotheca decipiens* is a small, diurnal, terrestrial snake that is reported to consume amphibians and small lizards (Solorzano 2004. Snakes of Costa Rica. Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica. 791 pp.). At 2000 h on 22 September 2005 we found an adult female *U. decipiens* (240 mm SVL; 37 mm tail length; 6.8 g) moving through the leaf litter after dark in Omar Torrijos National Park (Cocle Province, Panama). A portion of the tail was missing, presumably lost as part of the antipredatory defense that is typical of the genus (Savage 2002. The Reptiles and Amphibians of Costa Rica. Univ. Chicago Press, Chicago, Illinois. 934 pp.). After collection the snake regurgitated the head and neck of a small *Sphaerodactylus* sp. This is the first report of *Sphaerodactylus* in the diet of *U. decipiens*, as well as the first report of *U. decipiens* in Cocle Province and Central Panama. In addition, our observation of the active snake at night suggests *U. decipiens* may not be entirely diurnal. The snake and its gut contents were deposited in the Circulo Herpetologico de Panama (*U. decipiens* CH 5975; *Sphaerodactylus* sp. CH 5976).

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GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 37, Number 1 (March 2006). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extension reports unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA MACULATUM (Spotted Salamander). USA: TENNESSEE: Cannon Co.: Cooper Hollow. 22 February 2006. J. L. Miller, J. A. Miller, J. H. Miller, and B.T. Miller. Verified by A. Floyd Scott. Austin Peay State University (APSU 18157, color photo). Adult male captured in a minnow trap set in a small, shallow pond adjacent Sinks Miller Rd. ca. 1 km E of Burt Burgen Rd. intersection. New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State Uniersity, Clarksville, Tennessee. 94 pp. Internet version <http://www.apsu.edu/amatlas> contains links to information on Tennessee distribution of amphibians that have appeared since 1996, accessed 23 February 2006).

Submitted by **JOSHUA A. MILLER** and **JACOB H. MILLER**, Saint Rose of Lima School, Murfreesboro, Tennessee, 37085, USA; and **JOYCE L. MILLER** (e-mail: jlmiller@mtsu.edu) and **BRIAN T. MILLER,** Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee 37132, USA (e-mail: bmiller@mtsu.edu).

AMBYSTOMA TIGRINUM TIGRINUM (Eastern Tiger Salamander). USA: OHIO: Preble Co.: Jefferson Township. Paul McKee Road 0.25 km west of Rawley Road (39°52.857'N, 84° 45.108'W). 16 February 2006. Jeffrey G. Davis and Natalie A. Fath. Verified by John W. Ferner. CMNH 8935. New county record (Pfingsten and Matson 2003. Ohio Salamander Atlas. Ohio Biological Survey, Columbus). Adult male 122 mm SVL, 254 mm TL.

Submitted by **JEFFREY G. DAVIS**, Cincinnati Museum Center, Fredrick and Amye Geir Research and Collections Center, 1301 Western Avenue, Cincinnati, Ohio 45203-1130, USA (e-mail: anura@fuse.net); and **NATALIE A. FATH**, Institute of Environmental Sciences, Miami University, 102 Boyd Hall, Oxford, Ohio 45056, USA (e-mail: fathna@muohio.edu).

NECTURUS MACULOSUS (Mudpuppy). USA: ILLINOIS: Pope Co.: Upstream of Regan Ford in Lusk Creek, end of road 1007 off of Eddyville Blacktop 7 (37°30'35"N, 88°32'19"W). 15 February 2006. Diane K. Shasteen. Verified by Ronald A. Brandon. SIUC H-8323. Juvenile specimen. New county record (Philips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, Champaign, Illinois. xii + 282 pp.).

Submitted by **DIANE K. SHASTEEN**, Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901, USA.

NOTOPHTHALAMUS VIRIDESCENS LOUISIANENSIS (Central Newt). USA: ARKANSAS: Union Co.: Beech Creek at St. Hwy. 160, ca. 3.2 km E of Mount Holly (Sec. 25, T16S, R18W).

29 November 2005. Henry W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 29520). Verified by Stanley E.Trauth. New county record (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

Submitted by **HENRY W. ROBISON**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA; e-mail: hwrobison@saumag.edu.

ANURA

APLASTODISCUS CAVICOLA (Perereca-verde; Green Treefrog). BRAZIL: MINAS GERAIS: Municipality of Caratinga: Reserva Particular do Patrimônio Natural Feliciano Miguel Abdala (RFMA), (19°44'S, 41°49'W). 26 August 2000. J. Cassimiro. Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil (MZUSP A-133902, J. Cassimiro field number 38). Municipality of São Gonçalo do Rio Abaixo: Estação Ambiental de Peti (19° 52'23"–19°54'27"S; 43°20'51" – 43°23'28"W). 17 April 2002. J. Cassimiro and M. A. S. Canelas. Herpetological Collection of Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil (UFMG Field Numbers P33 and P41). Both verified by R. Neves Feio. Published distribution for the species is Serra da Mantiqueira, Minas Gerais, and Serra da Boa Vista, Espírito Santo, southeastern Brazil (Frost 2004. Amphibian Species of the World: an Online Reference. Version 3.0. 22 August 2004. Electronic database available at http://research.amnh.org/herpetology/amphibia/index.html. American Museum of Natural History. New York). These are the most inland records for the species. The record from Estação Ambiental de Peti extends known distribution ca. 205 km airline N from Juiz de Fora municipality, Minas Gerais (Cruz and Peixoto 1984. Arq. Univ. Fed. Rur. Rio de Janeiro, Itaguaí 7:31–47), and the record from RFMA ca. 128 km W from Santa Teresa municipality, Espírito Santo (Cruz and Peixoto 1984, *op. cit.*).

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DENDROPHRYNISCUS LEUCOMYSTAX. BRAZIL: SANTA CATARINA: Municipalidade de Guaramirim, Quati (26°26'S, 48°57'W). 9 July 2002. G. Woehl Jr., Natural History Museum & Biodiveristy Research Center Slide Collection, Kansas University, Lawrence, Kansas (KU-CT 11954–11957). Verified by J. Peres Pombal, Jr. Previously known from states of Rio de Janeiro and São Paulo (Izecksohn 1968. Rev. Brasil. Biol. 28[4]:357–362). First state record and from the Atlantic forest in southern Brazil, extends known distribution ca. 300 km from Registro, Sao Paulo State, the nearest locality known (Izecksohn and Da Cruz 1972. Arq. Univ. Fed. Rural do Rio de Janeiro 2[2]:63–69).

Submitted by **GERMANO WOEHL, JR.** and **ELZA N. WOEHL**, Instituto Ra-bugio para Conservacao da Biodiversidade, Rua Antonio Cunha, 160 sala 25 – Baependi – 89256-140 Jaragua do Sul, Santa Catarina, Brazil (e-mail: germano@ra-bugio.org.br).

ELEUTHERODACTYLUS ANGUSTIDIGITORUM (Patzcuaro Peeping Frog). MÉXICO: JALISCO: Municipality of Tuxpan, 9–15 road miles W Atenquique, 2012–2500 m elev. Between 12 and 17 July 1966. J. R. Dixon and W. R. Heyer. LACM 25447,25471–25583. 6 road miles W Atenquique, 2195 m elev. 20 July 1964. R.G. Webb. LACM 25448–70. Near Concepción de Buenos Aires, Jalisco (19°56'N, 103°13'W), 2264 m elev. 6 June 2004. P. Ponce-Campos. Bosque Tropical Herpetological Collection, Guadalajara, Jalisco (BT, M-030). All verified by H. M. Smith. First records for Jalisco, with the Atenquique records being an approximate range extension of 110 km WNW and the Concepción record a 97 km W extension from the nearest Michoacan localities depicted in Dixon (1957. Texas J. Sci. 9:379–409).

Submitted by **PAULINO PONCE-CAMPOS**, Bosque Tropical, A. C., Apartado Postal 5-515, Guadalajara, Jalisco 45042, México (e-mail: poncecp@hotmail.com); and **KENT BEAMAN**, Natural History Museum of Los Angeles County, 900 Exposition Blvd., Los Angeles, California 90007, USA (e-mail: helodermia@adelphia.net).

ELEUTHERODACTYLUS SYMINGTONI (NCN). CUBA: PINAR DEL RÍO: Sierra de la Güira, small cave 2 km SW of Los Bermejales (22°40'5.9"N, 83°26'30.5"W). 14 December 2003. A. Rodríguez. Instituto de Ecología y Sistemática, Colección Zoológica de la Academia de Ciencias de Cuba (CZACC14. 12798). Sierra de la Güira, Los Bermejales, Cueva de Bartolo (22°49'5.9"N, 83°25'53.0"W). 14 December 2003. O. Jiménez and M. Condis. CZACC 14. 12799. Both verified by L. V. Moreno. First records for Sierra de la Güira, and a range extension of 15 km SW from the nearest known locality at Pan de Guajaibón, and only the seventh known locality for this species on Cuba (Schwartz 1957. Proc. Biol. Soc. Washington 70:209–212; Estrada 1989. Rev. Biol. 3:155–165). Both frogs were found during daylight inside caves. The records could influence future assessments on the conservation of this species, which was considered critically endangered by Rodriguez et al. (1999. *In* Perez et al. [eds.], Conservation Breeding Specialist Group (SSC/IUCN). Report of Conservation Assessment and Management Plan Workshop for Selected Cuban Species: SBSG. Apple Valley, Minnesota).

Submitted by **ARIEL RODRÍGUEZ** and **ROBERTO ALONSO**, Instituto de Ecología y Sistemática, Carr. De Varona, Km 3 1/2, Capdevila, Boyeros. AP 8029, CP 10800, Ciudad de la Habana, Cuba; e-mail: ariel@ecologia.cu.

GLYPHOGLOSSUS MOLOSSUS (Blunt-headed Burrowing Frog). THAILAND: PHETCHABURI PROVINCE: Ban Lat District: Huay Luk Subdistrict: Poo Toom Mountain, near Ban Poo Toom. 21 January 2006. O.S.G. Pauwels. Thailand Natural History Museum, Pathum Thani (THNHM 09966). Verified by Wichase Khonsue (Chulalongkorn University, Bangkok). A single adult specimen caught at 1515 h in a rock crevice filled with water and tree leaves on a hilltop in dry dipterocarp forest. It was found

in syntopy with an adult *Bufo melanostictus*. First provincial record and southwesternmost record for the genus. The closest Thai record is from Ratchaburi Province, to the north, without a precise locality (Taylor 1962. Univ. Kansas Sci. Bull. 43[8]:265–599; Nutphund 2001. Amphibians of Thailand. Amarin Printing and Publishing Public Co., Ltd., Bangkok; Chan-ard 2003. A Photographic Guide to Amphibians in Thailand [in Thai]. Darnsutha Press, Bangkok; Nabhitabhata et al. "2000" [2004]. Checklist of Amphibians and Reptiles in Thailand. Office of Environmental Policy and Planning, Bangkok, Biodiversity Series, vol. 9).

We thank Tanya Chan-ard (National Science Museum, Pathum Thani) and Peter Paul van Dijk (Conservation International, Washington, D.C.) for information and Thongchana Chimsunchart (Ban Lat) for assistance in the field.

Submitted by **OLIVIER S. G. PAUWELS**, Department of Recent Vertebrates, Institut Royal des Sciences Naturelles de Belgique, Rue Vautier 29, 1000 Brussels, Belgium; e-mail: osgpauwels@yahoo.fr.

HYLA VERSICOLOR (Gray Treefrog). USA: ARKANSAS: JEFFERSON Co.: Big Creek at US Hwy. 79 (Sec. 17, T7S, R10W). 14 October 2005. Henry W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 29521). Verified by Stanley E.Trauth. New county record and fills a gap in southern Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

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HYALINOBATRACHIUM IBAMA. VENEZUELA: ESTADO BARINAS: San Isidro (8°50'23"N; 70°34'23"W), 1479 m. 14 June 2005. R. Rivero and C. L. Barrio. Museo de la Estación Biológica Rancho Grande, Ministerio del Ambiente, Maracay, Estado Aragua (EBRG 5229–33). Verified by J. M. Guayasamín. First record of the species in Venezuela. *Hyalinobatrachium ibama* was recently described by Ruíz-Carranza and Lynch (1998. Rev. Acad. Colomb. Cienc. 22[85]:571–586) from Municipios Gámbita, Charalá, and Santa Bárbara, Departamento de Santander, Colombia. The closest distance between a Colombian locality and San Isidro is 421 km NE.

Submitted by **CÉSAR L. BARRIO-AMORÓS,** Fundación Andígena, Apartado 210, Mérida 5101-A, Venezuela; e- mail: cesarlba@yahoo.com.

PSEUDACRIS CRUCIFER CRUCIFER (Northern Spring Peeper). USA: TENNESSEE: HARDIN Co.: White Oak Wildlife Management Area, Milledgeville Quad (35.34726°N, -88.25979°W.). 26 January 2005, 16.7°C. Brandon Wear. Austin Peay State University Museum of Zoology (APSU 17697). Call index # 2 of *P. c. crucifer* digitally recorded near bottomland hardwoods during a Tennessee Amphibian Monitoring Program (TAMP) route run. New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.; hard copy and Internet versions [http://www.apsu.edu/amatlas/], the latter of which includes links to information on amphibians in Tennessee recorded since 1996; accessed 3 January 2006). FAYETTE Co.: Wolf River Wildlife Management Area , SE Moscow Quad (35.02223°N, -89.28274°W, NAD 83). 31 January 2005, 12.2°C.. Brandon Wear. APSU 17704. Full chorus digitally recorded near bottomland hardwoods/ depressional wetland during a TAMP route run. New county record (Redmond and Scott 1996, *op. cit.),*

Digital recording made under the authority of the Tennessee Wildlife Resources Agency; field work supported by State Wildlife Grant (SWG) funding under the authority of the U.S. Fish and Wildlife Service. Specimens verified by A. Floyd Scott.

Submitted by **CHRIS HUNTER**, Tennessee Wildlife Resources Agency Region I, 200 Lowell Thomas Drive, Jackson, Tennessee 38301, USA; e-mail: christopher.hunter@state.tn.us.

PSEUDACRIS FERIARUM FERIARUM (Upland Chorus Frog). USA: TENNESSEE: HAYWOOD Co.: Near the intersection of Windmon Road and Cherryville Road located in the Jones Quad (35.727820°N, -89.178520°W.). 7 February 2005, 9.4°C. Chris Hunter. Austin Peay State University Museum of Zoology (APSU 17691). Full chorus digitally recorded near roadside ditch in agriculture field during a Tennessee Amphibian Monitoring Program (TAMP) route run. New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.; hard copy and Internet versions [http://www.apsu.edu/amatlas/], the latter of which includes links to information on amphibians in Tennessee recorded since 1996; accessed 3 January 2006). CROCKETT Co.: Near Randolph Road and Randolph Massey Road intersection located in the Maury City Quad (35.767830°N, -89.150260°W). 7 February 2005, 8.9°C. Chris Hunter. APSU 17692. Call index # 2 digitally recorded near a roadside ditch in an agricultural field during a TAMP route run. New county record (Redmond and Scott 1996, *op. cit.*).

Digital recordings made under the authority of the Tennessee Wildlife Resources Agency; field work supported by State Wildlife Grant (SWG) funding under the authority of the U.S. Fish and Wildlife Service. Specimens verified by A. Floyd Scott.

Submitted by **CHRIS HUNTER**, Tennessee Wildlife Resources Agency Region I , 200 Lowell Thomas Drive, Jackson, Tennessee 38301, USA; e-mail: christopher.hunter@state.tn.us.

PSEUDIS CARDOSOI (NCN). BRAZIL: SANTA CATARINA: Municipality of Lebon Régis, Serra da Esperança (26°51'28"S, 50°41'13"W, 1125 m elev.). 25 October 2005. R. Lingnau. Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil (MCP 8607 male, collected at night, vocalizing at a permanent pond). Verified by A. Kwet. The species occurs in the southern regions of the Serra Geral, and is known from several localities in Rio Grande do Sul State (Kwet 2000. Amphibia-Reptilia 21:39–55). It is assumed that the species also occurs in Santa Catarina, but no voucher is preserved in collections (Kwet, *op. cit.*). First vouchered record from the Santa Catarina State, extending the known range ca. 150 km N airline from the Municipality of Vacaria, in Rio Grande do Sul State.

Submitted by **RODRIGO LINGNAU** (e-mail: rodrigolingnau@yahoo.com.br) and **MARCOS DI-BERNARDO**, Laboratório de Herpetologia, Museu de Ciências e Tecnologia and Faculdade de Biociências, Pontifícia Universidade Católica do Rio

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TESTUDINES

APALONE SPINIFERA PALLIDA (Pallid Spiny Softshell). USA: ILLINOIS: JERSEY CO.: Side channel of the Mississippi River, west of the confluence of Piasa Creek and the Mississippi River side channel at approximate River Mile 209 (UTM: zone 15 E 734629m, N 4312837m, NAD27CONUS). 24 October 2005. Collected by John K. Tucker, James T. Lamer, and Chad R. Dolan, Illinois Natural History Survey. INHS 19855. Verified by Chris Phillips, INHS. Specimen is a first county and state record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois.) Specimen was live-captured in a fyke net along with 32 Eastern Spiny Softshell Turtles (*Apalone spinifera spinifera*) after a four-day set. This is a significant range extension (~1000 km) for this subspecies as it is typically found in western Louisiana to southern Oklahoma, and most of the northern and eastern parts of Texas (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Inst. Press, Washington and London. 578 pp.). It is the first specimen reported from Illinois, and may be a released captive. Its true origin and means of arriving in Illinois is uncertain. This specimen is of significance because of its potential to interbreed with *A. s. spinifera*, the native subspecies. Shell dimensions and mass for this male specimen, recorded while still alive, are as follows: carapace length = 165 mm, carapace width = 134 mm, carapace height = 49 mm, plastron length = 119 mm, mass = 510 g.

Submitted by **JAMES T. LAMER, JOHN K. TUCKER,** and **CHAD R. DOLAN,** Illinois Natural History Survey, 8450 Montclair Ave., Brighton, Illinois 62012, USA.

KINOSTERNON LEUCOSTOMUM (White-lipped Mud Turtle, Tortuga Amarilla). HONDURAS: CAYOS COCHINOS ARCHIPELAGO: Bay Island Province: Cayo Cochino Pequeño, SE side of island near a freshwater outlet (15°56'59"N, 86°29'59"W, datum: WGS84), 1 m elev. 25 July 2004. S. M. Boback. Verified by Andy Holycross. Photo vouchers, of complete empty shell with intact scutes, deposited in Arizona State University Museum (ASU HP-00049–00050). First record for Cayo Cochino Pequeño (McCranie et al. 2005. Amphibians and Reptiles of the Bay Islands and Cayos Cochinos, Honduras. Bibliomania, Salt Lake City).

We thank the Honduran Coral Reef Foundation and Operation Wallacea for supporting our research in the Cayos Cochinos.

Submitted by **SCOTT M. BOBACK**, Department of Biological Sciences, University of Alabama, Tuscaloosa, Alabama 35487, USA (e-mail: sboback@ua.edu); **CHAD E. MONTGOMERY**, Southern Illinois University, Department of Zoology, Carbondale, Illinois 62901, USA (e-mail: chad_mont@yahoo.com); and **ROBERT N. REED**, Department of Biology, Southern Utah University, Cedar City, Utah 84720, USA (e-mail: reed@suu.edu); and **STEPHEN GREEN**, 18 Durand Road, Earley, Reading, Berkshire, RG6 5YR, United Kingdom (e-mail: steveinsabah@hotmail.com).

MAUREMYS ANNAMENSIS (Annam Pond Turtle). VIETNAM: GIA LAI PROVINCE: Buon Luoi [= Buon Loy, Ban Loi], ca. 20 km NW of Kannack Town, An Khe District. 15 November 1993. Ilya S. Darevsky and Nikolai L. Orlov. MVZ 222124. Verified by Theodore J. Papenfuss and Jonathan J. Fong. This is the third record of this critically endangered turtle. The species has been previously reported from Da Nang [= Phuc Son], Da Nang Province (Siebenrock 1903. Mathem.-Naturwiss. Klasse 122:333–352) and Hoi An [= Fai-Fo], Quang Nam Province (as its junior synonym *Annamemys merkleni*; Bourret.1939. Annexe Bull. Gén. Instr. Publ. 1939:5–39). The specimen is a hatchling turtle that fell into an artificial well.

Submitted by **JAMES F. PARHAM**, 1101 VLSB, University of California, Berkeley, California 94720, USA (e-mail: parham@socrates.berkeley.edu); **BRYAN L. STUART**, The Field Museum, Department of Zoology, Division of Amphibians & Reptiles, 1400 South Lake Shore Drive, Chicago, Illinois 60605, USA; and **NIKOLAI L. ORLOV**, Zoological Institute, Russian Academy of Sciences, Universitetskaya nab. 1, St. Petersburg, Russia, 199034.

TERRAPENE CAROLINA TRIUNGUIS (Three-toed Box Turtle). USA: TEXAS: KLEBERG CO.: Hwy 77 south frontage road, ca. 0.2 km S of jct. with General Cavazos Blvd (27°29.432'N, 97°50.882'W). 14 May 2004. Collected by Lucy E. Arispe. Verified by Travis J. LaDuc. Texas Natural History Collections (TNHC 63215). New county record, extends range south two counties (Dixon 2000. Amphibians and Reptiles of Texas, 2nd ed. Texas A&M Univ. Press, College Station. 421 pp.).

Submitted by **RANDY L. POWELL** and **LUCY E. ARISPE**, Natural Toxins Research Center, MSC 158, Texas A&M University, Kingsville, Texas 78363, USA; e-mail: randy.powell@tamuk.edu.

TERRAPENE NELSONI NELSONI (Southern Spotted Box Turtle). MÉXICO: JALISCO: Municipality of Guachinango, ca. 30 km WSW from Ameca, 1250 m elev. 18 June 1999. Omar Montes-Ontiveros. Verified by John Iverson. Bosque Tropical Herpetological Collection, Guadalajara, México (BT, M-018). First record for Jalisco and a 230 km range extension SSE of the nearest record at Pedro Pablo, Nayarit (Milstead and Tinkle 1967. Copeia 1967:180–187).

Submitted by **OMAR MONTES-ONTIVEROS,** Ornitorinco S.P.R. de R. L., Alliot # 3990, C.P. 45070, Zapopan, Jalisco, México (e-mail: ornitorrincomex1@hotmail.com); and **PAULINO PONCE-CAMPOS**, Bosque Tropical, A.C., Apartado Postal 5-515, Guadalajara, Jalisco 45042, México (e-mail: poncecp@hotmail.com).

TRACHEMYS SCRIPTA ELEGANS (Red-eared Slider). USA: FLORIDA: LEON CO.:, multiple localities in the vicinity of Tallahassee, first county records as follows. Lake Jackson (30.52872°N, 84.35580°W). Gravid female. 28 May 2004. Matthew J. Aresco (MJA). Florida Museum of Natural History (FLMNH) Herpetology Department photographic archive (UF 144701, color slide). MJA had earlier observed two adult females and three adult males here in 2000–2001. Additional records from Leon County include: UF 144704, color slide; UF 144703, color slide; and UF 144702, color slide. In addition, we have observed *T. s. elegans* at McCord Pond (30.47400°N, 84.26162°W), Tom Brown Park Pond

(30.4419°N, 84.2146°W), San Luis Pond (30.45951°N, 84.32244°W); Goose Pond (30.47897°N, 84.24391°W), and Hidden Pond (30.47165°N, 84.32929°W).

Besides recording nesting and gravid females, MJA recorded several instances of hybridization with native *T. s. scripta*, based on intermediate color patterns. These included three hybrids from Lake Jackson, 2 July 2000, UF 141456–141458, and nine hatchlings from Lake Jackson, 9 May 2000, 11 June 2000, 14 June 2000, and 28 June 2000 (unvouchered DOR specimens). All specimens and photographic identifications verified by Kenneth Krysko.

Trachemys. s. scripta is the dominant emydid in many lentic freshwater bodies in the Florida panhandle, including Leon County. *Trachemys. s. elegans* poses a real threat of hybridization and genetic swamping to this native subspecies. We have already recorded evidence of hybridization at Lake Jackson and suspect it at most of the listed sites. We therefore have called upon state regulatory agencies to institute an immediate prohibition on further sales and importation of *T. s. elegans* into the state.

Submitted by **MATTHEW J. ARESCO**, Florida State University, Tallahassee, Florida 32306, USA (e-mail: aresco@bio.fsu.edu); and **DALE R. JACKSON**, Florida Natural Areas Inventory, Florida State University, 1018 Thomasville Road, Suite 200-C, Tallahassee, Florida 32303, USA (e-mail: aresco@bio.fsu.edu).

LACERTILIA

AMPHISBAENA DUBIA. BRAZIL: MINAS GERAIS: Belo Horizonte, Serra do Curral (19°55'S, 43°54'W, 1100 m elev.), area of highlands ("campo rupestre") in transition region between the Atlantic Forest and "Cerrado" biomes. 15 July 2005. P. R. Evers Jr., A. L. Silveira and D. S. Lima Filho. Museu Nacional, Rio de Janeiro, Brazil (MNRJ 13254). Verified by R. Fernandes. Species previously known from the states of São Paulo, Paraná, Santa Catarina, and one record in Minas Gerais, Brazil (Barros Filho et al. 2005. Herpetol. Rev. 36[3]:335; Gans 1964. Breviora 205:1–11; Peters and Orejas-Miranda 1970. Catalogue of the Neotropical Squamata: Part II Lizards and Amphisbaenians. U.S. Natl. Mus. Bull. 297:31; Vanzolini 2002. Pap. Avul. Zool. 42[15]:351–362). Second state record and the northern limit of its known distribution, ca.130 km NE from the closest previous record (Brazil, Minas Gerais, Ritápolis municipality; Barros Filho et al. 2002, *op. cit.*).

Submitted by **PAULO R. EVERS JR.** (e-mail: pauloevers@hotmail.com), **ADRIANO LIMA SILVEIRA** (e-mail: biosilveira@yahoo.com.br), and **DORIVAL SANTOS LIMA FILHO** (e-mail: lima.dorival@gmail.com), Setor de Herpetologia, Departamento de Vertebrados, Museu Nacional, Universidade Federal do Rio de Janeiro, Quinta da Boa Vista, São Cristóvão, CEP 20940-040, Rio de Janeiro, RJ, Brazil.

BACHIA PYBURNI. BRAZIL: AMAZONAS: Municipality of São Gabriel da Cachoeira, Parque Nacional do Pico da Neblina: Morro dos Seis Lagos (0°17'28"N; 66°40'57"W), 12 May 2004. Coleção de Anfíbios e Répteis, Instituto Nacional de Pesquisas da Amazônia, Manaus, Amazonas, Brazil (INPA-H 12754, SVL 84.4 mm; body mass in life 4 g); terra firme forest near right bank of the Tucano River (0°37'20"N; 65°55'26"W), 12 November 2004 (INPA-H 12753, SVL 77.8 mm; body mass in life 5.4 g), and trail in terra firme forest (0°38'34"N; 66°00'46"W), 26 September 2005 (INPA-H 14967, SVL 90.7 mm; body mass in life 4 g). Vinicius T. Carvalho and L. Bonora. Verified by M. Hoogmoed. This species was previously known from Colombia and Venezuela (Kizirian and McDiarmid 1998. Herpetologica 54:245–253). These specimens represent the first Brazilian records, extending the known distribution 318 km, 394 km, and 384 km (airline) east, respectively, from the type locality in the Vaupés River drainage, SW Colombia (1°01'N; 69°27'W) and 83 km (airline) from the paratype in the western part of Cerro de la Neblina, southern Venezuela (0°49'50"N; 66°09'40"W) (Kizirian and McDiarmid 1998, *op. cit.*).

Submitted by **VINICIUS T. DE CARVALHO** (e-mail: viniciustc@ig.com.br), **LUCÉIA BONORA, RICHARD C. VOGT,** Instituto Nacional de Pesquisas da Amazônia, Coleção de Anfíbios e Répteis, Coleções Zoológicas, INPA – Campus II. Av. André Araújo, 2936. C.P. 428. CEP 69.083-000 Manaus, Amazonas, Brazil; and **TERESA C. S. ÁVILA-PIRES,** Departamento de Zoologia, Museu Paraense Emílio Goeldi, C.P. 399, CEP 63.017-970 Belém, Pará, Brazil.

CARINATOGECKO HETEROPHOLIS (Iraqi Keel-scaled Gecko). IRAN: KERMANSHAH PROVINCE: Kuh Salan Mts close to Iraq border (approx. 35°14'N, 46°17'E) 1800 m elev., near Owraman (35°17'N, 46°10'E) NW of Pave-Darian, W Kermanshah, W Paveh, NW Nowsud on road to Marivan, 22–25 April 2003. Hamid Bostanchi. ZMGU 1925. Verified by Steven C. Anderson. Adult captured between layers of stones in a rocky habitat in mountain oak woodland. This specimen represents the rediscovery of this species and the second record for Iran. Previous records were Salahedin, Erbil Liwa, Iraq (type locality) (Reed and Marx 1959.Trans. Kansas Acad. Sci. 62[1]:91–122 [as *Alsophylax persicus*]; Minton et al. 1970. Proc. California Acad. Sci. 37[9]:333–362, fig. 12 [as *Tropiocolotes heteropholis*]) and Ilam, Iran (Anderson 1999. The Lizards of Iran. Contrib. Herpetol. Vol. 15. Society for the Study of Amphibians and Reptiles. Ithaca, New York. vii + 442 pp., 25 pl.). The present locality is ca. 78 airline km SE Sulaimaniyah, Iraq (35°34'N, 45°27'E) and 180 km NNW Ilam, Iran (33°38'N, 46°26'E). The specimen is in agreement with the description of the holotype (Minton et al. 1970:357–358, fig. 12).

Submitted by **HAMID BOSTANCHI**, P.O. Box 31375–378 Karaj-Mehrvila, Iran; e-mail: hamid_bostanchi@yahoo.com.

CROTAPHYTUS COLLARIS (Eastern Collared Lizard). USA: TEXAS: DALLAM CO.: Rita Blanca National Grasslands (36°23'264"N, 102°28'965"W), 1229 m elev. 27 August 2005. Photo voucher (UTA Digital Collection-1002). Verified by Jonathan Campbell. First county record (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station. 421 pp.).

Submitted by **STACEY E. BUCKLIN** and **ANDREW M. BRINKER**, Department of Biology, Texas Christian University, Fort Worth, Texas 76129, USA; e-mail: a.brinker@tcu.edu.

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). USA: TEXAS: GRIMES CO.: County Road 192 ca. 1.5 km W of the

City of Carlos and 0.4 km from the Texas State Highway 30 and County Road 192 intersection (30°35'40"N, 96°5'34"W). Collected on 22 February 2006. TCWC 90687. Verified by Toby Hibbitts. New county record (Dixon 2000. Amphibians and Reptiles of Texas, Second edition, Texas A&M Univ. Press, College Station. 421 pp.) Fills in the hiatus between Montgomery and Brazos counties. Specimen collected at a residence.

Submitted by **KJ LODRIGUE, JR.**, Texas A&M University, Department of Wildlife & Fisheries Sciences, College Station, Texas 77843-2258, USA.

LIOLAEMUS LOBOI. ARGENTINA: NEUQUÉN: Departamento Huiliches: Surroundings of San Ignacio, San Ignacio, 39°54'S, 70°51'W. 14 March 1961. L. E. Pena. Field Museum of Natural History, Chicago (FMNH 133128, 133131, 133746, 133752, 133755, 133760). Verified by S. Quinteros. Extends the range 145 km NE from the only previously known locality: Neuquén Province, Los Lagos Department, intersection between national route 237 and national route 231 (type locality, Abdala 2003. Cuad. Herpetol. 17[1–2]:3–32).

Submitted by **CRISTIAN ABDALA**, Instituto de Herpetología de la Fundación Miguel Lillo, Miguel Lillo 251, 4000, Tucumán, Argentina (e-mail: popper@tucbbs.com.ar); and **FERNANDO LOBO**, CONICET -Cátedra de Anatomía Comparada, Facultad de Ciencias Naturales, Universidad Nacional de Salta, Bolivia 5150, 4400, Salta, Argentina (e-mail: flobo@unsa.edu.ar).

LYGOSOMA TANAE (Tana River Writhing Skink). KENYA: COAST PROVINCE: Malindi District, Watamu at Jimba (03°54'S, 39°33'E). 24 June 2003. Royjan Taylor. National Museums of Kenya NMK L/2664. SVL 77.0 mm. Verified by Robert C. Drewes. First record for Malindi District (Spawls et al. 2002. A Field Guide to the Reptiles of East Africa. Academic Press, San Diego, 543 pp.). Loveridge (1935. Bull. Mus. Comp. Zool. 79:1–19) described *Riopa tanae* from Kau, near the mouth of the Tana River in Kenya, with paratypes from the nearby localities of near Witu, Golbanti and Ngatana, all in the Lamu and Tana River districts of Coast Province. Howell and Msechu (1984. Herpetol. Rev. 15:78) recorded it from Ndungu, South Pare, Kilimanjaro Region, Tanzania. Additional specimens are known from coastal southern Somalia (Lanza and Carfi 1968. Monit. Zool. Ital. N.S. 2, Suppl.:207–260). The new locality is ca. 115 km SSW of the localities on the lower Tana River and 245 km NE of Ndungu.

Submitted by **AARON M. BAUER**, Department of Biology, Villanova University, 800 Lancaster Avenue, Villanova, Pennsylvania 19085–1699, USA (e-mail: aaron.bauer@villanova.edu); and **PATRICK K. MALONZA**, Department of Herpetology, National Museums of Kenya, Museum Hill, P.O. Box 40658–00100, Nairobi, Kenya (e-mail: cbd@museums.or.ke).

PETROSAURUS REPENS (Short-nosed Rock Lizard). MÉXICO: BAJA CALIFORNIA SUR: Coronados Island. (26°7'43.7"N, 111°16'37.1"W). 12 September 2004. Crystian S. Venegas-Barrera. Verified by Jesse L. Grismer. La Sierra University Digital Photo Catalogue (LSUDPC 688–89). First record for this species on Coronados Island; the only other island in the Sea of Cortés where the species is known to occur is Danzante (Grismer 2002. Amphibians and Reptiles of Baja California: Including Its Pacific Islands and the Islands in the Sea of Cortez. Univ. California Press, Berkeley).

Submitted by **CRYSTIAN S. VENEGAS-BARRERA**, **GUSTAVO ARNAUD**, Centro de Investigaciones del Noroeste, Baja California Sur, La Paz, B.C.S. 23090, México; **LEE L. GRISMER**, Departament Biology, La Sierra University, Riverside, California 92515, USA; and **ÁNGEL RODRÍGUEZ**, Centro de Investigaciones del Noroeste, Baja California Sur, La Paz, B.C.S. 23090, México (e-mail: sadiel@cibnor.mx).

PLESTIODON LYNXE BELLI (Bell's Oak Forest Skink). MÉXICO: JALISCO: Municipality of Quila (20°17'N, 104°03'W) 2000 m elev. P. Ponce-Campos, R. and H. Romero-Contreras, and R. Romero-Luna. 5 March 2003. Verified by H. M. Smith. Bosque Tropical Herpetological Collection (BT, M-010). First record for Jalisco and a range extension of ca. 315 km N of nearest confirmed record, 16 mi. W Milpillas, Zacatecas (Webb 1968. Publ. Mus. Michigan State Univ. Biol. Ser. 4:1–28). One possible Jalisco record of *Eumeces l. lynxe*, reported by Taylor (1935. Univ. Kansas Sci Bull XXIII:1–643), was determined by Webb (*op. cit.*) to be a *E. dugesi*.

Submitted by **PAULINO PONCE-CAMPOS** and **RODOLFO ROMERO-CONTRERAS**, Bosque Tropical, A.C. Apartado Postal 5-515, Guadalajara, Jalisco 45042, México; e-mail: poncecp@hotmail.com.

PLESTIODON SEPTENTRIONALIS OBTUSIROSTRIS (Southern Prairie Skink). USA: TEXAS: JACK CO.: immediately adjacent to FM road 3324 (33.112° N, 98.122° W; 380 m elev.). 1 April 2005. Jesse M. Meik and A. Michelle Lawing. Verified by Carl J. Franklin. University of Texas at Arlington transparency collection (UTA 33306–07). Two individuals were found at 1630 h, beneath separate small limestone slabs, part of a small, scattered rock field within a mosaic of open pasture, tallgrass prairie, and post oak woodland. The air temperature was 15.2°C and the surface temperature under the rocks ranged from 18.8–20.6°C. First county record (Dixon 2000. Amphibians and Reptiles of Texas. 2nd Edition. Texas A&M Univ. Press, College Station).

Submitted by **A. MICHELLE LAWING** and **JESSE M. MEIK**, Department of Biology, The University of Texas at Arlington, Arlington, Texas 76012, USA; e-mail: jmeik@uta.edu.

TROPIOCOLOTES STEUDNERI (Steudner's Dwarf Gecko). IRAN: Qeshm Island: in the southern part of Qeshm Isand, out of Qeshm city (26°58'N, 56°16'E), ca. 100 m from the sea. S. M. Dakhteh and K. Kamali. 4 April 2004 at 2200 h. ZMGU 840. Verified by Haji Gholi Kami and Steven C. Anderson. This is the first record of this species from Qeshm Island and the third known specimen from Iran. The specimen fits the diagnosis and color pattern in Anderson (1999. The Lizards of Iran. SSAR Contribution to Herpetoloy, Ithaca, New York) and with the descriptions of Anderson's (MMTT 1048) and Guibé's (MNHNP 1966.18) specimens, both from the vicinity of Bandar-e Lengeh (26°33'N, 54°53'E), on the coastal mainland across a narrow stretch of the Persian Gulf from Qeshm Island. See Anderson (1999:197–198) and Guibé (1966. Bull. Mus. Nat. Hist. nat., Paris, ser. 2, 38[2]:337–346) for further remarks on this taxon.

Submitted by **KAMRAN KAMALI**, No.554, Between Jamalzadeh and Pirouz streets, Jomhouri Ave., Zistandish Environmental Research Co., Zip code: 13187–63797(e-mail: canis58@yahoo.com and kamran@zistandish.com) and **S. MOHAMMAD DAKHTEH**, In front of Edareye Barq, Jahad Street, Qeshm Island, Hormozgan province, Iran, Zip code: 79517–43354; e-mail: ophiomorus@yahoo.com.

SERPENTES

CLELIA QUIMI. BRAZIL: BAHIA: Municipality of Paulo Afonso, Usina Hidrelétrica Itaparica (09°21'S, 38°14'W), area with typical caatinga vegetation. 30 September 1988. U. Simon. Fundação Ezequiel Dias, Belo Horizonte, Minas Gerais, Brazil (FUNED 34). MINAS GERAIS: Municipality of Três Marias, Km 289 of BR 040 (18°12'S, 45°15'W). 10 November 2002. A. L. Silveira. Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil (MNRJ 10925). Verified by R. Fernandes. Species previously known from the Atlantic Forest in the states of Santa Catarina, Paraná, São Paulo, and Espírito Santo, and areas of Cerrado in states of São Paulo, Minas Gerais, and Distrito Federal, Brazil (Franco et al. 1997. J. Herpetol. 31[4]:483–490). First record from the state of Bahia, extends known distribution ca. 1295 km northeast from the closest previous record (Brazil, Distrito Federal, Brasília Municipality; Franco et al., *op. cit.*), also first record from Caatinga vegetation. The record in Três Marias fulfills a gap of distribution between the south Minas Gerais and Distrito Federal localities (Franco et al., *op. cit.*).

Submitted by **ADRIANO LIMA SILVEIRA**, Setor de Herpetologia, Departamento de Vertebrados, Museu Nacional, Universidade Federal do Rio de Janeiro, Quinta da Boa Vista, São Cristóvão, CEP 20940-040, Rio de Janeiro, RJ, Brazil, e-mail: biosilveira@yahoo.com.br; **GISELLE AGOSTINI COTTA**, Serviço de Animais Peçonhentos, Fundação Ezequiel Dias, Rua Conde Pereira Carneiro, nº 80, Bairro Gameleira, CEP 30510-010, Belo Horizonte, MG, Brazil; e-mail: crotalus@funed.mg.gov.br.

COELOGNATHUS FLAVOLINEATUS (Yellow Striped Ratsnake). THAILAND: PRACHIN BURI: NADI: BUPHRAM. Water Reservoir for the village of Buphram. (14°20'30"N, 101°49'35"E), ~485 m elev. 25 June 2004. (FMNH 263527). Daryl R. Karns and John C. Murphy. NAKHON RATCHASIMA: WANG NAM KHIEO: UDON SAP. Entrance to Sakaeret Biosphere Reserve (~14°30'32"N, 102°02'45"E), 185 m elev. 6 July 2004. CUBMZR 2005.9. Jacques Hill. Verified by Tanya Chan-ard. These localities are about 28 km apart along Highway 304. The adult male specimen from Buphram was salvaged from a fishermen's gill net. The Sakaeret specimen was DOR on highway 304 near the entrance to the Reserve and a second Sakaeret specimen was observed on the Reserve's driveway (JH). Evidence of the Buphram population is also supported by FMNH 180298 collected in 1969 by W. R. Heyer at Khao Yai National Park (the eastern edge of the Park is on the opposite side of the road from the Buphram Reservoir). The 1969 specimen has apparently been overlooked in recent literature (Schultz. 1996. A Monograph of the Colubrid Snakes of Genus *Elaphe* Fitzinger. Koeltz Scientific Books, Havlickuv Brod; Grumprecht 1996. Sauria Suppl. 18:373–376; Grossman and Tillack, 1998. Sauria 20:43–45). Schultz (1996) and Grumprecht (1996) report a single specimen from Pak Chong, Nakhon Ratchasima Province and wrote that it "urgently requires confirmation." Because the Pak Chong specimen was located near an animal dealer's compound, it was suggested that the individual may represent a feral population. This population is also of interest because, prior to its collection at Pak Chong, this species was known only from continental Asia south of 7°N latitude and all Thai specimens were from the Peninsula (Schultz, 1996). However, Grossman and Tillack (1998) also reported specimens from Vietnam suggesting the species may be more widespread than previously thought. The Buphram specimen extends the range about 60 km east. The Sakaeret specimen extends the range about 50 km east of the Pak Chong locality. The Sakaeret Biosphere Reserve had an extensive herpetofaunal survey done in the late 1960s (Inger and Colwell 1977. Ecol. Monogr. 47:229–253). They did not mention this species because the 1969 specimen (FMNH 180298) was collected off the Reserve. It is unlikely that a large (1.5–2 m) diurnal snake would be overlooked during an 11-month herpetofaunal survey that obtained 4400 specimens. Two of us (DRK and JCM) visited Sakaeret in 2003 at which time we found a neonate *Python molurus* on the driveway of the Reserve, this species was also not reported by Inger and Colwell (1977, *op. cit.*) and suggests to us that recent environmental changes might have allowed *C. flavolineatus* and *P. molurus* to expand their distributions into the Sakaeret Reserve.

Submitted by **JOHN C. MURPHY** (e-mail: fordonia1@comcast.net) and **JACQUES HILL** (e-mail: ngookhiew@yahoo.com), Division of Amphibians and Reptiles, Field Museum of Natural History, Chicago, Illinois 60605, USA, and **DARYL R. KARNS**, Department of Biology, Hanover College, Hanover, Indiana 47243, USA (e-mail: karns@hanvover.edu).

OXYBELIS AENEUS (Brown Vinesnake). HONDURAS: CAYOS COCHINOS ARCHIPELAGO: Bay Island Province: Cayo Cochino Pequeño, northwest corner of island (15° 57' 11.3" N, 86° 30' 2.45" W). 04 August 2004. S. M. Boback. Verified by Andrew T. Holycross. Arizona State University Natural History Museum photograph collection (ASU HP-00041 – 00042). First record for Cayo Cochino Pequeño (McCranie, Wilson, and Kohler. 2005. Amphibians and Reptiles of the Bay Islands and Cayos Cochinos, Honduras. Bibliomania, Salt Lake City). An additional specimen was observed on the south side of the island near research station, but no voucher was taken.

We thank the Honduran Coral Reef Foundation and Operation Wallacea for supporting our research in the Cayos Cochinos.

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PITUOPHIS CATENIFER SAYI (Bullsnake). USA:

MINNESOTA: MARSHALL CO.: near Holt: County Rd 141 approx 2 km of Co. Hwy 7 (48° 16'30" 96° 16'00"). 26 September 2005. Joe Hermreck. DOR subadult male on gravel road in good habitat. Bell Museum of Natural History Collection JFBM 14448. Verified by Tony Gamble. Extends range 85 km north of the previous record for the state (Oldfield and Moriarty 1994. Amphibians and Reptiles Native to Minnesota. Univ. of Minnesota Press, Minneapolis).

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PSEUDOTOMODON TRIGONATUS (Culebra Enhebrada). ARGENTINA: CATAMARCA: Departamento Tinogasta: 4 km from Río La Punta to Tinogasta city (28°04'S; 67°34W) on National Road 60. 7 December 1985. E. Pereyra, O. Pagaburo and J. Bracamonte. Herpetological collection, Instituto de Herpetología, Fundación Miguel Lillo, Tucumán, Argentina (FML 1635). Medanitos (27°32'S; 67°36'W, 1650 m.a.s.l.), 7 March 1987, O. Pagaburo and J. Bracamonte (FML 1685-1 and 1685-2). TUCUMÁN: Departamento Tafí del Valle: 4 km NW from Amaicha del Valle (26°36' S; 65°55' W) on Ruta Provincial 307. 12 January 2006. G. A. Gallardo (FML 16739). All verified by G. Scrocchi. Endemic Argentinian species, previously known in the west of the country from Neuquén and Río Negro to La Rioja, east to Santiago del Estero and Córdoba, and a supposed disjunct area in southern Buenos Aires and La Pampa (Cei 1983. Reptiles del noroeste, nordeste y este de la Argentina. Museo Regionale di Scienze Naturali, Torino. Monografía XIV: 949 pp.; Giraudo and Scrocchi 2002. Smithsonian Herpetological Information Service 132:1–53). The records from Catamarca confirms the presence of the species in the province, which previous authors (Williams and Francini 1991. Boll. Mus. reg. Sc. nat. Torino 9[1]:55–90; Giraudo and Scrocchi, *op. cit.*) have mentioned that "need confirmation." The record from Tucumán is the first from the province and the northermost for the species, and extends distribution approximatelly 230 km airline from the La Rioja – Catamarca boundary, the closest area mentioned by Cei (*op. cit.*) without voucher reference.

Submitted by **GABRIELA A. GALLARDO** Instituto de Herpetología, Fundación Miguel Lillo, Miguel Lillo 251, 4000 Tucumán, Argentina; e-mail: gabrielagall@gmail.com.

STORERIA OCCIPITOMACULATA (Red-bellied Snake). USA: WISCONSIN: VERNON CO.: U.S. Highway 14/61 just east of County Trunk T (T11N, R3W, S7). 2 August 2002. Joseph A. Cochran. James Ford Bell Museum of Natural History, University of Minnesota (JFBM 14450). Verified by Tony Gamble. Dead on road; first vouchered record from county (Casper, G.S. 1996. Geographic distribution of the amphibians and reptiles of Wisconsin. Milwaukee Public Museum [MPM], Milwaukee, WI). Substantiates sight records ca. 25 km west northwest at ca. 0.4 km east of jct of Tewalt Rd and Anderson Rd (T\h \r 112N, R6W, S22 SW1/4 of NE1/4; Wisconsin Herp Atlas MADA 18, David G. \h \r 1Matheys), and three observations ca. 32–39 km northeast at \h \r 1Wildcat Mountain State Park (T\h \r 114N, R1W, S29, Wisconsin Herp Atlas THSA 51, Sam Thayer; T\h \r 114N, R1W, S11 SE1/4, Wisconsin Herp Atlas THSA 58, Sam Thayer; T\h \r 114N, R2W, S12, Wisconsin Herp Atlas THSA 58, Sam Thayer). Nearest records documented by specimens are southeast ca. 25 km (Richland County, MPM 6939, 6940) and north ca. 66 km (Monroe County, MPM 23404).

Submitted by **JOSEPH A. COCHRAN**, Chicago Medical School, Rosalind Franklin University of Medicine and Science, 3333 Green Bay Road, North Chicago, Illinois 60064, USA, **PHILIP A. COCHRAN**, Biology Department, Saint Mary's University, 700 Terrace Heights, Winona, Minnesota 55987, USA, and **GARY S. CASPER**, University of Wisconsin-Milwaukee Cedar Sauk Field Station, 3095 Blue Goose Road, Saukville, Wisconsin 53080, USA.

THAMNODYNASTES LONGICAUDUS. BRAZIL: ESPÍRITO SANTO: Santa Teresa municipality (19°55' S, 40°36' W, 670 m elev.), area of Atlantic Forest. 13 March1940. A. Ruschi. Museu Nacional, Rio de Janeiro, Brazil (MNRJ 0676). Verified by R. Fernandes. Species was previously known from the states of São Paulo and Rio de Janeiro, Brazil (Franco et al. 2003, Zootaxa 334:1–7). First state record and northern limit of its known distribution, ca. 380 km northeast from the closest previous record (Brazil, Rio de Janeiro, Teresópolis municipality, 22°24' S, 42°57' W, 872 m elev.; Franco et al. 2003, *op. cit.*).

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SSAR Treasurer Vacancy

The Society for the Study of Amphibians and Reptiles seeks applicants for the office of Treasurer. This is a non-paid position with funds available for work-study assistance. Term length is open-ended. Duties are as follows: maintain fiscal records of the Society; make monetary disbursements; coordinate payment to printers for costs of publications after approval by respective editors; invoice reprint orders; interact with Publications Secretary/Membership Office relative to stocks of publications and counts of current number of members; submit annual report which includes budget request for following year to the Secretary prior to annual meeting of the Board. Membership management, investment management, and IRS reports are not part of current duties. The office provides an important contribution toward continuity of information within the Society, thus, attendance at the annual meetings is mandatory. Individuals interested in the position should contact Kirsten E. Nicholson at knicholson@biology2.wustl.edu no later than 16 July 2006.

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New Distributional Records for Reptiles from North Carolina

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The geographic distribution of reptiles in North Carolina (USA) was summarized by Palmer and Braswell (1995) and supplemented by Beane (1998). We here report new distributional records based upon specimens verified by Alvin L. Braswell and housed at the North Carolina State Museum of Natural Sciences (NCSM).

Crocodylia

Alligator mississipiensis (American Alligator). COLUMBUS CO.: 6.9 km S Lake Waccamaw (town), Lake Waccamaw dam spillway. 24 June 1999. D. G. Cooper et al. NCSM 60135. First voucher for county. Palmer and Braswell (1995) reported observational records.

Testudines

Chelydra serpentina serpentina (Eastern Snapping Turtle). BURKE CO.: South Mountains State Park, 10.8 km WSW Pleasant Grove. 28 June 1999. A. L. Braswell, R. Bowers, and D. Wise. NCSM 60098. New county record. LINCOLN CO.: ca. 4.5 km ENE Lowesville, just SW Cowan's Ford dam. 5 April 1968. E. E. Brown. NCSM 56094. First voucher for county. Palmer and Braswell (1995) reported an observational record. MOORE CO.: 4.0 km SE Southern Pines. 9 June 1973. J. H. Carter III. NCSM 62324. 8.4 km W.SW Pinebluff. 6 September 1998. J. C. Beane and J. T. Finnegan. NCSM 58157. First vouchers for county. Palmer and Braswell (1995) reported an observational record. NEW HANOVER CO.: 2.1 km WNW Carolina Beach, Carolina Beach State Park (34°02'32"N, 77°54'49"W). 14 May 2002. G. S. Grant. NCSM 63500. New county record. STOKES CO.: 0.8 km SSE Danbury. 4 June 1951. E. E. Brown. NCSM 56089. New county record.

Chrysemys picta picta (Eastern Painted Turtle). CUMBERLAND CO.: *ca*. 5.6 km WSW Spring Lake, Fort Bragg (UTM Zone 17: N3890589 m, E678587 m). 3 June 2002. B. S. Ball. NCSM 64211. First voucher for county. Brimley (1944) and Palmer and Braswell (1995) reported an observational record. WARREN CO.: Warrenton. 10 June 1997. S. Fearne. NCSM 55630. New county record.

Deirochelys reticularia reticularia (Eastern Chicken Turtle). CUMBERLAND CO.: ca. 7.2 km ESE Lena, White Pond Bay. 2 June 2000. G. S. Grant. NCSM 60846. First voucher for county. Brimley (1944) and Palmer and Braswell (1995) reported an observational record.

Pseudemys concinna concinna (Eastern River Cooter). DURHAM CO.: *ca*. 8.0 km SE Bahama, Eno River, Butner Game Lands, Butner Depot Waterfowl Impoundment. 18 January 2003. J. S. Zawadowski and R. B. G. Bogwalker. NCSM 64390. New county record. UNION CO.: 4.2 km N New Salem along Rocky River. 7 May 2000. A. L. Braswell, S. L. Braswell, et al. NCSM 60369. New county record.

Sternotherus odoratus (Stinkpot). ANSON CO.: ca. 4.0 km SSE Peachland at Brown Creek. 16 May 1975. E. E. Brown. NCSM 53222. First voucher for county. Brown (1992) and Palmer and Braswell (1995) reported a visual record, apparently from this same locality. HYDE CO.: 10.5 km E Fairfield. 31 August 1998. R. P. Fengya. NCSM 58849. New county record.

Terrapene carolina carolina (Eastern Box Turtle). CALDWELL CO.: 4.0 km NNW Lenoir. 4 August 1962. T. D. Murphy and D. M. Davis. NCSM 54491. 8 km NE Lenoir. 3 August 1962. T. D. Murphy and D. M. Davis. NCSM 54504. 13 km ENE Lenoir. 24 July 1962. J. R. Bailey et al. NCSM 54528. First vouchers for county. Van Devender and Nicoletto (1983) and Palmer and Braswell (1995) reported observational records. IREDELL CO.: 4.3 km W Mooresville. 5 August 1962. T. D. Murphy and D. M. Davis. NCSM 54502. New county record. JACKSON CO.: 4.8 km S Cullowhee. 21 May 1974. J. R. Bailey. NCSM 54533. New county record. MARTIN CO.: 2.0 km SSE Williamston. 25 November 2001. A. B. Braswell and S. L. Braswell. NCSM 62534. First voucher for county. Palmer and Braswell (1995) reported a visual record. YADKIN CO.: ca. 3.2 km W Yadkinville. 3 August 1962. T. D. Murphy and D. M. Davis. NCSM 54527. First voucher for county. Palmer and Braswell (1995) reported observational records. YANCEY CO.: ca. 3.2 km NNE Burnsville. 13 July 1966. A. Sharer et al. NCSM 54512. New county record.

Trachemys scripta scripta (Yellow-bellied Slider). ROWAN CO.: 6.8 km NE Salisbury along Grants Creek. Ca. December 1997. M. J. Baranski. NCSM 58014. New county record.

Lacertilia

Cnemidophorus sexlineatus sexlineatus (Eastern Six-lined Racerunner). FRANKLIN CO.: 6.8 km NNE Franklinton. 20 Sept. 1997. R. Mullins. NCSM 53721. New county record.

Eumeces anthracinus (Coal Skink). POLK CO.: 3.1 km WNW Tryon, Melrose Mountain. 30 September 2001. D. A. Jackan et al. NCSM 62419. New county record. Extends range ca. 33 km SE of nearest record in Henderson County.

Eumeces inexpectatus (Southeastern Five-lined Skink). WARREN CO.: ca. 12.5 km NE Vaughn. 8 October 1972. J. R. Bailey and M. Bailey. NCSM 41436. New county record.

Ophisaurus attenuatus longicaudus (Eastern Slender Glass Lizard). BEAUFORT CO.: 5.0 km ESE Bunyan. 15 May 1992. R. W. Gaul, Jr. NCSM 31806. New county record. GRANVILLE CO.: ca. 6.4 km W Stovall. 24 May 1995. G. Parham. NCSM 57551. New county record.

Ophisaurus ventralis (Eastern Glass Lizard). HARNETT CO.: 9.3 km ESE Spout Springs (35°14'4.25"N, 78°57'51.12"W). 24 August 2001. C. L. Bryan. NCSM 62575. New county record. MONTGOMERY CO.: 8.1 km SSE Emery. 16 June 2000. J. C. Beane and S. L. Alford. NCSM 60405. New county record. Extends range ca. 16 km NW of nearest records in Moore and Richmond counties.

Scincella lateralis (Ground Skink). MACON CO.: ca. 3.2 km NNW Franklin. 29 October 1997. D. Crisp. NCSM 54610. New county record. Fills gap between Clay and Jackson counties. RANDOLPH CO.: ca. 8 km NNE Farmer, Ridges Mountain. 15 March 1998. J.

C. Beane et al. NCSM 57408. First voucher for county. Palmer and Braswell (1995) reported observational records.

Serpentes

Agkistrodon contortrix (Copperhead). Davie Co.: ca. 5.8 km SSE Advance. 27 May 1994. H. Woltz. NCSM 36276. First voucher for county. Palmer and Braswell (1995) reported a sight record. Forsyth Co.: ca. 6.4 km NW center Winston-Salem. 10 August 1998. E. Brandon. NCSM 58148. First voucher for county. Palmer and Braswell (1995) reported an observational record.

Coluber constrictor constrictor (Northern Black Racer). Wilkes Co.: 6.6 km WNW Traphill. 31 May 1999. J. C. Beane and V. K. Rice. NCSM 60083. First voucher for county. Palmer and Braswell (1995) reported an observational record.

Crotalus horridus (Timber Rattlesnake). Alleghany Co.: 4.0 km SW Whitehead. 29 August 1998. P. D. McMillan. NCSM 58188. First voucher for county. Palmer and Braswell (1995) reported observational records.

Farancia abacura abacura (Eastern Mudsnake). Gates Co.: 5.6 km ENE Gatesville. 5 October 2000. J. C. Wyche. NCSM 61568. First voucher for county. Palmer and Braswell (1995) reported observational records.

Farancia erytrogramma erytrogramma (Rainbow Snake). Washington Co.: 12.7 km SSW Cherry, S shore of Lake Phelps. 22 May 1997. S. A. Shearin. NCSM 53554. New county record.

Heterodon platirhinos (Eastern Hog-nosed Snake). Gates Co.: ca. 6.4 km NE Gatesville, Merchants Millpond State Park. 12 April 1998. J. C. Wyche. NCSM 57875. 5.6 km ENE Gatesville. 1997. F. K. Williams. NCSM 57876. 5.6 km ENE Gatesville. 14 October 1998. J. C. Wyche. NCSM 61745. First vouchers for county. Palmer and Braswell (1995) reported an observational record. Surry Co.: 0.6 km SW Low Gap. 5 September 1998. L. Marion. NCSM 58151. 8 km S Low Gap. 10 October 1998. S. K. Eanes. NCSM 60160. New county records.

Lampropeltis calligaster rhombomaculata (Mole Kingsnake). Granville Co.: 3.5 km NNW Butner. 26 April 1998. M. E. Welker. NCSM 57878. 5.3 km NNW Stem. 6 June 2001. M. E. Welker. NCSM 61885. First vouchers for county. Palmer and Braswell (1995) reported an observational record. Wilkes Co.: 6.8 km W Traphill. 9 May 1998. D. T. Sawyer. NCSM 58000. New county record. Extends range ca. 36 km W and ca. 39 km NNW of nearest records in Surry and Iredell counties, respectively. Partially fills range hiatus shown in Conant and Collins (1998).

Lampropeltis getula getula (Eastern Kingsnake). Davie Co.: 3.2 km NE Cooleemee. 13 May 2000. D. T. Sawyer and T. B. Sawyer. NCSM 60386. New county record. Wilkes Co.: 0.6 km SW Traphill. 22 June 1998. D. T. Sawyer. NCSM 58150. 1.6 km ENE Traphill. 16 October 2000. D. T. Sawyer. NCSM 61558. 6.9 km W Traphill. 6 May 2002. T. B. Sawyer. NCSM 63012. First vouchers for county. Beane (1998) reported a photographic record.

Opheodrys aestivus (Rough Greensnake). Alleghany Co.: 3.6 km ESE Citron, Doughton Park Recreational Area. 10 August 1996. D. L. Stephan. NCSM 58513. New county record. Extends range ca. 18 km NW of nearest record in Wilkes County. Partially fills range hiatus shown in Conant and Collins (1998). Specimen was collected at an elevation of ca. 1095 m, exceeding the previous elevation record for North Carolina of ca. 914 m (Huheey and Stupka 1967; King 1939; Palmer and Braswell 1995). Lee Co.: 4.8 km NW Sanford. 15 October 1996. A. L. Kyles. NCSM 45080. New county record. Rutherford Co.: 2.3 km NW Hollis. 26 May 2002. G. R. Mayfield III. NCSM 63772. First voucher for county. Weller (1930) and Palmer and Braswell (1995) reported observational records. Vance Co.: 6.0 km ENE Williamsboro, Kerr Lake State Recreational Area. 31 August 2000. M. M. Mohamed. NCSM 61559. New county record.

Regina septemvittata (Queen Snake). Harnett Co.: 6.4 km SSE Spout Springs, Ft. Bragg, "Overhills Tract" (UTM Zone 17: N3898806 m, E679904 m). 16 July 2002. A. Westmoreland and B. S. Ball. NCSM 64212. New county record.

Storeria dekayi (Dekay's Brown Snake). Franklin Co.: 11.3 km SW Louisburg. 15 June 1999. D. Cash. NCSM 60091. New county record. Hoke Co.: 1.1 km ENE Antioch. 7 January 1998. J. C. Beane and R. A. Davis. NCSM 55511. New county record.

Storeria occipitomaculata occipitomaculata (Northern Red-bellied Snake). Cabarrus Co.: ca. 8 km E Davidson, Egg Rock Woods. 1 May 1949. T. Daggy. NCSM 52428. New county record.

Tantilla coronata (Southeastern Crowned Snake). Craven Co.: 3.9 km SSW Askin, Cool Springs Environmental Center. 2 July 2002. J. G. Hall. NCSM 64952. 4.0 km SSW Askin, Cool Springs Environmental Center. 16 July 2002. J. G. Hall. NCSM 64953. New county records. Harnett Co.: 7.1 km SE Spout Springs, Fort Bragg, Overhills Tract. 25 April 2002. B. S. Ball and A. Young. NCSM 63009. First voucher for county. Palmer and Braswell (1995) reported an observational record.

Virginia valeriae valeriae (Eastern Smooth Earth Snake). Moore Co.: 2.9 km SE Jackson Springs. 11 September 2002. S. L. Alford. NCSM 64001. New county record. Richmond Co.: 5.7 km E Ellerbe. 8 September 1999. S. L. Alford. NCSM 60153. New county record.

Acknowledgments.—We thank all those whose field work resulted in new distributional records. A. L. Braswell and S. D. Busack reviewed the manuscript.

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New Geographic Distribution Records of Amphibians and Reptiles in Texas

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Since the publication of Dixon's second edition of *Amphibians and Reptiles of Texas* (2000) and Werler and Dixon's *Texas Snakes* (2000), numerous new county records have been documented for various amphibians and reptiles of the state (Bryson and Mueller 2002; LaDuc and Infante 2001; and others). A recent examination of the Angelo State Natural History Collection (ASNHC) has yielded additional records not documented over the last half-decade. Herein, I report 11 new county records for three amphibian and seven reptilian taxa from Texas. Specimens were verified by J. Kelly McCoy.

Anura

Bufo debilis debilis (Eastern Green Toad). Irion Co.: 1.6 km E Arden Rd. off FM 853. 19 April 1990. D. A. Trudo. ASNHC 12748. New county record that fills a distributional gap between Reagan and Tom Green counties.

Rana berlandieri (Rio Grande Leopard Frog). Crosby Co.: 1.6 km E Cone on FM 193 at Crawfish Creek. 11 April 1969. A. Flury. ASNHC 13675. Nolan Co.: 19.3 km NW Blackwell, Melvin Tubb Ranch. 26 July 1976. A. Flury. ASNHC 13625–13627, 13629–13632, 13652–13653. New county records. The Crosby Co. site is well outside the range depicted in Dixon (2000, see map. 35) and represents the northernmost locale for the species in the state.

Rana blairi (Plains Leopard Frog). Denton Co.: 9.7 km NE Lewisville at State Fish Hatchery. 2 June 1970. A. Flury. ASNHC 13693. New county record that fills small distributional gap between Dallas and Wise counties.

Testudines

Apalone spinifera guadalupensis (Guadalupe Spiny Softshell). Irion Co.: 1.6 km E Arden off FM 853 at Big Rocky Creek. 22 April 1990. D. A. Trudo. ASNHC 12762. New county record that extends range W from Tom Green County. A larger distributional gap remains for *A. spinifera* to the west in the state.

Apalone spinifera pallida (Pallid Spiny Softshell). Callahan Co.: 1.6 km E Eula at Pecan Bayou. 14 April 1990. J. Berry. ASNHC 12701. New county record that fills a distributional hiatus between Eastland and Taylor counties.

Lacertilia

Hemidactylus turcicus turcicus (Mediterranean Gecko). Live Oak Co.: 16.1 km N Mathis at Lake Corpus Christi. 7 April 1990. K. E. Sargent. ASNHC 12860–12864. New county record. This small introduced gecko continues to be reported from new locales in Texas with no less than eight new county records reported in *Herpetological Review* over the last five years.

Serpentes

Elaphe emoryi emoryi (Northern Plains Rat Snake). Mitchell Co.: 11.3 km S Ira on US 380, 12.9 km S on St. Hwy 350. 21 March 1990. A. M. Bragg. ASNHC 12727. New county record that fills a distributional gap between Howard and Nolan counties.

Hypsiglena torquata janii (Texas Night Snake). Runnels Co.: 20.9 km NW Ballinger at Underwood Farm. 27 April 1990. D. C. Stone. ASNHC 12657–12658. New county record filling a distributional hiatus between Coleman and Coke counties.

Tantilla nigriceps (Plains Black-headed Snake). Callahan Co.: 1.6 km W FM 604, 8.0 km S Clyde at Berry Farm. 28 April 1990. J. Berry. ASNHC 12715. New county record. Fills distributional gap between Coleman and Shackelford counties; larger distributional gap exists to the east in a 12-county area of central Texas.

Virginia striatula (Rough Earthsnake). Irion Co.: Butch Davis Place (specific locality not known). 13 May 1975. D. Davis. ASNHC 13101. New county record. This locale is outside the range depicted in Dixon (2000, map. 151) and Werler and Dixon (2000, plate 168) and extends the range two counties westward from Concho County. This record appears to be authentic, not related to specimens reported previously from El Paso, King, and Lubbock counties believed to be accidental introductions related to horticulture trade (see Dixon, 2000). However, Werler and Dixon (2000) do not mention these accidental records but show an additional record for *V. striatula* in Garza County while omitting the record from El Paso County.

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BOOK REVIEWS

Herpetological Review, 2006, 37(2), 247–248.

Revisión Taxonómica de la Familia Centrolenidae (Amphibia; Anura) de Venezuela, by J. Celsa Señaris and José Ayarzagüena. 2005. BIOSFERA, Publicaciones del Comité Español del programa Hombre y Biosfera-Red IberoMaB de la UNESCO, Ministerio de Medio Ambiente, Plaza San Juan de la Cruz s/n, 2ª planta, E-28071 Madrid, Spain. Num 7. vii + 337 pp. Softcover. ISSN 1138-8153.

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In recent decades, taxonomic knowledge of Neotropical amphibians has increased rapidly and significantly. In the face of destruction of natural habitats, there is a great need to understand the biota that surrounds us. The availability of new technologies and the increasing number of students of herpetology in the tropics have made advances in this field possible. Signigicantly, the most diverse countries in the world in amphibian diversity (all in the Neotropics) have taken a direct part in reviewing the most problematic groups of amphibians.

Glass frogs of the family Centrolenidae are among those groups of anurans that few people have dared to tackle. Others are *Leptodactylus, Eleutherodactylus*, and *Elachistocleis,* just to mention a few. Prior to the ground-breaking work of Lynch and Ruíz-Carranza in Colombia (Ruíz-Carranza and Lynch 1991 and subsequent papers), the family Centrolenidae was known poorly, chiefly through species descriptions (e.g., Goin 1963; Rivero 1968, 1986 for Venezuela alone), and a more comprehensive understanding of the group was lacking. Nonetheless, much additional study is needed, and this new book on glass frogs has appeared at an opportune time. It presents the results of more than 15 years of observations by José Ayarzagüena and Celsa Señaris in Venezuela (Ayarzagüena 1992; Señaris and Ayarzagüena 1993, 2001; Ayarzagüena and Señaris 1996; Señaris 1999; Duellman and Señaris 2003) and is mainly derived from the Ph.D. thesis of the latter author.

The book starts with acknowledgements and abstracts in Spanish and English. A general introduction to the Amphibia of Venezuela follows. The introduction is completed by an historical resumé of studies of the Centrolenidae throughout their range, a review of supraspecific classifications, and a subchapter about the family Centrolenidae in its Venezuelan context.

The materials and methods, covering both field and lab work, is comprehensive—detailing all measurements taken (morphology and morphometry), osteological methods, the study of tadpoles, and call analysis. The subsequent section is about the study area, which includes most of the Venezuelan bioregions important to glass frogs. It covers the geology and geomorphology of the country, hydrography, and physiographic and phytogeographic regions of Venezuela. Localities representative of different bioregions are described in detail and zoogeographic patterns of the Venezuelan herpetofauna are presented. A separate chapter outlines the 16 taxonomic characters employed in the study.

The longest part of the book provides a detailed account of each of the 23 species known for the country: five *Centrolene*, seven *Cochranella*, and 11 *Hyalinobatrachium*. The only species for which the account is rather sketchy is *Centrolene lema* Duellman and Señaris, 2003, which was not yet described formally when the text was initially sent to the publisher. Each account provides a complete synonymy, diagnosis, description (usually accompanied by drawings of the dorsal and lateral views of the head, and ventral views of hands, feet, and nuptial excrescences), coloration in life and in alcohol, osteology (usually with details of the skull, vertebral column, hand, humerus and spines), natural history, call description (with sonograms and oscilograms of almost all species), and description of the tadpole (also with a good schematic drawing); distribution, and comments or remarks. Accompanying point locality maps illustrate known Venezuelan localities. Following the accounts, the authors provide a dichotomous key to all species of Venezuelan glass frogs. This is quite simple to follow, except that its use requires males of *Centrolene* or *Cochranella.*

A long discussion follows, in which the authors comment on their findings and erect two new groups, one for Guayanan *Centrolene* (the *C. gorzulai* group) and another for Guayanan + Paria *Cochranella* (the *C. oyampiensis* group). In a biogeographic section, geographic, altitudinal, latitudinal, and spatial distribution are analyzed, centrolenid diversity per country is summarized, and instances of sympatry reviewed. "Conclusions and recommendations" summarizes the most significant findings and highlights the need for further research on glass frogs. A bibliography with 194 references ends the text section of the book.

Section IX (wrongly indicateded as VII) is a set of color plates, but only ten of the species are illustrated. It would have been useful to see all of the animals treated in the book in color, however, it is still an important contribution to provide the first color photos of selected species with restricted distributions, such as *Cochranella castroviejoi, C. helenae, C. revocata, C. vozmedianoi, Hyalinobatrachium antisthenesi, H. duranti, H. mondolfii*, and *H. taylori* (non-conspecific with *H. taylori* as treated by Lescure and Marty 2000, fide C. Señaris and S. Castroviejo, pers. comm.).

Finally, there are four annexes: a current checklist of all centrolenids, with summary distributional statements and comments about phenetic grouping; material examined; and a principal components analysis of the Venezuelan centrolenids.

There are a few typographic errors and some editorial inconsistencies. For example, the pagination indicated in the table of contents does not match the actual text and on page 249 the legend for Figure 170 repeats that for Figure 169, when it should say something like: "Distribución altitudinal de las diferentes especies venezolanas"... (Altitudinal distribution of different Venezuelan species...). However, some other issues are relevant to the use of

the volume. First, it appears to be difficult to acquire the book; indeed, I have not been able to locate it for sale in Venezuela. There is no indication of price and the main source of the book in Venezuela is directly from the first author. The problem must be the same in many other countries in which the book is likely to be of particular value. Finally, the book is written in Spanish, which is obviously good for all Spanish speakers, but perhaps makes it less accessible outside of Latin America. On the other hand, all herpetologists interested in Neotropical amphibians and reptiles really must have at least a reading knowledge of Spanish, and this book offers such people great opportunity to practice! Any minor criticisms aside, I must congratulate the authors for such an impressive effort, which undoubtedly contributes significantly to our understanding of this family of anurans.

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Herpetological Review, 2006, 37(2), 248–250.

Snakes of New England: Photographic and Natural History Study, by Linda Krulikowski. 2004. LuvLife Publishing, 69 Shore Drive, Old Lyme, Connecticut 06371, USA. [8] + xi + [1] + 308 pp. Softcover. US $42.50. ISBN 0-9764316-0-2.

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In the preface and introduction of this book, the author explains how she, an admitted non-herpetologist, became fascinated with snakes. Her initial ophidiphobia, caused by ignorance and the same taught fear that many people experience in early childhood, came to a head when her own son's close friend was bitten by a copperhead. Rather than reacting with the mindless fear one might expect, the author took it upon her self to learn more about snakes and overcome her own prejudices, and then to share this new found respect and appreciation with others through public lectures and a book on the subject. The author explains that when she first tried to learn about snakes she found that most of the literature available to her was written by professional herpetologists for other professionals and, thus, not in a language accessible to her. She then set out to produce a book geared specifically to other parents. A few reservations aside, she appears to have succeeded.

Following the Preface, Acknowledgements and Introduction, this book is organized into two main sections: General Information and Specific New England Snakes. The first section includes six chapters on General Biology, Behavior, Venomous Snakes and Snakebite, Mythology and Folklore, and Classification. The second includes sixteen chapters: one each on Colubridae and Viperidae, followed by individual accounts for all native New England snake species. There are five appendices: Diagrams of Important Scale Identification and Terminology of Timber Rattlesnake, Radiotelemetry Studies on Snakes, Captive Care, Range Maps and List of New England Snakes, and Northeast's Only Reptile and Amphibian Rehabilitation Center. A glossary of terms and an extensive bibliography complete the book.

Of the chapters in the first section, probably the most interesting is that on folklore. This section deals with a mixture of folk tales regarding snakes and commonly held snake myths. The coverage, though not by any stretch complete, does deal with the most

frequently encountered myths and provides information on their biological explanations.

The chapter on snake bite warns against some traditional first aide treatments, including the more ridiculous methods such as electroshock, many of which do more harm than good to the victim, and instead advises those bitten to seek medical attention immediately. The only other first aide discussed as viable is the use of an extractor mechanism, but not instead of medical attention. Such suggestions in a non-technical book are a welcome improvement on the diagrams showing the incision and suction technique that were a mainstay of some of the similarly-focused books that many of us grew-up with.

As noted above, the target audience for this book consists of concerned parents and new-comers to the world of snakes who simply want to learn as much as possible in easy-to-swallow morsels. However, it is difficult to say all that is important about such an interesting group of animals in relatively few words that are accessible to the lay person. Only a few pages and few, if any, literature citations are needed to tell a simple snake story, but authors who research the subject matter and learn more, and want to tell the reader more, quickly discover that it cannot be done in a *Readers Digest* format without leaving out significant and valuable information on these fascinating creatures.

There is a lot to say about snakes and the natural history information about each species could (and frequently does) fill volumes. Abbreviating any of this into a bite-sized morsel for the novice is difficult and the author likely discovered when writing the species accounts exactly why it is that other books on this subject originally appeared to her to be long and wordy. Her accounts are also fairly lengthy, but they written in a language and tone that should be palatable to the novice reader. The biological information in the text appears to be accurate and well-researched and some personal observations or human-interest stories are included for each species of snake.

The author of *Snakes of New England* also served as photographer. Her scientific photographs have been published in other works, including books on cell biology and at least one other on snakes. For this book she managed to photograph in the wild adults and juveniles of nearly every species (apparently augmenting with captives in some cases) as well as most of the major color variants within each species known to occur within New England.

Of the more than 350 color photographs of snakes or snake habitat, several are used more than once. For example, Figure 3.11 = 20.2 = 21.1; Figure 10.1 = 10.14 = 8.17 and is also repeated in an un-numbered series of photos on page 64, as are Figures 8.10, 8.14 (same as 9.12), 9.1, 9.9 (which is also 9.13), and 11.1. This causes some confusion and can result in individual photographs, rather than individual species of snake, becoming familiar to the reader. Additionally, while the composition of the photos is generally good, excellent in some cases, the exposure and focus are too frequently less consistent in quality: Figure 13.2 is nearly too dark to see more than the pink belly of the worm snake; Figure 15.5 is a photograph of a black racer on oak leaves and seems to be just out of focus; Figure 16.3 seems fuzzy, though not really out of focus, it could be a digital zoom of a scanned image; Figure 16.13 is a juvenile black rat snake sitting coiled on a rock, out of focus; and Figure 17.13 appears to be upside-down. For all this, however, the photographs capture aspects of the natural history of New England snakes that are rarely seen, let alone captured by a shutter. Among the more amazing shots, regardless of exposure, are photographs of hatching or birth in *Carphophis amoenus*, *Diadophis punctatus*, *Nerodia sipedon*, and *Agkistrodon contortix*. Also of interest are photographs of feeding by *Opheodrys vernalis* and *Storeria occipitomaculata*.

The illustrations are not as impressive as the photographs. Most are hand-drawn outline figures. Many appear to have been done as a high school art project, which may have been the case given the grass-roots aspect of this book. For example, the illustration of a cobra skeleton is crude at best, although it is clear what is intended. Illustrations in the dichotomous key are more useful and probably would be good references for the novice uncertain if a particular snake's scales are keeled or if the anal plate is divided or not. Line drawings of viperid fangs and mouth morphology are also acceptable and of likely use to the target audience. The maps are hand-colored with colored pencil.

This book was clearly a labor of love for the author and her helpers. However it could have benefited from additional external review and editing, including photo editing. Though well-researched and certainly a cathartic project for the author, the small details such as typographical errors, and inconsistent photo reproduction quality may be distracting to some readers. Still, the author has succeeded in producing a book on the snakes of New England (with information on snakes in general) for the non-professional reader. Though Conant and Collins (1998) may also be of use to this target audience, as it is to the rest of us, it covers all of the eastern U.S. and provides only abbreviated information about the biology of the species it covers. Klemmens (1993) is closer to the target focus, being about all amphibians and reptiles of Connecticut and adjacent areas (New York, Massachusetts and Rhode Island), but it contains details that may be too cumbersome for the novice reader and is out of print and not readily available. Behler and King (1979) covers all of North America, but also has inconsistent photo quality and is a generation out of date, though it is readily available in most shopping mall book stores.

Certainly this book could be of value to laypeople wanting information about New England snakes. However, the author appears to have missed an ideal opportunity to make her audience aware of the many local organizations and programs that promote the education and welfare of snakes and other reptiles. An appendix in *Snakes of New England* deals with a specific reptile rescue and rehabilitation center in Connecticut. The author claims that this is the only such organization in New England. Whether this is accurate or not may be subject to debate, but most of the many general wildlife rehabilitators in New England also deal with reptiles from time to time and several veterinarians treat native reptiles and amphibians each year. Nature centers at state parks and those run by private organizations including Connecticut Audubon Society also will care for wounded native reptiles and amphibians. Focusing on a single rehabilitation center may leave the reader unaware that there are, in fact, hundreds of people throughout the region in zoos, museums, herpetological and herpetocultural clubs, and governmental and non-governmental conservation agencies whose work benefits New England reptiles.

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Herpetological Review, 2006, 37(2), 250–251.

Snakes of the Americas: Checklist and Lexicon, by Bob L. Tipton. 2005. Krieger Publishing Company, Malabar, Florida, USA (www.krieger-publishing.com). xiv + 477 pages. Hardcover + accompanying CD. US $94.50. ISBN 1-57524-215-X.

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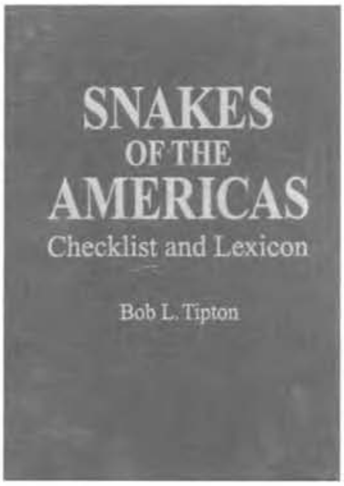

Bob Tipton's book and CD are clearly a labor of love. The author set out on an almost quixotic quest to link the common names used most comfortably by "most people" (Jonathan Campbell in the Foreword), especially native peoples and herpetoculturists, to the names used by scientists. To a large degree he has succeeded.

The heart of the CD is an Excel file containing a lexicon of almost 21,000 common names of American snakes, in more than 350 different modern and indigenous languages and dialects. These names are keyed to scientific nomenclature. Data in this huge file are extracted into several smaller subfiles that make their access much simpler. The lexicon is a remarkable document, winnowed from the literature, from personal communications from native speakers, and from the author's personal experiences. I am familiar with the Guaraní names for Paraguayan snakes; Tipton did not miss any that I know of, and he had several unfamiliar ones.

Another file on the CD is Tipton's working file that served as a basis for the hardcover checklist. It lists the American snake taxa to subspecies, the author and date of the name, and the countries in which the taxon occurs. For Latin America south of México, this in effect updates the checklist of Peters and Orejas-Miranda (1970; revised by Vanzolini, 1986).

The book is an exhaustively annotated checklist of American forms to subspecies, with scientific names for all taxa below the Order Serpentes, including authorities for the names, common English names, citations to much of the recent taxonomic literature, range descriptions, and remarks where the author encountered conflicting opinions. The style is that of the partial checklist of McDiarmid et al. (1999), with elements of the Peters and Orejas-Miranda (1970) Latin American synthesis. A section of *incerta sedis* contains 33 snake names that Tipton and other authors have been unable to allocate to currently recognized species. Finally, there is an 81-page bibliography, covering much of the taxonomic literature of New World snakes.

I am not a fan of invented common names. For starters, Tipton used the common names in Crother et al. (2000, 2003) for American species north of México, Liner (1994) for Mexican species, and Frank and Ramus (1995) for Central and South America. Where gaps occurred in these lists, Tipton coined new "recommended" common names. Inventing common names in an unfamiliar language can have confusing and even ludicrous results. For example, Tipton, following Liner, recommended the Spanish name "Culebra Palanaria de Sonora" for *Chionactis palarostris*. "*Palanaria*" is a frequent corruption in several languages of the flatworm genus *Planaria*. I doubt if a desert-dwelling sand snake has much to do with an aquatic worm. Delving further, we see that Tipton (and Liner) often use a translation of the Latin name for constructing a common name, and apparently *palanaria* is simply a misspelling of the Spanish *pala nariz*. This translates loosely as shovel-nosed, and is a direct translation of the Latin *palarostris*. There is another problem, however. *Nariz* is reserved for noses on humans; noses (and snouts) of animals are *hocicos*.

Trained in biophysics, Bob Tipton is, in his own words, an amateur, or serious novice, in the field of snake systematics. Recognizing this deficiency in his background, he became a protégé of one of the best: Jim Dixon of Texas A & M University. He also sought help from a long list of recognized authorities on problematic genera: Dixon for many genera; Hussam Zaher for *Oxybelis*, *Boiruna*, and *Clelia*; Robert Henderson for *Corallus*; Van Wallach for the Scolecophidia, etc.

However, the final result is uniquely Tipton. His lack of formal training shows through in many of his remarks, inconsistencies, and confused interpretations of taxonomic practice and content. For example, on page 3, the term "basal Alethinophidia" is a synonym of Haenophidia (or Henophidia elsewhere) "which are the Pythons and Boas." On page 8, "basal Alethinophidia" is a synonym of Macrostomata, which Tipton says, incorrectly, includes pipesnakes, boas and pythons. On pages 37–38, the term Haenophidia is dropped from the formal classification in favor of "Primitive (or BASAL) ALETHINOPHIDIA," which now includes only the Aniliidae. All other modern snakes, except Scolecophidians, are Macrostomatans, divided into basal Macrostomatans (Bolyeriidae, Tropidophiidae, Boidae, Pythonidae) and Caenophidia (all of the rest).

Reliance on non-peer reviewed publications, the opinions of amateurs, and the intrinsic problems in defining subspecies occasionally leads Tipton into a morass such as the mish-mash of "subspecies" of *Lichanura trivirgata* that have broadly overlapping geographic ranges.

The bibliography is one of the best parts of the book. The references appear to be accurate as far as they go, but key works are missed and secondary sources are often cited. In an especially personal example, Tipton credits a personal communication and the Smith and Smith (1993) checklist for synonymizing *Exelencophis nelsoni* and *Geatractus tecpanecus* with *Tropidodipsas annulifera*. However, this was done in Scott (1967), which is not in the bibliography. How many other, similar cases there are I can only guess.

Krieger Publishing and Tipton share responsibility for what is perhaps the most disturbing aspect of the book; it is replete with errors, both orthographic and factual. Some errors clearly predate the final editorial process, e.g., *Enicagnethus melanoauchen* [sic] for *Enicognathus melanauchen* (page 346) and the unjustified emendation of *Philodryas chamissonis* to *P. chamissona* in a misguided attempt to turn a Greek genitive ending into a feminine Latin nominative (page 201). These and other errors will have to be acknowledged in synonymies from now on.

The final editing was also incompetent. An especially egregious example is three spelling errors in a single phrase "sharing the punitive [sic] synapomorphy of a deeply bilobate hemipene [sic] and other characteristics of unknown polaritization [sic]" (page 343). Suffice it to say that I cannot remember a herpetological work, produced in the USA, with so many errors. It is a shame that the contents of the book do not live up to the excellent presentation and binding.

In summary, professionals and amateurs using the checklist need to check constantly to be sure that what they read is accurate. Tipton's book can be likened to a goldmine. There is much of value in it, but it must be selectively mined, and the resultant ore refined by experienced professionals.

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Herpetological Review, 2006, 37(2), 251–253.

Field Guide to the Amphibians and Reptiles of Aruba, Curaçao, and Bonaire, by Gerard van Buurt. Edition Chimaira, Frankfurt am Main, Germany (www.chimaira.de), distributed in the USA by Zoo Book Sales, Lanesboro, Minnesota (www.zoobooksales.com). 137 pp. Hardcover. US $39.95. ISBN 3-980612-66-6.

The Reptiles and Amphibians of the Dutch Caribbean: St. Eustasius, Saba, and St. Maarten, by Robert Powell, Robert W. Henderson, and John S. Parmarlee, Jr. 2005. The St. Eustasius National Parks Foundation (STENAPA), Gallows Bay, St. Eustasius, Netherlands Antilles (www.statiapark.org/intro.html). 192 pp. Softcover. US $25.00 ISBN 978-0-9673958-8-3.

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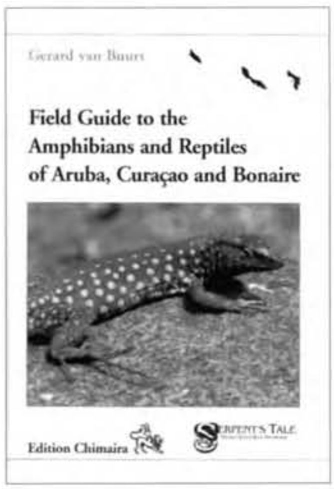

The Netherlands Antilles ("Dutch Caribbean") consist of two remote clusters of three major islands each that could hardly be more different and still fit in the same sea. These two books mirror and surpass that degree of difference.

The first published, van Buurt's *Field Guide*, is about the South American coastal islands of Aruba, Curaçao, and Bonaire (often called the ABC islands or Dutch Leewards) with a collective herpetofauna of 26 native or established exotic species (not counting marine turtles) of largely continental relationships. There is only one native amphibian, the leptodactylid *Pleurodema brachyops*, which will convince anyone of the close relationship of its family to Bufonidae. All the endemics are reptiles: The geckos *Phyllodactylus martini* on Curaçao and Bonaire and *P. julieni* on Aruba, the anoles *Anolis bonairensis* on Bonaire and *A. lineatus* on Aruba and Curaçao, the teiids *Cnemidophorus arubensis* on Aruba and *C. murinus* with geographic variants on all three islands, and the snakes *Leptodeira bakeri* on Aruba (and possibly the proximate mainland peninsula of Paraguana, Venezuela), *Liophis triscalis* on Curaçao, and—most celebrated of all—*Crotalus unicolor*, the rattler of Aruba.

In the preface van Buurt explains that this book began as an

English translation of a previously published Dutch version (not cited and not seen by me), but with extensive upgrading and revision. Still the text would have benefited dramatically from editing by someone schooled in grammar and spelling whose first language was English. Commas appear almost randomly scattered but are conspicuously absent from some places where needed. Novel spellings include "Carribean" (p. 79), the indecisive San "Nicolaas" or "Nicolas" (p. 90), "Cricetidaea" for the rodent family Cricetidae (p. 118) that most of us now subsume into Muridae, and the snake "fer the lance" (p. 114). In fairness, however, these errors are minor and do not seriously detract from comprehension.

The text begins with a discourse on paleogeography going back to Pangaea that is out-of-date. Recent work by Christopher Scotese presented in Lomolino and Heaney (2004) shows that there never was a "Laurasia." The Tethys seaway split Eurasia from North America and the latter remained attached to Gondwana for millions of years before a protocaribbean seaway opened. This ancient history, however, can have little to do with biogeography of living vertebrates. The notion suggested by van Buurt that iguanas date from Gondwanan unity does not fit with the evidence that their radiation is about 12 million years old (Hedges 2001).

A more troubling allusion to plate tectonics appears in a long (pp. 78–80) aside bracketed into the account of *Anolis bonairensis*. Here van Buurt dusts off the idea of the Dominica/Martinique tectonic juxtaposition put forth by Roughgarden (1995) to explain the Lesser Antillean relationship of *Anolis bonairensis* and the South American relationship of *Cnemidophorus vanzoi*. Perry and Lazell (1997) reviewed the geological evidence cited by Roughgarden and asserted that it had been catastrophically misunderstood: no evidence exists for that tectonic theory. Perhaps Perry and Lazell (1997) were wrong, but no one should assume that without checking the data and the geological texts.

The remainder of van Buurt's lengthy biogeographic discourse supports waif dispersal with good, if anecdotal, evidence. Elsewhere, however, he asserts that anurans are virtually unable to disperse across sea water (p. 19) and that the gecko *Hemidactylus mabouia* "does not seem to have a natural habitat in the New World" (p. 59). Many anuran clades have dispersed across sea water, not just in the Antilles, but all the way to the Seychelles in mid-Indian Ocean and *H. mabouia* is frequent on native trees in the Virgin Islands (Lazell 2005).

There is an interesting discussion of herbivory in lizards detailing the remarkable situation of the *Cnemidophorus* in these islands: small to midsize, largely herbivorous species. However extensive evidence of facultative herbivory in other small lizards like anoles (e.g., Lazell and Mitchell 1998) was not noted. Conversely, the assertion that "The adult green iguana is fully herbivorous" (p. 67) cannot possibly apply to Lesser Antillean populations (Lazell 1973) that are aggressive, facultative carnivores whenever possible. While on *Iguana iguana*, I note van Buurt believes all Virgin Islands populations were "probably introduced" but Iverson (1980) documented distinctive *Cyclura*-like gut anatomy in the original St. Croix population. Indeed, van Buurt's evidence from the islands he chronicles argues for great evolutionary diversity within *I. iguana*.

In the discussion of the introduced toad *Bufo marinus* van Buurt points out the potentially devastating effects this poisonous species might have on native predators. He also documents with photos (66, 67) a snake, *Lepidoptera bakeri*, consuming one, but does not report on the fate of the snake. Readers should also note that, technically, the toad's toxin is not a "venom" because it is not injected. Bits like this highlight the lack of a glossary which is needed for various terms used.

Generally, this is a solid guide with lots of interesting information and mostly good (some great) photos. I could wish for more detail on differences between closely related species, such as the geckos in *Phyllodactylus* and *Gonatodes*, and more information generally on a rarity like the lizard *Tretioscincus bifasciatus*, for which van Buurt seems to lack first hand information and shows only 70-year-old, very grainy, black-and-white photos.

In these respects this book tells us what we need to discover more about: a very useful and stimulating tool.

The volume by Powell et al. is a sort of natural history monograph loaded with technical detail (with terms defined in the text and a glossary). There are accounts of 25 species (including three marine turtles) four of which are established introductions: blind snake (*Typhlops* or "*Ramphotyphlops*" *braminus*), slider turtle (*Trachemys scripta*), whistling frog (*Eleutherodactylus johnstonei*), and Cuban treefrog (*Hyla* or "*Osteopilus*" *septentrionalis*). The latter two are the only anurans, so there are no native amphibians. Strictly speaking, there is only one endemic reptile, the Saba Anole, *Anolis sabanus*. This is an artifact produced by colonial history and resulting political boundaries: the three major islands—Saba, St. Eustatius, and St. Maarten—are on three separate oceanic banks (that were separate, larger land areas at glacial maximum). Were one to score endemic species on these banks there would be 11 more: the Red-faced Ground Lizard (*Ameiva erythrocephala*), Anguilla Bank Ground Lizard (*A. plei*), St. Kitts Bank Tree Anole (*Anolis bimaculatus*), Anguilla Bank Tree Anole (*A. gingivinus*), St. Maarten Bush Anole (*A. pogus*), the St. Kitts Bank Bush Anole (*A. schwartzi*), Anguilla Bank Dwarf Gecko (*Sphaerodactylus parvus*), Saba Dwarf Gecko (*S. sabanus*), Island Dwarf Gecko (*S. sputator*) Anguilla Bank Racer (*Alsophis rijgersmaei*), and Red-bellied Racer (*A. rufiventris*). Thus more than half the native herpetofauna is endemic to the banks with Dutch islands on them.

Powell et al. provide a lengthy discussion of conservation efforts and descriptions of conservation organizations active in these islands. Each species account also includes a section on conservation status. Two species, a skink (*Mabuya* sp. indet.) and the Anguilla Bank Racer, have apparently been extirpated from the Dutch islands (both from St. Maarten) but survive elsewhere. The native population of *Iguana delicatissima* also seems to be gone from St. Maarten, replaced by introduced *I. iguana*. Within *I. iguana*, Powell et al. make a strong case for the distinctiveness of the Saba population or form, but it was seriously reduced by human predation for food (a supposed aphrodisiac) a couple of decades ago, and may now be even more threatened by introduced pet trade *I. iguana*. Indeed introgression with exotic *I. iguana* threatens not only the genetic integrity of native *I. iguana* populations but the very survival of *I. delicatissima*.

Every species account in this book includes — in addition to fundamental description, distribution, and natural history data — sections on food, predators, reproduction, behavior, and conservation. Thus, this is far more than a field guide. The photographs are mostly excellent, although some are difficult to decipher (e.g.,

the lower of fig. 150; hint: search for the banded tail). Powell et al. weakly back me up on natural habitats for *Hemidactylus mabouia* (p. 110) but also say things like "Iguanas of all ages are almost exclusively herbivorous" (p. 65); they fess up to the truth occasionally: "... bird eggs and even carrion" (p. 66), "... bird eggs and carrion" (p. 73), and: "Young iguanas... will consume insects and other small animals..." (p. 61) [whenever they get the chance, believe me].

In addition to the regular eight headings in each species account, there may be an additional comment. That for the skink *Mabuya* is especially appealing to me because I believe considerable evolutionary diversity is going unrecognized in these lizards. In addition, many populations, as the authors note, are apparently declining and some have been extirpated before we got them sorted out.

The only account with which I have real problems is for the Asian exotic blind snake *Typhlops* or "*Ramphotyphlops*" *braminus*. The genus "*Ramphotyphlops*" is defined solely on the basis of male hemipenial structure and this species consists entirely of parthenogenetic females. Furthermore, these snakes frequently produce live young although they can also lay eggs (Lazell 2002 and references therein). Lastly, this blindsnake is not confined to the tropics but has apparently established populations as far north as Virginia and even Massachusetts (Savitsky et al. 2002 and references therein).

While a third longer than van Buurt's book, that of Powell et al. is short and compact enough to function as a field guide. The pages are plasticized; this makes for excellent photographic presentation and is water and mildew proof. However, the pages stick together infuriatingly and are very stiff. My copy is already breaking up at the binding and soon will be a bundle of cards. Much more than a field guide, Powell et al. is a virtual introduction to herpetology using the species of this little island cluster as examples. I can strongly recommend Powell et al. as a densely fact-packed good read on geology, geography, conservation, and natural history in general.

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THE LIFE AND HERPETOLOGICAL CONTRIBUTIONS OF MARIO GIACINTO PERACCA (1861-1923)

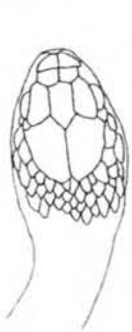
WITH AN INTRODUCTION, ANNOTATED BIBLIOGRAPHY AND SYNOPSIS OF TAXA BY FRANCO ANDREONE AND ELENA GAVETTI

Mario Peracca (1861–1923) was one of the foremost Italian herpetologists of the late 19th and early 20th centuries. Although poorly known today in comparison to some of his contemporaries, Peracca published numerous faunal works, many including descriptions, based on the collections that reached the Turin Museum from the expeditions of Fea, Festa, Borelli and others. In addition, he collected within Italy himself, describing the salamander *Molge italica* (now *Triturus italicus*). He was also a pioneer of reptile husbandry, keeping a great diversity of species, including the tuatara, *Sphenodon punctatus*, and the now extinct skink *Macroscincus coctaei* in specially built enclosures at his villa in Chivasso, outside Turin. Although much of Peracca's work with captive animals remained unpublished, some of his observations formed the basis for papers on reproduction and behavior.

Among his faunal works, Peracca is perhaps best remembered for his papers on Madagascar and South America, although he also published on African and Asian taxa. Peracca published 64 scientific papers over the period 1882–1917. The majority of the papers are in Italian, with a few in English, French and German; all are included in facsimile in this SSAR volume. Peracca described 22 amphibian species (14 still valid) representing the families Bufonidae, Dendrobatidae, Hylidae, Leptodactylidae, Microhylidae, Pipidae, Mantellidae and Ranidae, and 52 reptiles (26 currently valid) in the Anguidae, Gekkonidae, Gymnophthalmidae, Hoplocercidae, Lacertidae, Polychrotidae, Scincidae, Teidae, Tropiduridae, Amphisbaenidae, Colubridae, Elapidae, Tropidophiidae, Typhlopidae and Viperidae.

An introduction by Franco Andreone and Elena Gavetti provides a biography of Peracca, a summary of all of the herpetological names he proposed, and an annotated bibliography. The biography uses archival copies of Peracca's correspondence to highlight his long association with G.A. Boulenger, whom he considered as his herpetological mentor, and to reveal a never-realized plan with Albert Günther to introduce tuataras onto small islands in the Mediterranean. Peracca spent his fortune in support of charity and of his private live animal research interests and died in bankruptcy.

Specifications: 550 pages, 6 x 9 inches, clothbound. ISBN 0–916984–69–9. To be published September 2006.



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ARTICLES

TECHNIQUES

NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 37, Number 1 (March 2006).

CAUDATA

AMBYSTOMA MACULATUM (Spotted Salamander). **MORTALITY**. *Ambystoma maculatum* are winter breeders in the southeastern United States. Individuals are often subjected to unpredictable environmental conditions, such as partial freezing of aquatic habitats, during their breeding activities. Adult mortality from partial freezing of aquatic habitat is known (Harris 1980. Copeia 1980:719–722), but has rarely been described. We report here on observations of *A. maculatum* mortality during reproduction after a partial freeze of a wetland in Mecklenburg County, North Carolina, USA during the winter of 2005.

Warm air temperatures (up to 20°C) and precipitation from 25–27 January proceeded and apparently initiated *A. maculatum* breeding activity. On 28 January, a cold front moved through the area and maximum air temperatures remained below freezing (-6°C) until 30 January. A thin (< 2 cm) layer of ice formed over the majority of the wetland, and remained until 8 February. We surveyed the wetland between 2–10 February 2005 and observed 27 dead *A. maculatum*; 21 females (mean SVL = 103.6 mm, SD = 3.82 mm; TTL = 192.3 ± 7.25 mm; N = 19), and 6 males (mean SVL = 99.2 ± 12.77 mm; TTL = 190.33 ± 28.12 mm). Seventeen of the females contained eggs (mean = 65.47 ± 48.59; range 11–182). Nine individuals had various body injuries such as missing pieces of the head and torso, or punctures in the ventral side. We also collected dead individuals of *Rana sphenocephala* (3), *R. catesbeiana* (2), *Pseudacris ferairum* (1), *Acris crepitans* (1), and *Chrysemys picta* (1).

Our observations confirm those of Harris (1980, *op. cit.*), which suggest that freezing of aquatic habitats can lead to mortality in *A. maculatum*, and that mortality is skewed towards females, even though males are often more numerous in breeding ponds (Stenhouse 1985. Copeia 1985:631-637). The reason females are more susceptible than males to freezing is unknown, however, we speculate it might be the result of egg-depositing behavior, sensitivity to reduced oxygen levels, or the reluctance to leave the wetland when gravid. Although we did find several individuals with injuries, we believe it is likely these injuries were induced post-mortem by aquatic invertebrates or other scavengers inhabiting the wetland. This research was supported by the Davidson College Department of Biology, Duke Power and National Science Foundation grant (DEB – 0347326) to MED.

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AMBYSTOMA TALPOIDEUM (Mole Salamander). **DIET**. On 18 March 2003, JGP removed a drowned terrestrial morph adult female *Ambystoma talpoideum* (51.5 mm SVL) from a plastic minnow trap set in a 0.3 ha seasonal wetland on Moody Air Force Base, Lowndes County, Georgia, USA. Upon dissection, the following aquatic invertebrates were removed from the salamander's stomach: nine clam shrimp (Lynceidae: *Lynceus*), three isopods (Asellidae: *Caecidotea*), two unidentifiable mosquitoes (one larva, one pupa; Culicidae), one beetle (Dytiscidae: *Uvarus*), and one beetle larva (Dytiscidae: *Agabus*).

Previous reports of metamorphosed *A. talpoideum* adults feeding while in breeding habitats include Cliburn and Carey (1975. J. Mississippi Acad. Sci. 20:49–52) and McCallister and Trauth (1996. Southwest. Nat. 41:62–64). Conspecific ova were consumed exclusively by the specimens examined by McCallister and Trauth (*op. cit.*). In addition to unidentified amphibian ova, Cliburn and Carey (*op. cit.*) observed aquatic invertebrates in *A. talpoideum* stomachs. Collectively, these three reports of aquatic feeding by metamorphosed adult *A. talpoideum* suggest that this behavior might not be uncommon. Moreover, aquatic feeding by adults might be an important strategy to recover energy reserves expended during the breeding season.

Funding for JGP was provided by the U.S. Air Force through a contract with the Center for Reptile and Amphibian Conservation and Management, Indiana-Purdue University, Fort Wayne, Indiana. Field work by JGP was authorized by Georgia scientific collection permit # 29-WMB-02-20. We thank Greg Lee for access to MAFB and Bruce Kingsbury for administering funding.

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ANEIDES AENEUS (Green Salamander). **DISPERSAL**. *Aneides aeneus* inhabits cliffs and rockface outcrops at elevations <1340 m in mountainous forests from southwestern Pennsylvania to extreme northeastern Mississippi (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington D.C. 587 pp.). Populations are largely confined to deep crevices within sandstone, granite, and schist formations but occasionally are found under loose bark of fallen trees (Petranka, *op. cit.*). The extent to which *A. aeneus* disperses between isolated rock outcrops is unknown. Individuals are rarely observed in adjacent forest floor habitats even when collecting around rock outcrops with large populations (Snyder 1991. J. Tennessee Acad. Sci. 66:165–169). Although *A. aeneus* has been recorded crossing roads during April–June (Cupp 1991. J. Tennessee Acad. Sci. 66:171–174; Williams and Gordon 1961. Copeia 1961:353), disturbance to forest habitats is thought to limit dispersal between rock outcrops (Petranka, *op. cit.*). Here we report dispersal of *A. aeneus* across an open, disturbed habitat in southern West Virginia.

On 1 October 2004 we discovered a single adult *Aneides aeneus* under an artificial coverboard in an actively grazed livestock pasture at Reba Farm (37°47'31"N, 80°58'30"W), a USDA Appalachian Farming Systems Research Center site near Beaver, Raleigh County, West Virginia, USA. All woody vegetation, coarse woody debris, and rocks had previously been removed from the pasture (884 m elev) to facilitate grazing. Natural ground cover within the pasture was limited to Orchardgrass (*Dactylis glomerata*) and

White Clover (*Trifolium repens*). The coverboard (30 cm × 46 cm × 5 cm), installed flush against the topsoil, was one of 20 white oak boards within the pasture. The coverboard was 54.9 m from the nearest rock outcrop and 45.7 m from the nearest woodland habitat. Surface temperature under the coverboard was 12.7°C. Searches of all habitat within a 150-m radius of the coverboard and all other boards within the pasture revealed no additional *A. aeneus*. Additionally, no *A. aeneus* were found when all coverboards in the pasture were re-sampled on 15 October 2004.

Although mating in West Virginia populations of *Aneides aeneus* occurs primarily during May–June, the timing of our observation coincides with a secondary breeding period that is thought to occur in September–October (Canterbury and Pauley 1994. J. Herpetol. 28:431–434). Our observation is significant as it documents dispersal of *A. aeneus* across non-forested, repeatedly disturbed habitat previously considered unsuitable for the species. Our observation also suggests the possibility that artificial cover objects might facilitate dispersal of *A. aeneus* between rock outcrops by providing suitable microenvironments or refugia within otherwise harsh, open habitats.

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DESMOGNATHUS MONTICOLA (Seal Salamander). **ARBOREAL BEHAVIOR.** On 15 August 2004, ca. 1345 h, an adult male *Desmognathus monticola* was found under the bark of a Yellow Buckeye tree (*Aesculus flava*) ca. 1 m above the ground and 4 m from the water of Indian Creek, Unicoi, Unicoi County, Tennessee, USA (N36°10.572', W82°17.884'). *Desmognathus monticola* is generally associated with streams and is known to ascend wet rocky stream banks (Dodd 2004. The Amphibians of Great Smoky Mountains National Park. University of Tennessee, Knoxville. 283 pp.). Nocturnal climbing, especially during rain, has been noted for other *Desmognathus* species (Hairston 1949. Ecol. Monogr. 19[1]:47–73; Hairston 1986. Am. Nat. 127:266–291; Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, DC. 587 pp.). However, to our knowledge, this is the first record of arboreality in this species and the first record of any *Desmognathus* using an arboreal diurnal retreat. The individual was collected under Tennessee permit number 1920 issued to Maxim Shpak and is deposited at Yale Peabody Museum of Natural History (YPM 10037).

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EURYCEA CIRRIGERA (Southern Two-lined Salamander). **GILL MORPHOLOGY**. Because larval two-lined salamanders (*Eurycea bislineata* complex) typically inhabit lotic environments (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Inst. Press. Washington, D.C. 587 pp.), little is known about interdemic variation in larval morphology. Herein we report on interdemic variation in gill morphology for *E. cirrigera* larvae from southern West Virginia, USA. Larvae were collected seasonally (April 1994–January 1995) from Fitzpatrick's Branch, an intermittent, first-order stream in Cabell County, West Virginia (Brophy and Pauley 2002. Maryland Nat. 45:13–22) and Trump-Lilly Pond, a small farm pond in Raleigh County, West Virginia (Brophy and Pauley 2001. Herpetol. Rev. 32:98–99).

Captured larvae were anesthetized in chloretone, fixed in a 4% formalin solution, and preserved in 70% ethanol. The following measurements were made on the left side of each larva using a dissecting microscope and ocular micrometer: Fimbria length (FimL) – length (mm) of longest fimbria on 3rd gill arch; Fimbria width (FimW) – width (mm) midway along FimL; Rachis length (RachL) – length (mm) of rachis on 3rd gill arch; and Number of fimbriae (NumFim) – total number of fimbriae on 3rd gill arch. All characters were standardized for body size by regressing each variable against SVL and using the residuals in statistical procedures (Atchley et al. 1975. Am. Zool. 15:829; Atchley et al. 1976. Syst. Zool. 25:137–148). Larvae within each site were grouped across seasons ($N = 95$ for each site) and two-tailed Student's t-tests on the residuals were used to determine whether differences in gill morphology occurred between larvae from different habitats.

Differences in gill morphology were very apparent between larvae from pond and stream habitats. In general, pond larvae had relatively larger gills and a greater number of fimbriae than their stream counterparts. Mean values of the residuals for FimL, FimW, RachL, and NumFim were significantly different between pond and stream larvae ($p < 0.0001$ and $df = 188$ in all cases; FimL: $t = 10.01$; FimW: $t = 9.67$; RachL: $t = 9.62$; NumFim: $t = 5.78$). Mean residual values of pond larvae (positive) were greater than those of stream larvae (negative) for all gill characters. Causes of interdemic variation in gill morphology are unknown in this case, but future studies should investigate dissolved oxygen levels (Bond 1960. Dev. Biol. 2:1–20; Timmerman and Chapman 2004. J. Fish Biol. 65:635–650), temperature (Smith 1990. Ecology and Field Biology, 4th ed. Harper Collins Publ. New York), larval activity rates (McFarland et al. 1979. Vertebrate Life, 1st ed. Macmillan Publ. Co. New York. 875 pp.), and ion concentrations (Timmerman and Chapman, *op. cit.*) as potential causal factors.

We thank Michele L. Brophy, Peter A. Kramer, and James W. Barron for their assistance in the field and lab. All specimens were collected under WVDNR permit numbers 19-1994 and 52-1995, and voucher specimens were deposited in the West Virginia Biological Survey collection at Marshall University (WVBS 6879–6921). This study was partially funded by a research grant to TRB from the Marshall University Graduate Student Council.

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EURYCEA CIRRIGERA (Southern Two-Lined Salamander). **COLORATION.** Herein we report a leucistic larval *Eurycea cirrigera* (24 mm SVL) collected in northern Raleigh, North Carolina, USA (35.8599°N, 78.6733°W; WGS84/NAD83) on 27 May 2004. This individual is believed to be the second observation of a leucistic *Eurycea cirrigera*. Typical larvae are gold in color with extensive dark mottling. The leucistic individual lacked most pigmentation, exhibiting a transparent, cream coloration with faint orange and light brown speckling. The individual was classified as leucistic because of the presence of brassy eyes with dark pupils, instead of the unpigmented eyes of an albino. The light coloration contrasted markedly from other normal individuals; however, similar size, development, and behavior were observed.

We believe this is the second report of a leucistic *E. cirrigera* in North Carolina or elsewhere. Review of files and reexamination of an adult female considered albinistic by Palmer and Braswell (1980. Brimleyana 3:49–52) supports calling it leucistic using current terminology (Bechtel 1995. Reptile and Amphibian Variants: Colors, Patterns, and Scales. Krieger Publ. Co., Malabar, Florida). Although the frequency of leucism is unknown, repeated sampling of 45 sites in Wake County, North Carolina, USA produced 866 observations of *E. cirrigera* larvae, including 58 observations at the site where this specimen was collected. No other leucistic individuals were observed. In addition, only one similar specimen or record of this color variant is present in the North Carolina State Museum of Natural Sciences (NCSM) collection, which documents over 9000 specimens of *E. bislineata* complex from throughout the state. The larva was believed to be one-year old at the time of collection and was lab reared through October of 2004 without metamorphosing. The individual is catalogued as NCSM 66443.

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ANURA

ATELOGNATHUS PATAGONICUS (NCN). **DIET**. Within the life history of a species, knowledge of its trophic habits is essential to draft a conservation strategy. *Atelognathus patagonicus* is an aquatic frog endemic to the endorheic pond system in Laguna Blanca National Park and the surrounding area in northwest Patagonia, Argentina (Cei and Roig 1968. Physis 27:265–284; Gallardo 1962. Neotropica 8:45–68). It is categorized as "Endangered" (IUCN, Conservation International, and Nature Serve. 2004. Global Amphibian Assessment. <www.globalamphibians.org>. 13 Dec 2004). Two forms of *A. patagonicus* have been recognized: "aquatic" and "littoral" (Cei and Roig 1968, *op. cit.*). The "aquatic form" has large interdigital membranes and highly developed cutaneous folds on its trunk and thighs. The "littoral form" lacks these features. The "aquatic form" makes up the largest part of the population, and lives under submerged rocks. The "littoral form" lives out of the water, some distance away from the ponds. The species has disappeared from the largest body of water in the system (Laguna Blanca, 1780 ha), and is currently restricted to 15 bodies of water smaller than 60 ha (Cuello, unpubl. data). The disappearance of *A. patagonicus* from Laguna Blanca has been linked to the introduction of *Percichthys colhuapiensis* (Perca) and salmonids in the mid-1960s. These species rapidly colonize ponds and feed on a variety of aquatic organisms (Ferriz 1989. Iheringia 69:109–116; Macchi et al. 1999. Ecol. Freshw. Fish 8:227–236). Here we report the first qualitative and quantitative data on the diet of the "aquatic form" *A. patagonicus*.

The study was conducted during the austral summer (January 2001) in Laguna del Hoyo (39°00'36"S, 70°25'48"W; ca. 1400 m elev.), a permanent pond in Laguna Blanca National Park. This pond has a surface area of 38 ha, and a perimeter of 2.69 km, 40% of which is rocky, providing an optimal habitat for the frog. A large variety of aquatic arthropods, mainly amphipods, thrive under the rocks. The rooted macrophyte *Miriophyllum quitense*, colonial Nostocaceae algae and filamentous algae are well-developed in the pond. Nine "aquatic form" *A. patagonicus* were captured by hand, immediately euthanized, and fixed in 10% formalin. Body length ranged from 27.1–40.5 mm. Mean body length was 33.4 ± 2.5 mm for males (N = 5) and 33.55 ± 2.1 mm for females (N = 4). The diet was analyzed by examining the digestive tracts (stomach–small intestine). Prey was identified to the lowest possible taxonomic level. The individual volume of each prey item and the number of prey items per digestive tract for each prey category were recorded. Frequency of occurrence of each taxon was calculated as number of digestive tracts in which a certain taxon was found, divided by total number of digestive tracts examined. The large intestine was analyzed qualitatively to obtain additional information.

The diet of the "aquatic form" of *A. patagonicus* was made up of aquatic organisms of phylum Arthropoda. The food consisted of three prey categories found in the stomach-small intestine and two additional prey categories found in the large intestine. The diet was dominated numerically and volumetrically by amphipods of the genus *Hyalella* (87.7% and 92.2%, respectively). *Hyalella* was the most frequent prey, found in 100% of the frogs. Additional prey categories found in the large intestine were caterpillars and insect eggs. From 2 to 19 prey items were found per frog. Size ranged from 2 to 12 mm. The mean length of prey body was 8.1 ± 7.1 mm and the mode was 7 mm. Medium-sized prey was the most numerous and consisted almost exclusively of *Hyalella*. The diet of the larger frogs had the widest range of prey size and the greatest number of food categories. Coleoptera and Hemiptera made up a secondary food source.

The feeding pattern of *Atelognathus patagonicus* "aquatic form" is a consequence of the microhabitat where it lives. Shallow water with a high density of aquatic vegetation, where invertebrate richness is usually high, enables food selection. As a result of our observations, we speculate that the frog shows prey selection, suggested by its high consumption of amphipods. We have noted that frogs in ponds adjacent to Laguna del Hoyo tend to feed on amphipods. Furthermore, from unpublished data available for comparison (Mazzuchelli 1991. Informe Final del Programa Relevamiento preliminar de las comunidades acuáticas del Parque Nacional Laguna Blanca, Unpubl. Report to Administración de Parques Nacionales. Delegación Técnica Regional Patagónica, San Carlos de Bariloche, Argentina. 13 pp.) we know that amphipods were the dominant food item in Perca diet in the early 1990s in

Laguna Blanca, where *A. patagonicus* is now extinct. This suggests that both frogs and Percas may have shared the amphipod resource in the pond.

The information on the feeding habits of *A. patagonicus* presented here is part of an investigation of the interaction between frogs and introduced fish. There is a need to preserve the essential trophic resource for the "aquatic form" of the frog species, and strict official control should prevent any further introduction of fish into these ponds.

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BUFO CALIFORNICUS (Arroyo Toad). **MORTALITY.** On 14 May 2001, in a dry arroyo along a secondary channel of San Ysabel Creek (San Pasqual Valley, San Diego County, California, USA: N33.05.396, W116.58.164, WGS 84) DAK found a freshly-crushed toad carcass pressed into the sand within a tire track of a utility quad (off highway-vehicle [OHV]). The specimen was collected and brought to ELE and RNF for identification. The amphibian was subsequently identified as the federally endangered *Bufo californicus* [42 mm, snout–urostyle length [SUL]: SDSNH 69059]. The body of the toad was vertically compressed with a skin abrasion on the ventral surface and a partially protruding tongue. Based on the injuries sustained we concluded that the cause of death was crushing due to vertical pressure, most likely sustained from the force of impact from the OHV tires. It is unclear whether the toad was run over while on the surface (e.g., foraging) or burrowed under the sand and subsequently writhed to the surface. As evidenced by the abundance of tire tracks along the braided channels and across the sandy upland terraces, the habitat on private and public lands of San Ysabel Creek in San Pasqual Valley (ca. 5.5 × 0.75 km) is subject to intensive use by OHV riders (pers. obs.).

The reach of San Ysabel Creek where the dead specimen was collected supports a large population of *B. californicus* (U.S. Fish and Wildlife Service 1999. Arroyo Southwestern Toad [*Bufo microscaphus californicus*] Recovery Plan. USFWS, Portland, Oregon 119 pp.; pers. obs.). Documentation of this crushed individual demonstrates the vulnerability of this endangered species to incompatible recreational activities within occupied habitats.

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BUFO HOUSTONENSIS (Houston Toad). **JUVENILE DISPERSAL.** *Bufo houstonensis* is an endangered anuran endemic to central-east Texas. Although its breeding behavior has been well documented (Hillis et al. 1984. J. Herpetol. 18:56–72; Price 2003. TPWD report 03-0401), the little published information concerning the juvenile life stages focuses mainly on predation (Freed and Neitman 1988. Texas J. Sci. 40:454–456), coloration (Mays and Freed 1985. Herpetol. Rev. 16:108–109), and growth (Greuter and Forstner 2003. Herpetol. Rev. 34:355–356; Quinn and Mengden 1984 Southwest. Nat. 29:189–195).

A *Bufo houstonensis* egg string was surrounded with an aluminum flashing enclosure during Spring 2004 at the Griffith League Ranch (GLR) in Bastrop County, Texas, USA to monitor post-metamorphic behavior. Upon emergence, 993 individuals were captured and a single toe was clipped to identify the cohort year. The flashing was removed and 100 individuals were dusted with inert fluorescent powder (Radiant Color, T1 pigment) and released as a single group at the point of emergence. Fluorescent pigment was successfully used to track adult *Pelobates fuscus* (Eggert 2002. Herpetol. J. 12:69–74) and the same technique was applied in tracking juvenile *B. houstonensis* dispersal. Toadlets were monitored immediately following release to determine if the pigment caused any malaise, and normal activity was observed. Metamorphs were located with a UV light (Raytech, Raytector–V Portable UV Light) for two consecutive nights and observed during the early morning hours of the day following their pigment-marked release. Metamorph locations were marked with marking flags; the area was left as undisturbed as possible, and the dispersal pattern was not analyzed until after the metamorphs left the pond's edge. It was our intention to follow the juveniles for a longer period, but during the afternoon of the third day, GLR received over 25 mm of rain. We believe this resulted in the pigment powder washing off of the toads as well as washing away trackways from the preceding night's dispersal.

We released the pigment-marked individuals at the point of emergence at the pond's edge. The tracks from individual metamorphs were not distinguishable within 0.5 m of the release site because of the large amount of powder deposited in a small area. However, tracks could easily be distinguished beyond the initial confused area of powder marks. When dispersing from the pond's edge metamorphs did not move in a straight line, but in a seeming random pattern that may have been foraging or shade seeking behavior. The majority of the pigment-marked individuals retreated into the water after release, which is normal behavior for post-metamorphic *B. houstonensis* (Greuter 2003. Unpubl. MS. Thesis, Texas State Univ. San Marcos, Texas. 80 pp.). We were able to track 15 individuals over two days. Within 48 h after emergence, 8 of the *B. houstonensis* metamorphs had dispersed at least 4 m from the pond's edge. Mean dispersal distance was 3.24 m (range 0.7–5.13 m; median distance 3.43 m; N = 15) from the release point. The majority of the individuals (N = 12) were found buried under grass or sedge tussocks. The dispersal pattern did not increase in diameter from 24–48 h after marking. After the rainfall event, no pigment-marked metamorphs were relocated, however, toe-clipped individuals were quickly located, so we assumed the pigment washed off during the rainfall.

During this study, metamorphs did not show any ill effects related to the powder. Using this method was an easy, efficient, and

cost effective way to track post-metamorphic juveniles. Nighttime observations of the movements of pigment-marked juveniles were easily monitored using UV light. Metamorphs were also observable during the day as the powder is highly visible, allowing us to observe toadlets without disrupting the point of emergence. We could visually track the individuals during day using binoculars from a distance of 3 m without difficulty. This is particularly relevant given the concentration of individuals at the pond's edge during the emergence period and the consequent care required to prevent accidental mortalities when trying to observe the behavior of these juveniles. We did not observe direct foraging during day or night surveys. Individuals appeared to be moving between shaded cover (daylight) or moving from one resting area to the next (night time). The technique does have an inherent weakness in very wet or rainy areas.

This study was conducted under permits issued to MRJF (USFWS: TE039544-1, TPWD: SPR-0102-191, and TXSTATE-IACUC: HGVMAD_02 and 5Qrs45_02).

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BUFO SPINULOSUS PAPILLOSUS (NCN). **REPRODUCTION**. Information on the reproductive biology of the Patagonian toad *Bufo spinulosus papillosus* is scarce. Species of the genus *Bufo* lay eggs in large clutches and are explosive breeders (Wilbur 1987. Ecology 68:1437–1452). Their eggs are typically laid in strings (Zug et al. 2001. Herpetology: An Introductory Biology of Amphibians and Reptiles. 2nd ed. Academic Press, San Diego, California. 630 pp.). This note provides the first description of the clutch characteristics, egg-laying site, and breeding season of *Bufo spinulosus papillosus* in northwest Patagonia, Argentina. *Bufo spinulosus papillosus* is distributed over the Andean and extra-Andean Patagonia in Argentina and Chile (Cei 1980. Amphibians of Argentina. Monit. zool. ital. [N.S.], Monogr. 2:[i-xii] + 1–609), and is found at altitudes of up to 2000 m (Úbeda, pers. obs.). It inhabits both the open steppe and temperate austral forests and their ecotones (Cei, *op. cit.*). It is common in rivers, streams, and steppe wetlands (*mallines*), and in open areas in the forest, such as lake and river shorelines (Christie 1998. Patagonia Silvestre [Ser.Tec.] 2:27–32).

Bufo spinulosus papillosus populations were studied at two localities. Locality 1 comprises a pond and a collateral arm of a stream, surrounded by semi-xeric thicket (41°10'52"S, 71°19'14"W; 906 m elev.). Locality 2 is a temporary pool located on a river floodplain surrounded by humid *Nothofagus* forest (41°13'52"S; 71°46'17"W; 850 m elev.). Observations were made during austral springs (September–December) from 2001 to 2004. Clutch sites (temperature, depth, substrate, and vegetation) and breeding timing were studied and compared at both localities. Clutch description was based on material from Locality 1. In the field, the duration of embryonic development was recorded for one clutch up to the time of hatching. Total length was measured for 4 clutches, from which segments were collected and preserved in 10% formalin. In the lab, segment length was measured and the number of eggs counted to obtain an estimate, by extrapolation, of the total number of eggs. String and egg diameters were also measured, and colouring described. In addition, 3 clutches were incubated to determine larval stage at hatching (Gosner 1960. Herpetologica 16:183–190). To verify species identity, these larvae were monitored until metamorphosis was complete.

Bufo spinulosus papillosus has a seasonal breeding pattern. It begins oviposition in early austral spring, acting as an early breeder. At Locality 1, a total 39 clutches were recorded (15, 1, 13, and 10 during the years 2001–2004). All eggs were laid from the last week in September to the first week in October, over a period of 4–7 days, except in 2002, when there was a delayed spring, and only one clutch was laid in the first week of November. In contrast, at Locality 2, five reproductive events were recorded from early austral spring to summer (October–December 2001). Although Locality 1 has two environments (pond and stream), which offer different microenvironments, the clutches were all laid in shallow zones (4.08 ± 1.52 cm deep, range 2–8 cm deep, N = 13), with very little or no current, little or no vegetation, on a substrate of silt or pebbles and cobbles. Water temperatures at the clutch sites in the pond in September 2003 were 9.7 ± 1.78°C at 0900 h, and 23.22 ± 4.08°C at 1500 h. Eleven clutches were found along 10 m of pond shoreline, located relatively close to each other (from 5 cm to 2 m apart), averaging 1.25 clutches per linear meter along the shore. Clutches are laid in strings of variable length (from 4–6 m) and very uniform diameter (minimum 8.3 mm), which become increasingly hydrated in contact with water (up to 17.3 mm). Clutches contained from 3250 to 6400 eggs (4480 ± 1348 eggs, N = 4), which are arranged alternately in two rows in the string. Egg diameter is 1.56 ± 0.09 mm (N = 104), and the coloring is dark brown, almost black at the animal hemisphere, fading gradually towards the vegetal pole, which is creamy pale grey. Under natural conditions, tadpoles hatched 4 days after the eggs are laid. Newly hatched tadpoles stay at the bottom of the water body, near the remains of the string. In the lab, they hatched at stage Gosner Stage 18–19 when muscular contraction begins.

The seasonal breeding pattern of *Bufo spinulosus papillosus* matches that of most anuran species in temperate regions of the world (Duellman and Trueb 1986. Biology of Amphibians. McGraw-Hill Book Co., New York. 610 pp.). Like other species of the genus, *B. s. papillosus* has several adaptations to accelerate embryonic and larval development, such as clutches laid in shallow, sunny sites, and highly melanized eggs laid in a gelatinous string which is presumed to have insulating properties. The presence of melanin and the gelatinous string also provide protection against ultraviolet radiation. These characteristics, plus a short larval period, are advantageous for exploiting temporary environments. Regarding the range of clutch size, it may depend on the body size of the females (maximum SVL 10 cm), as has been shown for other anurans (Duellman and Trueb, *op. cit.*). The two breeding strategies (explosive and prolonged), found at the two localities studied, have also been reported for some other *Bufo* species (Wagner and Sullivan 1992. Copeia 1992:647–658). The different strategies found in this study could be related to the difference in spring rainfall (October –December) between localities (100–150 mm at Locality 1 and 400–500 mm at Locality 2). Further studies are needed on the subspecies' breeding behavior prior to egg-laying.

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BUFO SPINULOSUS PAPILLOSUS (NCN). **TADPOLE BEHAVIOR**. Gregarious tadpole behavior has been described for several anuran species (Wassersug 1973. *In* Vial [ed], Evolutionary Biology of the Anurans: Contemporary Research on Major Problems, pp. 273–297. Univ. Missouri Press, Columbia). Aggregates are classified as asocial or simple aggregates (reacting to stimuli other than conspecifics) and biosocial aggregates or schools (reacting to stimuli of conspecifics) (Bragg 1948. Wasman Collector 7:65–79; Wassersug 1973, *op. cit.*).

In this note we describe for the first time gregarious behavior in tadpoles of *Bufo spinulosus papillosus*. Its distribution covers Patagonian forests and steppes, and it typically breeds in ephemeral and semi-permanent environments during spring. We studied a population in a semi-permanent pond in northwestern Patagonia (41°10'S, 71°19'W; 906 m elev., Río Negro Province, Argentina). Observations began when clutches appeared in the austral spring. We recorded water depth, temperature (inside and outside the aggregate), and the characteristics of the substrate and vegetation where the aggregates were found. Aggregation sites were identified and marked. Aggregate density was measured using a ring of known surface area (380 cm^2), and aggregates classified as: low tadpole density ($\leq$ 20 individuals), medium (20–50), and high (> 50). Tadpole behavior within the aggregates was recorded and classified according to three categories: feeding on the substrate, swimming, and resting on the bottom. The composition of developmental stages was analyzed (Gosner 1960. Herpetologica 16:183–190).

Thirteen clutches were found during 5–6 October 2001. After hatching at Gosner Stage 18, individuals remained on the pond sediment under the gelatinous string remains. During the first week, tadpoles reached Stage 24, characterized by active swimming very near the hatching site, without feeding or aggregating. Aggregates were formed at two weeks, when the tadpoles were predominantly Stage 28, on sunny days, when the body of water was thermally stratified. The tadpoles from all 13 clutches formed 9 aggregates that remained together until metamorphosis (Stage 42). Of the 9 aggregates, 3 were high-density, 4 medium-density, and 2 low density. Aggregates were located in the shallowest, warmest zones with silt on the bed (except for two cases where there were pebbles and stones on the bed). Aggregates were found either lined up at the shore or forming irregular patches. Aquatic and paludal vegetation was almost absent from the aggregation sites except at one site where there was a dense stand of rushes. Mean temperature at the aggregation sites was 25°C ± 1.5 (24–28°C). The temperature within the aggregate was over 1°C higher than that of the surrounding water. The tadpoles had a daily migration cycle. During the morning, they were at the bottom of the pond under the vegetation (metaphyton and aquatic plants, e.g., *Myriophyllum*). When the temperature in the shallow zones rose, the tadpoles swam towards the shore and grazed actively on rocks or aquatic plants. Between 1200–1300 h there was maximum tadpole activity during feeding. At about 1400 h, the aggregates formed in the shallow zones, with the tadpoles resting on the substrate near the shore. Aggregates did not form on cloudy days, when the temperature was homogeneous throughout the pond.

Our results suggest that temperature is an important factor in the formation of *Bufo spinulosus papillosus* aggregates, which could therefore be classified as asocial aggregates. Moreover, since these tadpoles are very dark and uniformly colored, and inhabit shallow, sunny environments, their aggregates could fulfill a thermal regulation function, as suggested for other species by Brattstrom (1962. Herpetologica 18:30–46). Nevertheless, we cannot dismiss the possibility that other factors might act synergistically on aggregate formation in this species.

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COCHRANELLA GRANULOSA (NCN). **FIGHTING BEHAVIOR.** In many species of anurans, vocalizations are sufficient to ward off an intruding male, but physical fighting might also be an important aspect in spacing of individuals at breeding sites (Duellman and Trueb 1986. The Biology of Amphibians, McGraw-Hill Co., New York. 670 pp.). Species of Centolenidae breeds in mountain streams of the Neotropics where male frogs exhibit intraspecific spacing and defend territories through vocalizations, and sometimes physical fighting (McDiarmid and Adler 1974. Herpetologica 30:75–78). Because of the lack of observations on centrolenid behavior, very few species have been observed in physical, intraspecific fighting. Fighting behavior has been reported in 5 of the >136 species (Guayasamin and Bonaccorso 2004. Herpetologica 60:485–494), and two of the three centrolenid genera. Males of *Hyalinobatrachium fleischmanni*, *H. valerioi* (McDiarmid and Adler 1974. Herpetologica 30:75–78), *Centrolenella prosoblepon* (Jacobson 1985. Herpetologica 41:396–404), *C. griffithsi* (Duellman and Savitzky 1976. Herpetologica 32:401–404), and *Cochranella buckleyi* (Bolȉvar-G. et al. 1999. Alytes 16:77–83) have been observed fighting during the breeding season. Aggressive behavior in Centrolenidae includes vocalizations directed towards the intruder, charging, kicking, shoving, grappling, and wrestling (Duellman and Savitzky 1976, *op. cit.*; Jacobson 1985, *op. cit.*), and such behaviors can be energetically costly and physically damaging Bolȉvar-G. et al., *op. cit.*). Herein we report on the fighting behavior of *Cochranella granulosa* and provide a brief description of aggressive vocalizations emitted during the fighting.

We observed two male *C. granulosa* engaged in a fight on 21 Sept 2001 at Río Tigrillo, Conte, Puntarenas Province, Costa Rica (N8°26'27.6", W83°01'30.0" elev. 52 m), near the Panamanian border. Cattle pastures, oil palm plantations, and scattered native trees and leafy herbaceous undergrowth (Heliconiaceae and Marantaceae) bordered the stream. The encounter was filmed using a Sony SONY CCD-TR940 video camera with night vision capabilities, and vocalizations recorded with a Marantz PM 222 shotgun microphone. The two individuals were first observed at

1944 h hanging 2.5 m above the stream, and our observations were concluded at ca. 2215 h. We did not observe the initiation of the bout and were unable to identify the intruder, the resident frog, or the true duration of the bout. When first observed, the frogs were hanging upside down belly-to-belly, one frog was hanging from the leaf by the right foot, while the other frog was hanging by both feet. We heard and/or saw at least 5 additional males calling from the same leafy bush. The typical advertisement call for this species has been described as a high pitched, three-note "creek-creek-creek" (Ibáñez et al. 1999. The Amphibians of Barro Colorado Nature Monument, Soberania National Park and Adjacent Areas, Panama, Editorial Mizarachi y Pujol). The first 24 minutes passed with both animals making soft "peep" calls at different intervals until the frog with both feet on the leaf started using its right foot to kick the second frog's foot off of the leaf. This behavior continued until both frogs, with arms wrapped around one another, fell ca. 1.0 m onto a lower leaf.

At this point the fight became more active and aggressive as both frogs jumped towards each other, collided, and wrestled. Throughout the fighting we observed pushing and kicking of the head and body, with some blows directed directly towards the eyes. Sporadically, after small wrestling bouts, the two frogs would separate for a couple of minutes and then jump towards each other again, repeating the colliding and wrestling. While the frogs were separated between bouts each frog would emitted a short, single-noted "creek" vocalization similar in pitch to the species typical "creek-creek-creek" advertisement call. As one frog produced the "creek" vocalization the second frog became aggressive and attacked the vocalizing frog. During the bout the frogs were continuously falling down to lower leaves until finally they were ca. 1.5 m above the stream. After descending to this point the fighting stopped temporarily as the frogs climbed back up the plant to higher perches. This did not happen simultaneously, but instead one male climbed first, and after several minutes the second male followed suit. Once at this perch, where the two frogs were originally observed, they began the physical fighting again.

During the second bout the frogs wrestled until they were hanging upside down, again apparently trying to knock the other frog off of the leaf. The two frogs fought in the same manner as described above until they were again ca. 1.5 m above the stream. At this point, 2 h and 24 min after the initial observation, the two frogs separated and ceased aggressive, physical combat. As they separated, one of the male frogs climbed through the vegetation near the original perch and began to emit the normal "creek-creek-creek" advertising vocalization. The other male frog, presumably the loser, hopped horizontally into the denser vegetation where we lost sight of him.

During our observations at this site we noticed three distinct calls from *C. granulosa*, including two that are previously undescribed. They were: 1) the advertisement call of "creek-creek-creek"; 2) a short, soft "mew" as the males were grappling belly-to-belly; and 3) a single-noted call—"creek"—similar in pitch to the normal advertisement call, which was heard during times of slight separation. The "mew" call has been described to function as an encounter call in other centrolenid species (McDiarmid and Adler 1974, *op. cit.*; Wells 1977. Anim. Behav. 25:666–693; Greer and Wells 1980. Herpetologica 36:318–326), and appeared to serve the same function in this observation. This is the sixth species of centrolenid known to exhibit fighting behavior, and the second observation in the genus *Cochranella*. Of the other centrolenid species that exhibit fighting, two have parental care in which males guard egg clutches, and three do not have parental care, including *C. granulosa*. In *Hyalinobatrachium*, males repeatedly guard multiple clutches on the same leaf (Jacobson 1985, *op. cit.*, Hayes 1985. Unpubl. PhD. Diss., Univ. Miami) and it could be surmised that the protection of offspring would facilitate fighting behavior. We suspect that in *C. granulosa* fighting behavior is used to establish and defend territory or a calling perch that attracts mates and leads to male–male spacing. It might be possible, as more behavioral observations are documented, to use fighting behavior as a phylogenetic character to organize species relationships in this diverse Neotropical frog family, and to understand how aggressive behaviors affect fitness and the social system of anurans.

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CONRAUA GOLIATH (Goliath Frog). **SKITTERING LOCOMOTION**. Typically, anurans are specialized for saltatory locomotion. This is an excellent mechanism to avoid encounters with potential predators. In frogs, escape behavior usually consists of a single long leap to a secure place, such as from land into water, which is characteristic for ranids (Duellman and Trueb 1986. Biology of Amphibians, McGraw-Hill, Inc., New York 670 pp.). An alternate escape behavior is the unusual skittering locomotion; "bouncing" on the water surface without sinking (Gans 1976. Ann. Zool. 12:37–40), from a perching site on land as described for *Hoplobatrachus occipitalis* (Chabanaud 1949. Copeia 1949:288), *Acris crepitans* (Blair 1950. Copeia 1950:237; Hudson 1952. Copeia 1952:185), and *Hyla cinerea* (Janson 1953. Copeia 1953:62).

We observed skittering behavior in *Conraua goliath* along riverbanks of the Nkebe River, Littoral Province, Cameroon (04°50'N, 09°55'E) during March–April 2004. Generally, frogs were perched on rocks and gravel banks within the river or on solid rock at the edge of large rock pools. Sizes varied from recently metamorphosed froglets (3–4 cm SVL) to juveniles and large adults 20 to ≥ 30 cm SVL. When we approached *C. goliath* within a few meters, most showed a ranid-typical escape behavior of jumping into larger bodies of water with one powerful leap. However, some individuals exhibited a straight-line series of five to seven short leaps in even intervals which kept them on the water surface before finally diving into the water. Frogs always escaped into the water as opposed to land even when approached from the "water side." The frogs' bodies were supported on the water surface by repeatedly and simultaneously striking the surface with both feet, which are fully webbed and possess an exceptionally large surface area. The distance covered on the water surface was 2.5–3.5 m in adults and was comparatively smaller in juveniles and recently metamorphosed individuals. We observed this locomotion during most times of the day and at night (0930–

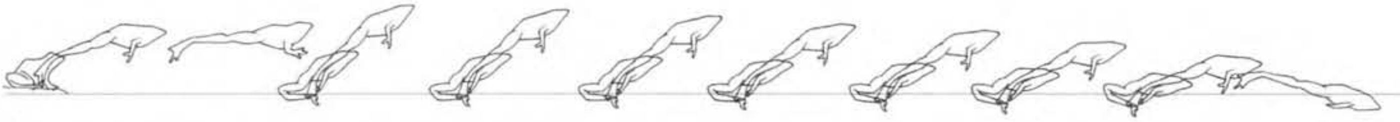

FIG. 1. Skittering behavior in a *Conraua goliath*.

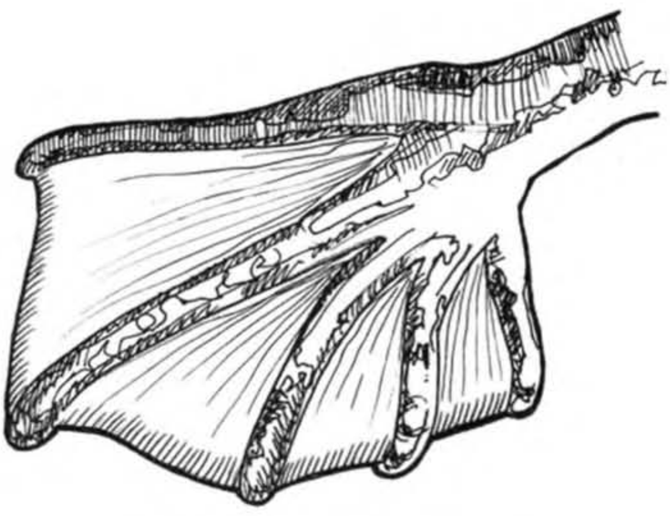

FIG. 2. Fully webbed right foot of a *Conraua goliath*.

2100 h). It seemed unrelated to particular microhabitat structures (i.e., shallow water).

Hudson (1952, *op. cit.*) suggests a selective advantage for skittering locomotion in *Acris crepitans* when predated by fishes. In Goliath Frogs there might be an advantage when dealing with aquatic predators such as fishes, giant ottershrews (*Potamogale velox*), otters (*Aonyx* and *Lutra* spp.), and crocodiles (*Crocodylus* and *Osteolaemus* spp.). These are likely to approach frogs, perched on land, from the water and possibly can follow them under water after their escape with a single leap. The frog's first escape phase on the water surface before submerging, as described here, might aid in confusing the predator and make predation less likely.

We thank the Cameroon Ministry of Scientific and Technical Research (MINREST) and the Ministry of Environment and Forestry (MINEF) for granting permits. The traditional authorities of the Bakaka tribe gave us access to the study area. We thank Wolfgang Böhme for discussions and literature. We are grateful to Tchiengue Barthelemew, Echalle Solomon, Djire Dansala, Joseph and Celestine for their help and support in the field.

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CROSSODACTYLUS CARAMASCHII (NCN). **MORTALITY.** *Crossodactylus caramaschii* is a diurnal, stream-dwelling anuran found in the Serra de Paranapiacaba, state of São Paulo, southeastern Brazil (Bastos and Pombal 1995. Copeia 1995:436–439). The species calls from emergent rocks in forest streams, where their eggs are laid and the tadpoles develop. During Sept 2003 in the municipality of Apiaí (24°33'45"S, 48°48'45"W; 925 m elev.) in the Atlantic Forest of the state of São Paulo, Brazil, five dead or moribund *C. caramaschii* were collected. These frogs were found recently dead on the rocks of the stream (N = 2) or were heard calling and died shortly after collection (N = 3). This situation is similar to the pattern reported from localities where local extinctions have been associated with infection by the chytrid fungus *Batrachochytrium dendrobatidis*, which causes chytridiomycosis (Berger et al. 1998. Proc. Nat. Acad. Sci. USA, 95:9031–9036). Clinical signs of amphibian chytridiomycosis include abnormal posture, lethargy, and loss of righting reflex (Daszak et al. 1998. Emerg. Infect. Dis. 5[6]:735–748). The first record of *B. dendrobatidis* in Brazil was reported from Serra da Mantiqueira in *Hylodes magalhaesi* (Leptodactylidae), a diurnal, stream dwelling frog closely related to *Crossodactylus* (Carnaval et al. 2005. Froglog 70:3). Although the dead or moribund *C. caramaschii* collected were not tested for the presence of *B. dendrobatidis*, the pattern of death observed suggests infection by this fungus. Therefore, *B. dendrobatidis* might be more widespread in Brazil than reported.

Identification of these frogs was verified by Vanessa K. Verdade, and four were catalogued at the Museu de Zoologia da Universidade de São Paulo (MZUSP 133906–909).

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HYLA CALCARATA (Rana de Espolones) and ***HYLA FASCIATA*** (NCN). **DEFENSIVE BEHAVIOR**. Anurans are known to display a wide variety of defensive behaviors to avoid predation. During a study conducted at two field sites (Tambopata Research Centre, Department of Madre de Dios and the Amazon Conservatory for Tropical Studies, Department of Loreto) in Amazonian Peru in May and June 2004, we observed and collected specimens of *Hyla calcarata* and *H. fasciata*. When individuals of these species were stimulated either through tapping on the head or grasped with the hand, we observed an unusual defensive behavior that was similar in both species. This behavior consists of closing the eyes, bringing the forelimbs to the head, positioning the thumb either beneath the lower jaw or beneath the lower edge of the eye, and positioning the remaining fingers splayed straight, either be-

low the lower edge of the eye or at eye level. We have used the term "boo behavior" to describe this behavioral pattern. We observed boo behavior in 11 of 14 *Hyla fasciata* (79%; museum vouchers: MUSM 19326, 19331, 19414, 19445, 19447, 21634, 21635) and in one *H. calcarata* (MUSM 19328). A somewhat similar behavior has been reported for *Boophis albilabris* (Andreone 2002. Herpetol. Rev. 33:299–300), although in the figure provided this species keeps the fingers scrunched together, whereas in *H. calcarata* and *H. fasciata* the fingers are stretched out.

The adaptive value of this behavior might reside in sending an "anti-signal" to potential predators, as it is possible that their search-image may be thrown off by a dramatic change in the familiar frog outline, as suggested by Channing and Howell (2003. Herpetol. Rev. 34:52). Alternately, an "increase" in head size, or making potential ingestion difficult by assuming this posture could account for this behavior. It is possible that this boo behavior might be phylogenetically constrained in *H. calcarata* and *H. fasciata*, but other related species need to be tested, in addition to performing necessary cladistic analyses.

We wish to thank Antje Chiu, Karina Quinteros, and Claudia Torres for help and company in the field. Thanks to Glenn K. Morris for helpful discussion. Support for fieldwork was provided through NSF grant number IBN-0078150 to D. Cannatella. We also thank the Instituto Nacional de Recursos Naturales (INRENA) of Peru for collecting permits (08 C/C-2004-INRENA-IANP and 032-2004-INRENA-IFFS-DCB).

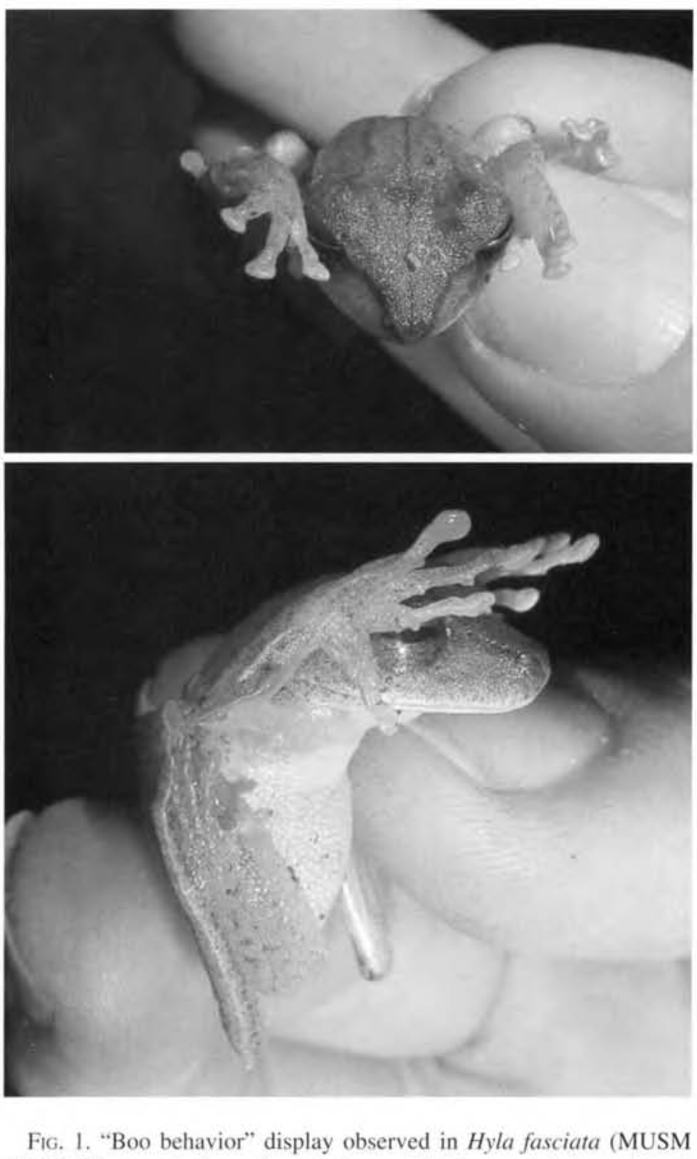

FIG. 1. "Boo behavior" display observed in *Hyla fasciata* (MUSM 19447). Top panel shows frontal view and bottom panel shows lateral view.

Submitted by **ARIADNE ANGULO**, Museo de Historia Natural de San Marcos, Apartado 14-0434, Lima, Peru; and **W. CHRIS FUNK**, Section of Integrative Biology, University of Texas, 1 University Station C0930, Austin, Texas 78712, USA.

LEPTODACTYLUS LABYRINTHICUS (Labyrinthicus Frog). **PREY**. *Leptodactylus labyrinthicus* belongs to the *pentadactylus* group and is one of the largest Brazilian frogs. Although its diet has been reported to be composed mostly of insects (França et al. 2004. Stud. Neotrop. Fauna Environ. 39:243–248), this species also preys on frogs and small snakes (Cardoso and Sazima 1977. Ciência e Cultura 29:110–1132; Sazima and Martins 1990. Mem. Inst. Butantan 52:73–79). During a bat survey in the Santuário Ecológico da Serra da Concórdia, municipality of Valença (600 m elev.), Rio de Janeiro, southeastern Brazil, we observed an attempt by *L. labyrinthicus* to prey upon a bat. At 2115 h, on 5 April 2005 while one of us was removing a Screaming Bat (*Anoura caudifer*) (mean mass 11 g) from a mist net, another bat, probably of the same species became entangled in the net for a few moments and then flew out a few centimeters above the ground. Immediately, a male *L. labyrinthicus* (340 g) captured the bat and started to ingest it. The bat was not completly swallowed because the wings remained opened. The frog released the bat as soon as the researcher caught it. Although this observation was possible only because of the bat becoming entangled in the net, a large number of small bats were observed in the area and it is possible the frog could catch additional bats.

C. F. Rocha (Ecology Department, UERJ) confirmed the identification of the frog which was deposited in the Museu Nacional, Rio de Janeiro (MNRJ N39310).

Submitted by **CARLOS E. L. ESBÉRARD**, **TÁSSIA JORDÃO**, **LUCIANA M. COSTA** and **HELENA G. BERGALLO**, Department of Ecology, UERJ, Rua São Francisco Xavier 524, 20550-013, Rio de Janeiro, RJ, Brazil (e-mail: cesberard@terra.com.br).

LEPTODACTYLUS MYSTACINUS (Shovel-Nosed Frog). **PARENTAL CARE**. Species of *Leptodactylus* in the *fuscus* group are known to build foam nests in underground chambers (Lescure 1972. Ann. Mus. Hist. Nat. Nice. 1:91–100; Giaretta and Kokubum 2004. Herpetozoa 16:115–126). The observation reported herein was made in Uberlândia, Minas Gerais, Brazil. On 13 October 2004 (ca. 1900 h), we found a courting pair of *L. mystacinus* and followed them until they entered the nest chamber. We returned to the site the following night (1930 h) and found the chamber entrance sealed with soil and an individual (likely a male) of the species nearby (ca. 10 cm). We opened the entrance and found a foam nest within the chamber. We left the site for 1.5 h and upon our return the chamber entrance was sealed again and the frog

was even closer (ca. 5 cm) to it. We again opened the entrance (the attendant individual remained motionless meanwhile) and observed the frog's behavior. Within five minutes the frog started closing the entrance of the nest chamber by pushing soil into it with its snout. When the entrance was almost closed, the frog threw loose soil into it by fast kicking to the side. The frog worked ca. 20 min. to completely seal the entrance. The following night (2100 h) the individual was not found beside the nest. The following day (900 h) we found the chamber entrance opened (ca. 20 × 15 mm) and the egg mass missing. Remaining with the egg mass the night after spawning and working to seal the damaged entrance indicate parental care in *L. mystacinus*. There are brief reports on parental care in *L. fuscus* (Lescure, *op.cit.*; Solano 1987. Amph.-Rept. 8:111–128) and chamber sealing in *L. bufonius* (Reading and Jofré 2003. Amph.-Rept. 24:415–427). Although not effective in this report, the parental behavior of *L. mystacinus* might enhance the survivorship of egg/tadpoles in the nest chamber.

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OSTEOPILUS SEPTENTRIONALIS (Cuban Tree Frog). **REPRODUCTION.** Males are often more abundant than females in breeding aggregations of anurans. This sex bias makes competition between males intense, and can promote diverse mating strategies (Anderson 1994. Sexual Selection. Princeton University Press, Princeton, New Jersey. 599 pp.), including amplexus displacement. Here, I document amplexus displacement in *O. septentrionalis*, a tree frog endemic to Cuba, but introduced in Hawaii, Georgia, and Florida (USA), Costa Rica, Puerto Rico, and other islands in the West Indies (Duellman 2001. The Hylid Frogs of Middle America. SSAR Contrib. Herpetol. 18:1–1180 pp.; Meshaka 2001. The Cuban Treefrog in Florida: Life History of a Successful Colonizing Species: University of Florida Press, Gainesville, Florida). Aspects of the natural history of *O. septentrionalis* and the potential detrimental impact of this species in invaded habitats have been studied (Meshaka 2001, *op. cit.*; Smith 2005. Biol. Cons. 123:433–441) but many details of its breeding behavior have not been published.

The following observations were made in a semi-permanent pond in Region San Antonio, Quebradillas, northwestern Puerto Rico (N18°25.113', W66°54.266'). At 0048 h on 14 Aug 2004, I observed a male *O. septentrionalis* (56 mm SVL) trying to remove an amplectant male (55.5mm SVL) from the dorsum of a female (82.5 mm SVL). The individuals were positioned in the top of a scrub (*Aeschynomene sensitive*, Leguminoseae) at a height of 1 m (Fig. 1). The intruder male attempted to pull the amplectant male off of the female, but the amplectant male moved its body and stopped the advance of the intruder male. There was not conspicuous movement of the amplectant male's hind limbs as recorded in other anurans (Davis and Halliday 1979. Anim. Behav. 27:1253–1267). Most of time the males were quiet, resting between movements and pushing attempts. The female did not move except when she jumped to the ground (0139 h) among dense vegetation (*A. sensitive* and *Ipomea tiliasea* Convolvuleaceae). Finally, when the amplectant male was pulled off the female it did not try to resume its amplexus position. This observation lasted for 1 h and 13 min, yet did not begin until after the males were engagement in conflict and the female was bleeding from the left side of her head. These individuals were not collected, but vouchers of the same population are deposited in the Museum of Zoology, University of Puerto Rico, Rio Piedras Campus (UPR 6276–77; 6279; 6283).

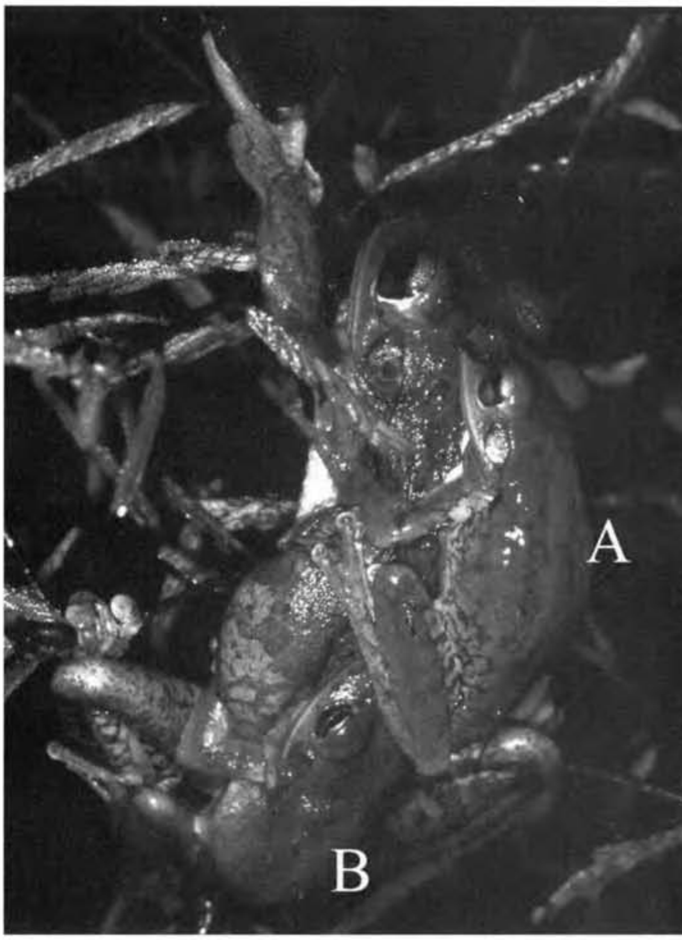

FIG. 1. Amplexus displacement in *Osteopilus septentrionalis*; A = amplectant male, B = intruder male.

Physical interactions between paired and unpaired male *O. septentrionalis* were often observed in breeding aggregations monitored during 2003 and 2004, but only the event described above was successful. Thus, in *O. septentrionalis* amplexus displacement apparently does not play a major role in the reproductive success of males.

I thank Marcos Caraballo and Frank Axelrod for plant identification, and Wilfredo Hernandez Aguiar and Ivan, Irvin, and Edsel Igartua Butler for help with fieldwork. These observations were made during MS thesis fieldwork of the author, which was supported by the University of Puerto Rico and IDEAWILD.

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PHRYNOPUS COPHITES (Cuzco Andes Frog). **REPRODCUTION**. *Phrynopus cophites* is a small leptodactylid frog of the Eleutherodactylinae clade endemic to the Cordillera de Paucartambo in the Peruvian Department of Cuzco (SE Peru). The species is only known from its type locality (Lynch 1975. Occas. Pap. Mus. Nat. Hist. Univ. Kansas 35:1–51); the southern slope of the Abra Acjanaco (13°10'9"S, 71°37'87"W, 3400 m elev).

On 7 Jan 1998 I found a brooding adult female (SVL 26.0 mm) *Phrynopus cophites*. The specimen was under moss in the puna (high Andean grassland), locality Acajanaco, Manu National Park (13°10'8"S, 71°38'05"W [datum: WGS84]; elev. 3410 m), Provincia Paucartambo, Departamento Cuzco, Peru. The nest contained 20 eggs (19 alive and 1 dead), each ca. 4 mm in diameter. I removed the nest and adjacent moss and kept them in a plastic box at ambient temperature. I measured the size at birth of juveniles as they were hatching: 6.3 mm (9 Jan), 6.9 and 6.3 mm (10 Jan), 6.1 mm (11 Jan), 6.2, 6.1, 6.3, and 6.4 mm (12 Jan), 6.6, 6.8, 6.2 and 6.7 mm (13 Jan), 6.8, 6.3, 6.5, 6.1 and 6.3 mm (15 Jan), 6.2 mm (16 Jan), 6.2 mm (19 Jan). Egg diameter a day before hatching varied from 4.8 to 5.3 mm (N = 8 eggs).

Frogs of the genus *Phrynopus* occur in páramo, puna, and cloud forests along the eastern slopes of the Andes from Colombia to Bolivia, where at least 34 species are presently known (Frost 2004. http://research.amnh.org/herpetology/amphibia). Recent descriptions of new species and a review of the genus (Lynch 1975, *op. cit.*) do not document any type of parental care for this genus, although terrestrial clutches and nest attendance have been reported in other eleutherodactylines (Duellman and Trueb 1994. Biology of Amphibians. Johns Hopkins Univ. Press, Baltimore). As far as I know, this is the first report of parental care, clutch size, and size at birth of juveniles for a species of *Phrynopus*.

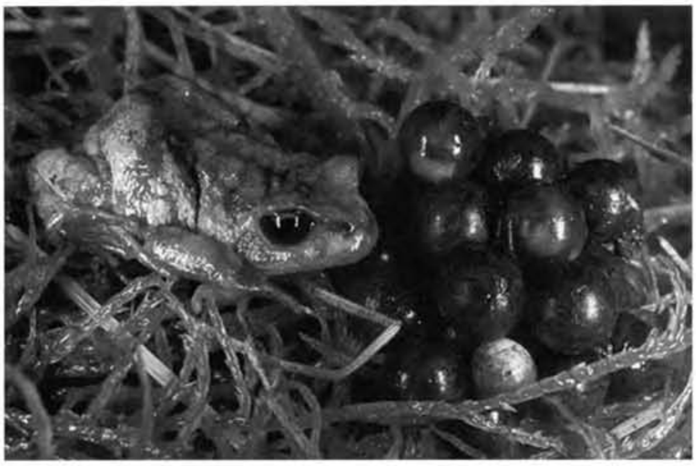

Fig. 1. Female of *Phrynopus cophites* attending terrestrial eggs.

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PHYLLOMEDUSA DISTINCTA (Leaf Frog). **MULTIMALE SPAWNING**. Multimale spawning in anurans is rarely reported. To date, simultaneous polyandry has been directly observed in six rhacophorids (Coe 1967. Nature 214:112–113; Coe 1974. J. Zool. Soc. Lond. 172:13–34; Fukuyama 1991. An. Behav. 42:193–199; Feng and Narins 1991. Naturwissenschaften 78:362–365; Jennions et al. 1992. Anim. Behav. 44:1091–1100; Kasuya et al. 1996. Research. Pop. Ecol. 38[1]:1–10), one bufonid (Kaminsky 1997. Herpetol. Rev. 28:84), one myobatrachid (Roberts et al. 1999. Anim. Behav. 57:721–726), two leptodactylids (Prado and Haddad 2003. J. Herpetol. 37:354–362), and four hylids in the subfamily Phyllomedusinae (Pyburn 1970. Copeia 1970:209–219; Roberts 1994. J. Herpetol. 28:193–199; Wogel et al. 2005. J. Nat. Hist. 39:2035–2045). Here we describe the occurrence of simultaneous polyandry in another phyllomedusine, *Phyllomedusa distincta*.

Observations were made in two permanent ponds located in remnants of Atlantic rainforest, Brazil. From September 1991 to February 1992, the study was conducted in the Parque Estadual Carlos Botelho, Municipality of Sete Barras, State of São Paulo (24°12'S; 47°55'W), and from August 2001 to October 2003, observations were made in the Municipality of Guaramirim, State of Santa Catarina (26°27'S; 49°00'W).

The observed pairs deposited egg clutches wrapped in leaves above water. During the observations in the Parque Estadual Carlos Botelho, three male *P. distincta* were observed trying to fertilize the eggs of one female. In other occasions, we observed single

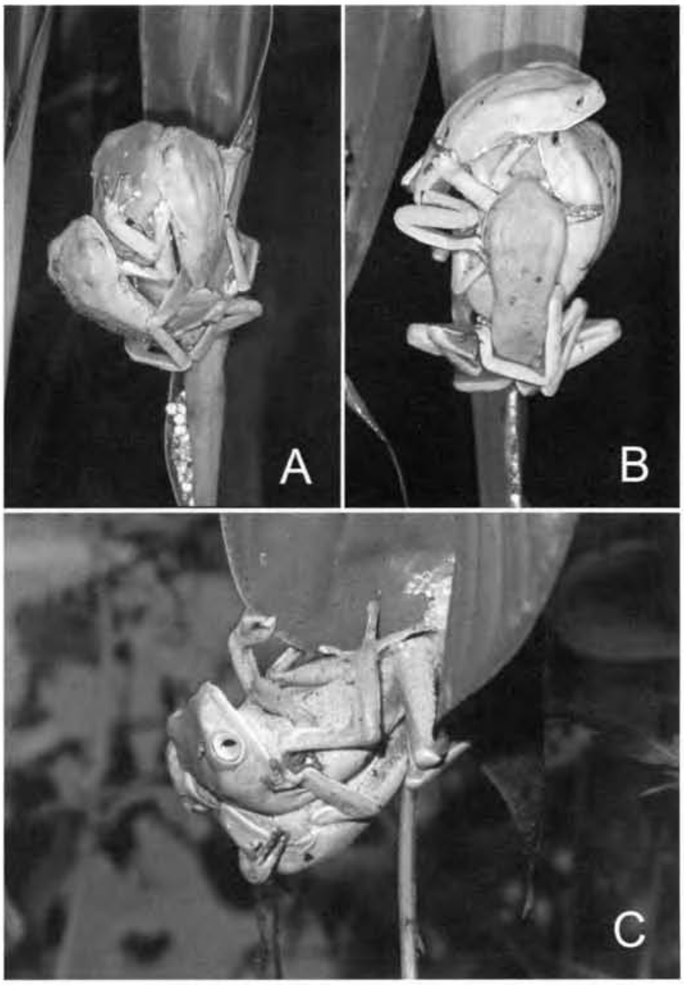

Fig. 1. Multi-male spawning in *Phyllomedusa distincta*. A) One female with two males; B) one female with three males; and C) a female dislodged from the leaf by two males.

males trying to join a pair already in amplexus, but they were not successful. Multi-male spawning in *P. distincta* was observed four times during the study conducted in the Municipality of Guaramirim. In three occasions (August 2001, September 2002, and October 2003) we observed two males spawning with one female (Fig. 1A). In September 2002, we saw three males with a female (Fig. 1B). In these four cases, after entering in amplexus, the female carried the male to an appropriate site to spawn, generally 3–4 m from the calling site. Additional males usually join the pair just before spawning begins; we have never seen a female transporting more than a single male on her back. The opportunistic males try to position their cloacae close to the eggs that are being deposited. After spawning was complete, the males slowly went away and the female remained to conclude the leaf sealing by depositing empty egg capsules to glue the leaf margins and to protect the eggs against desiccation. These clutches were monitored and egg development and hatching succeeded in three of the cases, including that with three males. However, in one occasion, when a female was spawning with two males, their weight disturbed the female by pulling her down and prevented her from sealing the leaf (Fig. 1C). The result was that almost the entire clutch desiccated. Furthermore, simultaneous polyandry was observed several times at Guaramirim, including one observation with four males with one female. The low number of cases of multimale spawning reported for anurans suggests that in general, the costs involved are higher than the advantages (Lodé and Lesbarrères. Naturwissenschaften 91:44–47). However, the advantages for the females could be to increase the chance of fertilization or the genetic diversity of offspring. For the opportunistic males, polyandry could increase the chances of fertilizing at least some eggs. Thus, mating with more than one male may be more common for anurans than reported (Roberts et al. 1999. Anim Behav. 57:721–726) and the recent increase in the number of cases reported seems to confirm this (e.g., Prado and Haddad, *op. cit.*; Wogel et al., *op. cit.*).

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PLEURODEMA NEBULOSA (NCN). **BODY TEMPERATURE.** *Pleurodema nebulosa* occurs in the arid areas of western Argentina, the Catamarca Mountains to the Rio Negro province. This distribution coincides with the Monte Phytogeographic Province (Cei 1980. Amphibians of Argentina. Ital. J. Zool., N. S. Monogr. 2, 609 pp.). The objective of the present work is to investigate selected parameters of the thermal ecology of this species: What is the average cloacal temperature (Tc) of the population? Is there an association between Tc and substrate temperature (Ts) and air temperature (Ta)? Is there a relationship between Tc and SVL?

The study area is located 40 km N of San Juan City on National Route N 40. Elevation reaches 800 m; the region is arid with an annual mean temperature of 16ºC. Rainfall occurs mostly during the summer with an annual average of 84 mm.

Thirty-one individual *P. nebulosa* were collected on 21 April 2005; cloacal temperature (Tc), substrate temperature (Ts), and air temperature (Ta) were measured to the nearest 0.1°C. Information was collected on substrate type and whether the individual was in the sun or shade.

Mean Tc was 22.8ºC (SD = 2.5, N = 31, range = 19.8–28.4°C). Tc was positively correlated with Ts ($r^2 = 0.75$ $p < 0.0001$, N = 31), and Ta ($r^2 = 0.75$, $p < 0.0001$, N = 31). There was no observed association between Tc and SVL ($p < 0.31$).

The results demonstrate that *P. nebulosa* is a thermal conformist, a mechanism where individuals do not need to invest time and energy actively selecting microhabitats for thermorregulation (Labra and Vidal 2003. *In* F. Bozinovic (ed.), Fisiologia Ecologica y Evolutiva, pp. 207–224. Ediciones Universidad Catolica de Chile. Santiago, Chile).

We thank Alejandro J. Laspiur for assistance in the field.

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RANA AURORA DRAYTONII (California Red-legged Frog). **DEFENSIVE BEHAVIOR**. On 3 April 2004, I observed a subadult (68 mm SVL) *Rana aurora draytonii* exhibit a "hands-up" defensive behavior after I hand-caught the frog. The capture was part of a relocation program of *R. aurora draytonii* under a 404 permit housing development site under construction in the City of Dublin, Alameda Co., California, USA (U.S. Army Corps of Engineers, Permit No. 25144S). The same frog exhibited the behavior a second time approximately two hours after being captured and retained in a plastic bag, holding the position so that I could photograph it. This behavior is similar to that expressed in the Gopher Frog, *R. capito* (Means 2004. Herpetol. Rev. 35:163–164), with the hands raised up to the side of the head and turned outward exposing the palm in an apparent attempt to shield the eyes. The nictitating membranes covered the eyes but the eyelids were not shut. As with *R. capito*, the *R. aurora draytonii* exuded a musty secretion.

Of ca. 800 adult, subadult, and juvenile frogs caught and handled during the three-year relocation effort, only a few (< 10) individuals, all subadults, exhibited this behavior. In contrast, all of the adult frogs (> 84 mm SVL) would either struggle or go limp when handled, and the juvenile frogs (< 65 mm SVL) would tuck the

hindlimbs under the body and hold the forelimbs out as in preparation to jump away. Some of the adult frogs also produced a high-pitched, repetitive cry when handled.

Observing this behavior in *R. aurora draytonii* suggests that, although rarely exhibited, it might be more common among other species of ranid frogs than reported.

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RANA BOYLII (Foothill Yellow-legged Frog). **PREDATION**. Select predators of *Rana boylii* are known, although predation by the California Giant Salamander, *Dicamptodon ensatus*, has not been reported. During a study along Big Carson Creek in Marin County, California, USA, I observed predation on *R. boylii* tadpoles by *D. ensatus* larvae.

On 21 March 2005 a *R. boylii* egg mass (Gosner Stage 9) was found attached on the side of a cobble located in a small shaded pool. On 1 April, the egg mass had fully hatched and 15 tadpoles were counted in the pool. Next to the hatched egg mass, a California Giant Salamander larva was preying directly on one of the tadpoles. Twenty minutes later, the *D. ensatus* larva was still immobile next to the egg mass. On 10 April, I observed three *D. ensatus* larvae at the pool; one of them located at the same place where the egg mass was previously attached. At that time, no tadpoles were found on that pool. I have never observed other large predators (fish, Rough-skinned Newts [*Taricha granulosa*], crayfish) at that breeding site excluding Coast Gartersnakes (*Thamnophis elegans terrestris*). Gartersnakes were observed for the first time on 17 April.

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RANA CHIRICAHUENSIS (Chiricahua Leopard Frog) and ***RANA CATESBEIANA*** (American Bullfrog). **REPRODUCTIVE BEHAVIOR**. Reproductive interactions between amphibian species (Christman et al. 2000. Herpetol. Rev. 31:99–100; Kwet 2002. Herpetol. Rev. 33:47–48; Lind and Bettasso 2003. Herpetol. Rev. 34:234–235), families (Smith 2004. Herpetol. Rev. 35:374–375; Jennings et al. 2005. Herpetol. Rev. 36:53), and even orders (Höbel 2005. Herpetol. Rev. 36:55–56) has been well documented in the literature. Herein, we report the first documented observance of reproductive interference by the invasive, exotic *R. catesbeiana* with *R. chiricahuensis*, a species federally listed as threatened under the Endangered Species Act.

On 27 Sept 2003 at 1230 h, a male *R. chiricahuensis* was observed in amplexus with a female *R. catesbeiana* underwater ca. 0.46 m deep in a bedrock pool in Sycamore Creek [UTM Easting 12481804 / Northing 3476893 (NAD 27)], an intermittent stream in Santa Cruz County, Arizona. At the time of our observation, weather conditions were hot (32°C) and humid (ca. 50% RH) with high overcast. The specimens physically separated when we attempted to move them from partial obstruction for the purpose of photo documentation. Sycamore Creek is one of the few remaining strongholds of *R. chiricahuensis* in the United States and periodically is invaded by *R. catesbeiana*. Despite these invasions, *R. chiricahuensis* has maintained a population in Sycamore Creek.

The introduction and spread of *R. catesbeiana* from anthropogenic and natural means into the state of Arizona and throughout the western United States has had serious implications for native herpetofauna because of the risks of predation, competition, and the spread of disease. Reproductive interference is another concern of *R. catesbeiana* invasion. The effects of reproductive interference can be more significant than a temporary interference with a species' reproductive effort. A male *Spea hammondii* was once observed in amplexus with a female *Pseudacris regilla*; the latter died soon thereafter due to an apparent rupture of the abdominal wall (Wright and Wright 1949. Handbook of Frogs and Toads. Comstock Publishing Associates. Ithaca, New York. 640 pp.).

Ranid and hylid frogs as well as thamnophiine snakes have been documented as particularly vulnerable to the effects of *R. catesbeiana* invasion (Rosen and Schwalbe 2002. *In* Tellman [ed.], Invasive Exotic Species in the Sonoran Region, pp. 220–240. Univ. of Arizona Press and Arizona-Sonora Desert Museum. Tucson, Arizona). Reproductive interference is another possible adverse effect of *R. catesbeiana* invasion of *R. chiricahuensis* occupied habitat, a threat that has gone unrecognized to date.

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RANA LUTEIVENTRIS (Columbia Spotted Frog). **REPRODUCTION**. Many amphibians that oviposit in temporary wetlands or wetlands where water levels fluctuate risk having their eggs stranded terrestrially. Terrestrial stranding of egg masses has been described most frequently for the Wood Frog (*Rana sylvatica*; Forester and Lykens 1988. Can. J. Zool. 66:1733–1735; Wright and Wright 1995. Handbook of Frogs and Toads of the United States and Canada, Comstock Publishing Associates, Ithaca, New York, 640 pp.). Many other amphibians have similar breeding habits (e.g., early spring, explosive, oviposit in shallow water), including *R. luteiventris* and its sister species *R. pretiosa* (Licht 1974. Can. J. Zool. 52:613–627), but survival of their eggs and other ranid frogs after stranding has been described less frequently. Herein, I report survival of *R. luteiventris* embryos for ≥ 21 days after becoming stranded.

On 6 April 2005 seven *R. luteiventris* egg masses that were laid communally between 1–5 April were found in ca. 5 cm of water in a wetland near Lost Horse Creek in the Bitterroot Mountains, Montana, USA (46°05'91"N, 114°15'82"W; 1324 m elev.), where breeding activity is monitored annually. A visit on 31 March indicated that breeding had not yet begun. Breeding by *R. luteiventris* in this wetland typically begins shortly after snow melts and the north half of the water's surface is ice free, usually during the first week in April. Most egg masses are deposited in shallow water

along the north shore. The egg masses were fully enlarged when I found them but no elongation of the embryos was evident (Gosner Stage < 14; Gosner 1960. Herpetologica 16:183–190). By the next visit on 8 April, the water level had dropped and the egg masses were perched atop a wet clump of dormant vegetation surrounded by mud. Four new masses had been laid on 6–7 April in a slight depression nearby and were in < 5 cm of water. Three of these four masses were laid communally, and the fourth mass was ca. 30 cm away. The group of seven masses was still stranded on 11 April and the four more recent masses were stranded by then as well. All of the masses were still stranded on 18 April but most embryos still looked viable and some were moving inside the egg jelly (ca. Gosner Stage 18). On 21 April I estimated > 90% of embryos in the stranded masses were still viable and development seemed to be proceeding at about the same rate as in non-stranded masses of similar age. Most tadpoles had congregated at the edges and low spots of the egg jelly and some that tried to emerge from the jelly were dehydrated and dead. Most tadpoles in a sample of ca. 20 (Gosner Stages 21–23) taken from the edge of an egg mass started swimming immediately after being placed in a bottle of water, and all were swimming by the next morning. Also on 21 April, tadpoles from egg masses of the same estimated age (laid between 1–5 April) that did not get stranded were free-swimming (Gosner Stages 21–25). On 25 April, all tadpoles in the stranded non-communal mass and most tadpoles in the communal egg masses were dead. However, some tadpoles (est. < 10%) in the two groups of communal masses remained alive in the areas with the deepest jelly and swam when placed in a bottle of water. By then, however, the egg jelly had developed a thick skin on its surface and it is uncertain whether tadpoles could have escaped even if the egg mass was inundated. All tadpoles in the two groups of communal masses were dead on 5 May.

Data from the Twelvemile Creek snow telemetry station (SNOTEL; 1647 m elev.; http://www.wcc.nrcs.usda.gov/snotel) ca. 14 km upstream of the Lost Horse Creek marsh indicate April 2005 was slightly warmer and wetter than the 1989–2004 mean. The average daily temperature was 3°C (range of daily averages: -1 to 8°C) and 7.9 cm of precipitation accumulated as snow and rain on 14 days between 1–25 April, often in increments of < 0.3 cm. The precipitation likely extended the viability of the stranded egg masses (Forester and Lykens, *op. cit.*), but I never found them inundated after they became stranded and the wetland continued to shrink throughout April. Maximum snow water equivalent (SWE; 18.5 cm) in 2005 was only 39% of normal and melted ca. 1 mo. earlier than the 1968–2004 average (48.0 cm), which resulted in a water deficit in the wetland and numerous stranded egg masses despite the periodic precipitation after breeding.

The ability of eggs to survive short-term terrestrial stranding is especially important to species that breed in wetlands where fluctuations in water levels are common. At this same wetland in 2000, I observed *R. luteiventris* tadpoles hatch from an egg mass that had been stranded for ca. 5 days before being re-inundated. Spring 2005 was the second time since 1999 that there has been complete loss of breeding effort at the Lost Horse Creek marsh. Years with complete loss of breeding effort coincided with the lowest (18.5 cm in 2005) and third-lowest (25.65 cm in 2001) maximum SWE at the Twelvemile Creek SNOTEL station since 1968. Licht (*op. cit.*) hypothesized mortality from stranding of egg masses was one of the strongest factors limiting *R. pretiosa* populations. The ability to survive short term terrestrial stranding may become even more important if climate change results in less predictable wetland hydroperiods (Brooks 2004. Wetlands 24:104–114).

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RANA PRETIOSA (Oregon Spotted Frog). **PREDATION**. Greater Sandhill Cranes (*Grus canadensis tabida*) have a seasonally varied diet dominated by grains, tuberous vegetation, and macroinvertebrates (e.g., Davis and Vohs 1992. Trans. Nebraska Acad. Sci. 20:81–86; Mullins and Bizeau 1978. Auk 95:175–178; Reinecke and Krapu 1986. J. Wildl. Manage. 50:71–79). *Grus c. tabida* are reported to take frogs (Barrows 1912. Michigan Bird Life. East Lansing, Michigan Agric. College. 822 pp.; Littlefield *in* Mullins and Bizeau, *op. cit.*; Stern et al. 2002. *In* Marshall, Hunter, and Contreras [eds.], Birds of Oregon: A General Reference, pp. 198–200. Oregon State University Press, Corvallis), but the species taken have not been identified. Herein we report direct observations of *G. c. tabida* predation on *Rana pretiosa* from south-central Washington State.

Our observations were made on 10 March 2005 at Conboy Lake National Wildlife Refuge (CLNWR), Klickitat County (45°55–59'N, 121°15–23'S [datum: WGS84]; elev. 554 m). CLNWR includes part of a ca. 2500-ha seasonal marsh of palustrine emergent wetland habitats (*fide* Cowardin et al. 1979. Classification of Wetlands and Deepwater Habitats of the United States. US Fish and Wildlife Service, Office of Biological Services, FWS/OBS-79/31, Washington, D.C.). The system harbors the largest nesting population (19–20 pairs) of *G. c. tabida* in Washington State (JDE, unpubl. data) and perhaps the largest extant population of *R. pretiosa* across its geographic range (Hayes 1997. Status of the Oregon spotted frog (*Rana pretiosa*) in the Deschutes Basin and selected other systems in Oregon and northeastern California with a rangewide synopsis of the species' status. Report to The Nature Conservancy and US Fish & Wildlife Service, Portland, Oregon. 57 pp.).

At 1045 h, using 12 × 50 binoculars, MPH observed a group of 5 foraging adult *G. c. tabida*. At 1052 h, a large male *G. c. tabida* broke off from the group and began walking directly toward MPH, foraging as he went. Simultaneously, MPH heard the soft calls of several male *R. pretiosa* (see Licht 1969. Can. J. Zool. 47:1287–1299) coming from a shallow pool between himself and the approaching *G. c. tabida* (ca. 8 m in front of MPH). Examination of this ca. 20-cm deep pool through binoculars revealed a calling group of at least 7 *R. pretiosa*. Frogs were mostly calling underwater, but individuals would irregularly surface over several-minute intervals, only to re-submerge within seconds. Besides their eyes being visible, surfacing males produced ripples across the water surface that were evident from a distance. At 1107 h, the male *G. c. tabida* reached a location within 3 m of the *R. pretiosa* group, when one of the frogs surfaced and the *G. c. tabida* immediately noticed it. In the typical low foraging posture, the *G. c. tabida* closed the distance between it and the *R. pretiosa* in four steps and struck the frog with a sharp peck just as the frog dove.

The *G. c. tabida* then gave 5–6 additional pecks close to where the *R. pretiosa* dove, and within 30 sec, came up with what was presumably the same frog, positioned sideways with its mottled-orange belly turned upwards in the crane's bill. Less than 10 min later, this same *G. c. tabida* captured a second *R. pretiosa* from the same group. In both cases, the *R. pretiosa* prey appeared to be adult males, ca. 70 mm SVL. After the *G. c. tabida* had moved on, MPH captured and released 4 male *R. pretiosa* at the location of the observations that were 67–74 mm SVL.

Most of the 40-odd sites across *R. pretiosa* geographic range where the species is extant are also used by *G. c. tabida* (Hayes, *op. cit.*; JDE, MPH, unpubl. data). Co-occurrence can be attributed to similarity in species habitat requirements, but our observation suggests that a trophic relationship may need further consideration.

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RANA PRETIOSA (Oregon Spotted Frog). **MAXIMUM SIZE.** As a candidate species for federal listing (USFWS 2005. Federal Register 70:24869–24934), *Rana pretiosa* has been the focus of much recent study (e.g., Marco et al. 1999. Environ. Toxicol. Chem. 18:2836–2839; Watson et al. 2003. J. Herpetol. 37:292–300; McAllister et al. 2004. Northwest. Nat. 85:20–25). Despite these efforts, few data exist regarding variation in *R. pretiosa* body size. Licht (1974. Can. J. Zool. 52:613–627; 1975. Can. J. Zool. 53:1254–1257) reported that female and male frogs in British Columbia mature at 62 mm snout–vent length (SVL) and 45 mm SVL, respectively; and recorded maximum sizes of 80 mm SVL (females) and 64 mm SVL (males). Based on collective data from several populations in Washington State, McAllister and Leonard (1997. Washington State Status Report for the Oregon Spotted Frog. [July] Washington Department of Fish and Wildlife, Wildlife Management Program, Olympia, Washington. 38 pp.) reported that adult males ranged from 46 to 66 mm SVL and adult females ranged from 51 to 89 mm SVL. McAllister and Leonard (*op. cit.*) further added that female *R. pretiosa* exceeding 90 mm SVL are rare, but exist in museum collections. This statement correctly implied that no *R. pretiosa* >100 mm had ever been recorded (K. McAllister, pers. comm.). Although Leonard et al. (1993. Amphibians and Reptiles of Washington and Oregon. Seattle Audubon Society, Seattle, Washington. 168 pp.) reported that Spotted Frogs reach 100 mm SVL, this statement was made before *R. luteiventris* was partitioned from *R. pretiosa* (see Green et al. 1997. Copeia 1997:1–7), making it unclear for which species this maximum was intended. Hence, we add to the data on variation in body size of adult *R. pretiosa* with reports of frogs >100 mm SVL from central Washington State, USA.

Our observations were made at Conboy Lake National Wildlife Refuge (CLNWR), Klickitat County (45°55–59'N, 121°15–23'S, WGS84; elev. 554 m). CLNWR includes part of a ca. 2500-ha seasonal marsh of palustrine emergent wetland habitats (*fide* Cowardin et al. 1979. Classification of wetlands and deepwater habitats of the United States. USFWS, Office of Biological Services, FWS/OBS-79/31, Washington, D.C.). CLNWR represents the only locality across *R. pretiosa*'s geographic range where it has co-existed with *R. catesbeiana* for >50 years (MPH, unpubl. data).

Between 2100 h and 0100 h on the nights of 19–20 and 20–21 August 2005, CJR and MPH systematically collected (i.e., specifically ignoring size) a series of post-metamorphic *R. pretiosa* from the seasonally shrunken remnant of Conboy Lake. We measured SVL (to the nearest 0.5 mm) and mass (to the nearest g) of each frog; the two largest frogs were photographed; and all individuals were subsequently released at their capture sites. Among the 30 *R. pretiosa* captured were 3 adult females >100 mm SVL; the size (and mass) of each female was: 103 mm (82 g), 104 mm (92 g), and 105 mm (97 g). On 11 July 2005, CJR captured an adult female *R. pretiosa* at CLNWR that measured 107.5 mm SVL (100.5 g), but no photograph was taken. Lastly, over the past 8 years, we have captured 12 different female *R. pretiosa* at CLNWR that were in the range of 101–103 mm SVL.

These frogs are all larger than the maximum size of "exceeds 90 mm SVL" reported for *R. pretiosa* (McAllister and Leonard, *op. cit.*), and of the 100 mm SVL reported for spotted frogs in general (Leonard et al., *op. cit.*). Notably, the high proportion (≥ 30%) of large (≥80 mm SVL) adult frogs recorded at CLNWR relative to 15 other *R. pretiosa* populations for which we have data is a pattern we have consistently observed since we began surveys there in 1996 (unpubl. data), and may reflect the unique local conditions influencing *R. pretiosa* size distribution. In particular, relatively long-term (>50 years) co-existence with *Rana catesbeiana* should be considered as a potential driver for this variation.

A photographic voucher for a large female *R. pretiosa* (105 mm, 97 g; Conboy Lake National Wildlife Refuge, Klickitat County, Washington State. UWBM 2301) was deposited (in electronic and hard copy) in the herpetological collection at the University of Washington Burke Museum. The Washington Department of Fish and Wildlife (Habitat Program, Science Division) and the USFWS (Ridgefield NWR Complex) supported this work.

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RANA SYLVATICA (Wood Frog) and ***AMBYSTOMA MACULATUM*** (Spotted Salamander). **BEHAVIOR.** Reports of multiple male anurans simultaneously attempting to mate with a single female of the same species are common, as are reports of male anurans attempting to mate with other anuran species (Vogt 1981. Natural History of Amphibians and Reptiles of Wisconsin.

Milwaukee Public Museum, Wisconsin. 205 pp.; Harding. 1997. Amphibians and Reptiles of the Great Lakes Region. Univ. Michigan Press, Michigan. 378 pp.). However, reports of multiple male anurans simultaneously amplexing with same-sex individuals from a different amphibian class are rare. Although Hobel (2005. Herpetol. Rev. 36:55–56) reported examples of salamander + frog breeding activity, these involved single anurans amplecting with single caudates (*Rana palustris* and *Ambystoma maculatum*). Furthermore, determining the sex of the caudates in these examples was not possible. Herein we report an instance of multiple male anurans simultaneously amplexing with a single male caudate.

On 9 April 2005 (ca. 1100 h) a survey of a woodland wetland near Stevens Point, Portage Co., Wisconsin, USA was being conducted for *Ambystoma maculatum* (which were reported to be breeding there a week prior). This survey yielded high numbers of *R. sylvatica* (calling males and amplectant pairs) and *Pseudacris crucifer* (only calling males), but few *A. maculatum*. After ca. 1 h of surveying, four male *R. sylvatica* were witnessed simultaneously amplexing with an object at the surface of the water among dormant cattails. Further investigation revealed that all were grasping a single *A. maculatum*, determined to be a male by its swollen cloacal lips. This male *A. maculatum* (8.7 cm SVL, 17 g) was lethargic, but alive, and later was released in a moist upland area. All male *R. sylvatica* escaped before further examination could be conducted. No other similar activity was witnessed during the remainder of the survey.

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RANA TEMPORARIA (Common Frog). **MIGRATION**. Mass migration of *Rana temporaria* was recorded in the Eastern Carpathians, Ciuc Basin (46°21'N, 25°46'E), 700 m elev., between 25–28 March 2005. Occasional observations were made before and after this period. We made observations on a 1200-m section of a permanent mountain stream (0.2 m^3/s runoff, 3 m/100 m slope gradient) and on ponds used for reproduction close to the stream, surrounded by a cultural landscape (few houses, mostly hayfields and arable land). The stream flows into an old branch of the Olt River. We made fixed-point counts of drifting frogs at midday (1300–1400 h) and in the evening (2000–2100 h) for 10 minute intervals. We also observed the movement and behavior of frogs along the stream until the inflow, and recorded the presence-absence of frogs in potential breeding ponds known from previous studies (Demeter 2004. A Csíki Székely Múzeum Évkönyve 1:323–333 [in Hungarian]). We recorded up to 1.5 drifting frogs/minute at midday and 2.3–6.5 drifting frogs/minute in the evening. The main migration was observed in the evenings, significant movement of frogs during the day was recorded only on 25 March. The frogs were apparently in a torpid state, flowing passively with the drift. Along the pool sections they actively swam downstream. The migration peaked on 25 March, when in the evening we counted 65 drifting frogs in 10 minutes. The migration probably started a few days earlier, as no migrating frogs were observed on or before 20 March. On 26 March during the evening we counted 23 frogs in 10 minutes, on 27 March 47 frogs in 10 minutes, and on 28 March 24 frogs in 10 minutes. The changes in the number of drifting frogs were parallel with the changes of the stream water temperature measured at midday (5.1°C on 25 March, 2.1°C on 26 March, 5.6°C on 27 March, 4°C on 28 March). Calling choruses of males and frogs departing from the stream were observed between 25–27 March on the lower sections of the stream (1000–1200 m downstream from the location of the fixed-point counts). After 27 March no frogs were observed in the stream. On 28 March we counted 47 egg clumps in a large shallow pond close to the lower section of the stream and 2 egg clumps in another small pond situated 300 m upstream. The weather cooled down in the following days. On 31 March the number of egg clumps in the large lower pond was 350, and in the upstreams pond was 30. No egg clumps or common frog activity was observed in the rest of the ponds situated close to the stream.

The first documented observation of the mass migration of *Rana temporaria* in the Carpathians was made during April 1986 in the Retezat Mountains, at 1300 m elev. (Cogalniceanu 1991. Herpetol. Rev. 22:54). The author observed a synchronous movement of frogs from a terrestrial hibernaculum towards a nearby stream at noon that lasted ca. 30–40 min. The migration coincided with an increase in daytime air temperature to 16°C, while nighttime temperatures were still below 0°C. Our observations provide further evidence that *R. temporaria* uses mountain streams for the spring migration of up to several kilometers. Further studies are needed to document this type of migration rarely described in the literature for this species, and to investigate the geographical range and ecological significance of this behavior.

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SCAPHIOPUS HOLBROOKII HOLBROOKII (Eastern Spadefoot). **ALBINISM**. Herein we report an observation of albinism in *Scaphiopus holbrookii holbrookii*. On 31 March 2003, we observed 65 albino larvae (Gosner Stage 36, Gosner 1960. Herpetologica 16:183–190) in a small diameter (35 m) ephemeral wetland in Gainesville, Alachua County, Florida, USA. The exact locality is withheld to ensure protection of this population. These albino individuals comprised ca. 1% of the entire *S. h. holbrookii* larval population.

The dorsal skin of each tadpole was light orange with a light yellow lyre-shaped marking bordered by a series of darker orange spots. The sides were light orange, and the venter was transparent with scattered yellowish-white flecks. The eyes were entirely orange.

Thirty tadpoles were collected with dipnets and returned to the lab for further study of their behavior, growth, and survivorship. All of these tadpoles successfully completed metamorphosis. One month after metamorphosis, these individuals exhibited coloration similar to the tadpole stage. The metamorphs had entirely orange eyes, a light orange dorsum and sides, and a translucent yellowish-white flecked venter. In addition, the individuals had numerous red tubercles on the dorsum. Some of these tubercles

reinforced the border of the light yellow lyre-shaped marking that was evident in the tadpoles. Because of their complete absence of melanin and presence of yellow, orange, and red pigmentation, these individuals fit the description of partial albino with xanthophores and erythrophores (Dyrkacz 1981. SSAR Herpetological Circ. No. 11). Color photos were deposited in the Florida Museum of Natural History (UF 140596).

To our knowledge, this is the second documentation of albinism in *S. h. holbrookii*. Albino tadpoles were previously observed in New Kent County, Virginia (Hensley 1959. Publ. Mus. Michigan State Univ. Biol. Ser. 1:135–159).

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SCINAX FUSCOVARIUS (Snouted Treefrog), ***SCINAX* cf. *RUBER***, and ***PHYSALAEMUS ALBONOTATUS*** (Menwig Frog). **PREDATION**. Predatory events in nature are rarely published (Martins et al. 1993. Amphibia-Reptilia 4:273–296). Birds are generally reported preying on tadpoles (McAlpine et al. 2001. Herpetol. Rev. 32:183–184), but attacks on adult frog are less well documented (Brodie and Nussbaum 1987. Herpetol. Rev. 18:8–9; Master 1998. Herpetol. Rev. 29:164–165; Prado 2003. Herpetol. Rev. 34:231–232). Herein we describe four events of predation on three species of frogs by two birds, Whistling Heron (*Syrigma sibilatrix*, Ardeidae) and Great Kiskadee (*Pitangus sulphuratus*, Tyrannidae) observed during fieldwork in the Cerrado region of Central Brazil. The observations were made in a flooded field in Canaã Farm (20°40'30.4"S, 56°45'20.2"W), Municipality of Bodoquena, State of Mato Grosso do Sul, Brazil.

On three occasions were observed a Whistling Heron preying upon adult frogs in the edge of a flooded field: *P. albonotatus* (5 Dec 2000 at 1350 h), *S.* cf. *ruber* (6 Dec 2000 at 0834 h), and *S. fuscovarius* (6 Dec 2000 at 0944 h). *Physalaemus albonotatus* was hidden in the grass, and *Scinax* cf. *ruber* and *S. fuscovarius* were partially submerged along the edge of the flooded field. On 8 Dec 2000 at 1330 h we observed a Great Kiskadee prey upon *P. albonotatus*.

These birds forage in this temporary environment during the wet season, as many amphibians and fish use these flooded fields for reproduction. This environment is similar to that found in the Pantanal, where the ponds or flooded fields are used as foraging sites by many species of wading birds. Predation at these sites could represent a significant impact on populations of amphibians (Prado 2003. Herpetol. Rev. 34:231–232).

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SPEA HAMMONDII (Western Spadefoot). **PREDATION.** Although predation on adult *Spea hammondii* by American Bullfrogs (*Rana catesbeiana*) has been previously documented (Morey and Guinn 1992. *In* Williams et al. [eds.], Endangered and Sensitive Species of the San Joaquin Valley, California. California Energy Commission. 388 pp.), published documentation of predation on larval *S. hammondii* by *R. catesbeiana* is lacking. On 25 March 2004 we collected and preserved two *R. catesbeiana* from a vernal pool near Orange Cove, Tulare County, California, USA (36°37'30"N, 119°16'00"W). Six *S. hammondii* larvae were recovered from the stomach of one *R. catesbeiana* (68 mm SVL) and five larvae were found in the other (64 mm SVL). Larval total length was 12–30 mm, although Gosner life stages of the larvae were not determined (Gosner 1960. Herpetologica 16:183–190). Several thousand *S. hammondii* and Western Toad (*Bufo boreas*) larvae were found within the pool from which the Bullfrogs were collected. Although this is the first published report of Bullfrog predation on larval *S. hammondii*, predation on larval *S. multiplicata* by *R. catesbeiana* has been observed at a temporary pond in the San Simon Valley along the Arizona/New Mexico stateline (Marie Simovich, pers. comm.).

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STEFANIA EVANSI (Groete Creek Carrying Frog). **REPRODUCTION**. *Stefania evansi* is a large hemiphractine hylid frog restricted to Guyana from Kartabo and Groete Creek, westward to Mount Roraima at elevations of 10–1402 m (Duellman and Hoogmoed 1984. Misc. Publ. Mus. Nat. Hist. Univ. Kansas 75:1–39; MacCulloch and Lathrop 2002. Herpetologica 58:327–346). Like all other *Stefania* species, female *S. evansi* are known to carry eggs and juveniles exposed on their back, adhering to a mucus layer. As noted by Jungfer and Boehme (1991. Rev. fr. Aquariol. 18:91–96), very few female *S. evansi* carrying eggs or embryos are known. Only 4 cases of egg brooding females are known to us: Boulenger (1904. Proc. Zool. Soc. London 1904[2]:106) reported a female with 22 eggs from Groete Creek; Lang (1923. Nat. Hist. New York 24:467–478) reported a female with 24 eggs from Kamakusa; Jungfer and Boehme (*op. cit.*) reported a female carrying 21 juveniles from Ataro River; MacCulloch and Lathrop (*op. cit.*) reported a female with 11 near-term juveniles from the base of Mount Ayanganna.

Here we report a female (97.5 mm SVL—likely a new size record) carrying 25 eggs (Fig. 1). This large, striped morph female (Pattern B of Duellman and Hoogmoed, *op. cit.*), was collected by Festus Marco and two of us (PJRK and PB) at 1500 h on 24 June 2004 on rocks along a cascading stream in primary forest near Tukeit, ca. 150 m elev. in Kaieteur National Park, Guyana.

FIG. 1. Female *Stefania evansi* (IRSNB 13673), 97.5 mm SVL, carrying 25 eggs in the vicinity of Tukeit, Kaieteur National Park, Guyana.

The specimen was deposited in the herpetological collection of the Royal Belgian Institute of Natural Sciences (IRSNB 13673).

Duellman and Hoogmoed (*op. cit.*) indicated that reproduction of *Stefania* species is probably restricted to the wetter times of the year because most females carrying eggs have been collected in the rainy season. These authors also indicated that duration of development and egg brooding is unknown, but should probably require 2–3 months. According to the four literature records and this observation, female *S. evansi* carrying eggs were found in January, June, and late November while females with near-term juveniles were collected in October and early November. There are two distinct wet seasons in Guyana, the first "long" wet season occurring approximately from April to August and the second "short" wet season occurring approximately from November to January. Although breeding activity of *S. evansi* seems to be more common during the two rainy seasons, the available data do not indicate a rigid schedule of breeding.

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TESTUDINES

ACTINEMYS MARMORATA (Pacific Pond Turtle). **NEST ARCHITECTURE/ PREDATION.** Little has been published on the nest architecture of *A. marmorata*. Here we report nest architecture data and nest depredation characteristics of *A. marmorata* nest sites.

On 21 June 2004, approximately 8 depredated *A. marmorata* nests were observed in an approximately 0.202-ha exposed clearing along the western shoreline of a vernal lake in Lake County, California. The nests were concentrated 6–15 m from the high water mark, and the shoreline was characterized by low-stature non-native annual grasses and rocky outcrops. Most of the nests were situated within 3 m of the treeline, characterized by mixed evergreen forest with an understory dominated by manzanita. All of the nests detected showed evidence of depredation, including partially to fully excavated nest plugs, scattered shell remains, irregular shell fragment sizes, puncture holes, and broken edges pointing inward (Ashton et al. 2001. Ecology and Sampling Methods for the Western Pond Turtle. USDA Forest Service. Pacific Southwest Research Station, Redwood Sciences Laboratory. 60 pp.) (Fig. 1). Again on 31 July 2004, two additional depredated nests were observed in the same clearing. Although both showed signs of depredation, upon closer inspection, one nest contained a single undisturbed egg; the second contained 3 undisturbed eggs within the egg chamber. On a return visit 30 July 2005 to this same location, at least 15 depredated *A. marmorata* nests were recorded. All were easily detected based on signs of depredation. Several additional excavated holes and eggshell remains were detected in the immediate vicinity. Of the 15 confirmed nest sites, 7 were closely examined and data were recorded for each on soil compaction and nest characteristics (e.g., extent of depredation-related excavation, presence and number of shell remains, and presence of salient roots or stones within the nest chamber).

Following the study design of Witzell (2005. Herpetol. Rev. 36[1]: 59), each of the 7 nest sites was then carefully excavated by hand of all loose stones and debris, and casts were made of each

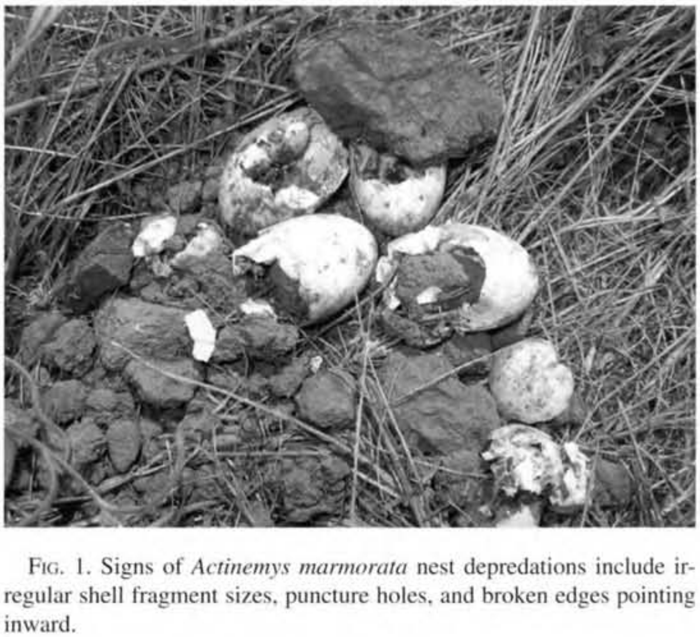

FIG. 1. Signs of *Actinemys marmorata* nest depredations include irregular shell fragment sizes, puncture holes, and broken edges pointing inward.

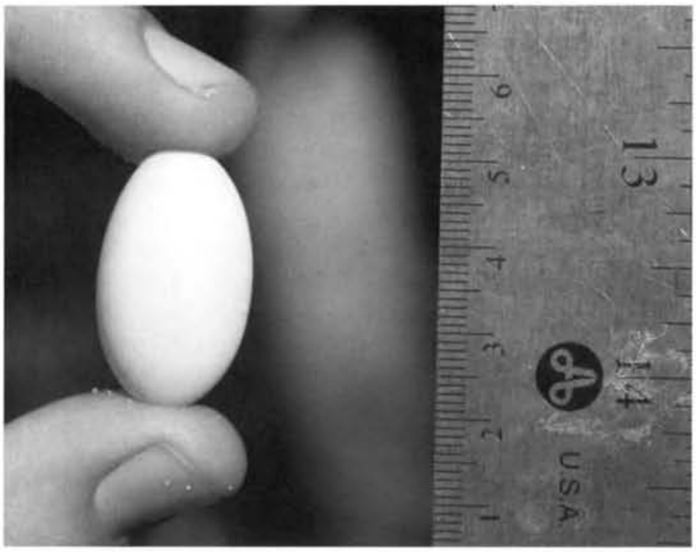

FIG. 2. Typical *Actinemys marmorata* egg recovered from aboveground.

nest chamber using a polyurethane insulating foam sealant. Once the casts had cured, each cast was hand-excavated. The minimum diameter of the neck, the maximum diameter of the egg chamber, and the depth of the egg chamber, measured from the top of the soil to the base of the chamber, were extrapolated from measurements of the casts. Soil compaction data was taken in the field with a single pocket penetrometer reading at the perimeter of each nest opening. One intact *A. marmorata* egg was recovered aboveground along the lake's perimeter close to the depredated nests; however, the immaculate condition of the egg suggests that it might not have been originally deposited inside of a nest chamber (Fig. 2). Those egg remains recovered from nest spoils were markedly soiled, likely due to soil moisture, cloacal mucus, or female turtle urine evacuated during nest construction.

Typical *A. marmorata* nests have been described as "flask or pear shaped" (Rathbun et al. 1992. Southwest. Nat. 37[3]:319–324) or "lightbulb/pear-shaped" (Holland 1994. The Western Pond Turtle: Habitat and History. Final Report. U.S. Department of Energy, Bonneville Power Administration. 303 pp.). Rathbun et al. (*op. cit.*) reported average dimensions of newly excavated, open, empty nests to be 6.5–8 cm deep, 6.5–7 cm maximum diameter across the egg chamber, and 3.5–4 cm maximum diameter across the neck. Holland (*op. cit.*) reported greater nest depths of between 9 to 12.5 cm.

At the Lake County study site, nests were roughly pear- or flask-shaped, but were offset in such a way as to exhibit bilateral rather than radial symmetry (Fig. 3). Several nest chambers were lined with large stones or crisscrossed by roots. The mean depth from the top of the soil to the base of the egg chamber was 8.5 cm ($\pm$ 1.2 cm), the mean minimum diameter of the neck was 22.1 cm ($\pm$ 2.8 cm), and the mean maximum diameter of the egg chamber was 22.6 cm ($\pm$ 2.6 cm). Soil compaction measurements taken at the perimeter of each nest opening ranged between 2 and 3.5 tons/sq ft. Between 1 and 6 eggshell remains that were greater than 50 percent intact were detected at each of the seven nest sites.

Although these architectural dimensions provide some insight into typical *A. marmorata* nests, it is important to point out that these dimensions are based solely on depredated nests sites. The wider neck apertures reported herein may be directly related to the excavation efforts of predators, for example. Given the diffi-

FIG. 3. Polyurethane nest molds of depredated *Actinemys marmorata* nests showing variation in size and shape.

culty involved in human detection of undisturbed nest sites, it is unknown what percentage of the total nests excavated in the 2004 and 2005 breeding seasons these depredated nests represent. If viable nest sites evaded detection by predators, this could be due to architectural dimensions that impede nest detection or depredation (i.e., greater nest depths).

Known predators of *A. marmorata* nests, including Striped Skunk (*Mephitis mephitis*), Coyote (*Canis latrans*), and Grey Fox (*Urocyon cinereoargenteus*) (Holland, *op. cit.*), are known to inhabit the study area. Other known nest predators, such as Raccoons (*Procyon lotor*) and Opossums (*Didelphis virginiana*) (Holland, *op. cit.*), are also likely residents of the area. However, no tracks or sign were evident to suggest what species might be depredating these nests. A study on the sensory perception of two known turtle nest predators, the Striped Skunk and Raccoon (Galois 1996. Turtle Nest Sensory Perception by Raccoon (*Procyon lotor*) and Striped Skunk (*Mephitis mephitis*): An Approach Through Discrimination Learning of Potential Nest Cues. Ph.D. dissertation. McGill Univ, Montreal. 105 pp.) has shown that these species in particular use visual, olfactory, and tactile cues to detect turtle nests. Among the potential cues that may attract such predators are female turtle urine and cloacal mucus deposited during nest construction, soil moisture (related to either urine/mucus or damp soils exposed during excavation), and differences in soil compaction between nest plugs and the surrounding soils (Galois, *op. cit.*).

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ACTINEMYS MARMORATA (Pacific Pond Turtle). **NEONATES.** *Actinemys marmorata* historically ranged from Oregon to Mexico, mainly west of the Cascade–Sierra Nevada axis (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 578 pp.; Jennings and Hayes 1994. California Dept. of Fish and Game, Rancho Cordova Final Report, Contract 8023, 260 pp.; Storer 1930. Univ. California Pub. Zool. 32:429–441). Populations of *A. marmorata* in California's San Joaquin Valley are declining and it is currently listed as a California Species of Special Concern (Jennings and Hayes, *op. cit.*). However, we know little about the natural history of this species, especially the neonatal stage. Here, I report dates and locations of neonatal *A. marmorata* captures.

I trapped *A. marmorata* at five sites in the northern San Joaquin Valley, California, USA, near the town of Los Baños. Los Baños Creek and Mud Slough North are in the China Island Unit of the North Grasslands Wildlife Area and Field 26, Field 42, and the Wasteway were in the Volta Wildlife Area. During 2003, Los Baños Creek was trapped from 4 April and 31 May, Mud Slough North from 5 April–17 June, Field 26 from 1 April–24 May, Field 42 from 22 June–22 July and the Wasteway from 21 May–10 August. I captured neonate *A. marmorata* in modified eel pot traps (Casazza et al. 2000. Herpetol. Rev. 31:91–92) set to survey for Giant Garter Snakes (*Thamnophis gigas*) with 50 mm openings on either end. I placed traps 10 m apart along banks and tied them to emergent vegetation or stakes and checked them daily. I batch marked all captured neonates by clipping two V-shaped notches in the marginal scutes on each side of the nuchal scute prior to releasing them at the site of capture. I used dial calipers to measure the midline carapace length of three initial captures.

Mid-line carapace length of the initial 3 turtles captured were 23.8, 26.7, and 27.5 mm with additional captures being of comparable size and within the size range given for hatchling *A. marmorata* (Buskirk 2002. Radiata 11:3–30). The shells of all hatchlings caught had not yet hardened, further indicating they had emerged from the nest that year (Ernst et al., *op. cit.*). Neonate capture dates are as follows: Los Baños Creek (12 [2 captures], 20, 23 [1 recapture] April); Mud Slough North (19 April, 11 May, 12 June); Field 26 (13, 15, 19, 20 [2 captures], 22, 24, 29 [2 captures] April, 1 [recapture], 14 May); Field 42 (5 June); the Wasteway (27 June). Additional species captured included Giant Garter Snakes, Common Garter Snakes (*Thamnophis sirtalis*), California Kingsnakes (*Lampropeltis getula*), Gopher Snakes (*Pituophis catenifer*), Bullfrog adults and tadpoles (*Rana catesbeiana*), and various unidentified voles, birds, minnows, and aquatic insects.

Because *A. marmorata* is a California Species of Special Concern it is critical to understand its life history and population dynamics. Earliest captures dates for one site in central California (Alameda Co.) are consistent with our findings (Buskirk, *op. cit.*). Jennings and Hayes (*op. cit.*) reported no recruitment in populations in California's Central Valley. However, later research reported young turtles were caught throughout the Central Valley of California suggesting recruitment in these populations (Germano and Bury 2001. Trans. West. Sect. Wild. Soc. 37:22–36). Understanding the habitat requirements and fates of neonates will improve future assessments of the age structure and stability of Central Valley populations.

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GLYPTEMYS INSCULPTA (Wood Turtle). **PREDATION.** Mutilation in the form of missing limbs and shell damage among Wood Turtles has been reported by Harding (1985. Herpetol. Rev. 16:30) and Farrell and Graham (1991. J. Herpetol. 25:1–9). Natural limb loss has been attributed to raccoons, and shell damage to various mammals. Here we report on an incident of predation upon a population of Wood Turtles during hibernation, and suggest that the most likely culprits were otters.

This southern New Hampshire population has been continuously

monitored (by DMC) since 1988 (see Tuttle and Carroll 1997. Chelon. Cons. Biol. 2:447–449, and 2003. Chelon. Cons. Biol. 4:656–663, for habitat descriptions), and nearly all of the turtles ($\approx$ 200 during that time) have been uniquely marked. Most have been located in multiple years and multiple times within a year. In late March of 1990, one adult male was found that had recently lost its left front and right hind legs, and a 6–8 yr-old was found dead with two large canine punctures through its carapace. Since 1990, only three instances of attempted predation have been noted, all consisting of limb loss by surviving subadults during the active season. During the spring of 2005, it became evident from observations of emerging turtles that there had been a major predation event during the previous hibernation period. Collections from 25 March 2005 until 11 July 2005 of 45 turtles included 21 (3 dead and 18 injured) that had been attacked. Turtles attacked had straight-line carapace lengths from 7.1 to 18.4 cm. The most common injury was the loss of part or all of one or two limbs, most commonly the front limbs (18 of 23 injuries). Additional undiscovered fatalities are likely, as several turtles that would normally have been located during the first two months after spring emergence had not been found by 11 July.

The portion of the study site where attacks occurred includes stretches of about 100 m and 300 m of two first-order streams ca. 75 m upstream of their confluence, which is in turn about 1.6 km distant from a small river. Undamaged turtles were found both upstream of the 100 m section (1, about 3 km) and downstream (5, about 0.4 km) of the confluence, indicating that this was a localized predation event. Otters (*Lutra canadensis*) are implicated from scats and prints in the area, and the fact that the turtles were submerged in up to 1.5 m of water. The hibernating turtles are often exposed on the bottom, frequently wedged between rocks, among woody debris, or among roots in the banks, which would make them easy prey for an underwater predator. Episodic otter predation upon hibernating Snapping Turtles (*Chelydra serpentina*) has been noted by Brooks et al. (1991. Can. J. Zool. 69:1314–1320), Park (1971. The World of the Otter. J. P. Lippincott Co., New York), and Surface (1908. Zool. Bull. Div. Zool., Pennsylvania Dept. Agric. 6:105–196), indicating that otters are capable of locating and killing hibernating turtles. In the case of Snapping Turtles, otters typically remove them from the water and eviscerate them ventrally, where the reduced plastron makes these turtles vulnerable. We speculate that the otters also removed the Wood Turtles from their hibernacula and took them to the stream banks (one of the three known fatalities was located on a stream bank), but were in most cases unable to do more than mutilate one or two limbs. The abandoned turtles would then have returned to the water.

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HOMOPUS SIGNATUS (Speckled Padloper). **MAXIMUM MALE SIZE.** *Homopus signatus* is considered the world's smallest tortoise species. In the nominate subspecies *Homopus s. signatus* average straight-line carapace lengths (SLCL) of 87.9 mm for females (N = 35) and 77.9 mm (N = 36) for males have been reported (Loehr 2002. J. Herpetol. 36:378–389). The largest specimen recorded was a female with a SLCL of 110 mm; the largest male reported had a SLCL of 89.5 mm and a body mass of 113.0 g (Loehr, *op. cit.*). The southern subspecies *Homopus signatus cafer* is reportedly somewhat smaller. The SLCL range is 69.9–79.8 mm in males and 83.8–95.7 mm in females (Boycott 1986. J. Herpetol. Assoc. Afr. 32:10–16).

On 14 October 2004 we found a male *Homopus signatus cafer* hiding in a rock crevice in the vicinity of Lambertsbaai, South Africa. The SLCL was 93.0 mm, the straight-line plastron length was 71.9 mm, the maximum shell width was 66.2 mm, and the maximum shell depth was 35.1 mm. The body mass of the male was 128.2 g.

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KINOSTERNON SUBRUBRUM SUBRUBRUM (Eastern Mud Turtle). **PREDATOR ESCAPE**. Known avian predators of *Kinosternon subrubrum* include crows and eagles (Ernst et al. 1994. Turtles of the United States and Canada, Smithsonian Inst. Press, Washington, DC; Mitchell 1994. The Reptiles of Virginia, Smithsonian Inst. Press, Washington, DC). Bald Eagles (*Haliaeetus leucocephalus*) are opportunistic foragers capable of exploiting a wide range of prey taxa (Buehler 2000. *In* A. Poole and F. Gill [eds.], The Birds of North America, No. 506, pp. 1–40. The Birds of North America, Inc., Philadelphia, Pennsylvania). Turtles have been documented as regular but uncommon prey primarily within the eastern portion of their breeding range (e.g., Bendell 1959. Can. Field Nat. 73:131–132; Broley 1947. Wilson Bull. 59:3–20; Ganier 1951. Migrant 22:37–39). Quantitative analyses of diets show that turtles account for < 2% of overall prey items taken by Bald Eagles (e.g., McEwan and Hirth 1980. Condor 82:229–231; Hunt et al. 2002. J. Raptor Res. 36:245–255). However, within the Chesapeake Bay, turtle shells are found with some regularity under eagle nests. An evaluation of prey remains collected from nest sites throughout the Chesapeake Bay over a five-year period documented the use of five turtle species (Clark 1981. J. Field Ornithol. 53:49–51). How eagles capture and consume these turtles is poorly understood, and we do not know if predation attempts are always successful. We observed predation of four turtle species during video monitoring of eighteen Bald Eagle nests in eastern Virginia during 2002 to 2003 (Markham and Watts, unpubl. data). Here we report on how one *K. subrubrum* escaped from attempted predation by this raptor.

During one observation on 17 April 2003 at an eagle nest on the York River, Virginia, an adult female eagle brought an adult *K. subrubrum* to her nest at 1114 h EST. She attempted several times to insert her beak enough between the plastron and carapace to grab onto the turtle's flesh. Attempts were made anteriorly and posteriorly over a period of 1 min 40 sec after which she abandoned the turtle and left it lying on its back. Sixty-nine minutes later the turtle turned over and walked to the edge of the nest and fell to the ground.

These observations document that at least some *K. subrubrum* brought to Bald Eagle nests can survive attempted predation. The

hinged plastron, the ability of this species to close up its shell or nearly so, and shell thickness prevented the eagle from being able to extract flesh with her beak. We suspect that Eastern Box Turtles (*Terrapene carolina*), with their ability to close their shells completely, are seldom found in eagle nests. Turtles of other species without this characteristic (e.g., *Chrysemys picta*, *Sternotherus odoratus*) are much less likely to survive predation from this large avian predator.

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MACROCHELYS TEMMINCKII (Alligator Snapping Turtle). **FEEDING BEHAVIOR**. Observations of lingual luring in Alligator Snapping Turtles are common in captive specimens but apparently rare in the wild (Ernst et al. 1994. Turtles of the United States and Canada, Smithsonian Institution Press, Washington, DC. 578 pp.; Pritchard 1989. The Alligator Snapping Turtle: Biology and Conservation, Milwaukee Public Museum, Milwaukee, Wisconsin. 104 pp.). Herein, we provide an account of luring by an adult male Alligator Snapping Turtle in a clear-water, riverine environment. The turtle was observed by WRH on 21 September 2004 feeding (i.e., luring using its tongue appendage) at the bottom of the Eleven Point River in Randolph County, Arkansas, USA (N36.39383, W91.11433; NAD 27 CONUS) while we were scuba diving. The turtle was located in ca. 4 m of water and was positioned midstream on the gravel/bedrock interface, which is a typical characteristic of a lateral scour pool. Visibility was ca. 3 m, and the water temperature was 20°C. (The discharge rate was approximately 1000 ft^3/sec—USGS, Ravenden Springs reporting station.) The turtle's head was facing directly upstream with mouth gaping. The ventral portion of his body was resting partially on bedrock and partially on cobble/gravel; one set of his posterior claws was embedded into the gravel, and the other set was grasping to secure a hold on the bedrock. The anterior claws were positioned in a similar manner. The carapace was completely exposed, yet was well camouflaged within the surrounding substrate.

The turtle was captured by hand by WRH and was taken to the herpetology lab at Arkansas State University for photographing and processing. This turtle had a mass of 14.1 kg, a straight-line carapace length of 37.3 cm, a pre-anal tail length of 10.4 cm, and a post-anal tail length of 29.0 cm. An encrypted (AVID® Identification Systems, Inc., Norco, California) PIT (passive integrated transponder) tag was implanted within the dorsal musculature of the tail. The turtle was released back into the river at the point of capture on 23 September 2004.

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LACERTILIA

ANNIELLA PULCHRA PULCHRA (Silvery Legless Lizard). **HABITAT.** Except for a questionable account from Redwood Canyon, Marin County (Rivers 1902. Bull. So. California Acad. Sci. 1:27; Jennings and Hayes 1994. Amphibians and Reptile Species of Special Concern in California. California Department of Fish and Game, Rancho Cordova, California. 255 pp.), the range of *Anniella pulchra pulchra* is known to extend north to the south bank of the San Joaquin River, California, along the river's downstream approach to the San Francisco Bay Delta. Although the species is known to occur in the dunes at the Antioch Dunes National Wildlife Refuge, the East Bay Regional Park District Legless Lizard Preserve, and at scattered locations throughout Antioch, Oakley, and Brentwood, Contra Costa County, little has been published on its habitat requirements in this region beyond the treatment of Miller (1944. Ecol. Monogr. 14:271–289) and the species overview in Jennings and Hayes (*op. cit.*). As both a California Species of Special Concern and a Federal Species of Concern, more complete information on habitat conditions at the northern end of its range are needed. Hence, we help fill that gap with a report of the recent occurrence of 19 individuals in the Antioch/Oakley area, and describe a heretofore undescribed vegetation community—Oakley sand stabilized interior dunes—within which we have recorded this species.

On 28 January 2004, during herpetofaunal surveys of a 2.71-ha portion of sand dune ca. 2.4 km E of the City of Oakley, we found a single *A. p. pulchra* beneath a piece of 0.6 × 1.8 m corrugated sheet metal. A follow-up visit on 29 January 2004 revealed a second *A. p. pulchra* ca. 90 m north of the first sighting beneath a pile of ca. 15 pieces of similarly sized corrugated sheet metal. Also observed on this occasion were a *Coluber mormon* and a *Pituophis catenifer catenifer* between sheets situated higher in the pile. In both these cases, *A. p. pulchra* was observed above ground (i.e., not buried within the sandy substrate) between the substrate-cover interfaces, but each was quick to burrow into the sandy substrate when exposed.

At this same dune, focused follow-up surveys were conducted on 28–29 June and again on 26 July 2004. Focused surveys consisted of excavating target areas with habitat components thought to be important to *Anniella* (e.g., sandy soils in proximity to trees and shrubs and associated leaf litter; see Miller, *op. cit.*) and sifting the sands with a hand cultivator tool. Excavations reached depths of up to 60 cm and were generally confined within the drip-line of trees and consisted of trenches that extended up to 6 m from the trunks. We encountered 11 more *A. p. pulchra* at depths between 15 and 30 cm, typically close to the horizon between

deeper moist sand and overlying dry sand. All occurrences were within 90 m of the January occurrences and located beneath the drip-lines of Coast Live Oaks (*Quercus agrifolia*), estimated by CHT to be 50 to 200 years in age.

On 17 March 2005, we focused surveys on an adjacent 0.67-ha portion of dune immediately southwest of the dune searched between January and July 2004. This second location had a well-developed stand of Silvery Bush Lupine (*Lupinus albifrons*) with an understory of non-native annual grassland dominated by such species as Hairy Vetch (*Vicia villosa*), brome grasses (*Bromus* spp.) and filaree (*Erodium* spp.). One *A. p. pulchra* was found beneath a fine layer of sand covered by a discarded steel automobile hood ca. 3 m from the nearest lupine. On 25 April 2005, we found 4 more *A. p. pulchra*. Three were detected by raking the sand beneath a pile of three 1.2×2.4 m plywood sheets, and the fourth was partially exposed in sand underneath a $15 \times 15 \times 121$ cm fencepost.

These *A. p. pulchra* occurrences are unique in that the dune complex in which they were found supports a vegetation assemblage that has been poorly recognized and is yet to be adequately described. Holland (1986. Preliminary Descriptions of the Terrestrial Natural Communities of California. California Department of Fish and Game, Sacramento, California. 156 pp.) recorded a similar vegetation assemblage, but based on his specific location on the bank of the San Joaquin River and his inclusion of two plants, Antioch Dunes Evening Primrose (*Oenothera deltoides* var. *howellii*) and Contra Costa Wallflower (*Erysimum capitatum* var. *angustatum*), endemic to a single locality, this description appears to be specific to the Antioch Dunes and effectively excludes other dunes in the region.

In the Oakley area, loose to consolidated sandy soils generally mapped as Delhi sand, Piper sand, and Piper fine sandy loam (USDA 1977. Soil Survey of Contra Costa County, California. Natural Resources Conservation Service) characterize this habitat, which we refer to here as Oakley sand stabilized interior dunes. These soils are on sites often referred to locally as "sand mounds," and are widely distributed in the area. The presence of locally uncommon native plant species including California Croton (*Croton californicus*), Desert Evening Primrose (*Oenothera deltoides* ssp. *cognata*), Small Evening Primrose (*Camissonia* spp.), Slender Buckwheat (*Eriogonum gracile* var. *gracile*), Blue Head Gilia (*Gilia capitata* ssp. *staminea*), Kellogg's Tarweed (*Deinandra kelloggii*), and Valley Lessingia (*Lessingia glandulifera* var. *glandulifera*) characterize the vegetation. The dune flora also often supports the aforementioned *Q. agrifolia* and *L. albifrons*, which, unlike the other plants listed, are also common on other soil types in the region.

Similar, isolated pockets of dune habitat were also present 0.8 km north of the described dune complex, but we observed no *A. p. pulchra* during two months involving over 70 h of surveys and spot checks in January–February 2004. Based on the 1977 NRCS soil survey maps, these outlier dunes were once connected to the eastern boundary of the greater dune system typical of the Antioch/ Oakley area. When compared to the NRCS soils survey maps, agricultural fields, well-trafficked roads, irrigation canals, and urban sprawl isolate most such remaining dune habitat.

Documentation of *A. p. pulchra i*n Contra Costa County is recorded from the 1930s to the present, and includes 7 specimens collected in Antioch and a single specimen collected in Oakley (California Academy of Sciences); 36 specimens from 8 indeterminate locations in Oakley, Antioch, and Brentwood (Museum of Vertebrate Zoology); and three Contra Costa County locations identified in the California Natural Diversity Database (www.dfg.ca.gov/whdab/html/cnddb.html), which includes the East Bay Regional Park District Legless Lizard Preserve where on 26 April 2004, MPB found a freshly killed specimen outside of the preserve's perimeter with a puncture wound to its abdomen (CAS 228525).

Based on our observations of the present distribution of sandy soils and plants associated with the Oakley sand stabilized interior dunes vegetation community, together with our *A. pulchra pulchra* occurrences reported here, we surmise that the museum and database records noted from Contra Costa County occurred in locations supporting this habitat type. Understanding the degree of linkage between this association and *A. p. pulchra* distribution will help elucidate *A. p. pulchra* habitat requirements at the northern end of its range.

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ANOLIS PULCHELLUS (Grass Anole). **NECTIVORY.** Nectar feeding has previously been reported in anoles (e.g., Liner 1996. Herpetol. Rev. 27:78). Perry and Lazell (1997. Herpetol. Rev. 28:150–151) argued that, though episodic, it is more common that usually thought, and recent reports (Campbell 2000. Herpetol. Rev. 31:239; Echternacht et al. 2000. Herpetol. Rev. 31:173; Rios-López 2004. Herpetol. Rev. 35:386; Townsend 2004. Herpetol. Rev. 35:141–142) support that view. Here we report on another such case.

On the afternoon of 24 September 2005, we observed an adult (ca. 4.5 cm SVL) male *Anolis pulchellus* licking at a button-like structure near the base of the leaf of a small *Leucaena leucocephala* tree (Leguminosae). The lizard was about 1 m above the ground and the behavior continued for about a minute. Although nectar was not apparent to the naked eye, these structures are known to be extrafloral nectaries (Minu 1991. Acta Botanica Indica 19:49–54).

This is but the second report of lizards using extrafloral nectaries; the first (Rios-López 2004. Herpetol. Rev. 35:386) occurred in a closely related lizard species of similar size that also occurs on the Puerto Rico bank. Anoles also occasionally engage in outright herbivory (e.g., Lazell and Mitchell 1998. Herpetol. Rev. 29: 237), and episodic nectivory also occurs in other lizard clades (e.g., Perry and Ritter 1999. Herpetol. Rev. 30:166–167).

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ANOLIS SAGREI (Brown Anole). **TESTICULAR PATHOLOGY**. At 0822 h on 18 April 2002, GN collected a male *Anolis sagrei* (55 mm SVL, 4.7 g) in an irrigation ditch in an agricultural area of Santzepu, Shuisan District, Chiayi County, Taiwan (23°25'42"N, 120°28'55"E datum: WGS84; elev. 60 m). A paved road and a rice paddy bordered the sides of the ditch. The lizard was emaciated, and easily caught.

Dissection revealed that the stomach contained a hymenopteran, but no abdominal fat was present. The liver index (liver weight/SVL × 100) of this lizard was 0.236, slightly lower than the average (0.268) of the other males collected in that month. It was also noted that the right testis was a grayish-black color, much reduced in size (3.5 mm long, 2.9 mm wide, 0.05 g), and hard, while the left testis was a normal dark mustard color and appeared to be in a normal condition and size (6.2 mm long, 5.2 mm wide, 0.12 g). Both left and right testes, as well as the liver, were fixed in 10% formalin, embedded in wax, sectioned at 5μ and stained with Ehrlich's hematoxylin and eosin (HE), Periodic-Acid-Schiff (PAS) and Ziehl-Nielsen (ZN) stains. The liver was very dark in color and had white nodules on the ventral side near the gallbladder, but no abnormalities were observed during the histological examination. Sections of the left testicular adnexa (Fig. 1) revealed a necrotizing granuloma, composed of central necrosis surrounded by epithelioid to polygonal histiocytes and fibrosis, but adjacent testicular tissue did not appear to be affected and was undergoing spermatogenesis. Sections of the right testis (Fig. 2) revealed only a residual granuloma without any normal testis and adnexal tissue. The granuloma was composed of central necrotic eosinophilic granular materials, surrounded by plump histiocytes. A ring of

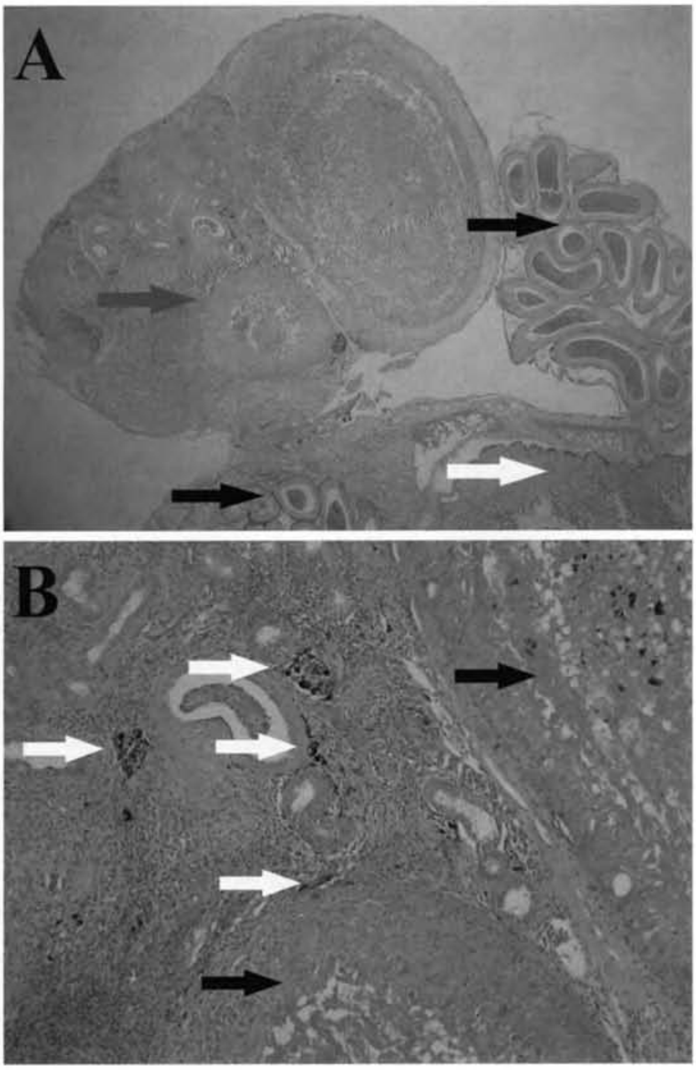

FIG. 1. **A** – A section of the left testicular adnexa (40× magnification, HE stain). Note the lesion in the upper left hand portion of the image; and the spermatozoa in the epididymis (center lower and right hand portion of the image); as well as the reproductively active seminiferous tubules (the lower right hand corner of the image). **B** – The same section (100× magnification, HE stain); note the melanin in the center of the nodule and the necrosis in the lower right hand and upper right hand corner of the image.

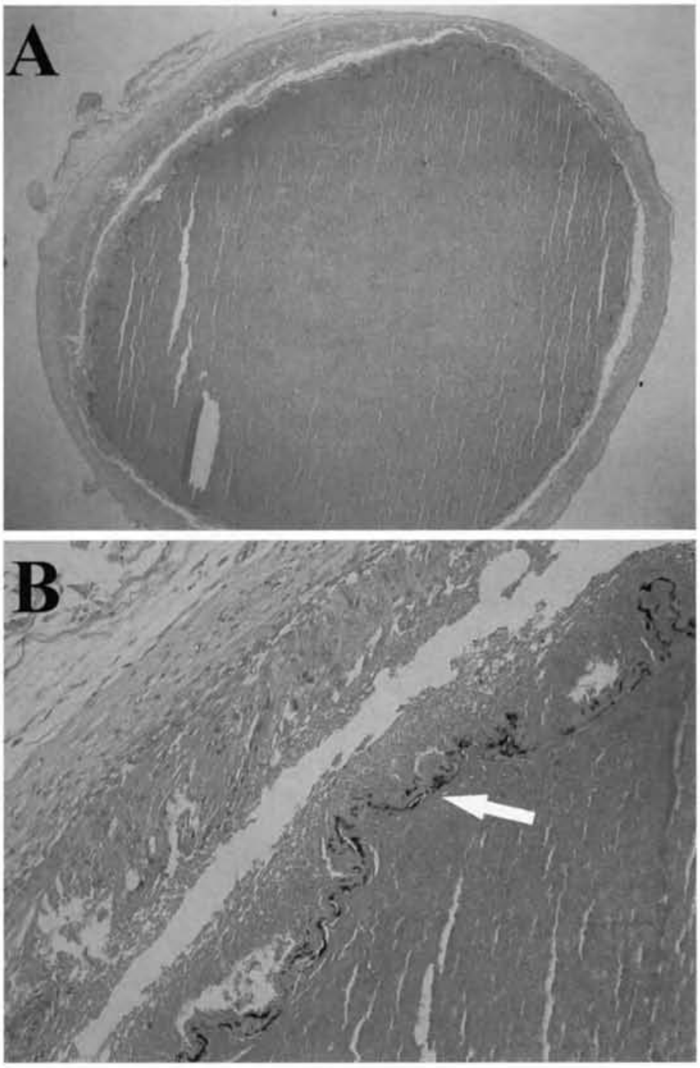

FIG. 2. **A** – A section of the right testis without any normal testis and adnexal tissue (40× magnification, HE stain). **B** – Note the melanin that is surrounding the necrotic tissue (200× magnification, HE stain).

melanin surrounding the necrotic focus suggests that the lesion originated from the testicular adnexa.

In sections of the left and right testes, as well as the liver, treated with PAS and ZN stains, no fungi or acid-fast bacilli were observed; thus, the exact cause of these lesions is uncertain. Since this *A. sagrei* was part of other studies, necessitating that the organs be treated as needed for those investigations (i.e., fixation), culture of fungi and bacteria was not possible. This appears to be the first report of such lesions in *A. sagrei* from Taiwan.

We would like to express our gratitude to Mei-Hsiu Cheng and the other laboratory technicians of the Chiayi Christian Hospital cytology laboratory for preparing the microscope slides, and to Dr. Rod Suepaul for his suggestions.

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COLEONXY BREVIS (Texas Banded Gecko). **COLOR PATTERN.** *Coleonyx brevis* is a nocturnal gecko restricted to the northern and east-central parts of the Chihuahuan Desert, the western and southern edge of the Balconian Biotic Province and most of the Tamaulipan Biotic Province of Texas and Mexico (Blair 1950. Texas J. Sci. 2:93–117); in México, the species occurs in northeastern Chihuahua, most of Coahuila, north and central Nuevo León, and small portions of northwestern Tamaulipas and northeastern Durango (Bartlett 1996. Reptiles 4:48–67; Dixon 1970. Cat. Amer. Amphib. Rept. 88.1–88.2; Stebbins 2003. A Field Guide to Western Reptiles and Amphibians. 3rd ed. Houghton Mifflin Co., New York. 353 pp.). The species is small (maximum SVL = 59 mm [females], 56 mm [males]), and the typical dorsal pattern consists of a series of small spots alternating with dorsal bands (Dial and Grismer 1992. Syst. Biol. 41:178–195; Dixon 1970, *op. cit.*; Klauber 1945. Trans. San Diego Soc. Nat. Hist. 10:133–216). To our knowledge, no aberrant color patterns in *Coleonyx* involving longitudinal dorsal stripes have been reported (see Klauber 1945, *op. cit.*; Dyrkacz 1981. SSAR Herpetol. Circular 11:1–31). Hence, we describe a *C. brevis* with a longitudinal-striped pattern from central Nuevo León, Mexico.

FIG. 1. An unusual pattern in a juvenile male *Coleonyx brevis* from El Carmen, Nuevo Leon, México.

On 22 April 2004, while conducting a herpetological survey on the slopes of Cerro Minas Viejas in a submontane matorral biotic community in the municipality El Carmen (25°56'57.5"N, 100°21'40.9"W, datum: NAD27; 556 m elev.), we found a subadult male *C. brevis* (41 mm SVL; 26 mm tail, 1.8 g) under a 17 x 15 cm rock. It lacked typical dorsal banding pattern on the body, having instead longitudinal stripes (Fig. 1), but the tail had the typical banding pattern. The lizard was photographed and released. Other reptile species are known to have banded and striped morphs (Fox et al. 2003. Lizard Social Behavior. Johns Hopkins Univ. Press, Baltimore, Maryland. 464 pp.; Zug et al. 2001. Herpetology: An Introductory Biology of Amphibians and Reptiles, 2nd. edition. Academic Press, San Diego, California. 630 pp.), but the significance of the striped morph in *C. brevis* will require an understanding of its population-level frequency and its relationship to different habitat conditions.

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CTENOTUS SPALDINGI (NCN). **NEST SITE DISTUBANCE; HATCHING.** The scincid genus *Ctenotus* is a large group of diurnally active insectivorous lizards (Cogger 2000. Reptiles and Amphibians of Australia. Reed Publishing, Sydney, Australia. 808 pp.) that reach among the highest species diversities of any terrestrial vertebrate (Pianka 1986. Natural History of Desert Lizards. Princeton University Press, Princeton, New Jersey. 222 pp.). Still, little is known about the nesting or potential cues responsible for hatching in most members of this genus. Hence, here I report an observation of nesting habitat, nest disturbance and subsequent hatching of the species *Ctenotus spaldingi*.

During fieldwork in the desert uplands of northeastern Queensland, I uncovered a nest containing 5 eggs (mean dimensions; 12 × 11 mm; N = 5) positioned against the wall of a pitfall bucket while checking an established trapping grid. The nest was situated in Mitchell grass (*Astrebla* sp.)-dominated black soil plains habitat (Morgan 1999. *In* Sattler and Williams [eds.], The Conservation Status of Queensland's Biogeographical Ecosystems, pp. 10/1–10/35. Environmental Protection Agency, Brisbane, Queensland, Australia). The nest was relatively shallow with a 4.5-cm covering of dried soil with the entrance to the nest connected to a hole leading into a nearby crack in the soil. In the uncovering process, one of the eggs was inadvertently damaged, and an attempt was made to move the eggs to a suitable incubation site. While moving the remaining eggs, one egg began to hatch;

in just over 4 min, it had fully emerged from its egg, at which point the hatchling was still attached to its yolk sac via the umbilicus. The time between when the eggs were uncovered to when the hatchling fully emerged from its egg was ca. 7 min. Remaining eggs were transferred to a small plastic bag with moist grass and leaves and allowed to incubate at an air temperature averaging 25°C; the remaining viable eggs hatched over the next 4 days. The clutch size and nest depth documented in this observation of *C. spaldingi* is similar to that reported in another study of *Ctenotus* (clutch size: 4–6 in *C. robustus*; 2–6 in *C. taeniolatus*; nest depth: 5 cm in *C. robustus*; 4 cm in *C. taeniolatus*; Taylor 2005. Aust. J. Zool. 52:649–666). However, I am unaware of other reports suggesting that nest disturbance may induce hatching in the genus *Ctenotus*.

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GAMBELIA WISLIZENII (Long-nosed Leopard Lizard). **PREDATION.** Previous observations of *Gambelia wislizenii* have revealed that this lizard preys on large invertebrates and small vertebrates, including other lizards and mammals (e.g., McCoy 1967. Amer. Midl. Nat. 77:138–146; Parker and Pianka 1976. Herpetologica 32:95–114; Pietruszka et al. 1981. J. Herpetol. 15:249–250). Although herpetologists might have often witnessed *G. wislizenii* feeding in the wild, photodocumentation of the predation process is lacking. Here we photodocument the details of a *G. wislizenii* predation event on *Uta stansburiana* from southern Utah, USA.

At 1457 h on 12 May 2004, we witnessed an adult (> 90 mm SVL) *G. wislizenii* (a male based on lack of nuptial coloration) seize an adult (> 40 mm SVL) *U. stansburiana* (also a male based on the bluish throat color and the intensity of the lateral spot behind the forelimbs) and digitally photographed the encounter. The incident occurred just a few meters north of the newly restored Paria Canyon Movie Set in Grand Staircase-Escalante National Monument, Kane County (37°14.237'N; 111°57.498'W; elev. 1450 m). Triassic-age rocks around the site weather readily, producing abundant soft alluvium in the valley. Consequently, sagebrush grows relatively densely, providing ample shade and shelter among rocks and sandy areas for basking.

Our photodocumentation omits the first 30 sec of the assault. During this phase, the *G. wislizenii* grasped its prey by the neck and immobilized it by repeated shaking and visibly clenching its jaw. This process continued, increasingly less vigorously, until the *U. stansburiana* stopped moving. The *G. wislizenii* then rapidly rotated its prey and ingested its entire torso, head first and belly up, within a minute (Figs. 1A–B). Ingestion of the torso was followed by a minute-long pause. The final effort consisted of swallowing the tail. This appeared to be a strenuous process during which the leopard lizard repeatedly contorted its body (Fig. 1C), presumably to roll up the food item in its stomach. During ingestion, our observation distance was 3–4 m. Following prey ingestion, the *G. wislizenii* noticeably slowed its movements, and it tolerated an even closer approach to a distance of 2 m. Based largely on the camera's digital clock, the entire progression from initial attack to completion of prey ingestion took about 3.5 min.

A literature search revealed that detailed descriptions of predation of *Gambelia* spp. are rare since most food habits studies fo-

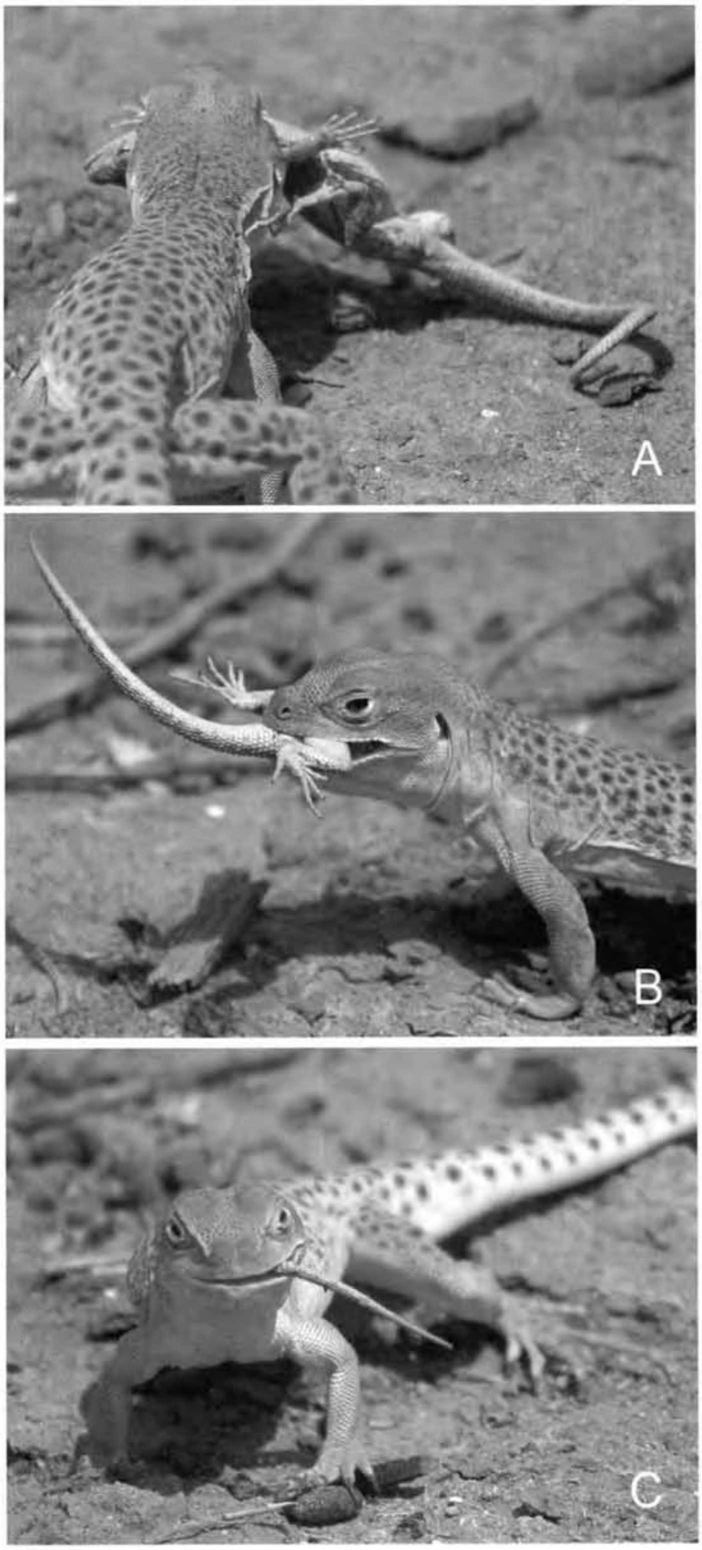

FIG. 1. A) Seven seconds after the observation began, the *Gambelia* has immobilized the *Uta* with repeated shaking and jaw clenching. B) Fifty-three seconds after the observation began, the prey is swallowed head first and belly up. C) To swallow the tail of its prey, the *Gambelia* repeatedly contorts its body; 149 sec after the observation began.

cus on the stomach contents of these lizards (e.g., Knowlton and Janes 1932. Ohio J. Sci. 32:467–470, Knowlton and Janes 1934. Copeia 1934:10–14, Knowlton and Thomas 1936. Copeia 1936:64–66, Milstead and Tinkle 1969. Am. Midl. Nat. 81:491–499). *Gambelia* is a fast, aggressive and tenacious predator that can capture prey running at full speed (Tanner and Krogh 1974. Herpetologica 30:63–72). However, the time needed for swallowing seems to vary greatly. A male *G. sila* caught and swallowed a conspecific hatchling "within a few seconds" (Germano and Williams 1994. Herpetol. Rev. 25:26–27), but the consumption of a pocket mouse *Perognathus* by a juvenile female *G. wislizenii* necessitated more than 1.5 h (Pietruszka et al. 1981. J. Herpetol. 15: 249–250). Large prey is swallowed with the aid of bending movements of the head and body, whereas small prey is masticated before ingestion (Montanucci 1956. Herpetologica 21:270–283).

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GERRHONOTUS LIOCEPHALUS (Texas Alligator Lizard). **MORTALITY**. In México, forest fires occur primarily over two seasonal intervals. One season, which runs January to June, applies to the entire country save the northeast; the other, which begins in May and ends in September, applies to northeastern México. Both coincide with the dry season (SEMARNAP, 2000. Texto Guía Forestal. Subsecretaría de Recursos Naturales, Dirección General Forestal-SEMARNAP. México, D.F., 150 pp.). Forest fires have the potential to negatively affect forest faunas, and in particular, amphibians and reptiles (Bury 2004. Conserv. Biol. 18:968–975). Fire-induced formation of light gaps in forest canopies can favor certain reptiles, but reptiles may have greater difficulty finding refuge in fire-affected sites (Bury, *op. cit.*; Ernst et al. 1995. Herpetol. Rev.26:185–187). However, few data exist indicating the vulnerability of reptiles. Hence, here we provide an observation from Nuevo Leon, México implying that *Gerrhonotus liocephalus* might sometimes be at risk from forest fires.

During a visit to the central part of the Parque Ecológico Estatal Chipinque, in an area known as El Empalme (25°36'16.0"N, 100°21'06.0"W, datum: NAD27, elev. 1270 m) on 25 April 1998, we found an adult female *G. liocephalus* (141 mm SVL; 36 mm tail with a 20 mm regenerated piece; 33.5 g) that died probably due to a forest fire that had passed through the area over the interval 9–22 of April 1998 (fire information online at http://www.jornada.unam.mx/1998/04/11/incendios.html and http://www.horacero.com.mx/130_edicion/30130.html). This female lacked digits on its left front foot, and all metatarsals and phalanges were missing on its right front foot. All digits on the hind feet were incomplete, as the outer portion of each digit up to at least the second phalange was missing. Moreover, the dorsal scales were much darker than normal and sloughed off in alcohol after only two days of preservation, suggesting the lizard was exposed either to fire directly or to a hot substrate. Our visit to the site occurred two days after the fire was brought under control, which suggests that this animal survived the fire but succumbed from fire-related injuries. In this same area we also found under a rock a specimen of *Plestiodon brevirostris pineus* that had not been affected. More information on the vulnerability of fire to reptiles will be needed to determine whether demographic consequences to this sort of mortality exist.

The *G. liocephalus* (UANL 5532) was deposited in the herpetological collection of the Universidad Autonoma de Nuevo Leon, Facultad de Ciencias Biologicas.

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HOPLODACTYLUS MACULATUS (Common Gecko). **SOCIAL ASSISTANCE**. Cooperation, especially parental care, is a significant life history component in many vertebrates (Clutton-Brock 1991. The Evolution of Parental Care. Princeton University Press, Princeton. 368 pp.). However, documentation of parental care in reptiles is sparse, having been reported or inferred for only 3.4% of lepidosaurians (Somma 2003. Parental Behavior in Lepidosaurian and Testudinian Reptiles: A Literature Survey. Krieger Publishing Company, Malabar, Florida. 174 pp.). Moreover, reports of parental care among lepidosaurians are taxonomically biased towards snakes (Shine 1988. *In* Gans and Huey [eds.], Biology of the Reptilia. pp. 275–329. Alan R. Liss, New York), and among lizards are biased towards skinks (Somma, *op. cit.*). Of the nearly 1000 recognized species of geckos (Suborder Gekkota; Pianka and Vitt 2003. Lizards: Windows to the Evolution of Diversity. University of California Press, Berkeley. 333 pp.), parental care has been reliably documented in only 21 (all in the Family Gekkonidae; Somma, *op. cit.*). Further, reports of parental care of post-hatching juveniles (as opposed to eggs) are even less common (Shine, *op. cit.*; but see Evans 1959. Copeia 1959:103–110; O'Connor and Shine 2004. Anim. Behav. 68:1361–1369 for exceptions). Hence, here we report observations of juvenile *Hoplodactylus maculatus* using adult conspecifics to aid in dispersal to foraging grounds from a communal retreat site.

Hoplodactylus maculatus, moderate-sized (to 82 mm SVL) nocturnal geckos endemic to New Zealand (Gill and Whitaker 2001. New Zealand Frogs and Reptiles, David Bateman, Auckland, New Zealand. 112 pp.), are known to form large diurnal aggregations (Hare and Hoare 2005. Herpetol. Rev. 36:179). During a two-week period in November 2004 (austral spring), we observed and video-recorded nocturnal emergence behavior of a diurnal aggregation of ~100 individual *H. maculatus* on Stephens Island, Cook Strait, New Zealand (40°35'S, 173°55'E; elev. 200 m). Geckos (adults, sub-adults, and < 1-month-old neonates) emerged singly from their retreat site at dusk (~2030 h NZDT) from two exits and were seen moving in progression along branches, and between coastal trees to reach the canopy, presumably to forage. Neonate geckos were observed travelling with 1–2 adults on several occasions. More importantly, however, we observed neonate geckos using the body of adult geckos that were bridging the gap between twigs of different trees to make arboreal crossings (Fig. 1).

FIG. 1. An adult *Hoplodactylus maculatus* (large animal in center) forming an arboreal bridge between the twigs of adjacent trees over which a juvenile conspecific (on left) has just crossed.

Two neonate geckos observed attempting to cross from one tree to another without the assistance of adult geckos were unsuccessful in their endeavors to reach the next tree. In a location, such as Stephens Island, with a high density of ground-dwelling nocturnal predators of geckos (Tuatara, *Sphenodon punctatus*, known to prey on *H. maculatus* [Walls 1981. New Zealand J. Ecol. 4:89–97], occur at an average density of 2015/ha in forest habitat; Carmichael et al. 1989. New Zealand J. Zool. 16:269), the risk of mortality as a consequence of falling to the ground during arboreal crossings, or using the ground to move between trees, is likely to be high.

We cannot confirm relatedness of adult and neonate geckos seen travelling together, but our observations provide evidence of social interaction between *H. maculatus* of differing ages and tolerance of neonates by adults. The level of social assistance seen in *H. maculatus* has rarely been reported among reptiles (reviewed by Chapple 2003. Herpetol. Monogr. 17:145–180), and particularly geckos (Shine, *op. cit.*; Somma, *op. cit.*).

Despite *Hoplodactylus maculatus* being frequently observed in diurnal aggregations (Hare and Hoare, *op. cit.*) nocturnal emergence behaviors associated with these aggregating geckos have not been reported. Living in dense aggregations might necessitate dispersal preceding their diel activity period to forage effectively. We encountered geckos in the surrounding coastal forest throughout the night at distances of > 10 m from their diurnal retreat site. Social assistance among conspecific nocturnal geckos might facilitate foraging and predator avoidance of neonates within social aggregations. Clarifying the relatedness among aggregations of individuals and the purpose and extent of social assistance might significantly contribute to knowledge of sociality and parental care in reptiles.

We thank Kelly Hare for comments on the draft. Our research was conducted with New Zealand Department of Conservation approval.

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HOPLODACTYLUS MACULATUS (Common Gecko). **LONGEVITY**. The New Zealand lizard fauna is characterized by extreme longevity, low reproductive output, and high species diversity for its size when compared with other temperate regions in the world (Bannock et al. 1999. New Zealand J. Ecol. 23:101–103; Cree 1994. New Zealand J. Zool. 21:351–372). Longevity estimates for free-living *Hoplodactylus* geckos (*H. duvaucelii* and *H. maculatus*) are currently at least 36 years (Bannock et al., *op. cit.*; Thompson et al. 1992. J. Royal Soc. New Zealand 22:123–130).

Determining the maximum life span for wild geckos is difficult. Growth rate data cannot be used to age geckos once they attain maturity, a process which can take up to eight years (Sheehan et al. 2004. New Zealand J. Zool. 31:109). Longevity estimation therefore requires that identifiably marked individuals be recaptured over long time intervals. Because mark-recapture studies are not usually conducted over decades, return visits to sites where geckos were marked in previous studies provide the only alternative means of extending longevity records. We report here on a visit to one such site and the resulting recapture of five *H. maculatus* of extreme age.

The 3.7-ha Motunau Island in North Canterbury (43°03'S, 173°04'E) supports large populations of seabirds and lizards—the nocturnal gecko *H. maculatus* and the diurnal skinks *Oligosoma lineoocellatum* and *O. nigriplantare polychroma*. *Hoplodactylus maculatus* comprises a cryptic species complex (Daugherty et al. 1994. New Zealand J. Zool. 21:317–323) and the taxon present on Motunau Island has been given the tag-name *H.* aff. *maculatus* 'Canterbury'; however, we use *H. maculatus* here pending formal description of the species.

During ecological surveys carried out from 1967–1975, TW caught and individually marked 133 *H. maculatus* by toe-clipping. Geckos were captured in 25 pitfall traps spaced 5 m apart in a 20 × 20 m grid. The island was revisited in the summer of 1996–1997 and 16 of the original geckos were recaptured, at which time ten were estimated to be at least 36 years old (Bannock et al., *op. cit.*). In March 2005, ML visited the island and recaptured five geckos (two males, three females) originally marked by TW. When marked in 1967–1975 these geckos had snout-to-vent lengths that ranged from 47–73 mm. All except the largest individual could be assigned their approximate age (± 1 yr) by calibrating their SVL at time of first capture against the predicted SVL/age relationship growth curve generated by Bannock et al. (*op. cit.*). The estimated ages of these five 'old' geckos were 36, 36+, 37, 38, and a remarkable 42 years old! Interestingly, none of these geckos was recaptured by Bannock et al. (*op. cit.*). To our knowledge, our observation represents a new global record for longevity in a free-living gecko population. In addition, these geckos were still living within < 20 m of where they were marked more than 30 years earlier, thus implying significant site fidelity.

Our research adds to other observations on longevity and site

fidelity in New Zealand geckos. Such studies are not possible without a permanent marking system (e.g., toe clipping, PIT tagging) and long-term study involving different researchers (Hare and Cree 2005. New Zealand J. Ecol. 29:137–142). Despite the extreme longevity of New Zealand geckos, more than 80% are considered threatened or have a 'Data deficient' ranking due to a scarcity of records (36/43 or 83% of species; Hitchmough and Bull [compilers], in press.Threatened Species Occasional Publication, Department of Conservation, Wellington, New Zealand). The vulnerability of New Zealand geckos to introduced predators and habitat loss, coupled with their low annual reproductive output (≤ 2 offspring/female/yr; Cree, *op. cit.*) limit their ability to persist in human-altered landscapes, and highlight the pressing need for on-going and effective conservation management.

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KENTROPYX STRIATA (Striped Kentropyx). **JUVENILE PREDATION**. *Kentropyx striata* is a common lizard in northern Brazil (Ávila-Pires 1995. Lizards of Brazilian Amazonian (Reptilia: Squamata). Zoologische Verhandelinger 299:1–706). Few predators of *K. striata* have been identified (Ávila-Pires, *op. cit.*). Here I describe an observation of Great Kiskadee (*Pitangus sulphuratus*) predation on a juvenile *K. striata* from northern Brazil. At 1150 h on 25 September 2001, I observed a juvenile (ca. 10 cm SVL) *K. striata* running in the backyard of a house in the village of Alter do Chão near the Tapajós River, Santarém, Pará State (2°30'S, 54°57'W, datum: WGS 84; elevation 50 m). Patches of savannah within Amazon forest vegetation characterized this region. A *P. sulphuratus* made an initial unsuccessful attempt to catch the lizard as it ran; it escaped into a pile of bricks. However, the bird caught the lizard on a second pass after pausing on a branch near the lizard's refuge for ca. 30 sec. After the capture, the *P. sulphuratus* carried the *K. striata* to a nearby tree and beat the lizard's head several times on the branch. Using its beak, the bird grabbed the lizard by the head and swallowed it head first. The entire predation episode took 3 minutes.

This observation reveals that small lizards can be vulnerable to smaller predatory birds, like this tyrannid flycatcher. *Pitangus sulphuratus*, a species broadly distributed in Brazil (Sick 1997. Ornitologia Brasileira, Nova Fronteira, Rio de Janeiro, Brazil. 912 pp.), can prey on a variety of animals, such as bats, fish, arthropods, amphibians, and reptiles (Sick, *op cit.*; Argel-de-Oliveira et al. 1998. Rev. Brasil. Zool. 15:1103–1109). This note represents the first record of *P. sulphuratus* predation on juvenile *K. striata*.

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LEIOCEPHALUS CARINATUS ARMOURI (Northern Curlytail Lizard). **PREDATION.** *Leiocephalus carinatus armouri* is a well-established exotic species in Florida (Meshaka et al. 2004. The exotic amphibians and reptiles of Florida, Krieger Publishing Company, Malabar, Florida. 155 pp.; Meshaka et al., *in press*, Southeastern Nat. 4); however, few vertebrate predators of this species have been documented within its introduced range (e.g., Smith and Engeman 2003. Herpetol. Rev. 34:245–246; Smith and Engeman 2004a. Herpetol. Rev. 35:169–170; Smith and Engeman 2004b. Florida Field Nat. 32:107–113). To date, only one avian predator of *L. c. armouri*, the Little Blue Heron (*Egretta caerulea*), has been recorded in Florida (Smith and Engeman 2004a, *op. cit.*). Here, we augment the sparse information on avian predators of *L. c. armouri* in Florida with the observation of the probable predation of a juvenile *L. c. armouri* by a Northern Mockingbird (*Mimus polyglottos*).

At 1040 h on 30 April 2005, a clear sunny day (air temperature ca. 25°C), HTS observed an adult Northern Mockingbird perched atop fence-line shrubbery with a small lizard in its bill at the Woolbright Road colony site of *L. c. armouri* located in Boynton Beach (see Smith and Engeman 2003, 2004b, *op. cit.* for site descriptions). Closer examination revealed it to be a juvenile *L. c. armouri* (SVL ca. 5 cm). The lizard, being held sideways by its neck, was completely limp (including tail and limbs), and seemed dead. The lizard remained limp during the 20–30 sec observation period, after which the mockingbird flew out of view with its prey over an adjacent building rooftop. The pliant appearance of the *L. c. armouri* suggested to us that it was taken recently rather than scavenged.

Mockingbirds are generalist omnivores and have been reported to prey on *Anolis* lizards (Derrickson and Breitwisch 1992. *In* Poole et al. [eds.], The Birds of North America, Species Account No. 7, Northern Mockingbird, American Ornithologists' Union, Washington, D.C. and the Academy of Natural Sciences, Philadelphia, Pennsylvania. 26 pp.), and a Rough Earth Snake (*Virginia striatula*) (Sorrell 2004. Herpetol. Rev. 35:75–76).

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MICROLOPHUS ATACAMENSIS (Atacama Desert Runner). **PREDATION**. Interspecific predation, like that between lizards and snakes in the Chilean Atacama desert (Labra and Niemeyer 2004. Ethology 110:649–662), is well documented in reptiles (e.g., Jackson et al. 2004. Zoology 107:191–200). *Microlophus atacamensis*, a lizard endemic to the coastal zones of northern Chile (Donoso-Barros 1966. Reptiles de Chile. Ediciones de la

Universidad de Chile, Santiago, Chile. 458 pp.), feeds on marine (crustaceans and green algae) and terrestrial (isopods, coleopterans, dipterans) prey (Ortiz 1980. Actas I Reunión Iberoamericana Zool. Vert., La Rábida, pp. 355–377). No studies have reported predation on *M. atacamensis,* implying that this species is a top predator (Fariña et al. 2003. Ecol. Appl. 13:1533–1552). Nonetheless, here we describe predation on *M. atacamensis* by *Philodryas chamissonis* (Long-tailed Snake, Chilean Green Racer), a diurnal hunter whose diet consists of anurans, passeriform birds, rodents, lagomorphs, and in particular, lizards of the genus *Liolaemus* (Greene and Jaksic 1992. Rev. Chil. Hist. Nat. 65:485–493).

During diurnal sampling for *M. atacamensis* at 1530 h on 10 July 2005, we encountered a male *Philodryas chamissonis* (667 mm SVL, 105.6 g, 12.8 mm head width) feeding on an adult male *M. atacamensis* (93.5 mm SVL, 89.5 g, 22.7 mm head width). The observation was made in a coastal zone at Arrayán, La Serena, Coquimbo's Province, Chile (29°41'S, 71°19'W, datum: WGS84; elev. 8 m). The habitat corresponds to an arid Mediterranean biome with thorny shrubs (di Castri 1968. *In* Delamare and Rapoport [eds.], Biologie de l'Amérique Austral, pp.7–52. Edition du Centre National de la Recherche Scientifique, Paris), including *Nolana lycioides* (Nolanaceae) and *Heliotropium stenophyllum* (Boraginaceae) as dominant species. When first encountered, the lizard was being ingested by the head, with its hind limbs and tail still exposed. Upon capturing the snake, the lizard was released.

This is the first record of predation on *M. atacamensis* and indicates that this species might not always be a top predator in the trophic web of the northern Chilean coast. Additional observations of this interaction will be required to understand its frequency and relevance to *M. atacamensis* population dynamics.

The snake (SSUC 7233) and lizard (SSUC 7234) were deposited in the collection Prof. Patricio Sánchez Reyes, Pontificia Universidad Católica de Chile. We thank María Victoria Reyna for field assistance and Fondecyt 1040783 for financial support to JMF.

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NOROPS HUMILIS (Ground Anole). **KLEPTOPARASITISM.** Kleptoparasitism, a behavior in which a resource (frequently prey) is stolen from a potential competitor, has been repeatedly documented in birds, fish, mammals, and varied invertebrates, but to my knowledge, only two reports exist of kleptoparasitism among non-avian reptiles (Cooper and Perez-Mellado 2003. Amphibia-Reptilia 24:219–224; Whiting and Greef 1997. Copeia 1997:811–818). Here I augment the sparse data on kleptoparasitism in non-avian reptiles with two observations involving a common leaf-litter anole, *Norops humilis*, in northeastern Costa Rica.

Observations were made at the La Selva Biological Station (10°25'N, 84°00'W, datum WGS84; elev. ~40 m). This site is a 1600-ha primary evergreen wet forest reserve dominated by lowland closed canopy forest with relatively limited seasonality in precipitation (Sanford et al. 1994. *In* McDade et al. [eds.], La Selva: Ecology and Natural History of a Neotropical Rain Forest, pp. 18–33. University of Chicago Press, Chicago. 486 pp.). At ca. 1130 h on 18 July 2003, I observed an adult *Norops humilis* (~ 35 mm SVL) in leaf litter along a trail in primary forest. An unidentified ant (~ 10 mm long) was walking across the leaf litter carrying a lycosid spider (~10 mm SVL). The spider was immobile, presumably having been incapacitated by the ant. The lizard approached the ant and snatched the spider from the ant's grasp and retreated a short distance (~ 20 cm) where it consumed the spider. The ant made no attempt to reclaim its lost prey.

At 0857 h on 17 July 2005, I observed another adult *Norops humilis* (~30 mm SVL) in leaf litter along a trail in secondary forest. An unidentified myrmicine ant (~10 mm long) was walking slowly through leaf litter carrying a small bee (~10 mm long). The lizard approached the ant and snapped at the bee, seized it from the ant, and retreated ca. 20 cm to consume the bee, disregarding the ant. Again, the ant made no attempt to reclaim its prey.

My casual observations suggest that kleptoparasitism may be frequent in *N. humilis*. It was impossible to determine whether or not these lizards actually recognized the presence of the ants, so it is unclear whether this is a unique foraging strategy opportunistically employed by the lizards or if the lizards are simply responding to the behavioral stimuli for prey capture (movement of a small spider or bee across the leaf litter) regardless of the presence of the ants. To my knowledge, this is the first report of any reptile stealing prey from another species; these observations also suggest that opportunities may exist to investigate interspecific interference competition between markedly different organisms.

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PAROEDURA STUMPFFI (Madagascar Ground Gecko). **PREDATION.** *Zonosaurus madagascariensis* is widely distributed in Madagascar (Raselimanana 2003. *In* Goodman and Benstead [eds.], The Natural History of Madagascar, pp. 978–983. Univ. of Chicago Press, Chicago, Illinois). It occurs in dense primary forests on the east coast as well as deforested and cultivated areas on the west coast (Raxworthy 1988. Biol. Conserv. 43:181–211; Glaw and Vences 1997. A Field Guide to the Amphibians and Reptiles of Madagascar. 2nd edition. M. Vences & F. Glaw Verlags GbR, Köln. 480 pp.; Raselimanana, *op. cit.*). All species of *Zonosaurus* are diurnal and forage generally on the ground, although some climb trees (Raselimanana, *op. cit.*; Glaw and Vences, *op. cit.*). Their diet includes mostly insects and fruits (Raselimanana, *op. cit.*). Some *Zonosaurus* are reported to consume small vertebrates (Raselimanana, *op. cit.*), but the genus *Pareodura* has not been reported as prey. Hence, I add to what little is known about the feeding habits of *Zonosaurus* in nature with an observation of predation on *P. stumpffi* by *Z. madagascariensis*.

This observation was made during a field trip to Madagascar in September 2004 on Nosy Komba, a small (2200 ha) island off the northwest coast (48°19'–48°21'S, 13°26'–13°28'E; Andreone et al.

2003. J. Nat. Hist. 37:2119–2149). I became aware of the animals because something was moving rapidly and rustling in the litter near a small limestone formation. A subadult (ca. 10 cm SVL) *Z. madagascariensis* was hunting a small (ca. 4 cm SVL) gecko. The gecko displayed the conspicuous coloration of juvenile *Paroedura stumpffi*: several white cross bands on a dark dorsal ground color. After a few seconds of pursuit, the gecko threw off its tail, but the *Zonosaurus* caught it just behind his head. The *Zonosaurus* slipped between pieces of limestone, where it presumably swallowed the gecko. After several minutes, the *Zonosaurus* emerged again and grabbed the tail of the gecko, which was still moving, and ate it.

In contrast to other Malagasy geckos, some species of *Paroedura* are exclusively terrestrial (e.g., *Paroedura pictus*), and juveniles of most species differ in coloration from adults (Glaw and Vences, *op. cit.*; Bauer 2003. *In* Goodman and Benstead [eds.], The Natural History of Madagascar, pp. 973–977. Univ. Chicago Press, Chicago, Illinois). As *Paroedura stumpffi* frequently utilizes forest-floor habitats on the north and northwest coast of Madagascar, including the nearby island Nosy Be (Andreone et al., *op. cit.*; Glaw and Vences, *op. cit.*; Liebel et al. 2004. Draco 5:28–39) and the Comores (Liebel et al., *op. cit.*), significant opportunity exists for it to serve as prey for the frequently terrestrial foraging *Z. madagascariensis*. This represents the first report of *Pareodura* predation by *Zonosaurus*.

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PHELSUMA MADAGASCARIENSIS GRANDIS (Madagascar Giant Day Gecko). **NECTARIVORY; POTENTIAL POLLINATION**. Some palms (Arecales: Arecaceae) are mainly insect-pollinated (though some may be wind-pollinated), and both pollen and nectar are rewards to their pollinators (Henderson 1986. Bot. Rev. 52:221–259). Day geckos (*Phelsuma* spp.) are reported to be important pollinators by providing plant outcrossings in their native range (Nyhagen et al. 2001. J. Trop. Ecol. 17:755–761) and in their introduced range on Hawaii (Calviño-Cancela 2005. Herpetol. Rev. 36:182–183). Herein, we report nectar consumption and the potential for pollination of non-native coconut palms (*Cocos nucifera*) by non-native *Phelsuma madagascariensis grandis* in the lower Florida Keys.

Phelsuma m. grandis is native to northern Madagascar (Henkel and Schmidt 2000. Amphibians and Reptiles of Madagascar and the Mascarene, Seychelles, and the Comoro Islands. Krieger Publishing Company, Malabar, Florida, 319 pp.) and has been introduced onto five islands in the Florida Keys (Krysko et al. 2003. Florida Sci. 66:222–225; Krysko and Sheehy 2005. Carib. J. Sci. 41:169–172). On 6 July 2003 at 1000 h, we observed an adult (ca. 190 mm total length [TL]) *P. m. grandis* that had climbed onto the flowering spikes of a *Cocos nucifera* on Little Torch Key (24°40.39'N, 81°23.262'W, datum: WGS84; elev. < 1 m). This gecko licked the nectar from male flowers for about 20 min before climbing to a more secluded position on the tree. At 0900 h on 9 July 2003, we observed 3 adults (ca. 200–250 mm TL) of both genders exhibiting this same foraging behavior for ca. 30 min on another *C. nucifera*. These geckos were also observed snapping at hymenopterans as the insects approached flowers. At 0910 h that same day, we observed a neonate (ca. 70 mm TL) *P. m. grandis* licking nectar from male flowers on a nearby *C. nucifera*. This small gecko allowed us to approach it within ca. 25 cm for photography. Since these observations were made, we have noted this foraging behavior on at least 5 occasions suggesting that the behavior is not a rare phenomenon.

Cocos nucifera is normally allogamous, but autogamy may occur (Patel 1938. The Coconut. Government Press, Madras, India; Ohler [ed.] 1999. Modern Coconut Management, Palm Cultivation and Products. Available online: http://ecoport.org/ep?SearchType=earticleView&earticleId=127&page=-2; Meléndez-Ramírez et al. 2004. Agric. For. Entomol. 6:155–163). Climbing on flowers and drinking nectar followed by contact of both stamens and stigmas in the same palm could result in autogamy. If geckos were to simply climb onto a nearby palm, outcrossings might occur as they do in other areas *Phelsuma m. grandis* occurs.

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PHYLLODACTYLUS VENTRALIS (Venezuelan Leaf-toed Gecko). **ECOLOGY; PREDATION.** *Phyllodactylus ventralis* is the only member of its genus in northeastern Colombia and the northern Venezuelan mainland, where it inhabits mostly dry thorn forests and savannahs (Dixon and Huey 1970. Contr. Sci. Los Angeles Co. Mus. Nat. Hist. 192:1–78; Rivas and Barrio-Amorós 2005. Herpetol. Rev. 36: 205–209). Although this is the most common of the three *Phyllodactylus* species in Venezuela, almost nothing is known of its natural history. Ruthven (1922. Misc. Pub. Mus. Zool. Univ. Michigan 8:5–69) and Mechler (1968. Rev. Suisse Zool. 75:305–371) provided a few ecological data on Colombian populations, but the only data for Venezuelan populations are the brief comments in Roze (1964. Mem. Soc. Cienc. Nat. La Salle 69:209–241). Hence, here we report on *P. ventralis* retreat sites from the arid region of north-central Venezuela, on the species that share these microhabitats, and on a snake predator.

Our observations took place at a campground on Camatagua Reservoir in the northern part of the State of Aragua, Venezuela (09°49'3.36"N, 66°46'41.28"W, datum: WGS84; elev. 230 m) between 0900 and 1730 h on 16 May 2001, a hot (> 30°C), dry day with a constant slight breeze. Local vegetation consists of dry thorn scrub. The few buildings in the campground consisted of open picnic shelters with wooden roofs. Numerous corrugated metal panels, other trash, and rocks were on the ground beneath the shelters. Four *P. ventralis* were found under rocks, both those shaded by the shelters and those exposed to direct sunlight. Another 3 *P. ventralis* were observed beneath metal panels and other trash. The

wooden roofs and columns of the shelters offered many crevices and potential retreat sites; despite careful inspection, we found no geckos there. All *P. ventralis* were found under terrestrial cover on the ground during the day. Overturned rocks revealed up to three individuals sharing the same retreat site. Under one of these, two adults and a juvenile were found, showing no obvious signs of intraspecific antagonistic behavior. We also found scorpions (*Rhopaulurus laticauda*) sheltering under rocks with many of the geckos; a mouse (probably *Mus musculus*) was found under each of two metal panels with *P. ventralis*. The harsh, arid climate at Camatagua may induce nocturnal animals to share terrestrial retreat sites.

Analysis of the stomach contents of a specimen of the colubrid snake *Leptodeira annulata ashmeadii* deposited in the herpetological collection of the Museo de Historia Natural La Salle, Caracas (MHNLS), revealed a *P. ventralis*. The snake (MHNLS 9818), a juvenile (295 mm SVL), was collected at the Urbanizacion El Tejar, Puerto Piritu, in the northern portion of the State of Anzoategui. Despite its small size, the snake had an adult female *P. ventralis* (73 mm SVL) with a recently broken tail in its gut. Judging from its position in the snake, the lizard was eaten head-first. Duellman (1958. Bull. Amer. Mus. Nat. Hist. 114:1–152) reported mostly frogs and toads from the stomachs *L. annulata*, but he also found one *Gonatodes vittatus*, a smaller diurnal species. Lack of experience often exhibited by young snakes may explain the presence of such a large prey item in this juvenile *L. annulata*. To our knowledge, this is the first record of predation on *P. ventralis* and the second on lizards by the snake *L. annulata*. We thank Aaron Bauer (Villanova University) for his valuable comments and corrections to a preliminary version of this note.

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SCELOPORUS COUCHI (Couch's Spiny Lizard). **SAUROPHAGY**. *Sceloporus couchi*, one of the least known phrynosomatid lizards in México, is restricted to the central-western portion of the state of Nuevo León, and the central eastern portion of the state of Coahuila (Köhler and Heimes 2002. Stachelleguane, Herpeton, Offenbach, Bundesrepublik Deutschland. 174 pp.; Smith 1939. Zool. Ser. Field Mus. Nat.Hist. 26:1–397). Here, we provide a record of saurophagy for *S. couchi* from Nuevo León, México.

At 1030 h on 28 May 2005, while conducting a vertebrate inventory in the municipalities of Dr. Gonzalez, Higueras, and Cerralvo, in the Sierra Picachos (25°58'08"N, 99°53'32"W, datum: NAD27; elev. 794 m), we collected an active adult (58.8 mm SVL, 94.0 mm tail, 5 g) male *S. couchi* male (air temperature 27°C) in a small canyon named Potrero Grande. It was found in an open dry river channel with walls of conglomerate; *Cordia boisieri*, *Pithecellobium pallens*, *Hellieta parvifolia*, *Prosopis glandulosa*, and *Aloysia macrostachya* dominated the vegetation along the channel. When first observed, the lizard was eating a neonate *S. poinsetti poinsetti* (29.8 mm SVL, 1.2 mm tail) with a broken tail. Other sympatric phynosomatid lizards observed in the area included *S. grammicus disparilis and S. parvus parvus*. This is the first observation of saurophagy in *S. couchi*.

The lizard (UANL 6772) was deposited in the herpetological collection of Universidad Autonoma de Nuevo Leon, Facultad de Ciencias Biologicas.

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SCELOPORUS CYANOGENYS (Blue Spiny Lizard). **PREDATION.** The few studies on the biology of *Sceloporus cyanogenys* address reproduction (Kennedy 1960. Southwest. Nat. 5:44–45), general behavior (Greenberg 1977. J. Herpetol. 11:177–195), taxonomy and distribution (Wiens and Reeder 1997. Herpetol. Monogr. 11:1–101), and mite infestation (García-de la Peña et al. 2005. Bull. Chicago Herp. Soc. 40:52–53). Here we add an observation of predation on this lizard.

During a visit to Parque Ecológico Chipinque (municipios of Monterrey and San Pedro Garza Garcia, Nuevo León, México), in an area known as El Estacionamiento (25°37'11.747"N, 100°21'35.171"W, datum: NAD27; elev. 1091 m) on 16 June 2004, we found a small female (311 mm total length, 7.1 g) Southwestern Rat Snake (*Pantherophis emoryi*) that had ingested two-thirds of a 58 mm SVL (4.7 g) female *Sceloporus cyanogenys*. The snake was found DOR, presumably killed by a vehicle before it could swallow the entire lizard. This demonstrates snake vulnerability during ingestion on roadways near human development, and adds *P. emoryi* to the *S. cyanogenys* predator set.

Both reptiles were photographed and deposited (UANL 6349ab) in the herpetological collection of Universidad Autonoma de Nuevo León, Facultad de Ciencias Biologicas.

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SCELOPORUS VIRGATUS (Striped Plateau Lizard). **CLUTCH SIZE**. Mean clutch size in *Sceloporus virgatus* from the Chiricahua Mountains of southeastern Arizona ranges from 7.6 to 10.15 (Abell 1999: J. Herpetol. 33:173–180; Smith et al. 1995. Herpetologica 51:342–349; Vinegar 1975. Ecology 56:172–182). However, virtually nothing is known of clutch size in this species outside of the Chiricahua Mountains.

As part of a study on the herpetofauna of Chihuahua and Sonora (Lemos-Espinal et al. 2004: Introducción a los Anfibios y Reptiles del Estado de Chihuahua, CONABIO. 128 pp.), we collected

specimens of *S. virgatus* from Puerto de San Luis, Sierra San Luis, Sonora, México (31°19'12.0"N, 108°45'42.0"W, datum: WGS84; elev. 1417 m). One of these individuals was a gravid female (53 mm SVL) with 4 shelled eggs. The observed clutch size of 4 is less than the 6.77 predicted for a similar-sized female from the Chiricahua Mountains using the regression of clutch size on SVL in Smith et al. (*op. cit.*). This difference, although based on one clutch, implies that significant interpopulation variation in clutch size may exist in *S. virgatus*.

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SERPENTES

AGKISTRODON PISCIVORUS LEUCOSTOMA (Western Cottonmouth). **DIET**. Cottonmouths are opportunistic predators and scavengers that consume a variety of vertebrate prey (Gloyd and Conant 1990. Snakes of the *Agkistrodon* Complex: A Monographic Review. SSAR, Oxford, Ohio. 614 pp, and references therein). Watersnakes (*Nerodia* spp.) are considered a common component of the cottonmouth diet, but few studies have reported which species of *Nerodia* are consumed (Burkett 1966. Univ. Kansas Publ. Mus. Nat. Hist. 17:435–491; Gloyd and Conant, *op. cit.*). Here, we report *Agkistrodon piscivorus leucostoma* attempting to prey upon *Nerodia erythrogaster flavigaster*.

At ca. 1430 h on 3 August 2005 we encountered an adult *A. p. leucostoma* in a dry creek bed (Goose Prairie Creek) in the Caddo Lake National Wildlife Refuge (CLNWR), Harrison County, Texas, USA. Directly adjacent to the cottonmouth was a dead adult male *N. e. flavigaster* (576 mm SVL, 765 cm TL; 139 g). We observed two puncture wounds surrounded by a moist sheen on the dorsum of the *N. e. flavigaster*, ca. 300 mm posterior of the rostrum. *Agkistrodon piscivorus* are known to eject venom from the fangs when releasing prey following envenomation (Kardong 1975. J. Herpetol. 9:169–175) and we speculate that the moist sheen around the bite mark on the watersnake was fresh cottonmouth venom. Shortly following our arrival, the *A. p. leucostoma* crawled out of the creek bed and into adjacent bottomland hardwood forest. We collected the *N. e. flavigaster* for further examination, and it was later deposited in the Campbell Museum, Clemson University, Clemson, South Carolina (CUSC 2291).

Although *A. piscivorus* are known to feed on carrion, including dead watersnakes (Berna and Gibbons 1991. Herpetol. Rev. 22:130–131; Hamel 1996. Herpetol. Rev. 27:143), our observations suggest envenomation of a live watersnake with the intent of consumption. The cottonmouth might have envenomated and held the watersnake at the location at which we encountered the two snakes, or it may have envenomated it elsewhere and trailed it to this location (Kardong 1982. Copeia 1982:337–343; Chiszar et al. 1986. J. Herpetol. 20:269–272). To our knowledge, this is the first account of *Agkistrodon piscivorus leucostoma* envenomating *Nerodia erythrogaster flavigaster*. Although Collins and Carpenter (1970. Proc. Oklahoma Acad. Sci. 49:15–18) reported finding two "yellow-bellied water snakes" in the stomach of a Western Cottonmouth, the scientific name they provided (*Natrix erythrogaster transversa*) and the location from which the cottonmouth was collected suggest these snakes were most likely Blotched Watersnakes (*N. e. transversa*) rather than Yellow-bellied Watersnakes (*N. e. flavigaster*).

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ALSOPHIS PORTORICENSIS ANEGADAE (NCN). **AQUATIC ACTIVITY**. West Indian racers in the genus *Alsophis* are generally characterized as diurnal, primarily terrestrial, actively foraging snakes. Many of the islands on which they live do not have permanent bodies of fresh water and few references address aquatic activity.

In the course of a multi-year study of population structure of *A. portoricensis anegadae* on Guana Island (British Virgin Islands), we recorded four instances of aquatic activity. In October 2003, an adult snake escaped capture by entering and swimming across an intermittent pool of water several meters wide and about 20 cm deep. Three additional observations were made during an unusually pluvial year (2005). On 6 October, an individual (579 mm SVL) attempted to escape capture by diving into a temporary pool near the base of Quail Dove Ghut. Once submerged, it remained motionless with its anterior body adpressed against accumulated debris about 30 cm deep until disturbed by the collector. On 8 October, a female (653 mm SVL) was found near North Beach swimming in a large pool covering a flooded dirt track and adjacent forest. On 9 October, another female (570 mm SVL) was found in the southeastern lowlands resting at the edge of a large puddle with over half of its body in the water, suggesting that it had just crossed the water. Members of the staff residing on the island also reported sporadic observations of snakes swimming in the sea (T. Peliwan, pers. comm.). All but one sighting occurred in shallow water within 20 m of shore, but one snake was reportedly seen swimming toward a nearby island.

We have found no previous records of aquatic behavior in this species, but some exist for congeners (Schwartz and Henderson. 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History. Univ. Florida Press, Gainesville. xvi + 720 pp.). Although anecdotal, our observations suggest that *A. p. anegadae* is at least opportunistically aquatic, presumably in

much the same fashion as it is facultatively arboreal. Moreover, ocean swimming might explain how some snakes disperse from one Caribbean island to another.

We thank Henry and Gloria Jarecki and the Falconwood Foundation for the opportunity to conduct research on Guana Island.

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FIG. 1. Juvenile *Bothrops jararaca* capturing a *Hypsiboas bischoffi*.

BOTHROPS JARARACA (Jararaca). **PREY**. *Bothrops jararaca* is a terrestrial, slender, and medium-sized viperid snake widespread in southeastern Brazil (Campbell and Lamar 2004. The Venomous Reptiles of the Western Hemisphere. Cornell University Press, Ithaca, New York. 870 pp.). This species preys mainly on small vertebrates and exhibits an ontogenetic shift in diet: juveniles feed mostly on frogs, commonly attracted by caudal luring, whereas rodents are the main food of adults (Sazima 1992. *In* Campbell and Brodie Jr. [eds.], Biology of the Pitvipers, pp. 199–216. Selva, Tyler, Texas; Martins et al. 2002. *In* Schuett et al. [eds.], Biology of the Vipers, pp. 1–22. Eagle Mountain Publishing, Utah).

Here we present data about previously undocumented prey taxa and habitat use of juvenile *B. jararaca* from Parque Estadual Carlos Botelho, municipalities of Sete Barras and São Miguel Arcanjo, State of São Paulo, southeastern Brazil, in an area of Tropical Atlantic Rain Forest.

On 11 December 1999 (2200 h; 20°C), we observed a juvenile *B. jararaca* (ca. 420 mm SVL) preying on a tree frog, *Hypsiboas bischoffi* (ca. 50 mm SVL) at the edge of a permanent pond. The snake was coiled in the leaf litter, immobile, in ambush posture. Caudal luring was not observed. As the frog jumped toward the snake, the snake struck quickly, seizing the frog until all movements ceased (Fig. 1). The snake then released the frog, inspected it, and began ingestion headfirst. The predation sequence lasted ca. 110 sec. After ingestion, the snake returned to its original position.

On 9 February 2002 (0005 h; 22°C) we encountered another juvenile *B. jararaca* (270 mm SVL) coiled in a tree branch at a height of ca. 50 cm. The snake was apparently inactive. Following manipulation, the snake regurgitated a leptodactylid frog, *Eleutherodactylus binotatus*, with its anterior region partially digested.

Between 2000 and 2002 we observed 10 active juvenile *B. jararaca* in the study area: one were found during the day, two in the evening, and seven at night. Three were observed in leaf litter; seven were encountered in vegetation 30–200 cm above ground (mean = 123.6 cm, SD = 62.7 cm). Our data differ from those reported by Hartmann et al. (2003. Phyllomedusa 2:35–41) in which most juvenile *B. jararaca* observed along streams in one Atlantic Forest area were found active during the day, foraging on diurnal frogs at ground level. Taken together, these observations suggest that juvenile *B. jararaca* are most active at the same time of locally abundant prey.

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CORALLUS ANNULATUS (Annulated Boa). **OVOPHAGY.** *Corallus annulatus* is a boid whose ecology and behavior are poorly known. Its distributional range extends from Guatemala south to Colombia (Henderson et al. 2001. Stud. Neotrop. Fauna Environ. 36:39–47). In Costa Rica, this primarily arboreal species inhabits the Caribbean versant at elevations up to 650 m, where it generally occupies the upper parts of trees; it has been found at heights from a few meters up to 40 m (Solórzano 2004. Serpientes de Costa Rica/Snakes of Costa Rica. INBio, Santo Domingo de Heredia, Costa Rica. 792 pp.).

Three adult *Corallus annulatus* (1 male, ca. 1 m TL; 2 females, each ca. 1.5 m TL) collected at Guayacán de Siquierres, Limón Province, Costa Rica, were held in captivity at Parque Reptilandia (SW San José Province) for over one year. On 1 November, the male was introduced into the females' enclosure. Within two days the male copulated with both females, and sexual activity continued until 13 November.

On 19 July, prior to 0600 h, the first female gave birth to nine offspring and passed at least five undeveloped ova (= slugs). When the female was first observed, she was eating one of the slugs and apparently had ingested at least two others (Fig. 1). On 4 August,

FIG. 1. A female *Corallus annulatus* eating an undeveloped ovum after parturition.

from late morning to early afternoon, the second female gave birth to 12 offspring. This female also was observed to eat the undeveloped ova.

Captive observations on the post-parturient behavior of certain species of New World boids suggest protective advantages to adults and young after parturition. Females of *Corallus hortulanus*, *Epicrates maurus*, *E. fordii*, *E. s. striatus*, *E. s. strigilatus*, and *Eunectes murinus* have been reported to eat freshly passed undeveloped ova and/or living or dead young (Neill and Allen 1962. Quart. J. Florida Acad. Sci. 25:73–75; Hanlon 1964. Herpetologica 20:143–144; Boos 1976. AAZPA Newsletter 17[9]:13; Huff 1980. *In* J. B. Murphy and J. T. Collins [eds.], Reproductive Biology and Diseases of Captive Reptiles, pp. 125–134. SSAR Contrib. Herpetol. 1; Townson 1978. Brit. Herpetol. Soc. Newsl. 18:11–14; Groves 1980. Brit. J. Herpetol. 6:89–91; Miller 1983. Herpetol. Rev. 14:46–47). Neill and Allen (*op. cit.*) suggested that females might obtain physiologically and metabolically useful substances by ingesting their own birth debris. Groves (*op. cit.*) felt that this behavior might be influenced by captivity, and further suggested that living young are eaten because of poor development or a weakened condition and thus would not have survived. Further, Groves (*op. cit.*) proposed that because this behavior was reported only in species that produce their young in aquatic or terrestrial situations, where chances of predation are high, that it might relate to the protection of young and adults from potential predators by eliminating odors associated with the birth debris. Although Miller (*op. cit.*) reported a captive observation of ovophagy in the arboreal *Corallus hortulanus*, it is unknown whether in nature *C. hortulanus* gives birth to young in terrestrial or arboreal situations.

In view of the observations presented here and those in the literature, it appears that ovophagy is not uncommon in certain boids in captive situations. Because of the debilitated state of female boids after a lengthy gestation and parturition, we concur with Neil and Allen (*op. cit.*) that female snakes might obtain physiologically and metabolically useful substances by ingesting their birth debris. It remains unknown, however, whether in nature arboreal boids like *Corallus annulatus* and *C. hortulanus* give birth in arboreal or terrestrial situations, and thus the suggestions of Groves (*op. cit.*) remain inconclusive.

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CORALLUS HORTULANUS (Amazon Treeboa). **DIET**. *Corallus hortulanus* is an arboreal, nocturnal, forest and forest-edged boid widely distributed in the Guianas and in the Amazon Basin (southern Colombia, southern Venezuela, Ecuador, Peru, Bolivia and Brazil) (Henderson 2002. Neotropical Treeboas: Natural History of the *Corallus hortulanus* Complex, Krieger Publ., Malabar, Florida. 197 pp.). Henderson (*loc. cit.*) summarized the feeding habits of *C. hortulanus* by indicating that the species is euryphagic, feeding on frogs, lizards, birds, bats, rodents and other small mammals.

In early October 2004, a large adult female *Corallus hortulanus* (150.7 cm total length) was killed by itinerant miners living at Menzie's Landing in Kaieteur National Park (05°10'23"N; 59°28'52"W), Guyana, preserved in formalin and donated to us. The snake was found in primary forest, in a tree along the Potaro River and had a remarkable swelling in its abdomen, which proved to be a just-fledged -Paradise Jacamar (*Galbula dea*, Galbulidae). The bird, swallowed headfirst, was partly digested but was still identifiable.

The Paradise Jacamar is a bird known to perch on low to high outer branches of forest-edge trees along water courses (de Schauensee and Phelps 1978. A Guide to the Birds of Venezuela, Princeton University Press, New Jersey. 424 pp.). This environmental setting is similar to the habitat of *C. hortulanus* in Kaieteur National Park.

This report is the first record of *C. hortulanus* eating *G. dea* and the first record of *C. hortulanus* feeding on a bird in the family Galbulidae.

In Kaieteur National Park, active *C. hortulanus* were commonly observed at the beginning of the night in trees along streams. In addition to the aforementioned specimen, two other adult specimens were collected as vouchers by us during our inventory of the park's herpetofauna. Both snakes were foraging in trees along streams around 2100 h, at heights of 2–6 m, and both had empty stomachs.

The *C. hortulanus* and the remnants of the *G. dea* are deposited under the same collection number (IRSNB 17049) in the herpetological collections of the Royal Belgian Institute of Natural Sciences, Brussels, Belgium.

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CROTALUS BASILISCUS (Mexican West Coast Rattlesnake). **PREDATION.** Several species of snakes have been documented as predators of adult rattlesnakes (Klauber 1972. Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind, 2 vols. 2nd ed. Univ. of California Press, Berkeley. 1533 pp.), although the extent of this phenomenon remains unknown. Radio-telemetry research suggests that predation of adult rattlesnakes by other snakes is infrequent, however the number of observations has significantly increased over the past decade with the onset of new technology used to study rattlesnakes. Herein we report on the predation of an adult *Crotalus basiliscus* by an adult Indigo Snake (*Drymarchon corais*).

On 15 August 2005, a large adult *Drymarchon corais* was observed resting along the banks of the Rio Cuchujaqui in southern Sonora, Mexico. The snake was ca. 1675 mm SVL, and was in the middle of ecdysis as its eyes were opaque. Upon being captured and photographed, the snake regurgitated the remains of an adult *Crotalus basiliscus* (ca. 1200 mm TL) with an incomplete rattle with 12 segments. To our knowledge, this observation represents the first published snake predator of *C. basiliscus*. Indigo Snakes are common along the rivers and arroyos in southern Sonora and are likely significant predators of snakes in these regions. Greene (1997. Snakes: The Evolution of Mystery in Nature. University of California Press, Berkeley, California. 196 pp.) provides accounts of Indigo Snakes consuming other large snake species, including rattlesnakes. Observations of predation by snakes on adult rattlesnakes remain infrequent, although with new technology and further research into the diets of large snakes, the number of similar observations might increase.

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DRYMOLUBER DICHROUS (NCN). **OPHIOPHAGY.** A female *Thamnodynastes hypoconia* (SVL = 310 mm; TL = 144 mm) was found in stomach contents of a mature male *Drymoluber dichrous* (SVL = 768 mm; TL = 344 mm) collected in Municipality of Ilhéus, Bahia, Brazil (14º49'S; 39º02'W) (Museu Nacional, Rio de Janeiro; MNRJ 2195) on 5 March 1944. The direction of ingestion was anterior–posterior. Borges-Nojosa and Lima (2001. Bol. Mus. Nac. Zool. 468:1–5) noted that anurans (especially from the family Leptodactylidae) and lizards (Gekkonidae and Gymnophthalmidae) comprised the diet of *D. dichrous* examined from an Atlantic Forest population (Ceará, Brazil). Ophiophagy in *D. dichrous* was previously noted only from Amazonian populations (Cunha and Nascimento 1978. Publ. Avul. Mus. Par. Emílio Goeldi 31:1–218; Cunha et al. 1985. Publ. Avul. Mus. Par. Emílio Goeldi 40:10–92; Dixon and Soini 1986. The Reptiles of the Upper Amazon Basin, Iquitos Region, Peru. Milwaukee Publ. Mus., Milwaukee, Wisconsin), in which the colubrid genera *Oxybelis* and *Drymoluber* were reported as prey.

Species identifications were confirmed by Francisco L. Franco and Ronaldo Fernandes.

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LAMPROPELTIS TRIANGULUM ELAPSOIDES (Scarlet Kingsnake). **OPHIOPHAGY**. *Lampropeltis triangulum elapsoides* is known to take a variety of prey items, including snakes: *Carphophis amoenus*, *Opheodrys vernalis*, *Storeria dekayi*, *Tantilla coronata*, *Thamnophis sirtalis*, and *Virginia striatula* (Williams 1988. Systematics and Natural History of the American Milk Snake, *Lampropeltis triangulam*. Milwaukee Public Museum. 176 pp.; Palmer and Braswell 1995. Reptiles of North Carolina. Univ. North Carolina Press. 412 pp.). Here I report a novel prey item for *L. t. elapsoides*.

On 19 March 2005 at 1603 h, I found a female *L. t. elapsoides* (351 mm SVL, 52 mm tail length, 18 g) under the loose bark of a fallen *Pinus palustris* (Longleaf Pine) in Forrest County, Mississippi, USA. Upon measuring the animal it regurgitated two juvenile *Diadophis punctatus* (124 and 142 mm SVL, 29 and 31 mm tail length, 2.0 and 3.0 g, respectively). The *L. t. elapsoides* was given a unique identification mark (Brown and Parker 1976. J. Herpetol. 10:247–249), and both the snake and the prey items were placed under the bark at the point of capture. On 20 March 2005 at 1700 h, I discovered the *L. t. elapsoides* in the exact same location with a slight bolus in its stomach and both *D. punctatus* were missing. Presumably, the snake re-ingested both prey.

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LAMPROPELTIS ZONATA (California Mountain Kingsnake) **PREDATION**. On 26 September 1999, a dead *Lampropeltis getula* (188 g; CUMV catalog number pending) was found on Bear Creek Road ca. 3 km W of Summit Road in the Santa Cruz Mountains (Santa Cruz County, California, USA). In its stomach were the nearly complete remains of an adult *Lampropeltis zonata* (53 g; CUMV catalog number pending). The range of *L. getula* overlaps or lies adjacent to the range of *L. zonata* (Stebbins 1985. Western Field Guide to Reptiles and Amphibians. Houghton Mifflin, Bos-

FIG. 1. Adult *Diadophis punctatus* swallowing a juvenile *Lampropeltis zonata*, Tuolumne Co., California, USA.

ton, Massachusetts), though habitat associations may render these species largely segregated. Both species are known from the general vicinity of this observation (MVZ 32243, 47168, 50770, 209452). Although *L. getula* is larger and known for preying on other snakes, this is the first record of a predator-prey interaction between these species.

On 15 May 2005 at ca. 1330 h, in the Sierra Nevada (Tuolumne County, California, USA) a *Diadophis punctatus* was observed ingesting a juvenile *L. zonata*. When discovered, the *L. zonata* was approximately half consumed, motionless, and flaccid. The *L. zonata* and *D. punctatus* had a combined mass of 21.3 g. The *L. zonata* was similar in size to young of the previous year at this location (mean mass = 6.1 ± 0.7 g, range 4.8–7.2 g, N = 12). Extrapolating from this, we estimate the original mass of the *D. punctatus* at roughly 15 g. *Diadophis punctatus*, especially *D. p. regalis*, are known for preying on other snakes, although there is only a single record of ophiophagy for a Californian *D. punctatus*, involving the consumption of a *Thamnophis hammondii* (Goodman and Tate 1997. Herpetol. Rev. 28:90). Populations of these two species are often both sympatric and syntopic (Stebbins 1985, *op. cit.*; pers. obs.), suggesting a potential for frequent predator-prey interactions.

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LATICAUDA SAINTGIRONSI (New Caledonian Yellow-lipped Sea Krait). **PREDATION.** *Laticauda saintgironsi* is a newly described species of sea krait that is endemic to the New Caledonian region (Heatwole et al. 2005. Herpetol. Monogr. 19:1–136). It occurs in high density in waters surrounding southern New Caledonia and spends much of its time on land, chiefly on small islets (Ineich and Laboute 2002. Sea Snakes of New Caledonia. IRD Éditions, Paris. 302 pp.; Saint Girons 1964. Terre et Vie 1964:185–214). Its confirmed predators in New Caledonia include Ospreys (*Pandion haliaetus*; Leach 1928. Emu 28:20–42) and Reef Herons (*Egretta sacra*; Bauer and DeVaney 1987. Proceedings of the 4th Ordinary General Meeting of the Societas Europaea Herpetologica. Catholic University of Nijmegen, Nijmegen, pp. 43–48) as well as sharks and other large fishes (Saint Girons 1964, *op. cit.*; Rancurel and Intès 1982. Tethys 10:195–199). At 1230 h on 1 July 2004, a ghost crab (*Ocypode* sp., ca. 80 mm carapace width) was observed actively feeding on a dead juvenile *L. saintgironsi* (ca. 650 mm TL) on the northern sandy shore of Moro, a small islet located ca. 2 km off of the west coast of the Isle of Pines, New Caledonia (22°39'06"S, 167°23'37"E). There was a large laceration on the lateral side of the snake's tail and another behind the head, where the crab was feeding. Although it was not possible to determine whether the snake had been killed or merely scavenged by the crab, predation by a portunid crab (Guinea 1986. Aspects of the Biology and Toxicology of the Common Fijian Sea Snake *Laticauda colubrina* (Schneider). Unpubl. Master's thesis, University of the South Pacific, Suva, Fiji. v + 206 pp.) and injuries consistent with crab predation have been observed in *L. colubrina* in Fiji (Pernetta 1977. Can. J. Zool. 55:1612–1619). This new observation adds further support to the interpretation of decapod crustaceans as potentially important predators of marine snakes in general (Voris and Jeffries 1995. J. Trop. Ecol.11:569–576).

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MASTICOPHIS FLAGELLUM (Coachwhip). **OPHIOPHAGY.** *Masticophis flagellum* is known to have a varied diet, which includes a number of snake species (see Beaman and Harris 2002. Herpetol. Rev. 33:214–215), and the western subspecies *M. f. piceus* has even been reported to prey upon a juvenile *Crotalus adamanteus* in captivity (Klauber 1956. Rattlesnakes: their Habits, Life Histories, and Influence on Mankind, 2 vols. Univ. of California Press, 1533 pp.). Herein we report the first instance, to the best of our knowledge, of a *M. flagellum* preying upon a *C. adamanteus* in the field.

On 28 September 2004 at ca. 1600 h, a large *M. flagellum* (ca. 180 cm total length) was observed ingesting a small *C. adamanteus* (ca. 80 cm total length) in an open grassland habitat on the Camp

Shelby Training Site, Perry County, Mississippi, USA. When first discovered, the rattlesnake was already one-third ingested, and after 10 minutes, it was half ingested. At this point an attempt was made to capture the *M. flagellum*; however, it quickly moved into a Gopher Tortoise (*Gopherus polyphemus*) burrow. For that reason, measurements and sexes of both snakes were not recorded. The entire time the incident was observed the tail of the prey snake was rattling. While traveling to the burrow, the *M. flagellum* had its head elevated with the rattlesnake hanging out of its mouth.

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MASTICOPHIS LATERALIS EURYXANTHUS (Alameda Whipsnake). **HABITAT.** *Masticophis lateralis euryxanthus* have been reported to be associated with a narrowly defined set of habitat characteristics; specifically chaparral and scrub plant communities on northeast, east, southeast, south, and southwest facing slopes (Swaim 1994. Unpubl. Masters Thesis, California State University, Hayward, CA. 140 pp.; United States Fish and Wildlife Service [USFWS] 1997. Federal Register 62:64306–64320; USFWS 2002. Draft recovery plan for chaparral and scrub community species east of the San Francisco Bay, California, Portland, Oregon 306 pp.). However, the USFWS reported that the habitat description for this subspecies "may have been biased" by focused trapping efforts (USFWS 2000. Federal Register 65:58933–58962). Swaim and McGinnis (1992. Trans. West. Sect. Wildl. Soc. 28:107–111) reported finding no *M. l. euryxanthus* on west-facing slopes and suggested a possible relationship to a lack of morning sun. However, Alvarez et al. (ms. in review, Trans. West. Sect. Wildl. Soc.) report that 32% of documented observations place *M. l. euryxanthus* in plant communities other than those described above. Herein, I present evidence that *M. l. euryxanthus* are found on a variety of slope aspects.

One hundred and twenty-seven records of free-ranging *M. l. euryxanthus* (and possible intergrades with *M. l. lateralis*) in Alameda and Contra Costa Counties (California) were reviewed by Alvarez et al. (*op. cit.*). These included specimens in the Museum of Vertebrate Zoology (MVZ) and California Academy of Sciences (CAS), reports from the California Natural Diversity Data Base (CNDDB), publicly accessible consulting reports from survey efforts, and personal communications from knowledgeable individuals (including my own observations). Slope aspect could be reliably determined for 82 of these observations. Data collected were transposed onto a commercial mapping program. Observations were deemed ambiguous (and not usable) if an error polygon associated with the observation placed the animal on multiple slope aspects. I visited every locality in 2004 to determine habitat type and confirm slope aspect. Seventeen of 82 observations (21%) were associated with west, north, and northwest slope aspects. These include three museum specimens (MVZ 128223, CAS 227730, CAS 201051); eight reported in the CNNDB, 13 reported by McGinnis (1990. Survey for the Alameda Whipsnake on the north-facing slope of the Kellogg Creek watershed west of Vasco Road, Contra Costa County, California, Unpubl. ms. 16 pp.), and two of my own observations. In addition to these documented records, two biologists report capturing more than 50 *M. l. euryxanthus* (collectively) on west and north-facing slopes (J. Sheppard and A. Murphy, pers. comm.).

The majority of *M. l. euryxanthus* observations reported in publicly accessible documents, databases, and collections do coincide with slope aspects reported by Swaim and McGinnis (1992, *op cit.*) and Swaim (1994, *op. cit.*). However, observations presented here indicate that *M. l. euryxanthus* uses virtually all slope aspects available, and data presented in Alvarez et al. (*op. cit.*) demonstrate that oak woodlands and annual grasslands are also occupied by these snakes. This information should be incorporated in conservation planning for this federally threatened snake (USFWS 1997. Federal Register 62:64306–64320). Specifically, chaparral, scrub, oak woodland, and grassland plant communities that occur within the range of *M. l. euryxanthus* should be recognized as potentially occupied habitat, irrespective of slope aspect.

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NERODIA FASCIATA (Southern Watersnake). **DIET**. Gibbons and Dorcas (2004. North American Watersnakes: A Natural History. Univ. of Oklahoma Press, Norman, Oklahoma. 438 pp.) summarized the literature on dietary records of *Nerodia fasciata*. The primary prey of this species are fish (e.g., *Gambusia affinis*) and amphibians (primarily frogs) (Gibbons and Dorcas, *op cit.*, Dundee and Rossman 1989. The Amphibians and Reptiles of Louisiana. Louisiana State University Press, Baton Rouge, Louisiana. 300 pp.). Several aquatic salamanders are recorded in the diet of *N. fasciata*, however, of the family Sirenidae, only *Siren lacertina* have been documented in the diet of this species (Gibbons and Dorcas, *op cit.*). This is especially noteworthy because the ranges of sirens and *N. fasciata* overlap extensively (Conant and Collins 1991. A Field Guide to Reptiles and Amphibians of Eastern/ Central North America. Houghton Mifflin Company, Boston, Massachusetts. 608 pp.).

On 14 March 2002 at 2056 h, an adult female *N. fasciata* (SVL 570 mm, TL 162 mm, 197 g without prey item) was found foraging in floating marsh habitat at Jean Lafitte National Historical Park and Preserve, Barataria Unit, Jefferson Parish, Louisiana, USA. The snake had an obvious bulge in its stomach and was retained until the following morning for measurements and determination of stomach contents. The stomach contents were obtained by forced regurgitation. A partially digested *Siren intermedia* (total length 225 mm, 19 g) was found swallowed tail-first. To our knowledge, this observation represents the first documentation of *N. fasciata* predation upon the commonly syntopic prey species, *S. intermedia*.

We thank the National Park Service (David Muth) for permits and financial support of the herpetological inventory.

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OPHEODRYS AESTIVUS (Rough Green Snake). **PREDATION**. Despite their arboreal habits (Plummer 1981. J. Herpetol. 15:425–432) and consequent proximity to the nests of many birds, bird eggs have not been documented in the diet of *Opheodrys aestivus*. By most accounts, diet consists primarily (if not exclusively) of invertebrates (Plummer, *op. cit.*).

On 11 May 2005 at 0945 h, we watched an adult *O. aestivus* (ca. 600 mm TL) depredate the nest of a *Vireo atricapilla* (Black-capped Vireo). The nest was 0.68 m above ground in a *Quercus sinuata* (Shin Oak) and contained two eggs. The *O. aestivus* launched itself 0.76 m towards the nest from a neighboring *Q. sinuata*, where it had been sitting at approximately the same height as the nest. Upon landing in the *Q. sinuata* that held the nest, the *O. aestivus* went directly inside the nest and immediately swallowed an egg. Because *V. atricapilla* is endangered (USFWS 1987. Federal Register 52:37,420–37,423) we removed the *O. aestivus* and released it >1 m from the nest. However, when we checked the nest later that day, the second egg was gone. We assume that the snake returned and ate it.

This observation documents *O. aestivus* predation on eggs for the first time. Further, this observation adds *O. aestivus* to a growing list of snakes that prey on *V. atricapilla* nests (*Agkistrodon contortrix* [Noa 2005. Demographic Differences of Black-capped Vireos (*Vireo atricapilla*) in Two Habitat Types in Central Texas. M.S. thesis, Univ. of Vermont, Burlington. 55 pp.], *Elaphe obsolete*, and *Masticophis flagellum* [Stake and Cimprich 2003. Condor 105:348–357]).

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PHALOTRIS MATOGROSSENSIS (False Coral Snake). **DIET**. Insects, earthworms, molluscs, frogs, lizards, amphisbaenians, and snakes (in captivity) have been reported in the diet of snakes of the genus *Phalotris* (Amaral 1977. Serpentes do Brasil – Iconografia colorida. Ed. Melhoramentos/EDUSP. São Paulo. 247 pp.; Lema et al. 2005. Iheringia Ser. Zool. 95:65–78). However, some of these items need confirmation and there are few reports of feeding observations in wild. Here we report an observation of *P. matogrossensis* feeding in nature.

On 8 December 2000 at 1400 h Fábio R. Luiz encountered a *Phalotris matogrossensis* (310 mm SVL, 6.5 g) in the process of swallowing an *Amphisbaena* sp. (245 mm SVL, 9 g) in an open area at Vale do Formoso farm, Municipality of Ribas do Rio Pardo, Mato Grosso do Sul States, Brazil. The amphisbaenian was collected dead, possibly because of envenomation during subjugation by snake. This is the first record of *P. matogrossensis* eating an *Amphisbaena* sp. The specimens are in the Museu de História Natural Capão da Imbuia (MHNCI), in Curitiba Municipality, Paraná, Brazil (*P. tricolor*, MHNCI 10.446; *Amphisbaena* sp., 10.447).

We thank F. R. Luiz and J. C. Moura-Leite for assistance.

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PHALOTRIS MERTENSI (False Coral Snake) and ***AMPHISBAENA MERTENSI*** (NCN). **PREDATION**. Both *Phalotris mertensi* and *Amphisbaena mertensi* display fossorial habits, and data concerning feeding behavior are rare. Ribas and Brito (2003. Joint Meeting of Icthyologists and Herpetologists, abstract) reported predation on a *A. mertensi* (SVL = 250 mm, tail = 10 mm, mass = 8.78 g) by a *P. mertensi* (SVL = 350 mm, tail = 30 mm, mass = 12.73 g) in Rio Claro, São Paulo state, Brazil. Ingestion was head-first. On July 2002, at ca. 1700 h at Tietê (23º06'S, 47º42'W, São Paulo state, Brazil, 508 m elev.), an adult *P. mertensi*, ca. 500 mm total length, was found swallowing an adult *A. mertensi*, ca. 350 mm TL. Immediately, the snake regurgitated the freshly-killed amphisbaenian and escaped.

I thank Valdir José Germano and Hebert Ferrarezzi, Laboratório de Herpetologia, Instituto Butantan, for verification of snake and amphisbaenian species identification, and Veranice Galha for photography.

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PHALOTRIS TRILINEATUS (NCN). **PREDATION.** At ca. 1000 h on 30 October 2001 in a swamp-grassland area at Arroio Teixeira, northeast of Rio Grande do Sul, Brazil, I observed a male American Kestrel (*Falco sparverius*) flying with a snake (*Phalotris trilineatus*) in its claws. The kestrel alighted on a wire near a secondary road and started to pluck out pieces of flesh. The snake was still alive when the kestrel started to eat it, an uncommon behavior for this falcon, which usually kills vertebrate preys before eating. As a car drove by on the road, the kestrel flew off, leaving the still-living snake hanging on the wire. When the kestrel returned to its prey, the snake attempted defensive strikes and fell to the ground. The kestrel hovered for ca. 1 min and flew away.

Although *Falco sparverius* is known to prey on small snakes, I am unaware of any reports for predation on *Phalotris trilineatus*. The snake (259 mm total length) was pecked on two body regions: 18 mm and 90 mm behind the rostrum. In both regions the ribs were broken and the viscera and flesh were plucked out. The snake was deposited in the herpetological collection of the Departamento de Zoologia of the Universidade Federal do Rio Grande do Sul (UFRGS 3563), Porto Alegre, Rio Grande do Sul, Brazil. I thank Gilberto Alves de Souza Filho for the snake identification and Paulo Hartmann for comments.

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SIBON NEBULATUS (Common Snaileater). **MAXIMUM SIZE.** *Sibon nebulatus* is one of the larger members of its genus and reaches a maximum length of 850 mm total length (Solorzano 2004. Snakes of Costa Rica: Distribution, Taxonomy, and Natural History. Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica. 791 pp.). At 1830 h on 31 July 2005 we found an adult female *S. nebulatus* crossing Barrigon Road ca. 0.9 km south of Parque Nacional General Omar Torrijos Herrera (Cocle Province, Panama). The live snake measured 779 mm SVL, 234 mm tail length, and weighed 128.0 g. At 1013 mm total length, this specimen (Museo de Vertebrados de la Universidad de Panama; MVUP 1863) is the longest known *S. nebulatus*. In addition, palpation suggested that the female was gravid and contained seven eggs.

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THAMNODYNASTES STRIGILIS (NCN). **PREY**. *Thamnodynastes strigilis* is a terrestrial colubrid distributed from central-western and northeastern Brazil to Uruguay (Franco and Ferreira 2002. Phyllomedusa 1:57–74). The few reports on the feeding habits of snakes in the genus *Thamnodynastes* suggest they feed mainly on anurans (especially hylids and lepdodactylids) but also on rodents, fish, and lizards (Bernarde et al. 2000. Rev. Brasil. Biol. 60:695–699; França and Souza et al. 2003. Herpetol. Rev. 34:378; Kopp and Wachlewski 2005. Herpetol. Rev. 36:71–72; Lema et al. 1983. Comun. Mus. Cienc. PUC-RS 26:41–121; Rocha and Vrcibradic 1998. Cienc. Cult. 50:364–368; Ruffato et al. 2003. Phyllomedusa 2:27–34).

We examined the stomachs of eight specimens (MNRJ 9793 and 13383–13389) of *T. strigilis* (averaging 473.2 ± 80.2 mm SVL) for the presence of prey remains. All eight specimens were collected in and around a temporary pond in secondary Atlantic Rainforest surrounding Vila Dois Rios, Ilha Grande (23°11'S; 44°12'W), off the coast of the state of Rio de Janeiro (Brazil) during the evening (1900–2330 h) over a seven-year period (Apr/96, Dec/97, Oct/98, Jul/99, Oct/99, Oct/02). We discovered prey remains in four specimens. One (MNRJ 9793; female; 518 mm SVL; Oct/02) contained a *Physalaemus signifier* (26 mm SVL) and the tail and 3 limbs of a lizard (*Gymnodactylus darwinii*). A second specimen (MNRJ 13384; male; 565.6 mm SVL; Jul/05) contained the hind limbs of a *Eleutherodactylus guentheri* (leptodactylidae). A third specimen (MNRJ 13387; female; 360 mm SVL; Oct/01) contained a male (37.2 mm SVL) and female (27.3 mm SVL) *Scinax trapicheiroi* (hylidae). The fourth specimen (MNRJ 13383; female; 491 mm SVL; Oct/99) contained a *Chiasmocleis* sp. (Microhylidae; 20 mm SVL).

This is the first report of a microhylid frog (*Chiasmocleis* sp.) in the diet of *Thamnodynastes*. Frogs of the genus *Physalaemus* and the lizard *Gymnodactylus darwinii* have been previously reported as prey of other species of *Thamnodynastes* (Rocha and Vrcibradic, *op.cit.*; Bernarde et al., *op. cit.*; Ruffato et al., *op. cit.*). These observations offer further support for the hypothesis that *Thamnodynastes* are important predators on anurans.

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THAMNOPHIS ATRATUS (Aquatic Gartersnake). **PREDATION**. On 30 May 2004, JD and KR were conducting amphibian surveys along a stretch of Bennett Creek in Mendocino National Forest, Tehama County, California, USA (UTM Coordinates 531484 E, 4408974 N, Zone 10,NAD27, 336 m elev). The weather was clear with a light breeze; air temperature was 28°C, and the creek temperature was 22°C. At about 1300 h, two adult *Thamnophis atratus* were found sitting on a wet rock immediately adjacent to a small waterfall in the reek. Both snakes were loosely coiled in a striking posture, and had their heads near the water. The snakes appeared to be intently watching the water. The snakes were observed for 10 minutes during which time both snakes were observed to strike at smal fish as the fish attempted to swim up the waterfall. After one of the snakes was successful, it was captured with the fish still in its mouth. The fish was a California Roach (*Lavinia symmetricus* [=*Hesperoleucus symmetricus*]). The snake was 59.5 cm (SVL); the other snake was also captured and was 50.0 cm SVL. A video recording was obtained along with photographs of one snake catching a fish.

Lind and Welsh (1994. Anim. Behav. 48:1261–1273) reported that *T. atratus* foraging techniques varied ontogeneically, with juveniles (< 44.9 cm SVL) using both ambush and underwater substrate-crawling, and adults using underwater substrate-crawling almost exclusively. The snakes we observed were both adults, yet they were using an ambush style of foraging, somethng that Lind and Welsh found only once in 38 observations of adult *T. atratus* foraging.

Catching small fish as they ascended a small waterfall would require good visual acuity and a rapid strike. Alfaro (2002. Funct. Ecol. 16:204–215) reported that *T. couchii* aerial strike speed was more than five times that of *T. sirtalis*. Drummond (1985. Anim. Behav. 33:206–215) and Schaeffel and De Queiroz (1990. Copeia 1990:50–58) reported that the aquatic specialists *T. couchii* and *T. melanogaster* had superior vision compared with *T. sirtalis* and other *Thamnophis* with more terrestrial foraging modes. Both these factors would suggest that *T. atratus* would be particularly well adapted to the type of ambush foraging that we observed.

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UROTHECA DECIPIENS (Collared Glass-tailed Snake). **DIET**. *Urotheca decipiens* is a small, diurnal, terrestrial snake that is reported to consume amphibians and small lizards (Solorzano 2004. Snakes of Costa Rica. Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica. 791 pp.). At 2000 h on 22 September 2005 we found an adult female *U. decipiens* (240 mm SVL; 37 mm tail length; 6.8 g) moving through the leaf litter after dark in Omar Torrijos National Park (Cocle Province, Panama). A portion of the tail was missing, presumably lost as part of the antipredatory defense that is typical of the genus (Savage 2002. The Reptiles and Amphibians of Costa Rica. Univ. Chicago Press, Chicago, Illinois. 934 pp.). After collection the snake regurgitated the head and neck of a small *Sphaerodactylus* sp. This is the first report of *Sphaerodactylus* in the diet of *U. decipiens*, as well as the first report of *U. decipiens* in Cocle Province and Central Panama. In addition, our observation of the active snake at night suggests *U. decipiens* may not be entirely diurnal. The snake and its gut contents were deposited in the Circulo Herpetologico de Panama (*U. decipiens* CH 5975; *Sphaerodactylus* sp. CH 5976).

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GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 37, Number 1 (March 2006). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extension reports unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA MACULATUM (Spotted Salamander). USA: TENNESSEE: Cannon Co.: Cooper Hollow. 22 February 2006. J. L. Miller, J. A. Miller, J. H. Miller, and B.T. Miller. Verified by A. Floyd Scott. Austin Peay State University (APSU 18157, color photo). Adult male captured in a minnow trap set in a small, shallow pond adjacent Sinks Miller Rd. ca. 1 km E of Burt Burgen Rd. intersection. New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State Uniersity, Clarksville, Tennessee. 94 pp. Internet version <http://www.apsu.edu/amatlas> contains links to information on Tennessee distribution of amphibians that have appeared since 1996, accessed 23 February 2006).

Submitted by **JOSHUA A. MILLER** and **JACOB H. MILLER**, Saint Rose of Lima School, Murfreesboro, Tennessee, 37085, USA; and **JOYCE L. MILLER** (e-mail: jlmiller@mtsu.edu) and **BRIAN T. MILLER,** Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee 37132, USA (e-mail: bmiller@mtsu.edu).

AMBYSTOMA TIGRINUM TIGRINUM (Eastern Tiger Salamander). USA: OHIO: Preble Co.: Jefferson Township. Paul McKee Road 0.25 km west of Rawley Road (39°52.857'N, 84° 45.108'W). 16 February 2006. Jeffrey G. Davis and Natalie A. Fath. Verified by John W. Ferner. CMNH 8935. New county record (Pfingsten and Matson 2003. Ohio Salamander Atlas. Ohio Biological Survey, Columbus). Adult male 122 mm SVL, 254 mm TL.

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NECTURUS MACULOSUS (Mudpuppy). USA: ILLINOIS: Pope Co.: Upstream of Regan Ford in Lusk Creek, end of road 1007 off of Eddyville Blacktop 7 (37°30'35"N, 88°32'19"W). 15 February 2006. Diane K. Shasteen. Verified by Ronald A. Brandon. SIUC H-8323. Juvenile specimen. New county record (Philips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, Champaign, Illinois. xii + 282 pp.).

Submitted by **DIANE K. SHASTEEN**, Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901, USA.

NOTOPHTHALAMUS VIRIDESCENS LOUISIANENSIS (Central Newt). USA: ARKANSAS: Union Co.: Beech Creek at St. Hwy. 160, ca. 3.2 km E of Mount Holly (Sec. 25, T16S, R18W).

unsuitable for oviposition by *S. albicans*. However, no significant negative relationship was recorded.

The patterns found show aggregation size to be remarkably constant by the standards of any vertebrate populations. The permanence of males in aggregation was high, and the little variation in aggregation size was explained by variations in the numbers of males entering the aggregation each month. The possibilility that aggregation size could be used as in index to population size is jeopardized by its high constancy and lack of relationship with rainfall patterns. Possibly aggregation size is rather controlled by social factors regulating the number of males calling at a time in any given place.

Acknowledgments.—We thank IBAMA (Instituto Brasileiro de Meio Ambiente e Recursos Naturais Renováveis) for allowing the work at Parque Nacional da Serra dos Orgãos; Instituto Nacional de Meteorologia (INEMET) for climatic data; Sergio Potsch de Carvalho e Silva for teaching on amphibians, for logistic support and co-supervising DN's MSc dissertation; the several colleagues, especially Fábio Nascimento, who helped in field work; Rômulo Barroso for company in all field work and discussions throughout the study; José P. Pombal Jr., William Magnusson, Jon Loman, Monique Van Sluys, Ronaldo Fernandes, Gunther Koehler and an anonymous referee for very useful comments on the manuscript; Jorge Luiz do Nascimento for ideas in this study and for financial support.

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Abundance and Biomass of Twelve Species of Snakes Native to Northeastern Kansas

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The purposes of this paper are to examine abundance and biomass estimates of the dozen most abundant snake species in our area of northeastern Kansas, and to relate these numbers to information reported in the literature. Hirth and King (1968) stated, "In spite of all the current interest in ecosystem ecology there is still a dearth of information concerning biomass densities of snakes in various habitats." Except for a few studies (e.g., Bonnet et al. 2002; Godley 1980; Hirth and King 1968; Reichenbach and Dalrymple 1986; Winne et al. 2005), the situation does not seem to have changed appreciably in the last 37 years.

Methods and Study Area

Snakes have been studied for the past 56 years on Kansas University's Natural History Reservation (FNHR) following establishment of the area as a reserve. Although protected from anthropogenic alterations, the area has undergone continual and progressive change due to natural ecological succession (Fitch 1999; Fitch et al. 1984, 2001, 2003b). The closing in of forest and elimination of open places associated with agriculture and grazing has been unfavorable for snakes. Several of the species have disappeared from this 239-hectare tract, and almost all species have been drastically reduced (Fitch 1999). The adjoining Nelson Environmental Study Area (NESA), acquired by the University in 1970, has provided a contrast to FNHR in terms of habitat stability. Invasion of woody vegetation is prevented on NESA by the regular mowing of blocks of former pasture and cultivated land, and as a result, existing snake populations resemble those found on FNHR in earlier stages of succession (Fitch 1999).

Sampling areas (House Field, Quarry Field, etc.) are described by Fitch (1999). Of the 12 censuses reported here, eight were from FNHR and were done in the earlier years of study (before 1979) except that for *Thamnophis sirtalis*. Of the remaining four species, *Carphophis vermis* was censused by Clark (1970) on private property adjoining FNHR and three, *Lampropeltis triangulum*, *L. calligaster*, and *Coluber constrictor*, were censused post-1990 on NESA.

Unless otherwise noted, density estimates are based on field records and censuses originally published in Fitch (1999) except for Clark's (1970) *Carphophis* figures. Mark-recapture records and the Petersen Index were the bases for the abundance estimates for most species, including *Agkistrodon contortrix* (Copperhead), *Carphophis vermis* (Western Wormsnake), *Coluber constrictor* (Racer), *Crotalus horridus* (Timber Rattlesnake), *Diadophis*

punctatus (Ring-necked Snake), *Nerodia sipedon* (Northern Watersnake), *Pantherophis obsoletus* (Black Ratsnake), *Pituophis catenifer* (Bullsnake), and *Thamnophis sirtalis* (Common Gartersnake). For the remaining three species, *Lampropeltis calligaster* (Prairie Kingsnake), *Lampropeltis triangulum* (Milksnake), and *Storeria dekayi* (DeKay's Brownsnake), densities were estimated from their respective numbers relative to one or more species with larger mark-recapture samples.

Weights are based on figures from Fitch (1999, Table 98). Number of snakes, weight, and biomass per hectare were log transformed for the regressions. Representative weight for each species is the midpoint between the means for the adults of both sexes (excluding gravid and recently parturient females). For the sake of consistency, only adult mass was used to calculate biomass from density, although immatures were present for every species censused (see Fitch 2000, for age pyramids for 10 of the species). Attempting to factor in mean mass across all sizes had the potential of introducing more bias than was inherent in excluding these other size classes. Relative abundance of life history stages varied markedly over each trapping season, but these seasonal fluctuations were not synchronized among species. Also, age composition of each species censused was partly a function of trapping method. For example, entrance holes of the wire funnel traps were mostly too small to allow entry of large adult Timber Rattlesnakes. In contrast, the traps were well suited to catch larger young and adults of the Common Gartersnake, while tiny neonates of this species easily passed through the quarter-inch mesh of the traps, and hence are missing from the trapping records. More information is available in Fitch (1999), including details of food habits and population fluctuations. Age structure pyramids and "standing crop" biomass estimates for 10 local snake species are presented in Fitch (2000).

Results

Dates of census, sampling area, abundance, mean adult weights, and other numbers based on these figures are listed in Table 1. The following list explains the specifics of the abundance estimate for each species.

Agkistrodon contortrix—18.6/ha is the mean of ten censuses in 1977 on FNHR, five for House Field and five for Quarry Field.

Carphophis vermis—729/ha in 1966 on private property 1 km west of FNHR headquarters (Clark 1970). This was the highest density estimate given by Clark (1970). We use it because it was derived with the Petersen Index, as were the estimates for the other species reported here. Clark obtained a lower estimate with the Hayne modification of the Lincoln Index, but this modification is apparently more appropriate for small mammals than for snakes (Carpenter 1952).

Coluber constrictor—13.2/ha based on five separate 0.5-month sampling periods in 1991–1994 on the northwestern pens area of NESA. These five were chosen from a number of available censuses for this species (Fitch 1999) because all included more than one recapture, and shorter sampling periods generally seem to yield the most reliable estimates for this species.

Crotalus horridus—0.2/ha for the northwestern quarter of FNHR in the early 1960s from a Petersen Index estimate (previously unpublished) based on only two recaptured rattlesnakes, at a time when the species was already dwindling. The last capture of *C. horridus* from FNHR was in 1964. By contrast, 12 were captured from a 10-ha area of NESA (Biotic Succession Area) in the years 1990 through 2002 (Fitch et al. 2003). Additionally, in the spring of 2003, 26 were captured along a rock outcrop about 100 m long near Frank B. Cross Reservoir, in an area adjoining NESA on the east (Fitch et al. 2004).

Diadophis punctatus—Many different censuses are available for the once-abundant Ring-necked Snake (Fitch 1999). Seven were done in Quarry Field in 1966–67 and 1969–70, with sampling periods ranging from 0.5 to 2 months. Eliminating the extreme lowest and highest estimates (597 and 4000/ha) gave a range of 791–2039/ha and a mean of 1325/ha. An additional eight censuses were from House Field with sampling periods ranging from 0.5 to 3 months (1965–1967); excluding the lowest and highest estimates (262 and 1792) gave a mean of 1224/ha (range = 773–1761). Averaging the means for these two areas, both on FNHR, gives an overall mean of 1275/ha.

Lampropeltis calligaster—2.5/ha, 1990–1997, on the northwestern pens area of NESA. This estimate is the average of 1.6/ha (based on ratio of capture records compared to *Thamnophis*) and 3.3/ha (compared to *Coluber*). Since 2001, 14 *L. calligaster* have been captured on NESA, and only two individuals (both in 2002) have been found on FNHR.

Lampropeltis triangulum—0.6/ha, 1990–1997, on the northwestern pens area of NESA. This estimate is the average of 0.52/ha (compared to *Thamnophis*) and 0.73/ha (compared to *Coluber*). The last capture of *L. triangulum* on FNHR was in 1999. Since 2001, 17 have been captured on NESA.

Nerodia sipedon—The majority of records were concentrated about the FNHR pond, but a few were scattered over a much larger area, reflecting the fact that these snakes travel, following the water supply in drainage systems. The Petersen Index indicated 10 snakes for 1978. The area covered was approximately 25 ha, resulting in an estimate of 0.4/ha (previously unpublished).

Pantherophis obsoletus—Records for the Black Ratsnake are perhaps not sufficiently concentrated in time to yield a reliable sample free from the effect of temporal change, although survivorship in this species is longer than in most. Hence the Petersen Index estimate may have some validity, despite the long sampling period (1950 through 1960) and the large area involved (129.5 ha), approximately the northern half of the Reservation. Based on varying sampling and resampling times, densities of 0.9 to 3.6/ha have been calculated (Fitch 1999, Table 101). The average of these, 2.3/ha, is used for this study.

Pituophis catenifer—From the start, the Bullsnake was unfavorably affected by successional changes, and it dwindled through the 1950s and 1960s (Fitch 2003). Censuses, taken almost entirely from the northwest quarter-section (64.7 ha) of FNHR in 1958, 1959, 1963, 1964, and 1966 averaged 38.5 snakes per year, giving an estimate (previously unpublished) of 0.60 snakes/ha. The last FNHR capture of this species was in 1984. Six were captured on NESA during the period 1997–2002.

Storeria dekayi—Estimated at 42/ha in the House Field-Quarry Field area, 1966–67 and 1969–70, based on a 3.3% ratio of brown snakes to the more readily censused *Diadophis*.

Thamnophis sirtalis—15.4/ha in House Field, 1988–1997. Although the Common Gartersnake was abundant enough to provide a surfeit of samples from several areas, only samples from

TABLE 1. Abundance and biomass of 12 snake species on the Fitch Natural History Reservation (FNHR), a plot of private land adjoining FNHR (*Carphophis*), and Nelson Environmental Study Area (NESA).

Species	Site of census	Year(s) of census	Number individuals/ha	Percentage of total number of snakes	Mean adult weight (g)	Biomass per hectare (g/ha)	Percentage of total snake biomass/ha
Agkistrodon contortrix	FNHR	1977	18.6	0.89	150	2790	13.4
Carphophis vermis	1 km W FNHR	1966	729.0	34.72	7	5103	24.5
Coluber constrictor	NESA	1991-1994	13.2	0.63	140	1848	8.9
Crotalus horridus	FNHR	1960-1963	0.2	0.01	713	143	0.7
Diadophis punctatus	FNHR	1965-67 1969–70	1275.0	60.72	6	7650	36.7
Lampropeltis calligaster	NESA	1990-1997	2.5	0.12	202	505	2.4
Lampropeltis triangulum	NESA	1990-1997	0.6	0.03	73	44	0.2
Nerodia sipedon	FNHR	1978	0.4	0.02	202	81	0.4
Pantherophis obsoletus	FNHR	1950's	2.3	0.11	392	902	4.3
Pituophis catenifer	FNHR	1958-1966	0.6	0.03	671	403	1.9
Storeria dekayi	FNHR	1966-67 1969–70	42.0	2.00	5	210	1.0
Thamnophis sirtalis	FNHR	1988-1997	15.4	0.73	77	1186	5.7

House Field (10 ha area, FNHR) are reported here. In this area, snakes were found beneath shelters, and the hand captures included first-year young that can escape through quarter-inch mesh of live traps used, for example, at the NESA site. Of 44 census figures available from 1985–1997 (Fitch 1999), 13 were selected because each included more than one recapture and each was conducted in approximately two consecutive months of sampling (first month for primary sample followed by a 3–4 week re-sampling period). Shorter and consecutive sampling periods are probably more reliable for this species because longer sampling periods may result in inflated estimates (Fitch 1999).

DISCUSSION

The mark-recapture method of assessing population size is, in most cases, the most available method for assessing the numbers of a reasonably abundant species. However, numbers acquired through this approach are perhaps most appropriately compared for similarities/differences in orders of magnitude (Fitch 1975). A further caveat is that not all censuses were completed in exactly the same area and time for each of the 12 species. However, most of those from FNHR were done in the same or overlapping areas of the Reservation before ecological succession had resulted in shrub/forest encroachment (Fitch et al. 2001). The three censuses on NESA were done between 1990–1997; all three were at the same site, one that resembled earlier stages of succession on FNHR. For these reasons, we discuss these figures as if they were acquired from the same area in the same years. Our premise is that the numbers reported here are representative of relative snake abundance during the earlier stages of succession on FNHR.

Among the 12 species of FNHR/NESA snakes yielding sufficient data (Table 1, Fig.1), there was a statistically significant inverse relationship ($r = - 0.85$, $P < 0.001$) between typical adult weight of each species and number of snakes/ha (Fig. 1), implying that smaller snakes tend to be more abundant than larger species. There was also a statistically significant ($r = 0.82$, $P = 0.001$) relationship between number of individuals/ha and biomass/ha, suggesting that the more abundant species tend to form a larger portion of the snake biomass per unit area.

Consistent with the inverse relationship between size of snake and number/ha, the highest population numbers were recorded for the three species of smallest snakes. These were also the only species specializing in a diet of earthworms and/or slugs (Fitch 1999). *Diadophis punctatus* outnumbered (60% of total numbers) the population estimates for all other species combined. Its numbers

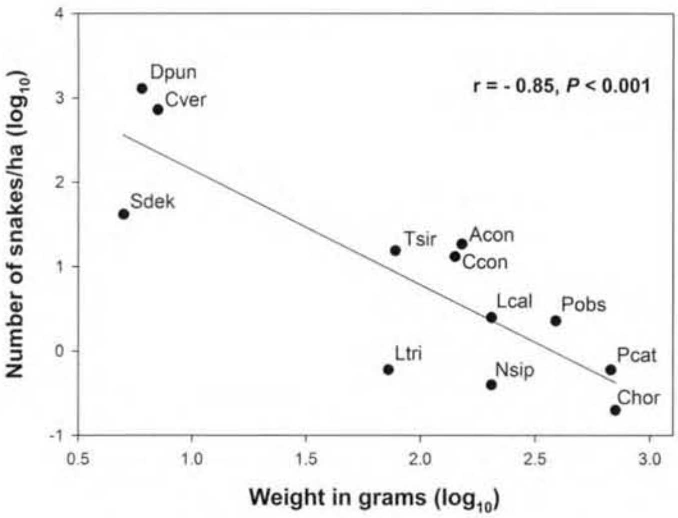

FIG. 1. Relationship between a typical adult weight of a snake species and number per unit area. Species codes (in parentheses) are as follows: *Agkistrodon contortrix* (Acon), *Carphophis vermis* (Cver), *Coluber constrictor* (Ccon), *Crotalus horridus* (Chor), *Diadophis punctatus* (Dpun), *Lampropeltis calligaster* (Pcal), *Lampropeltis triangulum* (Ltri), *Nerodia sipedon* (Nsip), *Pantherophis obsoletus* (Pobs), *Pituophis catenifer* (Pcat), *Storeria dekayi* (Sdek), and *Thamnophis sirtalis* (Tsir).

(mean 1275/ha) are comparable to those (1289/ha, censused by quadrat counts) reported by Godley (1980) for the Striped Swamp Snake, *Regina alleni*, in two water hyacinth-choked canals in southern Florida. To our knowledge, these figures are the highest known for any North American snake species, excluding reproductive and denning aggregations. Godley (1980) stated that his estimated mean standing crop for the *Regina* population (30.8 kg/ha) was greater than that known for any snake species; his estimate far exceeds our highest (7.65 kg/ha for *Diadophis*). In a study of another diminutive species, Clark and Fleet (1976) reported a range of 229 to 348/ha (mark/recapture, Lincoln Index) for the Rough Earthsnake, *Virginia striatula*. Like *Diadophis* in northeast Kansas, *Virginia* in eastern Texas apparently specializes in a diet of earthworms (Clark and Fleet 1976).

The second and third most abundant species were *Carphophis* and *Storeria*. Excluding *Diadophis*, wormsnakes was more abundant (729/ha) than all remaining species combined, and accounted for 35% of the total snakes (24% of total snake biomass). The diminutive natricine, *Storeria dekayi* (42/ha), was several times more abundant than an estimate (14/ha) based on mark-recapture for the same species in Ontario, Canada (Freedman and Catling 1978), but it should be noted that our estimate was indirect, based on a ratio to the more adequately sampled *Diadophis*.

Among the remaining nine species, primary prey consisted of vertebrates except for first-year garter snakes that tended to feed predominantly on earthworms (Fitch 1999). Among these nine species, four (Timber Rattlesnake, Northern Watersnake, Milksnake, Bullsnake) occurred at densities of less than one per hectare. Even at such low densities, the Timber Rattlesnake contributed 3–4 times the biomass/ha of that estimated by Hirth and King (1968) for a congener, the Great Basin Rattlesnake, *C. oreganus lutosus*, in desert habitat of northwestern Utah. *Nerodia* was fairly localized around the FNHR pond and associated waterways. *Pituophis*, *Crotalus*, and *Lampropeltis triangulum* were among the first to disappear from FNHR as succession progressed, and dense undergrowth and unbroken forest canopy invaded previously open fields and forest-edge habitat. Although the rattlesnake is a forest inhabitant, it apparently requires open sunny places for basking. Local Milksnakes prefer open woodland or forest edge with flat rocks, and the Bullsnake requires short-grass habitat. Pocket gophers (*Geomys bursarius*) and Five-lined Skinks (*Eumeces fasciatus*), favored prey for, respectively, Bullsnakes and Milksnakes, also disappeared or became scarce in the early years of FNHR succession (Fitch 1999; Kettle, Fitch, and Pittman, unpubl. ms.).

Despite relatively low abundances (< 3/ha), *Lampropeltis calligaster* and *Pantherophis obsoletus*, particularly the latter because of its greater bulk, constituted a moderate proportion of the total biomass represented by the nine larger snake species. Our figure of 2.3/ha for the Black Ratsnake is comparable to the density (3.9–4.2/ha) reported by Weatherhead and Haysack (1989) for a population at the northern edge of the species' range in eastern Ontario. Of the less abundant forms so far discussed, the Black Ratsnake is the only species that seemed to maintain a relatively stable population despite the successional changes on FNHR. The Prairie Kingsnake, by contrast, disappeared from FNHR as encroachment of brush and forest replaced its preferred tallgrass habitat.

The three remaining species, the Copperhead, Racer, and Common Gartersnake, were all prominent members of the local snake fauna. Because they were present in approximately comparable numbers, their relative contributions to the overall snake biomass were determined more by weight than by large differences in abundance. The average Copperhead weighed about twice as much as a Common Gartersnake and slightly more than the Racer, thus Copperheads constituted the most substantial portion (35%) of the biomass of the nine larger species, followed by the Racer (23%) and the Common Gartersnake (15%). Hirth and King (1968) reported a mid-summer density of 49g/ha for *Coluber constrictor mormon*, in desert habitat in northwestern Utah, a figure that seems strikingly low when compared with our figure of 1848g/ha for *C. c. flavivientris* in northeastern Kansas. With the caution that fall samples "...may be subject to minimum bias compared with samples collected at other times of year...", Fitch (2000) reported a much lower density (4.9/ha) and mean weight (103.6g) for fall samples of Copperheads than we report here. This difference reemphasizes the fact that local populations show large fluctuations in abundance and that census figures are rough approximations best used for relative comparisons and assessed in terms of orders of magnitude difference.

Our estimate of 15.4/ha for *Thamnophis sirtalis* is well within the range of values reported for this species: 1.7 in British Columbia (Farr 1988 as cited by Rossman et al. 1996) and 89 in Ohio (Reichenbach and Dalrymple 1986). The latter study estimated a biomass density of 2.8–5.5 kg/ha for *T. sirtalis* in Ohio, 2.3–4.6 times greater than our estimate for Kansas garter snakes. Among those snake species that have been abundant on FNHR, the Common Gartersnake has perhaps been the most persistent, and was one of the few species of this study that maintained sufficiently high population numbers to produce a useful FNHR estimate in the 1990's. Among the 12 snakes we studied, this species might

be considered the most generalized in food habits, as it consumes invertebrates, amphibians, mammals, and birds. Although found in field habitats, it is also relatively tolerant of shade, and, as stated by Fitch (1999, Table 102), its population fluctuations seem to be more affected by annual weather changes than by succession. Such plasticity helps explain the wide geographic range and high abundances of this species.

Parker and Plummer (1987) and Iverson (1982) provide general reviews of snake densities, and Ernst and Barbour (1989) and Rossman et al. (1996) summarize the data for various species of *Thamnophis*. A comparison of the numbers reveals extensive inter- and intra-specific variation in density patterns. As documented for snakes in the vicinity of FNHR, the extent of intraspecific fluctuations in a single area can rival that attributable to geographic or interspecific variation (Fitch 1999).

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The Tadpole of the Mexican Treefrog *Plectrohyla hazelae* Taylor, 1940

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Recently obtained tadpoles from the vicinity of Ixtlan de Juarez, Sierra Juarez, Oaxaca, Mexico, were raised in captivity and determined to be those of *Plectrohyla hazelae*. Herein, we describe the tadpole of *P. hazelae*.

All the tadpoles (UMMZ 236001–02) were collected on 7 May 2004, on muddy bottoms of shallow pools in one small creek 3.8 km from "Rancho Tejas," Sierra de Juarez, on the Ixtlan de Juarez-Rancho Tejas road (17°18'96", 96°26'61"; 1900 m elev.). The tadpoles were taken to Mexico City (2400 m) and raised to adult stage except for few which were killed in 10% formalin at stages 30, 34, 36, 38, 39, 42, and 43 (Gosner 1960).Terminology and

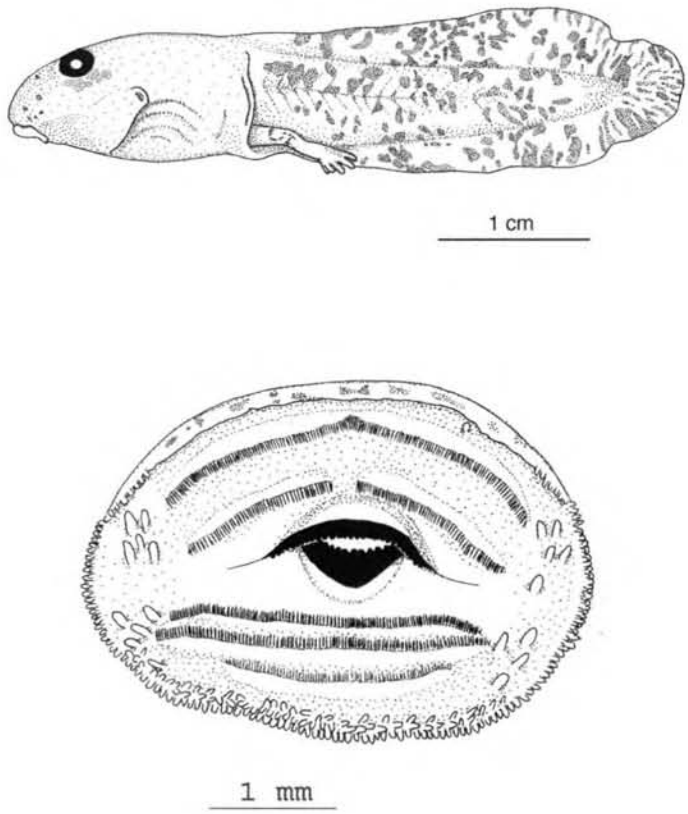

FIG. 1. Tadpole and oral disc of *Hyla hazelae* (Stage 38) (UMMZ).

measurements follow those proposed by Altig and McDiarmid (1999). Acronyms as follows: UMMZ = University of Michigan Museum of Zoology.

A typical tadpole in Stage 38 (Gosner 1960) (UMMZ 236001; Fig. 1; measurements in mm): body length 15.6; tail length 29.7; total length 45.3; body slightly depressed; snout round in dorsal view and profile; eyes large (eye diameter 2.6), dorsolateral, bulgy, separated by a distance of 3.1; nostrils separated by a distance of 3.4, slightly closer to eyes than to tip of snout; spiracle sinistral, C-type (Fig. 3.1 in Altig and McDiarmid 1999), directed posterodorsally, angled 80° with respect to longitudinal axis of body, opening below midline of body and half way between tip of snout and posterior end of body; vent tube dextral, G-type (Fig. 3.5 in Altig and McDiarmid 1999); width of caudal musculature 5.1; dorsal fin extending slightly onto body; maximum height of tail located at posterior 3/4 of tail; tip of tail round (partly damaged in this individual).

Oral disc medium size (oral disc diameter/max. body width = 0.5), elliptical, ventrally located, not emarginate, bordered by marginal papillae laterally and posteriorly; marginal papillae on lateral and posterolateral parts of oral disc biserial; marginal papillae of posterior part of oral disk slightly offset, intercalated, biserial to triserial; 4 to 5 large submarginal papillae on each side of oral disc; labial tooth row formula 2(2)/3; gap of A-2 1/5 of row length; lengths of A-1 and P-2 equal, reaching submarginal papilla; relative lengths of posterior teeth rows P-2>P-1>P-3; P-3 distinctively shorter than other rows; labial teeth of P-3 shorter than those of other rows; labial tooth ridges rigid; upper jaw sheaths poorly keratinized, bearing small round serrations but not lateral processes; lower jaw sheath moderately keratinized, V-shaped, bearing 20–25 small round serrations.

In life, body dark gray with slightly darker blotches. In preservative, body gray brown, tail musculature gray beige, and blotches dark brown; large dark blotches scattered on dorsal and lateral parts of body, anterior surface of oral disc, dorsum of legs, tail musculature and fins; fins more pigmented on posterior 2/3 of tail than on anterior 1/3; tail musculature more pigmented on anterior than posterior half of tail; rims of vent, nostrils, and spiracle darkly pigmented.

Keratin can be present or absent on both jaw sheaths, or present only on the lower jaw. The keratin on the lower jaw can form a narrow continuous arch or two discontinuous patches. The marginal papillae can be well or poorly defined on the anterior edge of the oral disc. In dorsal view, the body is ovoid (Stages 36 and younger) or elongated (Stages 37 and older).

The tadpoles of *Plectrohyla hazelae* differ from those of other stream-dwelling species of *Plectrohyla* from the Sierra de Juarez (i.e., *P. bistincta*, *P. crassa*, *P. calthula*, *P. celata*, *P. cembra*, *P. cyanomma*) by having a tail with its highest point at the posterior 2/3 and by lacking one or several rows of large submarginal papillae anterior to A-1 and/or posterior to P-3.

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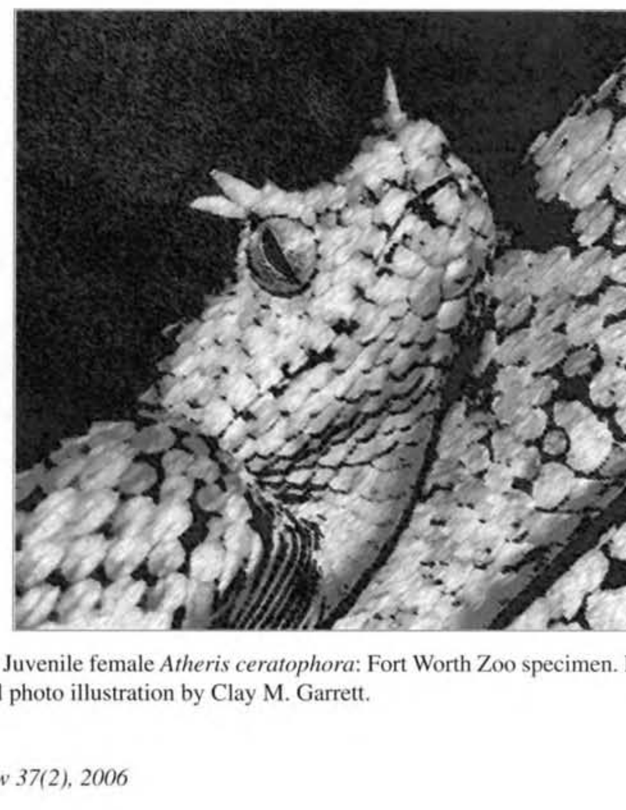

Juvenile female *Atheris ceratophora*: Fort Worth Zoo specimen. Digital photo illustration by Clay M. Garrett.

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Checklist and Comments on the Terrestrial Reptile Fauna of Kau Wildlife Area, Papua New Guinea

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The island of New Guinea has been identified as a megadiverse region because of its extraordinary biodiversity and highly endemic biota (Mittermeier and Mittermeier 1997). New Guinea, the world's largest and highest tropical island, occupies less than 1% of global land area yet 5–7% of the world's biodiversity is found on the island (Beehler 1993; Dinerstein and Wikramanayake 1993; Mack 1998; Myers et al. 2000). The herpetofauna of New Guinea currently known to science accounts for about 5% of the world's reptile and amphibian diversity (Allison et al. 1998). Remarkably, this is an underestimate of true diversity; it is predicted that 30–60% of the reptile and amphibian fauna of New Guinea remains unknown to science (Allison 1993). The vast diversity of biological life on New Guinea is a result of the island's diverse topography, extensive range of habitat types, and complex geological history. With elevations ranging from sea level to over 5000 m, the varied habitat zones, packed into an area one-tenth the size of the United States, include relictual tropical glaciers, alpine grasslands, montane moss forests, dense lowland rainforests, sago palm swamps, and eucalypt savannas.

The lowland rainforest on the north coast of Papua New Guinea has been severely impacted by logging (Beehler 1993). One of the few areas of lowland rainforest set aside for conservation and scientific study is the Kau Wildlife Area (KWA: 05°09'S, 145°46'E) near the provincial capital of Madang, Madang Province. The KWA is community owned and managed by the Didipa Clan of Kau and Baitabag Villages. The 800-ha KWA reserve is part of the extensive and broadly continuous Northern New Guinea lowland ecoregion that is made up of lowland, freshwater, and peat swamp forests. The lowland forests and freshwater swamps from this ecoregion contain diverse habitats, including lowland and hill forest, grass swamps, swamp forests, savannas, and woodlands (Conn 1995; Gressitt 1982; Henty 1981; Womersley 1978). The KWA, between 20–70 m in elevation, includes primary, successional, and riparian lowland broadleaf-evergreen forest. As many as 155 species of trees have been identified within a 1-ha plot of primary forest in the KWA (Bonaccorso et al. 2002). Dense stands of sago palm (*Metroxylon sagu*) are found in the low wet areas along the Kau and Biges Rivers. Many areas of the KWA have historically been subjected to traditional shifting fruit and vegetable gardens and many old abandoned garden areas surround the reserve. The climate of this region is wet tropical forest and in nearby Nagada Harbor annual precipitation averaged 3460 mm from 1994–96. The area is typified by distinct wet and dry seasons with less than 100 mm of monthly precipitation from June through August (Bonaccorso et al. 2002).

The northern region of New Guinea is a very active tectonic area with a complex geologic history. Over the last 40 million years interplate impact resulted in considerable uplift and volcanism and importantly the accretion of at least 32 tectonostratigraphic terranes along the northern leading edge of the island that have influenced the biodiversity of the region (Pigram and Davies 1987; Polhemus and Polhemus 1998).

To date there has been no comprehensive herpetofaunal reports from the KWA. Here I compile a list of terrestrial reptile species present in the KWA based on fieldwork over the past 14 years. The KWA terrestrial reptile fauna, exclusive of crocodylians and turtles, currently includes 25 lizards and 7 snakes representing 8 families and 21 genera (Table 1). A similar compilation is underway for the amphibians of the region (S. Richards, pers. comm.). Specific specimen and locality information as well as associated tissues can be accessed via a searchable database of the LSU Museum of Natural Science reptile and amphibian collection (http://www.lsu.edu/museum).

Species Richness, Taxonomy and Species-complex Groups

There are a large number of species complexes in the diverse New Guinea reptile fauna, especially among the scincid lizards. In addition to species complexes, many currently recognized species likely represent more than one taxon. Species richness, therefore, is likely much greater than is currently recognized. Below I comment on and address some of the taxonomic impediments to understanding the KWA terrestrial reptile fauna.

The agamid genus *Hypsilurus* is a poorly understood group. The taxonomy of the genus has been muddled by inadequate original descriptions, misidentified museum specimens, and the fact that the last comprehensive work on this group is 90 years old (de Rooij 1915). In particular, the geographic distribution and specific-level variation for virtually all species of *Hypsilurus* is not well understood. A recent comprehensive review of all type material has provided a much needed taxonomic summary and clarification (Manthey and Denzer 2006). Manthey and Denzer recognize 14 species of *Hypsilurus* acknowledging that this diversity is undoubtedly an underestimate (Manthey and Denzer 2006; Moody 1980). There are two species of *Hypsilurus* in the KWA: *H. modestus* and *H. papuensis*. *Hypsilurus modestus* is a relatively common small-bodied (maximum SVL = 107 mm) *Hypsilurus* with a broad range throughout the Papuan region (New Guinea and nearby associated islands), whereas *H. papuensis* is large bodied (maximum SVL = 190 mm) and uncommon with a poorly identified distribution throughout the Papuan region.

The gekkonid genus *Nactus* includes the widespread *Nactus pelagicus* complex that undoubtedly consists of several distinct species, the identification of which has been hindered by morphological conservatism and lack of adequate study. Based on morphological data, Zug and Moon (1995) determined the distribution of the asexual *N. pelagicus*, which includes Micronesia, southern Vanuatu (Erromango and Tanna Islands), New Caledonia, and eastward to Melanesia and Polynesia. *Nactus multicarinatus*, a bisexual species, has a range from the southern Solomon Islands and Vanuatu (excluding the islands of Tanna and Erromango) (Zug and Moon 1995). Donnellan and Moritz (1995) identified two highly differentiated populations of the *Nactus pelagicus* complex in Madang Province, Papua New Guinea based on allozymes. One of these Madang populations showed no fixed differences

TABLE 1. Checklist of the terrestrial reptile fauna of Kau Wildlife Area, Papua New Guinea. I refer to a species as 'Common' if it is typically encountered in an appropriate 8-h search period. Species listed as 'Uncommon' are encountered infrequently in the KWA and typically require more than a single day/night search of 8 h to locate.

Species	Comments & Literature
Lizards	
Agamidae	
Hypsilurus modestus	Common (Manthey and Denzer 2006; Moody 1980)
Hypsilurus papuensis	Uncommon (Manthey and Denzer 2006; Moody 1980)
Gekkonidae	
Nactus multicarinatus	Common (Donnellan and Moritz 1995; Moritz 1987; Zug and Moon 1995)
Cyrtodactylus sp.	Uncommon (Brown and Parker 1973)
Gekko vittatus	Common (de Rooij 1915)
Gehyra sp.	Uncommon (Beckon 1992; Chrapliwy et al. 1961; King 1984; King and Horner 1989)
Hemidactylus frenatus	Common (Mortiz et al. 1993)
Lepidodactylus lugubris	Common (Mortiz et al. 1993)
Scincidae	
Carlia mysi	Common (Zug [2004] revised the *Carlia fusca* complex)
Emoia caeruleocauda	Common (Brown 1991)
Emoia longicauda	Uncommon (Brown 1991)
Emoia jakati	Common (Brown 1991)
Emoia kordoana	Uncommon (Brown 1991)
Lamprolepis smaragdina	Common (Greer 1970)
Lipinia noctua	Uncommon (Austin 1998; Zweifel 1979)
Lobulia brongersmai	Uncommon (Allison and Greer 1986; Zweifel 1972)
Prasinohaema virens	Uncommon (Mys 1988)
Sphenomorphus jobiensis	Common (Donnellan and Aplin 1989)
Sphenomorphus mulleri	Uncommon (de Rooij 1915)
Sphenomorphus simus	Common (formally *S. stickli*, Shea and Greer 1999)
Sphenomorphus solomonis	Common (de Rooij 1915)
Sphenomorphus derooyae	Uncommon (de Rooij 1915)
Triblonotus gracilis	Uncommon (Cogger 1972; Zweifel 1966)
Varanidae	
Varanus indicus	Common (low density) (Böhme 2003)
Varanus prasinus	Uncommon (low density) (Böhme 2003; Sprackland 1991)
Snakes	
Boidae	
Candoia aspera	Common, the most common terrestrial snake found in Kau (Austin 2000)
Candoia carinata	Uncommon (Austin 2000)
Pythonidae	
Morelia viridis	Uncommon (low density) (Rawlings and Donnellan 2003)
Colubridae	
Boiga irregularis	Uncommon (O'Shea 1996)
Stegonotus modestus	Uncommon (O'Shea 1996)
Stegonotus parvus	Uncommon (O'Shea 1996)
Elapidae	
Micropechis ikaheka	Uncommon (O'Shea 1996)

with the Solomon and northern Vanuatu bisexual *Nactus multicarinatus* populations and thus this name should apply to one of the two Madang populations (Zug and Moon 1995). The contact zone, if there is one, between the two genetically distinct Madang populations has not been identified and it is possible that both populations, likely corresponding to two distinct species, occur

in the KWA.

The gekkonid genus *Gehyra* in New Guinea consists of several species, the taxonomy of which is in need of revision (King 1984; King and Horner 1989). The geographic distribution and specific-level variation for virtually all species of New Guinea *Gehyra* is not well understood and many collections have misidentified taxa.

The scincid *Sphenomorphus jobiensis* complex was first identified from allozyme data and, to a limited extent, morphology, but these data were not used to delineate species boundaries (Donnellan and Aplin 1989). DNA sequence data (Austin, unpubl. data) confirm the apparent specific-level differentiation found by Donnellan and Aplin (1989). In addition to the *S. jobiensis* complex, there are many other complexes that involve multiple cryptic species. These include the complexes within the genus *Sphenomorphus* (*S. derooyae*, *S. leptofasciatus*, *S. mulleri*, *S. pratti*, and *S. solomonis*, complexes). *Sphenomorphus derooyae* is likely a complex of several species with many names available for different populations (*cranei*, *derooyae*, *maindroni*, and *wolfi*; G. Shea, pers. comm.). In addition, other problematic groups include the *Lipinia noctua* complex (Austin 1999a,b), *Papuascincus stanleyanus* complex, *Emoia longicauda* complex, and *Carlia fusca* complex (Zug 2004). Only the latter complex has been adequately studied with 14 morphologically distinct species identified and taxonomically delineating in the New Guinea region (Zug 2004). *Carlia mysi*, with a broad range across the northeast coast of New Guinea and the Bismarck Archipelago, is the only *Carlia* species recorded from the KWA.

Unconfirmed Species that Possibly are Present in the KWA

Species not collected or visually confirmed, but likely present in the KWA, include (1) members of the *Cryptoblepharus boutonii* complex, which includes up to 36 'forms' (Mertens 1931) many of which are likely distinct species. Although not seen in the KWA, forest populations of *Cryptoblepharus* are often more secretive than coastal intertidal populations. (2) The genus *Emoia* includes approximately 42 species from New Guinea and associated archipelagos. The diversity and morphological conservatism in New Guinea *Emoia* has led to considerable confusion concerning the identification and taxonomy of this group. The genus *Emoia*, comprising 72 species, was revised by Brown (1991). This much-needed revision helped, but did not eliminate taxonomic obstacles for this large genus. In addition to the four *Emoia* recorded from KWA, six species of *Emoia* that occur in adjacent areas may be present in KWA. These include *Emoia battersbyi*, *E. cyanogaster*, *E. loveridgei*, *E. pallidiceps mehelyi*, E. *popei*, and *E. veracunda* (Brown 1991). (3) Seven other skinks with widespread yet patchy distributions along the north coast of New Guinea may be present in the KWA. These include *Eugongylus rufescens*, *Lipinia longiceps*, *L. pulchra*, *Sphenomorphus minutus*, *S. neuhaussi*, *S. pratti*, and *Tiliqua gigas* (Austin 1995, 1998; Mys 1988). *Sphenomorphus minutus*, although currently included in the *Sphenomorphus* group of Lygosomine skinks (Greer 1974, 1989; Hutchinson 1993), is actually a member of the *Eugongylus* group (Austin, unpubl. data). (4) Three pythons (*Apodora papuana*, *Leiopython albertisii*, and *Morelia amethistina*), while not recorded from the KWA, are likely present as they have been collected in nearby forested and human-disturbed areas adjacent to the KWA. (5) *Dendrolaphis calligasta* and *D. punctulatus* have both been recorded from Madang Province and likely occur in the KWA (O'Shea 1996). (6) *Acanthophis* spp. have been recorded from Madang Province, but are typically found in open grassland not heavily forested regions like the KWA (O'Shea 1996). Various specific epithets have been given to the several geographic races of New Guinea populations of *Acanthophis*, yet authors differ in their assignment and the taxonomy of this group needs examination (McDowell 1984; Storr 1981; Wüster et al. 2005).

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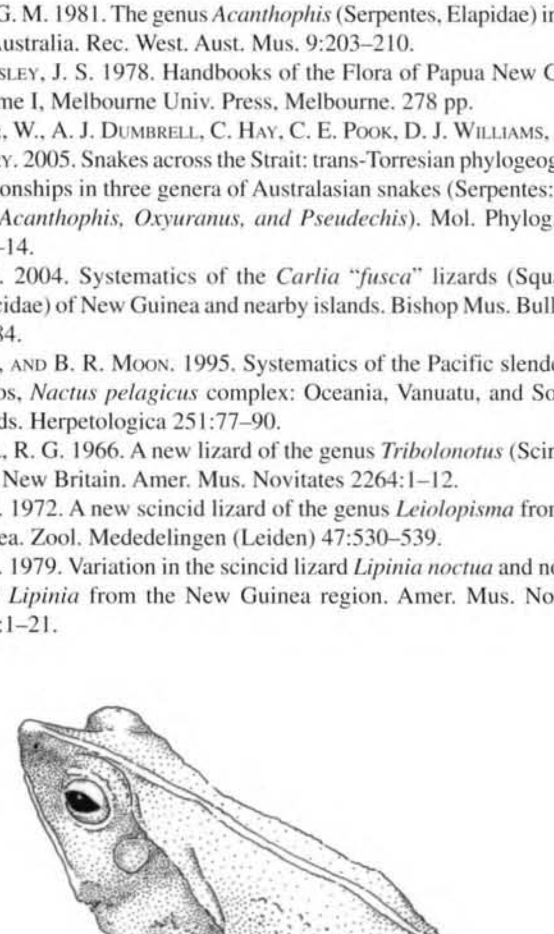

Bufo typhonius (Bufonidae). Locality: Vereda Guaimia, Bajo Anchicayá, Valle del Cauca, Pacific cost of Colombia. Illustration by Fernando Vargas Salinas.

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Forensic Implications of Dorsal Scale Row Counts on Puff-faced Water Snakes (Colubridae: Homalopsinae: *Homalopsis buccata*)

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"The Dorsals. These scales are perhaps the most useful of all guides in enabling us to differentiate between species and genera, but authors have not availed themselves of their full value." [Wall 1902:338]

Wildlife, including live animals, parts, or products manufactured from wildlife, must be properly declared to species of origin when imported into, or exported from, the United States. Forensic scientists at the U.S. National Fish and Wildlife Forensics Laboratory (U.S. Fish & Wildlife Service) assist law enforcement agencies in identifying animals and animal products in cases where suspected wildlife violations have occurred (Goddard and Espinoza 2000). While the Laboratory does not initiate or lead such investigations, it provides forensic support in a broad range of areas including species identification (morphological and molecular), cause of death examination, forensic chemistry, digital evidence analysis (computer, audio, video and photography), fingerprint, firearm, and tool mark analysis, and crime scene investigation.

Rigorous methods for identifying species in the wildlife trade are critical to law enforcement efforts to enforce wildlife legislation and international treaties (e.g., CITES), and to facilitate the legal trade in wildlife. Here I review published accounts of dorsal scale row counts in the puffed-faced water snake (*Homalopsis buccata*) and their forensic implications for identifying this species in the wildlife trade. While this species is not listed on CITES, enforcement personnel are often called upon to identify this snake to facilitate the legal trade in wildlife. I show that published scale row counts vary considerably and summarize these for wildlife law enforcement purposes.

The puffed-faced water snake is exploited extensively in the wildlife trade, where its skin is used to manufacture leather products (Stuart et al. 2000). Zhou and Jiang (2004) reported that between 1991 and 2001 alone, 1,448,134 skins of this species were imported into China for the leather trade. Stuart (2004) reported numerous live specimens in reptile trade shops in Vietnam. Jenkins and Broad (1994) list *H. buccata* as the third most common reptile skin imported into the U.S. during the years 1984–1990, consisting of 1,645,448 skins.

This species is distributed through southeast Asia, including parts of Bangladesh, India, Nepal, Myanmar, Thailand, Cambodia, Malaysia, Indonesia, Laos, Singapore, and Vietnam (Al-Murani 1990; David and Vogel 1996). Various other common names have been applied to *H. buccata*, including the Masked Water Snake (Murphy et al. 1998), the Dog-faced Water Snake (Campden-Main 1984) [this name is more commonly applied to *Cerberus rynchops*], and the Asian False Water Boa (Franke and Telecky 2001). Reviews of the general morphology, ecology, and phylogenetics of *H. buccata* (in addition to those in Table 1) are provided by Berry and Lim (1967), Murphy and Voris (1994), Stuart et al. (2000), Voris and Murphy (2002), and Voris et al. (2002). Two subspecies (*H. b. buccata* and *H. buccata nigroventralis*) have been described (Deuve 1970), though few researchers appear to be aware of these designations.

Although morphological descriptions of this snake are provided by many researchers, there is marked variability in published ranges for dorsal scale row counts (Table 1). This has the potential to lead to confusion in law enforcement efforts to monitor trade in this species, and has implications for the concept of "scientific certainty" (Bird 2001) in identifying this snake in a forensic context. Snake skins in the leather trade are often dyed, obscuring any original body coloration or banding patterns. Identification, therefore, may rely on scale shape, keeled vs. smooth scale morphology, and dorsal scale row counts to determine if a leather item is consistent with the species it was declared to be.

One of the most widely available texts to assist law enforcement personnel in their identification of snake skins in the leather trade is Mahnert (1981). The entry for *H. buccata* in this volume lists the number of dorsal scale rows in this species as 43–47, citing Taylor (1965), a reference well known and extensively used by herpetologists. In this example, a dyed snake skin with a dorsal scale row count of 35 at mid-body could be interpreted to be inconsistent with *H. buccata,* given the fact that Taylor reports the range for this species as 43–47. However, further review of the literature shows marked variability in published scale row counts for this species (Table 1).

Taylor (1965) noted that "The number of scalerows on the body is an important character and the number may vary at different points on the body." His description is somewhat confusing though, in that he stated "…number of scalerows variable, 37–47" (Taylor 1965:921), while at the same time noting "Variation in scalerows at the middle of the body is 43–47, the usual number being 45" (Taylor 1965:922). Though not explicitly stated, Taylor's report of 37–47 scale rows presumably refers to variability across the entire body length of an individual.

Even more confusing is Smith's (1943) description. In his general description of the monotypic genus *Homalopsis*, he describes the scales as "…in 39 to 47 rows" (Smith 1943:390). However, his more detailed entry under the species name *Homalopsis buccata* lists "Scales in 43–47, usually 45, rows" (Smith 1943:43–47). In neither description did he note body location, a critical variable in interpreting scale counts.

Gyi (1970), in his extensive and often cited revision of the subfamily Homalopsinae, reported dorsal scale rows in *H. buccata* as "37–41 at midbody." However, a closer review of his raw data (Table 12, p. 141) shows a range of 35–47 scale rows at midbody. In his key to the genera of the Homalopsinae, he describes *Homalopsis* with "dorsal scales in 39–47 rows" (Gyi 1970:61). The origin of this significant discrepancy by Gyi in these three instances is not clear.

The earliest report of scale row counts for *H. buccata* uncovered in my review is Günther (1864), who described the scales as ranging from 37–47 rows. The two most recent references (Fuchs and Fuchs 2003; Stuebing and Inger 1999) also produced the widest ranges (Table 1). While the notation of Fuchs and Fuchs (2003:229) (see Table 1) is not elaborated, the inference is that scales typically occur in 43–47 rows, but are known to range from

TABLE 1. Published ranges for dorsal scale row counts in *Homalopsis buccata*.

Citation	Dorsal scale rows (range)	Body location	Geography[1]
Al-Murani 1990:128	39–43	Mid-body	—
Bergman 1951:514	37–47 (citing Rooy 1916)	—	
	43–47 (citing Smith 1943)	—	
	33–41 (citing Kopstein 1930)	Gallbladder[2]	Indonesia
	34–40 (p. 514)	Gallbladder[2]	
Bosch 1985:30	37–47	—	Sulawesi
Campden-Main 1984:82	43–47	Mid-body	Vietnam
Cox 1991:198	43–47 ("usually 45")	Mid-body	Thailand
David and Vogel (1996:183)	37–47	Mid-body	Sumatra
Deuve 1970:179–185	37–47 (*H. b. buccata*)	—	
	35–39 (*H. buccata nigroventralis*)	—	Laos
Fuchs and Fuchs 2003:229	(37) 43–47 (49)	Mid-body	—
Günther 1864:285	37–47	—	British India
Gyi 1970:61, 138, 141	39–47 (p. 61)	—	
	39–45 (p. 138)	Anterior	Myanmar, Thailand,
	37–47 (p. 141)	Anterior	Malaya, Sumatra, Java
	37–41 (p.138)	Mid-body	
	35–47 (p. 141)	Mid-body	
	27–31 (p. 138)	Anterior to vent	
	23–33 (p. 141)	Anterior to vent	
Lim 1964:182	> 35	Mid-body	Malaysia
Mahnert 1981	43–47	—	Thailand (by citing Taylor 1965)
Manthey and Grossmann 1997:307, 357	35–47	—	Southeast Asia
Marx and Rabb 1972:78–79	Range not reported, through range span listed as 11	Mid-body	—
Rooij 1917:186–187	37–47	—	Indo-Australian Archipelago
Saint Girons 1972: 48, 110–114	43–47	—	Cambodia
Smith 1943:390–391	39–47 (p. 390)	—	Myanmar, Sri Lanka, India
	43–47 (p. 391)	—	
	("usually 45, rows") (p. 391)		
Stuebing and Inger 1999:96	32–48	Mid-body	Borneo
Taylor 1965:921–922	37–47 (p. 921)	—	
	43–47 (p. 922)	Mid-body	Thailand
	("usual number being 45") (p. 922)	Mid-body	
Tweedie 1983:17, 103	37–47	Mid-body	Malay Peninsula (including parts of Thailand, Malaysia and Singapore)

[1]Refers to geographic coverage of the text
[2]Interpreted to mean mid-body

37–49 rows. This count of 49 scale rows is the highest of any mid-body dorsal rows reported for this species. The lowest count at mid-body is reported by Stuebing and Inger (1999), who list a range of 32–48. Interestingly, they do not elaborate on the low end of their range or compare it to previous accounts, which are generally higher. The combined ranges of Fuchs and Fuchs (2003) and Stuebing and Inger (1999) result in a published dorsal scale row count in *H. buccata* of 32–49 scales at midbody. This range is significantly different from most accounts in Table 1, especially that reported by Mahnert (1981), a reference used by many of those responsible for monitoring the wildlife trade. Based on this review, it appears that the entire range of dorsal scale counts of 32–49 at mid-body should be considered consistent with *H. buccata* by wildlife law enforcement personnel.

This review reiterates that both accurate and precise morphological descriptions are critical not only to taxonomic research, but to forensic efforts and the conservation of species. It is likely that many herpetologists are unaware that their research, even basic descriptions, may be used in a forensic and legal context. In addition, enforcement personnel must be made aware that published morphological descriptions may refer only to a limited range of variability within a species. It appears that Taylor's (1965) data have been used inappropriately by some as a diagnosis for the species from its entire range. The wide geographic range of *Homalopsis buccata* and additional research has revealed further variability in dorsal scale rows in this species. Additional documentation of scale count variability in *H. buccata* outside the range summarized here is also warranted, as are similar reviews of other snake species in the wildlife trade.

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Identification of Molluscan Prey from Feces of Iwasaki's Slug Snake, *Pareas iwasakii*

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For decades, herpetologists have been striving to reveal the foraging ecology of snakes (Arnold 1993). In spite of considerable effort to collect snake dietary information, the diets of many species remain unknown. The diets of snail-eating snakes are among the least well known. Adaptations for extracting snails from their shells have arisen independently in at least three subfamilies of colubrid snakes: Pareatinae, Natricinae, and Dipsadinae (Gotz 2002; Rossman and Myer 1990; Sazima 1989). When feeding on a large snail, the snake inserts its mandibles into the snail's aperture, and moves each mandible forward and back to extract the body of the snail. Although snails have been confirmed as the primary prey of these snake species via feeding observations of captives and from gut content analysis of wild snakes, the natural prey have rarely been identified to species. This is because molluscs that are swallowed without shells were thought to leave no diagnostic remnants in the guts or feces of snakes (Peters 1960). The only available report in which snails eaten by wild snakes were identified to species is that of Judd (1954). He identified prey on the basis of shells, jaws, and radulae of snails found in the stomachs, intestines, and feces of several individuals of *Storeria dekayi* in Ontario, but he did not describe the characters on which he based his identification of species.

All species of the pareatine genus *Pareas* occur in Southeast Asia and are believed to feed exclusively on terrestrial snails and slugs (Greene 1997). This diet was confirmed by providing non-native terrestrial snails to captive snakes of the genus *Pareas* (Hirata and Ota 1993; Otani 1983) but the species identity of native prey species has not been determined. Here we present the first record of prey species identified from the feces of *Pareas iwasakii*, determined by scanning electron microscopy (SEM). We propose that our method may be applicable to the identification of prey in other snail-eating snakes.

We surveyed literature on the terrestrial molluscan fauna of Iriomote and Ishigaki Islands (Azuma 1995; Habe and Chinen 1974) to determine which species of large snails (shell diameters > 10 mm) and slugs were potential prey for wild *P. iwasakii*,. To examine preferences for these species of snails, a male *P. iwasakii* (SVL = 440 mm, captured on Iriomote Island on 19 May 2004) was maintained in a cage with snails collected from Iriomote Island. Snails that remained alive in the cage with the snake for more than one month were considered not to be preferred species, and thus were excluded from the reference species to which fecal samples were compared.

Prior to its use in the preference experiment, and before it had fed in captivity, the same male *P. iwasakii* excreted feces on 21, 22, and 24 May. These three fecal samples were preserved in 99% ethanol. Microscopic examination of the earliest sample revealed a jaw and several fragments of a radula that were seemingly derived from a single snail. The radula and jaw are the hardest parts of a snail's body, except for the shell, and are not digestible because they are composed of chitin. The minute radular teeth and jaw have been used as characters for the classification of terrestrial snails (Solem 1978). We examined the radula (using SEM) and the jaw (using a binocular microscope), and compared them with reference specimens prepared from terrestrial snails from Iriomote Island that had been selected as described above.

The literature survey revealed that the large terrestrial molluscs of Iriomote and Ishigaki include 13 species of snails in 9 genera and no native slugs (Table 1). Of the snails, *Pareas iwasakii* ate only 7 species (3 genera; *Satsuma, Aegista*, and *Acusta*). *Bekkochlamys masakii* and *Videna carthcartae* were not eaten by *P. iwasakii*, but the early deaths of these snails precluded confirmation of their status as prey species.

SEM could not reveal the formula of the radula contained in the feces because the marginal teeth were damaged; thus, the number of transverse radular teeth could not be counted. Nonetheless, the

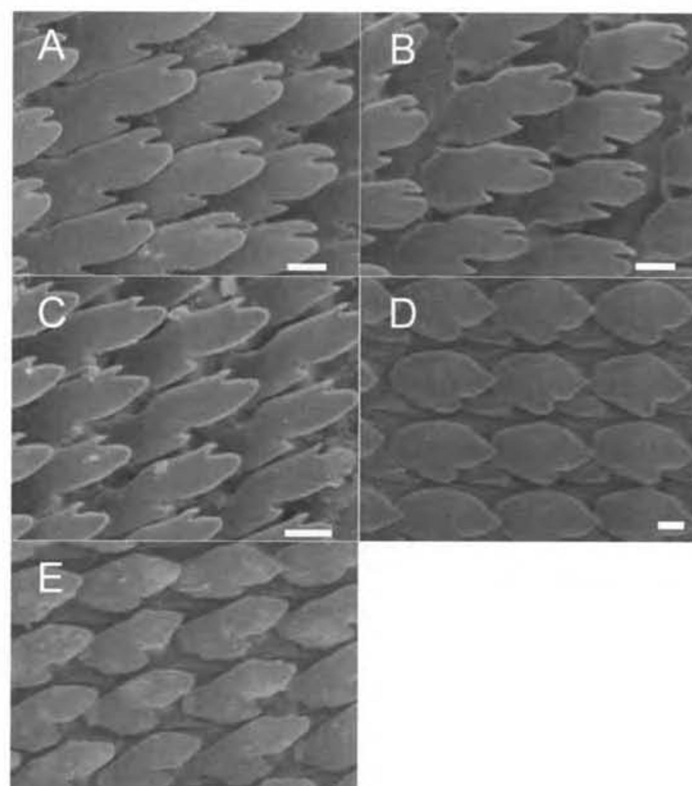

FIG. 1. The SEM photographs of the radulae of terrestrial snails. (A) The radula recovered from feces of a wild-captured *Pareas iwasakii*. (B) The radula of *Satsuma caliginosa*. (C) The radula of *S. yaeyamensis*. (D) The radula of *Acusta tourannensis*. (E). The radula of *Aegista mackensii*. Scale bars = 10 μm.

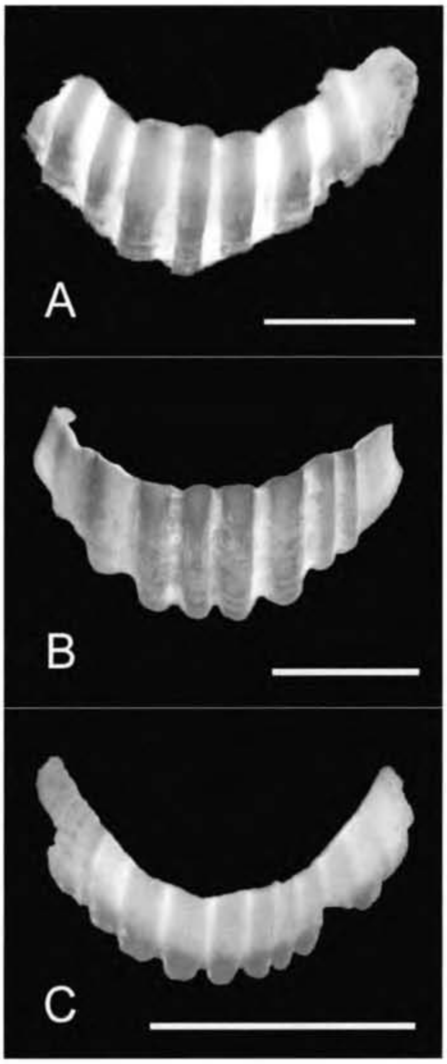

FIG. 2. Binocular photographs of the jaws of terrestrial snails. (A) The jaw recovered from feces of *Pareas iwasakii*. (B) The jaw of *Satsuma caliginosa*. (C) The jaw of *S. yaeyamensis*. Scale bars = 1 mm.

radula was conclusively identified as belonging to an individual of the genus *Satsuma* based on the diagnostic deeply notched trident structure of the radular tooth (Figs. 1A–E). Although it was difficult to distinguish between the radular teeth of *S. caliginosa* and *S. yaeyamensis* (Figs. 1B, C), the two congeners could be distinguished by the size and microstructure of the jaw (Figs. 2B, C). Consequently, the prey item was identified as *S. caliginosa* (Figs. 1A, B, 2A, B). Furthermore, comparison of the recovered jaw with those of *S. caliginosa* of various sizes suggests that the prey item was an immature individual.

Food habits of snakes are generally investigated by examination of gut contents of preserved specimens or by forced regurgitation of stomach contents from live specimens. Because both forced regurgitation of soft bodied prey and identification of extracted or well-digested snails are difficult, most herpetologists have thought that it is impractical or impossible to identify molluscan prey eaten by snakes (Cobb 2004; Kofron 1982; Peters 1960). Conceivably, the stomach contents of a snake that had eaten a snail just before capture might include the undigested reproductive organ, which is an important diagnostic feature. However, the diagnostic feature of a reproductive organ would rarely be recovered from the stomach because any soft tissues of a snail would be rapidly digested. Moreover, not all stomach contents may be collected by forced regurgitation. *P. iwasakii* is a vulnerable species (Ota 2000), and Pareatinae occur only in the tropical forests of southeastern Asia, which are rapidly being modified by human activities (Laportaferreira and Salomao 2004). Thus, the identification of prey species of snail-eating snakes based upon fecal analysis is strongly recommended as a non-invasive method.

TABLE 1. The large-shelled native inland snails of Iriomote and Ishigaki Islands (diameter > 10 mm), and feeding preference of *Pareas iwasakii* for these snails. D: diameter of snails according to Azuma (1995), Y: eaten by the snake, N: not eaten by the snake.

Species	D (mm)	Feeding result
Acusta tourannensis	16.0	Y
Aegista mackensii	42.5	Y
Ae. vermis	28.5	Y
Ae. caerulea	23.0	Y
Ae. osbeckii	20.0	Y
Bekkochlamys masakii	15.0	N?
Cyclophorus turgidus radians	26.5	N
Cyclotus taivanus peraffinis	15.0	N
Leptopoma nitidum	17.0	N
Luchuena eucharista	11.5	N
Satsuma caliginosa	37.0	Y
S. yaeyamensis	31.0	Y
Videna carthcartae	16.5	N?

To identify prey from visually unrecognizable remains in predator diets, a polymerase chain reaction (PCR)-based molecular method may provide a powerful tool (Symondson 2002). However, molecular methods have three disadvantages in comparison with our method. First, molecular methods require more expensive equipment and reagents than does our method. Second, PCR is not always successful because of the possible deterioration of DNA during digestion. Third, molecular methods may not reveal the number and size of identified prey. In the present paper, the number of prey consumed was confirmed to be one individual. Although the size of the prey was not definitively determined, examination of reference specimens enabled us to estimate the size of the consumed snail. On the other hand, a disadvantage of our method is that it requires preparation of reference samples of radulae of local snails. However, molecular methods also require the preparation of reference DNA sequences, although sequences from closely related species in DNA databases would also yield useful results. We suggest that the identification of radulae and jaws from feces is a more useful method for identifying the prey of snail- and slug-eating snakes than is identification from DNA contained in feces or identification from stomach contents obtained by sacrificing snakes. Furthermore, the stomach contents of road-killed snakes or preserved snake specimens in museums may be available.

We offer the following suggestions to those preparing samples for the identification of molluscan prey based on radulae retained in stomach or fecal contents of snakes. It is best to clean the radu-

lae in vials with very little water, using ultrasonic cleaning equipment for a few minutes. Excessive treatment sometimes disintegrated the fragile radulae of snails collected from feces. Holznagel (1998) recommended an enzymatic cleaning method for radulae that could be adapted for use with fecal samples. Because it is difficult to distinguish the dorsal from the ventral side of a radula prior to SEM, the radulae should be divided into two or more pieces and the resulting samples prepared so that both sides will be visible during SEM observation.

Our captive observations suggest that *P. iwasakii* has preferences for specific groups of land snails. Otani (1983) reported that *P. iwasakii* refused to eat certain snails including Cyclophoracea (*Leptopoma nitidum*, *Cyclophorus turgidus radians*, and *Cyclotus taivanus peraffinis*). Because of the early accidental death of *Bekkochlamys masakii* during our experiment, it is unclear whether *P. iwasakii* will consume that species.

The identified prey, *S. caliginosa*, is one of the most abundant, rather arboreal snails in the habitat of *P. iwasakii* at night (M. Hoso, unpubl.). The snake is assumed to be an arboreal, forest-dependent species (Toyama 1996), and several species of *Pareas* are able to extract snails deftly and eat soft tissues while perched on a branch in captivity (Gotz 2002; M. Hoso, pers. obs.). These observations suggest that *P. iwasakii* forages above the ground, so we suppose that the snake encounters *S. caliginosa* frequently.

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TECHNIQUES

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Cross-Species Amplification of DNA Microsatellite Loci in an Australian Lineage of Social Lizards (Scincidae, Genus *Egernia*)

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Advances in molecular technology have led to the discovery of a number of lizard species living in stable family groups. These social lizards provide an opportunity to test current hypotheses about the evolution and maintenance of vertebrate social systems developed using endothermic models (i.e., birds and mammals). As such, social lizards have increasingly been the focus of intense research, in particular studies within the Australian *Egernia* Group lineage of skinks.

The scincid genus *Egernia* comprises 32 species of medium to large-sized viviparous skinks and is endemic to Australia (Chapple 2003). Recently, much interest has been generated in this group due to the realization that complex social systems and monogamy are widespread within the genus, with reports on 26 of the 32 species suggesting social structures of varying complexity, ranging from predominately solitary through to large social aggregations in excess of 30 individuals (reviewed in Chapple 2003). Long-term behavioral and genetic studies on four species have shown that these large aggregations are stable between years and consist of closely related individuals (Chapple 2003). In addition, *E. cunninghami*, *E. saxatilis* and *E. stokesii* have been shown to exhibit long-term social and genetic monogamy, with *E. cunninghami* and *E. stokesii* exhibiting strong inbreeding avoidance (Gardner et al. 2001, 2002; O'Connor and Shine 2003; Stow et al. 2001; Stow and Sunnucks 2004a,b). Such behavioral traits are extremely rare in lizards (Bull 2000), therefore the genus provides a unique opportunity to examine the evolution of complex sociality within squamate reptiles and test existing hypotheses about the evolution of vertebrate sociality (Chapple 2003).

Several factors have enabled *Egernia* to be utilized as a 'model' system for examining the evolution of sociality and monogamy in lizards. First, most species are large, long-lived and exhibit a strong attachment to a home site (e.g., rock crevice, burrow, log) and therefore are well-suited to long-term behavioral and genetic studies (Chapple 2003). Second, a large number of microsatellite primers have been developed for *E. stokesii* (Gardner et al. 1999; 11 EST primers), *E. cunninghami* (Stow 2002; 5 Ecu primers) and the closely related *Tiliqua rugosa* (Cooper et al. 1997; 6 Tr primers). However, what has facilitated the research to date is a high degree of successful cross-species PCR amplification of microsatellite loci within the lineage using the same primer pairs. These primers have now been utilized for examining aspects of sociality and mating systems in *E. stokesii* (Gardner et al. 2001, 2002), *E. saxatilis* (O'Connor and Shine 2003), *E. cunninghami* (Stow et al. 2001; Stow and Sunnucks 2004a,b), *E. striolata* (Bonnett 1999; Bull et al. 2001), *E. whitii* (Chapple and Keogh 2006) and *E. frerei* (Fuller et al. 2005).

Because this is a burgeoning and active area of research, similar studies are expected to be conducted for most other *Egernia* species (Chapple 2003). However, at present there is a lack of detailed information on the cross-species amplification of available *Egernia* microsatellite primers (especially for those that were problematic for some species). Microsatellite markers are costly and time intensive to develop and successful cross-species amplification can represent a substantial reduction in cost and time. Detailed information on the potential utility of each microsatellite locus would aid in selecting primers for particular *Egernia* species, saving time and money. Here we report the cross-species application of the available microsatellite primers in five *Egernia* species. These species represent four of the six species groupings within the genus: *E. cunninghami* and *E. stokesii* (*cunninghami* group, 4 species), *E. saxatilis* (*striolata* group, 9 species), *E. whitii* (*whitii* group, 12 species) and *E. frerei* (*major* group, 4 species). Since the remaining two species groups comprise a total of three species (*E. kingii* group, 1 species; *E. luctuosa* group, 2 species), the four species groups that we examine contain 29 of the 32 species in the genus and therefore should provide valuable information for future researchers. In order to supplement our detailed analysis of five species we provide a brief summary of the results from published studies that have used microsatellites in *Egernia* species.

The PCR conditions used for each species are contained within the original published studies and therefore we only provide relevant information that has not been published elsewhere. For *E. stokesii* details regarding PCR conditions and parameters are contained in Cooper et al. (1997) and Gardner et al. (1999, 2000, 2001, 2002), with the conditions for the Ecu primers as detailed in Stow (2002). For *E. cunninghami* this information is provided in Stow et al. (2001), Stow (2002), and Stow and Sunnucks (2004a, b),

TABLE 1. Cross-amplification of the available microsatellite primers in the *Egernia*, *Tiliqua* and *Cyclodomorphus* species tested to date. P = polymorphic; M = monomorphic; U = unsuccessful amplification; ? = some degree of amplification (see Table 2 for further detail). Species codes as follows: EC = *E. cunninghami*, EF = *E. frerei*, EI = *E. inornata*, ESa = *E. saxatilis*, ESto = *E. stokesii*, EStr = *E. striolata*, EW = *E. whitii*, TA = *T. adelaidensis*, TR = *T. rugosa*, TS = *T. scincoides*, CB = *C. branchialis*, CC = *C. casuarinae*, CG = *C. gerrardii*.

Locus	EC	EF	EI	ESa	ESto	EStr	EW	TA	TR	TS	CB	CC	CG
Tr3.2	P	U[1]			P	P[4]	U	P[1]	P[6]	P[1]		P[1]	U[1]
Tr4.6	?	M?[1]			P[1]			M?[1]	P[6]	M?[1]		P[1]	U[1]
Tr4.11	P	M		P	P[1]		U	P[1]	P[6]	M?[1]		P[1]	U[1]
Tr5.20	P	P		P	P[1]		U	U[1]	P[6]	P[1]		P[1]	M?[1]
Tr5.21	P	P		P	P[1]		U	P[1]	P[6]	P[1]		P[1]	U[1]
EST1	P	P		P	P[2]		P						
EST2	P	P	P[1]	P	P[2]	P[5]	P	P[1]	P[1]		P[1]		
EST3	U		U[1]		P[2]	U[1]	U	U[1]	U[1]		U[1]		
EST4	?	P	P?[1]		P[2]	U[1]	P	P[1]	U[1]		M?[1]		
EST6	?				P[1]								
EST8	?	?	P[1]	?	P[1]	P[5]	U	M?[1]	M?[1]		M?[1]		
EST9	P	P	P[1]	?	?[2]	U[1]	P	P[1]	U[1]		P[1]		
EST12	P	M		P	?[2]	P[5]	P						
EST14					?								
EST15	U				P								
EST16					?								
Ecu1	P	?		P	P[3]		P		?				
Ecu2	P			P	P[3]		P		?				
Ecu3	P	P		U	U[3]		U						
Ecu4	P			U	P[3]		U		P?				
Ecu5	P			P	P[3]		P		P?				

References

[1]Gardner (1999); [2]Gardner et al. (1999, 2000); [3]Stow (2002); [4]Bull et al. (2001); [5]Bonnett (1999); [6]Cooper et al. (1997).

while those for *E. frerei* are contained in Cooper et al. (1997), Gardner et al. (1999, 2000), Stow (2002), and Fuller et al. (2005).

Information relating to the cross-amplification in *E. whitii* is contained in Chapple and Keogh (2005, in press). In this species PCR was performed in a 20 µl volume reaction, containing approximately 100 ng of template DNA, 2.5 pmol of the M13(-21) tailed sequence-specific forward primer, 10 pmol of the sequence-specific reverse primer, 10 pmol of a fluorescent dye-labelled M13(-21) universal primer (either 6-FAM, NED or PET; Applied Biosystems), 2 µl 10x PCR Buffer, 2 µl 10x Enhancer Solution (Gibco BRI Life Technologies), 3 mM $MgSO_4$, 2 mM dNTPs and 0.2 units of Platinum *Taq* DNA polymerase (Gibco BRI Life Technologies). A 'stepping down' PCR program was used to amplify each locus. Reactions were initially denatured at 94°C for 5 min, followed by an annealing step at 70°C for 15 sec and extension at 72°C for 1.5 min. This was followed by a further round of denaturation at 94°C for 30 sec, annealing at 70°C for 15 sec and extension at 72°C for 1.5 min. The annealing temperature was then dropped by 5°C in the next two rounds of cycling. This 'stepping down' in annealing temperature was repeated until a final annealing temperature of 35°C was reached. The next 50 cycles then were performed with this annealing temperature. A final extension step at 72°C was done for 7 min.

Details concerning the amplification of the loci in *E. saxatilis* are contained in Cooper et al. (1997), Gardner et al. (1999), and O'Connor and Shine (2003). PCR was performed in a 10 µl volume reaction, containing 5 µl of template DNA, 1x PCR reaction buffer, 1.5 mM $MgCl_2$, 0.1 mM dNTPS, 400 nM of each primer, and 0.25 units of *Taq* DNA polymerase (all Sigma reagents). The PCR parameters for the Ecu primers followed Stow (2002). The PCR program for EST2, EST12 and Tr4.11 involved an initial denaturing step of 94°C for 3 min, followed by 35 cycles of 94°C for 30 sec, 55°C for 30 sec, and 72°C for 30 sec, followed by a final extension step at 72°C for 10 min. The parameters for EST1 and Tr5.21 were similar except that the 35 cycles were substituted with one cycle with an annealing temperature of 55°C, followed by single cycles at 53°C, 51°C, and 49°C, with a further 30 cycles at 47°C. For Tr5.20, these cycles were replaced by 7 cycles at each of the following annealing temperatures: 55°C, 53°C, 51°C, and 49°C. For EST8 and EST9 the 35 cycles were replaced by annealing temperatures of 55°C (2 cycles), 53°C (2 cycles), 51°C (2 cycles), 49°C (2 cycles) and 47°C (20 cycles).

Within *Egernia* there are eight primer pairs that appear to perform well across all lineages (Table 1). The most successfully used loci are EST1, EST2, EST12, Tr5.20 and Tr5.21 with promising preliminary results from the recently developed Ecu1, Ecu2 and Ecu5 primers. The *Egernia* range of primers is highly polymorphic and extremely informative (Table 2). Tr4.11 however, ap-

TABLE 2. Cross-amplification of the available microsatellite primers in five *Egernia* species. Several loci were not trialled in each of the species: *E. cunninghami* (Tr3.8, EST14, EST16), *E. saxatilis* (Tr3.2, Tr3.8, Tr4.6, EST3-4, EST6, EST14-16), *E. whitii* (Tr3.8, Tr4.6, EST6, EST14-16), *E. frerei* (Tr3.2, Tr3.8, EST3, EST6, EST14-16, Ecu2, Ecu4-5) and *E. stokesii* (Ecu3). N = number of individuals trialled; NA = number of alleles; Ho = Observed heterozygosity; He = Expected heterozygosity; HWE P = *P*-value for Hardy-Weinberg equilibrium for each locus.

Locus	N	Size range	NA	Ho	He	HWE P	Notes
[1]*E. cunninghami*							
Tr3.2	189	161–269	20	0.961	0.928	NS	Linkage disequilibrium with EST12
Tr4.6	10	amplified				NS	Could not optimise [at](47, 55, 60)
Tr4.11	189	amplified	12	0.460	0.809	< 0.001	Sex-linked (females heterozygous)
Tr5.20	189	146–152	3	0.260	0.268	NS	High frequency of putative null alleles at one site (ca. 12%)
Tr5.21	189	79–145	18	0.887	0.875	NS	
EST1	189	209–337	20	0.940	0.883	NS	
EST13 (= EST2)	189	164–252	17	0.868	0.926	NS	
EST4	189	amplified	17	0.538	0.888	< 0.001	High frequency of null alleles (ca. 24%)
EST6	10	amplified				NS	Could not optimize [at](47, 55, 60)
EST8	10	amplified				NS	Could not optimize [at](47, 55, 60)
EST9	189	215–279	12	0.660	0.646	NS	
EST12	189	amplified	26	0.915	0.921	NS	Linkage disequilibrium with Tr3.2
Ecu1	161	144–194	17	0.883	0.902	NS	
Ecu2	161	154–196	13	0.848	0.843	NS	
Ecu3	161	220–272	11	0.784	0.825	NS	
Ecu4	161	76–288	29	0.825	0.924	NS	null alleles (ca. 9%)
Ecu5	161	120–164	17	0.894	0.904	NS	
E. saxatilis							
Tr4.11	28	134–137	2				Sex-linked
Tr5.20	277	127–191	29	0.693	0.894	<0.001	null alleles (ca. 13%)
Tr5.21	280	80–120	17	0.821	0.883	NS	
EST1	279	209–309	25	0.928	0.931	NS	
EST2	276	194–274	21	0.804	0.922	NS	
EST8	42	Amplified					Could not optimize
EST9	24	Amplified					Could not optimize
EST12	281	191–267	19	0.865	0.606	NS	
Ecu1	4	Amplified					
Ecu2	4	Amplified					
Ecu5	4	Amplified					
E. whitii							
EST1	127	226–314	20	0.787	0.928	NS	
EST2	127	188–280	20	0.969	0.923	NS	
EST4	127	123–179	14	0.858	0.874	NS	
EST9	15	259–277	4	0.400	0.579	NS	Putative null alleles
EST12	127	276–374	21	0.890	0.933	NS	
Ecu1	16	159–243	18?	0.813	0.915	NS	Di-repeat with 4 peak stutter
Ecu2	127	149–179	13	0.535	0.790	<0.001	null alleles (ca. 24%)
Ecu5	14	122–136	4	0.929	0.643	NS	
E. frerei							
Tr4.6	1	Amplified	1				
Tr4.11	28	130	1	N/A	N/A	N/A	Monomorphic
Tr5.20	229	118–126	6	0.489	0.485	NS	Di-repeat with stutter
Tr5.21	224	82–88	7	0.799	0.754	NS	Alleles differ by 1bp
EST1	225	188–266	30	0.804	0.935	NS	Alleles differ by 2bp
EST2	229	173–243	18	0.764	0.912	<0.001	Short allele dominance
EST4	225	108–120	4	0.280	0.261	NS	
EST8	85	104–176	?				Could not optimize
EST9	228	227–303	20	0.803	0.904	NS	
EST12	29	247	1				Monomorphic
Ecu1	16	141–151	3?				Could not optimize
Ecu3	15	229–281	9	0.800	0.883	NS	
E. stokesii							
Tr3.2	150	176–234	20	0.867	0.880	NS	Linkage disequilibrium with EST12
Tr5.21	50		4	0.292	0.2	0.0012	Null alleles (ca 13%), stutters
EST1	150	234–282	12	0.913	0.865	NS	
EST2	141	206–286	24	0.915	0.910	NS	

TABLE 2. Continued.

Locus	N	Size range	NA	Ho	He	HWE P	Notes
EST3	141	246–346	16	0.865	0.884	NS	Low frequency of null alleles, short allele dominance
EST4	150	141–189	11	0.793	0.850	NS	Low frequency of null alleles, short allele dominance
EST6	10	163–189	8	0.80			
EST8	149	101–141	8	0.799	0.816	NS	
EST9	10	235–263	9	0.60			High frequency of null alleles
EST12	149	288–336	13	0.846	0.879	NS	Linkage disequilibrium with Tr3.2
EST14	10	114–178	7	0			May contain null alleles
EST15	10	129–141	2	0.10			
EST16	10	156–184	5	0.40			May contain null alleles
Ecu1	50	111–186	4	0.612	0.22	<0.001	Null alleles (ca 28%), large alleles stutter.
Ecu2	50	132–170	8	0.683	0.62	NS	
Ecu4	50	64–72	3	0.578	0.58	NS	
Ecu5	50	107–121	11	0.87	0.8	NS	

[1] PCR conditions for optimized loci given in Stow et al. (2001) and Stow (2002)
[at] = annealing temperatures trialled (°C)

pears to be sex linked (females heterozygous) and Tr3.2 and EST12 appear to be directly linked (Table 2). Problems with short allele dominance and null alleles are present within the lineage but are not consistently related to a particular primer but rather the primer-species interaction (Table 2). Overall, the *Egernia* microsatellite loci are highly polymorphic and extremely informative for studies of sociality.

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Innovative Techniques for Sampling Stream-inhabiting Salamanders

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Although salamanders are excellent indicators of environmental health, the ability to catch them efficiently without substantially disrupting their habitat is not always practical or even possible with current techniques. Ripping open logs and raking leaf packs onto shore (Bruce 1972) are examples of such practices that are disruptive but widely used by herpetologists who have no other means of efficient collection. Drift fences with pitfall traps are effective in catching animals moving within or between habitats but are time consuming and require an initial financial investment and constant upkeep to maintain functionality and prevent animal fatalities (Gibbons and Semlitsch 1981). One current alternative to drift fences is the use of coverboards (Grant et al. 1992), which require less maintenance and sampling effort than drift fences. However, coverboards do not integrate captures over a long time period and often result in a lower number of captures per trap (Grant et al. 1992).

The purpose of our study was to evaluate the effectiveness of a new trap design for sampling stream-inhabiting salamanders. The traps were designed to be non-destructive to the habitat while being economical and time efficient. The new trap, a combination of PVC pipe and coverboard (PC trap), was specifically designed to take advantage of the tendency of species in habitats near water to run toward the water when their cover is disturbed and then remain motionless amongst the detritus. The coverboard of PC traps was used to create a habitat for the salamanders that could be efficiently surveyed and replaced. The other "traps" (coverboards and sections of PVC pipe) were used as comparisons. We predicted that the PC trap would have a higher number of captures per trap than coverboards or sections of PVC used separately. Although the techniques tested are being referred to as "traps," they are designed to be "escapable" and thus able to be left in place unaltered and unchecked indefinitely without causing mortality to salamanders or non-target species.

The study site, a seep-fed spring that originated at the bottom of a gorge and terminated at a constructed pond, spanned approximately 365 m of mixed hardwood forest near the Fall Line in Richmond County, Georgia. Twenty arrays were placed at 12.4-m intervals along the spring's banks. An array consisted of one of each trap type placed in random order at 1.8-m intervals. Randomness was achieved by designating each trap with a number (PVC = 1, coverboard = 2 and PC = 3) and then using a random number table to select their order. Each interval was measured from the closest edge of each trap. All traps were 73 cm in length. Arrays were numbered from 1 to 20 starting at the beginning of the spring and each trap was labeled by array number and type. For example, type "A" (PVC), type "B" (coverboard), and type "C" (PC) in array 15 were labeled as "15A," "15B," and "15C," respectively. Arrays were checked, in order, from the downstream end (array 20) to the upstream end (array 1).

The PVC trap consisted of a 73 cm section of 18 cm polyvinyl chlorate (PVC) with holes drilled on each end for "stakes" (wire insulation supports) to anchor it into the spring bed. These were placed in the middle of the spring and were checked internally before being rolled over on each survey date. Coverboards were composed of a 73 cm × 73 cm section of 11-mm plywood. These were placed parallel to the spring with approximately 18 cm of the board overhanging the spring or in the spring to mimic the amount of overhang associated with the PC trap.

The novel trap, PC, was a "PVC-coverboard hybrid" made of two independent parts (Fig. 1). The first part of the PC trap was a section of 11 mm plywood identical to that of the coverboards. This was used in conjunction with a 73 cm section of lengthwise-halved 18 cm PVC. Wire screen (gutter guard) was cut to fit each end of the PVC halves and was attached to the pipe with six zip ties that were drawn through six small, evenly spaced holes on each end of the PVC. The halved PVC of PC traps were anchored with the same "stakes" as PVC traps. These halved pipes were anchored by pushing the "stakes" into the ground on the terrestrial side of the pipe and bending their ends to catch the lip of the pipe. The pipe halves of PC traps were placed inside the spring parallel to and touching the bank with their terrestrial edge as tightly fitting with the bank as possible. The terrestrial side was always somewhat lower than the spring side, which allowed salamanders to enter and leave at will. While it was possible for the salamanders to navigate in and out of the halved pipe, once they fled to the water, they would remain motionless in the bottom of the pipe and would not move unless disturbed. The plywood was then placed on the bank with enough overhang (18 cm) to cover the halved-pipe. After lifting the board in the same manner as used for coverboards, the inside of the pipe was examined for salamanders and, if present, the salamanders could be lifted out of the water while still in the pipe and then could be handled one at time while the others remained in the pipe. The space under the pipe was also checked either by sight or, for best results, by using the PVC halve in place to scoop out anything underneath it. Time and money invested into each trap were estimated by creating a sum of all steps and parts associated with the trap type (cutting boards, constructing half pipes, material prices, etc.).

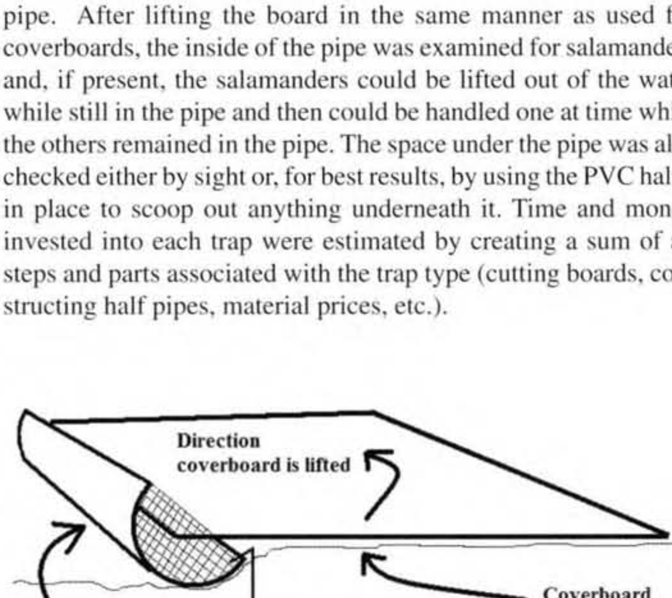

FIG. 1. PC trap as used in a spring at the study site.

TABLE 1. Total trap captures of each species and totals for each trap type. Surveys were conducted daily from 24 December 2003 to 3 January 3 2004, and on 1 February 2004 and 8 March 2004.

Species	PVC	Coverboard	PC traps	Total
Larval *Pseudotriton ruber*	6	16	59	81
Adult *Pseudotriton ruber*	0	3	2	5
Eurycea guttolineata	0	1	1	2
Eurycea cirrigera	0	2	3	5
Desmognathus conanti	0	5	0	5
Desmognathus auriculatus	1	1	3	5
Eurycea spp. Larvae	0	2	5	7
Totals	7	30	73	110

All traps were set on 22 December 2003 and checked daily from 24 December 2003 to 3 January 2004 and then again on 1 February 2004 and 8 March 2004 for a total of 13 days. Traps were checked, in order, from array 20 to array 1. We recorded the number and developmental stage of each species of salamander seen. Prior to release at the site of capture, each salamander was given a temporary ID by toe clipping, to keep track of recapture levels and movements. The same data for captures resulting from lifting or rolling natural cover within 1 m of the spring were collected, and the location was marked with an orange utility flag bearing information on species, date and time, ID number, and developmental stage. Cover that had been lifted or rolled for surveying purposes was replaced as close to the original position as possible and was checked on each successive survey. All larval salamanders considered too small for toe clipping were captured, noted, and released.

At the conclusion of trapping, 121 salamanders had been marked and were recaptured 57 times for a total of 178 captures. Species captured were *Desmognathus auriculatus*, *D. conanti*, *Eurycea cirrigera*, *E. guttolineata*, and *Pseudotriton ruber*. Larval *P. ruber* were captured most frequently (Table 1). Total number of salamander captures for the PVC, coverboard, and PC traps were 7, 30, and 73, respectively.

Each step in construction was done all at once (wood cutting, pipe sawing, etc.) and was timed along with assemblage to estimate overall construction times (Table 2). We used a hacksaw to cut through the PVC, which added time onto PVC and PC traps. PVC was the least effective of the three types in terms of both time and money invested per capture. Coverboards were the most efficient in terms of construction time invested per capture. The most efficient trap in terms of money invested per capture was the PC trap. Recently metamorphed *Rana clamitans* (N = 9) hibernated under the coverboards and PC traps. Only one snake, a *Nerodia fasciata* under trap 17B on 8 March 2004 (ca. 24 cm SVL), was found during the survey as it occurred during the winter season when they were inactive. Small crayfishes under 15 mm were occasionally found under boards and halved pipes of traps closer to the springhead.

TABLE 2. Construction cost and time invested per trap and per capture.

	Construction Cost	Construction Time	Cost/ Capture	Time/ Capture (min)
PVC	2.39	4	$6.81	11.4
Coverboard	1.62	5	$1.07	3.3
PC Traps	3.22	15	$0.88	4.1

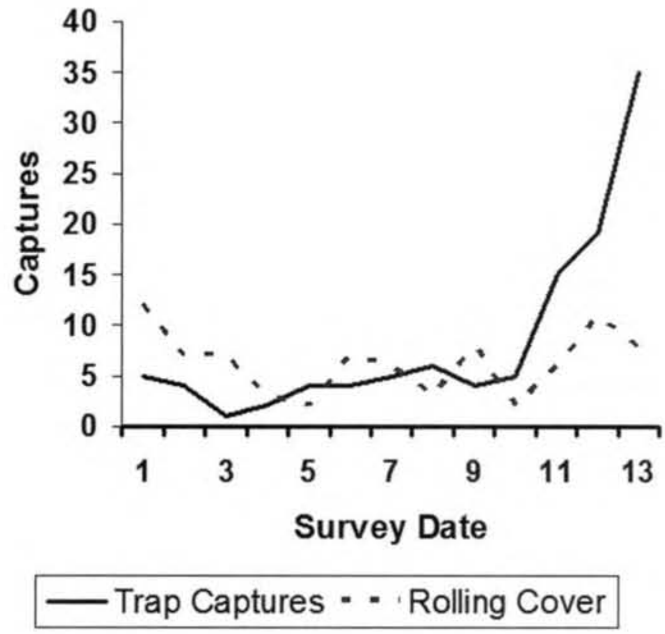

FIG. 2. Number of salamanders captured on each survey date (24 December 2003–3 January 2004, 1 February 2004 and 8 March 2004) resulting from trapping efforts and rolling natural cover present within 1 m of the spring.

The number of trap captures was few at the inception of the survey in comparison to the number of captures resulting from the rolling of natural cover. However, the number of trap captures increased as the project continued until they accounted for most daily captures (Fig. 2). The initial decrease in the numbers of salamanders in traps and under natural cover may have resulted from their refugia being disturbed on a constant basis for the first eleven survey dates. On the last three survey dates, which were each a month apart, the number of salamanders under each type of refugia increased and the number of salamanders under natural cover approached pre-survey levels. This positive trend is probably due to the decrease in disturbance to refugia as well as a possible increase in activity. The PC traps were more effective than all other traps in terms of total captures and became the most overall productive method as the study continued. This trend may be the result of salamanders having more time to find the traps and use them as refugia. Forty-six (63%) of the 73 salamanders found in the PC traps were either in or under the PVC, which may indicate a microhabitat preference.

A potential bias of the PC trap is that it depends on animals to select it as refugia and may not be equally effective for species with differing microhabitat preferences. This bias is evident in the number of the total larval *P. ruber* that were found in PC traps (N = 59) as compared to the combined total of coverboards and PVC traps (N = 22). Another possible bias was exhibited by *D. conanti*, which were present only under coverboards.

One major advantage of the PC trap was that it could be left unattended for an indefinite amount of time without any mortality because the animals were able to escape. This allows much more flexibility in trapping schedule and much less constant upkeep when compared to techniques such as drift fences that must be checked daily (Gibbons and Semlitsch 1981). Although drift fences are an effective way of collecting species moving from one finite area to another such as a seasonal wetland, they may not be practical to use in long and thin habitats such as springs and streams that cannot be surrounded easily. Drift fences may also fail to capture salamanders that are able to climb out of pitfalls or over fences. Ryan et al. (2002) suggested that a combination of census techniques should be used when monitoring herpetofaunal communities to account for the maximum number of species. The PC trap, while efficient in sampling salamanders in its immediate area and habitat, is not designed to be an all-inclusive, mass sampling technique such as a drift fence. Instead, it is most useful when sampling fully or semi-aquatic salamanders in or in very close proximity to water on a sporadic sampling schedule.

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An Effective and Durable Funnel Trap for Sampling Terrestrial Herpetofauna

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The global population decline of amphibians has attracted much international attention (Alford and Richards 1999). Although less attention has been paid to reptile populations, they appear to be declining at a faster rate than amphibian populations (Gibbons et al. 2000). Part of the discrepancy in attention between the two groups is due to the difficulty in estimating the population trends of reptiles. Reptiles tend to be secretive, solitary, and dispersed, making them difficult to sample, and these traits hinder long-term mark-recapture studies that are necessary to generate population trends.

To study the population ecology of terrestrial herpetofauna, researchers have employed various techniques such as timed searches, cover boards, and drift fences with pit fall traps or funnel traps (Renken et al. 2004; Ryan et al. 2002). Although all of these methods are effective, drift fences with funnel traps catch the largest species diversity and the most individuals (Ryan et al. 2002), especially for reptiles. Here we present our design for an effective, light, and durable funnel trap.

Species that aggregate for hibernation allow for a unique opportunity to acquire reliable population size estimates (Blouin-Demers et al. 2000; Prior et al. 2001). Each spring since 1996, we have sampled a population of Black Ratsnakes (*Elaphe alleghaniensis*) at the Queen's University Biological Station (150 km S of Ottawa, Ontario, Canada) by enclosing 12–18 hibernacula with perimeter fences fitted with funnel traps. We surround the hibernaculum with a wooden frame to which we staple heavy-gauge polyethylene plastic sheeting. We fold the plastic on itself twice before stapling and we staple through a piece of cardboard (3×10 cm) to prevent the plastic from ripping under wind force. We fold the plastic towards the inside of the fence at the bottom and pile rocks, sticks, and leaves on the fold until it is completely covered. We install one funnel trap along the fence when the enclosure has a diameter < 5 m and we install two traps diametrically opposed if the diameter of the enclosure is between 5 and 10 m. The enclosure and funnel traps allow a large proportion of the ratsnake population to be sampled: we capture ca. 200 individuals each spring (Blouin-Demers et al. 2000). We capture all size classes, from neonates (SVL = 250 mm, mass = 7 g) to adults (SVL = 1750 mm, mass = 1250 g). In addition, our funnel traps regularly capture (approximately 50 individuals per year) the other eight species of snakes encountered at our study site that use ratsnake hibernacula: *Nerodia sipedon, Thamnophis sirtalis, T. sauritus, Storeria dekayi, S. occipitomaculata, Diadophis punctuatus, Liochlorophis vernalis,* and *Lampropeltis triangulum*.

We construct the cylindrical frame of the trap and the funnel

with 1.27 cm (0.5 inch) hardware cloth (18–20 wire gauge) fastened with cage rings (these materials are commonly available at farm supply stores). We shape the funnel to be ca. 60 cm long, with a large opening of diameter > 30 cm and a small opening of diameter ca. 5 cm. We attach the funnel to a square piece (60 cm × 60 cm) of 1.91 cm (0.75 inch) plywood with a 30 cm circular hole cut 5 cm from the bottom (Fig. 1). The funnel is thus 5 cm above the ground after installation, but because we pile rocks, sticks, and leaves on top of the plastic sheeting we use as fencing, the opening of the funnel is actually level with the substrate (Fig. 2). We push the funnel from the outside through the opening in the plywood until it fits tightly and then cut, flatten, and secure (with 8 mm staples) the outer rim of the funnel to the plywood (Fig. 1). The diameter of the trap is also 30 cm, allowing us to use the plywood circle (cut out for the funnel) as the back of the trap.

To allow the capture of small snakes and to dissuade larger snakes from pushing their heads through the hardware cloth, we wrap the trap and funnel with aluminum window screening. We overlap the screening ca. 10 cm and sew it to the hardware cloth with aluminum wire (20–22 gauge), using 2-cm long stitches. The window screening and hardware cloth can both be purchased in 122 cm (4 feet) width, which is a convenient trap length.

After sewing the window screening to the trap, we install the

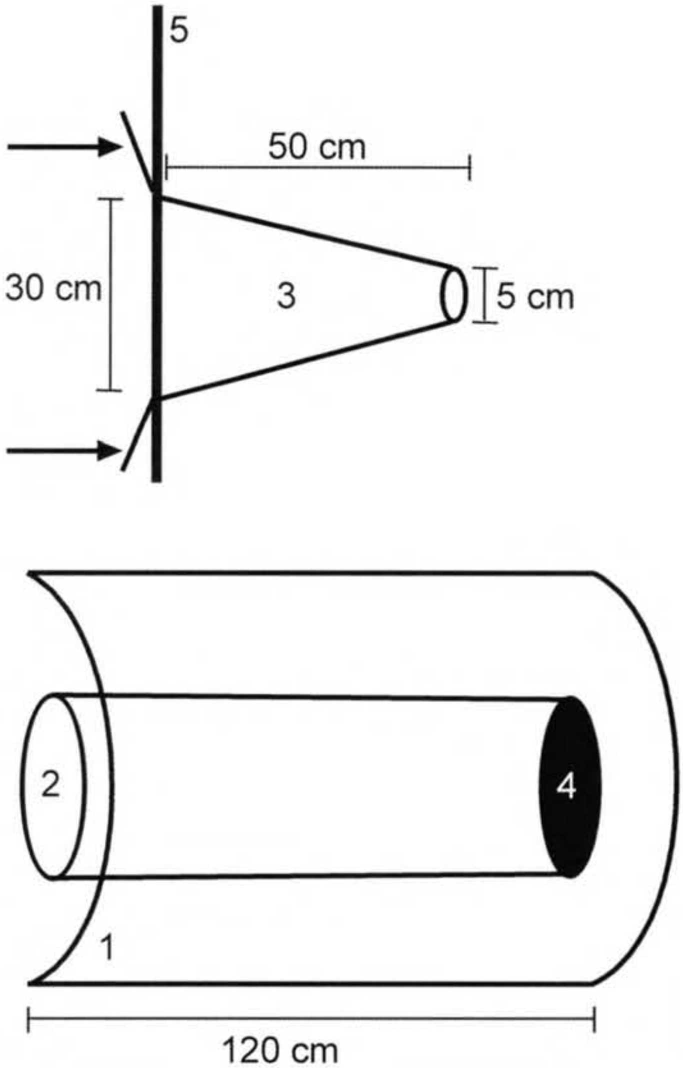

FIG. 1. Diagram of a simple and durable funnel trap. The trap (2) and the funnel (3) are made out of 1.27 cm (0.5 inch) hardware cloth and surrounded with aluminum window screening (1). The support for the funnel (5) and the back of the trap (4) are made with 1.91 cm (0.75 inch) plywood. The funnel is pushed through the hole in the support and then cut, flattened, and secured with staples around the edge of the funnel (arrows).

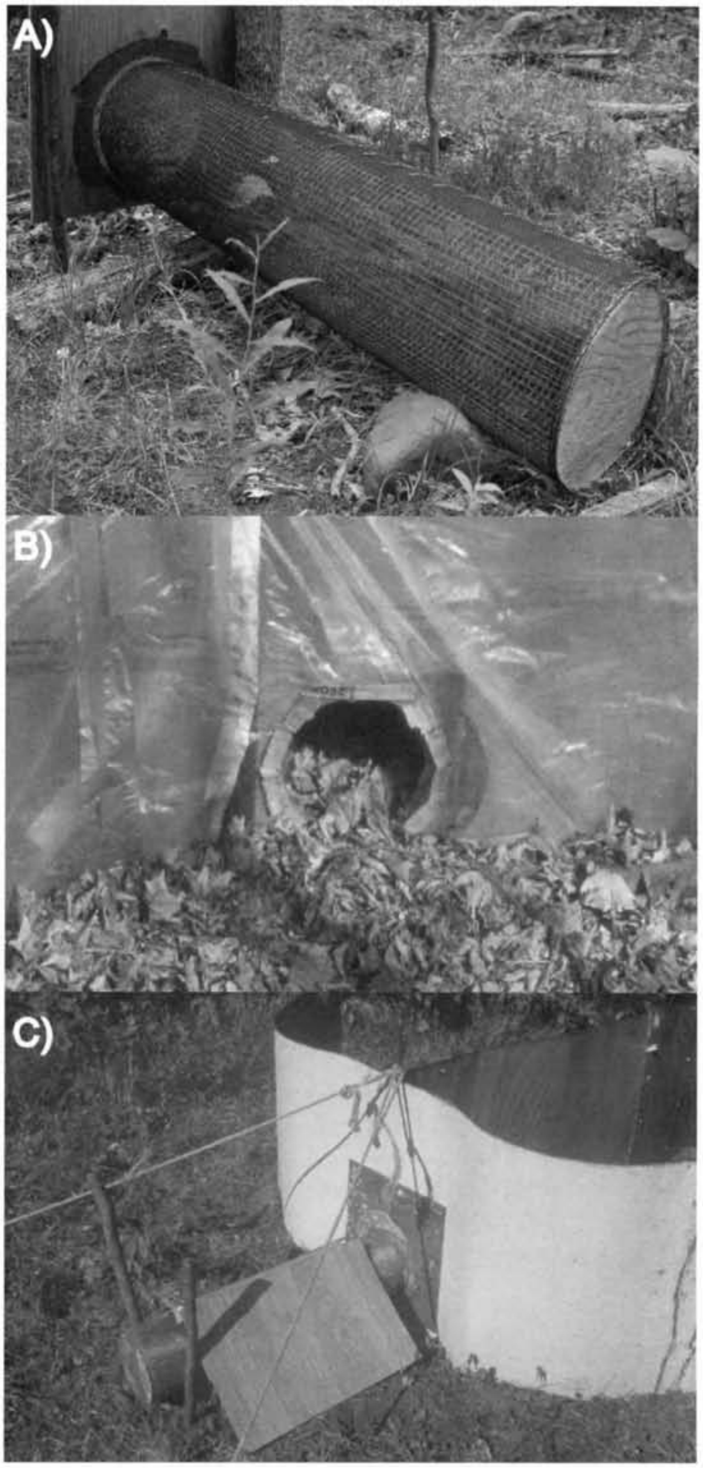

FIG. 2. Photographs of the simple and durable funnel trap (A), of the accumulation of debris on the plastic fencing that allows the funnel to be level with the substrate along a perimeter fence (B), and of the trap in use at the end of a metal drift fence with leads (C).

plywood circle at the back of the trap and secure it with 8 mm staples. It is important to attach the back of the trap last because it facilitates sewing the screening and the staples can secure both the hardware cloth and the mesh to the back of the trap.

Finally, we coat the small opening of the funnel with two-part epoxy (we found Plasti-Dip to be much less durable than epoxy). We dip the end of the funnel multiple times to build a thick coat. This serves two purposes: it makes the funnel more durable by hardening and securing the window screening and it covers sharp ends from the cut window screening which could injure snakes or deter them from entering the trap.

The trap is pushed tight against the funnel and secured by attaching a rope to the plywood on each side of the funnel (through two drilled holes) and passing that rope around the back of the trap. Because the trap is made of screening and hardware cloth, a visual inspection of the trap is sufficient to detect the presence of animals. When animals are captured, we detach the retaining rope, pull the trap back and quickly surround the opening of the trap with a snake bag (we use a pillow case). We gently raise the back of the trap until the animals slide in the bag. To prevent bites when dealing with venomous snakes, one could empty the trap in a hard plastic bucket or a garbage can instead of a bag.

To prevent overheating, we ensure that animals have shade by covering one end of the trap with a tarp or plywood scraps. Only one end is covered, as covering the whole trap could impede airflow and also lead to overheating.

Our funnel trap was inspired by earlier versions that were made solely of window screening held with office staples (e.g., Enge 1997), but we found those too flimsy for our purpose. The addition of hardware cloth, epoxy, and plywood does not add much weight and retains the effectiveness of earlier designs, but renders the traps more durable (some of our traps have been in service for 10 years) and better able to handle numerous large snakes (Fig. 2). Although we designed those traps to be placed on perimeter fences, they are versatile and can be placed at the end of a drift fence with leads (Fig. 2) or can be modified easily into a two-ended funnel trap (by the addition of a second funnel) to be placed at the center of a fence. Compared to box designs, we believe our mesh design is advantageous because it is light and see-through, but we think it is also more effective because it allows airflow. Airflow is likely a cue animals use to find an escape hole along a fence. If one makes many traps, the cost will be < US $20 per trap because the materials can be purchased in large quantities (e.g., full plywood sheets, 30.5 m (100 feet) rolls of hardware cloth and window screening). In conclusion, the traps can be used to catch a variety of terrestrial herpetofauna in numerous environments.

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Using Deep-Water Crawfish Nets to Capture Aquatic Turtles

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The most primitive method used to capture turtles is by hand, and a variety of hand capture methods appear in the literature (Cagle 1950; Carpenter 1955; Marchand 1945). Non-baited traps, particularly basking traps of various forms, have also been used in many turtle studies (Cagle 1950; Lagler 1943; Petokas and Alexander 1979; Robinson and Murphy 1975). The most popular baited-trap method is the hoop net, originally described by Legler (1960), and later refined by others to suit their specific needs. Since Plummer (1979) reviewed collection methods for turtles, many individuals have improved earlier trap designs and developed innovative capture techniques (e.g. Kuchling 2003; Sharath and Hegde 2003). Here we describe a novel technique that uses baited deep-water crawfish nets to capture carnivorous or omnivorous turtles. We include some preliminary data using this technique and discuss the potential advantages and disadvantages of these nets over traditional hoop nets.

Two dozen custom-made deep-water crawfish nets were purchased for US $75/dozen from a private dealer in Chalmette, Louisiana. Deep-water crawfish nets were constructed from a 50.8 cm diameter stainless steel ring (4.8 mm diameter) to which 16 mm black-dipped mesh was attached loosely to form a pocket (Fig. 1). Three 30.5 cm ropes were attached to the steel ring at equal distances from each other and were tied together at the other end to form a knot. A 5.1 cm diameter, 1.9 cm thick cork was attached above the knot followed by another knot to keep this cork in place. When placed in water, the cork suspended the three ropes above the mesh and minimized interference caused by turtles attempting to feed. A larger, second cork (5.7 cm in diameter and 3.8 cm

FIG. 1. Illustration of deep-water crawfish net.

thick) was positioned 91.4 cm above the smaller, first cork. The larger cork floated on the water surface and was used as a "catch" to extract the net from the water with a hollow aluminum pole (3.8 cm diameter, 195.6 cm long). Two stainless steel rods (6.4 mm in diameter) were attached on opposite sides of the same end of the aluminum pole (Fig. 2). The rods were 30.5 cm long, but extended only 15.2 cm beyond the pole. For added strength the remaining length of the rods was placed inside the aluminum pole and secured tightly by hammering flat the end of the pole. Both rods were slightly curved to prevent the large cork from falling off as the net is pulled from the water. The distance between the rods was 2.5 cm at the point they contacted the pole, but increased to 3.5 cm toward their end. The greater distance at the end of the rods facilitated grabbing the large cork, and as the net was pulled from the water, the cork slid down to the base of the rods where they contacted the pole. The point where the rods contacted the pole was the strongest part of the pole, and the strain of picking up nets rested on this position, not on the end or middle of the rods.

Each net was baited with chicken backs or leg quarter portions purchased from a local grocery. Each net was equipped with a center string for bait attachment, but to achieve longer bait life, a standard shower curtain clip was attached to the center of each net. The thickest part of the chicken back was pushed through the open clip, snaking the clip through the thin bone as many times as possible for a firm attachment, and then the clip was snapped close. Large turtles can remove poorly secured bait, and straighten clips while feeding; therefore, extra clips and replacement bait were required for an entire day of trapping.

Deep-water crawfish nets were set in waters ranging in depth from 15.2 cm to 121.9 cm. Spacing between nets was variable and depended primarily on depth and clarity of the water body. In murky, lentic waters (e.g., canals, ponds, sloughs, etc.) nets were positioned close together. In clear, lotic waters (e.g., rivers, streams, etc.) the distance between nets was increased. The nets rested flush with the substrate to reduce the chance of turtles, especially mud and musk turtles, from feeding beneath the net. To accomplish this, the aluminum pole was used to clear vegetation or debris from the water. After positioning the net, the larger cork was placed to one side of the net in a position to be easily grabbed with the rods of the aluminum pole. If the habitat allowed, the larger cork was placed out of the water on the bank or vegetation. Only in deep water was the larger cork ever directly above the net.

When using the pole to check nets, care was taken to minimize disturbance to the water surface, as this alarmed feeding turtles. To check nets, the larger cork was grasped between the rods, and then the cork was pulled straight up, and over to shore with one quick, fluid motion. Some turtles attempted to crawl or swim out of the net as it was picked up. Thus, checking nets was most efficiently accomplished with two individuals: one individual picked up the net and the second individual used a dipnet to catch any turtles that fell out of the net as it was being moved to land. Larger turtles (e.g., *Chelydra serpentina*) did not always completely enter the net while feeding. However, as the net was being lifted from the water, larger turtles often had their jaws firmly attached to the bait and could be lifted, albeit temporarily, from the water. If a second person was present with the dipnet ready, the turtle could be netted.

The frequency of checking nets depended on a variety of environmental variables, including habitat type, weather, water depth, water clarity and turtle behavior. Initially, nets should be set for at least fifteen minutes before checking to allow the scent of the bait to spread and attract turtles. However, because the scent was generally detected quickly in smaller lentic waters, nets needed to be checked every ten minutes. If feeding activity was low, more time between checking nets was required. In clear, lotic waters turtles could be observed feeding. Thus, to avoid disturbing feeding turtles, stealth was required in approaching and picking up the net. As turtles fed on the bait, oils and lipids rose and the presence of oil or small pieces of chicken fat at the water surface usually indicated feeding. Typically, the more oils at the surface, the larger the turtle (or more than one turtle) that was feeding. Also, larger turtles sometimes caused the larger cork at the surface to move while feeding in the net.

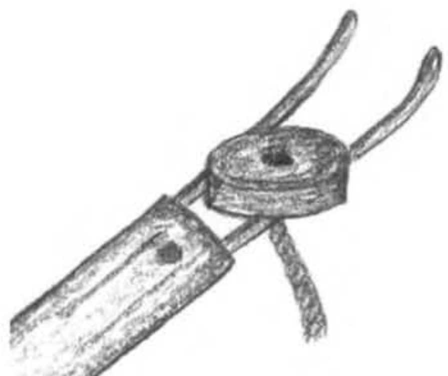

FIG. 2. Illustration of terminal end of aluminum pole showing position of steel rods used to extract deep-water crawfish nets from water via the large cork.

This technique has captured seven turtle species in several different aquatic habitats, including drainage canals in St. Bernard Parish, Louisiana (*Kinosternon subrubrum*, *Sternotherus odoratus* and *Trachemys scripta*), floodplain ponds and the main channel of the Stones River in Rutherford County, Tennessee (*S. odoratus*, *T. scripta*, *Apalone spinifera*, *C. serpentina*, and *Graptemys geographica*), and a roadside slough adjacent to Reelfoot Lake in Lake County, Tennessee (*K. subrubrum*, *S. odoratus*, *T. scripta*, *C. serpentina*, and *Chrysemys picta*). At the roadside slough (36°21.150'N, 89°24.920'W), 16 deep-water crawfish nets were used on 25 September 2004 for eight hours (0900–1700 h). All 16 nets were set from the shore in a straight (ca. 190 m) stretch of the slough. The total catch was 125 turtles with the following counts: 111 *S. odoratus*, 8 *C. picta*, 5 *T. scripta*, and 1 *C. serpentina*.

The largest turtle captured using this technique was a *C. serpentina* with a plastron length of 234 mm and a mass of 10.25 kg. This large turtle was captured with the aid of a dipnet, as it was not entirely within the net when it was pulled from the water. *Chelydra serpentina* exceeding 10 kg fed in the nets, but managed to escape during net retrieval. If the diameter of the ring for the nets were increased, this might increase chances of capturing these larger snapping turtles. *Trachemys scripta* ranging in size from 42 to 235 mm plastron length and 19.5 to 2575 g have been captured using deep-water crawfish nets. The smallest turtle captured was a hatchling *S. odoratus* with a plastron length of 16.6 mm having a mass of 3.2 g. Therefore, these nets are suitable for capturing nearly all size classes of carnivorous/omnivorous aquatic and semi-aquatic turtles. They are especially adept at capturing *S. odoratus*.

These nets have a number of advantages over traditional hoop nets: 1) With this active method of catching turtles exact times of feeding can be ascertained, which could not be done with any precision with hoop nets. 2) They are less expensive and less bulky than hoop nets. In general, two dozen deep-water crawfish nets takes up less space than a traditional hoop net. 3) Turtles can be captured in extremely shallow waters with these nets. 4) With hoop nets, there have been reports of turtle injury or mortality resulting from prolonged periods within the net (e.g., Barko et al. 2004; Dodd 1989). The likelihood of injury using deep-water crawfish nets is significantly reduced because turtles are not 'trapped', and nets are checked frequently. 5) Lastly, unlike hoop nets, there is little chance of theft or sabotage to deep-water crawfish nets that you are actively checking from the shore.

Hoop nets do have some advantages over deep-water crawfish nets. Because hoop nets only have to be baited, set and checked every so often, the time required to sample in this manner is significantly less than sampling using deep-water crawfish nets. The actual trapping of hoop nets is done passively as opposed to the active method of using deep-water crawfish nets where the investigator must be present. Hoop nets are advantageous in situations where trapping must be done from a boat. We suggest that deep-water crawfish nets will not work well in these situations because the surface disturbance created by a moving boat would scare feeding turtles out of the net before it could be checked. Also, hoop nets are useful in trapping turtles that feed at night. By comparison, deep-water crawfish nets are more difficult to use at night. However, we increased our trapping success at night by wearing headlamps and affixing reflective tape to the large cork and rods of the aluminum pole.

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Fluorescent Powder Pigments as a Harmless Tracking Method for Ambystomatids and Ranids

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Many amphibian species require both aquatic and terrestrial habitats to fulfill their biphasic life cycle. Research often focuses on processes and life stages occurring in aquatic habitats because the high concentration of animals facilitates the logistics of research and strong density dependence in larvae suggests that populations may be regulated by this life stage (Wilbur 1980). However, adult amphibians use extensive amounts of terrestrial habitat (Semlitsch and Bodie 2003), populations worldwide are declining due to habitat loss (Stuart et al. 2004), and new evidence suggests that the juvenile or adult life stages may be important in regulating populations (Biek et al. 2002). Efforts to study amphibians in terrestrial habitats have increased greatly in the last decade, but limitations in finding, capturing or tracking animals away from breeding sites still restrict our ability to answer basic ecological questions in terrestrial habitats.

Fluorescent powdered pigments (hereafter referred to as powder) have been used to track a variety of organisms including small mammals, reptiles and larval amphibians (Blankenship and Bryan 1990; Fellers and Drost 1989; Ireland 1973; Lemen and Freeman 1985). More recently, powder has been used to track amphibians in terrestrial habitats (Birchfield and Deters 2005). The primary assumption of all tracking studies is that the tracking method does not affect the animal (White and Garrott 1990; Millspaugh and Marzluff 2001). Experimentally testing this assumption is an important step to validate this technique. While reports of negative effects of powder tracking are rare, the inhalation of powder was reported to cause moderate levels of histiocytic pneumonia in deer mice, *Peromyscus maniculatus* (Stapp et al. 1994), and powder can persist in the environment for long periods of time (Halfpenny 1992). Studies examining the effects of powder on amphibians are limited (but see Berger 2000; Eggert 2002).

We experimentally tested both short-term (i.e., powder present on the skin) and long-term effects of powder on both recently metamorphosed Wood Frogs, *Rana sylvatica*, and Spotted Salamanders, *Ambystoma maculatum*. We chose the rate of water loss as the short-term response because water regulation is a critical process for amphibians in terrestrial habitats and because amphibian skin affords virtually no protection from desiccation (Ray 1958; Thorson 1955). The large surface area to volume ratio in recently metamorphosed juveniles causes water loss to be a greater threat to juveniles than adults (Thorson 1955). In addition, the small particle size of the powder coating the skin may alter the flow of water across the skin and thus presents a possible mechanism for how the powder could affect an amphibian. We chose survival and growth as our long-term responses because these variables provide an indication of the general health of an amphibian and relate to demographic processes.

Materials and Methods.—Wood Frog egg masses were collected from the Daniel Boone Conservation Area in Warren County, Missouri, USA, on 6 March 2004. After hatching, tadpoles were reared until metamorphosis in outdoor 1000-liter cattle tank mesocosms stocked with 1 kg leaf litter and zooplankton inoculum. Larval Spotted Salamanders were collected (using dip nets) from the Baskett Wildlife Research Area in Boone County, Missouri, USA, on 25 August 2004 and maintained in aquaria with aerated pond water until metamorphosis. Newly metamorphosed frogs and salamanders were housed in aquaria with moist sphagnum moss at the University of Missouri and fed crickets *ad libitum*.

Two long-term experiments tested for differences in growth and survival of Wood Frogs and Spotted Salamanders covered and not covered with powder. For the experiment on frogs, 70 individuals were randomly assigned to six treatment groups based on powder color on 6 June 2004: blue (N = 10), green (N = 10), orange (N = 10), yellow (N = 10), red (N = 10), and a no powder control (N = 20). For the experiment on salamanders, 20 individuals were randomly assigned to two treatment groups on 20 September 2004: red (N = 10) and a no powder control (N = 10). Treatment consisted of dipping each individual in fluorescent powder pigments (Radiant Color, Richmond, California, USA) until completely covered. Control animals were handled in a similar manner, except they were not dipped in powder. Animals were randomly assigned to an individual $17 \times 12 \times 9$ cm plastic container that contained moist sphagnum moss with a fiberglass window screen lid. All animals were fed approximately 18% of their body weight in small crickets each week, split between two feedings. Every two weeks for a six-week period all animals were weighed and the powder treatment was re-applied.

Two short-term experiments tested for differences in the rate of water loss between animals covered and not covered with powder. Similar procedures were followed for both the wood frog experiment on 12 August 2004 and the spotted salamander experiment on 9 November 2004. Animals were placed in a plastic container containing 0.5 cm of carbon-filtered water for approximately 12 hrs prior to the beginning of the experiment to ensure all animals were fully hydrated. The dehydration chamber consisted of a square chamber ($5 \times 5 \times 5$ cm) constructed of metal window screen (similar to Pough et al. 1983) that was suspended, exposing all sides to air and did not prevent animals from using water conserving postures. Animals were assigned to a powder treatment or control group according to the treatment that individual received during the long-term experiments, thus 20 frogs (i.e., $N_{control} = 10$ and $N_{red} = 10$) and 18 salamanders (i.e. $N_{control} = 10$ and $N_{red} = 8$) were tested. Using the same animals in both the short-term and long-term experiments did not bias our results because the data from the experiments were analyzed separately and because any potential carryover effects from the long-term experiments should increase the likelihood of detecting an effect in the short-term experiments. Each chamber was weighed, an animal was randomly assigned to the chamber, and the combination of the animal and chamber was weighed every 30 minutes for 120 minutes until animals lost approximately 15% of their body mass. Thus animals were not exposed to lethal dehydration levels: 30–35% for ranids

(Thorson and Svihla 1943); and 36–40% for ambystomatids (Pough and Wilson 1970; Ray 1958).

Changes in mass over six weeks for the long-term experiments and over 120 minutes for the short-term experiments were analyzed using repeated measures analysis of variance. Only animals without missing observations (i.e., individuals that survived the entire experiment) were included in the analysis of mass. Analysis of variance was used to test for the effects of the powder treatment on survival, with number of days alive as the response variable. All weights were obtained using a Mettler AT261 Delta Range electronic balance with readability of 0.01mg.

Results.—Growth between animals covered and not covered with powder did not differ for either Wood Frogs ($F = 0.19$, d.f. = 5,57, $P = 0.97$; Fig. 1a) or Spotted Salamanders ($F = 0.24$, d.f. = 1,17, $P = 0.63$; Figure 1b). A significant increase in mass occurred throughout the six weeks for both Wood Frogs ($F = 354.77$, d.f. = 3,55, $P < 0.0001$) and Spotted Salamanders ($F = 213.00$, d.f. = 3,15, $P < 0.0001$). No interactions between the powder treatments and time occurred (all $P \geq 0.40$). The number of days alive did not differ between frogs covered and not covered with powder ($F = 0.58$, d.f. = 5,64, $P = 0.71$), but seven frogs died throughout the course of the long-term experiment. Survival was 100% in the long-term salamander experiment, but one escaped and one from the red treatment died after the completion of the long-term experiment but prior to the short-term experiment. We believe the mortality occurred when animals were not feeding readily, because these individuals were the smallest at the initiation of the experiments.

Water loss between the control and powder treatments did not differ for either Wood Frogs ($F = 0.34$, d.f. = 1,18, $P = 0.57$; Fig. 2a) or Spotted Salamanders ($F = 0.49$, d.f. = 1,16, $P = 0.49$; Fig. 2b). Continuing the experiment until all animals had lost approximately 15% of their body mass produced a significant decrease in mass for both the frogs ($F = 590.04$, d.f. = 4,15, $P < 0.0001$) and the salamanders ($F = 442.29$, d.f. = 4,13, $P < 0.0001$). No interactions between powder treatments and time occurred (all $P \geq 0.34$). Survival was 100% in both short-term experiments.

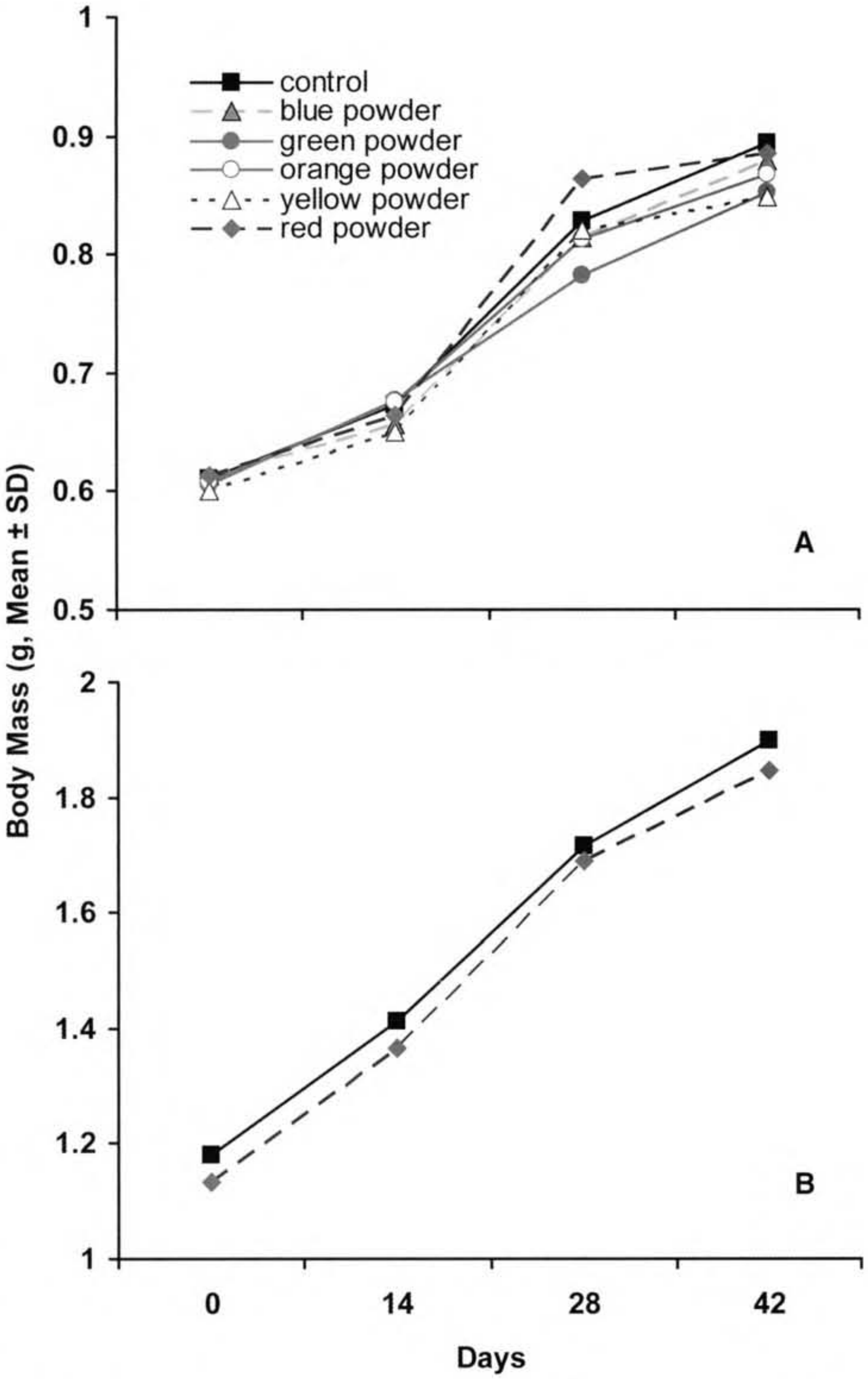

FIG. 1. Mean growth for each powder treatment during the long-term experiments for Wood Frogs (A) and Spotted Salamanders (B) at two week time intervals.

Discussion.—We did not detect any short-term or long-term effects of powder on either Wood Frogs or Spotted Salamanders. Growth and survival over a six-week period, as well as rates of water loss, were unaffected by being covered with powder. We suggest that being covered with powder is similar to being covered with other natural items, such as soil or organic debris, and conclude that powder is a harmless method for tracking ambystomatids and ranids in terrestrial habitats.

All experiments provided conditions that may cause the powder to be more stressful than animals would experience when powder is used to track amphibians in the field. First, animals in the laboratory had limited opportunity to remove the powder by rub-

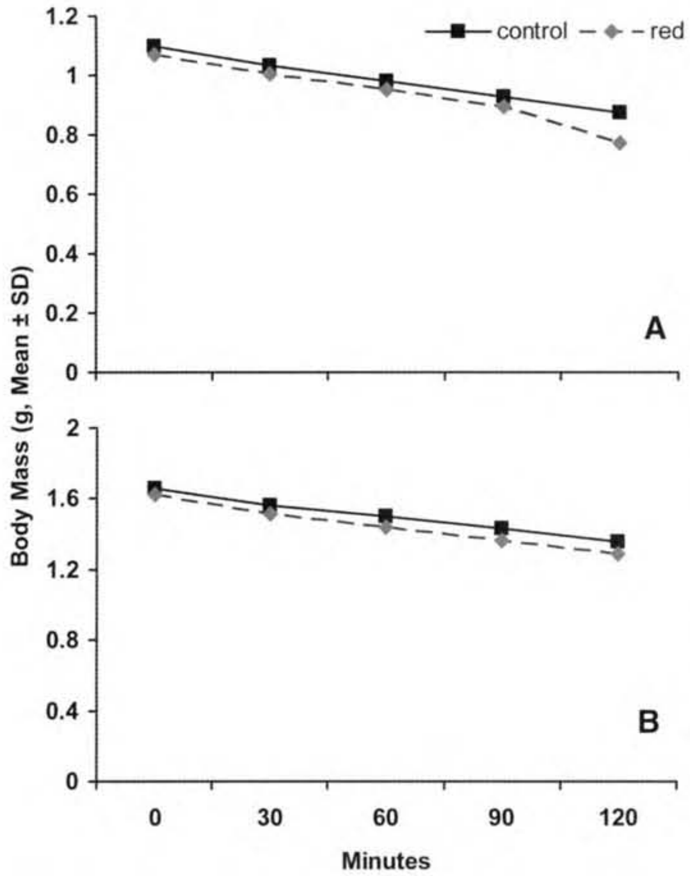

FIG. 2. Mean water loss for each powder treatment during the short-term experiments for wood frogs (A) and spotted salamanders (B) at 30 min time intervals.

bing against vegetation or hopping around. This was especially true in the dehydration experiments where small enclosures restricted hopping movements and substrate was not provided. Animals in these experiments remained completely covered with powder for the entire 120 minutes. Although we did not observe any behavior that suggested animals were purposely attempting to remove the powder, animals in the long-term experiments lost the powder quickly, with powder visible on approximately 52% of the animals at 24 h after powder application and no powder visible on any of the animals at 3 days after powder application. Second, animals in the long-term experiments were exposed to the powder on three occasions. When powder is applied in the field, animals are often only covered with powder once, because the individual is not recovered after being released. We found no evidence that repeated exposure to the powder is harmful to amphibians.

Three tracking methods are primarily used for directly following amphibians in terrestrial habitats: radio-telemetry, thread-trailing, and fluorescent powder pigments. Each method has advantages and disadvantages. For example, although radio-telemetry allows a researcher to track an individual for the longest time period (e.g., 1–4 months depending on transmitter size) and longest distances (e.g., Bartelt et al. [2004] tracked *Bufo boreas* > 200 m), the cost of radio-telemetry is the greatest (US $150 per transmitter plus additional costs for receiving equipment) and risk to the animal can be the greatest (see Rittenhouse 2002 for mortality caused by transmitter implantation). Tracking amphibians with powder often provides the shortest movement paths of all the tracking methods; however, several benefits can make powder the preferred tracking method in many instances. Powder tracking results in a detailed description of the movement path (e.g., Birchfield 2002; Eggert 2002). Powder can be used on juveniles or species too small for other tracking devices and is relatively inexpensive (e.g., US $12 per one-pound can). However, a possible side effect to amphibians is the potential increase in visibility to predators that use color to locate prey. Although the optimum tracking method will vary based on the research objectives of a study, tracking amphibians with powder is an underutilized tracking technique that does not appear to detrimentally affect growth, water regulation or survival in the laboratory of ambystomatids or ranids. Therefore, this technique might be particularly useful when studying rare or endangered species.

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A New Technique for Measuring Body Color of Lizards in the Field

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Measurement of color in reptiles can play a fundamental role in research areas as diverse as behavior, physiology, evolution, and ecology. For example, studies incorporating color have investigated the behavioral role of dewlap color in *Anolis* lizards (Macedonia et al. 2003; Thorpe and Stenson 2003), thermoregulation in desert reptiles (Norris 1967), sexual selection in chuckwallas (Kwiatkowski and Sullivan 2002), and predator evasion in agamid lizards (Stuart-Fox et al. 2004). These studies rely on the ability to accurately quantify body color.

There are a number of small portable spectrometers available that measure reflectance or radiance. Previous studies using spectrometers to measure the color of lizards and/or their backgrounds in the field typically used sunlight as the source of illumination (Macedonia et al. 2002, 2003). This approach can cause problems if the measurements are not taken under similar and constant conditions, as weather conditions, nearby vegetation, different microhabitats, seasons, and the time of day can result in drastically different radiance spectra of the animal or background being measured (Endler 1990, 1993). Consequently, moment-to-moment fluctuations in lighting conditions can cause errors and alter the radiance or reflectance output given by a spectrometer (Endler 1990, 1993). Thus, a method that eliminates or greatly reduces inconsistencies in lighting would provide far more consistent and repeatable measurement of reflectance or radiance. In particular, the exclusion of ambient light, which can change over short time periods because of movement of clouds or overhead vegetation (Endler 1993), would increase the constancy of reflectance spectra. Yet such a method has limitations when used in the field, because of the difficulty of removing all sources of ambient light. Until now these limitations have meant that study subjects have been returned to the laboratory to take controlled reflectance readings in a darkened room (Macedonia et al. 2002; Stuart-Fox et al. 2003, 2004). However, removing lizards from their natural habitat may result in stress responses, which could lead to skin-color changes, as reported in species that have the ability to rapidly lighten or darken their skin color, such as some agamids (Christian et al. 1996) and iguanians (e.g., Cooper and Greenberg 1992). When investigating background-color matching, such color changes may not be indicative of the lizard's typical body color.

We have designed and tested an opaque probe cover for use with a portable spectrometer that allows accurate and controlled measurement of reflectance in the field. We tested the reliability of this new method during a study of background-color matching in the painted dragon, *Ctenophorus pictus*. In this article we describe an effective method for measuring reflectance of virtually any species of lizard in the field with the aid of this probe cover. In fact, the methods described would have applicability across a wide range of animal taxa. Our methods are inexpensive, easily constructed, and portable.

Cover for Optical Fiber Probe.—Measures of reflectance were taken using an Ocean Optics USB2000 Miniature Fiber Optic Spectrometer® (Dunedin, Florida) and an illumination source was provided by a PX-2 Pulsed Xenon Lamp® (Dunedin, Florida), connected to the spectrometer by a standard reflection probe (200 µm diameter). The spectrometer and light source were then connected to a laptop computer via a USB cable for reflectance calculations using the Ocean Optics software package, OOIBase32.

We designed an opaque cover that attaches to the optical fiber probe, ensuring that only the light from the xenon lamp illuminates the target area. This cover was constructed from a large plastic drinking straw that fit snugly over the probe (Fig. 1). The straw was wrapped in layers of black duct tape to block out ambient light. One end of the straw was then cut to make a 45° angle at a distance of 1 cm from the end of the probe to the surface sampled (following Endler 1990). Once the probe was cut to size, several layers of duct tape were placed around the cut end of the probe to create a base (10 × 10 cm), which further reduced light from entering the receiving end of the probe. This base can be made to any size and/or shape to suit different-sized lizards. The resulting probe cover is flexible and after being placed on a lizard can be peeled backwards to ensure the probe is positioned in the desired location. The lizard is restrained by wrapping the base of the probe around the body until the measurement was made but we also recommend restraining the lizard while measurements are being taken (e.g., Rose et al. 2006). Additionally, a transparent probe cover was constructed to test the accuracy of the opaque-probe cover using the same methods described for the opaque cover, the only

difference being that clear tape was used instead of black duct tape to create a transparent rather than opaque cover.

All measurements were expressed relative to a white reflectance standard (> 95–98% reflectivity). Lizards were placed on a black backing during the readings to ensure that only the reflectance of the lizard was being measured. The probe cover, where it meets the surface being measured, has an area of 0.55 cm^2, meaning that the surface quantified would need to be at least this size to ensure all ambient light was eliminated. The area of color being measured with the opaque cover is equivalent to the diameter of the optical fiber aperture used (200 μm), with the area of light leaving the probe equal to 0.31 cm^2.

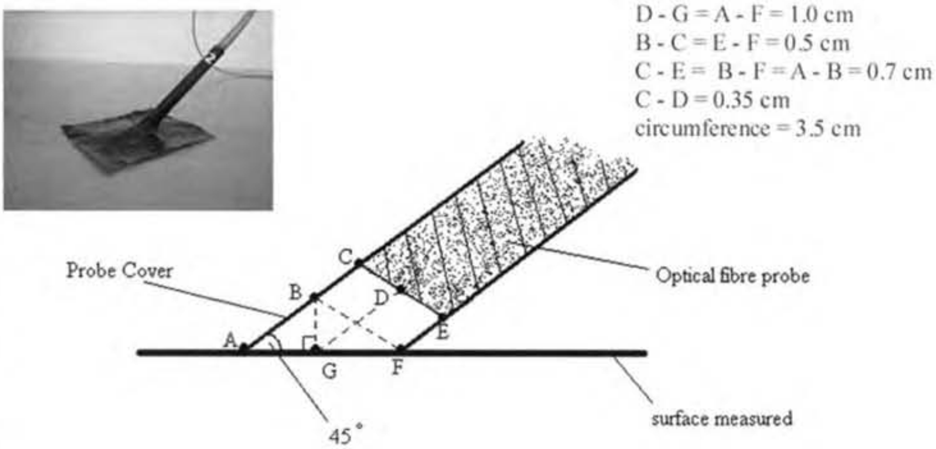

FIG. 1. Design of the cover for the optical fiber probe.

Testing the Efficiency of the Opaque Probe Cover.—To determine whether our opaque probe cover provided an improvement over measuring radiance in ambient light, we conducted an experiment using color standards. We tested the opaque cover by measuring color standards (blue, green, red, and yellow) in a darkened room, outdoors in full light, and outdoors under the shade of a tree. Three methods (no probe cover, transparent probe cover, and opaque probe cover) were tested in each light environment to determine if there were significant differences between spectral readings among the three methods.

In obtaining the spectral data, the parameters for each method could not be kept constant. The integration times for the spectral readings had to be adjusted (Table 1) to ensure that the reference calibration was not being saturated. As a result, we standardized the maximum height of the peak for the standard in scope mode to approximately 3500 counts and used the corresponding integration time.

The opaque probe cover was highly consistent across all three light environments (Table 1), as it did not require the integration time to be altered. The integration times for the opaque probe cover were also equivalent to the integration time needed without a probe cover in a darkened room. This suggests that the opaque cover can be used in a variety of light environments and still be equivalent to taking readings without a probe cover in a darkened room.

All spectral data presented throughout this study were analyzed from 320–720 nm. This range includes the spectrum visible to humans (400–700 nm) as well as some ultraviolet (UV) (below 400 nm) and infrared (above 700 nm) regions. This region was chosen for a study of the body color of *Ctenophorus pictus* because many animals see beyond the human spectrum, including birds (Bennett and Cuthill 1994; Hart et al. 2000) and some lizards (Fleishman et al. 1993).

The raw reflectance data were grouped into 10-nm bins for statistical analysis, which reduces the problem of non-independence of data points (Leal and Fleishman 2002; Macedonia et al. 2002; Thorpe and Stenson 2003). We analyzed the reflectance data by principal components analysis (PCA) to reduce the number of variables for analysis (Endler 1990; Macedonia et al. 2003). Three principal components (PCs) were extracted from the PCA combining the three methods of data acquisition (no probe cover, transparent probe cover, and opaque probe cover) for four color standards (blue, green, red, and yellow) across three lighting environments (darkened room, outdoors full-light, and outdoors shaded). The eigenvalues and percentage of explained variance were as follows: PC1 (17845.72, 69.43%); PC2 (5717.55, 22.24%); PC3 (1936.52, 7.53%). We compared the three measurement methods in each of the light conditions for each PC separately, using paired *t*-tests. In outdoor full light we found significant differences between using the opaque probe cover and no probe cover for PC2 (t_3 = -3.469, P = 0.040) and PC3 (t_3 = -7.950, P = 0.004), and between the opaque probe cover and the transparent probe cover for PC2 (t_3 = -3.856, P = 0.031) and PC3 (t_3 = -10.935, P = 0.002). In outdoor shaded light we found significant differences between using the opaque probe cover and no probe cover for PC2 (t_3 = -3.208, P = 0.049) and PC3 (t_3 = -7.027, P = 0.006) and between the opaque probe cover and the transparent probe cover for PC2 (t_3 = -4.711, P = 0.025) and PC3 (t_3 = -4.288, P = 0.023). In the shaded condition there was also a significant difference between using no probe cover and using the transparent probe cover in PC1 (t_3 = 3.350; P = 0.044). There were no significant differences among the three methods in a darkened room.

These results indicate that there are significant differences between using the opaque probe cover and using no probe cover or a clear probe cover across different lighting conditions, especially in terms of PC2 and PC3. These differences are most likely to be a result of changes in ambient light from the time when the white standard sample was recorded, and when the color standard was measured. This could be the result of changes in reflected radiation (e.g., cloud cover, vegetation), or experimental error such as subtle changes in the lizard's body position among readings. Nevertheless, the opaque probe cover performed most consistently across a range of lighting conditions, regardless of whether the ambient light conditions were varied.

Testing the Opaque Probe Cover on a Study Species.—We tested for dorsal background-color matching in two populations of *Ctenophorus pictus*. Five females were collected from the Little Desert National Park (36°34'02"S; 141°20'55"E; white sand population) and five were from the Murray Sunset National Park (36°34'46.5"S; 141°36'38"E; red sand population) in northwestern Victoria. Lizards were measured outdoors, under natural light

Table 1. Integration times (ms) needed in each light environment for each probe cover to obtain 3500 counts in scope mode.

	Integration Time (ms)		
Probe cover	Inside	Full light	Tree shade
No cover	110	30	70
Transparent cover	70	35	70
Opaque cover	110	110	110

conditions, using the opaque cover and then these measurements were repeated indoors in a darkened room without use of the probe cover, which is a more typical method of color measurement. To provide consistency in the tests, we used the same spectrometer settings across all measurements.

The lizards were warmed to 37.8°C immediately before reflectance was measured. This value was chosen as it lies within the two published mean active body temperatures of this species (34.4°C, Melville and Schulte 2001; 39.0°C, Mayhew 1963). Four reflectance readings were taken for each lizard on the dorsal surface of the body: head, between the shoulders, mid-back, and at the base of the tail. These locations encompass the range of dorsal color and pattern variance for this species. We measured the dorsal surface because we were interested in background-color matching. Readings on the mid-back of the lizard were taken slightly off center to avoid the black patterning along the middle of the back. This was achieved by folding back the flexible opaque cover as it was being placed on the back of the lizard to ensure the precise locality of reflectance readings.

A PCA reduced the data set to three axes, with eigenvalues and the percentage of explained variance as follows: PC1 (1658.77, 88.29%); PC2 (202.52, 10.78%); PC3 (10.52, 0.56%). To test for differences between using the probe cover outside and measuring reflectance inside, we used a one-way repeated measures ANOVA for each of PC1, PC2, and PC3. No significant difference was detected in using the probe cover outside in natural light, or taking reflectance measures in a darkened room without a probe cover for each PC score (PC1: $F_{1,9} = 0.380$; $P = 0.553$; PC2: $F_{1,9} = 0.006$; $P = 0.940$; PC3: $F_{1,9} = 2.766$; $P = 0.131$). A problem that we noted in taking the readings inside without the probe cover was the difficulty in estimating the constant 1-cm distance and 45° angle desired for taking readings.

Next, we measured the dorsal reflectance of 112 *Ctenophorus pictus* in the field using the opaque cover. Because *C. pictus* are easily caught in these sandy deserts, we could measure their reflectance immediately at the point of capture. We also measured the reflectance of the sand the lizard was on at the point of capture, thereby permitting estimates of background-color matching *in situ*.

Ctenophorus pictus is an ideal study species because they are easily caught within proximity of our field vehicle. Consequently, the light source could be powered by the vehicle's battery: a voltage transformer was plugged into the car's cigarette lighter, and a 25-m extension cord was attached to the transformer. This allowed us to measure the reflectance of lizards and their backgrounds up to 25-m away from the vehicle. Our method could be used in the field even without a support vehicle if researchers were willing to transport a spotlight or car battery into the field.

Our opaque probe cover provides an inexpensive easy to construct method to measure reflectance across that should prove suitable for a wide range of taxa. We have shown the advantages of measuring reflectance in the field. In addition, this method is applicable to measuring the reflectance of any surface > 0.55 cm^2. In the past, optical fiber probe covers have been used to hold the probe at a constant distance and 45° angle to the surface (Stuart-Fox et al. 2004; Thorpe 2002; Thorpe and Stenson 2003). However, these covers were not designed to block out ambient light from entering the surface being measured. Other studies have relied on attaching a ruler to the end of the probe to maintain a constant distance between the probe and the surface being measured (Macedonia et al. 2002, 2003). Our probe cover is an improvement on previous methods because, as well as providing constant distances between the probe and the surface of analysis, it also blocks out ambient light, making it suitable for repeatable measurements of reflectance in the field.

Acknowledgments.—We thank L. Revell for his assistance with the spectrometer and analysis. We are grateful to J. Van Buskirk and J. Ng for their advice and assistance. We are especially thankful for the valuable comments made by two anonymous reviewers. Permits for field work were provided by the Department of Sustainability and Environment Victoria (Permit No. 10002952), and the Department for Environment and Heritage South Australia (Permit No. E24870). Funding for this study was provided by ARC Discovery Grant (DP0452082) and Australian Society of Herpetologists Student Research Grant. This research was approved by The University of Melbourne Faculty of Science Animal Experimental Ethics Committee and The South Australian Wildlife Ethics Committee.

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A Technique for Restraining Lizards for Field and Laboratory Measurements

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Numerous techniques have been used for restraining lizards including controlling by hand, anesthetizing (Nelson and Jayne 2001), and thermal cooling combined with the use of sticky tape (Hoefer et al. 2003). Restraining devices are often designed for use with members of specific genera (Poulin and Ivanyi 2003) or for lizards of a particular size (Hoefer et al. 2003). Such methods impose limitations on studies that seek to measure morphological characteristics of live lizards representing a broad range of body sizes.

Here we describe an effective technique for restraining various species of lizards that range in body size from 30–250 mm snout-vent length (SVL). Our technique reduces the time spent processing individual animals and may, therefore, minimize handling stress. Our method is easily constructed, inexpensive, and portable making it suitable for both laboratory and field studies. We used this restraining method successfully on three species of agamid lizards (Painted Dragon, *Ctenophorus pictus*; Mountain Dragon, *Rankinia diemensis*; and Bearded Dragon, *Pogona vitticeps*) and one species of gecko (Knob-tailed Gecko, *Nephrurus amyae*). Specifically, we provide detailed descriptions of the methods used to restrain *Ctenophorus pictus* in the field for morphometric analysis using digital photography.

Restraining Tray.—When using digital photography to conduct morphometric analyses it is critical to maintain all lizards in the same position for each image, and to provide an unobstructed view of the appendages. With this in mind, we designed a restraining tray using single-sided Velcro with an adhesive backing to hold the animal's body in place, and a plastic tray as the base. Strips of the hooked side of Velcro were stuck onto the tray, and thin strips of the looped Velcro were cut and the adhesive backing covered in flexible cotton material to avoid dirt and sand sticking to it. Lizards were placed onto the Velcro base of the tray and positioned as needed. We restrained lizards with one strip of Velcro placed firmly over the neck, plus a second strip just above the pelvic girdle (Fig. 1). In the case of juveniles or very small lizards, one strip of Velcro across the neck was adequate for restraint. We surrounded the base of hooked Velcro with strips of looped Velcro, which allowed the claws of the lizards to grip onto the base, ensuring that the limbs remained in the desired position.

Morphometric Analysis.—For the morphometric analysis of *Ctenophorus pictus*, we attached a clear plastic ruler to the restraining tray and a label was included in each image for identification purposes. We then took digital photographs of restrained individuals, ensuring that the ventral surface of the lizards was flat on the tray and that their body was straight (Fig. 1). At least one hind limb and one forelimb were physically extended on the restraining tray to ensure accurate measurement of limb proportions from the digital image. One advantage of digital images is that the photographs can be archived and accessed at any time for analysis.

Six measurements were taken for each lizard (N = 128): head length, SVL, axilla-groin distance, forelimb length, hind limb length, and tail length. Lizards measured included juveniles and adults of both sexes ranging from 31.2–77.9 mm SVL. All lizards measured were successfully restrained using our device, without a single lizard escaping or being injured.

Morphological analyses from the photographs were performed using ImageJ (v. 1.32j) digital image analysis software (Rasband 2004). We tested the accuracy of measuring a subset of the morphological characters by comparing the measurements made with the digital images and analysis software to those recorded with digital calipers. The measurements using ImageJ differed by 1.7% (N = 20) from caliper measurements, which would represent a 0.9 mm difference in the measurement of a 50 mm SVL lizard.

The restraining tray proved ideal for the wide range of sizes of agamid lizards in our study. Our success across these agamid species may be a result of the rough scales and well-defined neck in these lizards, which facilitated holding them in place with the Velcro strips. Hence, this method should be applicable to most

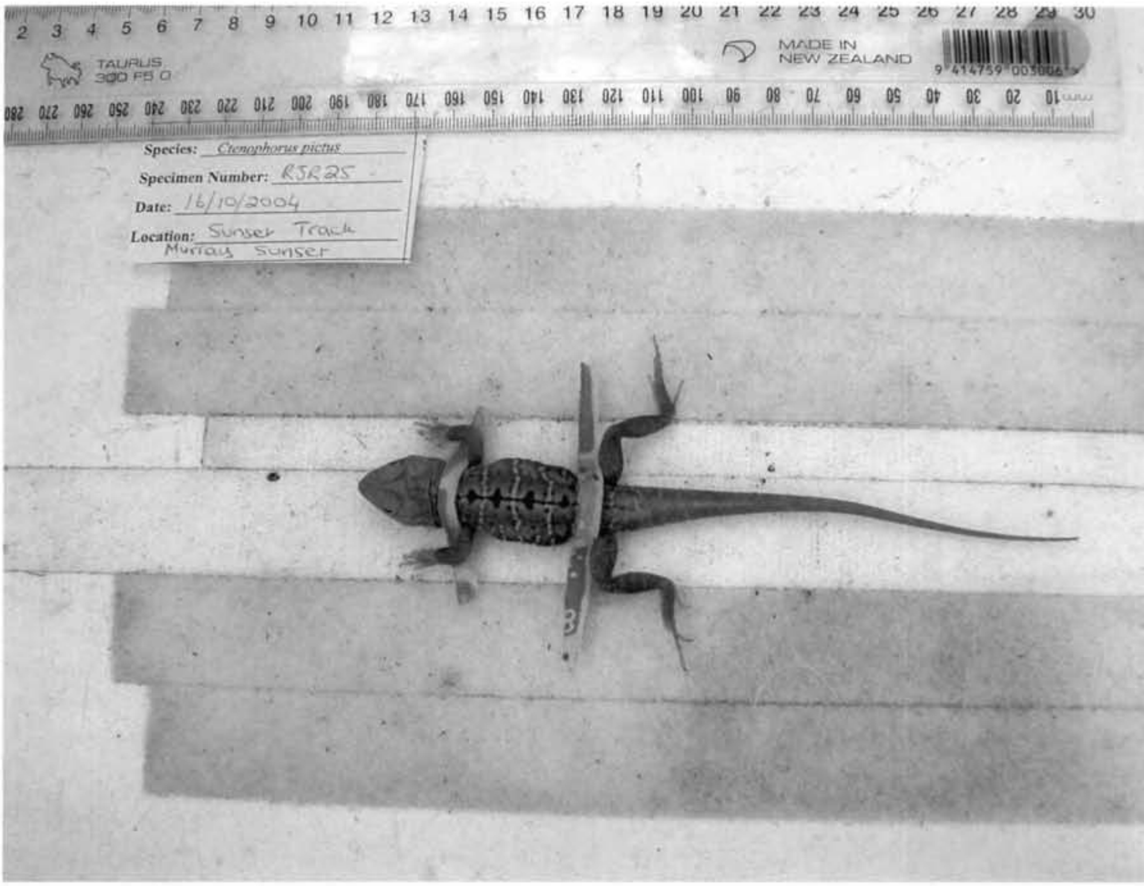

FIG. 1. Digital image of an adult male *Ctenophorus pictus* positioned on the restraining tray.

lizard taxa with rough scales and defined necks, such as agamids, iguanids, cordylids, some lacertids, and many geckos. In fact, we successfully used this restraining method on the gecko *Nephrurus amyae* without any damage to its delicate "knob-tail." This method ensures that lizards are only held for a short period of time, therefore reducing prolonged stress, which can result in tail autotomy.

Our technique is inexpensive and allows efficient data collection in the field or laboratory. The design of the tray allows lizards to be positioned for a number of purposes including taking morphological and color measurements, photographs, or tissue samples.

Acknowledgments.—We thank J. Van Buskirk for his advice and assistance, J. Sinclair, the Live Exhibits staff at Museum Victoria, and two anonymous reviewers. Permits were provided by the Department of Sustainability and Environment Victoria and the Department for Environment and Heritage South Australia (Permit Nos. 10002952 and E24870, respectively). Funding was provided by an Australian Research Council Discovery Grant (DP0452082) and an Australian Society of Herpetologists Student Research Grant. This research was approved by The University of Melbourne Faculty of Science Animal Experimental Ethics Committee and The South Australian Wildlife Ethics Committee.

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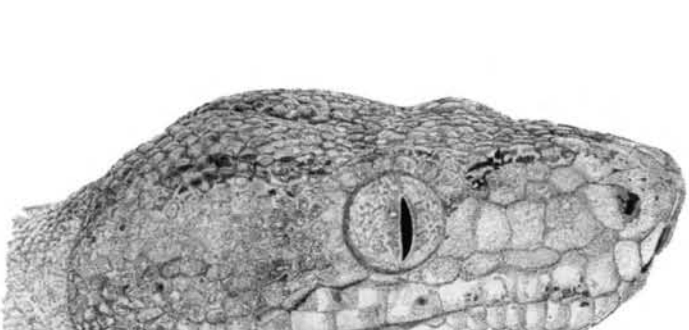
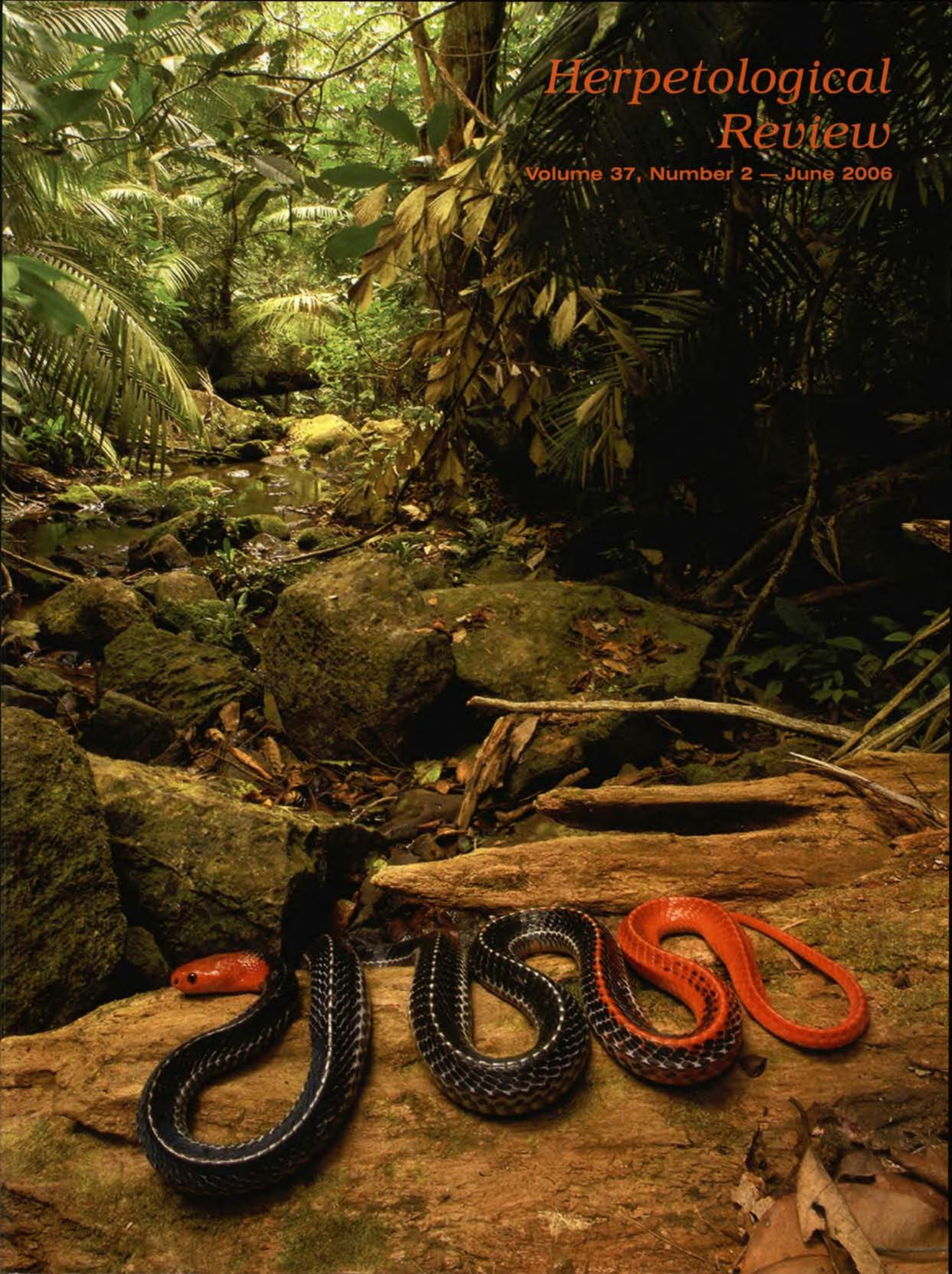


Corallus hortulanus (Amazon Tree Boa): Two-year old female, unknown locality. Pen-and-ink illustration by Will Brown (www.blueridgebiological.com).



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HERPETOLOGICAL REVIEW

The Quarterly News-Journal of the Society for the Study of Amphibians and Reptiles

SOCIETY FOR THE STUDY OF AMPHIBIANS AND REPTILES

www.ssarherps.org

The Society for the Study of Amphibians and Reptiles, the largest international herpetological society, is a not-for-profit organization established to advance research, conservation, and education concerning amphibians and reptiles. Founded in 1958, SSAR is widely recognized today as having the most diverse society-sponsored program of services and publications for herpetologists. Membership is open to anyone with an interest in herpetology—professionals and serious amateurs alike—who wish to join with us to advance the goals of the Society.

All members of the SSAR are entitled to vote by mail ballot for Society officers, which allows overseas members to participate in determining the Society's activities; also, many international members attend the annual meetings and serve on editorial boards and committees.

ANNUAL DUES AND SUBSCRIPTIONS: Annual membership dues for the year 2006 in the Society for the Study of Amphibians and Reptiles are as follows: **REGULAR** membership US$60 (Student $30)—includes *Journal of Herpetology* and *Herpetological Review*; **PLENARY** membership US$80 (Student $45)—includes *JH*, *HR*, and annual subscription to the *Catalogue of American Amphibians and Reptiles*; **INSTITUTIONAL SUBSCRIPTION** $115—includes JH and HR. Additional fee for airmail postage outside USA $35 for one year. Additional membership categories available on the SSAR webpage: http://www.ssarherps.org/pages/membership.html.

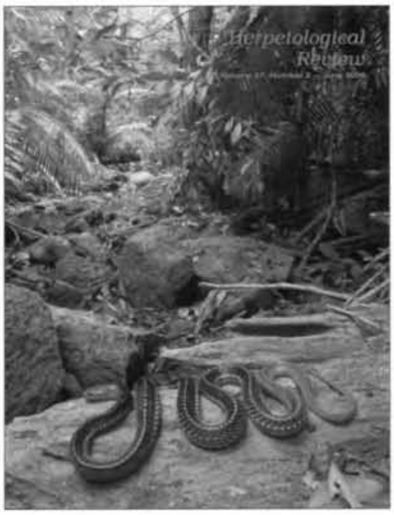
All members and institutions receive the Society's primary technical publication, the *Journal of Herpetology*, and its news-journal, *Herpetological Review*; both are published four times per year. Members also receive pre-publication discounts on other Society publications, which are advertised in *Herpetological Review*.

Payment must be made in USA funds, payable to "SSAR," or by International Money Order, or with VISA or MasterCard (account number and expiration date must be provided). Payment should be sent to: Breck Bartholomew, SSAR Membership Office, P.O. Box 58517, Salt Lake City, Utah 84158, USA. Fax: (801) 453-0489; e-mail: ssar@herplit.com.

Future Annual Meetings

2006 — New Orleans, Louisiana, 12–17 July (with ASIH, HL)
2007 — Saint Louis, Missouri (with ASIH, HL)

About Our Cover: *Bungarus flaviceps*



The Red- (or Yellow-) headed Krait (*Bungarus flaviceps*) is one of the rarest species of *Bungarus* despite its extensive distribution which extends throughout Indochina and south through peninsular Thailand and Malaysia to Singapore and onto the islands of Sumatra and Borneo. Snakes are found in both lowland and hilly forested areas, and in peninsular Malaysia, seem to be associated with small watercourses provided that suitable cover is nearby. Adult *B. flaviceps* can reach nearly 2 m in length, and given the toxicity of their venom, this makes them quite dangerous. Although secretive and shy by nature, *B. flaviceps* can become extremely aggressive, quick, and agile when cornered and photographing this species can be rather nerve wracking. Like most elapids, *B. flaviceps* feeds on other reptiles, principally snakes and skinks. The foregoing is drawn largely from Manthey and Grossmann (1997. Amphibien & Reptilien Südostasiens. Natur und Tier Verlag, Müster. 512 pp.) and Stuebing and Inger (1999. A Field Guide to the Snakes of Borneo. Natural History Publications, Kota Kinabalu, Borneo. 254 pp.).

The specimen illustrated on the cover is the first *Bungarus flaviceps* to be collected from Pulau Tioman, although reports of an early specimen exist (van Rooijen 2001. Lacerta 59:97–103). Pulau Tioman is a relatively small, landbridge island located 29 km off the southeastern coast of peninsular Malaysia in the South China Sea. Pulau Tioman is just one of 62 islands in the Seribuat Archipelago (Grismer 2006. A Field Guide to the Amphibians and Reptiles of the Tioman Archipelago, Malaysia. Forestry Department, Peninsular Malaysia) and harbors at least 98 species of which 17% are endemic (see Grismer et al. 2006. Raffles Bulletin of Zoology 54:157–180 and references therein). The high herpetofaunal diversity of Tioman Island is supported by the extreme environmental diversity of its pristine habitats ranging from mangrove swamps along the coast to lowland and hill dipterocarp rainforests inland.

The cover specimen was collected at night along the Mentawak River on the eastern side of the island as it was moving across the leaf litter of the forest floor. It was placed in position the next day at the top of the Tekek-Juara trail and photographed using a Nikon D100 with a 20 mm lens at an ISO equivalent of 200. The photographer, **Lee Grismer**, is Professor of Biology at La Sierra University in southern California. Grismer's fieldwork since 2000 has been centered in Malaysia, but has recently expanded into Cambodia and will move into southern Vietnam this summer. He is currently working on a mongraphic revision of the lizards of peninsular Malaysia, Singapore, and associated islands. Much of this work involves collaborations with Malaysian scientists and students from Universiti Kebangsaan Malaysia (National University of Malaysia).

SSAR BUSINESS

SSAR Herp Hotline is Up and Running

The new SSAR Herpetology Education Committee has activated an on-line questionnaire form to facilitate communication and education between the public and professionals. The hotline also frees the presidents of our societies, who historically took responsibility for answering many letters, phone calls, and emails from enthusiasts. Just since January, over 70 questions on many topics, including specimen identification and husbandry for pets, have been posted and answered, primarily by herpetologists at Zoo Atlanta. We're especially grateful to Dr. Brad Lock (Zoo Atlanta) for his contributions. Gregory Watkins-Colwell of the Yale Peabody Museum of Natural History and Joseph Mendelson of Zoo Atlanta have worked together to design and implement this important interface. We also hope that professionals and experts in academia will participate by posting questions and serving as authorities in answering queries on specific topics. The form is currently accessible from the SSAR web page. Check it out!

http://www.peabody.yale.edu/collections/vz/herpform.html

Dean E. Metter Memorial Award 2006

The Dean E. Metter Memorial Award was established to encourage students to pursue field research in herpetology and to facilitate field research by providing funds for related expenses. The Metter Memorial Award Committee is pleased to announce that this year's winner is Ms. Cybil Nichole Smith, whose project is titled: "The Significance of the Distinctive Color Pattern and Behavior of Hatchling Great Plains Skinks (*Eumeces obsoletus*)." Ten proposals were submitted this year and the committee (Joe Beatty, Anne Maglia, and Brian Miller) was impressed with all, but had to choose a single awardee.

Nikki Smith graduated with honors from Oklahoma State University in May 2006 with a B.S. in Wildlife and Fisheries Ecology (emphasis in Wildlife Management). Since 2003, she has worked in the laboratory of Dr. Stanley F. Fox, who will serve as her advisor and mentor for this project. She has also participated in several other research projects while completing her degree that involved both laboratory and field work. Ms. Smith is the first undergraduate to win the Metter Memorial Award.

Her proposal will address the significance of the phenotypic (color and behavior) differences between juvenile and adult *Eumeces obsoletus*. She has designed a series of experiments to test whether or not the Giant Whipscorpion (Vinegaroon), (*Mastigoproctus giganteus*), might be a noxious model for the juvenile phenotype of *E. obsoletus*.

NEWSNOTES

A. Stanley Rand Fellowship Established

In recognition of Stan Rand's efforts to foster and promote the careers of Latin American biologists and his belief in the importance and value of organism-driven, field-based tropical research, the Smithsonian Tropical Research Institute has established an A. Stanley Rand Fellowship, to be awarded preferentially to a Latin American student who is studying animal behavior or ecology. This Fellowship fund, which has already grown to almost US $15,000, will honor Stan's memory and lifetime scientific achievements.

Contributions or inquiries may be sent to: Lisa Barnett, Smithsonian Tropical Research Institute, 1100 Jefferson Drive, Suite 3123, MRC-705, Washington, DC 20013-7012, USA.

Canadian Association of Herpetologists

The Canadian Association of Herpetologists publishes *The CAH/ACH BULLETIN* twice each year. The BULLETIN will print articles and news of interest to herpetologists in Canada. These may be in the form of short announcements or letters, or may be written as longer articles (non-peer reviewed). The BULLETIN especially requests news of your research lab and current research activities, lists of your latest publications (up to one year old), travel plans, new students, grants, awards, fellowships, new books or book reviews, trivia or concerns. Please send your submissions to the Editor (Jackie Litzgus, jlitzgus@laurentian.ca) as an MS Word document attached to an email.

You can receive a free copy of the latest issue of the *CAH/ACH BULLETIN* by emailing Jackie (jlitzgus@laurentian.ca) with a request. Please distribute the *BULLETIN* widely to all those that you may think would be interested in participating in the CAH/ACH. The last page of the BULLETIN is a CAH/ACH membership form—please join us!

Extinction is Imminent for the Guatemalan Beaded Lizard (*Heloderma horridum charlesbogerti*)

The Guatemalan Beaded Lizard is endemic to the arid, desert region of the Motagua valley in southeastern Guatemala and is one of the most endangered animals in the world. This animal was first seen by scientists in 1984, formally described in 1988 and a decade later was thought to be extinct in the wild. In 2002, a few individuals were found and limited natural history and ecology studies resulted in the first, but sparse, data on their lives in the wild. Most aspects of the lives of these creatures remain a mystery. The Department of Herpetology at Zoo Atlanta is working closely with the Guatemalan organization ZooTropic to create a conservation plan for these lizards.

What Happened?

What were the some of the factors that have led to the decline of the Guatemalan Beaded Lizard? First, beaded lizards live only in a tiny sliver of isolated desert habitat in the Motagua Valley of Guatemala; this area is isolated by massive cloud-forested mountains and rainforest valleys. Thus, it seems these Guatemalan lizards have had an historically limited range and have evidently existed in total isolation on this tiny island of desert habitat for many thousands of years. Further, land conversion for cantaloupe, tobacco, and corn farming has reduced the suitable habitat for this lizard to about 40,000 acres (roughly the size of Disney World in Orlando); best estimates have it that this area could support only 150–200 individuals. These numbers are similar to some of the most endangered island iguanas. Being a venomous creature has not helped this lizard; many negative myths and attitudes surround this animal. For example, it is thought by the local inhabitants, that if your shadow crosses or touches a lizard you will begin to slowly waste away and eventually die. Due to these myths, until recently, lizards have been killed on sight. Lastly, the rarity of this subspecies in particular and the popularity of beaded lizards and gila monsters as captives in general has led to exploitation for the animal collection market. It has been estimated that approximately 35 individuals were captured and sold abroad during the decade of the 1990s.

Is There Any Hope?

Because of the recent re-discovery of the species and the two natural history studies performed with support of Zootropic, the government of Guatemala has shown interest in protecting this animal and its habitat. In addition, Zootropic has launched an education campaign working with villagers in the Motagua region. This program has already visited over 25,000 children and adults and, since 2004, there have been no reports of lizards being killed or sold. Studies are planned to answer basic questions concerning critical habitat needs. These will be the main data needed to guide land-preservation decisions to best help this creature. There are also about nine animals in captivity in Guatemala, spread among as many institutions. A breeding facility in the Motagua Valley is urgently needed to produce young animals for attempted reintroduction (and education) programs in protected areas.

How You Can Help

As stated, there are likely no more than 200 individual Guatemalan Beaded Lizards left on Earth. Your help is desperately needed to save these unique creatures. Wayne Hill and the 2006 National Reptile Breeder's Expo have agreed to support the conservation effort for the Guatemalan Beaded Lizard. All proceeds from this year's annual auction will go to the "Project Heloderma" fund. This is hugely important, and we thank Wayne for his generous support of this project. To make this auction a success we request auction items of any sort. Monies collected for this fund will only go to efforts to save the Guatemalan Beaded Lizard. This fund will be specifically used to fund conservation research projects, raise public awareness in Guatemala, and establish a critically needed in-country breeding and conservation facility. Auction items should be sent so as to arrive by the first week in August. For more information on the auction please visit www.IRCF.org/Project Heloderma.

If you would like to help by contributing auction items please send these to:

Wayne Hill
621 Avenue M S.W.
Winter Haven, Florida 33880, USA
Attn: Project Heloderma

Please e-mail a description and value of potential auction items to: Dr. Brad Lock, Assistant Curator of Herpetology, Zoo Atlanta (e-mail: block@zooatlanta.org).

MEETINGS

Meetings Calendar

Meeting announcement information should be sent directly to the Editor (rwh13@csufresno.edu) well in advance of the event.

12–17 July 2006—49th Annual Meeting, Society for the Study of Amphibians and Reptiles, together with The Herpetologists' League and the American Society of Ichthyologists and Herpetologists. New Orleans, Louisiana, USA. Information: http://www.dce.ksu/jointmeeting/.

10–13 August 2006—Turtle Survival Alliance, Fourth Annual Conference, St. Louis Zoo, St. Louis, Missouri, USA. Joint meeting with IUCN Tortoise and Freshwater Turtle Specialist Group. Information: http://turtlesurvival.org/.

6–9 November 2006—9th Reunión Nacional de Herpetología México, hosted by the Mexican Herpetological Society. Universidad Autónoma de Nuevo León, Monterrey, Nuevo León, México. Information: http://www.sociedadherpetologicamexicana.com/.

24–27 November 2006—Herpetological Association of Africa 8th Conference. Potchefstroom campus of the North-West University, South Africa. Information available from the conference website: www.wits.ac.za/haa/2006conf.htm.

16–20 April 2007—First Mediterranean Herpetological Congress, Marrakech, Morocco. Information available from the Congress website: www.ucam.ac.ma/cmh1.

CURRENT RESEARCH

The purpose of **Current Research** is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, **María del Rosario Castañeda** or **Michele Johnson**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can be found at: http://www.herplit.com/contents.

Biogeography of West Indian Ocean *Cryptoblepharus* Lizards: An Example of Transoceanic Dispersal

The genus *Cryptoblepharus* is composed of ~36 morphologically similar forms considered to be subspecies within a single species, *C. boutonii*. The geographic distribution of the group includes the Indo-Pacific, Australian, and Malagasy regions. According to biogeographical theory, three different scenarios could result in this disjunct distribution: 1) evolution of the ancestral form at a time when the landmasses were connected, 2) natural long-distance transoceanic dispersal over a long period of time, and 3) recent human-mediated transportation. The authors used mitochondrial DNA (12S and 16S fragments) to reconstruct phylogenetic relationships between *Cryptoblepharus* subspecies of the Western Indian Ocean region, test alternative mechanisms to explain the present geographic distribution and evaluate the current taxonomic status. The previously estimated age of the group and the low genetic divergences found between Indo-Pacific/Australian and Malagasy sequences reject the ancient vicariance hypothesis. In addition, the geographically structured genetic variation observed rejects the recent human-mediated transportation hypothesis, supporting by process of elimination the transoceanic dispersal scenario as the origin of the Western Indian Ocean *Cryptoblepharus*. The authors also found that morphological variation (especially distinct coloration patterns) is not always concordant with molecular variation, as some of the morphologically distinct forms share or have closely related haplotypes, and considerable genetic variation is found in morphologically undistinguishable forms. Based on these findings the authors propose the maintenance of the subspecific status of all the forms as the most appropriate taxonomic arrangement for the group.

Rocha, S., M. A. Carretero, M. Vences, F. Glaw, and D. J. Harris. 2006. Deciphering patterns of transoceanic dispersal: the evolutionary origin and biogeography of coastal lizards (*Cryptoblepharus*) in the Western Indian Ocean region. Journal of Biogeography 33:13–22.

Correspondence to: D. James Harris, Centro de Investigação em Biodiversidade e Recursos Genéticos (CIBIO/UP), ICETA, Campus Agrário de Vairão, 4485-661 Vila do Conde, Portugal; e-mail: james@mail.icav.up.pt.

Asynchronous Eye Closure as an Antipredator Strategy in *Sceloporus* Lizards

Sleeping is a behavioral state in which an animal is highly vulnerable to predation. Some animals have developed mechanisms to reconcile the need to be vigilant and the need to sleep. Keeping one eye open while the other is closed, called asynchronous eye closure (ASEC), is a behavior associated with unihemispheric sleep (in birds and aquatic mammals), where the hemisphere opposite to the closed eye sleeps while the other hemisphere remains awake with its associated eye open and functional. In birds ASEC has been suggested to be an important antipredatory strategy; however, this association is poorly studied in other animals. The au-

thors studied ASEC behavior in the Western Fence Lizard *Sceloporus occidentalis*. Three different eye states were specified: both eyes open (synchronous eye opening, SEO), one eye open and the other closed (asynchronous eye closure, ASEC), and both eyes closed (synchronous eye closure, SEC). Using video recordings, the authors determined the eye state of the subjects under three different treatments: 1) an empty control, where the lizard was alone in a terrarium, 2) a movement control, where the lizard was presented with a moving object, and 3) the predator treatment, where the lizard was presented with a living snake. The authors also determined the orientation of the open eye during the ASEC state. Results support the predictions based on the anti-predator hypothesis: visual scanning increased in the presence of a possible predator (due to an increase of ASEC and a reduction of SEC, with SEO remaining invariable) and the opened eye was directed towards the threat. The authors also discuss alternative hypotheses of the purpose of ASEC considering their findings.

MATHEWS, C. G., J. A. LESKU, S. L. LIMA, AND C. J. AMLANER. 2006. Asynchronous eye closure as an anti-predator behavior in the Western fence lizard (*Sceloporus occidentalis*). Ethology 112:286–292.

Correspondence to: John A. Lesku, Department of Ecology and Organismal Biology, Indiana State University, Terre Haute, Indiana 47809, USA; e-mail: jlesku@indstate.edu.

Ultrasonic Communication in Frogs

The authors report evidence of ultrasonic communication in the Concave-eared Torrent Frog *Amolops tormotus* from Huangshan Hot Springs in China. Experiments to detect communication included acoustic playbacks in the frog's natural environment with 1) the ultrasonic component of the call only, and 2) the audible component of the call only. Five out of eight experimental male subjects responded to the ultrasound signal with an increase in the calling rate. Additionally, to detect ultrasonic sensitivity in *A. tormotus*, electrophysiological recordings from the torus semicircularis (the portion of the midbrain where auditory processing occurs) were used. Both auditory-evoked potentials (AEPs) and tone-burst responses revealed high ultrasonic sensitivity. Based on the acoustic spectrum of the background noise of *A. tormotus* environment, the authors suggested that ultrasonic sensitivity is probably an adaptation to prevent the masking of the calling by background noise. Two additional species were tested for ultrasonic sensitivity: *Odorrana livida*, which also inhabits Huangshan Hot Springs, and *Pelophylax nigromaculata*, which is common in rice fields. The former showed the ability to detect ultrasound, but the latter showed a limited upper hearing limit, supporting the association between noisy environments and ultrasonic hearing. Furthermore, to determine if ultrasound detection in *A. tormotus* occurs by ear stimulation via bone conduction, the authors recorded the sound reception of the midbrain with the subjects' ears unobstructed or obstructed with clay; results indicate that ultrasonic sensitivity is mediated by acoustic stimulation of the ear. Finally, the authors report unusual morphological features found only in the ear of *A. tormotus* males, which might help explain the capacity to detect ultrasound. However, further experiments are required to test if females could also detect ultrasound or if the ultrasonic hearing in *A. tormotus* is sexually dimorphic.

FENG, A. S., P. M. NARINS, C. H. XU, W. Y. LIN, Z. L. YU, Q. QIU, Z. M. XU, AND J. X. SHEN. 2006. Ultrasonic communication in frogs. Nature 440:333–336.

Correspondence to: Albert S. Feng, Department of Molecular and Integrative Physiology and Beckman Institute, University of Illinois, Urbana, Illinois 61801, USA; e-mail: afeng1@uiuc.edu.

Prey Size and Phenotypic Plasticity in *Boa* Snakes

Diet studies in vertebrates have shown that type and size of food items could have a significant effect on morphological phenotypic plasticity. The authors manipulated the diet of *Boa constrictor* juveniles to test whether prey size induces skull and jaw phenotypic plasticity early in ontogeny. Additionally, they studied the specific timing of expression of sexual size dimorphism (SSD; in *B. constrictor* adult females are significantly larger than adult males). Twenty-three neonates from a single-sired litter (reducing the effects of parental genetic variation) were maintained under two different diet regimens: 1) small-prey (mice), and 2) large-prey (rats) items. Individuals in both treatments received equivalent prey mass: the small-prey treatment was fed a larger number of smaller prey, while the large-prey treatment was fed a smaller number of larger prey. Morphological measurements were taken twice during the experiment, at 5 and 58 weeks, and included the premaxilla–basioccipital length and mandible length (using x-rays), snout–vent length, body length, tail length, and body mass. No statistical difference was found in the premaxilla–basioccipital length or mandible length between the two treatments, rejecting the hypothesis that large prey induces phenotypic plasticity of head elements early in ontogeny in *B. constrictor.* However, at 1-year of age, SSD was found in snout–vent length and body length (females > males) and tail length (males > females), suggesting a strong genetic component early in ontogeny in the SSD, independent from environmental factors (e.g., prey mass consumed). Finally, the authors comment on future directions of the study of ontogenetic growth and SSD expression.

SCHUETT, G. W., D. L. HARDY SR., R. L. EARLEY, AND H. W. GREENE. 2005. Does prey size induce head skeleton phenotypic plasticity during early ontogeny in the snake *Boa constrictor*? Journal of Zoology 267:363–369.

Correspondence to: G. W. Schuett, Department of Integrated Natural Sciences, Arizona State University West, P.O. Box 37100, Phoenix, Arizona 85069-7100, USA; e-mail: biogws@langate.gsu.edu, gwschuett@yahoo.com.

Tempo and Mode of Diversification in *Plethodon* Salamanders: A Non-Adaptive Radiation Case

Clades that exhibit rapid divergence into a wide variety of adaptively dissimilar forms, called adaptive radiations, have been model systems to quantify rates of diversification. However, few studies have quantified the tempo of diversification in species-rich clades that have negligible adaptive disparity (non-adaptive radiations). *Plethodon* salamanders form a specious clade that exhibits extreme morphological stasis. Using mitochondrial DNA, the authors 1) reconstructed the phylogeny of eastern North Ameri-

can species (44 spp), 2) estimated diversification rates using the constant rate (CR) test (which tests for a significant departure from the null hypothesis of a constant rate of diversification), and 3) tested three alternative models for lineage accumulation using the program Diversi v.0.20. Additionally, the authors tested the effects of possible missing lineages on the diversification rates estimations, and the assumption of equal probability of speciation and extinction among lineages. Results indicate that major *Plethodon* clades exhibit significant differences in rates of lineage accumulation, and even within major clades the lineage accumulation has not been constant throughout its phylogenetic history. Southern clades showed higher lineage diversification than northern clades, which the authors suggested is related to areas unsuitable for occupation during Pleistocene glacial maxima. Furthermore, the authors point out that diversification rates of *Plethodon* are comparable with those classical examples of adaptive radiation, and that the temporal depth of this group is also notable since there has been a longer time for extinction, comparing with more recent adaptive radiation examples. The authors finally discuss characteristics of the evolutionary history and probable causes of the particularly high rates of diversification within *Plethodon*.

Kozak, K. H., D. W. Weisrock, and A. Larson. 2006. Rapid lineage accumulation in a non-adaptive radiation: phylogenetic analysis of diversification rates in eastern North American woodland salamanders (Plethodontidae: *Plethodon*). Proceedings of the Royal Society: Biological Sciences 273:539–546.

Correspondence to: Kenneth H. Kozak, Department of Ecology and Evolution, Stony Brook University, Stony Brook, New York 11794, USA; e-mail: kozak@life.bio.sunysb.edu.

Forest Fragmentation Effects on *Phyllomedusa* Reproductive Dynamics

In the late 1970's and early 1980's a project was created to study fragmentation effects in Brazil, the Biological Dynamics of Forest Fragments Project (BDFFP), which consisted of a series of forest patches of 1, 10 or 100 ha, surrounded by a matrix of pasture and regenerating vegetation areas. In this fragmented landscape, the authors studied the reproductive dynamics of *Phyllomedusa tarsius*, a hylid frog that breeds in ponds located in continuous forest, as well as highly disturbed habitats. Body size, abundance, and movement patterns were measured/estimated in five different habitats: 1) pasture, 2) *Vismia* spp. regrowth (areas that have been cleared and burned), 3) *Cecropia* spp. regrowth (areas that have been cleared but not burned), 4) small forest fragments (1–10 ha), and 5) continuous forest. Reproductive ponds were visited during three consecutive years, and capture-mark-recapture techniques were implemented. The authors found differences between habitats in number of frogs per pond (*Cecropia* spp. regrowth had the highest number) and pond area. They also found that the beginning of the reproductive season varied among habitats, initiating in November in continuous forest and in January in disturbed habitats. Rainfall was positively correlated and significant with number of captures in pastures, and *Vismia* and *Cecropia* patches. Movement patterns of frogs differed between habitats: *Vismia* spp. regrowth, pastures, and forest fragments had the highest proportion of male movements. No movements from disturbed habitats into the continuous forest were recorded, even though the longest journey observed was longer than the distance between forest and secondary growth ponds, suggesting that interbreeding between habitats is possible, though is not occurring. The authors highlight the importance of studies that identify factors responsible for persistence of populations in different habitats as a base to design areas for biodiversity conservation.

Neckel-Oliveira, S., and C. Gascon. 2006. Abundance, body size and movement patterns of a tropical treefrog in continuous and fragmented forests in the Brazilian Amazon. Biological Conservation 128:308–315.

Correspondence to: Selvino Neckel-Oliveira, Museu Paraense Emilio Goeldi, Coordenação de Zoologia - CZO, C.P. 399, 66017-970 Belém, Pará, Brazil; e-mail: sneckel@museu-goeldi.br.

Negative Effects of Natural Disturbances Disruption in Salamanders

Human disturbances in native habitats have been associated with creating suitable conditions for invasive species establishment, contributing with the decline of local species. One type of human alteration results from changing the intensity and/or frequency of natural disturbances. In the San Rafael Valley, Arizona, cattle farmers have replaced seasonal marshes with artificial ponds to maintain water available all year round. The Sonoran tiger salamander, *Ambystoma tigrinum stebbinsi*, a recently listed endangered species whose range is restricted primarily to the San Rafael Valley, now breeds in the artificial ponds. These ponds have been invaded by bullfrogs (*Rana catesbeiana*) and several species of fishes that otherwise would not survive in the area due to their high susceptibility to pond drying. The authors hypothesized that reduction in the natural drying frequency of the aquatic habitats has led to the invasion by bullfrogs and fishes, and that these species exclude native salamanders. Data was collected from 1979 through 1999; pond-drying frequency, permanence, and new colonization or reappearance of bullfrogs, fishes and salamanders were estimated. In addition, the effects of a range of drying frequencies on the distribution of fish, bullfrogs and salamanders were estimated using a variation of the Levin's (1969) metapopulation model. Results show that after pond drying both bullfrog and fish populations disappeared; salamander populations were also affected by drying, but to a lesser extent. Salamanders were more likely to recolonize a pond following drying, i.e. when fish and bullfrog populations were eliminated, and once salamanders were eliminated from a pond the population rarely reappeared unless fishes were eliminated. The mathematical model predicted a community dominated by fishes and bullfrogs when pond drying was infrequent, but an increase drying frequency would also be detrimental for salamanders because it would restrict breeding. These results suggest that an adequate management of disturbance regimes is an important tool in controlling invasive species.

Maret, T. J., J. D. Snyder, and J. P. Collins. 2006. Altered drying regime controls distribution of endangered salamanders and introduced predators. Biological Conservation 127:129–138.

Correspondence to: Timothy J. Maret, Department of Biology, Shippensburg University, 1871 Old Main Drive, Shippensburg, Pennsylvania 17257, USA; e-mail address: tjmare@ship.edu.

Population Structure of *Podocnemis expansa* in a Conservation Context

Podocnemis expansa, the giant Amazon River turtle, is distributed in the Amazon, Orinoco and Esequibo river basins east of the Andes. Once widely common in the area, this species has been the subject of intense poaching for meat and eggs, given their large size, high fecundity and gregarious nesting. The authors evaluated broad-scale patterns of population genetic variation, and estimated the extent of population declines and their effects on the loss of genetic diversity. Data included sequences from the complete mitochondrial control region and nine nuclear microsatellite markers from eighteen localities, for a total of 453 samples. Several analytical methods were implemented including equilibrium and nonequilibrium population genetic methods to account for possible model assumption violations given nonequilibrium conditions expected in declining or expanding populations. Results show concordance between datasets and methods. Population structure reflects a pattern characterized by limited dispersal among sub-basins and high gene flow among populations within a sub-basin. Populations within sub-basins appear to be panmictic, and there is a lack of natal homing to individual nesting beaches; however, a natal-river fidelity that maintains differentiation between rivers seem to exist, even when geographically close. Large differences in haplotype and allele frequencies, as well as microsatellite data are consistent with the observation that population size has been extensively reduced due to hunting over the past two centuries. The authors discuss the conservation implications of their results for the genetic management of this species.

PEARSE, D. E., A. D. ARNDT, N. VALENZUELA, B. A. MILLER, V. CANTARELLI, AND J. W. SITES JR. 2006. Estimating population structure under nonequilibrium conditions in a conservation context: continent-wide population genetics of the giant Amazon River turtle, *Podocnemis expansa* (Chelonia; Podocnemididae). Molecular Ecology 15:985–1006.

Correspodence to: Devon E. Pearse, NOAA Fisheries, Southwest Fisheries Science Center, 110 Shaffer Rd., Santa Cruz, California 95060, USA; e-mail: devon.pearse@noaa.gov.

Morphological Changes After Colonization in the Invasive Species *Bufo marinus*

After colonization, invasive species are expected to suffer a reduction in their genetic variability as a result of strong founder effects. However, many invasive species show phenotypic lability as a response to new environments. Understanding the phenotypic changes that invasive species undergo after colonization might also help understanding the long-term effects of the colonization itself. The cane toad, *Bufo marinus*, is a very successful and highly toxic invader that affects native terrestrial predators that are naïve to their toxicity and die trying to consume them. The authors studied changes in body size and parotoid gland size (as an index of toxicity level) of *B. marinus* with respect to time of colonization in Australia. Body size (snout–ischium length) and parotoid size (length and width) of museum specimens, in addition to climatic factors including temperature, precipitation, and humidity, were analyzed with multiple regression and a model selection approach. Time since colonization was estimated in ARCVIEW using linear interpolation of locality and date of collection data from specimens. Results show a significant effect of climate, latitude and time since colonization on toad morphology. Time since colonization appears to be associated with reduction in body size and parotoid gland size, however, in areas of higher rainfall, the effects appear to be reduced or reversed. The authors suggest this change in morphology could be related with the detrimental effect of toads on the quality of the environment (e.g., reducing food resources), causing the attainment of large size more difficult or as an adaptive change to the new environment, where large body sizes or higher toxicity grants little or no selective advantage. Fortunately, results indicate that *B. marinus* impact over native predators is maximal at first arrival and decreases over time.

PHILLIPS, B. L., AND R. SHINE. 2005. The morphology, and hence impact, of an invasive species (the cane toad, *Bufo marinus*): changes with time since colonization. Animal Conservation 8:407–413.

Correspondence to: Ben L. Phillips, School of Biological Sciences A08, University of Sidney, NSW 2006, Australia; e-mail: bphi4487@mail.usyd.edu.au.

OBITUARIES

Herpetological Review, 2006, 37(2), 134–137.

A. Stanley Rand (1932–2005)

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There is a hole in my chest where my heart used to be, and a chasm in tropical biology the size of the Panama Canal. Stan Rand died on November 14, 2005 and we are all the worse off for it, personally and professionally.

Stan Rand at the World Congress of Herpetology in Prague, 1997.

Dr. Austin Stanley Rand, Stan to all who knew him, was born on September 29, 1932. Perhaps destiny dealt him no choice but greatness in biology, as his father Austin was already a famous

ornithologist at Stan's birth. Stan was never far from field biology or museums when he grew up— he published his first paper when he was 12!

Stan began his graduate studies with Dr. Ernest Williams at Harvard, where he became an early member of that awesome lineage of students of *Anolis* biology under Williams' tutelage. He received his Ph.D. in 1961, and remained at Harvard on a postdoc for one year which included an intensive period of study of Jamaican anoles at the University of the West Indies. He and his wife Pat then relocated in Sao Paulo, Brazil, for two years while Stan was a postdoc with Dr. Paulo Vanzolini. Initially, Stan was paid from royalties from a song that "Vanzo" wrote which must have been quite a hit in Brazil—maybe, Stan always lived modestly and money was never a big issue to him. Regardless, the Rand's first child, Hugh, was born there and it appears he didn't starve.

In 1964 Stan received an invitation from Dr. Martin Moynihan to join a new cadre of impressive young scientists that Moynihan was assembling at the Smithsonian Tropical Research Institute in Panama. Stan joined the staff. He, Pat, and Hugh moved to Panama and had two daughters, Margaret and Katherine, on STRI's Barro Colorado Island (BCI), where the forest was inhabited by anoles and iguanas during the day and the Rands were serenaded by choruses of túngara frogs at night.

Stan published early and often— over 100 scientific papers in 60 years of publishing. (Note that he is not done yet. Túngara Frog papers with his data will continue to bare his name for some time, and I predict there will be one in 2014 which will mark Stan's 70th year in the scientific literature.) Much of Stan's scientific contributions can be partitioned into studies of *Anolis* lizards, iguanas and crocodiles, and, as a grand finale, his study of Túngara Frogs. Stan explored many fascinating tidbits of nature in between these projects but I will briefly review only these contributions here.

Stan published a series of studies on *Anolis* biology in the 1960s that had an immediate and lasting impact on tropical biology, ecology, and behavioral ecology. Prominent among those contributions was his notion of the "ecomorph." The genesis of this concept originated with his data showing that on each island of the Greater Antilles, different *Anolis* species had diversified and adapted to nearly identical niches among islands. During that time Stan also investigated dominance interactions among lizards, showing that if the size difference between males was sufficient, the larger male won, but if there were a smaller size difference the resident won. He demonstrated the "residency effect" in 1967, well before this became an important issue in behavioral ecology. Stan also integrated physiological ecology into his studies. Critical to the concept of the ecomorph was the climatic, not just the structural, habitat the lizards occupied. At the behavioral level he showed that lizards' response to predators was strongly influenced by their body temperature. All of this foreshadowed Stan's continuing emphasis on the organism's entire biology and the necessity of viewing in its natural context.

Stan made at least two other major contributions from his work with *Anolis*. One was a paper with Williams in 1970 on signal redundancy in communication systems. They used information theory to estimate the quantity of information about species identity that could potentially be communicated in a lizard community. They calculated that the total amount far exceeded what was necessary. This study was a wonderful demonstration of how animals use multiple aspects of their displays to reinforce the same message, and it was one of the first uses of information theory applied to animal communication in the wild. Stan also considered the relationship between ecological space and predator-prey interactions in the context of "aspect diversity," arguing that variation among species could result from predator-driven selection that causes species to diverge in the "escape space" available to them. This concept greatly augmented studies of apostatic selection and anticipated much of the work we see today in sensory ecology. (Thanks to both Ray Huey and Jonathon Losos for their thoughts on Stan's *Anolis* work.)

Another stage in Stan's work dealt with social behavior in and between green iguanas and crocodiles. Much of this work was with Gordon Burghardt and his students, centered on the small island of Slothia, a mere stone's thrown from Barro Colorado Island. Female iguanas swim to Slothia from BCI and communally nest. Stan and his brother Will wrote an insightful paper on conflict resolution. It analyzed the competition between female iguanas over burrows they dug for nesting. The analysis combined stochastic processes and energetic constraints and showed that females took into consideration the amount of energy they had expended in building the burrow. This study later lead to some consternation among theoreticians interested in honest signals who were convinced that the "Concorde Effect" (adding more investment only because past investments have been made) should be maladaptive. I remember one night on BCI when, over some rather mediocre Panamanian rum, John Maynard Smith (who to me was always the "Stan of theoretical biology"), asking Stan just how this could be. Although Stan knew the theory about games, the data reined supreme— this is what they do, he replied.

There were also some interesting interactions between crocs and the female iguanas that few besides Stan had witnessed. A female croc had earlier nested at the same site where the fecund iguanas sought shelter for their eggs. The female croc, Natasha as the several meter crocodile was affectionately known, rushed a nesting iguana, and grabbed the expectant mother in her mouth. Instead of devouring her, or at least dismembering her as any protective maternal archosaur should do, Natasha delicately carried the iguana back to the water and released her. Crocodiles carry their newly hatched young to the water, so Stan thought that having a small squirming baby reptile in her mouth released Natasha's maternal instincts. Some of this crocodile work is published, and much more is oral history on BCI. When great scientists such as Stan pass, we marvel at the accumulation of knowledge they left us, and we lament the untapped knowledge that went with them.

Stan began to study acoustic communication in frogs in the forest of Boracéia in Brazil while conducting his postdoctoral research with Vanzolini. That interest continued when he moved to Panama. He immediately set out to document the vocal diversity of these gnomes of the Panamanian nights, but he also turned his considerable nocturnal skills towards one species, the túngara frog, *Physalaemus pustulosus*, which then had the more melodious moniker of *Engystomops*.

I went to BCI to begin my studies of sexual selection and communication in red-eyed tree frogs in 1978. These frogs proved intractable for the study I had planned, and I quickly switched my attention to túngara frogs. At this point Stan had published one paper on their foam-nesting behavior, although nothing on their

communication. But he gave me a manuscript that had been written in the late 1960's or early 1970's. It described the complex calling of these frogs, a simple call, or "whine," that could be produced alone or could be followed by one-to-many secondary components, or "chucks". The manuscript was filled with incredibly interesting and detailed natural history as well as experimental studies of female phonotaxis. Among other things, Stan was interested in whether female frogs were more attracted to the complex call over the simple call. These experiments were conducted when the emphasis of mate recognition was focused at the species level and was concerned with how it contributed to speciation through behavioral isolation. In frogs this work was being carried out in exemplary fashion by such luminaries as Murray Littlejohn and Carl Gerhardt both of whom were inspired by the earlier studies of Frank Blair. So at that time, Stan was working in the intellectual shadow of the Modern Synthesis and its emphasis on speciation, but instead he was addressing questions about female choice and sexual selection. This was some time before Robert Trivers (who also worked on *Anolis* and was advised by Williams during his Ph.D. thesis) wrote his paper on parental investment and sexual selection in 1972. I added some to that early manuscript of Stan's and we published it in 1981. I finished my thesis in 1982 while Stan was still concentrating on reptiles.

Stan and I remained in touch during the next few years while neither of us worked on these frogs. In 1985 we met in the halls of the Smithsonian's Natural History Museum in Washington D.C. and I asked, why don't we start up a joint project with those little beasts. In 1986 we began a now 20-year collaboration on what became known to some as the "túngara frog project". Our initial interests were modest as we began testing female phonotaxis in a car port using a plywood and burlap testing chamber in Gamboa, Panama. Stan and family had just moved from Panama City to Gamboa, and STRI was figuring to have some laboratory facilities there soon. The first question we addressed was what aspects of the mating call made it attractive to females, and the first studies we published in 1990 argued that in this system sexual selection was generated by sensory exploitation. That idea, convergent with and inspired by others such as MJ West Eberhard at STRI, has generated some interest. Our interests in sexual communication in these frogs continued to expand in concert with the lab facilities in Gamboa, which in turn accommodated a more sophisticated approach to our own research questions.

Stan was always interested in the entire biology of the animal and our studies soon grew to embrace additional aspects of communication, comparative studies of populations and related species and, through our collaboration with Dr. Walt Wilczysnki, the neural mechanisms that controlled mate choice. Memorable during those years was a 5000 km transect that Stan and I sampled in which we collected túngara frog calls and tissues throughout the entire range of this species. Most of the data were collected when we departed from Austin, Texas after the meetings of the American Society of Ichthyologist and Herpetologist (ASIH) that was hosted there in 1993. We drove from Texas to Panama collecting all the way. Those samples were supplemented by numerous trips to South America, where we studied other populations of túngara frogs and their relatives. The data from that transect has provided the grist for at least four separate studies, and its uses are still not exhausted.

In the year 2000, Stan, Walt Wilczynski, David Cannatella and I were PI's on a multidisciplinary grant. This grant, which involved collaborations among more than half-a-dozen labs, addressed issues from phylogenetics to molecular neurobiology, all emanating from the basic biology of the túngara frog that Stan first glimpsed in 1964. As the grant ended in 2004 we were asked to organize a two-day symposium on "Sexual Communication in Túngara Frogs" at the Animal Behavior Society meetings in Oaxaca, Mexico. To kick off this symposium numerous attendees, many with little or no interest in frogs, sexual selection, or communication per se, packed the room to hear Stan Rand present what ended up being his last scientific presentation—"Natural History of the Túngara Frog". When Stan finished that talk, there was a sustained applause in which I detected a tone of reverence and appreciation for someone special.

The work on túngara frogs will continue unabated, it will be a scientific legacy to Stan, but more so. It will be a continuing collaboration from the grave. Although no longer with us, we will never outlive Stan's inspiration nor exhaust his insights.

Having now provided a most cursory summary of Dr. Rand's scientific career, I would like to end saying more about Stan as the person; this is the real reason why so many of us mourn his passing

Above all Stan was a naturalist. His eyes, ears, and mind were focused on the organism in its environment. He was well schooled in theory but not terribly impressed by it. He was a great experimenter, but was always a bit cynical about how such results might apply in the wild. An anecdote. We were waiting out a drought in a small dusty town in the bush in Brazil. We went to see a movie, "Edward Scissorhands". An old woman narrates the story in which as a youth she befriends a boy who has scissors for hands. Afterwards, I asked Stan how he liked the movie. He said it was totally unrealistic, the chronology didn't match, the old woman could not have been a youngster when she first met Edward S. I said "Stan, for chris-sakes, the boy had scissors for hands! How realistic is that. So what if the chronology was off". He wouldn't budge. The opening of the movie was built on a house of cards and he could contemplate no further.

For most Stan is intricately associated with STRI. The Smithsonian Tropical Research Institute is a great institution, and Barro Colorado Island is its crown jewel. We celebrated Stan's retirement from STRI with a symposium in his honor at the 1998 meetings of the ASIH in Guelph, Canada, the proceedings of which are published in "Anuran Communication" (Smithsonian Institution Press, Washington DC, 2001). All of the more than 20 authors I first invited to participate said yes—so much for a back up list! When I introduced the symposium I said that but perhaps for BCI, Stan was STRI's most valuable resource. An institution's greatness is defined, of course, not just by its physical facilities but by its humanity. And it is here that Stan made by far his greatest contribution. Because of his immense knowledge of tropical biology, Stan was often called upon for advice, especially to initiate novices to this land of plenty. His generosity knew no bounds, and his humor, warmth and enthusiasm were contagious. He readily extended this generosity into the personal realm. He and Pat were the social hub of Gamboa for the last 20 years and their house a scientific salon. Pat's famous "frog dinners" for many of the visiting researchers in Gamboa (regardless of whether or not the sci-

entists worked on frogs) were the social highlight of our summer. These dinners were also an incubator of scientific ideas. Stan was not a "science nerd," he was broadly informed and could entertainingly engage one with a broad array of topics, but his insights and wit were always sharpened and ready to be administered to the next scientific question.

I remember once bemoaning that because Stan was not at a university, numerous students missed out on all that he had to offer. Wrong, wrong, wrong! STRI offers a wide array of fellowships for researchers at all stages. They all need STRI sponsors. I have counted more than 50 students that Stan sponsored before 1990; surely I have missed many. In addition, since 1986 Stan has acted as sponsor to more that 70 interns and associates who have worked with us on the túngara frog project. He visited my lab in Austin twice a year for a long time; those visits were so heavily booked that I had to sequester Stan at a local pub to have time with him. But that hiding place was found too soon. Finally, there are literally hordes of students who owe Stan deeply. Two now rather famous biologists, one who studies monkeys the other ants, told me long before they were famous that Stan was crucial to the early development of their research forays on BCI. When I informed by mass e-mail numerous colleagues of Stan's death I received a plethora of responses in which the word "love" was used much more than one might associate with "macho" (and "macha") field biologists.

So now we say goodbye, Stan. Thanks for all that you shared, the family, the friends, the tropics, and the frogs. You will not be forgotten. Next rum's on me.

Herpetological Review, 2006, 37(2), 137–138.

John Luther Behler (1943–2006)

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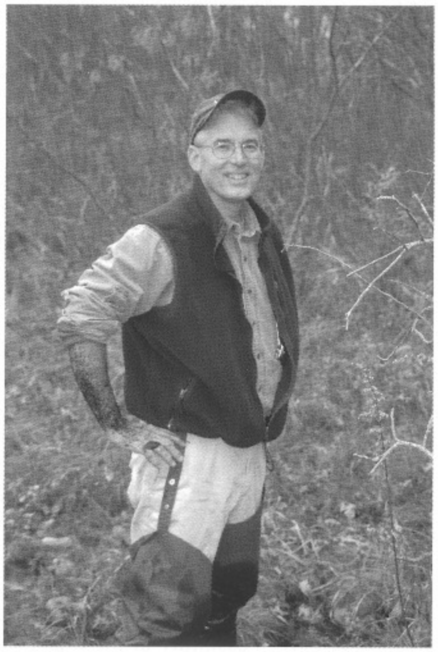
Many scientists achieve fame and immortality as a result of years of dedicated research and productivity in their chosen field. John Behler has achieved both, not only because of his dedication and contributions to conservation and herpetology, but also as a warm human being. He will be long remembered by many whose lives he touched, careers he helped, and for the compassionate counsel he gave when they needed it most.

John was born into a family of dentists. But it was not long before his real passion for the outdoors was evident. He loved to fish, hunt, catch and collect butterflies, and study insects, frogs, snakes, and turtles. He was passionate about natural history. His entry into dental school was abandoned when his father wisely advised him to pursue a career in zoology instead. He majored in zoology at the University of Miami and earned a Master's Degree in Education at East Stroudsburg University in Pennsylvania. During the summer months, John worked for the National Park Service at Indian Town Gap National Park. He taught for a short period at Hobart and William Smith College in upstate New York. His interests, which remained with him throughout his life, soon focused on turtles and salamanders.

John joined the Wildlife Conservation Society in 1970 as a curatorial intern in the Department of Herpetology. He brought his passions with him, and later, as the Curator of Reptiles, he became a conservation icon. He developed the first management plan to save the American crocodile in Florida, and developed programs for the conservation of endangered Madagascan tortoises, to name only a few of his achievements. While Raymond L. Ditmars, the first Bronx Zoo curator of reptiles, was the first to introduce the public to herpetology through popular writings, John brought zoo herpetology into the arena of international conservation. He was particularly concerned with the plight of turtles, crocodilians, and other reptiles around the world, a concern that took him traveling to the far reaches of the globe. He created and administered the first crocodilian Species Survival Program (SSP) for the Chinese Alligator under the American Zoo and Aquarium Association, a program that still stands as a model for the successful conservation and management of an endangered species. He was instrumental in developing captive breeding programs for reptiles at the Society's Wildlife Survival Center on Saint Catherine's Island, off the coast of Georgia. When John ran a program, it was, by definition, going to be successful, despite the shambles he might find it in when he inherited the task.

Yet, he never lost sight of the problems faced by species in his own backyard. John worked tirelessly to save the rare and endangered Bog Turtle, and helped state agencies and local governments in designating and protecting critical wetland habitats. He was instrumental in the creation of the Bog Brook Unique Area, in Putnam County, New York, as a New York State sanctuary for all three indigenous turtle species.

While John might sympathize with the overzealous private collectors who found themselves running afoul of the law for some wildlife infraction, he also worked closely with state, national, and international wildlife law enforcement authorities to provide expertise, training, and advice.



A typical day in the field for John Behler—wet, muddy, and smiling. Photo taken at Delaware Water Gap National Forest, November 2003. Behler and other researchers were conducting a multi-year study of Wood Turtles. Photographer unknown.

His field guides and

books on native and exotic reptiles can be found on bookshelves throughout the US and abroad, and John's popular articles and scientific writings continue to thrill and excite young people and adults alike. His latest work, *Frogs, a Chorus of Color*, co-authored with his wife Debbie Behler, highlights these beautiful and unique creatures and stimulates public concern for amphibian populations, which are declining worldwide. Unfortunately, John died before seeing the publication of what may have been his greatest pride, a book on the reptiles and amphibians of New York State, written in collaboration with the New York State Department of Environmental Conservation.

John always credited his experiences at the Bronx Zoo for teaching him so much about the care and habits of the animals he loved. But John could not imagine the wealth of knowledge and the insights he so casually shared with those around him, including his professional peers.

John is survived by his wife Debbie, his mother Mildred, sister Judy, his children Cindy Sibilia and David Behler, and five grandchildren. Most of all, John is survived by a legacy of willingness to help others in his profession, and a genuine care for the future of all living creatures. We will all miss John and his counsel.

ZOO VIEW

Rarely is a zoo blessed with many prominent curators but New York's Wildlife Conservation Society (WCS), headquartered at the Bronx Zoo, enjoys a worldwide reputation in herpetology because of the writings and diverse backgrounds of five men: Raymond L. Ditmars, James A. Oliver, Herndon G. Dowling, F. Wayne King, and John L. Behler. Our dear friend and colleague, Curator of Herpetology John L. Behler has passed away after a lengthy illness (Fig. 1). The moving tribute to John in this issue written by his co-workers at WCS for so many years—Peter Brazaitis and Bill Holmstrom—clearly shows how an accomplished and effective herpetologist can contribute to conservation outside zoo boundaries (see 2003 Herpetol. Rev. 34:192–193, for example).

John was a prolific writer and was always focused on public education. Here is one recent example—said to be the most successful traveling exhibit at the American Museum of Natural History in New York City was *FROGS! A CHORUS OF COLORS*. This exhibit was created by the staff at Clyde Peeling's Reptiland in Allenwood, Pennsylvania and featured hundreds of living frogs and spectacular graphics. Behler and his wife Deborah A. Behler, editor-in-chief of the Society's *Wildlife Conservation* magazine, produced a splendid companion volume to this exhibit with the same name. Geared primarily to the layman, this lovely book (Sterling Publishing Co., Inc., New York; ISBN: 1-4027-2814-X, 2005), is filled with remarkable pictures, readable text on important aspects of anuran biology, and a strong conservation message.

I have selected some of Behler's important books and papers below to show his versatility across a wide range of herpetological subjects.

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BEHLER, J. L., P. BRAZAITIS, K. GERETY, AND B. FOSTER. 1987. Propagation of crocodilians at the Bronx Zoo. p. 63–73. In 11th International Herpetological Symposium on Captive Propagation and Husbandry. Chicago IL: International Herpetological Symposium.

BLANCO, S., J. L. BEHLER, AND F. KOSTEL. undated. Propagation of the batagurine turtles *Batagur baska* and *Callagur borneoensis* at the Bronx Zoo. *In* K. R. Beaman, F. Coporaso, S. McKeown, and M. D. Graff (eds.), Proceedings of the First International Symposium on Turtles and Tortoises: Conservation and Captive Husbandry, pp. 63–65. Chapman University, 9–12 August 1990. California Turtle and Tortoise Club, Van Nuys, California.

MCCRYSTAL, H. K., AND J. L. BEHLER. 1982. Husbandry and reproduction of captive giant ameiva lizards *Ameiva ameiva* at the New York Zoological Park. Inter. Zoo Yearb. 22:159–163.

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CHISZAR, D., C. W. RADCLIFFE, T. BOYER, AND J. L. BEHLER. 1987. Cover-seeking behavior in red spitting cobras (*Naja mossambica pallida*): Effects of tactile cues and darkness. Zoo Biol. 6:161–167. [clear snake hiding boxes are recommended.].

HOLMSTROM JR., W. F., AND J. L. BEHLER. 1981. Post-parturient behavior of the common anaconda, *Eunectes murinus*. Zool. Gart. (N.F.), Jena 51:353–356.

Medical Management

NAPOLITANO, R. L., E. P. DOLENSEK, AND J. L. BEHLER. 1979. Reptilian amoebiasis. Inter. Zoo Yearb. 19:126–131.

OTIS, V. S., AND J. L. BEHLER. 1973. The occurrence of Salmonellae and *Edwardsiella* in the turtles of the New York Zoological Park. J. Wildl. Dis. 9:4–6.

Husbandry

BRAZAITIS, P., AND J. L. BEHLER. 1973. A durable housing facility for reptiles. Laboratory Anim. Sci. 23:866–868.

General

BEHLER, J. L. 1970. The bog turtle (*Clemmys muhlenbergi*) in Monroe County, Pennsylvania. Bull. Maryland Herpetol. Soc., Sept.:52–53.

FIG. 1. John Behler (far left) holding tail of an enormous Reticulated Python (*Python reticulatus*) named "Samantha," rescued from hide hunters in 1993. The snake was 21 feet and 175 pounds when captured. She grew to over 26 feet and 275 pounds at the Wildlife Conservation Society (Bronx Zoo) until her death in November 2002. Her favorite food was pigs. Peter Brazaitis is next to Behler on the tail end, and William Holmstrom is holding the snake's head. Photograph courtesy of Wildlife Conservation Society, headquartered at Bronx Zoo.

BEHLER, J. L. AND D. A. BEHLER. 1998. Alligators & Crocodiles. Voyageur Press, Inc., Stillwater MN.

BEHLER, J. L., AND F. W. KING. 1979. The Audubon Society Field Guide to North American Reptiles and Amphibians. Alfred A. Knopf, Inc., New York.

Behler, J. L., B. Winn, and R. H. Hayes Jr. 1997. Snake fauna of St. Catherines Island, Georgia. Herpetol. Rev. 28(3):152. [St. Catherines Island was the satellite breeding site for the Wildlife Conservation Society.].

Calle, P. P., J. L. Behler, J. McDougal, S. M. Lee, I. Schumacher, and D. R. Brown. 1998. Mycoplasma survey of captive and free-ranging eastern box turtles (*Terrapene carolina carolina*) in New York. Proc. Amer. Assoc. Zoo Vet.:285–287.

"Animal Kingdom" Magazine produced by WCS

BEHLER JR., J. L. 1970. Galapagos tortoise *Geochelone elephantopus*. Anim. Kingdom 73(5):33.

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BEHLER, J. L. 1972. Toads. Anim. Kingdom 75(5):33.

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Charles (Charlie) H. Hoessle

R. Marlin Perkins hired Charles (Charlie) H. Hoessle as a reptile keeper at the St. Louis Zoo in 1963. Only two years later, he was elevated to assistant general curator and by 1969, Charlie was general curator. Charlie continued to rise and in 1972, he became deputy director. In 1982, he was installed as permanent director, a post he held until he retired twenty years later. He has stayed on as director emeritus.

It was fitting that Charlie received the prestigious R. Marlin Perkins award, the highest honor bestowed to a zoo professional by the American Zoo and Aquarium Association. In 2005, Charlie was recognized by zoo supporters in St. Louis with a full-sized bronze statue of him with a Boa Constrictor draped over his shoulders in front of the newly-named Charles H. Hoessle Herpetarium. This historic building—built in 1927—with its beauty and grace, has always been one of my favorites and it is wonderful that he has been recognized for his many accomplishments in our field (Fig. 2). Charlie joins a select list of directors in the United States who specialized in herpetology—Arthur Brown, Roger Conant, Carl Kauffeld, Edward Maruska, James Oliver, R. Marlin Perkins, George Rabb, and John Werler.

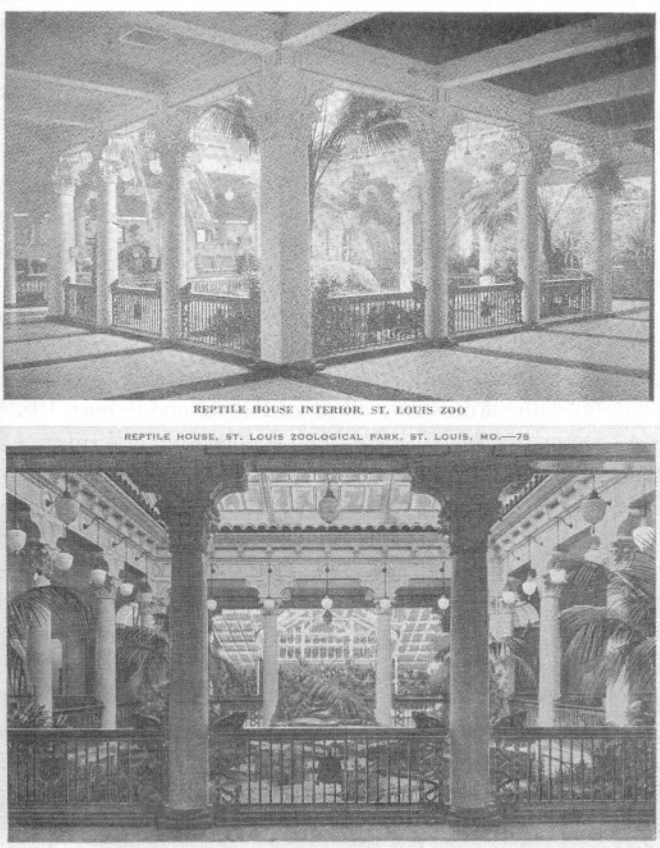

FIG. 2. Postcards of St. Louis Zoological Park's reptile house in 1944. Courtesy of Brint Spencer.

HERPETOLOGICAL PUBLICATIONS BY CHARLES H. HOESSLE

Husbandry

HOESSLE, C. 1969. Simple incubators for reptile eggs at St. Louis Zoological Park. Inter. Zoo Yearb. 9:13–14.

LENTZ, M. J. R., AND C. H. HOESSLE. 1971. Mite control at St. Louis Zoo. Inter. Zoo Yearb. 11: 235. [account detailed the use of Shell No-Pest Strips©].

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WALLACH, J. D., AND C. HOESSLE. 1967. Visceral gout in captive reptiles. J. Amer. Vet. Med. Assoc. 151:897–899.

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WALLACH, J. D., AND C. HOESSLE. 1968. Fibrous osteodystrophy in green iguanas. J. Amer. Vet. Med. Assoc. 153:863–865.

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General

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—James B. Murphy, Section Editor

ARTICLES

Herpetological Review, 2006, 37(2), 140–142.

Leptodactylus pustulatus Peters, 1870 (Amphibia: Leptodactylidae): Notes on Habitat, Ecology, and Color in Life

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The Brazilian Cerrado remains one of the most poorly understood habitats in that country. Among the little known anurans from the Cerrado is a reclusive member of the genus *Leptodactylus* which Peters (1870) described as *Entomoglossus pustulatus*, collected from Ceará, Brazil (Bokermann 1966). Boulenger (1882) reassigned the species to the genus *Leptodactylus*. A number of subsequent publications briefly mention the species by either including it in faunal, distributional, or nomenclatural listings, or by providing short physical descriptions of preserved specimens (Bokermann 1962, 1966; Duellman 1999; Frank and Ramus 1995; Frost 1985; Heyer and Pyburn 1983; Liner 1992; Lutz 1926, 1930; Miranda Ribeiro 1926, 1927; Vanzolini and Heyer 1988), but little else has been reported. The holotype was long believed lost, leading Heyer (1970) to designate a neotype (MCZ 373). Subsequently, the original type has been relocated in Berlin, Germany (ZMB 6951) (Bauer et al. 1995).

Habitat associations.—Little is known of the biology or ecology of this species. These frogs have been primarily associated with Amazon, Cerrado, and Caatinga habitats south of the Amazon River; the four drainage systems for which reliable locality records exist are the Xingu, the Paranaíba, the Araguaia, and the Tocantins in Central Brazil (Heyer 1970). The majority of the locality records associate the species with Cerrado (Heyer 1994). The type specimen was collected in Ceará, Brazil (Peters 1870), an area dominated by Caatinga habitat. Bokermann (1962) reported finding individuals beneath an old boat along the Xingu River. The locality, Posto Jacaré, is located in transitional forest between Cerrado and Amazonian biomes (as are the localities for the new specimens reported herein). Aside from association with riparian habitat, frogs have also been found in patches of marsh-like wetlands within the outlined habitat types, known in Brazil as "vereda." No other habitat information for *L. pustulatus* has been published (Heyer 1994, Heyer, pers. comm.), except for male calling sites (Brandão and Heyer, *in press*).

Habitat description (Locality 1).—In August 2000, we collected two specimens and observed a third along the upper Tocantins River in the state of Tocantins, Brazil. Vereda in the vicinity of the city of Tocantinópolis ranges from mildly disturbed to completely cleared for cattle grazing. We found our specimens in a heavily disturbed clearing with a natural spring that maintains the small wetland area, even in the dry season. During the wet season, the entire cleared area, ca. 50 ha^2, is inundated with water ranging from 0.2–1 m in depth. During the dry season, the wetland is reduced to small patches roughly one tenth the size of the wet season habitat. Tall grass covers the clearing at roughly 0.6 m in height. The ground is uneven and is arranged in a random series of slightly elevated mounds. These mounds become small, soggy "islands" in the wet season and are separated by shallow water. All *L. pustulatus* from this locality were found on these mounds at night. When approached, individuals crawl in a bufonid-like fashion rather than hopping away in a typical leptodactylid fashion. The following anurans were found syntopically: *Leptodactylus ocellatus*, *L. podicipinus*, *Hypsiboas raniceps*, *Dendropsophus minutus*, *Scinax* sp., and *Pseudis tocantins*.

Habitat description (Locality 2).—The city of Peixe, Tocantins State, is connected to the "Peixe Angical" hydroelectric impoundment of the Tocantins River by a road that crosses the Tocantins River before reaching the dam. That road is fringed by area cleared for the grazing of cattle. Patches of vereda are common along the road. On the right bank of the Tocantins River, immediately after the road crosses it, is a patch of vereda. We examined the habitat on 25 April 2005 at 2000 h and 17 June 2005 at 1900 h. The wetland is ca. 6 ha^2 with water depths ranging from .01 to 2.1 m depth. The vereda is maintained throughout the year by springs and aquatic vegetation is present. The edges of the wetland, and small islands within, are covered by grass 0.4 m in height. All *L. pustulatus* at this locality were found on muddy banks of the wetland, among clumps of grass. The following anurans were found syntopically: *Pseudis tocantins*, *Dendropsophus anataliasiasi*, *D. minutus*, *D. cruzi*, *D. nanus*, *Hypsiboas raniceps*, *Leptodactylus ocellatus*, *L. fuscus*, *L. labrynthicus*, *L. podicipinus*, *L. troglodytes*, *Physalaemus cuvieri*, and *P. nattereri*. We observed Cuvier's Dwarf Caiman (*Paleosuchus palpebrosus*), a potential predator, in the wetland.

Color in life.—The dorsal coloration of individuals range from a dark, forest green, to dark brown, with darker brown or black irregularly shaped and spaced spots. In contrast to other *L. pustulatus* without dorsolateral ridges (Heyer and Pyburn 1983), these specimens have six small, elevated dorsolateral ridges extending along the dorsum to the vent with an uneven surface. A maroon V-shaped pattern extends from behind each eye to the nasal openings. A faint black line also extends from the base of each eye to the nasal openings. The pupils are horizontal and black. The iris is a faded copper color marked by irregularly spaced black reticulations that extend to the edge of the eye. The ventral pattern and coloration of *L. pustulatus* is a distinguishing character from other anurans, save for *L. podicipinus*. The ventral ground color ranges from charcoal gray to black and can change within 20 minutes from gray to jet black or vice versa. Circular and ovoid spots cover the ventral surface extending from the throat covering to the groin and undersides of the legs and arms, as well as onto the flanks. The spots wrap around the throat and onto the lower lip. Syntopic *L. ocellatus* and "*L. podicipinus*" also have white spots of similar proportion on their lower lip which confuses visual iden-

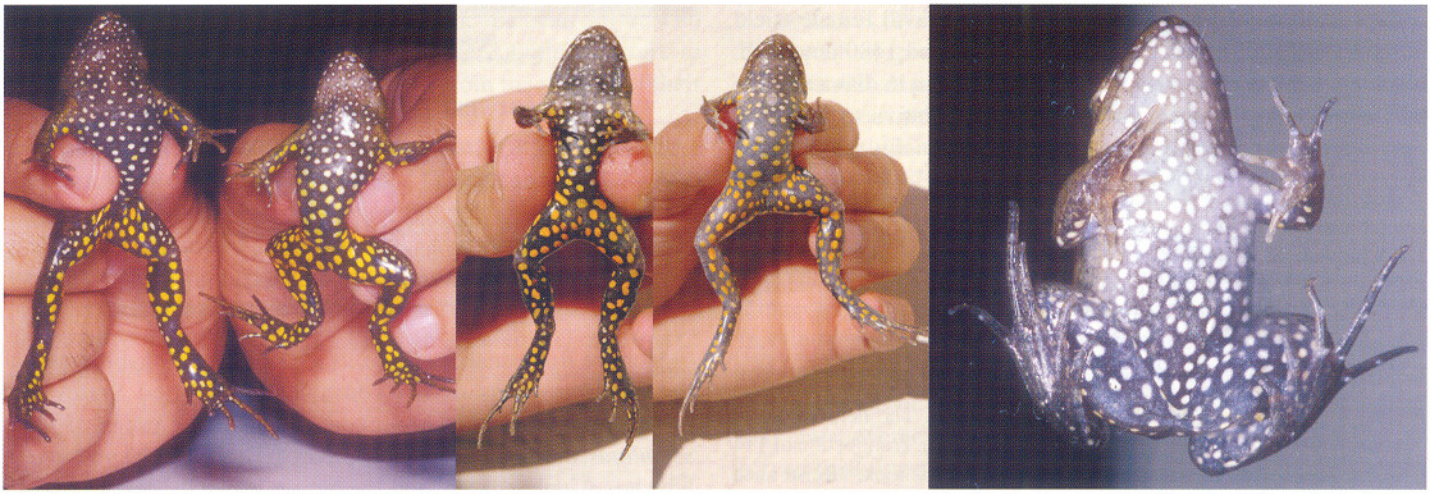

FIG. 1. The ventral surface of *Leptodactylus pustulatus* demonstrating ventral color in life and variation in color and pattern. From left to right: HLR20 and HLR21 from outside "Paudo Chapinha:" wetland on the left bank of the Tocantins River: Tocantins State: Brazil; NAT1222, NAT1223, and NAT1228 from the road connecting the town of Peixe, and "Peixe Angical" hydroelectric impoundment: wetland on the right bank of the Tocantins River: Tocantins State: Brazil. Note, NAT1228 is a juvenile with only faint traces of the orange coloration filling spots on the outer thighs and arms.

tification when facing an individual from a distance. The ventral spots on *L. pustulatus* do not connect and are white in the throat and chin region. All of the spots near the groin and lower abdomen range from a brilliant orange to canary yellow in adults. Individual variation exists in the relative number of colored versus white spots, and in the progression of the orange spots up the ventral surface toward the animal's head (Fig. 1). In most individuals, orange colored spots can be found on the underside of the upper arms, even if the orange spots don't extend far up the ventral surface. In a resting position, the spots are visible on the chest and lower lip when approaching the animal from the front. Two juvenile frogs were collected at the Peixe locality. The spots on their ventral surface were primarily white. The orange coloration of the spots on the thighs and groin area was faint (see Fig. 1). This observation suggests that either 1) juveniles do not have well defined orange colored spots early in life, or 2) that some individuals never develop well defined orange or yellow spots. Because all adults observed from this locality and elsewhere have had well defined orange or yellow colored ventral spots, the first hypothesis is the likely condition. Accordingly, this increases the likelihood of confused identifications between juvenile *L. pustulatus* and *L. podicipinus* (similarly sized and colored dorsally—also with white spots on the ventral surface). One discriminating character is that in *L. pustulatus*, the ventral surface of the tarsal units have distinct white spots, whereas in *L. podicipinus* the surfaces are mottled rather than clearly spotted (W. R. Heyer, pers. comm.).

TABLE 1. Morphometric measurements for specimens of *Leptodactylus pustulatus* from (1) outside "Paudo Chapinha": wetland on the left bank of the Tocantins River: Tocantins State: Brazil, and from (2) the road connecting the town of Peixe, and "Peixe Angical" hydroelectric impoundment: wetland on the right bank of the Tocantins River: Tocantins State: Brazil. All measurements taken using digital calipers, in mm: SVL = snout to vent length, HW = head width, HL = head length, IOD = inter-ocular distance, END = eye to nostril distance, TD = tympanum diameter, FeL = femur length, TL = tibia length, FL = foot length, Juv. = juvenile. All specimens deposited in the collection at the Universidade Católica de Goiás, Goiás, Brazil.

Locality	Field Number	SVL	HW	HL	IOD	END	TD	FeL	TL	FL	Sex
Tocantinópolis Locality											
	HLR20	56.3	17.0	22.4	5.5	4.8	3.8	21.5	21.6	26.0	Female
	HLR21	49.0	16.7	20.2	5.3	5.0	2.8	14.1	16.9	24.7	Female
Peixe Locality											
	NAT1222	35.9	13.9	17.3	6.3	3.8	3.6	10.5	16.1	18.3	Male
	NAT1223	47.0	15.9	18.3	5.1	4.1	3.9	17.3	20.6	25.6	Female
	NAT1224	34.7	13.3	16.3	4.6	3.2	3.4	11.7	16.0	20.8	Male
	NAT1225	33.9	12.9	16.4	4.4	3.8	3.5	12.8	15.9	20.9	Male
	NAT1226	40.0	13.3	19.2	4.9	4.3	3.3	13.4	17.3	22.3	Male
	NAT1227	32.5	13.0	14.5	5.7	3.7	2.8	13.3	16.0	19.9	Male
	NAT1228	24.8	9.6	10.3	5.5	3.1	1.8	9.5	11.5	15.0	Juv. Male
	NAT1229	24.4	9.3	9.9	4.7	2.6	2.1	10.0	12.4	14.1	Juv.

Reproductive output.—We collected one gravid female (field number NAT1223) at the Peixe locality. She had 1480 unyolked, black eggs in her abdomen. All eggs were 1 mm in diameter. She had a noticeably greater girth to her body relative to two non-gravid females collected at the Tocantopolis locality.

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Rain-Harvesting in a Wild Population of *Crotalus s. scutulatus* (Serpentes: Viperidae)

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Mohave Rattlesnakes (*Crotalus s. scutulatus*) inhabit many of the desert regions of the southwestern United States and northcentral Mexico. Throughout much of the range of *C. s. scutulatus*, the dominant plant is Creosote Bush (*Larrea tridentata*), which is widely spaced, and the terrain is mostly devoid of rock outcroppings and other significant topographic features. This habitat is also characterized by dry, porous soils that rapidly absorb rainfall, creating little opportunity for surface water to accumulate. Most precipitation in the Mohave Desert, where this study was conducted, occurs during the winter. Summer monsoon rains are less predictable and less significant than in the more southern Sonoran and Chihuahuan Deserts (Jaeger 1957), where *C. s. scutulatus* also occurs.

Several authors have described viperid snakes drinking water from the external surfaces of their own skin. Bogert (1927) describes a technique for captive husbandry of "rattlesnakes taken on the desert miles from water" as requiring water to be "sprayed upon them, as well as upon the rocks in their cage." He goes on to describe the snakes "sucking the water off the rocks and sometimes off their own backs." Also referring to captive animals, Hediger (1964) describes "some rattlesnakes" as preferring to "drink drops from the scales on their own bodies." Greene (1997) describes watching a wild Terciopelo (*Bothrops asper*) "drinking rain droplets off her own skin" in a Costa Rican rainforest. Andrade and Abe (2000) report captive juvenile Brazilian Lanceheads (*Bothrops moojeni*) coiling when sprayed with water, which was trapped between body loops and ingested. Captive Peringuey's Adders (*Bitis peringueyi*) from the Namib Desert have twice been reported to flatten their bodies when sprayed with water, which they then "drink" (Robinson and Hughes 1978) or "lick" (Louw 1972) from their own skin. Aird and Aird (1990) reported a captive adult female Great Basin Rattlesnake (*Crotalus oreganus lutosus*) in an outdoor enclosure flattening her body, forming concentric coils, and drinking rainwater trapped between the coils. A single observation of a wild xeric rattlesnake, *Crotalus oreganus concolor*, drinking rainwater from its skin was reported by Ashton and Johnson (1998).

Body posturing has been reported to enhance the collection of water from the skin by some desert lizards, including *Phrynocephalus helioscopus* (Schwenk and Greene 1987), *Phrynosoma cornutum* (Sherbrooke 1990), *P. platyrhinos* (Peterson 1998), *P. modestum* (Sherbrooke 2002), and *Trapelus pallidus, T. mutabilis,* and *T. flavimaculatus* (Vesely and Modry 2002). The term "rain-harvesting" was first used by Sherbrooke (1990) to describe the combination of integumental microstructure that enhances capillary movement of water and associated stereotypical posturing by *Phrynosoma cornutum* to collect and ingest rainwater.

I herein use "rain-harvesting" to describe the behavior of wild *C. s. scutulatus* by which they adopt a stereotypical posture to collect rainwater, which they then drink from the surface of their skin.

Methods.—Ten male and 10 female adult (> 180 g) Mohave Rattlesnakes were surgically implanted (Reinert and Cundall 1982) with temperature-sensing radio transmitters (model SI-2T, Holohil Ltd., Ontario, Canada) and radio-tracked for periods ranging from 18 days to 32 months (mean = 16 months).

Observations were made from August 2001 through April 2004, which involved > 2700 individual encounters with telemetered *C. s. scutulatus* and 84 chance encounters with 40 non-telemetered specimens. These observations were made in all seasons, at all times of day, and in a wide variety of weather conditions, including rainfall.

The study site is in the western Mohave Desert near Victorville, San Bernardino County, California, USA (ca. 34°36'N, 117°10'W) on a Creosote Bush-dominated bajada at a median elevation of about 975 m.

Current and historical precipitation data were obtained from the National Oceanic and Atmospheric Administration for its "Victorville Pump Plant" station (COOP ID 049325), located 14 km SW of the study area.

Results.—Individual *C. s. scutulatus* were visible on 1633 occasions. In 1097 of these observations (67%), they were found motionless in round "resting/ambush" coils, in which the anterior body was coiled on top of and covering the posterior body and tail. The head rested on top, oriented to face away from the center of the coil, with the axis of the head usually on a radius of the coils. The crown of the head was usually level or the nose was slightly elevated (Fig. 1).

In 12 of 16 observations during rainfall, the snakes were observed to be coiled with the body spiraling out from the tail in the center; the coils of the anterior body were adjacent to, rather than on top of, the coils of the posterior body. The abdominal area was extraordinarily flattened dorso-ventrally, maximizing the surface area exposed to the rain. Adjacent posterior abdominal coils were in contact, forming a shallow trough between them where rainwater collected. The position of the head was adjusted to a nose-down attitude, placing the rostral area in the trough formed by the adjacent abdominal coils (Fig. 2). This posture and behavior was also observed on six additional occasions shortly after rainfall had stopped but while the snakes were still wet. These 18 observations involved 12 different animals during 9 storms in 3 calendar years.

In each case where rain-harvesting behavior was observed, the snake positioned its head so that the rostral area was within about 2 mm of, or actually in contact with, the animal's skin. Slight rhythmic movement could be observed in the temporal-mandibular musculature and the rostral area was moved every few seconds to different areas of the trough between adjacent coils. Although actual jaw movement could not always be seen, water could be observed to disappear as it came into contact with the snake's rostral area.

On 10 July 2002, an 828 mm SVL (snout–vent length) male *C. s. scutulatus* (Css25) was observed just as a summer evening thunderstorm struck. The snake was in a resting/ambush coil, under the edge of overhanging Mormon Tea (*Ephedra nevadensis*) foliage, when a few large scattered raindrops began to fall. In < 10 seconds, he moved about 20 cm to a position that was not overhung by the shrub, assumed the rain-harvesting posture and began to search for water on his own skin in a very animated manner. This occurred even before he or the surrounding substrate was visibly wet. Immediately after this observation, I returned to a 770 mm SVL female (Css20) that had been visited 22 minutes before and found her in rain-harvesting posture, having also moved from under foliage (*Larrea*), where she had earlier been in a resting/ambush coil.

On three other occasions, Mohave Rattlesnakes were observed to move away from their rain-harvesting positions (usually to retreat from the observer) and the substrate under each snake was noted to be dry, contrasting with the adjacent soil that had been darkened by moisture.

Study animals ignored large granite rock outcrops in parts of the study site where temporary puddles of rainwater can be expected to occur. In some areas frequented by the study animals,

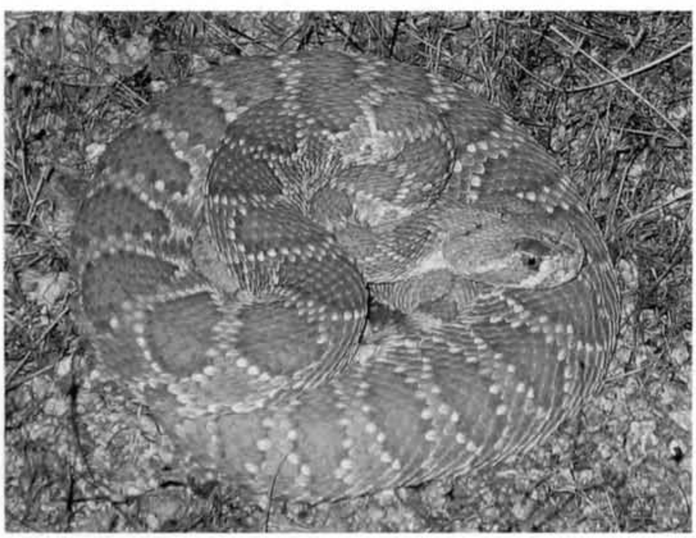

Fig. 1. *Crotalus s. scutulatus* (Css42, 1 May 2004) in stereotypical resting/ambush posture.

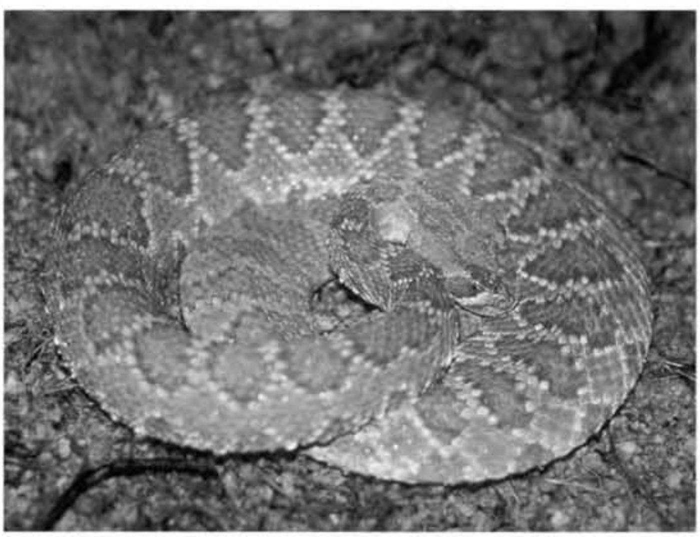

Fig. 2. *Crotalus s. scutulatus* (Css03, 30 October 2001) in stereotypical rain-harvesting posture.

the ground is littered with cobble (stones 65–256 mm) that accumulated rainwater on their surfaces in quantities that appeared at least comparable to the water that collected on the snakes' bodies. While other small creatures (e.g., *Hadrurus* scorpions) drank from these small rocks and from dripping vegetation, *C. s. scutulatus* were never observed to use water from these or any surfaces except their own bodies.

Crotalus s. scutulatus were observed harvesting rainwater in March, April, July, August, September, October, and November. Mean body and air temperatures during observed rain-harvesting were 18.2°C (range 12 – 32; N = 13) and 17.6°C (range 11 – 30; N = 16), respectively. Fewer body temperatures were recorded than air temperatures because of transmitter failure (N = 1) and chance observations of non-telemetered snakes (N = 2).

Study animals were visited on 22 occasions during rainfall events in November, January and March. With the exception of one mid-March observation, there was no indication that the animals emerged from their winter shelters (mammal burrows) to drink.

Discussion.—*C. s. scutulatus* are ambush predators and, in this study, 67% of their time above ground was spent in resting/ambush coils. By minimizing exposed skin, this position minimizes transdermal moisture loss in conditions of very low humidity (Cohen 1975). Compared to the resting/ambush coil, the rain-harvesting posture increases exposed skin surface (thereby intercepting more rain), decreases the slope of the lateral skin surface (thereby slowing water runoff), and creates troughs between adjacent coils where water accumulates. Although water is also available on the surface of small stones and foliage during and immediately after rain, the rain-harvesting posture is more efficient in that it does not require time to be spent during typically brief storms searching for a suitable surface from which to drink.

Drinking snakes' core body temperatures were very close to the surrounding air temperatures (mean difference < 1°C) and revealed that they were willing to endure body temperatures as low as 12°C to harvest rainwater. Sherbrooke (1990) observed nocturnal emergence, presumable at lower temperatures, of Texas horned lizards (*Phrynosoma cornutum*) to harvest rain during nighttime storms.

Desert rattlesnakes, like other desert animals, depend on metabolic water obtained from the food they consume. Nonetheless, it has been shown that reptiles cannot produce enough metabolic water to entirely compensate for water loss (Nagy 1987). *Crotalus s. scutulatus* appears to be adapted to efficiently exploit one of the rarest yet most important resources in xeric environments, especially considering that nearly 70% of annual precipitation in this study area occurs from December through March (National Climatic Data Center 2002), when cold temperatures apparently prevent *C. s. scutulatus* from taking advantage of it.

Two observations of *C. s. scutulatus* moving out from under foliage at the first hint of rain suggest that these snakes take up rainfall-harvesting positions very early in a rainfall event. It should be noted, however, that these two observations were made during a storm season (October 2001–September 2002) that yielded 71% less precipitation than the 30-year mean for the area (National Climatic Data Center 2001–2002 and 2002). Observations of dry ground under other rain-harvesting specimens is consistent with such early movements but is equally consistent with those snakes being in suitable rain-harvesting locations before rainfall began.

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Between a Rock and a Hard Place: Responses of Eastern Box Turtles (*Terrapene carolina*) When Trapped Between Railroad Tracks

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Human transportation infrastructures, such as roads, can adversely affect animal populations via fragmentation (Forman and Alexander 1998; Mader 1984) and habitat deterioration due to construction (Ritters and Wickham 2003), changes in predator/prey concentrations (Dijak and Thompson 2000) and vegetation composition (Angold 1997), and the spread of invasive species (Tyser and Worley 1992) (for summary references see Forman et al. 2003). Direct mortality has been demonstrated for many animals, including mammals (Groot Bruinderink and Hazebroek 1996; Havlín 1987), and amphibians and reptiles (e.g., Ashley and Robinson 1996; Hels and Buchwald 2001; Smith and Dodd 2003). Other land transportation networks, such as railroads, can result in direct mortality due to collisions with trains, although this has been primarily documented for mammals (see Van Der Grift 1999 for review). Although some lizards may benefit from railroad structures (Blanke 1999), the railroad bed itself may be lethal for smaller animals that can become trapped between the rails, where they may be susceptible to predation or physiological stress. Railroads can also form barriers, either physically (inability to cross) or behaviorally (avoidance), that can result in fragmented populations (Groot Bruinderink and Hazebroek 1996). For example, Van Der Grift (1999) points out that few Hedgehogs (*Erinaceus europaeus*) are killed by trains, but the structure of the railroad may act as a barrier to movement.

Eastern Box Turtles (*Terrapene carolina*) are found throughout most forests of the eastern United States. In many regions, their habitat is traversed by railroads. Points where roads intersect railroads (i.e., railroad crossings) likely increase the probability of turtles entering and becoming trapped between railroad rails. Apparent railroad-induced mortality has been documented for *T. carolina* due to individuals becoming trapped between the rails (Dodd 2001; Palmer and Braswell 1995). Anecdotal evidence of 10–15 *T. carolina* shells of varying sizes in a 5-km section of railroad in north Florida, suggests that turtles have difficulty crossing or escaping from between the rails (Pierson Hill, pers. comm.).

In this study, we examine the potential impacts of railroads on *T. carolina* by testing their ability to escape from between railroad tracks. Additionally, we estimate the temperatures that *T. carolina* experience while trapped. Finally, we use Geographic Information System (GIS) data to determine the likelihood of a turtle encountering potential entry and exit points along railroads within our study area.

METHODS

We conducted our study near the town of Davidson in northern Mecklenburg and southern Iredell counties, North Carolina, USA, on a seldom-used stretch of railroad track typical of those in the region. The railroad rails are T-shaped and approximately 190 mm high and 70 mm wide at the top of the rail (Fig. 1).

We tested 12 adult *T. carolina* (8 male, 4 female) with a mean ± SE body mass of 383.1 ± 14.4 g). Mean ± SE measurements of the turtles we tested were: carapace length = 130.1 ± 1.7 mm, plastron length = 126.1 ± 1.4 mm, shell width = 103.4 ± 1.3 mm, and shell height = 62.3 ± 1.3 mm (Fig. 1). All turtles were captured by members of the Davidson College Herpetology Laboratory or the Davidson community and tested between 4 September and 2 October 2004. Turtles were maintained in the laboratory for < 2 weeks prior to experiments and were provided with food and water *ad libitum*. No animals used in the experiments were injured or displayed signs of deteriorating health while in captivity. After completion of the experimental trials, we released turtles at their original capture locations.

Experiment 1. Can box turtles climb over railroad rails?

To examine the ability of *T. carolina* to escape from railroad tracks, we placed turtles between the rails of a railroad at a predefined common location (i.e., starting point) and oriented them in one of three randomly chosen directions: facing away from the observer or towards the observer's left or right. After releasing the turtle, the observer sat motionless on the track at least 20 m away and remained 20–40 m away from the turtle for the duration of each experiment. The turtle's movements and behavior were followed using a spotting scope (Spacemaster, 15–45x zoom; Bushnell Corporation, Overland Park, Kansas). Trials started when the turtles emerged from their closed shells and began moving. Trials ended after 60 min or when the turtles escaped from the track. We recorded the frequency of the following behaviors during the trials: 1) Exploring – when a turtle stopped and extended its neck, apparently attempting to assess the surrounding environment and/or look over the tracks; 2) Climbing attempt – when a turtle was oriented perpendicular to and tried to climb over a rail; 3) Falling – when a turtle fell on its back after an attempt to climb; 4) Retraction – when a turtle's limbs and head were drawn inside the shell; 5) Direction change – when a turtle substantially altered its course from a straight-line movement.

Using a measuring tape, we recorded to the nearest 0.1 m, 1) the distance between the starting point and the furthest point that a turtle reached (referred to as "furthest distance"); and 2) the modal sum of the displacement vectors' lengths ("total distance"). Turtle walking speed was estimated at specified distances using predefined markers not visible to the animals.

We conducted the experiment on a 1 km section of railroad with adjacent forested land on either side of the tracks. Secondary growth mixed pine and hardwood forest on both sides of the railroad may have provided visual cues to the turtles that preferable habitat was available nearby. The forest also helped to reduce noise from nearby streets and provided shade, easing possible thermal stress to the turtles during our tests.

Experiment 2. Will box turtles escape at railroad crossings?

To test turtle behavior upon reaching a railroad crossing (i.e., intersection of a road with a railroad), we positioned all 12 subjects between railroad tracks, facing a railroad crossing 5 m away.

This site (ca. 3 km N of the location of Experiment 1) was a section of the railroad that ran between a large grass field and a two-lane road with a moderate amount of traffic running parallel to the track. A second road with low traffic levels crossed the railroad and intersected with the two-lane road. The area between the tracks at the crossing was filled to the level of the road and rail with asphalt; large wooden beams separated the track from the asphalt. The asphalt sloped at ca. 45° up to the level of the road, which allowed turtles to climb up from the railroad bed.

Observations began once the turtle started moving and lasted until one of the following events occurred: 1) the turtle turned around, walked away from the railroad crossing and passed the starting point; 2) the turtle climbed up on the asphalt, crossed the road, and continued traveling between the rails on the other side of the road; 3) the turtle moved from between the tracks towards the grass field, or 4) the turtle moved from between the tracks and traveled towards the two-lane road. The frequency of behaviors such as climbing attempts and falling (defined above) were also recorded. The observer stayed < 5 m from the turtle throughout the experiment to ensure that the turtle did not get hit by vehicles, but attempted to disturb the turtles as little as possible.

To determine the likelihood that a turtle would encounter potential entry and exit points along the railroads within our study area, we calculated the mean distance between railroad crossings using mile-marker data in a GIS for railroads passing through the towns of Davidson, Cornelius, and Huntersville, North Carolina (Mecklenburg County GIS files, Mecklenburg County Information Services and Technology).

Experiment 3. How long does it take a turtle to overheat between tracks?

We experimentally measured the changes in turtle body temperature (T_b) when placed on a railroad tie equidistant from both railroad tracks. We conducted this experiment in an area of full-sun exposure from late morning (ca. 1000 h) to early evening (ca. 1900 h) on three mild days (T_{air} ca. 22°C) during late September 2004. We used two turtles in this experiment and two different turtles during preliminary trials. All were collected after being recently killed on the road but had minimal damage to the shell and body. They had similar dimensions to the living turtles used in our study, and were kept frozen until use. To estimate shell temperature, we glued a microdatalogger (Thermochron iButton, Dallas Semiconductor, Inc., Dallas, Texas, USA) to the top of each dead turtle's carapace (Grayson and Dorcas 2004). Because cloacal temperatures of *T. carolina* correlate well with core turtle temperatures (Russo 1972), we recorded core body temperature by inserting a thermistor attached to a datalogger approximately 7 cm into the cloaca (StowAway XTI Temperature Logger, Onset Computer Corp., Bourne, Massachusetts, USA). Both dataloggers were set to record every 5 min and had a resolution of ± 0.5°C (Grayson and Dorcas 2004; Onset Computer Corp.). We obtained data on air temperature from an automated weather station located ca. 2 km from the test site.

Results

Experiment 1. Can box turtles climb over railroad rails?—Only one of the 12 turtles tested successfully climbed over the rail and escaped from between the railroad tracks. All but three turtles made at least one attempt to climb the rails during the 1-h experiment. Of 42 climbing attempts, 11 were made at connecting brackets that joined two consecutive rails. The turtle that successfully climbed over the rail had the highest number of overall escape attempts (12) and was able to climb over the tracks at the connecting brackets. Some turtles that failed in their attempts to climb the rails tried to escape more frequently than others (mean = 3.75 ± 0.94 attempts; range = 1–8 attempts; N = 8). While attempting to climb, two turtles fell on their backs, but managed to right themselves within a few seconds.

Overall, turtles traveled primarily in straight lines. The mean furthest distance the turtles traveled while between the rails was 79.4 ± 13.2 m (range = 37.3–188.3 m). Two turtles moved more than 100 m; most moved between 45 and 70 m. Mean total distance traveled while between the rails was 89.9 ± 13.05 m (range = 37.3–188.3m) because some turtles changed directions several times. Directional changes occurred frequently, but were generally restricted to short time periods within the test (mean = 22.6 ± 4.7 direction changes per turtle; range = 3–49). Turtles walked on railroad gravel and ties at speeds ranging from 0.083 to 0.056 m/s (5 m in ca. 60–90 s) during at least part of each trial when they were not stopping or exploring the surroundings. During the testing period, turtles showed signs of exploring on average 46 ± 7.52 times per hour (range = 15–87). Three turtles retracted into their shells during the trial; one of these retractions occurred as a person walked on the tracks next to the turtle. Three other turtles buried themselves under piles of leaf litter that had accumulated on the inside of one of the rails.

Experiment 2. Will box turtles escape at railroad crossings?—Of the 12 turtles tested at the railroad crossing, five escaped and crawled towards the grass field, four escaped and moved towards the nearby moderately-trafficked road, two continued straight and remained between the tracks on the other side of the railroad crossing, and one turned back before it reached the railroad crossing.

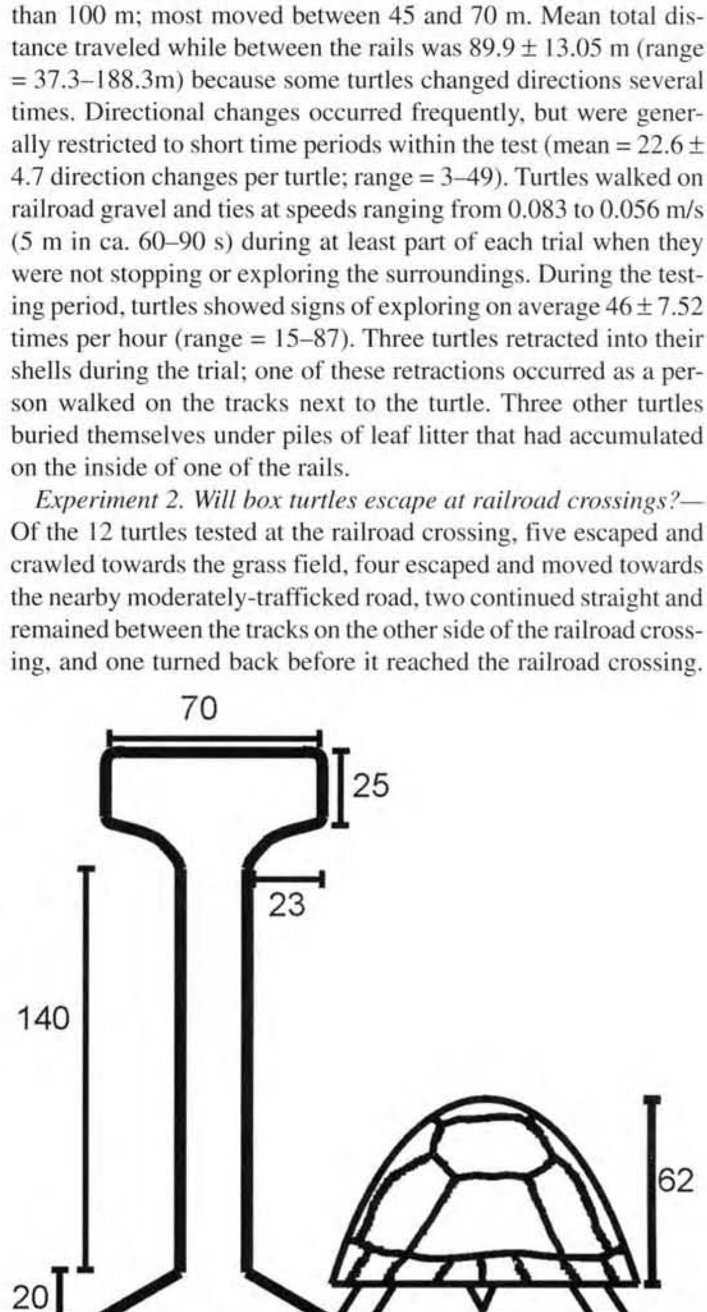

Fig. 1. Mean size of tested Eastern Box Turtle (*Terrapene carolina*; N = 12) compared to railroad track rail dimensions (in mm).

During the course of this experiment, four turtles made eight climbing attempts. The turtle successful at escaping during Experiment 1 accounted for five of the climbing attempts, although it fell over on its back and had to right itself three times.

The mean distance between consecutive railroad crossings in the study area was 379.6 m (range: 48.3–1223.1 m); 30% of the crossings were less than 200 m apart, 16% of the crossings were between 200 and 300 m apart, and 54% were more than 300 m apart.

Experiment 3. How long does it take a turtle to overheat between tracks?—The T_b and shell temperatures of the two dead *T. carolina* tested in late September reached temperatures considerably higher than the air temperature by about noon and remained high most of the day (10–20°C > T_{air}; Fig. 2). The two turtles' T_b and shell temperatures were nearly identical throughout the day. The turtles' core temperatures (maximum = 40.5°C; temperature increase = 0.31°C/h) did not reach mean lethal T_b for the subspecies *T. carolina triunguis* (42.98 ± 1°C; Sturbaum 1981). However, it approached critical thermal maximum (41°C for *T. ornata luteola*; Plummer et al. 2003), defined as the point at which a turtle becomes incapable of coordinated locomotion. Estimated shell temperature stayed consistently higher than core T_b throughout the day and peaked at 48.5°C (Fig. 2).

Discussion

Our results indicate that adult *T. carolina* often cannot escape when trapped between railroad tracks. Most turtles clearly have the ability to escape at railroad crossings, although they may encounter unfavorable conditions (e.g., automobile traffic) upon escaping. While between railroad tracks, turtles can quickly reach critically high body temperatures, even on relatively mild days.

The failure of turtles to climb over the railroad tracks might result both from physical and behavioral characteristics of *T. carolina*. A comparison of turtle and rail dimensions clearly illustrates that the rails represent a considerable height obstacle (Fig. 1). Although a full-grown *T. carolina* erect on its hind legs can sometimes reach the top of the rail, they generally cannot pull themselves over to escape. Willbern (1982) reported several instances of *T. carolina* climbing a 77 cm vertical wire mesh fence. In contrast, the shape and smoothness of a railroad rail, and potentially the high temperature of the rail, appear to impede successful climbing by adult turtles (Fig. 1). Although hatchling and juvenile *T. carolina* might be able to crawl under rails, especially where the gravel underneath the track has been removed, their small size makes them more prone to rapid, and potentially lethal, increases in T_b.

When faced with obstacles, *T. carolina* will often travel along the edge of habitat boundaries such as roads, forest edges, and streambeds, rather than attempting to climb (Lemkau 1970). Our data support this observation because the turtles we tested tended to spend most of their time walking rather than trying to climb over railroad rails. However, because we conducted our experiment under conditions without thermal stress (i.e., in the shade), turtles may not have been as motivated to try to escape quickly from between the railroad rails. When turtles did escape from railroads at crossings, many moved towards a nearby road rather than moving towards a grassy field, thus increasing their probability of being struck by vehicular traffic (Carr and Fahrig 2001; Hels and Buchwald 2001).

We suspect that most turtles that suffer mortality on railroad tracks enter via a railroad crossing (an intersection of a road and a railway where the pavement levels off with the rails). Even in the suburban areas of our study site, the distance between approximately 50% of the railroad crossings was greater than 300 m. The time required for turtles to travel this distance would be at least 1.5 h, assuming the turtle walked continuously at the speeds we measured (comparable to Adams et al. 1989; Lemkau 1970; Muegel and Claussen 1993; Strang 1983).

When trapped between railroad rails, *T. carolina* may quickly reach critical T_b. *Terrapene* spp. thermoregulate behaviorally primarily by varying activity periods and choosing particular microclimatic conditions (Converse 1999; Ernst and Barbour 1972; Reagan 1974). However, railroad tracks rarely provide habitats conducive to behavioral thermoregulation and once air temperature reaches 50°C, *T. carolina* are unable to maintain T_b's within their tolerance limits (Sturbaum 1981). A similar situation was documented in Madagascar, where Radiated Tortoises (*Geochelone radiata*) fell in a steep embankment on the side of an unfinished road and died of sun exposure or drowning (Goodman et al. 1994).

Most research on thermoregulation in *Terrapene* spp. has been conducted with *T. ornata*. do Amaral et al. (2002) failed to conclude whether *T. ornata* has a higher thermal tolerance, more precise physiological methods of thermoregulating, and a potentially higher critical thermal maximum and lethal T_b than the forest-inhabiting *T. carolina*. However, *T. ornata* selected for higher tem-

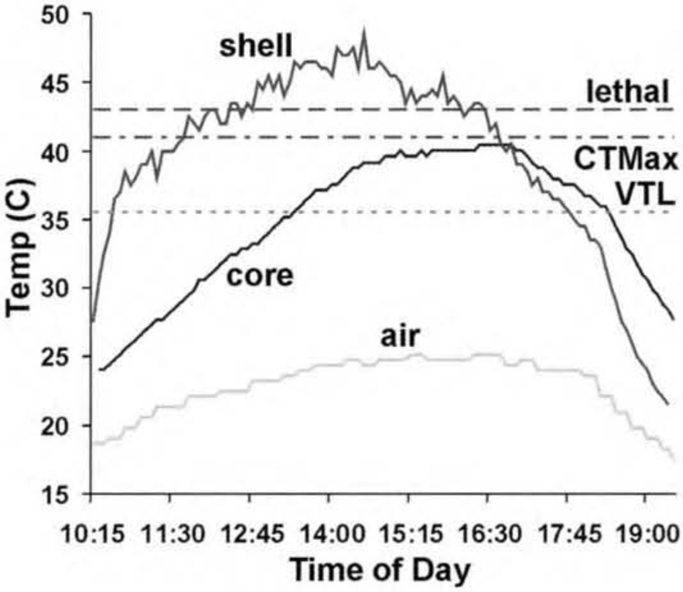

FIG. 2. Core and shell temperatures of a freshly dead Eastern Box Turtles (*T. carolina*) between railroad tracks on 25 September 2004, southern Iredell County, North Carolina. Shell and core temperatures peaked respectively at 48.5°C and 40.5°C; both were consistently higher than the air temperature by 10–20°C. Measured T_b approached estimated lethal T_b for *T. carolina triunguis* (42.98 ± 1°C; Sturbaum 1981). The critical thermal maximum (CTMax) of 41°C and maximum voluntary tolerated level (VTL) of 35.5°C (Plummer et al. 2003) for *T. ornata luteola* may be higher than those of *T. carolina* (Sturbaum 1981) because they tend to choose higher T_b (do Amaral et al. 2002).

peratures than *T. carolina*. Therefore, even though core temperatures in Experiment 3 (Fig. 2) did not quite reach critical levels for *T. ornata*, the highest temperatures recorded might represent critical T_b for *T. carolina*. Two preliminary shorter trials on slightly warmer days (T_{air} approximately 28.5°C at 1500 h) resulted in faster temperature increase (0.61°C/h and 0.42°C/h, similar to Bethea 1972) than the rate of 0.31°C/h for our trial on a relatively mild day (Fig. 2). On these warmer days, it would have taken approximately 4.5 h for a turtle with an initial T_b of 20°C to reach lethal T_b. During all of our temperature tests, the dead turtles' T_b surpassed the maximum preferred voluntary locomotory temperature of 32°C (Adams et al. 1989).

We stipulate that the presence of railroad tracks is detrimental to the health of *T. carolina* populations. Even in the suburban areas of Davidson, approximately one-half of the railroad crossings are separated by what are likely lethal distances for *T. carolina*. Even though a higher number of crossings may increase the chance for escape, individuals whose home ranges border the infrastructure would also be more prone to get trapped between the tracks. Furthermore, railroads in forested regions with fewer railroad crossings may act as physical barriers for exchange of genetic material and decrease the long-term survivability of *T. carolina* populations.

Several investigators have suggested structures such as road tunnels to reduce road mortality (Langton 1989; Messmer and West 2000); structures that reduce the possibility of turtles becoming trapped within railroad rails should be investigated. Additionally, formal studies are needed to evaluate the long-term effects of railroads on *T. carolina* populations.

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Female Reproductive Aspects and Seasonality in the Reproduction of *Eleutherodactylus binotatus* (Spix, 1824) (Amphibia, Leptodactylidae) in an Atlantic Rainforest Fragment, Southeastern Brazil

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Most species of the genus *Eleutherodactylus* Duméril & Bibron, 1841 are direct developers with eggs laid in terrestrial sites (Wake 1978). Internal fertilization occurs in two species and may be more widespread within the genus (Townsend et al. 1981; Townsend and Stewart 1994). Live-bearing occurs in at least one species (*Eleutherodactylus jasperi*; Wake 1978). Despite these uncommon reproductive features among anurans, detailed aspects of reproductive biology are known for only a few species of the genus (e.g., Diesel et al. 1995; Donnelly 1999; Lutz 1944; Lynn and Lutz 1946a, b; Ovaska and Rand 2001).

Eleutherodactylus binotatus is a common species distributed along Atlantic Rainforest in Brazil but data on its natural history are scarce (Haddad and Sazima 1992; Pombal and Gordo 2004). The objects of this study are: A) to present data on *E. binotatus* female reproductive investment verifying the correlation between female snout–vent length and the number of ovarian follicles of the largest size class; and B) to analyze the reproductive seasonality in *E. binotatus* by evaluating the seasonal variation of total ovarian mass, the number, and mean diameter of ovarian follicles of the largest size class.

We examined 36 adult female *Eleutherodactylus binotatus* collected in a fragment of Atlantic Rainforest (22°01'S 43°31'W; ca. 600 m above sea level), at Municipality of Belmiro Braga, State of Minas Gerais, Southeastern Brazil. Individuals were collected during three seasons: the first wet season from September 2000 to March 2001; the dry season from April to September 2001; and the second wet season from October 2001 to March 2002. Specimens are housed in the herpetological collection of Museu Nacional, Rio de Janeiro, Brazil (MNRJ 27371–72, 27376, 27380, 27383, 27386–87, 27394, 27397, 27404, 27409, 27411, 27414, 27417–18, 27420, 27422–24, 27446, 27448, 27451–52, 27460, 27474–78, 27490, 27492-93, 27556, 28317–18, and 28479).

Reproductive maturity of adult females was determined by oviduct condition according to Lynch and Duellman (1997). The snout-vent length (SVL) was measured with calipers to the nearest 0.1 mm. Ovaries were removed and weighed on an electronic balance to the nearest 0.001 g. Ovaries always presented several follicles grouped in different, discrete size classes. We considered only follicles of the largest size class from each ovary as we assumed these follicles constitute a single clutch. The ovarian follicles of the largest size class in ovaries were counted and measured under a stereomicroscope with an ocular micrometer.

We examined the relationship between the SVL and the number of ovarian follicles of the largest size class using a Pearson's test. We performed an Analysis of Variance (ANOVA) to test for differences among seasons regarding 1) ovarian mass, 2) number, and 3) mean diameter of follicles of the largest size class.

Females were divided into two categories according to ovarian mass (females with ovarian mass greater than 0.560 g and smaller than 0.560 g; this corresponds to the mid-point of the total range) in order to determine the frequency of females with the highest ovaries through time and to estimate the approximate time of clutching.

At the study site, female *E. binotatus* ranged in body size from 44.3 to 55.7 mm (= 49.8 ± 2.3 mm); ovarian mass ranged from 0.011 g to 1.128 g (= 0.389 ± 0.340 g); the number of follicles of the largest size class ranged from 20 to 67 (= 32.5 ± 10.1), and mean diameter of follicles of the largest size class ranged from 1.1 mm to 4.6 mm (= 2.6 ± 1.0 mm) (Table 1).

Correlation between the number of follicles of the largest size class and the snout–vent length of female *E. binotatus* was not significant ($r = 0.0553$; $p = 0.78$). Significant correlation between female size and clutch size is common in anurans (Kuramoto 1978; Salthe and Duellman 1973). However, Crump (1974) found this correlation in only to 26.8% of studied species in a tropical anuran community. In some species of the genus *Eleutherodactylus* there is a correlation between egg number and female size (e.g. *E. altamazonicus*, *E. lacrimosus*, and *E. lanthanites*: Crump 1974; *E. coqui*: Townsend and Stewart 1994; *E. johnstonei*: Bourne 1997; and *E. bransfordii*: Donnelly 1999) but Crump (1978) found no significant correlation in *E. conspicillatus*, *E. croceoinguinis*, *E. martiae*, *E. ockendeni*, *E. pseudoacuminatus*, and *E. variabilis*, as well *Ischnocnema quixensis*, a species that also has direct development. Species of *Eleutherodactylus* have, in general, smaller clutches with larger eggs than other genera (Salthe and Duellman 1973; Wake 1978). Probably, egg size is more important than clutch size to the reproductive success of species with direct development. Unfortunately, we did not test this hypothesis in the present study because our size data referred to follicles at different stages of development and we could not estimate the final size of eggs from our data.

There is no significant difference among wet and dry seasons, on ovarian mass ($F = 0.5379$; $df = 1, 34$; $p = 0.47$), number of follicles ($F = 2.1898$; $df = 1, 26$; $p = 0.15$), and mean diameter of follicles ($F = 0.0919$; $df = 1, 26$; $p = 0.76$). Nevertheless, females with the heaviest ovaries (ovarian mass higher than 0.560 g) were found only from September to November (Fig. 1). Furthermore, development of ovarian follicles of the largest size class (indicated by the variation in mean diameter of follicles over time; Fig.

TABLE 1. Mean, standard deviation (SD), and range of snout–vent length (SVL), ovarian mass, number, and mean diameter of follicles of the largest size class of female *Eleutherodactylus binotatus* (N = 36).

Variables	mean ± SD	range
SVL (mm)	49.8 ± 2.3	44.3–55.7
Ovarian mass (g)	0.389 ± 0.340	0.011–1.128
Number of follicles	32.5 ± 10.1	20–67
Follicles mean diam (mm)	2.6 ± 1.0	1.1–4.6

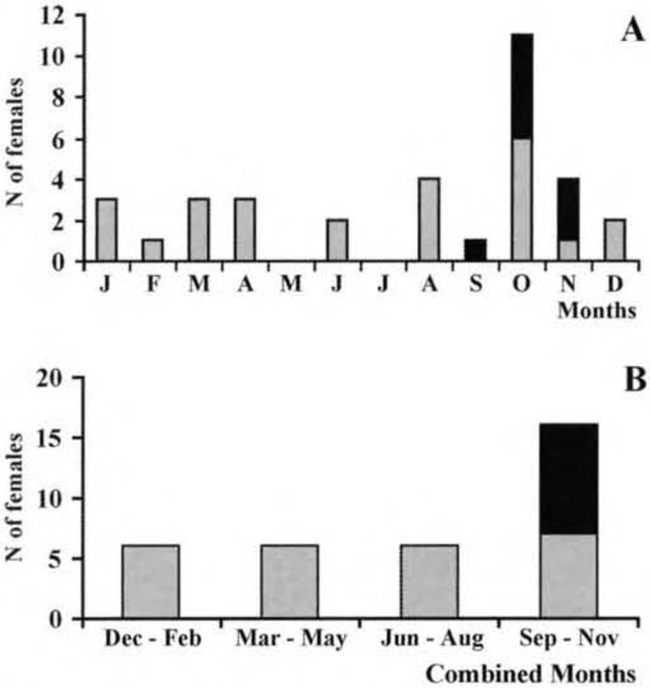

FIG. 1. Number of female *Eleutherodactylus binotatus* with ovarian mass higher than 0.560 g (black) and females with ovarian mass smaller than 0.560 g (gray), data were summed for months sampled during different years. (A) Month to month and (B) combined three-to-three months.

2) showed follicles growing during the dry season (April to September) and reaching a developmental peak at the beginning of the wet season (October to November). This peak is followed by a decrease in the mean diameter of follicles, suggestive of an end to the clutching period.

The statistical tests only compare the means among the different seasons and the graphs demonstrate that the follicles are uniformly middle sized in the whole dry season and the largest follicles are present especially at the beginning of the wet season while the smallest follicles are present at the ending of this season. Thus, despite the not significant different means, we could assume that the reproduction in *E. binotatus* is seasonal, occurring at the beginning of the wet season. This is also the time period of the highest vocalization activity of male *E. binotatus* in the same population (C. Canedo, unpubl. data).

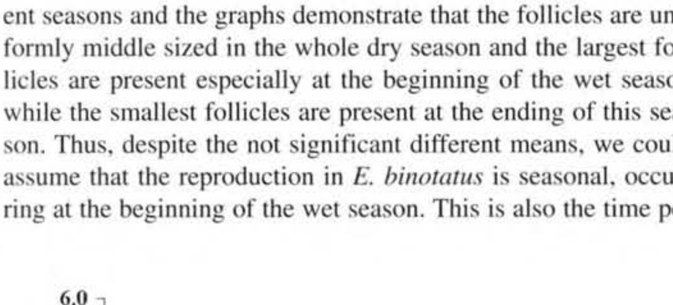

FIG. 2. Mean diameter in millimeters of ovarian follicles of the largest size class in female *Eleutherodactylus binotatus* from September 2000 (S) to March 2002 (M), presenting polynomial of third order trendline.

In the Atlantic Rainforest, in Southeastern Brazil, most anuran species reproduce only during the wet season (e.g., Pombal 1997), as we found for *E. binotatus*. However, *Eleutherodactylus* species have continuous reproduction along the year showing seasonal variation only in the frequency of reproductive activity at Amazonian Rainforest (e.g., Bourne 1997; Towsend and Stewart 1994) and Costa Rican Rainforest (Donnelly 1999).

We conclude that the studied *E. binotatus* population: 1) presents no significant correlation between number of follicles and size of females, and 2) present seasonal reproduction, occurring at the beginning of the wet season.

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Longevity and Breeding Site Fidelity in the California Newt (*Taricha torosa*): A Long-Term Study Showing the Efficacy of PIT Tagging

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California Newts (*Taricha torosa*) inhabit the streams and surrounding terrestrial habitats along the California coast. In the winter and spring, adults migrate from terrestrial habitats to nearby streams or ponds for breeding. Few studies have examined the behavioral patterns of adult *T. torosa* in any great detail, but extensive population and migration studies on *T. rivularis* have demonstrated site fidelity and homing behavior in individuals displaced from capture locations during the breeding season (Twitty 1966). Salamanders in other families (e.g., Ambystomatidae, Plethodontidae) have been shown to possess strong breeding pond fidelity from season to season (Mathis 1989; Trenham et al. 2000), and we suspected that this characteristic exists in *T. torosa* as well.

However, demonstrating breeding site fidelity in *Taricha* is challenging experimentally, due to both their longevity and the difficulty that lies in identifying individual newts and their migrations from year to year. We examined PIT tagging as a marking method for identification in *T. torosa*. This marking technique was successful over our long-term study and enabled us to confirm breeding site fidelity in this species.

Site fidelity in newts was first verified by the use of coded toe clipping, but that technique was reliable for only a couple years following marking because newts regenerated amputated appendages and limbs (Twitty 1966). Radio transmitters, either surgically implanted or inserted into the salamanders' abdomen (Jehle 2000; Madison 1997), are not practical for long-term studies due to their limited battery life. While heat branding can be used to identify individuals years after their initial capture (Peterson et al. 1983), the use of passive integrated transponders (PIT tags) has been introduced recently as a more reliable technique (Trenham et al. 2000).

We conducted a mark-recapture study of *T. torosa* in Cold Creek, California (Los Angeles Co.), a stream located in the Santa Monica Mountains. Using permanent geographic land markers, we mapped 700 m of the stream. We surveyed this stream section annually from 1991 to 2003 and recorded the location, sex, SVL, and mass of adult newts. From 1991 to 1994, 36 adults were marked with PIT tags manufactured by AVID. Newts were anesthetized using MS222 and tags were inserted into the abdomen using a syringe. The incision was closed using New Skin® (Medtech). Each subsequent year until 2003, on several days during the breeding season, the stream was mapped and surveyed as before. Newts encountered during surveys were captured and scanned for a PIT tag. Recaptures were measured and weighed, and the distance from their first location was determined. Many individuals in this study were captured several times in a single breeding season, but only the data for their first capture of the season was included in analyses.

Through 2003, 14 of 36 (39%) tagged *T. torosa* adults were recaptured among years, up to 11 years post-tagging (mean 763 d). A few adults were captured more than once for a total of 22 recaptures. Each recapture increased in length (mean (SD): 0.12 (0.16) cm) and body mass (mean (SD): 1.11 (2.47) g) from when they had most recently been collected. Upon recapture, the mean distance between an individual's recapture site and site of initial capture was 15.5 m (SD: 30.1 m). Fourteen of the 22 total recaptures occurred at or within 10 m of an individual's original capture.

Our data demonstrate the utility of PIT tags for long term studies in newts and documentation of life history and population demography information. Our study is the first to document the potential lifespan of the California newt in the wild. One female, recovered in 2000, was originally tagged in 1991 and was last recaptured in May of 1993. Two males, originally marked in 1994, were recaptured and recorded in April of 2003, along with another male who had not been observed in the field since his original capture in 1992, 11 years earlier. Given that *Taricha* do not reach sexual maturity until at least three to four years of age in males, and slightly longer in females (Twitty 1959), the four individuals captured 9–11 years after their initial marking are likely, at minimum, 12–14 years of age.

In Southern California, the 6–12 week breeding period for *T. torosa* can last into May, but most adults leave the streams within several weeks following this period and densities drop to near zero over the course of the summer (Kats et. al 1994; Petranka 1998). Adults emerge from below ground and do not reenter streams, ponds, and reservoirs until after late Fall rains (Stebbins 2003). Our findings suggest that many individuals return to almost the exact locations within the stream among years. Exactly how *T. torosa* orient to the same location along a stream year in and year out is unknown. In *T. rivularis* and *T. granulosa*, Twitty (1959) ruled out visual navigation using landmarks and memorization of the topographical pattern of an individual's home range, and suggested navigation by a chemical mechanism. Extra-ocular magnetic orientation is now known in the red spotted newt, *Notophthalmus viridescens* (Deutschlander et. al 1999).

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Diet Analysis and Feeding Strategies of *Rana pipiens* in a West Virginia Wetland

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Studies analyzing anuran stomach contents are essential to determine many aspects of their ecology and natural history. Diet analysis has proven useful in many studies, including: recognition of feeding restrictions or food preferences (e.g., Parker and Goldstein 2004); examining natural history (Hamilton 1948); determining developmental stage effect on diet (Jenssen 1967); understanding niche overlap (Forstner et al. 1998; Hedeen 1972); comparing diet of sympatric species (Guidali et al. 2000); and confirming congenic/conspecific predation (Krupa 2002). Although stomach content analyses of Northern Leopard Frogs (*Rana pipiens*) and related species have been conducted (Collier et al. 1998; Knowlton 1944; Linzey 1967; Parker and Goldstein 2004), relatively no natural history data exists for this anuran in West Virginia, USA. We describe prey items and analyze feeding strategies of *R. pipiens* from one of four known breeding localities in the state.

Methods.—We captured frogs in Hoeft Marsh, an ephemeral wetland located on the western end of Greenbottom Wildlife Management Area (Cabell County, 38°35'9.4"N, 82°15'52.7"W) created by the West Virginia Division of Natural Resources in 1992 (Pauley and Barron 1995). Sampling was conducted June through November 2003, at about 2100 h and usually lasted 1–2 h. Captured frogs were stomach flushed using the method described in LeClerc and Courtois (1993). Stomach contents were preserved in 70% ethanol (v/v) and identified to class/order classification level.

Feeding strategies were determined by constructing a feeding strategy plot as described in Amundsen et al. (1996). In this method, prey-specific abundance (dependent variable) is plotted against frequency of occurrence (independent variable). Prey-specific abundance represents the percentage a prey taxon comprises only in stomachs of predators ingesting the prey taxon. Frequency of occurrence represents the frequency a particular prey item comprises out of all prey items recovered from flushing. Resulting feeding strategies can be assessed based upon location of points within the following quadrants of the feeding graph: 1) bottom left– predator population is feeding on various prey items with low frequency; 2) top right– predator population is specializing exclusively on one prey source; 3) top left– few predators out of the population are specializing upon one prey item, and; 4) bottom right– many predators out of the population are feeding on one prey item occasionally (Amundsen et al. 1996).

Results and Discussion.—Of 162 captured frogs, 64 regurgitated stomach contents during flushing. There were 216 food items identified, belonging to 19 taxonomic food groups (Table 1). Three main prey groups served as the prey base for *R. pipiens*, comprising 51.8% of total items: adult Coleoptera (24.5%), Oligochaeta (15.3%), and Hymenoptera (12.0%). Order Trichoptera represented 6% of the food items recovered, with 11 of 13 larval caddisflies procured from one frog. Additionally, one anuran, *Pseudacris c. crucifer* (Northern Spring Peeper), was recovered.

Feeding strategy analysis illustrated that *R. pipiens* was a generalistic feeder (Fig. 1), supporting the premise that they appear to be indiscriminate, opportunistic predators (Collier et al. 1998; Forstner et al. 1998; Guidali et al. 2000). There were 17 of 19 prey classes located near the bottom left of the feeding plot (Fig. 1), illustrating that numerous prey taxa were being consumed in low quantities. Also, coleopterans were being consumed occasionally by many frogs (frequency of occurrence = 0.5, Fig. 1), while trichopterans were a specialized prey taxon for a few frogs (prey specific abundance = 59, Fig. 1).

Although we did not assess prey availability, it has been suggested that availability of a particular prey item has a much greater influence than specificity in the diet of many anurans (Linzey 1967). Adult coleopterans were the major prey item for *R. pipiens*, most likely because of foraging habits for this frog. During the summer and fall months, *R. pipiens* forages in large, grassy meadows (Merrell 1977), a common habitat for many species of coleopterans. Collier et al. (1998) discovered that coleopterans were the most common food item recovered from a population of *R.*

TABLE 1. Stomach contents of 64 *Rana pipiens* in Greenbottom Wildlife Management Area, Cabell Co., West Virginia, USA.

Prey Taxon	No. Food Items (%)
Amphibia	
Anura	
Hylidae	
Pseudacris c. crucifer	1 (0.5)
Arachnida	
Araneae	11 (5.0)
Opiliones	1 (0.5)
Crustacea	
Isopoda	8 (3.8)
Diplopoda	4 (1.9)
Gastropoda	17 (7.9)
Insecta	
Coleoptera (Adult)	53 (24.5)
Coleoptera (Larvae)	13 (6.0)
Diptera (Adult)	13 (6.0)
Diptera (Larvae)	1 (0.5)
Ephemeroptera	1 (0.5)
Hemiptera	5 (2.3)
Homoptera	7 (3.2)
Hymenoptera	26 (12.0)
Lepidoptera (Adult)	2 (0.9)
Lepidoptera (Larvae)	5 (2.3)
Odonata	2 (0.9)
Trichoptera	13 (6.0)
Oligochaeta	33 (15.3)

pipiens in northeastern Ohio. Linzey (1967) suggested coleopterans function as the staple food item for *R. pipiens*; frogs would feed on ephemeral insects when in abundance, but coleopterans would function as a buffer when availability of other food items declined.

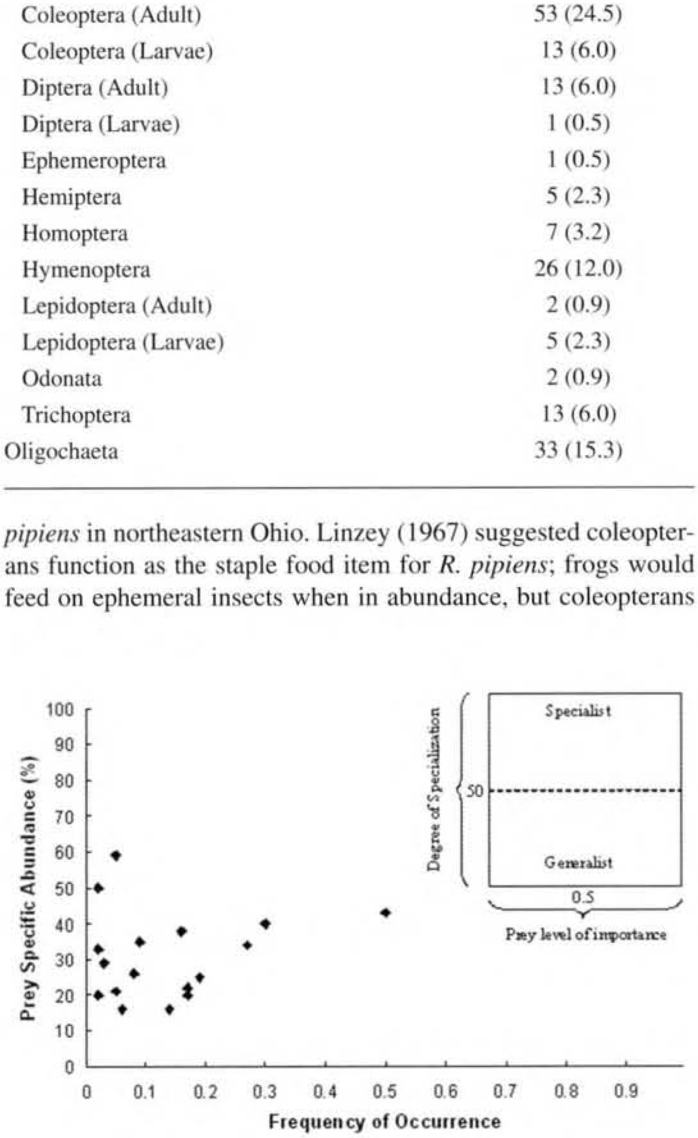

FIG. 1. Feeding strategy plot for *Rana pipiens* at Greenbottom Wildlife Management Area, Cabell Co., West Virginia, USA. Each point represents a unique prey taxon. Diagram at top right corner can be used to interpret graph results (adapted from Amundsen et al. 1996).

Prey item analysis indicates that prey specificity does not serve as a limiting factor for this species. However, availability of terrestrial habitat can be a limiting factor because *R. pipiens* requires large uncut wetland meadows for summer foraging habitat. From this, it should be a primary management concern to preserve this essential early successional wetland habitat.

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Nomenclatural Notes on a Caecilian (Amphibia: Gymnophiona) Name

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Bhatta and Srinivasa (2004) described a new species of caecilian, which they named *Gegeneophis madhavai*, from "Doddinaguli locality (Mudur Village, Kundapura Taluk, Udupi District, Karnataka State"…. "situated adjacent to the Mookambika Wildlife Sanctuary in the Western Ghats" (in southwestern India).

The new species was named for four individuals who share a first name, namely, Madhava Bhat, Madhavarao Bhide, Madhava Anantha and Madhava Gadgil. The spelling of the first (= given) name of the last individual is, in fact, Madhav, a contemporary north Indian version of the spelling. The name is derived from the Sanskrit, meaning vernal, originating from the name Madhu, a legendary king, whose most famous descendant is Krishna, a Hindu god (see Hanks and Hodges 1990).

According to Article 32.5 of the International Code of Zoological Nomenclature (International Commission of Zoological Nomenclature 1999), in case of clear inadvertent error in the formation of a new nomen, correction of the nomen is possible (see Bauer and Das 2000 and Michels and Bauer 2004, for some recent examples of corrections of original nomen). Indeed, Article 34.2 states that errors in spelling of the endings must be corrected. In the present case, because the new caecilian is named for more than a single individual, the termination of the species nomen should be *-orum*. The species nomen of the south Indian caecilian described by Bhatta and Srinivasa (2004) is here emended to *Gegeneophis madhavaorum*.

Under Article 33.2.2, the corrected nomen retains the original authorship and date. The valid name of the new south Indian caecilian is therefore *Gegeneophis madhavaorum* Bhatta and Srinivasa, 2004.

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A Male Hybrid from *Aspidoscelis sonorae* (Parthenogenetic) and *A. burti stictogramma* (Bisexual): Squamata, Teiidae

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Although *Aspidoscelis burti stictogramma* (Giant Spotted Whiptail) is remarkable for its past participation in hybridizations contributing to the origins of six triploid parthenogenetic species: *A. exsanguis*, *A. flagellicauda*, *A. opatae*, *A. sonorae*, *A. uniparens*, and *A. velox* (Reeder et al. 2002; Wright 1993), contemporary hybridization by *A. burti stictogramma* is undocumented. Participation in hybridization events by the six parthenogenetic species ranges from rare to absent, with the frequency determined by opportunity and ecological context (Taylor et al. 2001; Walker et al. 1989). Rare hybridization is exemplified by *A. exsanguis*, *A. sonorae*, *A. uniparens*, and *A. velox* (Cuellar and McKinney 1976; Hardy and Cole 1998; Neaves 1971; Taylor et al. 1989), and hybridization by *A. flagellicauda* and *A. opatae* is unknown—because contact with bisexual congeners is limited for the former (Wright and Lowe 1968) and absent for the latter (Wright 1967). The objective of this report is to describe the first known hybrid between *A. sonorae* and *A. burti stictogramma*.

On 12 June 1972, P. Casella collected a female *A. burti stictogramma* (119 mm snout–vent length [SVL]; Regis University [RU] 7232) and four specimens that I identified as parthenogenetic *A. sonorae* (RU 7233–7236). These five specimens were collected in a lush, Lower Sonoran Zone habitat (Lowe 1964, his Fig. 6) on a lower slope of the Santa Catalina Mountains (accessed from the Mount Lemmon Highway) east of Tucson, Arizona. In 1992, I dissected each specimen for evidence of egg clutches and was surprised to find normal appearing testes and vasa deferentia in RU 7234, a specimen of 70 mm SVL (Fig. 1). Its testes dimensions (left: 5.2×3.0 mm, right: 5.5×3.2 mm) were comparable in relative size to the testes (left: 5.4×4.4 mm, right: 6.5×4.0) of an adult male *A. burti stictogramma* of 87 mm SVL (RU 95170, Fig. 1) collected on 9 July 1995 from a different locality. The ratio of testis width to SVL for RU 95170 was within the 95% confidence interval expected for males of *A. burti stictogramma* collected in July (Goldberg 1987). Although RU 95170 (87 mm SVL) was likely reproductively mature, it still expressed the juvenile color pattern of *A. burti stictogramma*—pale gray, intact stripes sharply contrasting with the adjacent dark brown fields, each field supporting small tan spots, and a subdued dorsal pattern on the legs (Fig. 1). In contrast, the representative of *A. burti stictogramma* collected at the hybridization site (RU 7232, 119 mm SVL) had completed the ontogenetic transition—fragmentation of primary stripes into large spots, enlargement and lightening of dark field spots, and establishment of a high density of prominent pale spots on the dorsal surfaces of the legs—to a final color pattern characterized by spots rather than by stripes.

There were two reasons why RU 7234 could not be reassigned to *A. burti stictogramma*. First, the male had only 70 granular scales

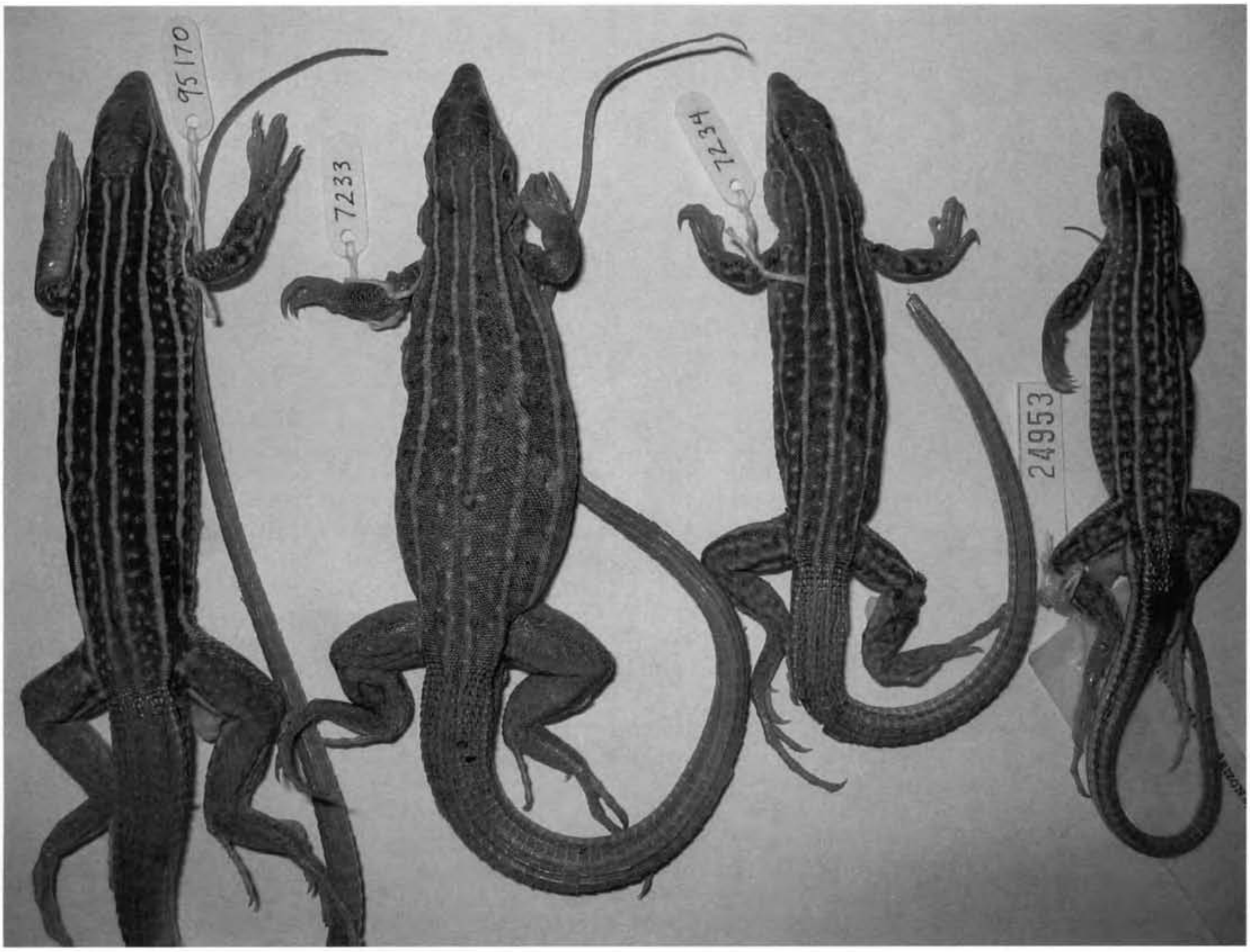

FIG. 1. Left to right: *Aspidoscelis burti stictogramma* (RU 95170: male, 87 mm SVL) with juvenile color pattern; *Aspidoscelis sonorae* (RU 7233: 84 mm SVL); *Aspidoscelis sonorae* × *Aspidoscelis burti stictogramma* (RU 7234: male, 70 mm SVL); *Aspidoscelis sonorae* × *Aspidoscelis tigris punctilinealis* (UAZ 24953: male, 63 mm SVL).

around midbody (GAB), whereas *A burti stictogramma* is characterized by GAB counts > 97 (Duellman and Zweifel 1962; Lowe 1956). Second, the SVL of 70 mm is well below the minimum size of reproductive maturity for male *A. burti stictogramma* (87 mm SVL) as determined histologically (Goldberg 1987). Thus, the only possible mode of origin for a male resembling *A. sonorae* of comparable size in color pattern and having a GAB count within the range of variation for this species (HLT, unpubl. data) was by fertilization of an unreduced egg ($3n = 69$) of triploid *A. sonorae* by a spermatozoan ($n = 23$) carrying a Y-chromosome from a bisexual species (Cole et al. 1969; Taylor et al. 2001). The only bisexual congener actually observed in syntopy with the hybrid and *A. sonorae* was *A. burti stictogramma*; however, there were two reasons to also consider *A. tigris punctilinealis* for the male parent of the hybrid. First, adequate sampling was not possible to rule out the possibility that *A. tigris punctilinealis*, well represented at lower elevations, was not also present at the collecting site. Second, *A. sonorae* is known to hybridize with *A. tigris punctilinealis*, and two *A. sonorae* × *A. tigris punctilinealis* hybrids (University of Arizona [UAZ] 24953 and 24954) described by Lowe et al.

TABLE 1. Quantitative differences among a putative *Aspidoscelis sonorae* × *A. burti stictogramma* hybrid (S × S) and two *A. sonorae* × *A. tigris punctilinealis* hybrids (S × P). See Appendix I for character definitions.

Specimen	GAB	FP	COS	SDL	ILS	LSG	PV	SVL
RU 7234 (S × S)	70	43	14	34	32	47	3	70
UAZ 24953 (S × P)	74	44	14	35	28	31	7	63
UAZ 24954 (S × P)	70	42	12	—*	21	27	3	64

*Both feet are missing from this specimen.

TABLE 2. Color and pattern differences between hybrids derived from *Aspidoscelis sonorae* females and *A. burti stictogramma* and *A. tigris punctilinealis* males.

Character	*A. sonorae* × *A. burti stictogramma* (RU 7234)	*A. sonorae* × *A. tigris punctilinealis* (UAZ 24953 and 24954)
Dark field color	brown	dark gray
Stripe color	cream	pale gray
Ventral color	cream	pale gray[1]
Dark field spots	few (small) indistinct; in dorsolateral and upper lateral dark fields	numerous (large) distinct; in dorsolateral and upper lateral dark fields
Paravertebral stripe	intact (with superimposed light spots)	disrupted (without superimposed light spots)[2]

[1]Ventral melanism, as expressed in *A. tigris punctilinealis*, is lacking.

[2]Pale spots may fuse with lateral margins of paravertebral stripes to produce irregular borders.

(1970) were available for comparisons to RU 7234. Although the male parents of RU 7234 and the two UAZ hybrids were of different taxa, all three specimens had enlarged postantebrachial scales, thereby resembling *A. sonorae* (and *A. burti stictogramma*), rather than *A. tigris punctilinealis*, in this character. Additional similarities between RU 7234 and the *A. sonorae* × *A. tigris punctilinealis* hybrids included six of seven meristic characters, with only the sum of the lateral supraocular granules on both sides of the head (LSG) suggesting a possible significant difference (Table 1). These scalation similarities among the three hybrids presumably reflect the genomic contribution to each from triploid *A. sonorae*. Nevertheless, five color and color-pattern differences between RU 7234 and the two UAZ hybrids identify *A. burti stictogramma*, rather than *A. tigris punctilinealis*, as the paternal parent of RU 7234 (Table 2, Fig. 1). Two character states, intact paravertebral stripes in *A. sonorae* × *A. burti stictogramma* and disrupted paravertebral stripes in *A. sonorae* × *A. tigris punctilinealis*, express phenotypic differences in the paternal taxa (see Appendix I for stripe descriptions). Disrupted paravertebral stripes are also exhibited by AMNH R-122989, a sterile female hybrid produced by housing *A. sonorae* with *A. marmorata* (= *A. tigris marmorata*) in the laboratory, which also inherited paravertebral stripe fragmentation from its male parent (Hardy and Cole 1998, their Fig. 1). There are, however, important color-pattern differences between AMNH R-122989 and the RU and UAZ hybrids. Some differences are related to age of the individual, but other differences are based on two different color-pattern classes of *A. sonorae* involved in the hybridizations. Two of several pattern classes of *A. sonorae* are illustrated, but not characterized, by Dessauer and Cole (1989, their Figs. 2D and F). The *A. sonorae* mother of AMNH R-122989 has white spots superimposed on paravertebral, dorsolateral, and lateral stripes, but spots are absent from her dark fields (Hardy and Cole 1998, their Fig. 1). In contrast, the *A. sonorae* pattern class involved in the production of RU 7234 and UAZ 24953–54 has spots in the dark fields as well as on the dorsal stripes (Fig. 1).

The identification of *A. burti stictogramma* as the male parent of RU 7234 might seem questionable because of the large size attained in this taxon and the striking difference in body mass eventually obtained by individuals of *A. burti stictogramma* and *A. sonorae*. However, reproductive maturity develops in male *A. burti stictogramma* at 87 mm SVL (Goldberg 1987), long before this size differential appears, and, because individuals of *A. sonorae* can attain a SVL > 87 mm (Taylor and Caraveo 2003), there is a size range of physical compatibility (Fig. 1). An additional factor seeming to weaken the candidacy of *A. burti stictogramma* as the paternal taxon of RU 7234 would be the low GAB count of 70 expressed by RU 7234. The argument derives from the accumulation of *A. burti stictogramma* genomes in the production of such a hybrid. The two-step hybridization sequence that led to the origin of *A. sonorae* (Reeder et al. 2002; Wright 1993) brought together two genomes from *A. burti stictogramma*. Step one was a cross between *A. inornata* and *A. burti stictogramma* to produce a parthenogenetic diploid. Step two was the mating of this diploid intermediate with *A. burti stictogramma* to produce the triploid, parthenogenetic hybrid from which *A. sonorae* originated. Therefore, if *A. burti stictogramma* is the male parental taxon of RU 7234, this hybrid should have three genomes ultimately traceable to *A. burti stictogramma*, a taxon that has GAB counts > 97. This difference between genetic endowment and phenotypic expression suggests that the single genome of *A. inornata* (GAB counts 55–72; Wright and Lowe 1965) carried by *A. sonorae* and the hybrids exerts a disproportionate effect on the expression of this character.

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APPENDIX I

Characters

GAB = number of granular dorsal scales in a single row around midbody (the 15th ventral scale posterior to the axilla established the point for beginning this count); FP = sum of femoral pores on both thighs; COS = bilateral total of circumorbital scales; SDL = number of subdigital lamellae on the fourth toe of one foot (right was chosen unless damaged); ILS = all interlabial scales between the lower labials and sublabials counted anterior to the suture line between 5th and 6th lower labials; LSG = sum of lateral supraocular granules on both sides of the head (the count includes all scales between the supraoculars and superciliaries, anterior to the suture line between the third and fourth supraoculars); PV = number of scales between paravertebral stripes at midbody; SVL = length of body from tip of snout to posterior edge of precloacal scales (in mm). PARAVERTEBRAL STRIPES = the most dorsal pair of pale stripes extending from each large parietal scale on the head to base of tail; LATERAL STRIPES = the most ventral pair of pale stripes extending from below the eye, across the top of the ear opening to the thigh, then continuing posterior to the thigh onto the base of the tail; DOSOLATERAL STRIPES = a pair of pale stripes located between paravertebral and lateral stripes, extending from the superciliaries just dorsal to the eye onto the base of the tail; DARK FIELDS = longitudinal dark areas separating pale stripes.

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Characteristics of Boreal Toad (*Bufo boreas*) Breeding Habitat in Colorado

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The distribution and abundance of the southern Rocky Mountain population of Boreal Toads (*Bufo boreas boreas*) have dramatically declined (Carey 1993; Corn et al. 1989; Loeffler 1998). *Bufo boreas* is currently listed as endangered in the state of Colorado. Improved understanding of breeding habitat preferences would be useful when surveying new habitats, evaluating potential translocation sites and constructing wetlands for *B. boreas*.

Bufo boreas appears to be a generalist in terms of the terrestrial habitats that it occupies but has more specialized breeding habitat requirements. In Colorado, *B. boreas* occurs primarily between 2250 m and 3600 m elevation in Lodgepole Pine (*Pinus contorta*), spruce (*Picea* sp.), Subalpine Fir (*Abies lasiocarpa*), and alpine meadows (Loeffler 1998). *Bufo boreas* breeds in the margins of ponds and lakes in May and June. Common types of breeding sites in Colorado are American Beaver (*Castor canadensis*) ponds, high elevation lakes and ponds, high elevation meadow ponds, and human excavated wetlands. Ideal *B. boreas* breeding sites presumably contain still water, very shallow margins and persistent water levels. Egg masses typically are deposited communally in the shallowest available areas of the breeding site (Livo 1999). Although *B. boreas* oviposition area characteristics have been described qualitatively (Livo 1999; Loeffler 2000), we are unaware of quantitative descriptions. Holland (2002) compared mean July water temperature, variance in water temperature, pond persistence, bank slope of the pond, and surface area in breeding and adjacent nonbreeding ponds. Detecting differences between breeding and nonbreeding sites proved difficult because of breeding site habitat variation. However, very shallow water was consistently selected for egg deposition. Our study objective was to further quantify characteristics at egg deposition areas throughout Colorado.

Methods.—We identified 33 breeding sites for southern Rocky Mountain *B. boreas* that had at least one egg mass for four consecutive years (1997–2000), and randomly selected 18 of these for study in 2000.

Study sites were in Chaffee, Clear Creek, Summit, Eagle, Routt, and Gunnison counties, Colorado, and ranged from 2542 m to 3487 m elevation. Sites were primarily in wet meadows in subalpine communities dominated by spruce-fir. *Salix* spp. and *Carex* spp. usually were found in riparian areas surrounding sites. Study

sites were visited from breeding through metamorphosis and comprised nine beaver ponds, one high elevation lake, three high elevation meadow ponds, and five sites of anthropogenic origin.

Water depth at the center of every identifiable egg mass was measured to estimate mean depth selected for oviposition per site. Depths were not measured unless *B. boreas* was still breeding at the site to ensure that water levels did not fluctuate between breeding and measurement. Amount of shallows present, and consequently potential breeding habitat, was quantified by measuring the length of shoreline that had water ≤ 10 cm depth, measured 30 cm from the margin for consistency. Ten centimeters was chosen because this was the maximum egg deposition depth observed in 1999 (Holland, unpubl. data). Finally, bank slope was evaluated by measuring depths at 0.30 m, 1 m, and 5 m from the margin on 10 transects in the egg deposition area at each site. Linear regression was used to examine depth as a function of distance from shore by site.

Results.—Breeding was initiated between 5 May and 9 June 2000. Mean number of egg masses deposited was 5.7 (S.E. = 0.9, range = 1–13, N = 18). Depths of 38 egg masses were measured at 10 sites while egg deposition was still occurring. Mean depth of egg masses by site was 6.1 cm (S.E. = 0.6, range = 3.0–9.8 cm, N = 10). Metamorphosis was initiated at 14 sites between 21 July and 29 August 2000.

Mean length of shallow shoreline was 52.1 m (S.E. = 9.9, range = 10–190 m, N = 18). The mean slope of the oviposition area bank was 0.07 (range = 0.02–0.12, N = 17) or a 7-cm increase in depth for every 1-m increase in distance from shore. Desiccation occurred prior to measurement at one site.

Discussion.—Our data support the presence of very shallow water as a cue for *B. boreas* oviposition in Colorado. A suitable site also appeared to have at least one gradually sloping bank with water ≤ 10 cm deep during the breeding season. The maximum mean egg mass depth for a site was 9.8 cm. This depth is consistent with those observed in 1999 and might be considered the maximum depth that southern Rocky Mountain *B. boreas* deposit their eggs. In contrast, Olson (1989) reported depths of oviposition for Oregon *B. boreas* between 5 and 25 cm, and on vegetation in up to 2 m of water at one site. In Colorado, eggs seem to be deposited in shallows despite the increased potential for egg mortality that exists as a result of desiccation and freezing (Livo 1999). Shallows that allow for elevated water temperatures on sunny days (Barandun and Reyer 1997) could be especially important to *B. boreas* because of cold water temperatures at high elevation.

Gradually sloping banks ensure that suitable breeding habitat exists at a variety of water levels. Gradually sloping breeding site banks also were found to be an important factor in predicting use by Natter Jack Toads (*Bufo calamita*) (Banks and Beebee 1987). Observed mean bank slope of 7% is steeper than would be expected given the fact that *B. boreas* appears unwilling to deposit eggs much deeper than 10 cm. The steep bank slopes of many study sites limit egg deposition to shallows very near shore, these shallows are not present in all Colorado mountain wetlands.

Mean length of shoreline in breeding sites with water depths ≤ 10 cm was 52.1 m. Size and suitability of ovipositioning areas may be more attractive to amphibians than actual breeding site area (Reading et al. 1991). Loman (1988) found that Common Frog *(Rana temporaria)* breeding sites were best predicted by the amount of shallows. However, *B. boreas* communal breeding behavior may not require large egg deposition areas.

These breeding habitat characteristics will be useful for evaluating breeding habitat suitability, potential translocation sites and when constructing wetlands for *B. boreas*. Potential translocations sites also should be examined in August to ensure that water retention at breeding sites is sufficient to allow completion of the larval period. In addition, a deeper water area may be necessary to provide tadpoles with a night refuge of warmer water (Beiswenger 1977; Bradford 1984). An old, but active, American Beaver pond complex seems an ideal model for a breeding site because shallow, eutrophic ponds exist in concert with water level maintenance by beaver. Future evaluation of how novel translocation sites and human excavated wetlands with different shoreline characteristics are used by breeding adults will provide additional information on how *B. boreas* select sites for egg deposition.

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Seasonal Variation in a Male Reproductive Aggregation of the Tree Frog *Scinax albicans* (Anura, Hylidae) in a Mountain Stream in the Brazilian Atlantic Forest

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Amphibians are regarded as highly sensitive to environmental changes. Their biological features make them vulnerable to several kinds of disturbances, including habitat modification (especially changes in the hydrology), climatic changes (especially rainfall reductions), and water pollution, including pesticides, sewage and acidic rains. Several authors have pointed out a global decrease in amphibian abundance and diversity, which can be linked to global climatic changes and/or to habitat modification, among other factors (Heyer et al. 1988; Houlahan et al. 2000; Young et al. 2001), although it may be difficult to distinguish clearly between human impacts and natural fluctuations (Pechmann et al. 1991).

The Atlantic Forest in eastern Brazil supports an extremely high diversity of anurans (Weygoldt 1989), has been dramatically reduced and fragmented during the last few centuries (Dean 1996). Population decreases and local extinctions of anuran populations have already been recorded in the Atlantic Forest (Heyer et al. 1988; Weygoldt 1989). Such changes may happen very quickly; Weygoldt (1989) reported that several species that were abundant in 1979 disappeared within ten years in Estação Biológica de Boracéia, State of São Paulo, Brazil. However, in order to determine whether these patterns were caused by human impacts, it is necessary to have a more detailed knowledge on processes involved in the natural population dynamics of Atlantic Forest anurans. An important feature of the demography of many anuran species is that males gather in reproductive aggregations where they call to attract females. The present study had the goal of studying seasonal variation in numbers of calling males in a reproductive aggregation of tree frogs *Scinax albicans* (Bokermann 1967) in a mountain stream within the Atlantic Forest in Southeastern Brazil.

Material and Methods.—The aggregation studied was located at a small stream tributary to Paquequer River, Parque Nacional da Serra dos Órgãos, municipality of Teresópolis, State of Rio de Janeiro, southeastern Brazil (22°26'57"S and 47°00'52"W). Parque Nacional da Serra dos Orgãos is located across a mountain range with steeply sloping terrain. The stream is located at an elevation of 1165 m. The climate in the study area is warm tropical. According to the Instituto Nacional de Meteorologia (INEMET) the average annual temperature was 20.5°C and average annual precipitation was 1569 mm during the period 1998–2002. The study period (from September 2001 to July 2002) present average temperature 20.9°C and average precipitation 1626 mm. The rainfall in the study period followed the usual seasonality of the area, as most was concentrated in a wet season from November 2001 to April 2002 (precipitation in these six months, 1349 mm). The study also included parts of two dry seasons, from September to October 2001, and from May to July 2002 (total precipitation in these five months 277 mm; Fig. 1). The sampled stream flows across steeply sloped terrain until reaching the Paquequer River. The substrate is formed of rocks and the water has little turbidity. Rapids alternate with pools. The depth of the pools varied from 12 to 60 cm. The riparian vegetation is Atlantic Forest, with Leguminosae, Begoniaceae, Mirtaceae, Meliacae, Piperaceae, Melostomataceae, Poaceae, Areceae, and Polypodiaceae among the most common families.

The aggregation was monitored through sampling sessions twice a month, from September 2001 to July 2002. In the data analysis, however, we used only sampling sessions where calling males were found (fifteen sessions), as aggregation size could not be estimated for the remaining sessions. Each session lasted an average of three consecutive nights. The sampling area corresponded to a strip of land along the stream margins where male frogs were found calling. The length of the strip was 16 m and its maximum width was 3 m. No calling males were found beyond the extremes of this strip, although there was no obvious habitat change. The frogs were localized acoustically and then captured by hand. The frogs were individually marked by toe-clipping, following the method of Martof (1953). After marking and recording the data (sex, snout-vent length, point of capture, and individual number), each individual was released at the place it had been captured.

Aggregation size (AS), loss rates, and recruitment of calling males to the aggregation were estimated using the Jolly-Seber method (Seber 1982). Each sampling session as a whole was regarded as a "capture" for Jolly-Seber analysis. As frogs were located acoustically, AS estimated by Jolly-Seber should reflect the number of males taking part in the reproductive aggregation, rather than the total population of males using the area. Loss rates (L) were calculated from Jolly-Seber's estimated survival rates (S), using the formula $L = 1 - S$. In our results mortality cannot be separated from dispersal; therefore, we preferred to use "loss" instead of mortality, and Jolly-Seber's survival is here regarded as an estimate of the proportion of males remaining in the aggrega-

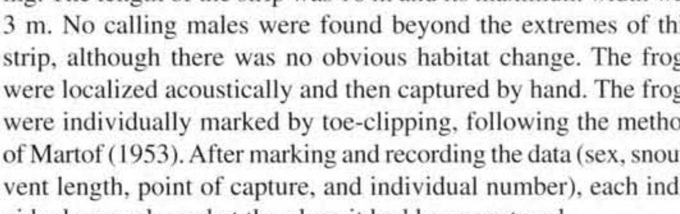

Fig. 1. Variations in rainfall and air temperature of the study area, Parque Nacional da Serra dos Órgãos, Teresópolis, from September 2001 to July 2002 (bars – monthly rainfall, line – monthly average temperatures).

tion between consecutive sampling sessions. Although the interval among the samplings were not constant, survival rates (and consequently loss rates) were standardized to 30-day intervals using logarithm transformations as suggested by Fernandez (1995).

Aggregation size (dependent variable) was related either to loss rates or to recruitment (independent variable) using simple linear regression (Zar 1999). Loss rates and recruitment (used now, one at a time, as the dependent variable) were also related to rainfall (independent variable), by single linear regressions (Zar 1999). The regressions between demographic rates and rainfall were carried out using the rainfall recorded: 1) during the days that formed each sampling session; 2) in the day before each session; 3) in the five previous days; 4) in the 15 previous days (corresponding roughly—as the intervals were not exactly equal—to the interval between sessions). The last three analyses aimed to look for delayed effects of rainfall on the processes (recruitment and losses) which affected the number of calling males in the aggregation.

Results.—Some sampling nights (including three whole sampling sessions) did not provide captures as no reproductive activity was recorded in those nights. From the remaining 15 sampling sessions, useful data could be obtained from a total of 28 nights. In total, 220 captures of 41 male individuals of *S. albicans* were obtained.

The average estimated aggregation size was 23.34 males. Variation along the study period was small (SD = 7.63, CV = 0.32). Permanence of *S. albicans* males in the aggregation was high. Loss rates were low through most of the study period, except for September 2001, March and May 2002 (Table 1; Fig. 2). Recruitment of males was quite variable, with peaks at the months of October 2001, January, May, and June 2002 (Table 1; Fig. 2).

In the regressions among demographic parameters, recruitment explained nearly 89% of the variation in the number of calling males in the aggregation ($r^2 = 0.8878$); the regression between these two variables was highly significant ($F_{1,10} = 79.16$, $P < 0.0001$). On the other hand, there was no significant regression between loss rates and number of males in the aggregation ($F_{1,11} = 0.61$, $P = 0.451$).

There was no significant relationship between either the loss rates or the recruitment and the rainfall between sampling sessions (recruitment, $F_{1,10} = 0.0163$, $P = 0.9009$; loss, $F_{1,11} = 9093$, $P = 0.3608$). The relationship remained non-significant either using the day before each session (recruitment, $F_{1,10} = 0.9979$, $P = 0.3414$; loss, $F_{1,10} = 0.3188$, $P = 0.5837$), five previous days (recruitment, $F_{1,10} = 0.1454$, $P = 0.7110$; loss, $F_{1,11} = 1.908$, $P = 0.1946$) or 15 previous days (recruitment, $F_{1,10} = 0.9733$, $P = 0.3471$; loss, $F_{1,11} = 0.0580$, $P = 0.8141$).

Discussion.—The modest variation in aggregation size along the study was explained better by the recruitment of new males to the aggregation than by their losses, which were low most of the time. Recruitment showed an irregular pattern, as peaks were recorded in different months without any clear seasonality. If aggregation size reflects the size of the whole *S. albicans* population in the area, a relationship of recruitment with rainfall would be expected – as rainfall usually is related with abundance of arthropods, which are important resources for anurans. However, no such relationship was found. Indeed, one of the peaks of recruitment was found in June 2002, one of the few months with water deficit along the study (Fig. 1). Actually, one could also expect a negative relationship of *S. albicans* recruitment and/or permanence with rainfall at least in short term—during the sampling session or in the day before, as in nights of strong rains or preceded by strong rains the frogs had decreased reproductive activity (Nascimento 2003). The strong currents in the stream these nights make the environment

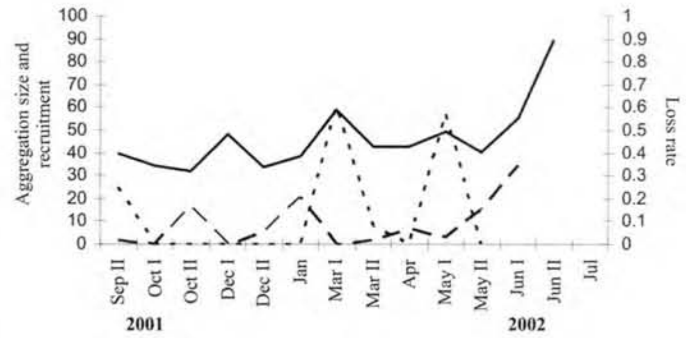

FIG. 2. Aggregation size (continuous line), loss rates (dotted line), and recruitment (dashed line) for *Scinax albicans* in a stream of the Parque Nacional da Serra dos Órgãos, Teresópolis, from September 2001 to July 2002.

TABLE 1. Demographic parameters for the aggregation of *Scinax albicans* in a stream of the Parque Nacional da Serra dos Órgãos, Teresópolis. Aggregation size, loss rates, and recruitment for males were estimated using the Jolly-Seber method. Traces (—) indicate cases where estimates cannot be obtained due to limitations of the Jolly-Seber method.

Period (i)	Aggregation Size (AS_i)	Confidence interval of AS_i	Recruitment ($\beta_{i,i+1}$)	Loss rates ($Ø_{i,i+1}$)
September I	—	—	—	0.00
September II	19.9	16 – 27.2	1.0	0.25
October I	17.1	13.7 – 20.6	0.0	0.00
October II	16	2 – 45.3	8.0	0.00
December I	24	5.9 – 42.1	0.0	0.00
December II	17	7 – 42.5	2.4	0.00
January	19.4	15.3 – 23.5	10.2	0.00
March I	29.6	18.1 – 41.2	0.0	0.61
March II	21.5	17.6 – 25.5	0.9	0.08
April	21.5	18.3 – 24.8	3.2	0.00
May I	24.8	15.1 – 34.4	1.5	0.58
May II	20.1	17.3 – 22.9	7.5	0.00
June I	27.6	21.8 – 33.4	17.2	0.00
June II	44.8	19 – 77.9	—	—
July	—	—	—	—
Averages (mean ± SD)	23.34 ± 7.63		4.00 ± 5.28	0.11 ± 0.22

unsuitable for oviposition by *S. albicans*. However, no significant negative relationship was recorded.

The patterns found show aggregation size to be remarkably constant by the standards of any vertebrate populations. The permanence of males in aggregation was high, and the little variation in aggregation size was explained by variations in the numbers of males entering the aggregation each month. The possibilility that aggregation size could be used as in index to population size is jeopardized by its high constancy and lack of relationship with rainfall patterns. Possibly aggregation size is rather controlled by social factors regulating the number of males calling at a time in any given place.

Acknowledgments.—We thank IBAMA (Instituto Brasileiro de Meio Ambiente e Recursos Naturais Renováveis) for allowing the work at Parque Nacional da Serra dos Orgãos; Instituto Nacional de Meteorologia (INEMET) for climatic data; Sergio Potsch de Carvalho e Silva for teaching on amphibians, for logistic support and co-supervising DN's MSc dissertation; the several colleagues, especially Fábio Nascimento, who helped in field work; Rômulo Barroso for company in all field work and discussions throughout the study; José P. Pombal Jr., William Magnusson, Jon Loman, Monique Van Sluys, Ronaldo Fernandes, Gunther Koehler and an anonymous referee for very useful comments on the manuscript; Jorge Luiz do Nascimento for ideas in this study and for financial support.

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Herpetological Review, 2006, 37(2), 161–165.

Abundance and Biomass of Twelve Species of Snakes Native to Northeastern Kansas

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The purposes of this paper are to examine abundance and biomass estimates of the dozen most abundant snake species in our area of northeastern Kansas, and to relate these numbers to information reported in the literature. Hirth and King (1968) stated, "In spite of all the current interest in ecosystem ecology there is still a dearth of information concerning biomass densities of snakes in various habitats." Except for a few studies (e.g., Bonnet et al. 2002; Godley 1980; Hirth and King 1968; Reichenbach and Dalrymple 1986; Winne et al. 2005), the situation does not seem to have changed appreciably in the last 37 years.

Methods and Study Area

Snakes have been studied for the past 56 years on Kansas University's Natural History Reservation (FNHR) following establishment of the area as a reserve. Although protected from anthropogenic alterations, the area has undergone continual and progressive change due to natural ecological succession (Fitch 1999; Fitch et al. 1984, 2001, 2003b). The closing in of forest and elimination of open places associated with agriculture and grazing has been unfavorable for snakes. Several of the species have disappeared from this 239-hectare tract, and almost all species have been drastically reduced (Fitch 1999). The adjoining Nelson Environmental Study Area (NESA), acquired by the University in 1970, has provided a contrast to FNHR in terms of habitat stability. Invasion of woody vegetation is prevented on NESA by the regular mowing of blocks of former pasture and cultivated land, and as a result, existing snake populations resemble those found on FNHR in earlier stages of succession (Fitch 1999).

Sampling areas (House Field, Quarry Field, etc.) are described by Fitch (1999). Of the 12 censuses reported here, eight were from FNHR and were done in the earlier years of study (before 1979) except that for *Thamnophis sirtalis*. Of the remaining four species, *Carphophis vermis* was censused by Clark (1970) on private property adjoining FNHR and three, *Lampropeltis triangulum*, *L. calligaster*, and *Coluber constrictor*, were censused post-1990 on NESA.

Unless otherwise noted, density estimates are based on field records and censuses originally published in Fitch (1999) except for Clark's (1970) *Carphophis* figures. Mark-recapture records and the Petersen Index were the bases for the abundance estimates for most species, including *Agkistrodon contortrix* (Copperhead), *Carphophis vermis* (Western Wormsnake), *Coluber constrictor* (Racer), *Crotalus horridus* (Timber Rattlesnake), *Diadophis*

cit.). Here, I report a reproductive event in *Uromacerina ricardinii*, a diurnal and arboreal snake occurring principally in Atlantic Forest in southeastern Brazil (Amaral 1978. Serpentes do Brasil. Melhoramentos Univ. São Paulo, Brazil. 246 pp.; Cunha and Nascimento 1982. Bol. Mus. Par. Emilio Goeldi, n.s. Zool. 113:1–9).

A gravid female (522 mm SVL, 415 mm tail, 28.5 g) was found on 9 November 2003 in Atlantic forest near Núcleo Santa Virginia (Parque Estadual da Serra do Mar, São Paulo, Brazil; 23°20'S, 45°08'W; ca. 810 m elev.) and maintained in captivity. On 12 November 2003, she laid five eggs between 2300–2400 h. These eggs averaged 24.8 ± 2.4 mm in length (range 22.4–28.8 mm), 10.2 ± 0.3 mm in diameter (9.9–10.8) mm, and 1.6 ± 0.1 g (1.5–1.8 g). Total clutch mass was 8.1 g and the female weighed 20 g after ovipositing, resulting in a relative clutch mass (RCM) of 40.5%. Relative reproductive effort (Lemen and Voris 1981. J. Anim. Ecol. 50:89–101), obtained by dividing the total clutch mass by female pre-oviposition mass, is 28.4%. The eggs were incubated in moist vermiculite (22–28°C). Hatching occurred between 25–28 January 2004 and the neonates were immediately weighed and measured. Four neonates (136.7 ± 4.7 mm SVL, range 131–142 mm; 103.5 ± 3.7 mm tail length, 102–105 mm; 1.12 ± 0.01 g, 1.12–1.14 g) hatched after an incubation period of 84–87 days. After twenty days the fifth egg was opened and a dead embryo was discovered. The female died seven days after ovipositing and was vouchered in the Instituto Butantan collection (IB69144).

Morato and Bernils (1989. Acta Biol. Leopol. 11:273–278) report a small clutch (three eggs) with oviposition in November and hatching in the end of January. Marques (1998, *op. cit.*) reported a gravid female with six eggs in November and two vitellogenic (follicles > 5 mm) females in August. Collectively, these observations suggest a seasonal reproductive cycle for *U. ricardinii*, with oviposition in the beginning of the rainy season (November–December) and hatching occurring in the end of the rainy season (February–March). *Uromacerina ricardinii* has the slender body typical of arboreal species but the RCM seems similar to that of terrestrial colubrids (Seigel and Ford 1987. *In* Seigel et al. [eds.], Snakes: Ecology and Evolutionary Biology, pp. 184–209. Macmillan Publ. Co., New York).

I thank O. A. V. Marques and M. T. Hartmann for reviews and FAPESP and CNPq for financial support.

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GEOGRAPHIC DISTRIBUTION

Herpetological Review publishes brief notices of new geographic distribution records in order to make them available to the herpetological community in published form. Geographic distribution records are important to biologists in that they allow for a more precise determination of a species' range, and thereby permit a more significant interpretation of its biology.

These geographic distribution records will be accepted in a **standard format** only, and all authors *must* adhere to that format, as follows: SCIENTIFIC NAME, COMMON NAME (for the United States and Canada as it appears in Crother 2000. *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding*. SSAR Herpetol. Circ. 29:1–82, available online at <http://herplit.com/SSAR/circulars/HC29/Crother.html>; for Mexico as it appears in Liner 1994, *Scientific and Common Names for the Amphibians and Reptiles of Mexico in English and Spanish*. Herpetol. Circ. 23:1–113), LOCALITY (use metric for distances and give precise locality data), DATE (day-month-year), COLLECTOR, VERIFIED BY (*cannot* be verified by an author—curator at an institutional collection is preferred), PLACE OF DEPOSITION (where applicable, use standardized collection designations as they appear in Leviton et al. 1985, *Standard Symbolic Codes for Institutional Resource Collections in Herpetology and Ichthyology*, Copeia 1985[3]:802–832) and CATALOG NUMBER (required), COMMENTS (brief), CITATIONS (brief), SUBMITTED BY (give name and address in full—spell out state or province names—no abbreviations).

Some further comments. This geographic distribution section does not publish "observation" records. Records submitted should be based on preserved specimens which have been placed in a university or museum collection (private collection depository records are discouraged; institutional collection records will receive precedence in case of conflict). A good quality color slide or photograph may substitute for a preserved specimen *only* when the live specimen could not be collected for the following reasons: it was a protected species, it was found in a protected area, or the logistics of preservation were prohibitive (such as large turtles or crocodilians). Color slides and photographs *must* be deposited in a university or museum collection along with complete locality data, and the color slide catalog number(s) must be included in the same manner as a preserved record. Before you submit a manuscript to us, check Censky (1988, *Index to Geographic Distribution Records in Herpetological Review: 1967–1986*; available from the SSAR Publications Secretary) to make sure you are not duplicating a previously published record. The responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extensions unless a thorough literature review has been completed.

Please submit any geographic distribution records in the **standard format only** to one of the Section Co-editors: **Alan M. Richmond** (USA & Canadian records only); **Jerry D. Johnson** (Mexico and Central America, including the Caribbean Basin); **Indraneil Das** (all Old World records); or **Gustavo J. Scrocchi** (South American records). Short manuscripts are discouraged, and are only acceptable when data cannot be presented adequately in the standard format. **Electronic submission of manuscripts is required** (as Microsoft Word or Rich Text format [rtf] files, as e-mail attachments). Refer to inside front cover for e-mail addresses of section editors.

Recommended citation for new distribution records appearing in this section is: Schmitz, A., and T. Ziegler. 2003. Geographic distribution. *Sphenomorphus rufocaudatus*. Herpetol. Rev. 34:385.

CAUDATA

AMBYSTOMA MACULATUM. (Spotted Salamander). USA. TENNESSEE: Fayette Co.: Wolf River Wildlife Management Area managed by the Tennessee Wildlife Resources Agency located in the SE Moscow Quad (35.029000° N., -89.265350° W; NAD 83). 06 January 2005. Brandon Wear of the Tennessee Wildlife Resources Agency. Austin Peay State University Museum of Zoology, APSU 18051 (color photo). Verified by A. Floyd Scott. One specimen found in a drift fence in bottomland hardwoods. Temperature at collection was 6° C. New county record that extends the range of the species in Tennessee into the eastern portion of Fayette Co. (Redmond and Scott. 1996). Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology,

Austin Peay State University, Clarksville, Tennessee. 94 pp. (Hard copy and Internet versions, http://www.apsu.edu/amatlas/, the latter of which includes links to information on Tennessee herpetology having appeared since 1996).

Voucher image collection made under the authority of the Tennessee Wildlife Resources Agency; field work supported by State Wildlife Grant (SWG) funding under the authority of the U.S. Fish and Wildlife Service.

Submitted by **CHRIS HUNTER**, Tennessee Wildlife Resources Agency Region I Wildlife Diversity Biologist, 200 Lowell Thomas Drive, Jackson, Tennessee 38301, USA; e-mail: christopher.hunter@state.tn.us.

AMBYSTOMA OPACUM (Marbled Salamander). USA: ARKANSAS: LONOKE CO.: 2.2 km E. Ward (T5N, R9W, S25). 1 October 2005. Kelly E. McKenzie. Verified by Stanley E. Trauth. Arkansas State University Museum of Zoology Herpetological Collection (ASUMZ 29510). New county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **MICHAEL V. PLUMMER**, Department of Biology, Box 12251, Harding University, Searcy, Arkansas 72149, USA (e-mail: plummer@harding.edu); and **DONALD F. McKENZIE,** Wildlife Management Institute, 2396 Cocklebur Road, Ward, Arkansas 72176, USA (e-mail: wmidm@ipa.net).

AMBYSTOMA TALPOIDEUM (Mole Salamander). USA: GEORGIA: CLARKE CO.: Whitehall Forest, man-made pond ca. 200 m SW of forest entrance gate (33.89471°N, 83.36306°W). 22 February 2004. Anna E. Liner. Verified by John Jensen. Georgia Museum of Natural History (GMNH 49911). New county record (Williamson and Moulis 1994. Distributions of Amphibians and Reptiles in Georgia. Spec. Publ. No. 3, Savannah Science Museum, Inc., Savannah).

Submitted by **ANNA E. LINER**, Warnell School of Forest Resources, University of Georgia, Athens, Georgia 30602-2151, USA; e-mail: linera@owl.forestry.uga.edu.

AMBYSTOMA TALPOIDEUM (Mole Salamander). USA: TENNESSEE: OBION CO.: Adult found under fallen timber near wetland adjacent to Walnut Log Road near Reelfoot Lake (36° 26.89'N, 89°20.84'W). 26 March 2005. Brad M. Glorioso, Matthew L. Niemiller, and Elizabeth L. Young. Verified by A. Floyd Scott. Color photo voucher in Austin Peay State University Herpetological Collection (APSU 18134). LAKE CO: Adult found in pitfall trap along drift fence in agricultural field adjacent to Carrington Road near Reelfoot Lake. (36°24.82'N, 89°25.60' W). 14 May 2005. Brad M. Glorioso and Elizabeth L. Young. Verified by A. Floyd Scott. Color photo voucher in Austin Peay State University Herpetological Collection (APSU 18135). First county records (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

Submitted by **BRAD M. GLORIOSO** (e-mail: bmg2g@mtsu.edu)**, ELIZABETH L. YOUNG,** and **MATTHEW L. NIEMILLER**, Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee, 37132, USA.

NOTOPHTHALMUS VIRIDESCENS LOUISIANENSIS (Central Newt). USA: TENNESSEE: HARDIN CO.: White Oak Wildlife Management Area managed by the Tennessee Wildlife Resources Agency located in the Milledgeville Quad (35.350820°N, 88.254500° W, NAD 83). 26 May 2005. Brandon Wear. Austin Peay State University Museum of Zoology, APSU 18049 (color photo). Verified by A. Floyd Scott. One specimen caught during a visual encounter survey in bottomland hardwoods. Temperature at collection was 24°C. New county record that extends the range in Tennessee into the northwestern corner of Hardin Co. (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. [Hard copy and Internet versions, http://www.apsu.edu/amatlas/, the latter of which includes links to information on Tennessee herpetology having appeared since 1996]).

Voucher image made under the authority of the Tennessee Wildlife Resources Agency; field work supported by State Wildlife Grant (SWG) funding under the authority of the U.S. Fish and Wildlife Service.

Submitted by **CHRIS HUNTER**, Tennessee Wildlife Resources Agency Region I, 200 Lowell Thomas Drive, Jackson, Tennessee 38301, USA; e-mail: christopher.hunter@state.tn.us.

PLETHODON SERRATUS (Southern Red-backed Salamander). USA: ARKANSAS: PERRY CO.: 3.7 km N of Hollis. 15 October 2005. Henry W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 29448). Verified by Stanley E. Trauth. New county record (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

Submitted by **HENRY W. ROBISON**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA; e-mail: hwrobison@saumag.edu.

SIREN INTERMEDIA (Lesser Siren). USA: ILLINOIS: CALHOUN CO.: Siren live-captured in a large-mesh fyke net in the lower unit of Swan Lake after a 24-h set (N 711657, W 4315331 using NAD27CONUS map datum in UTM's). 18 March 2005. Collected by Chad R. Dolan, John K. Tucker, and Thomas R. Timmermann, Illinois Natural History Survey (INHS 19579). Verified by Chris Phillips. First county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, 300 pp.).

Submitted by **CHAD R. DOLAN, JOHN K. TUCKER,** and **THOMAS T. TIMMERMANN,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

SIREN INTERMEDIA (Lesser Siren). USA: ILLINOIS: JERSEY CO.: Siren dip-netted in ephemeral, flood-plain pool adjacent to Long Lake (N 710947 W 4321492 using NAD27CONUS map datum in UTM's). 5 June 2003. Collected by John K. Tucker, Emily Dustman, and James T. Lamer, Illinois Natural History Survey (INHS 19341). Verified by Chris Phillips, INHS. First county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, 300 pp.).

Submitted by **JAMES T. LAMER, JOHN K. TUCKER,** and **EMILY DUSTMAN**, Illinois Natural History Survey, 8450

Montclair Ave, Brighton, Illinois 62012, USA.

ANURA

BARBOURULA BUSUANGENSIS (Philippine Discoglossid Frog). PHILIPPINES: PALAWAN PROVINCE: Quezon; Barangay; Panitian; Isapa Creek. 09 December 2004. Pierre Fidenci. California Academy of Sciences Photo Voucher (CAS-HPV 38). Verified by Michelle Koo. First record for Quezon Province and a ca. 80 km range extension SW from the closest known record (Alcala and Brown 1998. Philippine Amphibians. An. Illustrated Fieldguide. Bookmark, Inc., Makati City. xii + 116 pp.). Two adults were observed at night in a shaded primary forest creek (4 m wide and 0.1– 0.5 m deep) with a mixture of sand, silt, gravel, and boulder as substrate.

Submitted by **PIERRE FIDENCI,** Garcia and Associates, 1 Saunders Ave, San Anselmo, California 94960, USA; e-mail: pfidenci@garciaandassociates.com.

BOKERMANNOHYLA NANUZAE (Nanuzae's Treefrog). BRAZIL: MINAS GERAIS: Municipalidade de Ouro Preto, Serra da Brígida (20°22'S. 43°29'W, 1375 m elev.). September 2005. A. C. C. Lourenço, B. de Assis, D. P. B. da Costa, L. O. Drummond, and T. L. Pezzuti. Laboratório de Zoologia dos Vertebrados, Universidade Federal de Ouro Preto, Ouro Preto, Minas Gerais, Brazil (LZV 441A–445A). Verified by R. N. Feio. Previously known only from the mountains of Serra do Cipó (19°22'S. 43°34'W, 1200 m elev.), Municipalidade of Jaboticatubas, Minas Gerais (Bokermann and Sazima 1973. Rev. Bras. Zool. 33[3]:329–336). This record extends known distribution ca. 120 km SE from the Serra do Cipó.

Submitted by **ANA CAROLINA CALIJORNE LOURENÇO** (e-mail: carolcalijorne@gmail.com), **BRENO DE ASSIS, DÉLIO BAÊTA, LEANDRO DE OLIVEIRA DRUMMOND, TIAGO LEITE PEZZUTI,** and **MARIA RITA SILVÉRIO PIRES**, Laboratório de Zoologia dos Vertebrados, Universidade Federal de Ouro Preto, 35400-000, Ouro Preto, MG, Brazil.

BUFO ALVARIUS (Sonoran Desert Toad). MÉXICO: CHIHUAHUA: Municipality of Janos: Ejido San Pedro (30°51'30"N; 108°23'18"W), 1420 m elev. 21 August 2005. Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autonoma de México photographic collection (MZFC 1372). Rancho El Uno (30°51'42"N, 10°27'36"W), 1400 m elev. 23 August 2005. MZFC 1373. Both frogs photographed by E. Ponce Guevara. Both frogs verified by Luis Canseco Márquez. First Chihuahua records from east of the Sierra Madre Occidental (Lemos-Espinal et al. 2004. Introducción a los Anfibios y Reptiles de Chihuahua. UNAM-CONABIO. 128 pp.) and an 85 km range extension NE from the lowlands of northeastern Sonora (Fouquette 1970. Cat. Amer. Amphib. Rept. 93:1–4; Frost 2005. Amphibian Species of the World. http://research.amnh.org/herpetology/amphibia/index.php). The closest records in the USA are from the Animas Valley of southwestern New Mexico (Degenhardt et al. 1996. The Amphibians and Reptiles of New Mexico. Univ. New Mexico Press. 431 pp.). Both specimens were found in natural arid grasslands.

Submitted by **GEORGINA SANTOS-BARRERA**, Museo de Zoología, Facultad de Ciencias, UNAM, A. P. 70-399, C.P. 04510, México D.F. (e-mail: gsantos@miranda.ecologia.unam.mx); **JUAN CRUZADO**, **EDUARDO PONCE GUEVARA**, **RODRIGO SIERRA CORONA,** and **JESÚS PACHECO**, Instituto de Ecología, UNAM, A.P. 70-245, C.P. 04510, México D.F.

BUFO AMERICANUS AMERICANUS (Eastern American Toad). USA: TENNESSEE: RUTHERFORD Co.: Flat Rock Cedar Glades and Barrens State Natural Area (35°51'12"N, 86°18'13"W). 29 March 2005. Brad M. Glorioso. Verified by A. Floyd Scott. Photo voucher in Austin Peay State University Herpetological Collection (APSU 18137). One adult found underneath limestone rock at edge of cedar glade. Additional specimen collected on Tassey Rd N of Readyville (35°51'52"N, 86°10'45"W). 14 November 2005. Brad M. Glorioso and Matthew L. Niemiller. Verified by Brian T. Miller. Voucher specimen in Herpetology Collection at Middle Tennessee State University (MTSU 149A). First county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

Submitted by **BRAD M. GLORIOSO** (e-mail: bmg2g@mtsu.eduand) **MATTHEW L. NIEMILLER**, Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee 37132, USA.

BUFO CRUCIFER (NCN). BRAZIL: RIO DE JANEIRO: Municipalidade de Teresópolis: Parque Nacional de Serra dos Órgãos (PARNA-SO) (22°27'22" S, 42°59'18" W). 21 August 2005. A. M. P. T. de Carvalho-e-Silva et al. Verified by S. P. de Carvalho-e-Silva. Herpetological Collection of the Departamento de Ciências Naturais of Universidade Federal do Estado do Rio de Janeiro, Rio de Janeiro (2202-UNIRIO). The species was known from the state of Ceará to southern Espírito Santo and the northeastern state of Minas Gerais (Baldissera-Jr. et al. 2004 Arquivos do Museu Nacional 62[3]:255–282). This first state record extends the known distribution ca. 305 km southwest from Cachoeiro de Itapemirim, State of Espírito Santo (Baldissera-Jr. et al., *op. cit.*).

Submitted by **RAFAEL A. MARQUES**, Departamento de Ciências Naturais, Universidade Federal do Estado do Rio de Janeiro (UNIRIO), CEP 20290-240, Urca, Rio de Janeiro, Brazil (e-mail: marquesrafael@yahoo.com); **BRUNO B. ANNUNZIATA**, Departamento de Zoologia, Universidade Federal do Rio de Janeiro (UFRJ), C.P. 68.044, CEP 21944-970, Cidade Universitária, Rio de Janeiro, Brazil (e-mail: barcellos_ba@biologia.ufrj.br); and **ANA M. P. T. DE CARVALHO-E-SILVA**, Departamento de Ciências Naturais, Universidade Federal do Estado do Rio de Janeiro (UNIRIO), CEP 20290-240, Urca, Rio de Janeiro, Brazil (e-mail: atelles@unirio.br).

BUFO EMPUSUS (SAPO DE CONCHA). CUBA: SANCTI SPIRITUS: TOPES DE COLLANTES: Sierra Escambray, El Chorrito (21°54'5.1"N, 80°0'44.0"W), ca. 720 m elev. 1976. P. Hernández. Instituto de Ecología y Sistemática, Colección Zoológica de la Academia de Ciencias de Cuba (CZACC[I] 11678). Verified by L. V. Moreno. First record for Sierra del Escambray, where it was previously considered absent (Hedges 1999. *In* W. E. Duellman [ed.], Patterns of Distribution of Amphibians, A Global Perspective, pp. 211–254. Johns Hopkins Univ. Press, Baltimore) and the highest elevation recorded for this species, which has a wide dis-

tribution elsewhere in the lowlands of Cuba and on Isla de la Juventud and keys of the Sabana-Camagüey archipelago (Estrada and Ruibal 1999. *In* B. I. Crother [ed.], Caribbean Amphibians and Reptiles, pp. 31–62. Academic Press, San Diego).

Submitted by **ROBERTO ALONSO** (e-mail: ralonso@ecologia.cu) and **ARIEL RODRÍGUEZ**, Instituto de Ecología y Sistemática, Carr. de Varona, Km 3½, Capdevila, Boyeros, AP 8029, CP 10800, Ciudad de la Habana, Cuba.

BUFO FOWLERI (Fowler's Toad). USA: ARKANSAS: VAN BUREN Co.: Forest Road 1331A, Brock Creek Campground (N35.48929, W92.80676). 15 October 2005. Mauricio Solis et al. Voucher specimen in Arkansas State University Museum of Zoology (ASUMZ 29444). Verified by Stanley E. Trauth. First county record (Trauth et al., 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville, 421 pp.).

Submitted by **MAURICIO SOLIS**, **JOSH ENGELBERT**, **MELISSA PATRICK**, **JONATHAN STANLEY**, Department of Biological Sciences, Arkansas State University, P.O. Box 599, State University, Arkansas 72467-0599, USA (e-mail: mauricio.solis@smail.astate.edu); and **ERIKA SHELBY**, Arkansas Department of Environmental Quality, 8001 National Dr., Little Rock, Arkansas 72219, USA (e-mail: shelby@adeq.state.ar.us).

BUFO FOWLERI (Fowler's Toad). USA: NEW YORK: CHAUTAUQUA Co.: Town of Hanover, Sunset Bay on the S bank of Cattaraugus Creek at its confluence with Lake Erie. 10 June 2000. Jay DeCarolis. Verified by Alvin R. Breisch. New York State Museum (NYSM 3446). New county record (Wright and Wright 1949. Handbook of Frogs and Toads of the United States and Canada. Third ed. Comstock Publishing Associates, Ithaca. xxiv + 640 pp.). This specimen was videotaped before collection while it gave the typical advertisement call of *Bufo fowleri*. Arthur Clark of the Buffalo Museum of Science indicates a possible previous record of this species in Chautauqua Co, SW of Dunkirk on May 1960. The specimen was reportedly collected by Willard Stanley and was assigned Buffalo Museum of Science Cat. No. (A157). This specimen is now missing and could not be verified.

Submitted by **KENNETH J. ROBLEE**, New York State Department of Environmental Conservation, 270 Michigan Avenue, Buffalo, New York 14203-2999, USA.

BUFO FOWLERI (Fowler's Toad). USA: NEW YORK: ERIE Co.: Town of Evans, 80 m E of Lake Erie, 50 m N of Went Road, near Little Sister Creek. 24 August 1999. Malachy McKenna. Verified by Alvin R. Breisch. New York State Museum (NYSM 3445). New county record (Wright and Wright 1949, Handbook of Frogs and Toads of the United States and Canada. Third ed. Comstock Publishing Associates, Ithaca. xxiv + 640 pp.).

Submitted by **MALACHY MCKENNA** and **KENNETH J. ROBLEE**, New York State Department of Environmental Conservation, 270 Michigan Avenue, Buffalo, New York 14203-2999, USA.

BUFO OCELLATUS (NCN). BRAZIL: MATO GROSSO DO SUL: Município de Corguinho, Serra de Maracaju, 7 km NE of Taboco district (19°47'03.04"S, 55°15'27.61"W, elev. 272 m; WGS 84). 20 August 2005. P. Landgref Filho and R. W. Ávila. Coleção de Vertebrados da Universidade Federal de Mato Grosso do Sul, Campo Grande, Mato Grosso do Sul, Brazil (ZUFMS 793). Verified by C. Strussmann and D. H. Morais. Previously known from Pará, Mato Grosso, Minas Gerais, and Tocantins states. First state and southernmost record extends the known distribution ca. 1350 km SW from Posto Pimentel Barbosa, Mato Grosso State (Frost 2004. Amphibian Species of the World: An Online Reference. Version 3.0. 10 September 2005. http://research.amnh.org/herpetology/amphibia/ index.html).

Submitted by **ROBSON W. ÁVILA**, Departamento de Ciências do Ambiente, Campus de Corumbá, UFMS, Avenida Rio Branco, Caixa Postal 252, CEP 79301-970, Corumbá, Mato Grosso do Sul, Brazil (e-mail: robsonavila@gmail.com); and **PAULO LANDGREF FILHO**, Rua Francisco Alves Castelo, 316, ap. 16. Vila Ipiranga, CEP 79080-770, Campo Grande, Mato Grosso do Sul, Brazil (e-mail: paulograf@yahoo.com.br).

CYCLORAMPHUS CARVALHOI. BRAZIL: SÃO PAULO: Municipality of Campos do Jordão (22°42'23.2"S; 45°28'18.7"W), 1750 m elev. 20 October 2005. I. A. Martins, P. H. Bernardo, A. P. Suarez, and F. B. R. Gomes. Célio F. B. Haddad collection, deposited in Departamento de Zoologia, Universidade Estadual Paulista, Rio Claro, SP, Brasil (CFBH 9894, adult male SVL: 52.63 mm). Verified by C. F. B. Haddad. Species previously known only from the type locality (Brejo da Lapa, alto do Itatiaia, Rio de Janeiro, RJ; Heyer 1983. Arq. Zool. 30[4]:235–339. Frost 2004. Amphibian Species of the World: An Online Reference V3.0, http://research.amnh.org/herpetology/amphibia/index.html). First state record, extends known distribution ca. 200 km SW from the type locality.

Submitted by **ITAMAR ALVES MARTINS** (e-mail: istama@uol.com.br), **FELIPE BITTIOLI R. GOMES**, Universidade de Taubaté - UNITAU, Laboratório de Zoologia/IBB. 12030-1800, Taubaté, SP, Brazil; **PEDRO H. BERNARDO**, Universidade Federal de Ouro Preto (UFOP), Lab. de Zoologia dos Vertebrados, 35400-000, Ouro Preto, MG, Brazil; and **ANA PAULA SUAREZ**, Estação Ecológica de Bananal – IF, 12850-000, Bananal, SP, Brazil.

DISCOGLOSSUS PICTUS (Painted Frog). TUNISIA: GOUVERNORAT DE GABÈS: Oued el Ferd (33°46'N, 10°15'E), E of highway P-1, ca. 10.7 km E and 15 km S of Gabès. 28 March 1972. Stephen D. Busack. Verified by Robert C. Drewes. Carnegie Museum of Natural History (CM 56540). Extends the eastern range of the species along the Mediterranean coast to ca. 330 km S of Tunis, Tunisia (Schleich et al. 1996, Amphibians and Reptiles of North Africa. Koeltz Scientific Books, Koenigstein. 627 pp.). The specimen, a subadult, was taken among *Salicornia* (chenopods) at 1316 h in an area where six deep ponds house *Rana saharica*. A juvenile *Natrix maura* (CM 56543) and adult *Mesalina guttulata* (CM 56541–56542) were also found in the area.

Submitted by **STEPHEN D. BUSACK**, North Carolina State Museum of Natural Sciences, 11 West Jones Street, Raleigh, North Carolina 27601-1029, USA; e-mail: steve.busack@ncmail.net.

ELEUTHERODACTYLUS BRESSLERAE (NCN). CUBA: SANTIAGO DE CUBA: TERCER FRENTE: Sierra Maestra, vicinity of La Tabla (20°12'15.1"N; 76°23'45.2"W). 29 June 2003. R.

Alonso, A. Rodríguez, and A. Hernández. Instituto de Ecología y Sistemática, Colección Zoológica de la Academia de Ciencias de Cuba (CZACC 14.12786–97). All verified by L. V. Moreno.

First record for this species from the Sierra Maestra biogeographic region (Hedges 1999. *In* W. E. Duellman [ed.], Patterns of Distribution of Amphibians, A Global Perspective, pp. 211–254. Johns Hopkins Univ. Press, Baltimore) and ca. 220 km SW from the nearest known locality in Guantánamo Province, where the species was once thought to be endemic to the coastal area. (Schwartz 1960. Read. Publ. Mus. Art. Gall. 11:3–50).

Submitted by **ROBERTO ALONSO** (e-mail: ralonso@ecologia.cu) and **ARIEL RODRÍGUEZ**, Instituto de Ecología y Sistemática, Carr. de Varona, Km 3½, Capdevila, Boyeros, AP 8029, CP 10800, Ciudad de la Habana, Cuba.

GASTROPHRYNE CAROLINENSIS (Eastern Narrow-mouthed Toad). USA: TENNESSEE: Fayette Co.: Wolf River Wildlife Management Area managed by the Tennessee Wildlife Resources Agency located in the SE Moscow Quad (35.029000°N, 89.265350°W, NAD 83). 19 October 2004. Brandon Wear. Austin Peay State University Museum of Zoology, APSU 18053 (color photo). Verified by A. Floyd Scott. One specimen found in a drift fence in bottomland hardwoods. Temperature at collection was 21°C. New county record that extends the range of the species in Tennessee into the eastern portion of Fayette Co. (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. [Hard copy and Internet versions, http://www.apsu.edu/amatlas/, the latter of which includes links to information on Tennessee herpetology having appeared since 1996]).

Voucher image collection made under the authority of the Tennessee Wildlife Resources Agency; field work supported by State Wildlife Grant (SWG) funding under the authority of the U.S. Fish and Wildlife Service.

Submitted by **CHRIS HUNTER**, Tennessee Wildlife Resources Agency Region I Wildlife Diversity Biologist, 200 Lowell Thomas Drive, Jackson, Tennessee 38301, USA; e-mail: christopher.hunter@state.tn.us.

GASTROPHRYNE CAROLINENSIS (Eastern Narrow-mouthed Toad). USA: TENNESSEE: Grundy Co.: Abandoned rock quarry near entrance to Crystal Cave, Tennessee Cave Survey Num. GD10 (35°16' 28"N, 85°51'21"W). 12 May 2005. Matthew L. Niemiller, Jason M. Todd, Brian T. Miller, and Nathaniel G. Mann. Verified by A. Floyd Scott. Color photo voucher in Austin Peay State University Herpetological Collection (APSU 18133). Three adults found underneath limestone rock. First county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

Submitted by **MATTHEW L. NIEMILLER** (e-mail: mln2a@mtsu.edu), **JASON M. TODD**, **BRIAN T. MILLER** (e-mail: bmiller@mtsu.edu), Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee, 37132, USA; and **NATHANIEL G. MANN**, 225 Apple Valley Lane, Morrison, Tennessee 37357, USA.

HYLA CINEREA (Green Treefrog). USA: INDIANA: Posey Co.: Pointe Township, ca. 15 km SW Mount Vernon (37.8229N, 88.0029W, NAD 83). 10 June 2005. Zack Walker and Nathan Engbrecht. Verified by Chris Phillips. Photo voucher in Illinois Natural History Survey (INHS2005a). New county record and second record for the state of Indiana (Lodato et al. 2004. Herpetol. Rev. 35:281. Minton 2001. Amphibians and Reptiles of Indiana. 2nd ed., revised. Indiana Acad. Sci. 404 pp.). This record extends the range northward into the southwestern section of Indiana and appears to be the result of a natural expansion in the range of this species. Adults were in chorus at an oxbow slough dominated by Bald Cypress (*Taxodium distichum*) and Buttonbush (*Cephalanthus occidentalis*) near the conjunction of the Ohio and Wabash Rivers. A second chorus was later heard from the backwaters of Hovey Lake, ca. 3.75 km ESE of the oxbow slough. The origin of these populations is currently unknown, however, nearby populations of *H. cinera* in adjacent Union and Henderson counties, Kentucky might serve as source populations for this new locality.

Submitted by **ZACHARY WALKER** (e-mail: Zwalker@dnr.IN.gov), **NATHAN ENGBRECHT** (e-mail: Nengbrecht@dnr.IN.gov), and **REBECCA SCHMITT**, Indiana Department of Natural Resources – Wildlife Diversity/Herpetology, 533 East Miller Drive, Bloomington, Indiana 47401, USA.

HYLA GRATIOSA (Barking Treefrog). USA: TENNESSEE: Hardin Co.: White Oak Wildlife Management Area managed by the Tennessee Wildlife Resources Agency. Milledgeville Quad (35.340010°N, -88.333540°W, NAD 83). 7 July 2005. Brandon Wear. Austin Peay State University Museum of Zoology, APSU 18052 (color photo). Verified by A. Floyd Scott. One specimen caught in a funnel trap along a drift fence in bottomland hardwoods. Temperature at collection was 25°C. New county record that extends the range in Tennessee into the northwestern corner of Hardin Co. (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. [Hard copy and Internet versions, http://www.apsu.edu/amatlas/, the latter of which includes links to information on Tennessee herpetology having appeared since 1996]).

Voucher image made under the authority of the Tennessee Wildlife Resources Agency; field work supported by State Wildlife Grant (SWG) funding under the authority of the U.S. Fish and Wildlife Service.

Submitted by **CHRIS HUNTER**, Tennessee Wildlife Resources Agency Region I Wildlife Diversity Biologist, 200 Lowell Thomas Drive, Jackson, Tennessee 38301, USA; e-mail: christopher.hunter@state.tn.us.

LEPIDODACTYLUS LUGUBRIS (Mourning Gecko)**.** COLOMBIA: CÓRDOBA: San Antero: Cispatá Bay. 21 September 2000. E. Ruiz and A. Batista. Colección de reptiles Instituto de Ciencias Naturales-Universidad Nacional de Colombia, Bogotá D.C, Cundinamarca, Colombia (ICN 10398, 10399). BOYACÁ: Santa Maria: 5 km by road to Guateque. 26 January 1981. J. Clavijo. (ICN 5826). Verified by O. V. Castaño. Species known from southeastern Asia, Polynesia, Australia, USA, Central America, Galapagos Islands (Ecuador), and Chile (Uetz 2005. www.embl-heidelberg.de/~uetz/LivingReptiles.html). In Colombia it has been

recorded in Nariño, Cauca, Valle del Cauca, and Gorgona Departments, and Malpelo Islands (Sánchez-C et al. 1995. *In* Rangel-Ch, Colombia Diversidad Biótica I. Ed. Guadalupe). New department records extend the known distribution ca. 600 km N (Córdoba) and 600 km NE (Boyacá) from Valle del Cauca.

Submitted by **RAFAEL MORENO-ARIAS** (e-mail: rafamorearias@yahoo.es), Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Apartado Aéreo 55187, Bogotá, D.C. Colombia; **EDGARDO RUIZ** (e-mail: eruizs@unal.edu.co), Instituto de Ciencias Naturales, Universidad Nacional de Colombia. Apartado Aéreo 7495, Bogotá, D.C. Colombia; and **FABIAN MEDINA** (e-mail: sortyacalo@hotmail.com), Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Apartado Aéreo 7495, Bogotá, D.C. Colombia.

MICROHYLA FISSIPES (Narrowmouth Frog). SINGAPORE: PULAU TEKONG: Kampong Salabin. Large pothole along dirt track (1°25'0.9"N, 104°02'8.2"E, 29 m elev.). 03 August 2005. Norman T-Lon Lim. National University of Singapore, Raffles Museum of Biodiversity Research Zoological Reference Collection (ZRC.1.11543–11554, five adult males, seven larvae). Verified by Tzi Ming Leong and Kelvin K. P. Lim. New country record (Lim and Lim 1992. A Guide to the Amphibians and Reptiles of Singapore. Singapore Science Centre, Singapore. 160 pp.); represents the southernmost extent of its range in the Malay Peninsula. This species name was recently resurrected from the synonymy of *M. ornata* (see Matsui et al. 2004. Zool. Sci. 22:489–495).

Submitted by **NORMAN T-L. LIM**, **ALAN W. M. YEO**, and **KWOK-WAI CHAN**, Department of Biological Sciences, National University of Singapore, Singapore 119260.

PHYLLOMEDUSA ROHDEI (Mertens' Leaf Frog). BRAZIL: ESPÍRITO SANTO: NOVA VENÉCIA: 18° 42'S, 40° 30'W. 20 January 2003. R. L. Teixeira. Museu de Zoologia Prof. Mello Leitão, Santa Teresa, Espirito Santo (MBML 2529–48). Verified by J. P. Pombal Jr. LINHARES: Povoação (19° 28'S, 39° 54'W). 12 November 2001. R. L. Teixeira, G. I. Almeida, J. A. P. Schinneider (MBML 1955–7). Verified by C. A. G. Cruz. . MARECHAL FLORIANO: Alto Nova Almeida (20° 24'S, 40° 49'W). 20 October 2004. R. B. Ferreira. Museu Nacional, Rio de Janeiro (MNRJ 38955). Verified by C. A. G. Cruz. Previously known from the states of São Paulo, Rio de Janeiro and Minas Gerais, (Frost 2004. Amphibian Species of the World: An online reference. Version 3.0, http://research.amnh.org/herpetology/amphibia/index.html; Feio et al. 1998. Anfíbios do Parque Estadual do Rio Doce [Minas Gerais]. Universidade Federal de Viçosa, Viçosa, Brazil. 32 pp.). First state records. The record from Nova Venécia is the northernmost for the species and extends known distribution ca. 250 km NE from Parque Estadual do Rio Doce (Feio et al., *op. cit.*).

Submitted by **DAVOR VRCIBRADIC**, Departamento de Ecologia, Universidade do Estado do Rio de Janeiro, 20550-011, Rio de Janeiro, RJ, Brazil (e-mail: davor@centroin.com.br); **ROGÉRIO L. TEIXEIRA**, Museu de Biologia Prof. Mello Leitão, 29650-000, Santa Teresa, ES, Brazil (e-mail: rogeteix@terra.com.br); and **RODRIGO BARBOSA FERREIRA**, Departamento de Biologia, Universidade Federal do Espírito Santo, 29075-910, Vitória, ES, Brazil (e-mail: rodrigoecologia@yahoo.com.br).

PHYLLOMEDUSA VENUSTA. VENEZUELA: ESTADO ZULIA: Municipio Mara, La Orchila, Wayuu indigenous village, Sierra de Perijá piedmont, 11°37'N, 71°53'W, 230 m. 18 October 2003. E. Arrieta, E. Infante, and F. Rojas. Museo de Biología, Universidad del Zulia, Maracaibo, (MBLUZ A-185); 13 November 2003. F. Rojas (MBLUZ A- 201); 3 June 2004. E. Infante and F. Rojas (MBLUZ A-217–219); 4 June 2004. E. Infante and F. Rojas (MBLUZ A-231); 7 December 2004. Valeris and Velozo (MBLUZ A-247); 5 March 2005- E. Infante (MBLUZ A-258); 5 March 2005. E. Infante and P. Velozo (MBLUZ A-259). Cabimas, Cooperativa Bara en Tierra, 10°24'N, 70°55'W, 250 m. 30 April 2005. E. Infante (MBLUZ A-280). All verified by T. Barros. The former range of this species extended from southern Panamá to the middle Magdalena Valley and the slopes of the Sierra Nevada de Santa Marta, in Colombia (Duellman and Trueb 1967. Copeia 1967:125–131; Duellman 2001. Hylid Frogs of Middle America. Society for the Study of Amphibians and Reptiles, Ithaca, New York). First country records, extend known distribution 190 km ENE from the nearest reported locality at Fundación, Colombia (Ruthven 1922. Mus. Zool. Misc. Publ. 8:1–69 + XII plates). The presence of this species in western Venezuela was predicted by Barrio-Amorós (2004. Rev. Ecol. Lat. Am. 9:1–48).

Submitted by **EDWIN E. INFANTE-RIVERO** (e-mail: edwinfante@gmail.com), Museo de Biología Universidad del Zulia, Apartado Postal 526, Maracaibo 4011, Venezuela; **CÉSAR L. BARRIO-AMORÓS** (e-mail: cesarlba@yahoo.com), Fundación Andígena, Apartado 210, Mérida 5101-A, Venezuela; and **FERNANDO J. M. ROJAS-RUNJAIC,** Museo de Historia Natural La Salle, Sección de Herpetología, Apartado Postal 1930, Caracas 1010-A, Venezuela (e-mail: fernando.rojas@fundacionlasalle.org.ve).

PSEUDIS PARADOXA (Paradoxical Frog). VENEZUELA: FALCÓN: Municipio Mauroa, embalse de Matícora (10°40'N, 70°55'W). 28 January 2000. T. Barros. Museo de Biología de La Universidad del Zulia, Maracaibo (MBLUZ-A-0102). Verified by G. Rivas Fuenmayor. The species occurs east of the Andes from Colombia, Venezuela, and the Guianas to northern Argentina. (La Marca 1992. Catálogo Taxonómico, Biogeográfico y Bibliográfico de las Ranas de Venezuela. Cuadernos Geográficos, No. 9, Universidad de Los Andes, Mérida, 197 pp.). In Venezuela it has a wide distribution in the lowland savannas below 300 m (Barrio 1998. Acta. Biol. Venez. 18[2]:1–93; Gorzula and Señaris 1998. Contribution to the Herpetofauna of the Venezuelan Guayana I. A Data Base, Scientia Guaianae, No. 8, Caracas, 269 pp.; Pefaur and Rivero 2000. Amph. Rept. Cons. 2[2]:42–70; Rivero 1964. Carib. J. Sci. 4[1]:307–319). First state record and northernmost locality for the country, extends known range ca. 130 km N from La Ceiba in Trujillo state (Barrio, *op. cit.*).

Submitted by **FERNANDO J. M. ROJAS-RUNJAIC**, Museo de Historia Natural La Salle, Sección de Herpetología, Apartado Postal 1930, Caracas 1010-A, Venezuela (e-mail: fernando.rojas@fundacionlasalle.org.ve); **TITO R. BARROS BLANCO** (e-mail: trbarros@cantv.net), and **EDWIN E. INFANTE RIVERO**, La Universidad del Zulia, Facultad Experimental de Ciencias, Museo de Biología de La Universidad del

Zulia, Sección de Herpetología, Apartado Postal 526, Maracaibo 4011, Venezuela (e-mail: edwinfantembluz@hotmail.com).

RANA BEDRIAGAE (Bedriaga's Frog). MALTA: GOZO ISLAND: L-Ghadira ta' Sarraflu (36°02'3"N; 14°12'2"E). 500 m elev. 5 September 2004. Jonathan Abela, Nimrod Mifsud, Esther Schembri, Arnold Sciberras, and Jeffery Sciberras. National Museum of Natural History, Mdina, Malta (NMNHM AN01105). Verified by Ulrich Sinsch, Universität Bonn (on the basis of color photographs and recordings of advertisement calls). Introduced to the Maltese Islands, where *Discoglossus pictus pictus* is the only native amphibian (Baldacchino and Schembri 2002. Amfibji, Rettili, u Mammiferi fil-gzejjer Maltin. Il-Pjeta, Pubblikazzjonijiet Indipendenza, xii + 256 pp., Malta; Lanza 1972. Lav. Soc. Ital. Biogeogr. N. Ser., 3:755–804). Calls were first heard from the permanent freshwater pool at Ta' Sarraflu in April 2000, when approximately six individuals were calling. Individuals were first seen on 27 May 2004. Since then, choruses of at least 50 frogs have been heard around the pool. Eggs, tadpoles, and froglets were seen there, indicating successful reproduction. Choruses are now heard at two other localities on Gozo Island, indicating that the species is spreading.

Submitted by **ARNOLD SCIBERRAS** and **PATRICK J. SCHEMBRI** (e-mail: patrick.j.schembri@um.edu.mt), Department of Biology, University of Malta, Msida MSD06, Malta.

RANA BERLANDIERI (Rio Grande Leopard Frog). MEXICO: SONORA: 13 km SW San Luis Río Colorado, 30 m E Hwy 40 (32°24'34.1"N, 114°52'52.5"W), 27 m elev. 9 April 2005. James C. Rorabaugh and Jeffrey M. Servoss. Verified by T. Brennan. Arizona State University voucher photographs (ASU HP-00020–21). First records from Sonora; the closest accounts are from adjacent portions of Baja California Norte, Mexico and Arizona, USA (Grismer 2002. Amphibians and Reptiles of Baja California: Including Its Pacific Islands and the Islands in the Sea of Cortez. Univ. of California Press, Berkeley. 399 pp.; Rorabaugh et al. 2002. Southwest. Nat. 47:12–20). This Sonoran population most likely originated by means of invaders from southwestern Arizona (Platz et al. 1990. Copeia 1990:324–333), using the Río Colorado or agricultural canals as dispersal routes. Both specimens were observed in a concrete-lined ditch in an agricultural area within the valley of the Río Colorado.

Submitted by **JAMES C. RORABAUGH** (e-mail: Jim_Rorabaugh@fws.gov) and **JEFFREY M. SERVOSS**, U.S. Fish and Wildlife Service, 2321 West Royal Palm Road, Suite 103, Phoenix, Arizona 85021, USA.

RANA CASCADAE (Cascades Frog). USA: WASHINGTON: JEFFERSON CO.: 47°47.56'N, 124°23.80'W, 98 m elev. 17 March 2005. R. O'Donnell and J. MacCracken. Voucher photographs in the University of Washington Burke Museum (UWBM 2131–2133). Verified by Marc P. Hayes. Thirteen egg masses were found in a ca. 2–3 m 15 cm deep puddle with a mud/silt substrate at the junction of two logging roads. Embryos ranged from stage 14 to 24, including two egg masses that had begun to hatch (Gosner 1960. Herpetologica 16:183–190). A brief search of the surrounding area did not reveal any adults. JEFFERSON Co: N47°50.68', W124°22.87', 109 m elev. 3 May 2005. R. O'Donnell, L. Beatty, and R. McGinnis. Voucher photograph in the University of Washington Burke Museum (UWBM 2134). Verified by Marc P. Hayes. One juvenile found near a stream at a washed-out crossing of a decommissioned logging road. *Rana cascadae* is generally considered a species of high elevations. These observations represent new published low elevation records for the species by over 120 m (Stebbins 2003. Western Reptiles and Amphibians, 3rd ed. Houghton Mifflin Company, Boston, 533 pp.). However, several museum specimens are available from low elevations on the western side of the Olympic Peninsula which have not been reported in the literature from 167 m (MVZ 65571), ca. 100 m (PSM 1458), and ca. 73 m (CAS 47708–47723). The new records reported here provide needed recent confirmation of low-elevation records from the Olympic Peninsula which have not been reported since the 1910s, where the species had been thought to be extirpated (Leonard et al. 1993. Amphibians of Washington and Oregon. Seattle Audubon Society, Seattle, 168 pp.; McAllister 1995. Northwest Fauna 3:81–112).

Submitted by **RYAN P. O'DONNELL**, Washington Department of Fish and Wildlife, Olympia, Washington 98501, USA (e-mail: odonnrpo@dfw.wa.gov); **JAMES G. MACCRACKEN**, Timber Department, Longview Fibre Company, 300 Fibre Way, Longview, Washington 98632, USA (e-mail: jmac@longfibre.com); **LAURA M. BEATTY**, and **RYAN T. MCGINNIS**, Washington Department of Fish and Wildlife, Olympia, Washington 98501, USA.

RANA PALUSTRIS (Pickerel Frog). USA: TENNESSEE: RUTHERFORD CO.: McElroy Rd ca. 850 m SE of Kittrell (35°49'07"N, 86°14'14"W). 14 November 2005. Matthew L. Niemiller and Brad M. Glorioso. Verified by Brian T. Miller. Voucher in Middle Tennessee State University Herpetological Collection (MTSU 150A). Adult found on road after rainfall. First county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

Submitted by **MATTHEW L. NIEMILLER** (e-mail: mln2a@mtsu.edu) and **BRAD M. GLORIOSO**, Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee 37132, USA.

RANA SPHENOCEPHALA (Southern Leopard Frog). USA: MISSOURI: MARION CO.: Frog was caught alive on the Marion Co. bank of the Mississippi River at ca. river mile 323. 39.87130°N, 091.45054°W (NAD 83). 30 August 2005. Collected by Chad R. Dolan and James T. Lamer. INHS 19664. Verified by Chris Phillips, INHS. First county record (Johnson 2000. The Amphibians and Reptiles of Missouri. [2nd ed.] Missouri Dept. of Conservation).

Submitted by **CHAD R. DOLAN, JAMES T. LAMER,** and **JOHN K. TUCKER,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

RELICTIVOMER PEARSEI. VENEZUELA: ZULIA: Municipio Mara, La Orchila, Wayuu indigenous village, Sierra de Perijá piedmont (11°37'N 71°53'W), 230 m elev. 22 May 2004. E. Infante and C. Valeris. Museo de Biología, Universidad del Zulia, Maracaibo (MBLUZ A-207); 6 June 2004. E. Infante and F. Rojas. MBLUZ A-225; 5 March 2005. P. Colmenares. MBLUZ A-256; Municipio Rosario de Perijá, Barranquitas, SW of Maracaibo Lake.

10 November 2005. E. Luzardo and F. Escola. MBLUZ A-285; Municipio Cabimas, Cooperativa Barra en Tierra, 250 m elev. 26 April 2005. E. Infante. MBLUZ A-282-284. All verified by T. Barros. First vouchers from Venezuela in country musea. The species is distributed from southern Panama through Caribbean Colombia (Frost 2004. Amphibian Species of the World: an Online Reference. Version 3.0 [22 August 2004], accessible at http://research.amnh.org/herpetology/amphibia/index.php American Museum of Natural History, New York), and mentioned repeatedly as occurring in Venezuela (Barrio-Amorós 1998. Acta. Biol. Venez. 18:1–93; Gremone et al. 1986. Fauna de Venezuela, Vertebrados. Edit. Biosfera, Caracas, 269 pp.; La Marca 1997. *In* La Marca [ed.], Vertebrados Actuales y Fósiles de Venezuela, pp. 103–120. Museo de Ciencia y Tecnología de Mérida, Venezuela, 300 pp.) but no voucher specimens existed to confirm its presence. Barrio-Amorós (*op. cit.*) included it in his amphibian list of the country, stating that vouchers are needed. These voucher specimens confirm that this species occurs throughout the Maracaibo Lake basin in Venezuela.

Submitted by **EDWIN E. INFANTE R**, Museo de Biología Universidad del Zulia, Apartado Postal 526, Maracaibo 4011, Venezuela (e-mail: edwinfante@gmail.com); **FERNANDO J. M. ROJAS-RUNJAIC**, Museo de Historia Natural La Salle, Sección de Herpetología, Apartado Postal 1930, Caracas 1010-A, Venezuela (e-mail: fernando.rojas@fundacionlasalle.org.ve); and **CÉSAR L. BARRIO-AMORÓS,** Fundación Andígena, Apartado 210, Mérida 5101-A, Venezuela (e-mail: cesarlba@yahoo.com).

SCAPHIOPUS COUCHII (Couch's Spadefoot). USA: COLORADO: Las Animas Co.: Live on Colorado Highway 109 during cold rain (4.25 km W, 0.25 km N Lone Mesa; NAD27, UTM Zone 13, Easting 646887, Northing 4164548). 10 June 2005. L. J. Livo. Photographic print assigned UCM Ancillary Collection #155. Verified by H. M. Smith. First record for county and southernmost record in Colorado, further expanding the known range in the state (Hammerson 1999. Amphibians and Reptiles in Colorado, 2nd Ed. University Press of Colorado, Niwot, Colorado).

Submitted by **LAUREN J. LIVO**, Department of Integrative Physiology, University of Colorado, Boulder, Colorado 80309-0354, USA.

SCINAX BERTHAE (Dwarf-snouted Treefrog). ARGENTINA: BUENOS AIRES: Partido de Magdalena: Atalaya's Beach, 500 m W of Río de La Plata shore line (35°01'54"S, 57°29'59"W). 8 February 2000. R. Cajade, L. Alcalde, and G. S. Natale. Museo de La Plata, Buenos Aires, Argentina (MLP 1817–1820, four adult males). Partido de Punta Indio: Punta Indio's Beach, 200 m W of Río de La Plata shore line (35°16'37"S, 57°13'03"W). 27 December 2002. L. Alcalde, G. S. Natale, and D. P. Ferraro. Museo de La Plata, Buenos Aires, Argentina (MLP 3491–3492, 3497–3498, four adult males). Verified by Nestor G. Basso. *Scinax berthae* was recorded for southern Paraguay, Uruguay, southern Brazil, and northeastern Argentina (Braun and Braun 1975. Iheringia zool. 46:19 – 24; Kehr 1983. Neotropica 29[81]:43–44; Langone and Prigioni 1988. Bol. Soc. Zool. Uruguay (2 da época) 4:1–4; Lopez et al. 1999. Cuad. Herpetol. 13[1–2]:105–106; Waller and Beccaceci 2000. Cuad. Herpetol. 14[1]:75). The southernmost known locality is the type locality: Punta Lara, Buenos Aires province, Argentina (Barrio 1964. Copeia 1964[3]:583–585). However, Straneck et al. (1993. Catálogo de Voces de Anfibios Argentinos. Tomo I. L.O.L.A.:1–130) shows a map indicating that the southernmost locality of *Scinax berthae* is Bahia de Sanborombón, ca. 150 km airline S from Punta Lara, but there are no vouchers supporting this location. These records represent the southernmost locations for *Scinax berthae* supported by voucher specimens and extend the range of the species ca. 100 km airline S from Punta Lara.

Submitted by **RODRIGO CAJADE** and **GUILLERMO S. NATALE**, Centro de Investigaciones del Medio Ambiente, Departamento de Química, Facultad de Ciencias Exactas, UNLP, 47 y 115 (CP 1900), La Plata , Bs. As., Argentina; and **LEANDRO ALCALDE**, Instituto de Limnología "Dr Raúl A. Ringuelet," CC 712 (CP 1900), La Plata, Buenos Aires, Argentina.

SCINAX CONSTRICTUS (NCN). BRAZIL: MATO GROSSO DO SUL: Municipality of Corumbá (19°15'S, 57°22'W, 96 m elev.). 26–30 July 2005. R. R. Carvalho-Jr, C. A. B. Galdino, and R. W. Ávila. Coleção Zoológica de Referência, Laboratório de Zoologia, *Campus* of Corumbá, Universidade Federal de Mato Grosso do Sul, Corumbá, Mato Grosso do Sul, Brazil (CEUCH 3622). Verified by L. P. Lima. The species was recently described from the state of Goiás, Brazil, in just nine localities (Lima et al. 2004. Arq. Mus. Nac. 62[4]:505). First state record extends known distribution ca. 795 km airline SW from municipality of Jussara, state of Goiás (Lima et al., *op.cit.*)

Submitted by **RONALD REZENDE DE CARVALHO JÚNIOR**, Pontifícia Universidade Católica de Minas Gerais, Museu de Ciências Naturais, Av. Dom José Gaspar 290, Coração Eucarístico, 30536-610, Belo Horizonte, MG, Brazil (e-mail: rcjunior.bh@terra.com.br); **CONRADO ALEKSANDER BARBOSA GALDINO** (e-mail: galdinoc@terra.com.br), **RÓBSON WALDEMAR ÁVILA** (e-mail: robsonavila@gmail.com), Departamento de Ciências do Ambiente, Laboratório de Zoologia, Campus de Corumbá, Universidade Federal de Mato Grosso do Sul. Av. Rio Branco, 1270, Caixa Postal 252. CEP 79301-970, Corumbá, MS, Brazil.

SCINAX CURICICA (Lanceback Treefrog). BRAZIL: MINAS GERAIS: Municipalidade de Ouro Preto (17°24'36"S, 41°10'47"W, 400 m elev.). October 2002. R. Caldeira Costa. Laboratório de Zoologia dos Vertebrados, Universidade Federal de Ouro Preto, Ouro Preto, Minas Gerais, Brazil (LZV 394). Verified by L. B. Nascimento. Previously known only from the type locality in the mountains of Serra do Cipó (19°15'S, 42°29'W, 1314 m elev.), Municipalidade of Santana do Riacho, Minas Gerais (Pugliese et al. 2004. Zootaxa 688 (2004):1–15). Present record extends known distribution ca. 323 km NE from the type locality and establishes a new minimum elevation at which the species is found.

Submited by **DÉLIO BAETA, ANA CAROLINA CALIJORNE LOURENÇO,** and **MARIA RITA SILVÉRIO PIRES**, Laboratório de Zoologia dos Vertebrados, Universidade Federal de Ouro Preto, 35400-000, Ouro Preto, Minas Gerais, MG, Brazil (e-mail: scaldarum@gmail.com).

SCINAX FUSCOVARIUS (Snouted Treefrog). ARGENTINA: CATAMARCA: El Alto Departament: Rosario de Abajo (ca.

28°37'S, 65° 25'W), 500–750 m elev. 5 February 2004. D. Baldo and S. D. Rosset. Verified by G. R. Carrizo. Herpetological collection Museo de La Plata, La Plata, Buenos Aires, Argentina (MLP-DB 2666–2667). Male and female in amplexus, found in the bank of a small stream at Sierra de Ancasti. Species previously known from Corrientes, Chaco, Entre Ríos, Formosa, Jujuy, Misiones, Salta, Santiago del Estero, Santa Fe, and Tucumán (Lavilla et al. 2000. *In* Lavilla et al. [eds.], Categorización de los Anfibios y Reptiles de la República Argentina, pp. 11–34. Edición Especial Asociación Herpetológica Argentina, Tucumán, 97 pp.). First province record, extends the species range ca. 80 km S from Tucumán (Lavilla et al., *op. cit.*).

Submitted by **DIEGO BALDO**, Laboratorio de Genética Evolutiva y Molecular, Departamento de Genética, Facultad de Ciencias Exactas, Químicas y Naturales, Universidad Nacional de Misiones, Félix de Azara 1552, 3300 Posadas, Misiones, Argentina; and **SERGIO D. ROSSET**, Instituto de Limnología "Dr. Raúl A. Ringuelet" cc 712, 1900 La Plata, Buenos Aires, Argentina.

GYMNOPHIONA

CAECILIA GRACILIS. BRAZIL: MARANHÃO: Urbano Santos Municipality (ca. 40 m elev.): Fazenda Santo Amaro (3°12'28"S, 43°24'12"W) 6 and 12 March 2004. J. A. M. dos Santos. Museu de Zoologia da Universidade Federal da Bahia, Salvador, Bahia (MZUFBA 6010–6014 captured by digging in soil in a gallery forest). Verified by M. S. Hoogmoed. The previously known distribution was restricted to Surinam, French Guiana, northeastern Peru, and Pará state in the northern region of Brazil (Nussbaum and Hoogmoed 1979. Zoologische Mededelingen 54[14]:217–235). This new state record, extends range ca. 550 km eastward from Acará in Pará state. The occurrence of *Caecilia gracilis* in a gallery forest in Urbano Santos expands the distribution of this species to the Cerrado domain.

Submitted by **ADRIANO OLIVEIRA MACIEL** (e-mail: aombiologo@yahoo.com.br), **JERRIANE OLIVEIRA GOMES** (e-mail: jerrianegomes@yahoo.com.br), **JOÃO CARLOS LOPES COSTA** (e-mail: joaoclcosta@yahoo.com.br), and **GILDA V. ANDRADE** Universidade Federal do Maranhão, Departamento de Biologia, Campus do Bacanga, CEP 65080-040, São Luís, Maranhão, Brazil; e-mail: gandrade@ufma.br.

TESTUDINES

APALONE SPINIFERA (Spiny Softshell). USA: ILLINOIS: Pike Co.: found on bank of the Mississippi River in Pool 22 at approximate river mile 316 (39.49199°N and 091.06004°W, NAD83 map datum). 22 September 2004. James T. Lamer. INHS 19662. Verified by Chris Phillips, INHS. Turtle found dead of unknown causes on bank. Specimen is first county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, 300 pp.).

Submitted by **JAMES T. LAMER** and **JOHN K. TUCKER,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

APALONE SPINIFERA (Spiny Softshell). USA: ILLINOIS: Sangamon Co.: Softshell was live-trapped in Lake Springfield using a baited Legler-style hoop trap baited with fish carcasses. N 0270173 and W 4398154 using NAD27 CONUS map datum in UTM's. 21 August 2005. Specimen collected by Chad R. Dolan and James T. Lamer. Turtle is a large female: carapace length = 468 mm, carapace width = 346 mm, carapace height = 108 mm, plastron length = 322 mm, and mass = 8700 g. Turtle was photographed by James T. Lamer and John K. Tucker and then released back into Lake Springfield. INHS Herpetological Photograph 2005.23. Verified by Chris Phillips, Illinois Natural History Survey. First county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, 300 pp.).

Submitted by **JAMES T. LAMER, CHAD R. DOLAN,** and **JOHN K. TUCKER,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

CHELYDRA SERPENTINA (Snapping Turtle). USA: ILLINOIS: Christian Co.: Snapping turtle was live-trapped off of 1400 E Rd on Lake Taylorville using a baited Legler-style hoop trap. N 0305352 and W 4372318 using NAD27 CONUS map datum in UTM's. 20 August 2005. Specimen collected by James T. Lamer and Chad R. Dolan. INHS 19660. Verified by Chris Phillips, Illinois Natural History Survey. Specimen is a first county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, 300 pp.).

Submitted by **JAMES T. LAMER, CHAD R. DOLAN,** and **JOHN K. TUCKER,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

CHELYDRA SERPENTINA (Snapping Turtle). USA: ILLINOIS: Montgomery Co.: Snapping turtle was live-trapped in a cove of Lake Lou Yaeger using a baited Legler-style hoop trap baited with fish carcasses. GPS coordinates are as follows: N 0271409 and W 4339665 using NAD27 CONUS map datum in UTM's. 21 August 2005. Specimen collected by Chad R. Dolan and James T. Lamer. INHS 19659. Verified by Chris Phillips, Illinois Natural History Survey. Specimen is a first county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, 300 pp.).

Submitted by **JAMES T. LAMER, CHAD R. DOLAN,** and **JOHN K. TUCKER,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

CHELYDRA SERPENTINA (Snapping Turtle). USA: TEXAS: Jack Co.: (33.409°N, 98.197°W, 278 m elev.), DOR on St. Route 59. 17 June 2005. Jesse M. Meik and A. Michelle Lawing. Verified by Carl J. Franklin. University of Texas at Arlington Collection of Vertebrates (UTA R-53461). First county record (Dixon 2000. Amphibians and Reptiles of Texas. 2nd Edition. Texas A&M Univ. Press, College Station).

Submitted by **JESSE M. MEIK** and **A. MICHELLE LAWING**, Department of Biology, The University of Texas at Arlington, Arlington, Texas 76012, USA; e-mail: jmeik@uta.edu.

CHRYSEMYS PICTA (Painted Turtle). USA: ILLINOIS: Christian Co.. Turtle was live-trapped off of 1400 E Rd on Lake Taylorville between 800 N and 900 N Rd using a baited Legler-

style hoop trap. N 0305332 and W 4372345 using NAD27 CONUS map datum in UTM's. 20 August 2005. Specimen collected by James T. Lamer and Chad R. Dolan. INHS 19661. Verified by Chris Phillips, Illinois Natural History Survey. First county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, 300 pp.).

Submitted by **CHAD R. DOLAN, JAMES T. LAMER,** and **JOHN K. TUCKER,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

GRAPTEMYS OUACHITENSIS (Ouachita Map Turtle). USA: MISSOURI: Marion Co.. Turtle was caught alive via dip net after being stunned while electrofishing off of the bank of the Mississippi River at approximate river mile 323. 39.87130°N, 091.45054°W (NAD83). 30 August 2005. Collected by Chad R. Dolan and James T. Lamer. UMC 848P. Verified by Richard Daniel, Universtiy of Missouri-Columbia and Jeff Briggler, Missouri Department of Conservation. First county record (Johnson 2000. The Amphibians and Reptiles of Missouri, 2nd ed. Missouri Dept. of Conservation, Jefferson City). The turtle collected was male: carapace length = 96 mm, carapace width = 76 mm, carapace height = 33 mm, plastron length = 80 mm, and mass = 110 g.

Submitted by **CHAD R. DOLAN, JAMES T. LAMER, JOHN K. TUCKER,** and **ERIC J. GITTINGER,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

LEPIDOCHELYS OLIVACEA (Olive Ridley Seaturtle). Western North Atlantic Ocean: (43°11.0'N, 53°53.1'W). 22 October 2003. National Marine Fisheries Pelagic Longline Observer, David Sheuerman. Verified by Peter Dutton of the NMFS Marine Turtle Molecular Ecology Laboratory using mtDNA control region sequencing (Dutton et al. 1999. J. Zool., London 248:397–409). Biopsy tissue sample deposited at the National Marine Fisheries Service / Southwest Fisheries Science Center's Marine Turtle Molecular Ecology Laboratory, La Jolla, California (Reference ID: Z35983), and photographs deposited at the University of Florida (UF 145103). This is the northernmost record of this species in the western North Atlantic. *L. olivacea* is rare in the western North Atlantic outside the tropics. It was previously reported in waters surrounding southern Florida (Foley et al. 2003. Marine Turtle Newsl. 101:23–25), the Caribbean (Carr et al. 1982. Surveys of Sea Turtle Populations and Habitats in the western Atlantic. NOAA Tech. Memo. NMFS-SEFSC-91: 98 pp.), and more commonly along the northern coast of South America (Marcovaldi 2001. *In* Eckert and Abreu Grobois [eds.], Proceedings of the Regional Meeting: Marine Turtle Conservation in the Wider Caribbean Region: a Dialogue for Effective Regional Management. Santo Domingo, Dominican Republic, 16–18 November 1999, pp. 52–56. WIDECAST, IUCN-MTSG, WWF, and UNEP-CEP). This subadult Olive Ridley was incidentally captured during a pelagic longline fishery interaction. It measured 53.3 cm standard straight carapace length, and had inframarginal pores and 6 left and 7 right costal scutes. The specimen was released alive back into the wild (US federally-listed species) after the 9/0 J-hook was removed from its mouth.

Submitted by **LESLEY W. STOKES**, Cooperative Institute of Marine and Atmospheric Sciences, a Joint Institute of the University of Miami and NOAA Fisheries, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, Florida 33149, USA (e-mail: Lesley.Stokes@noaa.gov); and **SHERYAN P. EPPERLY**, National Marine Fisheries Service, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, Florida 33149, USA (e-mail: Sheryan.Epperly@noaa.gov).

TERRAPENE CAROLINA TRIUNGUIS (Three-toed Box Turtle). USA: ARKANSAS: Cleveland Co.: 4.8 km N of Rison, Arkansas on U.S. Hwy. 79 (Sec. 23, T8S, R10W). 13 November 2005. H. W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection photograph (ASUMZ 29518). Verified by Stanley E.Trauth. New county record in southwestern Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville, 421 pp.).

Submitted by **HENRY W. ROBISON**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA; e-mail: hwrobison@saumag.edu.

TRACHEMYS SCRIPTA ELEGANS (Red-eared Slider). USA: ILLINOIS: Christian Co.. Turtle was live-trapped off of 1400 E Rd on Lake Taylorville between 800 N and 900 N Rd using a baited Legler-style hoop trap. N 0305332 and W 4372345 using NAD27 CONUS map datum in UTM's. 20 August 2005. Specimen collected by James T. Lamer and Chad R. Dolan. INHS 19663. Verified by Chris Phillips, Illinois Natural History Survey. Specimen is a first county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, 300 pp.).

Submitted by **CHAD R. DOLAN, JAMES T. LAMER,** and **JOHN K. TUCKER,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

LACERTILIA

ANOLIS PUNCTATUS (Lagartixa Verde da Amazônia; Amazon Green Anole). BRAZIL: MINAS GERAIS: Municipalidade de Caratinga: Reserva Particular do Patrimônio Natural Feliciano Miguel Abdala (19°43'53"S, 41°49'00"W). 03 August 2000. J. Cassimiro. Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil (MZUSP 95077). Verified by M. T. Rodrigues. Formerly recognized as an Amazonian species, occurring probably in French Guiana and Suriname, parts of Guyana, Venezuela (questionable), Colombia, Ecuador, Peru, Bolivia, and Brazil (Peters and Donoso-Barros 1970. Bull. U.S. Natl. Mus. 297:1–293). In Brazil the species is found in most of Amazonia (Amapá, Maranhão, Pará, Amazonas, Rondônia, Acre; doubtfully Roraima), and in the Atlantic Forest (Avila-Pires 1995. Zool. Verh. Leiden 299:1–706). In the Atlantic Forest, the southernmost limit is Beach of Boracéia, state of São Paulo (Vanzolini 1972. Pap. Avulsos Zool., S. Paulo 26:83–115). However, there are few literature records giving accurate Brazilian localities. This first state record extends the known distribution ca. 185 km airline W from the closest known locality in Linhares, state of Espírito Santo (Rocha 1998. Anais do VIII Seminário Regional de Ecologia:869–881).

Submitted by **JOSÉ CASSIMIRO,** Departamento de Zoologia, Instituto de Biociências, Universidade de São Paulo, Caixa Postal 11.461, CEP 05422-970, São Paulo, SP, Brazil (e-mail: geckoides@yahoo.com.br); **VINÍCIUS XAVIER,** Universidade

Federal de Alfenas, Rua Gabriel Monteiro da Silva, 714, CEP 37130-000, Alfenas, MG, Brazil (e-mail: vinic@int.efoa.br); and **JAIME BERTOLUCI,** Departamento de Ciências Biológicas, Escola Superior de Agricultura "Luiz de Queiroz," Universidade de São Paulo, Av. Pádua Dias, 11, CEP 13418-900, Piracicaba, SP, Brazil (e-mail: bertoluc@esalq.usp.br).

BACHIA HETEROPA LINEATA (Worm Lizard). VENEZUELA: TRUJILLO: Municipio Pampanito, Urbanización "El Prado" (9°25'N, 70°27'W), 480 m elev. 20 November 2002. C. Cuevas. Museo de Biología de La Universidad del Zulia, Maracaibo (MBLUZ-R-0763). ZULIA: Municipio Jesús María Semprún, Casigua-El Cubo (8°45'N, 72°30'W). 12 August 1965. R. Hernández. Museo de Historia Natural La Salle, Caracas (MHNS-2497). Both verified by Gilson Rivas Fuenmayor. The distribution of this subspecies is restricted to Venezuela (Dixon 1973. Univ. Kansas Mus. Nat. Hist., Misc. Publ. 57:1–47). Previously known from the Capital District, Falcón, Yaracuy, and Portuguesa states (Dixon, *op. cit.*; Donoso-Barros 1968. Carib. J. Sci. 8[3–4]:105–122; Esqueda et al. 2001. Herpetol. Rev. 32:198–200; Markezich 2002. Herpetol. Rev. 33:69–74; Mijares and Arends 1999. Herpetol. Rev. 30:115). The specimens reported herein are the first records for these two states and establish the species in the Maracaibo Lake Basin. One specimen (MHNS-2497) extends the distribution ca. 210 km W (airline) from the nearest locality account (Markezich, *op. cit.*).

Submitted by **FERNANDO J. M. ROJAS-RUNJAIC**, Museo de Historia Natural La Salle, Sección de Herpetología, Apartado Postal 1930, Caracas 1010-A, Venezuela (e-mail: fernando.rojas@fundacionlasalle.org.ve); and **EDWIN E. INFANTE RIVERO,** La Universidad del Zulia, Facultad Experimental de Ciencias, Museo de Biología de La Universidad del Zulia, Sección de Herpetología, Apartado Postal 526, Maracaibo 4011, Venezuela (e-mail: edwinfantembluz@hotmail.com).

COLEODACTYLUS SEPTENTRIONALIS (Pygmy Gecko). VENEZUELA: ANZOATEGUI: San Diego de Cabruta, ca. 50 m elev. (10°06'55"N, 64°38'18"W). December 2003. Erik Arrieta. Museo de Historia Natural La Salle, Caracas (MHNLS 17084). Verified by César L. Barrio-Amorós. This tiny gecko has been previously reported from the northern part of Roraima (Brazil), western Suriname, the Pacaraima foothills (Guyana), and the Venezuelan Guiana. In this last country it is known from a few localities in the states of Delta Amacuro, Bolívar, and Monagas. First state record and the northwesternmost locality known, extending the distribution 273 km NW of the nearest locality in the Morichal del Río Uracoa, Monagas state (Ávila-Pires 1995. Zool. Verhand., Leiden 299:1–706; Rivas and Molina 2001. Herpetol. Rev. 32:275).

Submitted by **GILSON A. RIVAS F.** (e-mail: gilson.rivas@fundacionlasalle.org.ve), and **FERNANDO J. M. ROJAS-RUNJAIC,** Museo de Historia Natural La Salle, Sección de Herpetología, Apartado Postal 1930, Caracas 1010-A, Venezuela (e-mail: fernando.rojas@fundacionlasalle.org.ve).

EUMECES TETRAGRAMMUS BREVILINEATUS (Short-lined Skink). USA: TEXAS: STERLING CO.: 16.1 km E Sterling City off St. Hwy. 163. 8 April 2001. J. A. Holm and K. Perez. Angelo State University Natural History Collection (ASNHC 13555). Verified by J. K. McCoy. New county record partially filling a distributional gap among Coke, Irion, and Tom Green counties (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M University Press, College Station, Texas. 421 pp.).

Submitted by **CHRIS T. McALLISTER**, Department of Biology, Angelo State University, San Angelo, Texas 76909, USA (e-mail: chris.mcallister@angelo.edu); and **JAMES A. HOLM**, 201 S. Heights Blvd., Apt 2913, Houston, Texas 77007, USA (e-mail: jaz_holm@hotmail.com).

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). USA: NEVADA: CLARK CO.: Mesquite (36°48'49"N, 114°04'02"W). 26 May 2005. On grounds of Virgin River Casino on the north side of Interstate 15. Three individuals deposited at Arizona State University Museum (ASU 35720–35722). Verified by A. T. Holycross. Previously known in Nevada only from Las Vegas (Saethre and Medica 1993. Herpetol. Rev. 24:154–155; A. Heindl [UNLV Museum], pers. comm.). These specimens extend the range in Nevada ca. 130 km to the NE. *H. turcicus* appears to be spreading in human-occupied area along the Interstate 15 corridor via purposeful or accidental releases.

Submitted by **ROBERT N. REED, LESTER J. TRENKAMP, BROOK E. COX**, and **SELENA M. SORENSEN,** Department of Biology, Southern Utah University, Cedar City, Utah 84720, USA; e-mail: reed@suu.edu.

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). USA: UTAH: WASHINGTON CO.: St. George. 8 October 2005. Gecko was found in the Dixie Downs region of city of St. George, in a suburban backyard. One specimen deposited at Monte L. Bean Museum, Brigham Young University (BYU 5096). Verified by J. Sites. New state record. This specimen extends the range of *H. turcicus* ca. 65 km to the NE; the closest previously known population is in Mesquite, Nevada (Reed et. al. 2006. Herpetol. Rev. 37:106) *H. turcicus* appears to be spreading in human-occupied areas along the Interstate 15 corridor via purposeful or accidental releases. However, St. George and its environs are likely the northernmost limit of the species' advance along I-15, as the interstate rises to ~1800 m elevation soon after heading north from St. George.

Submitted by **ROBERT N. REED, EDWARD SNOW, LESTER J. TRENKAMP, BROOK E. COX,** and **SELENA M. SORENSEN**, Department of Biology, Southern Utah University, Cedar City, Utah 84720, USA; e-mail: reed@suu.edu.

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). USA: VIRGINIA: RICHMOND CO.: 3500 Pemberton Rd., Richmond (N 41.71074 17; W 80.3198, NAD1927), 5 August 2005. Verified by Raymond Fernald, Virginia Department of Game and Inland Fisheries. (KU-CT 958 photo voucher, University of Kansas). Populations of Mediterranean House Geckos have become established in many places in the southern United States (NatureServe 2005. NatureServe Explorer: An Online Encyclopedia of Life [web application]. Version 4.5. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer). Seven individuals, two neonates and five adults, were removed from a building in Richmond, Virginia. One female deposited two eggs shortly after capture. This is the northernmost reproducing population of *H. turcicus*

in the eastern United States (NatureServe, *op. cit.*) and the first such record for Virginia (Mitchell 1994. The Reptiles of Virginia. Smithsonian Inst. Press, viii + 352 pp.; Mitchell and Reay 1999. Spec. Publ. No. 1, Virginia Dept. of Game and Inland Fisheries, Richmond). This population might be able to overwinter successfully because it occupies a building that maintains suitable environmental conditions year-round.

Submitted by **JOHN D. KLEOPFER**, Virginia Department of Game and Inland Fisheries, 5806 Mooretown Rd., Williamsburg, Virginia 23188, USA (e-mail: john.kleopfer@dgif.virginia.gov); **SUSAN H. WATSON,** Virginia Department of Game and Inland Fisheries, 4010 West Broad St., Richmond, Virginia 23230, USA (e-mail: susan.watson@dgif.virginia.gov); and **JOSEPH C. MITCHELL**, Department of Biology, University of Richmond, Richmond, Virginia 23173, USA (e-mail: jmitchel@richmond.edu).

LIOLAEMUS DONOSOBARROSI. ARGENTINA: MENDOZA PROVINCE: San Rafael Departament: Surroundings of Lake El Nihuil. 15 February 1982. A. Malbec. Museo de Historia Natural de San Rafael, San Rafael, Mendoza, Argentina (MSR-H 1183: adult female, 56.11 mm SVL and MSR-H 1184: adult male, 56.64 mm SVL). Verified by F. Lobo. Previously known from Matancilla and Agua del Toro, Malargüe Department, Mendoza Province (Cei and Roig 1976. Deserta 4:69–91), and Cerro Bandera, Departamento Zapala, Neuquén Province (Avila 1996. Cuad. Herpetol. 9[2]:109–110). The present record extends the northeastern range 190 km from Agua del Toro (Cei and Roig, *op. cit.*).

Submitted by **CRISTIAN ABDALA**, Instituto de Herpetología de la Fundación Miguel Lillo, Miguel Lillo 251, 4000, Tucumán, Argentina (e-mail: popper@tucbbs.com.ar); and **RICARDO JUAREZ**, Departamento de Zoología, Museo de Historia Natural de San Rafael, Parque Mariano Moreno, 5600, San Rafael, Mendoza, Argentina (e-mail: ricardoj73@hotmail.com).

LIOLAEMUS LOBOI. ARGENTINA: NEUQUÉN: Departamento Huiliches: Vicinity of San Ignacio, San Ignacio, 39º54'S 70º51'W. 14 March 1961. L. E. Pena. Field Museum of Natural History, Chicago (FMNH 133128, 133131, 133746, 133752, 133755, 133760). Verified by S. Quinteros. Extends the range 145 km NE from the only previously known locality: Neuquén Province, Los Lagos Department, intersection between national route 237 and national route 231 (type locality, Abdala 2003. Cuad. Herpetol. 17[1–2]:3–32).

Submitted by **CRISTIAN ABDALA**, Instituto de Herpetología de la Fundación Miguel Lillo, Miguel Lillo 251, 4000, Tucumán, Argentina (e-mail: popper@tucbbs.com.ar); and **FERNANDO LOBO**, CONICET -Cátedra de Anatomía Comparada, Facultad de Ciencias Naturales, Universidad Nacional de Salta, Bolivia 5150, 4400, Salta, Argentina (e-mail: flobo@unsa.edu.ar).

LUPEROSAURUS BROWNI (Brown's Flap-legged Gecko). SINGAPORE: Pulau [= island] Tekong, Batu Koyok area (1°24'N, 104°02'E). In scrub vegetation near secondary rainforest; observed about 1 m off the ground, clinging in a horizontal position to the stem of an unidentified herbaceous climbing plant, and occurring syntopically with the house geckos *Hemidactylus frenatus* and *Gekko monarchus*. 4 August 2005 at ca. 2200 h. Kelvin K. P. Lim and Norman T-L. Lim. Raffles Museum of Biodiversity Research Zoological Reference Collection (ZRC 2.6140, adult male, SVL 58.9 mm, tail incomplete: regenerated). Verified by Indraneil Das. New country record (Lim and Lim 1992. A Guide to the Amphibians and Reptiles of Singapore, Singapore Science Centre, 160 pp.); second record for the Malay Peninsula (Brown et al. 2000. Copeia 2000:191–209; Das 2004. Lizards of Borneo, Natural History Publications [Borneo], p. 49).

Submitted by **KELVIN K. P. LIM** and **NORMAN T-L. LIM**, Department of Biological Sciences, National University of Singapore, Singapore 119260.

PSEUDOGONATODES MANESSI (Pygmy Gecko). VENEZUELA: SUCRE: trail between Macuro and Cerro Azul, Península de Paria, ca. 700 m elev. (10°41'33"N, 61°57'47"W). 19 July 2002. G. Rivas and C. L. Barrio-Amorós. Museo de Historia Natural La Salle, Caracas (MHNLS 16202). Verified by W. Schargel. *P. manessi* is an endemic species from Venezuela, known previously from two relatively close localities in the Central Coastal Range (Ávila-Pires and Hoogmoed 2000. Zool. Meded., Leiden 73[12]:209–223). First state record, extends the known distribution 526 km E from Los Canales de Naiguatá, Vargas state (Ávila-Pires and Hoogmoed, *op. cit.*).

Submitted by **GILSON A. RIVAS F.** (e-mail: gilson.rivas@fundacionlasalle.org.ve), **FERNANDO J. M. ROJAS-RUNJAIC** (e-mail: fernando.rojas@fundacionlasalle.org.ve), Museo de Historia Natural La Salle, Sección de Herpetología, Apartado Postal 1930, Caracas 1010-A, Venezuela; and **CÉSAR L. BARRIO-AMORÓS,** Fundación Andígena, Apartado 210, Mérida 5101-A, Venezuela (e-mail cesarlba@yahoo.com).

SCELOPORUS UNDULATUS CONSOBRINUS (Southern Prairie Lizard). USA: MISSOURI: Scott Co.: 6.5 km S Chaffee on State Hwy 77, 800 m E on Bluebird Lane (37°07.414'N, 89°40.259'W). 21 September 2005. Alex B. Heeb and Jacob D. Heeb. Verified by John S. Scheibe, Department of Biology, Southeast Missouri State University. Photographs deposited in Southeast Missouri State University Natural History Museum (SEMO-15105). One young animal (total length = 67.4 mm) was found on a W-facing concrete porch, surrounded by a clearing of 100 m within a hardwood deciduous forest. New county record (Daniel and Edmond 2005. Atlas of Missouri Amphibians and Reptiles. 68 pp.).

Submitted by **ALEX B. HEEB**, 159 Bluebird Lane, Chaffee, Missouri 63740, USA.

SERPENTES

AGKISTRODON CONTORTRIX (Copperhead). USA: ILLINOIS: St. Clair Co.: Sugar Loaf Township (38°27.947'N, 90°09.250'W). 29 June 2004. Robert Weck. Verified by Chris Phillips. Illinois Natural History Survey (INHS 19540). Adult found DOR on Stemler Road. New locality record and first voucher specimen for St. Clair Co. (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, 300 pp.).

Submitted by **ROBERT WECK**, Department of Biology, Southwestern Illinois College, 2500 Carlyle Avenue, Belleville, Illinois,

62221, USA; e-mail: bob.weck@swic.edu.

ATRACTUS LATIFRONS. BOLIVIA: DEPTO. SANTA CRUZ: GUARAYOS: Río Negrillo: 62°46'W, 15°05'S, 300 m elev. 30 October 2002. R. Montaño. Museo Historia Natural Noel Kempff Mercado, Santa Cruz de la Sierra (MNKR 3438–3439). Río NEGRO: 62°36.7'W, 14°59.5'S, 300 m elev. 28 October 2002. R. Montaño. MNKR 3436-3437. Campamento Río San Martín: 61°56'W, 15°03'S, 250 m elev. November 1992. D. Rumiz. MNKR 505. Verified by P. Passos. First country records, species previously known from Brazil, Peru, Colombia, French Guiana (Uetz 2005. http://www.reptile-database.org). Present records extend known distribution 432 km S from Nova Brasil in Brazil (Vanzolini 1986. Levantamento Herpetologico da Área do Estado de Rondônia sob a Influencia da Rodovia BR 364: Relatorio de Pesquisa, Rio de Janeiro 1:1–50). Vanzolini does not mention specimens but according to Carolina Mello (MZUSP, pers. comm.) it should be museum specimen MZUSP 8519 from Ribeirão Riachuelo.

Submitted by **DIRK EMBERT**, Zoologisches Forschungsinstitut und Museum Alexander Koenig, Adenauerallee 150-164, 53113 Bonn, Germany (e-mail: dirkembert@hotmail.com); **LUCINDO GONZALES** (e-mail: bichos10@hotmail.com) and **ROSSY MONTAÑO** (e-mail: rovina7@yahoo.com), Museo Historia Natural Noel Kempff Mercado, Avenida Irala 565, Santa Cruz de la Sierra, Bolivia.

CROTALUS HORRIDUS (Timber Rattlesnake). USA: ARKANSAS: NEVADA CO.: 11.2 km N of Willisville (Sec. 15, T14S, R20W). 3 September 2005. Daniel Allen. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 29447). Verified by Stanley E.Trauth. New county record in southern Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

Submitted by **DANIEL ALLEN** and **HENRY W. ROBISON**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA (e-mail: hwrobison@saumag.edu).

DIPSAS INDICA PETERSI (Dormideira). BRAZIL: RIO GRANDE DO SUL: Municipalidade de Dom Pedro de Alcântara (29°22'S, 49°50'W). 2004. G. Justo. Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil (MCP 15584). Verified by M. Borges-Martins. This subspecies is known from the Atlantic slopes of the coastal ranges of southeastern Brazil, from the State of Bahia to Santa Catarina (Hoge and Romano 1975. Mem. Inst. Butantan 39:51–60; Porto and Carcerelli 1992. XII Congr. Latinoam. e XIX Congr. Bras. de Zool. p.123; Alves and Argôlo 1998. Herpetol. Rev. 29:176). First state record, extends southern range 350 km airline from the Municipalidade de Joinville, Santa Catarina State (map plot, without voucher specimen, in Hoge and Romano 1975. *op. cit.*, and Instituto Butantan, São Paulo, Brazil [IB 41118], R. Fernandes, pers. comm.).

Submitted by **LEANDRO MONTECHIARO** (e-mail: lemontechi@terra.com.br), **ROBERTO BAPTISTA DE OLIVEIRA** (e-mail: rbolivei@pucrs.br), **GLÁUCIA MARIA FUNK PONTES** (e-mail: glaufp@pucrs.br), and **MARCOS DI-BERNARDO** (e-mail: madibe@pucrs.br), Laboratório de Herpetologia, Faculdade de Biociências and Museu de Ciências e Tecnologia of the Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), Av. Ipiranga, 6681, 90619-900, Porto Alegre, Rio Grande do Sul, Brazil.

DIPSAS PRATTI (Pratt's Snail-eater). COLOMBIA: SANTANDER: Bucaramanga: km 18 road to Pamplona, 1600 m elev. January 2003. R. Caicedo. Colección de Reptiles Museo de Historia Natural de la Escuela de Biología Universidad Industrial de Santander, Bucaramanga, Santander, Colombia (UIS-R 1302). Floridablanca: El Diviso, 2000 m elev. August 2003. Rancés Caicedo. UIS-R 938. Both verified by M. P. Ramirez. Tona: Vereda El Brasil, 1680 m elev. 20 and 23 June 2004. Rafael Moreno and John Jairo Mueses. Colección de reptiles Instituto de Ciencias Naturales-Universidad Nacional de Colombia, Bogotá D.C, Cundinamarca, Colombia (ICN 10423–424). Verified by O. V. Castaño. BOLIVAR: Santa Rosa del Sur: San Pedro Frío, 1600 m elev. 1 November 1996. W. Díaz. ICN 7957. Verified by O. V. Castaño. Colombian endemic species, known only from "Cordillera Central" (Pérez-Santos and Moreno 1988. Ofidios de Colombia. Monografía VI. Mus. Reg. Sci. Nat. Torino; Peters 1960. Univ. Michigan Mus. Zool. Misc. Publ. No. 114). New state records, extend known range to "Serranía de San Lucas" 245 km N and to "Cordillera Oriental" ca. 300 km NE from type locality, the nearest known locality (Peters, *op. cit.*)

Submitted by **RAFAEL MORENO-ARIAS**, Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Apartado Aéreo 55187, Bogotá D.C. Colombia (e-mail: rafamorearias@yahoo.es); **FABIAN MEDINA,** Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Apartado Aéreo 7495, Bogotá D.C. Colombia (e-mail: sortyacalo@hotmail.com); and **JOSÉ RANCÉS CAICEDO,** Grupo de Fauna Silvestre-Corporación Autónoma Regional para la defensa de la Meseta de Bucaramanga, Carrera 23 No 37-63, Bucaramanga, Colombia (e-mail: ranchocaicedo@yahoo.com).

ECHINANTHERA BILINEATA (Litter Snake). BRAZIL: PARANÁ: Municipalidade de Guarapuava, Parque Municipal "Araucarias" (25°21'S, 51°28'W, ca. 1073 m elev.). 17 November 2001. A. C. da Luz, Herpetological collection Museu de Ciências Naturais de Guarapuava, Guarapuava, Paraná (MCNG 047); 14 December 2001. J. M. Ribeiro (MCNG 054); 29 July 2002. A. C. da Luz (MCNG 170). Verified by E. J. Sanches. Species previously known from eastern areas of southern and southeastern Brazil, including the states of Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, Santa Catarina, and northeastern Rio Grande do Sul (Di-Bernardo and Lema 1991. Acta Biologica Leopoldensia 12[2]:359–392; Di-Bernardo 1992. Comun. Museu Ciências PUCRS, Série Zoologia 5[13]:225–256). First record from the third upland of Paraná state, extends known range ca. 180 km W from "Santa Cruz," the previous westernmost locality (Di-Bernardo and Lema, *op. cit.*).

Submitted by **CRISTIANE HIERT**, Museu de Ciências Naturais de Guarapuava, Universidade Estadual do Centro-Oeste, Caixa Postal 3010, 85010-990, Guarapuava, Paraná, Brazil; e-mail: chiert@unicentro.br.

FARANCIA ABACURA REINWARDTII (Western Mudsnake).

USA: TEXAS: RAINS CO.: Approximately 170 m W of Farm Road 2946 (1.25 km N of Jct 515). UTM (NAD 83) 15 S, 0250170 N, 3641841 W, 117 m elev. 22 October 2005. Robert C. Jadin and Jessica L. Coleman. University of Texas at Arlington – Amphibian and Reptile Diversity Research Center (UTA-R 53639). Verified by Ronald L. Gutberlet, Jr. Found dead in two incomplete pieces 20 m W of small cattle pond. New county record (Dixon 2000. Amphibians and Reptiles of Texas. 2nd Ed. Univ. of Texas A&M Press, viii+421 pp.).

Submitted by **ROBERT C. JADIN** (e-mail: snakeman1982@hotmail.com) and **JESSICA L. COLEMAN** (e-mail: jachooo@hotmail.com), University of Texas at Tyler, Department of Biology, 3900 University Blvd., Tyler, Texas 75799, USA.

GYALOPION QUADRANGULARE (Thornscrub Hook-nosed Snake). MÉXICO: CHIHUAHUA: Municipality of Chínipas, Chínipas (27°23'39.9"N, 108°32'9.7"W), 469 m elev. 7 August 2005. Julio Lemos-Espinal. Verified by Richard L. Holland. Herpetological Collection of Unidad de Biología, Tecnología y Prototipos (UBIPRO 14137). First record for Chihuahua extending its known range NE ca. 56 km from the vicinity of Álamos, municipality of Álamos, Sonora (Bogert and Oliver 1945. Bull. Am. Mus. Nat. Hist. 83:301–425).

Submitted by **HOBART M. SMITH**, Department of Ecology and Evolutionary Biology, University of Colorado, Boulder, Colorado 80309-0344, USA (e-mail: hsmith@colorado.edu); and **JULIO A. LEMOS-ESPINAL** (under CONABIO projects CE001 and CE002, with support from DGAPA-PASPA), Laboratorio de Ecología, UBIPRO, Facultad de Estudios Superiores Iztacala, UNAM, Av. de los Barrios 1, Los Reyes Iztacala, Tlalnepantla, edo. de México, 54090 México (e-mail: lemos@servidor.unam.mx).

HETERODON SIMUS (Southern Hog-nosed Snake). USA: FLORIDA: WALTON CO.: Eglin Air Force Base. Range Road 222, 0.8 km E of RR 214 (S 1/2 of SE 1/4 of NE 1/4 of NE 1/4 of Sec. 3, T1S, R21W). 10 November 2005. John G. Palis. SIUC R-4505. Verified by J. G. Stewart. DOR adult male adjacent to military testing range. First record for county, filling gap between Okaloosa and Holmes counties (Tuberville et al. 2000. J. Elisha Mitchell Sci. Soc. 116:19–40).

Submitted by **JOHN G. PALIS**, P.O. Box 387, Jonesboro, Illinois 62952, USA; e-mail: jpalis@yahoo.com.

IMANTODES GEMMISTRATUS LATISTRATUS (Red Blunt-headed Tree Snake). MÉXICO: CHIHUAHUA: Municipality of Chínipas, El Guamuchilito (27°23'21.9"N, 108°29'5.5"W), 510 m elev. 7 August 2005. Julio Lemos-Espinal. Verified by Richard L. Holland. Herpetological Collection of Unidad de Biología, Tecnología y Prototipos (UBIPRO 14134). First record for Chihuahua extending its known range NE ca. 55 km from the vicinity of Guirocoba, municipality of Álamos, Sonora (Bogert and Oliver 1945. Bull. Am. Mus. Nat. Hist. 83:301–425).

Submitted by **HOBART M. SMITH**, Department of Ecology and Evolutionary Biology, University of Colorado, Boulder, Colorado 80309-0344, USA (e-mail: hsmith@colorado.edu); and **JULIO A. LEMOS-ESPINAL** (under CONABIO projects CE001 and CE002, with support from DGAPA-PASPA), Laboratorio de Ecología, UBIPRO, Facultad de Estudios Superiores Iztacala, UNAM, Av. de los Barrios 1, Los Reyes Iztacala, Tlalnepantla, Edo. de México, 54090 México (e-mail: lemos@servidor.unam.mx).

OPHRYACUS UNDULATUS (Mexican Horned Pitviper). MÉXICO: GUERRERO: Municipio Tlacoapa, 0.7 km NW Cerro Verde (17°20.363'N, 98°50.124'W), 2501 m elev. 23 June 2005. Robert W. Bryson Jr. Verified by Luis Canseco Márquez. Instituto Tecnológico Agropecuario de Hidalgo herpetological collection (ITAH 1290). VERACRUZ: Municipio Xico, Xico Viejo, (19°26.992'N, 97 °03.440"W), 1752 m elev. 24 June 2004. Eric N. Smith, Ricardo Mendoza-Paz, Luis Canseco-Márquez, and Uri Omar García-Vázquez. Verified by Jonathan Campbell. UTA R-53008.

The Tlacoapa record fills in a distributional gap within the Sierra Madre del Sur near Omilteme, Guerrero, and Cerro San Felipe in Central Oaxaca (Campbell and Lamar 2004. Venomous Reptiles of the Western Hemisphere. Cornell Univ. Press, Ithaca, New York. 870 pp.). The snake was found at the base of a rocky outcrop in humid pine/oak forest. The Veracruz record fills in a distributional gap along the Sierra Madre Oriental between El Potrero, Hidalgo (Flores-Villela et al. 1992. Texas J. Sci. 44:249–250) and Orizaba, Veracruz (Campbell and Lamar 2004, *op. cit.*). This snake was found inside a grain shed on a cow pasture.

Submitted by **RICARDO FERNANDO MENDOZA-PAZ**, **FERNANDO MENDOZA-QUIJANO**, Instituto Tecnológico Agropecuario de Hidalgo, Km. 5.5 Carr. Huejutla-Chalahuiyapa, Apdo. Post. 94, C.P. 43000, Huejutla de Reyes, Hidalgo, Mexico; **ROBERT W. BRYSON, JR.**, Department of Biological Sciences, University of Nevada Las Vegas, Las Vegas, Nevada 89154, USA (e-mail: brysonjr@unlv.nevada.edu); and **ERIC N. SMITH**, Department of Biology, The University of Texas at Arlington, Arlington, Texas 76019, USA (e-mail: terrestre_3@hotmail.com.mx).

REGINA RIGIDA (Glossy Crayfish Snake). USA: GEORGIA: LOWNDES CO.: Moody Air Force Base. Burma Road at south end of runway. 24 February 2005. John G. Palis. SIUC R-4484. Verified by J. G. Stewart. DOR adult. First record for county (Williamson and Moulis 1994. Distribution of Amphibians and Reptiles in Georgia. Savannah Sci. Mus. Spec. Publ. No. 3, 712 pp.).

Submitted by **JOHN G. PALIS**, P.O. Box 387, Jonesboro, Illinois 62952, USA; e-mail: jpalis@yahoo.com.

STORERIA DEKAYI WRIGHTORUM (Midland Brown Snake). USA: MISSOURI: HOWELL CO.: Specimen found DOR on Hwy 60 West, ca. 0.5 km E of Willow Springs exit (36°55'N, 91°55'W). 21 August 2005. Eli Greenbaum. Verified by Edgar Lehr. KU 296428. New county record (Johnson 2000. The Amphibians and Reptiles of Missouri. Second Ed. Missouri Dept. Conserv., Jefferson City. 400 pp.).

Submitted by **ELI GREENBAUM,** Division of Herpetology, Natural History Museum and Biodiversity Research Center, 1345 Jayhawk Boulevard, The University of Kansas, Lawrence, Kansas 66045-7561, USA (e-mail: elig@ku.edu); and **DAWN M. DAVIS,** 4311 Roanoke #2N, Kansas City, Missouri 64111, USA.

TOMODON DORSATUS (NCN). URUGUAY: DPTO. ROCHA: Chuy (33°41'S, 53°27'W). March 1985. J. E. García. Colección Herpetologica del Museo Nacional de Historia Natural y Antropología, Montevideo, Uruguay (MNHN 5785, adult male). Verified by P. Cacciali. The range of the species includes South Brazil from Espirito Santo to 31°S in Rio Grande do Sul; Argentina in Misiones and Paraguay (Lema 1994. Comun. Mus. Ciênc. Tecnol. PUCRS, Sér. Zool., Porto Alegre 7:41–150; Franco 1999. Tesis de Disertación de Doctorado, Instituto de Biociências, Universidade de São Paulo, 252 pp.; Cei 1993. Mus. reg. Sci. nat. Torino, Monograf. 14, 949 pp.; Giraudo 2001. Serpientes de la Selva Paranaense y del Chaco Húmedo. L.O.L.A., Buenos Aires, 328 pp.; Giraudo and Scrocchi 2002. Smithson. Herpetol. Infor. Serv. 132, 53 pp.). Formerly, the southernmost location for this species was Bagé in Rio Grande do Sul (31°19'53"–54°66'25"S), specimen MCN 2915 (Fundação Zoobotânica, RS, Brazil). This specimen is the first country record for Uruguay and extends the known distribution more than 270 km S from Bagé in Rio Grande do Sul, Brazil.

Submitted by **SANTIAGO CARREIRA** (e-mail: carreira@fcien.edu.uy) and **IGNACIO LOMBARDO**, Dpto. Herpetología, Museo Nacional de Historia Natural y Antropología (MUNHINA), Juan C. Gómez 1436, CP 11000, Montevideo and Sección Zoología Vertebrados, Facultad de Ciencias, Iguá 4225, CP 11400, Montevideo, Uruguay.

TROPIDOCLONION LINEATUM (Lined Snake). USA: MISSOURI: SALINE CO.: Specimen found DOR on driveway adjacent to Brownsville Station Restaurant at I-70 East, Sweet Springs exit (38°57'N, 93°24'W). 20 November 2005. Eli Greenbaum. Verified by Andrew Campbell. KU 297918. New county record (Johnson 2000. The Amphibians and Reptiles of Missouri. Second Ed. Missouri Dept. Conserv., Jefferson City. 400 pp.).

Submitted by **ELI GREENBAUM,** Division of Herpetology, Natural History Museum and Biodiversity Research Center, 1345 Jayhawk Boulevard, The University of Kansas, Lawrence, Kansas 66045-7561, USA; e-mail: elig@ku.edu.

Sibon fasciata. (UMRC 79-305), 380 mm SVL. México: Quintana Roo. Illustration by Julian C. Lee.

Herpetological Review, 2006, 37(1), 110–111.

New Records and Type Locality Restriction for the Endemic Argentinian Lizard *Cnemidophorus tergolaevigatus* (Squamata: Teiidae)

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With the recent description of *Cnemidophorus tergolaevigatus* (Cabrera 2004) it has become evident that most of the previous records north to 30°S of *C. longicauda* (e.g., Cei 1993; Peters and Donoso-Barros 1970; Reeder et al. 2002) probably refer to the new species. Here we provide new locality records that extend the range of this species both northward and southward of those listed in the original description, adding three new provinces to La Rioja. Additionally, we also here restrict the type locality of *C. tergolaevigatus*.

Specimens housed at the Centro Nacional Patagónico-Conicet, Puerto Madryn, Argentina (LJAMM) and the Fundación Miguel Lillo, Tucumán, Argentina (FML) have been verified by M. Chiaraviglio, and those housed at San Diego State University, San Diego, California, (SDSU) and the American Museum of Natural History, New York (AMNH) have been verified by T. Reeder. MACN is the acronym of Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina.

Records

CATAMARCA PROVINCE: SANTA MARÍA DEPT.: Ruta nacional 40, 21.2 km E Los Nacimientos. 4 February 1991. FML 02981. Ruta nacional 40, 6 km W Punta de Balasto. 2246 m elev. (26°59'45.8"S, 66°11'40.1"W). 9 December 2001. L. Avila, D. Pérez, and N. Frutos. LJAMM 4274. TINOGASTA DEPT.: Ruta nacional 40, 45 km W Los Nacimientos (Campo Arenal). 2100 m elev. (27°00'06.9"S, 66°19'54.9"W). 14 January 1995. R. Espinoza. FML 03553. Medanitos. 1530 m elev. (27°30'S, 67°35'W). 15 January 1995. R. Espinoza. FML 03554. First provincial records.

LA RIOJA PROVINCE: ARAUCO DEPT.: 1 km S Bañados de los Pantanos. 828 m elev. (28°21'54.5"S, 66°50'02.4"W). 6 December 2001. L. Avila, D. Pérez, and N. Frutos. LJAMM 4181. New locality record for this Department. CASTRO BARROS DEPT.: 6 km E Anillaco (28°47'S, 66°52'W). 29 January 1999. L. Avila and L. Belver. LJAMM 1034–35. First Department records. CORONEL FELIPE VARELA DEPT.: Ruta provincial 26, 79.2 km SE central square of Villa Unión. 10 February 1991. R. Etheridge. SDSU 1118. New locality record for this Department, and southernmost known locality for the species. FAMATINA DEPT.: 9.9 km W Antinaco. 8 Febuary 1991. R. Etheridge, E. Lavilla, A. Marcus, R. Montero, and O. Pagaburo. AMNH R-144524–25; FML 02980.1, 02980.2;

SDSU 1063–64, 1304–05, 1307–08. Ruta provincial 11, 12 km E central square of Pituil. 7 February 1991. R. Etheridge. SDSU 1039. Ruta provincial 11, 9.2 km E of central square of Pituil. 7 February 1991. R. Etheridge. FML 02978. First Department records. SAN BLAS DE LOS SAUCES DEPT.: Ruta nacional 60, 2.1 km W Alpasinche. 974 m elev. (28°17'49.5"S, 67°04'02.8"W). 9 December 2001. L. Avila, D. Pérez, and N. Frutos. LJAMM 4263. First Department record.

SALTA PROVINCE: CAFAYATE DEPT.: Los Médanos, 0.5 km E Ruta nacional 68 and 6.7 km from junction of routes 68 and 40. 1650 m elev. (26°04'00.4"S, 65°54'38.2"W). 4 January 1991. R. Espinoza. FML 03552. First province record, and northernmost vouchered locality for the species.

TUCUMÁN PROVINCE: TAFÍ DEPT.: Between Santa María and Amaicha del Valle. 2 January 1989. R. Etheridge. SDSU 2438–39; AMNH R-144526–27. First province record.

Type locality restriction.—At the time of the description of *Cnemidophorus tergolaevigatus* the exact location from which the holotype and paratypes were obtained was unknown. According to entries in the MACN catalog these specimens were collected during a field trip to western Argentina in the austral summer of 1933–1934, in which the villages of Chilecito and Villa Unión, as well as Sierras of Famatina and Velasco, were visited. Other specimens of reptiles and anurans obtained during this expedition share the same provenance. Now that we know more accurately the present range of this species, we believe it is appropriate here to restrict its type locality. Therefore, in compliance with the International Code of Zoological Nomenclature (ICZN 1999, Article 76A.1.4) we here restrict the type locality of *Cnemidophorus tergolaevigatus* to Chilecito, in Chilecito Department, La Rioja province, Argentina.

Comments.—*Cnemidophorus tergolaevigatus* was previously known only for localities in the Argentinean province of La Rioja (Cabrera 2004). With the present records the northwestern provinces of Catamarca, Tucumán, and Salta are added to the range of the species, extending its distribution northward up to 26° south latitude.

Cnemidophorus tergolaevigatus and *C. longicauda* are endemic to Argentina, and are the only members of the *longicauda* species group (Cabrera 2004). The presence of individuals showing intermediate characteristics syntopic with both species of the group, collected at Coronel Felipe Varela Department in La Rioja province, as well as at near sites in Catamarca province (unpubl. data) suggests hybridization, a common phenomenon in the genus (Wright 1993) deserving further study.

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New County Records for Reptiles and Amphibians from Northeast Texas

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The geographic distribution of the herpetofauna of Texas is well documented (Dixon 2000). However, many counties in northeast Texas have not been sampled adequately, and the occurrence of several common species has not previously been documented. The following records provide new information regarding the geographic distribution of reptiles and amphibians in three counties in northeast Texas. New records were obtained while conducting a baseline inventory of reptiles and amphibians at Camp Maxey Army Base in Lamar County, Texas, as well as recent collecting efforts by the authors. All specimens were captured using time constraint searches, road cruising, cover board surveys, and minnow traps. All voucher specimens are deposited in the University of Texas at Arlington Amphibian and Reptile Research Diversity Center. All records represent new occurrences in their respective counties, based on Dixon (2000).

Caudata

Ambystoma maculatum (Spotted Salamander). LAMAR CO.: Found under rotten log on the edge of a bog in bottomland deciduous hardwood forest on the grounds of Camp Maxey Army Base,

Powderly, Texas (33°48'77"N; 95°32'73"W). 8 February 2003. Collected by B. E. Fontenot. Verified by Jonathan A. Campbell. Slide No. 31351. First county record. Previously reported from adjacent Red River Co.

Notophthalmus viridescens (Eastern Newt). LAMAR Co.: Captured by dip netting a small pond near disturbed prairie and bottomland deciduous hardwood forest on the grounds of Camp Maxey Army Base, Powderly, Texas (33°48'77"N; 95°32'73"W). 11 December 2002. Collected by R. Brenes. Verified by Ronald L. Gutberlet Jr. UTA A-56755. First county record. Previously reported from adjacent Red River Co.

Siren intermedia (Lesser Siren). LAMAR Co.: Found in minnow trap placed in small pond near disturbed prairie and bottomland deciduous hardwood forest on the grounds of Camp Maxey Army Base, Powderly, Texas (33°48'77"N; 95°32'73"W). 8 January 2003. Collected by V. Adams. Verified by Ronald L. Gutberlet, Jr. UTA A-56747. First county record. Previously reported from adjacent Delta Co.

Anura

Hyla cinerea (Green Tree Frog). MARION Co.: Large breeding chorus in lakeside vegetation at Potter's Point Marina, Boat Ramp 3644 off FM 727 (32°42'19"N; 94°04'25"W). 21 June 2002. Collected by S. Morrison. Verified by Ronald L. Gutberlet Jr. UTA A-56664. First county record. This specimen fills a gap in the distribution of this species in eastern Texas.

Hyla versicolor (Gray Tree Frog). LIMESTONE Co.: AOR, intersection of FM 1512 and NW Hwy 79, ca. 6.2 km W of Jewett, Texas (31° 20'3"N; 96°10'62"W). 26 June 2002. Collected by B. E. Fontenot . Verified by Ronald. L. Gutberlet Jr. UTA A-56665. First county record. This specimen fills a gap in the distribution of this species and was previously reported from adjacent Navarro, Freestone, Leon, Robertson, Falls, Mclennan, and Hill counties.

Rana areolata (Southern Crawfish Frog). LAMAR Co.: Breeding chorus at small pond in disturbed prairie habitat on the side of FM 1499 ca. 5 km N of Pat Mayse Lake, Powderly, Texas (33°49'92"N; 95°31'42"W). 6 March 2004. Collected by B. E. Fontenot. Verified by Jonathan A. Campbell. UTA A-56666. First county record. Previously reported from adjacent Red River and Fannin counties.

Lacertilia

Hemidactylus turcicus (Mediterranean House Gecko). LAMAR Co.: Found on side of building on the grounds of Camp Maxey Army Base, Powderly, Texas (33°62'72"N; 95°33'87"W). 25 July 2002. Collected by B. E. Fontenot. Verified by Ronald L. Gutberlet, Jr. UTA R-52877. First county record. This specimen represents a northeastern extension of the range of this species in Texas and was not previously reported in any adjacent counties.

Ophisaurus attenuatus (Slender Glass Lizard). LAMAR Co.: Under wooden cover board located on the edge of a disturbed prairie and bottomland deciduous hardwood forest on the grounds of Camp Maxey Army Base, Powderly, Texas (33°47'92"N; 95°34'46"W). 15 May 2003. This site was burned by a naturally occurring forest fire two days prior to the date of collection. Collected by B. E. Fontenot. Verified by Ronald L. Gutberlet, Jr. UTA R-52876. First county record. Previously reported from adjacent Red River and Fannin counties.

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New Records of Reptiles from Ilha Grande Island in Rio de Janeiro State, Brazil

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Ilha Grande, a continental island located in the southern coast of Rio de Janeiro State (Angra dos Reis Municipality) (23°15'S; 44°15'W) in Brazil, is one of the largest continuous remnants of the Atlantic rainforest in the State of Rio de Janeiro. Most of its 19,300 ha is covered by habitats characteristic of this biome (e.g., undisturbed dense forest, secondary forest, "restinga"s—coastal sand dune habitats—and mangroves). The remnants of the Atlantic Rainforest at Ilha Grande consist of a mosaic of forests with different levels of regeneration due to disturbances caused by human activities over the last three centuries. In the past the area was an important region for coffee, corn, and sugar plantations. Farming ceased when the area became a state park (Araújo and Oliveira 1988). Some remnants of primary forest can still be found in the most inaccessible central areas of the island. Annual rainfall in the area is about 1700 mm and mean annual temperature is about 23°C. During the last decade an increase in human activites have imperiled some habitats on the island (Alho et al. 2002). Despite being one of the most important remnants of the Brazilian Atlantic Rainforest, only three published reports regarding reptile species for Ilha Grande exist: Jackson (1978) noted a specimen of *Enyalius brasiliensis brasiliensis*; Rocha et al. (1999) reported on prey of the colubrid *Chironius multiventris foveatus*; and Van Sluys and Rocha (1999) described the activity of the teiid lizard *Tupinambis merianae*.

Since 1995, surveys on Ilha Grande carried out by personnel of the Departamento de Ecologia of the Instituto de Biologia of the Universidade do Estado do Rio de Janeiro have resulted in the accumulation of records of reptiles occurring on the island. Except for *C. m. foveatus*, *E. brasiliensis*, and *T. merianae*, the reptile species listed below represent the first published records for Ilha Grande. Measurements of lizards are presented in mm and those of snakes in cm. At each site where a reptile was collected, we recorded, whenever possible, the geographic position (using a Garmin III GPS) and elevation (using an altimeter). Because no voucher specimen of *T. merianae* at Ilha Grande had previously been collected (Van Sluys and Rocha 1999), here we include a record for the species supported by a voucher specimen. We also

include a recent voucher specimen of *Enyalius brasiliensis*.

Our report increases the number of reptiles species known from Ilha Grande to 25, including nine lizards and 16 snakes. All of the species found were expected, based on the previously known geographic distribution. Voucher specimens were deposited at the Museu Nacional, Rio de Janeiro (MNRJ). Ronaldo Fernandes, Curator, Department of Vertebrates, MNRJ, identified all specimens, with the exception of *Chironius exoletus* and *Xenodon newiedii*, which were identified by Daniel S. Fernandes of MNRJ.

Lacertilia

Diploglossus fasciatus. Vila dos Dois Rios Village. 4 April 1997. C. F. D. Rocha and M. Van Sluys. MNRJ 9782. Adult female (278.8 mm TTL; 120.3 mm SVL) collected in a garden (ca. 5 m elev.) (23°10'79.5"S, 44°10'68.8"W); Aventureiro Village. February 2001. Unknown collector. MNRJ 9783. Adult male (154.0 mm TTL; 91.0 mm SVL) collected in the secondary forest (23°10'49.3"S, 44°18'74.1"W).

Ecpleopus gaudichaudii. Vila dos Dois Rios Village. 15 September 1996. C. F. D. Rocha and M. Van Sluys. MNRJ 9792. Juvenile male (89.6mm TTL; 31.3 mm SVL) . On leaf litter (1230 h) at an undisturbed forest area (ca. 240 m elev.) (23°10'55.9"S, 44°12' 49.8"W). Mean leaf litter depth at collecting site was 77.1 ± 21.1 mm and litter temperature was 19.0°C.

Enyalius brasiliensis. Vila dos Dois Rios Village. 21 January 1996. C. F. D. Rocha and M. Van Sluys. MNRJ 9794. Adult gravid female (252.6 mm TTL; 100.6 mm SVL; clutch size = 10). On liana (20 mm diameter) 60 cm above ground (1115 h) at the secondary forest near the Mãe D'Água Dam (ca. 110 m elev.) (23°10'92.3"S, 44°12'04.4"W).

Gymnodactylus darwinii. Vila dos Dois Rios Village. 26 January 2000. M. Van Sluys and F. H. Hatano. MNRJ 9790. Adult male (78.3 mm TTL; 44.9 mm SVL; body temperature: 26.4°C; air temperature: 27.0°C). On the ground (1256 h) in secondary forest near the Barra Pequena River (ca. 5 m elev.) (23°11'30.7"S, 44°12"68.5"W).

Hemidactylus mabouia. Vila dos Dois Rios Village. 3 December 1998. C. F. D. Rocha and M. Van Sluys. MNRJ 9784. Juvenile (44.0 mm TTL; 24.5 mm SVL). On liana 2 m above ground (1453 h) in secondary forest near to the Barra Grande River (ca. 10 m elev.), along the trail linking Vila dos Dois Rios Village to Parnaioca beach (23°10'02.6"S, 44°09'20.1"W).

Leposternon microcephalum. Vila dos Dois Rios Village. 1 November 1998. C. F. D. Rocha and M. Van Sluys. MNRJ 9788. Adult male (287.2 mm TTL; 16.5 cm SVL) collected near urban area (at sea level) (23°10'62.4"S, 44°10'13.0"W), moving on ground after heavy rain.

Mabuya agilis. Praia do Sul. 14 February 2001. D. Vrcibradic. MNRJ 9789. Adult gravid female (111.0 mm TTL; 77.6 mm SVL; specimen presenting a broken tail) (5 ova in oviducts). Moving on the ground in the leaf litter in restinga habitat of Praia do Sul (ca. 5 m elev.) (23°10'32.0"S, 44°17'85.0"W); Vila dos Dois Rios Village. 12 January 1997. D. Vrcibradic and C. A. Cardozo. MNRJ 9494–9498. Juveniles (range 46.3–92.4 mm TTL; 33.8–41.5 mm SVL; all juveniles were found moving on the ground among the grass (ca. 5 m elev.) (23°10'74.3"S, 44°10'77.4"W).

Placosoma glabellum. Vila dos Dois Rios Village. December 1996. Received by C. F. D. Rocha from an island inhabitant who collected the specimen in secondary forest. MNRJ 9797. Adult male (72.0 mm TTL; 45.0 mm SVL; broken tail).

Tupinambis merianae. Vila dos Dois Rios Village. 10 October 2002. H. G. Bergallo. MNRJ 9772. Sub-adult male (745.0 mm TTL; 245.0 mm SVL; body mass 490 g) collected after being killed by a dog in urban area (ca. 5 m elev.) (23°10'76.9"S, 44°10'78.1"W).

Serpentes

Bothrops jararaca. Vila dos Dois Rios Village. 24 November 2001. M. A. Gomes and A. R. M. Azevedo. MNRJ 9786. Female (63.2 cm TTL; 53.8 cm SVL) collected on leaf litter bordering a temporary pond (2100 h) in secondary forest area (ca. 25 m elev.) along the trail linking Vila dos Dois Rios Village to Parnaioca beach (23°11'04.9"S, 44°11'77.6"W).

Bothrops jararacussu. Vila dos Dois Rios Village. 12 October 1996. E. Brito. MNRJ 9787. Juvenile female (42.3 cm TTL; 37.5 cm SVL) found under debris on grass-covered ground (at sea level) in the Central Square of the village (23°10'87.5"S, 44°10'63.0"W).

Chironius bicarinatus. Vila dos Dois Rios Village. 12 September 1999. C. F. D. Rocha and M. Van Sluys. MNRJ 9773. Adult female (129.0 cm TTL; 81.0 cm SVL) moving on ground at 0937 h under herbaceous vegetation in an area of undisturbed forest (ca. 230 m elev.) (23°10'71.5"S, 44°10'06.2"W); Caxadaço beach.19 April 1997. C. F. D. Rocha. MNRJ 9774. Adult male (169.3 cm TTL; 105.2 cm SVL) moving on ground at 1410 h along the trail to Caxadaço beach in secondary forest (ca. 30 m elev.) (23°09' 73.4"S, 44° 08'89.6"W); 9 February 1996. C. F. D. Rocha. MNRJ 9795. Juvenile female (34.1 cm TTL; 23.2 cm SVL) moving on ground in secondary forest area along the dirt road linking Vila do Abrahão to Vila dos Dois Rios Village (23°09'81.2"S, 44°08'13.3"W).

Chironius exoletus. Vila dos Dois Rios Village. 4 November 2002. Collected by an unknown island inhabitant. MNRJ 9799. Adult female (120.0 cm TTL; 78.0 cm SVL) found on grass-covered ground at the urban area of the Village (at sea level).

Chironius multiventris foveatus. Vila dos Dois Rios Village. 8 December 1996. C. F. D. Rocha. MNRJ 6717. Adult male (207 cm TTL; 129 cm SVL) collected in an undisturbed Atlantic Rainforest area (ca. 240 m elev.) (23°10'55.8"S, 44°12'49.9"W). The snake was moving over large boulders near a subterranean stream (see Rocha et al. 1999).

Clelia plumbea. Vila dos Dois Rios Village. 12 December 1998. C. F. D. Rocha. MNRJ 9791. Juvenile female (59.4 cm TTL; 9.4 cm SVL) moving on ground in secondary forest area (ca. 120 m elev.) along the trail to the Mãe D'Água Dam (23°10'81.6"S, 44°12'25.2"W).

Imantodes cenchoa. Vila dos Dois Rios Village. 26 November 2000. M. Rico. MNRJ 9777. Juvenile female (68.5 cm TTL; 48.7 cm SVL) collected at Barra Pequena River (23°10'90.6"S, 44°10' 20.4"W) near the village at sea level. The snake was on vegetation 1 m above a stream.

Liophis miliaris. Vila dos Dois Rios Village. 13 February 1997. E. Silva. MNRJ 9781. Juvenile (25.0 cm TTL; 21.5 cm SVL) col-

lected in a swamp area adjacent to the Estrada das Palmeiras in the village surroundings (23°10'67.3"S, 44°10'29.0"W).

Liophis poecilogyrus. Vila dos Dois Rios Village. 12 October 1996. C. F. D. Rocha. MNRJ 9780. Adult male (66.8 cm TTL; 54.0 cm SVL) collected when moving on the ground (1800 h) in secondary forest along the trail to the Mãe D'Água Dam (23°10'99.0"S, 44°12'12.5"W).

Micrurus corallinus. Parnaioca Beach. 17 October 1999. C. F. D. Rocha. MNRJ 9778. Adult female (61.4 cm TTL; 51.3 cm SVL) collected in secondary forest (ca. 40 m elev.) along the trail linking Parnaioca beach and Vila dos Dois Rios Village (23°11'79.6"S, 44°14'17.6"W). The snake was moving (1140 h) on the ground under herbaceous vegetation.

Oxyrhopus clathratus. Vila dos Dois Rios Village. 16 May 1997. C. F. D. Rocha. MNRJ 9776. Adult male (85.0 cm TTL; 68.8 cm SVL). Moving on ground under herbaceous vegetation (1940 h) in secondary forest near Mãe D'Água Dam (ca. 60 m elev.) (23°10' 92.3"S, 44°12'04.4"W).

Sibynomorphus newiedi. Vila dos Dois Rios Village. 16 August 1997. C. F. D. Rocha. MNRJ 9785. Adult female (59.9 cm TTL; 47.6 cm SVL) found on ground under a shrub (1530 h) in secondary forest (ca. 15 m elev.) (23°10'57.5"S, 44°11'79.1"W).

Siphlophis pulcher. Vila dos Dois Rios Village. 14 December 1997. C. F. D. Rocha. MNRJ 9775. Adult male (83.5cm TTL; 62.5 cm SVL) collected on leaf of a coconut palm, 4 m above ground in secondary forest area, at sea level (23°11'09.9"S, 44°11'45.6"W).

Spilotes pullatus. Vila dos Dois Rios Village. 17 November 1998. C. B. Lemos. MNRJ 9779. Juvenile (49.1 cm TTL; 37.3 cm SVL) collected in undisturbed Atlantic Rainforest (ca. 210 m elev.) on a branch of a shrub. (23°10'55.8"S, 44°12'49.9"W).

Thamnodynastes cf. *strigilis*. Vila dos Dois Rios Village. 30 October 2000. C. F. D. Rocha and M. Van Sluys. MNRJ 9793. Adult female (68.0 cm TTL; 51.8 cm SVL; 46.3 g; body temperature: 21.2°C; air temperature: 23.0°C) on leaf litter at bottom of dried temporary pond (1627 h) in secondary forest along trail to Parnaioca beach (ca. 10 m elev.) (23°10'98.5"S, 44°12'49.8"W).

Xenodon newiedii. Vila dos Dois Rios Village. 5 November 2002. Collected by an unknown island inhabitant. MNRJ 9800. Adult male (57.6 cm TTL; 47.0 cm SVL) collected on ground covered with grass and shrubs at the urban area of the village (at sea level).

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New County Records for Amphibians and Reptiles in Minnesota

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We examined recent amphibian and reptile specimens and photos deposited in the amphibian and reptile collection of the Bell Museum of Natural History (JFBM) and provide a list of new amphibian and reptile county records in Minnesota (Moriarty 1996; Oldfield and Moriarty 1994). The majority of new records were due to collecting efforts related to the Minnesota Dept. of Natural Resources' Minnesota County Biological Survey. Andrew M. Simons verified all specimens and photos. JFBM specimen numbers preceded by a "P" are cataloged in the photo collection. Nomenclature follows Crother (2000) except where noted.

Caudata

Ambystoma laterale (Blue-spotted Salamander). Kandiyohi Co.: Sibley State Park (45°18'48"N, 95°01'28"W). 20 May 1996. M. Carroll. JFBM P221. Wright Co.: Lake Maria State Park (45°19'30"N, 93°57'06"W). 10 June 2001. T. Gamble. JFBM P249.

Ambystoma tigrinum (Tiger Salamander). Lyon Co.: Prairie Marshes Wildlife Management Area, (44°21'45"N, 95°58'14"W). 29 June 19696. R. Lehtinen. JFBM 13532. Pope Co.: Wetland 1 mile N of Rocky Mountain Lake (45°25'17"N, 95°12'08"W). 2 July 1996. R. Lehtinen. JFBM 13677. Todd Co.: Wetland 3 miles S of Long Prairie, (45°55'27"N, 94°52'51"W). 3 July 1996. R. Lehtinen. JFBM 13679.

Hemidactylium scutatum (Four-toed Salamander). Carlton Co.: Nemadji State Forest along Harris Forest Rd, (46°26'01"N, 92°19'49"W). 4 May 1999. G. Casper. JFBM 14161. Adult. Nemadji State Forest along Harris Forest Road (46°26'01"N, 92°19'49"W). 4 May 1999. G. Casper. JFBM 14183. 3 eggs. Itasca Co.: Chippewa National Forest (47°27'05"N, 93°39'07"W). 22 August 1994. C. Dorff Hall & Suddendorf. JFBM 13472. Chippewa National Forest (47°27'05"N, 93°39'07"W). July 1995. J. LeClere.

JFBM 13568. Mille LACS Co.: Mille Lacs Kathio State Park (46°07'07"N, 93°42'59"W). 11 May 1999. LeClere. JFBM 14194. PINE Co.: St. Croix State Forest, E of Mcdermott Creek (46°05'4"N, 92°28'06"W). 5 May 1999. G. Casper. JFBM 14160. St. Croix Sate Forest, SE of Rock Lake access (46°02'50"N, 92°25'08"W). 9 May 1999. G. Casper. JFBM 14162. Nemadji State Forest (46°18'54"N, 92°20'05"W). 6 May 1999. G.Casper. JFBM 14198.

Necturus maculosus (Mudpuppy). DOUGLAS Co.: Lake Latoka in boulder rip-rap under Interstate 94 bridge (45°51'53", 95°26'08"). 24 May 2005. K Schmidt. JFBM 14411–14412, 14414. KANABEC Co.: Knife Lake (45°58'07"N, 93°18'20"W). 11 October 1989. K. Schmidt. JFBM 13355.

Notopthalmus viridescens (Eastern Newt). CHISAGO Co.: Taylors Falls (45°24'41"N, 92°39'06"W). 19 Apr 1980. D. Hanych. JFBM 13882. ITASCA Co.: Chippewa National Forest (47°27'05"N, 93°39'07"W). July 1995. J. LeClere. JFBM 13569–13570.

Anura

Bufo americanus (American Toad). CARVER Co.: Hwy 7 near Hollywood (44°54'23"N, 93°58'53"W). 16 May 1999. T. Gamble. JFBM 14188. CHIPPEWA Co.: Flooded field NW of Milan (45°06'53N, 95°56'19"W). 23 May 2003. T. Gamble, P. Berendzen, and B. Nagle. JFBM 14317–14320. MEEKER Co.: Hwy 21 N of Big Swan Lake (45°09'37"N, 94°15'38"W). 16 October 1996. R. Blasus and J. LeClere. JFBM 13910–13911. Hwy 7 W of Cedar Mills (44°56'29"N, 94°34'13"W). 16 May 1999. T. Gamble. JFBM 14189. WRIGHT Co.: Wetland near entrance of Lake Maria State Park (45°19'01"N, 93°56'03"W). 26 May 2003. T. Gamble and B. Nagle. JFBM 14326.

Bufo cognatus (Great Plains Toad). RENVILLE Co.: NW of Renville (44°49'50"N, 95°14'28"W). 8 June 1999. C. Dorff Hall and T. Gamble. JFBM 14144.

Bufo hemiophrys (Canadian Toad). YELLOW MEDICINE Co.: Sioux Nation Wildlife Management Area (44°40'54"N, 96°26'08"W). June 1996. R. Lehtinen. JFBM P245.

Hyla chrysoscelis (Cope's Gray Treefrog). CARVER Co.: Spring Peeper Meadow, University of Minnesota Arboretum, (44°51'25"N, 93°35'08"W). 20 May 1998. R. Lehtinen. JFBM 13734. Calling male. Restored wetland N of Waconia (44°51'42"N, 93°49'51"W). 25 May 1998. R. Lehtinen. JFBM 13747. Calling male. CASS Co.: S of Oshawa (46°43'28"N, 94° 32'14"W). 20 June 1994. C. Dorff Hall and S. J. Presley. JFBM 14084. FILLMORE Co.: N of York (43°32'36"N, 92°16'43"W). 11 June 1996. C. Dorff Hall and C. Van Gorp. JFBM 14071. Calling male. NICOLLET Co.: Wetland in Swan-Oshawa Wildlife Management Area (44°19'33"N, 94°06'44"W). 19 May 1998. R. Lehtinen. JFBM 13750. Calling male. STEELE Co.: Restored wetland adjacent to Straight Creek (43°53'45"N, 93°10'10"W). 27 May 1998. R. Lehtinen. JFBM 13733. Calling male. Restored wetland South of Straight Creek (43°53' 45"N, 93°11'48"W). 27 May 1998. R. Lehtinen. JFBM 13742. Calling male. OTTERTAIL Co.: County Hwy 128 at El Will Road (46°21'38", 95°37'56"W). 14 June 2003. B. Nagle. JFBM 14355. Calling male.

Hyla chrysoscelis/versicolor (Gray Treefrog). MCLEOD Co.: Highway 7 near Lester Prairie (44°54'23"N, 94°05'46"W). 16 May 1999. T. Gamble. JFBM 14184. MEEKER Co.: Highway 7 W of Cedar Mills (44°56'29"N, 94°34'27"W). 16 May 1999. T. Gamble. JFBM 14185. TODD Co.: Wetland 1 mile NE of Bunker Lake (45°49'28"N, 94°50'14"W). 15 July 1996. J. Husveth. JFBM 13683.

Hyla versicolor (Gray Treefrog). CARVER Co.: Restored wetland N of Waconia (44°51'42"N, 93°49'51"W). 5 May 1998. R. Lehtinen. JFBM 13736. Calling male.

Pseudacris crucifer (Spring Peeper). MARSHALL Co.: Near Red Lake Indian Reservation (48°29'06"N, 94°46'54"W). 9 August 1992. S. J. Presley. JFBM 13962. ST. LOUIS Co.: Ketagama Lake, Voyageurs National Park (48°28'07"N, 92°52'38"W). 9 August 1998. Palmer. JFBM 13352.

Pseudacris maculata (Boreal Chorus Frog). CARVER Co.: Spring Peeper Meadow, University of Minnesota Arboretum (44°51'25"N, 93°35'08"W). 5 June 1998. R. Lehtinen. JFBM 13732. Malformed. TODD Co.: Wetland 3 miles S of Long Prairie, (45°55'27"N, 94°52'51"W). 3 June 1996. R. Lehtinen. JFBM 13697. WRIGHT Co.: Wetland near entrance of Lake Maria State Park (45°19'01"N, 93°56'05"W). 22 April 2003. T. Gamble. JFBM 14283-14284. YELLOW MEDICINE Co.: Upper Sioux Agency SP, wetlands near MN River (44°44'20"N, W95°27'08"W). T. Gamble, P. Berendzen, and B. Nagle. 22 May 2003. JFBM 14309-14310. OTTERTAIL Co.: County Highway 128 0.3 miles E of Highway N78 (46°21'39"N, 95°33'56"W). 14 June 2003. B. Nagle. JFBM 14336.

Rana palustris (Pickerel Frog). OLMSTED Co.: North branch of the Root River (43°54'22"N, 92°19'04"W). 1 June 1995. C. Dorff Hall. JFBM 14095.

Rana septentrionalis (Mink Frog). STEARNS Co.: St. John's University, Gemini East Lake (45°35'15"N, 94°23'33"W). 2 August 2001. T. Gamble. JFBM P251. WRIGHT Co.: Eagle Lake, W of Monticello (45°17'03"N, 93°55'21"W). 13 September 2004. T. Gamble. JFBM 14409.

Rana sylvatica (Wood Frog). GRANT Co.: E of Pomme de Terre River (45°51'43"N, 95°50'33"W). 4 May 1999. C. Dorff Hall and T. Gamble. JFBM 14142. MCLEOD Co.: Hwy 7 near Lester Prairie (44°54'23"N, 94°05'46"W). 16 May 1999. T. Gamble. JFBM 14187. STEARNS Co.: Wetland 6 miles S of Sauk Center (45°38'33"N, 94°57'15"W). 12 June 1996. R. Lehtinen. JFBM 13705. WRIGHT Co.: Wetland in Crawford Woods Scientific Natural Area (45°10'37"N, 93°46'38"W). 2 June 1996. J. Husveth. JFBM 13546. Wetland near entrance of Lake Maria State Park (45°19'01"N, 93°56'04"W). 22 April 2003. T. Gamble. JFBM 14282.

Testudines

Apalone mutica (Smooth Softshell). LESUEUR Co.: Minnesota River, Kasota Township 1/8 mi upstream of Kasota public access (44°18'41"N, 93°57'24"W). 30 August 1996. T. Jessen. JFBM P225. NICOLLET Co.: Minnesota River, Ridgely Township, MN River 1 mile downstream of Ft. Ridgely (44°26'05"N, 94°42'33"W). 20 August 1998. T. Jessen. JFBM P224. SCOTT Co.: Minnesota River, Blakely Township, 2.5 miles upstream of Blakely (44°37'30"N, 93°49'25"W). 22 June 1997. T. Jessen. JFBM P228. SIBLEY Co.: Minnesota River, Henderson Township, upstream of Lesueur public access (44°30'07"N, 93°53'42"W). 16 June 1997. T. Jessen. JFBM P226.

Apalone spinifera. (Spiny Softshell). BLUE EARTH CO.: Rapidan dam on Blue Earth River (44°05'36"N, 94°06'30"W). 22 Jun 1998. T. Jessen. JFBM P236. BROWN CO.: Cottonwood River, Flandrau State Park, near New Ulm (44°17'25"N, 94°28'27"W). 28 May 1998. T. Jessen. JFBM P231. CARLTON CO.: Little Hanging Horn Lake (46°29'04"N, 92°40'30"W. 30 July 1996. D. Dexter. JFBM P219. NICOLLET CO.: Minnesota River across from Minneopa State Park (44°10'05"N, 94°05'31"W). 28 August 1996. T. Jessen. JFBM P235. REDWOOD CO.: Minnesota River across from Renville County Park (44°33'22"N, 95°02'37"W). 17 June 1998. T. Jessen. JFBM P230. SCOTT CO.: Minnesota River, Blakeley Township, upstream from Blakely access (44°37'30"N, 93°49'25"W). 22 June 1997. T. Jessen. JFBM P234. SIBLEY CO.: 1 mile upstream of Henderson Station access (44°32'13"N, 93°54'07"W). 18 June 1997. T. Jessen. JFBM P232. STEARNS CO.: Sylvia Lake near Melrose, Sauk River (45°44'55", W94°47'20"W). 15 July 2002. T. Gamble. JFBM P255.

Chelydra serpentina. (Snapping Turtle). STEARNS CO.: Black Oak Lake near Melrose 45°38'28"N, 94°48'22"W). 9 August 2002. T. Gamble. JFBM P252. WRIGHT CO.: Lake Maria, Lake Maria State Park (45°19'21"N, 93°56'52"). 10 June 2001. T. Gamble. JFBM P250.

Chrysemys picta. (Painted Turtle). MEEKER CO.: Hwy 21 and Bridge (45°10'03"N, 94°17'54"W). 16 October 1996. Blasus and LeClere. JFBM 13912. ROSEAU CO.: North of Casperson (48°35'46"N, 95°40'23"W). 19 August 1991. G. Nordquist. JFBM 13469. TODD CO.: Guernsey Lake near West Union (45°50'02"N, 95°01'45"W). 8 August 2001. T. Gamble. JFBM P254.

Graptemys pseudogeographica. (False Map Turtle). BLUE EARTH CO.: Minnesota River, Minneopa State Park (44°10'02"N, 94°05'53"W). 18 May 1998. T. Jessen. JFBM P238. LESUEUR CO.: Minnesota River, Kasota Township (44°18'41"N, 93°57'24"W). September 1997. T. Jessen. JFBM 13516. SCOTT CO.: Blakely Twp, 2.5 mi upstream of Blakely (44°37'30"N, 93°49'25"W). 22 June 1997. T. Jessen. JFBM P241. SIBLEY CO.: Minnesota River, Faxon Twp, 2 mi upstream from Blakely (44°38'16"N, 93°46'30"W). 22 June 1997. T. Jessen. JFBM P240. YELLOW MEDICINE CO.: Minnesota River. Upper Sioux Agency State Park (44°44'30"N, 95°26'58"W). 25 June 1998. T. Jessen. JFBM P242.

Lacertilia

Eumeces septentrionalis (Prairie Skink). COTTONWOOD CO.: Great Bend Township (43°55'38"N, 95°10'15"W). June 1999. R. Markl. JFBM P247. SWIFT CO.: Sleeping Bison North, W of Appleton (45°14'26"N, 96°05'47"W). 23 May 1999. C. Dorff Hall and T. Gamble. JFBM P257.

Serpentes

Coluber constrictor (Racer). FILLMORE CO.: Root River, S of Peterson (43°46'22"N, 91°50'30"W). 12 June 1996. C. Dorff Hall and J. Van Gorp. JFBM 14067.

Heterodon platirhinos (Eastern Hog-nosed Snake). FILLMORE CO.: Root River, S of Peterson (43°46'34"N, 91°49'45"W). 10 May 1999. J. Levell. JFBM P223.

Opheodrys vernalis (Smooth Greensnake). WADENA CO.: Crow River, NE of Staples (46°22'38"N, 94°44'47"W). 3 June 1995. S. Kittelson. JFBM 14096.

Pituophis catenifer sayi (Bullsnake). WRIGHT CO.: St. Michael (45°11'16"N, 93°45'23"W). 20 August 1997. J. Moriarty. JFBM 13896.

Storeria dekayi (DeKay's Brownsnake). MEEKER CO.: E of Lake Darwin (45°05'27"N, 94°23'32"W). 16 October 1996. R. Blasus and J. LeClere. JFBM 13909.

Storeria occipitomaculata (Red-bellied Snake). CHISAGO CO.: NE of Linn Lake (45°22'00"N, 92°49'09"W). 7 October 1999. K. Adolfson. JFBM 14193. COOK CO.: Lake Saganaga public landing (48°09'53"N, 90°52'58"W). 9 July 1998. D. A. Etneir. JFBM 13759. County Road 10 between Lake Saganaga and Voyageur Outfitters (48°09'29"N, 90°53'19"W). 25 June 2000. D. A.Etmeir. JFBM 14207. MEEKER CO.: Lake Darwin (45°05'27"N, 94°23'32"W). 10 October 1996. R. Blasus and J. LeClere. JFBM 13907–13908.

Thamnophis radix (Plains Gartersnake). SWIFT CO.: Near Appleton (45°11'36"N, 96°02'35"W). 4 May 1999. C. Dorff Hall and T. Gamble. JFBM 14146–14147.

Thamnophis sirtalis (Common Gartersnake). BECKER CO.: SE of White Earth (47°02'13"N, 95°45'58"W). 14 July 1999. C. Dorff Hall and K. Schmidt. JFBM 14134. S of Perch lake (46°50'27"N, 95°42'04"W). 14 July 1999. C. Dorff Hall and K. Schmidt. JFBM 14135. SWIFT CO.: Monson Lake State Park (45°19'20"N, 95°16'38"W). 2 May 1999. C. Dorff Hall and T. Gamble. JFBM P256.

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BOOK REVIEWS

Herpetological Review, 2006, 37(1), 117–119.

Reptilian Incubation: Environment, Evolution and Behaviour, edited by D.C. Deeming. 2004. Nottingham University Press, Thrumpton, Nottingham, United Kingdom (www.nup.com). xiv + 349 pp. Hardcover. £50.00 (approx. US $90.00). ISBN 1-897676-11-5.

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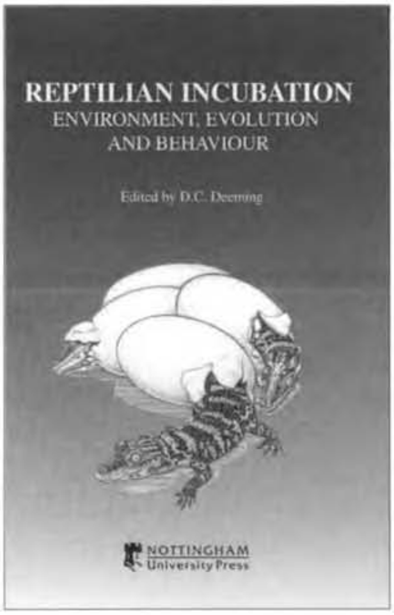

Given that the majority of the world's reptile species are oviparous (Zug et al. 2001), one could be excused for assuming that the environmental influence of incubation in reptiles had been comprehensively covered long ago. However, while the captive effects of incubation in reptiles have been explored recently (Köhler 1997), this treatment provides little evidence of potential environmental effects. *Reptilian Incubation* fills this void by examining the environmental effects of incubation and their implications for the evolution and behavior of reptiles. In short, this book aims to develop a comprehensive understanding of the way eggs are incubated outside the maternal body. Arranged in three parts, the book deals with how the incubation environment affects nests, eggs and embryos, and the repercussions of any long-term effects for reptilian biology.

In Chapter One, Deeming and Unwin focus on the origin and evolution of the reptilian amniotic egg, and review the evidence for reptilian incubation in the fossil record. They highlight important evolutionary stages in the development of eggs, egg shells, nests and the implications for embryos. The negative relationship between the degree of egg shell calcification and gas conductance means that, with some knowledge of egg shell formation and egg composition, it is possible to gain an idea of the nest environment in which many taxa evolved. In general, the eggs of lepidosaurs (with the exception of some geckos) and *Sphenodon* are poorly calcified and require moist environments, whereas the more extensively calcified eggs of chelonians and crocodilians are less reliant on external water for incubation. While the fossil egg record is limited to relatively few taxa, many of which are dinosaurs, it does provide a useful starting point for inferring the ovipositional environments in which these taxa evolved. The presence of fully formed embryos in the abdominal cavity of a mosasaur fossil strongly suggests that some forms were probably viviparous (Caldwell and Lee 2001), and that the fossil record can provide insight into the evolution of novel traits.

Ackerman and Lott (Chapter Two) focus on the thermal, hydric and respiratory environments likely to occur in soils surrounding buried and incubating reptile eggs, with a major focus on chelonians. The authors acknowledge that there are relatively few available data describing these variables for incubating eggs and offer at least one possible shortcut — the use of data from climatic archives, many of which are available on the web. Such data should provide a general starting point for those intending to examine species for which actual nest temperature data are unavailable or incomplete. Data on the temperatures experienced by eggs in natural nests is still scarce, but this situation appears to be changing rapidly (e.g., Shine and Harlow 1996). However, there remains a need for appropriate long-term measures of temperatures of the soil surrounding reptile nests incorporating techniques from soil science.

Thompson and Speak examine the morphology and composition of modern reptile eggs (Chapter Three). Separate descriptions place emphasis on those features salient to each lineage, with comparisons to birds. Data from all known studies detailing egg chemical compositions are clearly displayed in a series of tables. In summary, while the lipid, protein and energy content is generally similar across taxa (mean lipid : protein ratio 2:1), the evolution of the reptilian egg from that of amphibians was accompanied by a proportional increase in protein. Interestingly, the proportion that certain lipids occur in the eggs of several scincids differs from that in the maternal diet, and possibly reflects what remains of a phylogenetically conserved trait or dietary shift in these taxa.

In Chapter Four, Andrews discusses patterns of embryonic development with reference to the "evo-devo" (evolution and development) debate and the role of developmental biology and regulatory genes (e.g., Hox genes) in determining morphological traits and body plans (West-Eberhard 2003). Andrews reviews the qualitative and quantitative aspects of embryonic development, developmental arrest, egg and nest emergence, and factors affecting hatchling size. While both reptile and bird development are highly conservative, biologically significant differences do exist among reptiles. Hox and other genes associated with development provide some evidence for the absence of forelimbs and the reduction in limb size in various limb-reduced taxa. Another trend is for the chorioallantoic membrane to change size in response to the degree of water uptake and egg surface area in squamates, but remain of a fixed size in rigid shelled taxa (e.g., chelonians, crocodilians, etc.). In general, the earlier stages of development are most sensitive to temperature, with low temperatures and moist conditions producing larger hatchlings, with a relatively low proportion of residual yolk. One interesting consequence of the thin permeable shell of squamate eggs, which facilitates gaseous and fluid exchange *in utero*, may provide a mechanistic explanation for why viviparity has evolved so frequently in this lineage.

Birchard (Chapter Five) reviews the effects of temperature on embryonic development. Specifically, the thermal environment, the temperatures tolerated and a description of the effects of temperature on growth and physiological rates. Birchard incorporates

much additional information since the publication of earlier reviews of reptilian incubation (Deeming and Ferguson 1991; Ackerman 1994). In general reptile nests typically occur in sites where eggs experience a non-lethal range of temperatures. One interesting distinction being that between developmental period and incubation period — the former referring to the period during which temperatures exceed the minimum suitable for development; the latter to the overall period from laying to hatching. Strangely, despite the biological relevance of this distinction it has rarely been used. Further evidence for the importance of defining those temperatures experienced in natural nests comes from the effect of out-of-phase oscillations between surface soil and the deeper soil surrounding the nest, which can have important consequences for water and respiratory gas exchange in eggs.

In Chapter Six, Belinsky, Ackerman, Dmi'el and Ar, explore the delicate balance between the various environmental factors to which reptile eggs are exposed. Thus, while initial water content varies among taxonomic groups and environmental conditions, under most incubation and hydric conditions the majority of yolk-free hatchlings have relatively similar water content. Similarly, variation in egg shell types leads to equally varied changes in hydric conditions, with some lizard eggs gaining more than three times the original mass during incubation! Data are summarized in several tables presenting wet and dry egg masses. Compared to other taxa lizards typically have higher hatchling wet mass to egg wet mass ratios. Clearly, egg size and shell type are important for initial egg water concentrations. It seems likely that the plasticity of reptilian nest-site selection along with incubation conditions that affect the mass and water content of hatchlings and residual yolk have played a major role in reptilian evolution.

The same authors follow on with the longest chapter (Chapter Seven, 42 pages, 8 Tables, 7 Figures), presenting new and published data on energy density values for the components of reptilian eggs and hatchlings (26 species), as well as new data on oxygen consumption (25 species). Indeed, much of this chapter is taken up with data presented in tables and figures. They indicate that reptiles are a homogeneous group in terms of energy use, relative to birds, which exploit a wide range of incubation temperatures. An interesting finding being the similar mass-specific energy use efficiency of reptiles and birds, which appears suggestive of their common ancestry. However, compared to other reptiles, lizards differ as a group due to their greater oxygen-use efficiency.

Shine (Chapter Eight) examines the effects of the nest environment of squamate reptiles, using much of his data to explore the adaptive role of maternal exploitation of embryonic sensitivity, and in particular the role it has played in the evolution of maternal behavior and physiology. Specifically, where incubation-induced effects are of sufficient magnitude and duration to substantially affect offspring fitness, they are also likely to have a significant role in the evolution of maternal behavior and physiology. As such, there is a real need to identify those traits potentially under maternal control (e.g., nest site selection). The review begins with a description of those traits found within squamates (the group with the greatest range of reproductive traits), before incorporating information on other reptile groups and comparing forms of maternal manipulation of offspring phenotypes. Shine also highlights areas of future importance, including the use of intraspecific comparative studies to detect microevolutionary processes, defining and verifying the link between phenotypic traits and fitness, and using incubation conditions that resemble those of natural nests (Shine and Harlow 1996). Indeed, such studies may also be informative with respect to other adaptive processes (e.g., Temperature-dependent sex determination, TSD; Elphick and Shine 1999). While the effects of nest temperature on hatchling size, shape and locomotor performance may have important fitness consequences such effects may be offset if hatching occurs during a less favorable period. Nonetheless, while there is a need to mimic the conditions of natural nests in studies of the evolution of maternal manipulation of hatchling phenotypes, whether studies of other evolutionary phenomena based on constant temperature incubation are any less informative may be dependent on the system examined (e.g., Vanhooydonck et al. 2001; Kearney and Shine 2004). The next portion of the book focuses on the effects of incubation on TSD. In short, because reptiles possess both genotypic-sex determination (GSD) and TSD they are ideal for comparative studies of sex determination in vertebrates (Bull 1980). Valenzuela (Chapter Nine) focuses on how the environment affects sex determination from the thermal and biochemical standpoint in reptiles, with a consideration of the evolution of TSD. A large table provides details of species from families for which TSD is known and for which it is absent. Unfortunately, while a search using comparisons of thermal, physiological and molecular mechanisms of both TSD and GSD seems promising, they offer little insight into those factors occurring in nature. Nonetheless, Valenzuela provides several testable predictions for the evolution of TSD, including examples of conditions under which TSD is unlikely to occur. Despite the large number of examples, conclusive evidence of an adaptive explanation of TSD in vertebrates is known only from one species each of fish and lizard. Yet, while this is an extensive list of criteria the prospect that a species may have more than one explanation of TSD ensures that this will remain a challenging area of research (Valenzuela et al. 2003).

In Chapter Ten, Deeming reviews the post-hatching effects of incubation on reptile phenotypes. Laboratory and field studies indicate that the incubation environment of reptile eggs affects a wide variety of post-hatching traits including morphology, physiology and behavior. He also proposes that at present relatively few trends can be drawn from most taxonomic groups, as conclusions have typically been biased toward a few well studied species. Further, there remains the possibility that life histories of individual species may be important in the expression of post-hatching phenotypes, with the suggestion of future work increasing the current species database to identify trends and those physiological mechanisms that influence the phenotype long after hatching. Clearly, identifying incubation regimes for which post-hatching performance is compromised will have major value for conservation and management programs.

In the shortest chapter (Chapter Eleven; 11 pages), Booth reviews the role of artificial incubation for both experimental and captive research, and covers obtaining eggs, the movement of eggs, incubation temperatures, hydric conditions and microbial infections. In general, most reptile eggs incubate over a wider range of temperature than birds (e.g., 5–8°C). For maximal hatching success, Booth advocates the use of sterilized substrates, minimal egg movement, and the use of a different range of temperatures for reptiles from temperate and tropical regions. In the final chapter

(Chapter Twelve), Deeming overviews details of the previous eleven chapters. What becomes apparent is that current knowledge about both the eggs and nesting environments of reptiles is still poorly known. This is, in part, no doubt the result of the phylogenetic diversity, the range of reproductive modes exhibited and the range of habitats occupied, both within and among extant reptile groups, and because much of this research has focussed on a few key species from each group. In closing, Deeming makes various suggestions for future research.

In summary, Deeming has done a fine job in assembling the extensive range of contributors and researchers that have participated in this book. All chapters are thoroughly researched and well referenced and the most recent publications and many unpublished data have been incorporated. It is refreshing to observe that the Squamata have been afforded additional space, which likely reflects the increasing amount of research conducted on this group. Nonetheless, while there is some overlap among most chapters, which enables the reader to begin at any chapter, others may find the continued reintroduction of specific, key features somewhat redundant. The text is well complemented with numerous tables (33) and figures and black and white photographic plates (38), which are especially useful for some of the more theoretical chapters (e.g., Chapters 6 & 7). On the downside, there are many typographical errors throughout the text, with all chapters having at least one such obvious error. While this problem could have easily been avoided with more rigorous proofreading during the editing phase, it does little to detract from the breadth and quality of material presented. *Reptilian Incubation* promises to be a substantial addition to this field, and a worthy and helpful guide for students and researchers of herpetology and evolutionary ecology for years to come.

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Libro Rojo de los Anfibios de Colombia, edited by José Vicente Rueda-Almonacid, John D. Lynch, and Adolfo Amézquita. 2004. Conservación Internacional Colombia, Instituto de Ciencias Naturales-Universidad nacional de Colombia, Ministerio de Medio Ambiente, Bogotá, Colombia. 384 pp. Softcover. Approx. US $25.00. ISBN 33-6070-8.

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Many species and populations of amphibians are threatened, in severe decline, or have recently become extinct. With the problem at its zenith, concerned herpetologists and biologists around the world are trying to monitor populations, understand the reasons for such declines and extinctions, and provide possible solutions. National assessment of species at risk and the nature of the threats they face is an important step in this process. Amphibian richness in countries of tropical America is the highest in the world, but monitoring there has never been a priority, and thus information on amphibian populations is scarce and difficult to assess. *Libro Rojo de los Anfibios de Colombia*, published in the series Libros Rojos de Especies Amenazadas de Colombia, provides a comprehensive example for other countries to follow.

The book begins with two beautiful but small maps of the country, one political, the other physiographic. Following the table of contents, are prefaces by S. Suárez Pérez (Colombian Ministry of Environment, Housing and Territorial Development) and J. V. Rodríguez-Mahecha and F. Arjona (Conservation International, henceforth CI), acknowledgements, and a prologue by C. Gascon (CI). Colombia has the highest number of amphibian species (733) on Earth, making the task of the book a challenging one. The prologue emphasizes that the categorization of endangered amphibian species was a collective task that combined scarce quantitative data with the subjective interpretations of each specialist. The 24 contributors include specialists in each species or group of species and each taxon account is separately authored by one or more of these.

The Introduction is divided into several sections. "Generalidades de Colombia" includes geographic and hydrographic background and a very short explanation of Colombia's biogeography. I think that a more extensive introduction would have been more appropriate in order to place Colombia's high biodiversity (estimated to be 10% of the world total), in the context of the complex geography of Colombia.

Next a brief resumé of the history of herpetology in Colombia leads into an introduction of the general problem of endangered amphibians and the principal threats they face, like the destruction of natural habitats (e.g., only 1,200 km? or the original 80,000 km ? of deciduous and semi-deciduous forests of Colombia remain and only 27% of the original Andean forests persist). Other threats that amphibians confront are the fragmentation of habitats, the introduction of exotic species (e.g., pines, eucalyptus, fishes, and the bullfrog, *Rana catesbeiana*), pollution from herbicides, pesticides and acid rain, an increase in UV radiation and broader issues of climatic change, and overexploitation due to scientific collection and the pet trade. Another subchapter deals with recent amphibian declines, mentioning fungal infection and synergistic anthropogenic factors, and another discusses priority areas for amphibian conservation. Here the authors state the necessity to select such areas on the basis of their concentration of unique threatened species, but recognize that efforts to protect endangered amphibians are limited by the economic capacity to conserve them. The next subchapter is about the conservation *in situ*, and how existing protected areas can help. "Initiatives for Colombian amphibian conservation" deals with strategies such as, the modification of local cultivation practices (like coffee, which is highly destructive!) and promotion of corridors between protected areas. Another section of the introduction deals with the ecogeography of endangered species, showing that only seven of the 55 endangered species in this book occur below 1000 m, whereas 42 are from Andean forests, from which about 350 species are known. Finally, the methodology employed in assessing the species is provided along with a very useful explanation of the IUCN categories, and procedures for their application.

This is not a scientific book, but rather an identification guide for not only specialists, but government functionaries, naturalists, and those who are not very close to the amphibian world, but are interested in combating amphibian decline. This wide use is facilitated by a section explaining how to use the book, with an illustrated dichotomous key. Five color plates follow with small illustrations and photographs of the species mentioned. The illustrations are exactly the same as those appearing later in the species accounts, and do not follow the established systematic order for amphibians (e.g., Duellman 1993; Frost 1985, 2004). This arrangement is confusing; for example, in one plate salamanders are combined with several *Eleutherodactylus*, one *Osornophryne,* and one *Atelopus*, and in the next they are accompanied by *Phrynopus*, *Eleutherodactylus*, *Gastrotheca*, *Hyla*, and *Rhamphophryne*). Some order should have been followed, if not systematic at least one based on UICN categories. Regardless, as all these pictures are also presented in the species accounts, their inclusion here seems redundant. Before the species accounts, a list of species per threat categories is presented, but this includes only 48 species, not the full 55 treated in the accounts.

The first accounts are about the Critically Endangered (CR) species. For each account there is an illustration or photograph, all of good to very good quality, a common name, the scientific name, the family, and the category. This is followed by taxonomic comments (when considered important), the etymology of the scientific name, a description (which is really a short definition), the distribution (with a local map containing the known distribution at the end of each account), habitat, natural history, current status and threats. Under the last heading the most recent year of observation, conservation measures taken (if any), and the conservation measures proposed are provided. An additional helpful bit of information that could be included here in a future edition would be the number of specimens of each species in collections.

The last part of the book has a glossary of technical terms, followed by the acronyms used in the book, a literature section, and an index of common and scientific names. A map of the national parks of Colombia ends the book.

In general, I am happy to see this first step to do something about endangered amphibians in a neighboring country (I live in Venezuela), which is the first of its kind in Latin America. It is an attractive, well illustrated book, with a great deal of information on the general topics of amphibian decline and conservation and on the specific problems in Colombia. It meets all expectations for this first step by the authors.

One of the handicaps this book has is language, because it is written in Spanish. However, I think that all interested herpetologists working with tropical American species should be able to handle Spanish, at least to a reading level. I do, however, want to note some minor faults or details that could be improved in a subsequent edition. On page 76, in the section "How to use this book," a drawing of the dorsum of a frog appears, with some external anatomical features indicated. Two of these, "cloaca" and "glándula parotoidea" (parotoid gland) are not well delimited (especially the latter, because the frog is an *Eleutherodactylus*, which lack such glands!), and a non-frog specialist could be confused.

In the key (p. 81), couplet 3 leading to frog families says "palmeaduras sólo en las patas" (webs only on the feet) and is applied to dendrobatids and leptodactylids, although there are some dendrobatids with reduced webs and many *Eleutherodactylus* have no webs between the toes. On page 92, pictures of what I recognize as *Bufo granulosus* as an example of granular or tubercular skin, and the skin of *Atelopus farci* demonstrating a skin with warts, are not very adequate for the leptodactylids (mostly *Eleutherodactylus*). Likewise, illustrations (p. 93) of *Eleutherodactylus mnionaetes* dorsal skin as having "pliegues dorsolaterales cortos no extendidos" (dorsolateral folds short and not extended), and *Dendrobates lehmani* as illustrating "piel del dorso con tubérculos o gránulos bajos" (dorsal skin with low warts) are not the best examples to use (*D. lehmani* has completely smooth skin!). On page 96 there is a mention of "ranas grandes, LRC superior a 35 mm" (big frogs, SVL superior to 35 mm), and on page 98 the text reads "[ranas de] tamaño mediano, LRC= 56 mm)" (medium sized frogs, SVL = 56 mm). Although a specialist should understand that a dendrobatid of >35 mm can be considered big, and that an hylid of 56 mm can be considered of medium size, this is again confusing for non-specialists. Also, some terminology employed in the key, like "cabeza en forma de casco" (casque-headed form) for *Gastrotheca*, may have little meaning for non specialists. Even I do not find any similarity between a casque and

the head of a *Gastrotheca*.

In the current status and threats section of the *Atelopus ebenoides*, it is stated that *A. e. marinkellei* was last seen in 1995, but this information is not provided for *A. e. ebenoides*. In the same account the authors state that the species decline is related to global warming. Although all herpetologists are sure that global warming has a lot to do with the decline of some species, there is no direct evidence of such a link for this particular species.

The etymology of *Atopophrynus syntomopus* is not complete (the meaning of the generic name is not explained). That for *Atelopus subornatus* is inaccurate; the epithet makes reference to the fact that the species is ornately patterned on the underparts, not specifically that they are red or orange below. No meaning is given for the meaning of the specific epithet of *Atelopus farci*, although Lynch (1993) clearly stated that the nominative was "the acronym for a guerrilla group in Colombia (FARC) that frequents forests (especially cloud forests) and is dressed in khaki. Although FARC disrupt Colombian society, it does provide protection to the endangered cloud forests and their non-human inhabitants. The species is dedicated to FARC for its conservation, but not political, efforts." Indeed, it is strange that the armed conflict between the national army, the two main guerrilla groups (FARC and ELN), and the paramilitaries, which has catastrophic consequences for nature in general (e.g., deforestation, coca cultivation, use of herbicides) is hardly mentioned in the text at all.

Several illustrations are reproduced from other sources without attribution. For example, drawings of *Cryptobatrachus nicefori* (p. 160) from Cochran and Goin (1970) appear without citation, and in *Atelopus minutulus* account (p. 191) an unreferenced drawing of *Atelopus* sp. eggs comes from Lynch (1986). Illustrations of two types of *Atelopus* (*ignescens* and *longirostris* groups; p. 196), also unattributed, are derived from Peters (1973). References for illustrations are also lacking for should appear in pages 285, 290, 294, 320, 324 and 363, for *Phrynopus adenobrachius* (p. 285), *Rhamphophryne rostrata* (p. 290), *R. truebae* (p. 294), *Eleutherodactylus carranguerorum* (p. 320), *E. fallax* (p. 324), and *Rhamphophryne macrorhina* (p. 363).

In the account for *Colostethus edwarsi*, the description uses the webbing formula of Savage and Heyer (1967), although it cites Heyer (1967). Anyway, I do not understand why this old formula is used when an improved version was provided by Myers and Duellman (1982) and more recently by the original authors (Savage and Heyer 1997).

In the taxonomic comments for *Eleutherodactylus lichenoides* (p. 231), the author (Lynch) states that there are almost 200 species in the *E. unistrigatus* group, when on page 260, other authors (Rueda-Martínez and Rueda-Almonacid) say that there are about 150 species in the group. This is especially strange given that Lynch and Rueda-Almonacid have collaborated in many descriptions of *Eleutherodactylus*. Elsewhere it is stated that the lowland frogs of the *Atelopus longirostris* are not referred to in the book, but in fact *A. minutulus*, which has a species account, is referable to this group.

On page 276 photos two species of *Gastrotheca* appear, but these are not identified. The same is true of two species of *Dendrobates* appearing on page 306. A series of photos showing individual variation appears in the account of *Dendrobates occultator* (p. 311), but to me the species shown actually appears to be *D. bombetes*.

Finally, I will comment on the common Spanish names given to taxa in the *Libro Rojo*. Although it is perhaps odd to assign such names to species that are referred to only by specialists using their scientific names, it may be necessary for official purposes. I dealt with a similar issue in my list of Venezuelan amphibians (Barrio-Amorós 1998). While many names coined here make sense, others seem less appropriate. For example "rana saltona" (jumping frog) is given for *Colostethus*, which are usually called rocket frogs, and the "salamandra corpulenta café" (coffee robust salamander) for *Bolitoglossa lozanoi* seems less useful than "salamandra de Lozano." "Rana de lluvia de ojos rojos y amarillos" (red and yellow eyed rain frog) is provided as a common name for *Eleutherodactylus actinolaimus*, which has neither red nor yellow eyes! This might be better called "rana de lluvia de gola rayada" (throat striped rain frog). Perhaps strangest of all is "rana ladrona de azúcar" (sugar burglar frog), a strange name that makes no sense, applied to *Eleutherodactylus phragmipleuron*, for which something like "rana de lluvia [almost all *Eleutherodactylus* are called rain frogs] de Medellin" would have been more appropriate.

Despite my criticisms, I consider all these issues easy to solve in a future second edition of the *Libro Rojo*. This is a book of fundamental importance for all those who are concerned with amphibian declines, even if it is in Spanish (a good opportunity to learn a new language for some!), and a benchmark for all other countries in the Americas to aim for.

Acknowledgments.—I appreciate the comments of Ángela Suárez Mayorga on an earlier version of this book review.

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Lizard Social Behavior, edited by Stanley J. Fox, J. Kelly McCoy, and Troy A. Baird. 2003. Johns Hopkins University Press, Baltimore, Maryland (www.press.jhu.edu). xiv + 448 pp. Hardcover. US $89.95. ISBN 0-8018-6893-9.

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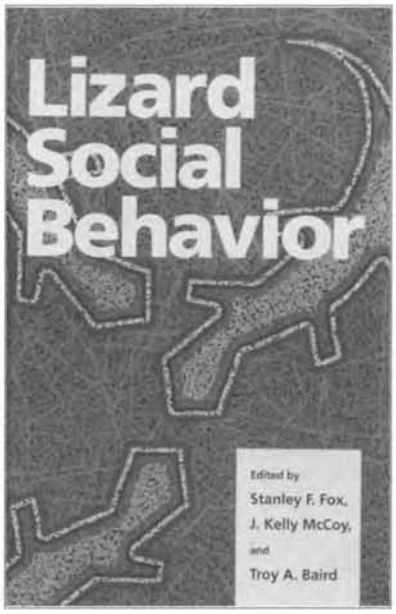

In recent decades, lizards have become model organisms for studying general problems of ecology and evolution. Three previous international symposia on lizard ecology have resulted in proceedings volumes (most recently Vitt and Pianka 1994) that acquired a wide audience, both in and outside the herpetological community. *Lizard Social Behavior* is the proceedings volume of another related symposium organized by J. K. McCoy, S. F. Fox, and T. A. Baird at the 1999 Joint Meeting of Ichthyologists and Herpetologists. This symposium gathered investigators who use lizard models to address theory in sexual selection and the evolution of social behavior. Due to a general lack of parental care and other complicated forms of behavior, and because of their particular convenience for field studies, it is often more advantageous to use lizards to test some basic predictions about mate choice and sexual selection determinants than birds and mammals. This book has demonstrated this convincingly and it has already been favorably reviewed in a number of behavioral and ecological journals (Otter 2003; Staple 2003; Goodman 2005).

The book includes 11 chapters divided into three major sections according to the level of variation studied: variation among individuals within populations; variation among conspecific populations; variation between species. Each section is supplied with an introduction by an eminent behavioral ecologist (P. Marler, G. H. Orians, and G. W. Barlow) that summarizes the contributions and evaluates their methodology. The editors' general introduction outlines the advantages and special properties of lizard models.

Baird, Timanus, and Sloan (Chapter 1) monitored and experimentally manipulated social behavior in two isolated populations of the collared lizard *Crotaphytus collaris*. They present uniquely thorough data on seasonal, ontogenetic, and individual differences for both sexes and discuss their determinants, mainly in terms of costs and benefits of territory defense in various natural contexts. The next three chapters are mostly restricted to male behavior. Whiting, Nagy and Bateman (Chapter 2) provide an extensive overview of research on the evolution and maintenance of social-status-signaling badges in different animal groups and put in this context their study of the bright ventral coloration in *Platysaurus capensis* (Cordylidae). The badge size tends to reflect true fighting capacity; when experimentally increased, it enhances the contest success of its owner. Zamudio and Sinervo (Chapter 3) explore a peculiar polymorphism for male mating strategies found in *Uta stansburiana*. Three behavioral morphs – territorial owners, moderately territorial female guards, and non-territorial sneakers – which also differ in throat coloration, are genetically fixed, and this polymorphism is balanced by a frequency-dependent sexual selection. A great advance of this study is a reliable method of measuring reproductive success using a molecular genetic procedure. Cooper (Chapter 4) thoroughly reviews relationships between antipredatory behavior and social behavior in light of predictions of optimal escape theory. The author's field observations and clever experiments on the skink *Eumeces laticeps* coupled with related studies on some other lizards, demonstrate that males often need to trade off time spent avoiding predators with time spent engaging in courtship, mate guarding, and territory defense. Social and mating costs of autotomy were also considered in depth in this chapter.

The second section of the book includes investigations of conspecific populations in different environments. Using both field and experimental approaches, McCoy, Baird and Fox (Chapter 5) studied sexual size dimorphism, sexual dichromatism, and various parameters of social and mating behavior of both sexes in three Oklahoma populations of *Crotaphytus collaris* (cf. Chapter 1). The results conform to their hypothesis that the study environments differ in their potential for intra- and intersexual selection — the phenotypic outcome (dimorphism, behavior) being additionally affected by natural counter-selection which also varies in intensity among habitats.

The next two chapters consider variation among island populations. Hasegawa's long-term investigation (Chapter 6) on the skink *Eumeces okadae*, which inhabits the Izu Islands of Japan, reveals an unusual, positive association of predation rate and sexual selection intensity. Under greater predation, females show a highly secretive behavior that results in a strongly biased operational sex ratio and exerts the male-male competition for mating opportunities.

An extensive study of lava lizards (*Microlophus* spp.) from the Galápagos Islands by Stone, Snell, and Snell (Chapter 7) addresses possible effects of the rates of predation, parasite infection, and food supply (these vary as predicted by island biogeography) on lizard population density, behavior, and morphology. The results suggest the importance of predation in shaping the inter-island variation in body size and shape, population density, and social system.

The final section addresses the variation between species; its contributions vary substantially in their research design and approach. Hews and Quinn (Chapter 8) explore the endocrine basis of signal coloration and behavior in a range of *Sceloporus* and *Urosaurus* species. Some of the species are dimorphic, with males differing from females in having a colorful patch and more aggressive behavior; the other species are not dimorphic, both sexes exhibiting either masculine or feminine pattern of the first group. Interspecific and sexual differences in target-tissue receptivity

(rather than hormone level) were identified as the primary proximate determinant for the observed diversity.

Gier (Chapter 9) compares two iguanid species, *Ctenosaura similes* and *Dipsosaurus dorsalis*, which occupy vastly different habitats (forest and desert), to reveal environmental correlates for the differences in their mating systems and sexual size dimorphism.

Fox and Shipman (Chapter 10) studied seven closely related *Liolaemus* species occupying different elevations in central Chile. Local environment was a more important determinant of social behavior than phylogeny. In this system, the highest study site (2900 m a.s.l.) provides the most optimal habitat (better thermal opportunities and food supply, low predation rate). The highland species, *L. bellii* and *L. leopardinus*, are more abundant and less aggressive than the other forms; also, they are more interactive, suggesting a more complex social behavior that has rarely been reported for other lizards (e.g., O'Connor and Shine 2003). This study uses original methods to quantify lizard thermal opportunities and to factor out phylogenetic effects.

The final chapter (Losos, Butler, and Schoener) discusses aspects of sexual dimorphism in body size and shape in the Caribbean anoles, whose repeated radiation on different islands produced the same set of ecomorphs adapted to particular habitats. The study offers further evidence that (1) local conditions, rather than phylogeny, determine patterns of sexual dimorphism in external morphology, and (2) habitat types can differ in their potential for sexual selection.

Each chapter clearly outlines its hypotheses and how they were tested. Extensive reviews of relevant literature include both special and more general contexts, and the pooled reference list (pp. 381–434) is valuable *per se*. This makes the book useful for both experienced researchers and students.

My minor criticism concerns an editing issue. In a number of places (particularly Chapter 5) the book contains sentences or larger text blocks that seem unnecessarily complicated, including apparent redundancies or other faults.

Overall, *Lizard Social Behavior* is an outstanding contribution to reptilian behavioral ecology, a must-have for everybody from this field and those who are dealing with sexual dimorphism and sexual selection. This book is also of great interest for students of life-history, ecological morphology, and particularly for evolutionists. Indeed, it may well have been appropriate for the book to have been entitled *Lizard Social Behavior: Evolutionary Implications.*

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Amphibian Declines: The Conservation Status of United States Species, edited by Michael Lannoo. 2005. University of California Press, Berkeley, California, USA (www.ucpress.edu). xxi + 1094 pp. Hardcover. US $95.00. ISBN 0-520- 23592-4

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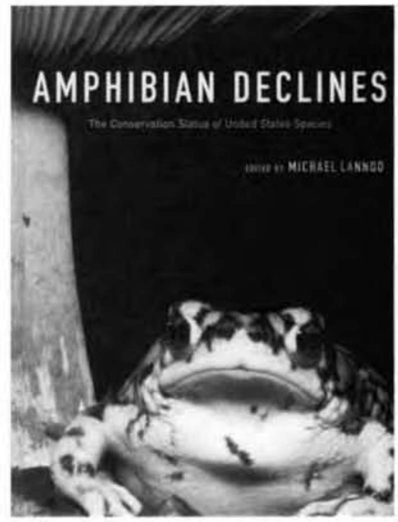

Fifteen years have elapsed since 'amphibian' and 'decline' first became welded together in our imaginations. Prior to the recognition of decline phenomena, amphibian conservation was a sleepy corner of our science. A Web of Science query (conducted 10 October 2005) reveals that of 392 articles answering to a subject search for 'amphibian and conservation' just one was published prior to 1990. During the ensuing explosion in research we have learned our initial suspicions were largely correct: the problem of declining amphibian species is widespread and severe enough to lead to multiple species extinctions in some regions (Houlahan et al. 2000; Stuart et al. 2004). Early on there were some, particularly in the media, who sought to characterize declines as emanating from a single mystery cause. Many biologists argued back that there was not enough known to decide what factors were responsible. While we still may claim ignorance, anyone concerned about the issue can now heft the 1100+ page volume entitled *Amphibian Declines: The Conservation Status of United States Species*, edited by Michael Lannoo.

The proportions of this book offer the first important clue about its contents. Lannoo has adopted an 'all flowers shall bloom' approach to amphibian declines. There are no fewer than 215 contributors; there is a decent chance you are one of them. So let me begin by noting that the book offers a definitive look at the issue of amphibian declines. While the stated geographic scope is the United States, several of the authors work elsewhere in the world. Issues which might not be expected to get top billing in a book on the U.S. are dutifully covered as are essays (52 in total) on every other potential cause of declines you may have heard of. In fact, it would be extremely difficult to fault the book for topics it fails to touch on. If amphibian declines are important to you, and they should be, then you should read this book.

But what does it mean to read a book like this? This was the first question crossing my mind as I attempted, unsuccessfully, to fit the new volume in my bookbag. Lannoo states that his intent is to "assemble and integrate" what we know about declines. A quick scan of the table of contents suggests this process has not incorpo-

rated meaningful triage. That job has been left to readers who must decide why, for example, there is an entire chapter on renal adenocarcinoma. If you were wondering whether there is any evidence to link this cancer to declines, the authors helpfully put that concern to rest: "…there appears to be little about the Lucké renal adenocarcinoma to concern population biologists (p. 101)." Other chapters focus on limb malformations. One can argue the case for inclusion: we still don't know whether abnormal limb development is a threat to amphibian populations. But why are there two of them and by what criteria is an additional chapter on the basic biology of trematodes justified (Trematode parasites *may* be responsible for some limb deformity outbreaks in nature and limb deformities *may* cause declines)? Chapters with dubious claims on the attentions of readers interested in declines are numerous. Fortunately, there are also outstanding, topical essays that will leave readers informed and intrigued.

The many essays offering overviews of research areas (e.g., Ecotoxicology authored by Ray Semlitsch and Christine Bridges) offer brief, informative summaries that give an idea of what has happened and where the field is headed. Many are structured like primers and are likely to be most useful for the uninitiated. Other more targeted essays are likely to be more appealing to specialists. As one example, a series of three essays on the Cricket Frogs (*Acris crepitans*) of the upper Midwest leaves readers with a well developed picture of a regional decline. While the authors of these studies are still far from determining the cause for declines, they have been unusually thorough in their use of observational data in the development of their research. In the study of some other North American declines there has been a tendency to rush immediately to experimentation without clearly describing the phenomenon to be understood. While the observation first approach is not fast, it is far more likely to lead to robust inferences (Storfer 2003).

Other essays are less about science than its context. A well titled chapter on "Houston toads and Texas politics," authored by Lauren Brown and Ann Mesrobian, leads the reader through an agonizing series of events and decisions that provides a warning to be heeded by all involved in amphibian conservation. The Houston Toad (*Bufo houstonensis*), a federally listed species, has gotten the kind of protective status and public attention that many biologists can only dream of garnering for their imperiled species. Nevertheless, there is little evidence that this has helped the toads much. This essay shows in stark terms that while we continue to toil to raise public awareness and provide evidence of threat, we will do well to consider what will or won't happen next. This theme is echoed in an excellent essay written not by a biologist, but a journalist. William Souder argues that amphibian biologists have been largely ineffective in communicating their findings to the public and offers some reasons why. His sobering chapter makes it clear that some of the obstacles are inherent in the way the media covers science—amphibian biologists hoping to surpass these hurdles will do well to consider his counsel closely.

Close followers of the amphibian decline literature will know that the last few years have witnessed the publication of a great deal of important research. This fact makes it especially disappointing that many of the essays in a book with a 2005 publication date appear to be a few years old or older. Whether this delay is a byproduct of attempting such a large publishing project is not clear. Regardless of its origin, the effect for readers is unfortunate. While it remains true that many of the essays still offer the most recent treatment of their respective topics, several have been superceded; for the remainder, readers will be left wondering how they might have changed given consideration of more recent work.

Another critical aspect of the book is tipped by its title. *Amphibian Declines: The Conservation Status of United States Species* is actually two books in one. The second half of the book is comprised of species accounts focusing on "the conservation status of United States species." Each account is divided into four categories (Historical versus current distribution, Historical versus current abundance, Life history features, and Conservation). Within the life history section there are 18 subheadings covering everything from breeding mode to longevity to anti-predator mechanisms. Anyone familiar with the amphibian literature will not be surprised that for most of these categories we know next to nothing for many of the 289 species recognized. However, the accounts offer nice summaries of what we do know and even experts can expect to learn new information about their own study species.

These accounts will undoubtedly be enormously useful to people interested in amphibian conservation as well as basic researchers. However, I must admit believing that a tremendous opportunity remains. The authors of the accounts invoke classic volumes such as Wright and Wright (1949) as the inspiration for their national scale effort. However, in 2005 should reference information like this be distributed in a printed book when it is so much more suited for distribution via the Web? To answer this question for yourself, check out the British Trust for Ornithology's Birdfacts database (http://www.bto.org/birdfacts/) and compare it with this or any book attempting to relate comparable information. Many of the same categories appear in Birdfacts which also includes legible maps and figures that can be easily updated as new information appears. Even the underlying data can be made available to users who can then readily generate their own summaries and customized comparisons. With apologies to salamander biologists, a "Frogfacts" database based on Lannoo et al.'s efforts could offer a highly useful complement to existing sites relating information on amphibian population monitoring (http://www.pwrc.usgs.gov/naamp/) and malformations (http://frogweb.nbii.gov/narcam/).

While perhaps cumbersome in their present form, one great benefit of including the species accounts in the book is the opportunity to summarize what they tell us about the overall status of the U.S. amphibian fauna. David Bradford takes on this challenge in what is arguably the most important essay in the book. His chapter is full of information that is clearly presented and, possibly, more striking and important than the understated and businesslike delivery will suggest to many readers. In fact, it leaves a large elephant in the room.

Amphibian biologists have spent 15 years amassing and supporting various hypotheses without doing much to eliminate them. Bradford's review offers one of the few opportunities in the book to get an overview of what we have learned and to decide where to go next. He shows very clearly that just three decline mechanisms can be considered broadly relevant to U.S. species: land use, exotic species and chemical contaminants. Of these land use is far and away the most often cited. The essay relates this finding with very little comment, but comment it deserves. If those interested in conservation want to take on the most important threats to amphibian populations in the United States, the most comprehen-

sive, national scale consideration has a clear answer—and it will be surprising to many people.

These findings, presented at the end of the book, offer a nice bookend to Tim Halliday's opening chapter in which he notes that we have excellent evidence that there is no 'smoking gun,' if by smoking gun we mean a single cryptic cause. He argues that it is high time to follow a critical consideration of what we have learned with a refocusing of our efforts on the factors that do matter. This will mean deciding that some avenues of research deserve less attention. One of the most critical unspoken conclusions from Bradford's essay is that ultraviolet radiation can now be placed in such a category. UV was one of the first nominated causes for declines and has received more attention than perhaps any other hypothesis. Bradford's review suggests that as a threat to U.S. species, UV ranks along with harvest as a minor issue. Recent work, not cited here, has called the relevance of UV for declines into serious doubt even for those species and regions where it was initially studied (e.g., Biek et al. 2002; Palen et al. 2002). If amphibian biologists are serious about achieving conservation goals, Halliday cogently argues that we will have to shift some of our attention to understanding demography of amphibians in human affected landscapes and their reliance on connections between wetland and upland, and among populations.

In the early 1990's declining amphibian populations attracted the notice of biologists and the public in large part because there was a strong suspicion that something unusual was happening. In essay after essay the veterans of the research campaign report that it is quite likely that there is nothing unusual about many U.S. amphibian declines. Amphibians offer typical stories from the conservation front: a set of factors, predominantly related to human use and alteration of the environment, is acting to reduce and eliminate populations and species. Along the way, biologists have also shown that amphibians may need to yield their unique 'canary' status—several authors note that it is time to stop considering amphibians to be unusual or particularly sensitive to environmental insult. Curiously, in being typical, future studies of declining amphibians may be in an even better position to offer lessons for the conservation of other animals less amenable to study and for which a book of the size and thoroughness of "Amphibian Declines: The Conservation Status of United States Species" is unlikely to appear for a long time to come.

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The Amphibians and Reptiles of El Salvador, by Gunther Köhler, Milan Vesely, and Eli Greenbaum. 2005 (dated 2006). Krieger Publishing Company, 1725 Krieger Drive, Malabar, Florida 32950–3323, USA (www.krieger-publishing.com). ix + 238 pp. Hardcover. US $49.50. ISBN 1–57524–252–4.

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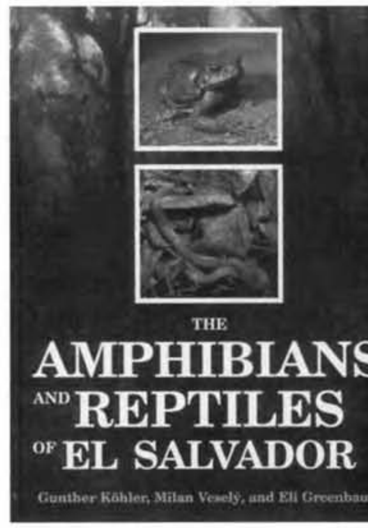

El Salvador (ES) is the smallest of the seven Central American countries and the only one located entirely on the Pacific versant. As such, its known herpetofauna of 130 species (32 amphibians and 98 reptiles) is also the lowest total for the seven nations. Nonetheless, a comprehensive synthesis of the ES herpetofauna was previously lacking (Mertens 1952, in his review of the ES herpetofauna, treated 23 amphibian and 75 reptilian species that were largely collected by German naturalists) and this book admirably fills that void.

The book begins with a short (1 p.) introduction followed by a two page materials and methods, each listed as a separate chapter. Chapter 3 (5 pp.) is on the environment and provides short descriptions of the country's physiography, climate, and vegetation. Chapter 3 also includes two maps, one showing the political boundaries of the country's departments and the other showing the country's "ecoregions." Ten plates showing various vegetation types accompany this chapter. Chapter 4 (4 pp.) is titled "Composition of the Herpetofauna" and includes a table on the taxonomic composition of the ES herpetofauna and another listing those taxa with a type locality in ES. A section on erroneous and questionable records is also included. Chapter 5 (64 pp.) treats the Class Amphibia and includes bilingual (English and Spanish) dichotomous keys to the adults of the three amphibian orders found in ES, the four salamander species, the 27 anuran species, and the larvae of 23 (counting both *Hypopachus barberi* and *H. variolosus*, which cannot be distinguished from one another morphologically) anuran species (not 20 as stated by the authors). Chapter 5 also includes the species accounts of the 32 amphibians known from the country. Each species account includes the scientific name (along with authorship), a suggested Spanish common name, a partial synonymy, geographic distribution (overall), ecological

distribution (in ES), description, call (anurans only), natural history, conservation status, and specimens examined (including precise locality records and museum numbers). Some of these species accounts also include a list of published locality records of specimens not examined by the authors, and occasional accounts also contain a section on taxonomic comments. Each species account also includes a color photograph of the animal and a map with the ES localities plotted. Drawings of some features of many of these species are also included. Drawings of the oral discs of 12 species of anuran larvae also complement the tadpole keys. Chapter 6 (141 pp.) treats the Class Reptilia. Bilingual dichotomous keys are also included for the "major groups" ("Serpentes, Testudines, Crocodylia, and Sauria"), the two crocodilian species, the eight turtle species, the 30 lizard species, and the 58 snake species. The reptile species accounts follow the same general format as those of the amphibians, except that the conservation status of most species is not given and the natural history sections are omitted from the *Drymobius chloroticus* and *Leptophis modestus* accounts. These reptile species accounts also include a color photograph of each species, a dot locality map for each species, and numerous drawings. Following Chapter 6 is a 16-page Literature Cited section that has 392 references listed (including several to web sites). The final section is a four page index that includes scientific names (species names listed by genus), higher rank names, and selected other names or words mentioned in the first three chapters.

The species descriptions are usually based on data taken from ES specimens, but occasionally information had to be taken from the literature (e.g., much of the sea turtle and crocodilian descriptions) or on data from specimens from other Central American countries or from southern Mexico (e.g., *Hyalinobatrachium fleischmanni*). These species descriptions necessarily vary in length, but I found them all to be well done. These descriptions used along with the identification keys should allow one to correctly identify any specimen of amphibian and reptile in hand from the country. The only complaint I have about the descriptions and identification keys is that there is no glossary to identify the numerous terms used. Given that the identification keys are not illustrated, it is even more desirable to have had a glossary included. Also, the meanings of ecomorphological guild (e.g., nektonic) and developmental mode (e.g., exotrophic) terms used for anuran larvae should have been explained in a glossary.

The natural history sections include information from the authors' field notes when available, field notes of others who have worked in the country, and published data from ES and other Central American countries. The information presented in this section nicely summarizes the available information on the natural history of each species. The call sections of each anuran species account also summarize what is known and point the interested reader to the pertinent literature.

I was especially pleased to see the detailed locality data and museum numbers for the voucher specimens included in the "Specimens examined" and "Published locality records" sections. Compiling these types of lists are very time consuming and tedious, but add greatly to the usefulness of these types of books. However, I would have liked for the authors to have included an accompanying gazetteer that gave the location, elevation, and coordinates for each locality. Also, the locality maps for each species account would have benefited from having the departmental boundaries identified. I also found one error in that the map of *Eleutherodactylus rupinius* has the open squares wrongly placed.

Putting together color photographs of 130 species of amphibians and reptiles is a time consuming and difficult task. This task was complicated by the authors' understandable desire to use photographs of ES specimens when possible. As a result, several of the used photographs are poorly focused or too dark. Two photographs that were used, indeed do demonstrate the desirability of using ES photographs when possible. The photograph of *Dryadophis* (= *Mastigodryas*) *melanolomus* used (from Nicaragua) shows a salmon colored venter, which color is restricted to populations from northeastern Honduras southward through Costa Rica, and that of the *Leptotyphlops goudotii* used (from the Islas de la Bahía, Honduras) shows a vividly striped pattern and large yellow snout and tail spots, whereas those from ES are typically essentially black with smaller snout and tail spots.

The drawings accompanying the species accounts are well done and add greatly to the overall appearance of the book. I found two errors with these drawings as follows: Figs. 9a = *Ptychohyla salvadorensis* and 9b = *P. euthysanota* instead of the opposite as stated in the figure legend; Fig. 41 shows the color pattern of a *Pliocercus elapoides* on a drawing of the head scales of a somewhat modified *Micrurus nigrocinctus* (compare with their Fig. 48a).

This book is remarkably free of typographical errors; I was able to find only Santa Lucia (= Santa Lucía) on Page 165, Tala (= Tela) on Page 210, and Ophidea (= Ophidia) twice on Page 219. Errors of other types also seem to be largely lacking. Three I found are: the reference Campbell (1989) on Page 12 is not included in the Literature Cited; the statement on Page 43 (Taxonomic comments), attributed to McCranie and Wilson (1999), that the prepollical width/prepollical length of the single male *Plectrohyla psiloderma* from ES falls within the range of *P. glandulosa* is erroneous; and the correct locality data for the *Rhinophrynus dorsalis* in Plate 42 is "HONDURAS: Yoro: Tegucigalpita (20 m)." I would also take exception to the statement on Page 82 that members of the family Cheloniidae are "Closely related to the leatherback turtle (Dermochelydidae)."

The layout of this book is attractive with the photographs and species maps placed nicely within the species accounts. The text is not right-hand-justified, which is unusual among herpetological books, but does not detract from the overall appearance of the book.

Despite my minor criticisms, the authors have combined their knowledge of the ES herpetofauna to produce a very useful and detailed book on the herpetofauna of that Central American country. The authors certainly succeeded in summarizing the morphological variation and distribution of the amphibians and reptiles of ES as they stated was their goal in their Introduction. Anyone with an interest in the natural history of Central America should own a copy of this book.

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plicable to other elements of pattern. Future advances in technology (i.e., ambystomatid pattern-recognition software, Ravela and Gamble 2004; D. Church, pers. comm.) will automate the process of identifying individuals. Pattern recognition research is progressing in the field of facial recognition (Zhao et al. 2000), and this emerging body of literature (and associated products) can have practical applications for wildlife biology. Even with automated pattern recognition, a subset of computer-determined individuals may require validation using methods similar to the process we present (see also Whitehead 1990; whale fluke identification). Regardless of method, some assessment of bias is useful in evaluating whether a technique violates the assumptions of capture-recapture modeling (specifically 1) that marks are not lost during the period of study and 2) observers can recognize marked individuals, and do not designate marked individuals as new captures). Validation of data subsets can allow investigators to evaluate a marking approach, and thereby qualify the derived estimates of population size or trend.

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Herpetological Review, 2006, 37(1), 60–68.

Further Observations of Oviposition in the Surinam Toad (*Pipa pipa*), with Comments on Biology, Misconceptions, and Husbandry

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Although the Surinam Toad (*Pipa pipa*) was originally described in 1758 (as *Rana pipa* by Linnaeus), published information on the biology of this species has been slow to accumulate. The limited information available has been derived largely from preserved materials and observations of a few captive specimens. This note reviews the biology of the species, details original observations on reproductive behavior in captivity, aims to dispel some persistent misconceptions, and offers recommendations for captive husbandry in the interest of stimulating further research.

The Surinam Toad occurs widely throughout northern South America and is certainly one of the strangest and most fascinating of all anurans. From its morphology to its reproductive mode, this species is strikingly different from what we think of as "typically anuran." *Pipa pipa* is extremely depressed (dorso-ventrally flattened) and has a broad, triangular head with several fleshy sensory protuberances, a huge mouth, and tube-like nostrils. These traits combine to produce a bizarre appearance uncannily similar to that of the Mata Mata Turtle, as noted by Rabb (1969) and Armburst (1979). At 10–20 cm body length, their size is equally

impressive. Although the common name 'toad' suggests otherwise, pipids in general are primarily aquatic frogs that rarely venture out of water. However, they have been observed moving over land in the wild (Buchacher 1993; Deuchar 1974; Hewitt and Power 1913; Myers and Carvalho 1945; Pefaur and Cardoso 1992; Pough et al. 1998; Wager 1965; Zippel, pers. obs.) and will readily leave open-top aquaria.

Pipids tend to inhabit murky or swampy water where their vision is likely obscured and they rely on tactile cues delivered through the sensitive protuberances on their face and fingertips and through their lateral-line systems. Schüette and Ehrl (1987) discussed in detail the structure and function of the fingertips as tactile organs. The eyes of *Pipa pipa* are very small and anterolaterally placed (see misconception #7 below regarding their ability to see). Rabb (1969) offered that wild Surinam Toads are known to eat "crayfish and small spiny catfish;" Duellman (1978) found two relatively large fish—"an *Erythrinus erythrinus* (Erythrinidae) 30mm long and a somewhat smaller pimelodid catfish"—in the stomach of a wild 78 mm Surinam Toad. Captives will eat almost any appropriately-sized animal or piece thereof (see husbandry recommendations below). Their small forearms seem to move in a single plane, from in front of the face to the open mouth. They execute this movement repeatedly as they sift through benthic debris looking for food. The hind legs are large and powerful with heavily webbed feet and are used for propulsive swimming. The hind foot even has a spade, similar to that in *Scaphiopus*, which might be used for burrowing into loose benthic substrate.

Male Surinam Toads might be slightly smaller than females and have thicker forearms. Males have a pointed, down-turned cloaca; in females, the cloaca is thicker, rounder, and upturned (Schüette and Ehrl 1987). The female cloaca in swollen, reproductive condition is illustrated in Rabb and Snedigar (1960) and clearly photographed in Armburst (1979), Rabb (1961), Schüette and Ehrl (1987), and Shibuya (1968) (see misconception #3, below). Males call year-round, particularly at night, but with greater frequency and intensity in the breeding season, which might be annual (Palmer 1994) or semi-annual (Schüette and Ehrl 1987). The call is produced by the striking of two small bones in the larynx (Rabb 1960). Single clicks are thought to be a challenging territorial call, while the more rapid series of clicks is probably a mating call (Rabb and Rabb 1963a). Schüette and Ehrl (1987) provided sonogram and frequency data. Males can be extremely territorial, and male-male combat involves head butting, grappling, biting, snapping, swooping, and kicking (Rabb and Rabb 1963a).

Breeding Behavior.—Certainly one of the more interesting and scrutinized aspects of *Pipa* biology is the bizarre behavior involved in reproduction. Amplexus is inguinal and can last for several days before oviposition. In all seven species of *Pipa*, the maneuvers involved in amplexus result in the eggs being deposited on the dorsum of the female. Here they are engulfed by the hypertrophying, tumescent integument and are incubated for periods of weeks to nearly half a year, depending on the species. In *P. carvalhoi* (Brazil), *P. myersi* (eastern Panama), and *P. parva* (northeastern Colombia and northwestern Venezuela), the eggs develop into tadpoles, which are released into the water after 3–4 weeks and filter feed until they metamorphose into aquatic froglets 2–3 months later. In *P. arrabali* (Guyana, Surinam, eastern Venezuela, and northern and central Brazil), *P. aspera* (Surinam), *P. pipa* (Colombia, Venezuela, Guyana, Surinam, French Guiana, Ecuador, Peru, Bolivia, Brazil), and *P. snethlageae* (Brazil), the eggs develop directly into froglets before being released into the water after gestation of two to nearly five months (Table 1).

That the eggs are brooded within the dorsum of the female Surinam Toad has been known since 1705 (Merian, *fide* Schüette and Ehrl 1987); however, it was not until a series of captive breedings at the Brookfield Zoo in the late 1950s and early 1960s that it was revealed how the eggs got there (Rabb 1961; Rabb and Rabb 1960, 1963a; Rabb and Snedigar 1960). Although this species has been bred at other zoos and by private individuals, observations and data are rarely published. Several other institutions or individuals, in Germany (Armburst 1979; Jahn 1982; Schüette and Ehrl 1987), Japan (Iwasawa 1979; Iwasawa and Tanaka 1980, 1993, 1994; Shibuya 1978), England (Bartlett 1896; Sclater 1895) and the US (Drewes 1977; Tenny 2002), have published articles regarding reproduction in *Pipa pipa*. Summaries of oviposition and gestation data (Table 1) and growth and development data (Table 2) are provided herein.

I was fortunate enough to observe a single successful breeding event, which is herein compared to the three documented breeding events (all involving a single female, two with the same male) at the Brookfield Zoo. All reproductive behaviors occurred as documented by Rabb and colleagues with one exception: the amplectant pair observed by me used a modified form of the ovipositional "turnover." According to Rabb and Rabb (1960, 1963a), the ovipositional turnover consists of two distinct rotations, one about the longitudinal axis (an ascending sideways half-roll) resulting in an inverted or upside-down position *near the water surface*, followed by one about the transverse axis (a descending head-first half-roll) returning the pair to an upright position on the substrate (Fig. 1A). Note: It is not a simple, circular somersault (see misconception #1 below). By my observations, the turnover sequence began with the amplectant pair at rest on the tank floor. As previously documented, the female pushed off sideways with a hind foot to begin the rotation about the longitudinal axis. However, the pair immediately flipped into the upside down position about 10 cm from the bottom, not near the water surface. From here, they swam backwards using jerky motions of the hind limbs and moved upwards into a vertical head-down position; it was during this movement that the eggs were released and rolled forward on the dorsum of the female. From the vertical position, the turnover was completed normally, and concluded with the typical tilted, resting position (Fig. 2).

The significance of this modification is unclear. It is not a function of water depth, i.e., that this pair had less vertical water space than the animals at Brookfield, and the initial longitudinal rotation left them too near the substrate to complete the transverse rotation. The Brookfield enclosure was actually shallower (see comments below in misconception #2 regarding water depth required for breeding). The frogs observed by me had 40 cm of vertical water available, but utilized only the lower 20 cm. Alternatively, this modified behavior pattern might represent variation among females: all three breedings at Brookfield forming the basis of the original descriptions involved the same female, two with the same male (Rabb and Rabb 1963a). In other documented breedings where turnover behavior was actually observed, variations similar to what I observed have been depicted or described. Ac-

TABLE 1. A summary of oviposition and gestation data in Surinam Toads (*Pipa pipa*).

# Eggs oviposited	Yolk diameter (mm)	# Eggs implanted[1]	# Froglets emerging	Gestation[2] (d)	Reference
	6.35	40–114 (N = 6)			Wyman 1854
		80–90 (N = 1)	0	at 21°C	Sclater 1895
			80 50–60		Deckert 1917
96	6	76	20	77–136 at 21–27°C	Rabb and Snedigar 1960
66		55			Rabb and Rabb 1960
105 78		103 62	0	at 25–27°C	Rabb and Rabb 1963a
		190	25	≤ 62 at 24°C	Drewes 1977
273	6	184			Shibuya 1978
208		208	0		Armburst 1979
250 250		192 193	52 24	105–139 129–145 both at 26 ± 2°C	Schüette and Ehrl 1987
73 128 130 138 167 183 230 283	5	68 115 130 106 163 173 159 184	0 0 0 0 0 5 0 0	75 at 24 ± 2°C	Iwasawa and Tanaka 1994
		~70		90 at 21 ± 3°C	Palmer 1994
60–64		59	57	70–88 at 29°C	R. Haeffner, pers. comm.
			14[3]	72–77 at 25–26°C	B. Johnson, pers. comm.
			27	83–100 at 24–27°C	K.C. Zippel, pers. obs.

[1] - the difference between # eggs oviposited and # implanted represents the lost infertile eggs and a few lost fertile eggs; infertile eggs might become attached prior to falling off, but are not implanted as are most fertile eggs.
[2] - gestation values include only animals that survived, omitting premature births.
[3] - nine of these died within the first month.

cording to the photographs in Shibuya (1978), the pair made their initial rotation about the longitudinal axis immediately, as did the animals I observed, such that they were upside down just above the substrate, not at or near the water surface. Armburst (1979) used the words "Salti rückwärts" or backward somersault to describe the maneuver, suggesting a backward-moving component to the ovipositional turnover. Translated from German: "A backwards somersault brought the animals into a nearly vertical position, head down." He also offered that the eggs were always released when the pair was in the vertical head-down position. His Figure 3 clearly shows the animals in a head down position perpendicular to the substrate and the legend reiterates that this is when oviposition occurs. As with my observations, there is a backward moving component to the maneuver, and eggs were laid during the vertical head-down component. Iwasawa and Tanaka (1994) also observed that oviposition occurred after the pair rotated transversely "when they reached mid-water rather than near the water surface ..." Sughrue (1969) showed a pair from the Brookfield breedings inverted just over the substrate, a position that likely would not allow a transverse roll without first some backward or

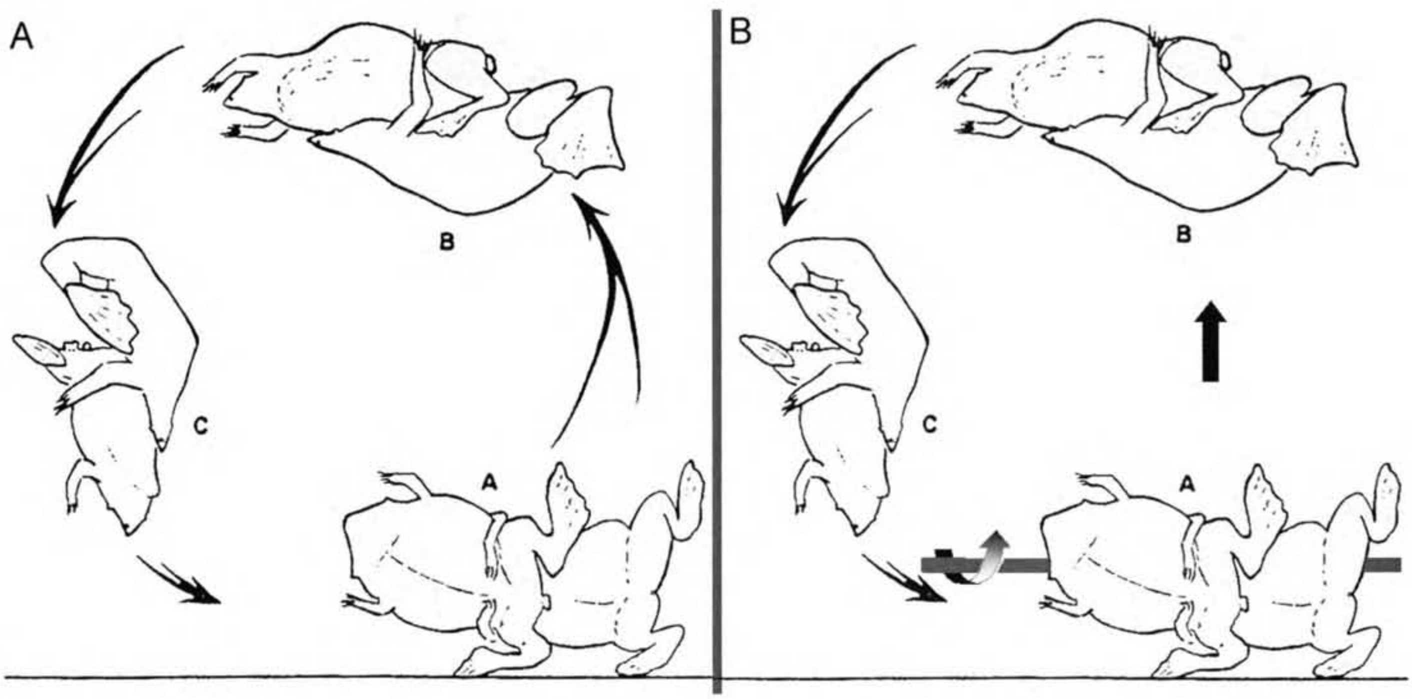

FIG. 1. The ovipositional turnover of *Pipa pipa* as observed by Rabb and colleagues. **A.** The original figure (Fig. 2) from Rabb and Rabb (1960), which might be misleading in its use of arrows connecting the different phases of the turnover using a circular format. **B.** My re-interpretation of the original: Position A has been moved directly under Position B and a straight vertical arrow connects the two. Note also the gray horizontal bar, which represents the longitudinal axis of the amplectant pair, the axis around which the first rotation occurs.

upward-moving movement. Eventually, Rabb (1973) changed his language, describing the location of the upside-down position and oviposition as "mid-water" without further explanation.

It is clear that the ovipositional acrobatics of *Pipa pipa* are more variable than is commonly assumed and are not clearly understood. Repeated observations, under captive conditions or preferably in the species' natural habitat, are required to determine the "normal" sequence.

Misconceptions.—In addition to my observations suggesting an element of variety in *Pipa pipa* ovipositional behavior, there are seven misconceptions that I wish to help dispel. Although several of these have been previously addressed throughout a disparate set of literature, some authors continue to miss them. These clarifications are herein summarized in one document, in the hope that the myths are not perpetuated in future works.

1. According to Rabb and Rabb (1960, 1963a), the ovipositional turnover consists of two distinct rotations: one about the longitudinal axis (a sideways ascending half-roll) leading to momentary pause in an inverted or upside-down position near the water surface, followed by one about the transverse axis (a descending head-first half-roll) returning the pair to an upright position on the substrate (Fig. 1). It can also sometimes include a backwards-swimming component during oviposition whereby the pair remains near the substrate (see discussion above, and Fig. 2). *In either case, it is not a simple, circular somersault.* This complex maneuver is photographed in Rabb (1961, unfortunately plates are printed in reverse order, per Rabb and Rabb 1963a,b), Shibuya (1978), and Sughrue (1969). However, it is still often described and illustrated as a circular somersault, both in the hobbyist/popular (Drewes 1977; Jahn 1982; Mattison 1991; Staniszewski 1995; Walls 1995; Zimmerman 1995) and academic secondary (Halliday and Adler 2002; Stebbins and Cohen 1995; Zug 1993) literature. This might be the result of misinterpretation of the Fig. 2 illustration in Rabb and Rabb (1960), recreated here in Figure 1A, which uses a circular format to show the different phases of the maneuver connected by arrows, thereby giving the misleading impression of a complete circular motion. I believe Rabb himself must have realized the confusion created; a later publication of this figure (1973) replaced the semi-circular arrow between A and B with a wavy arrow more vertical in orientation. I believe these figures would be

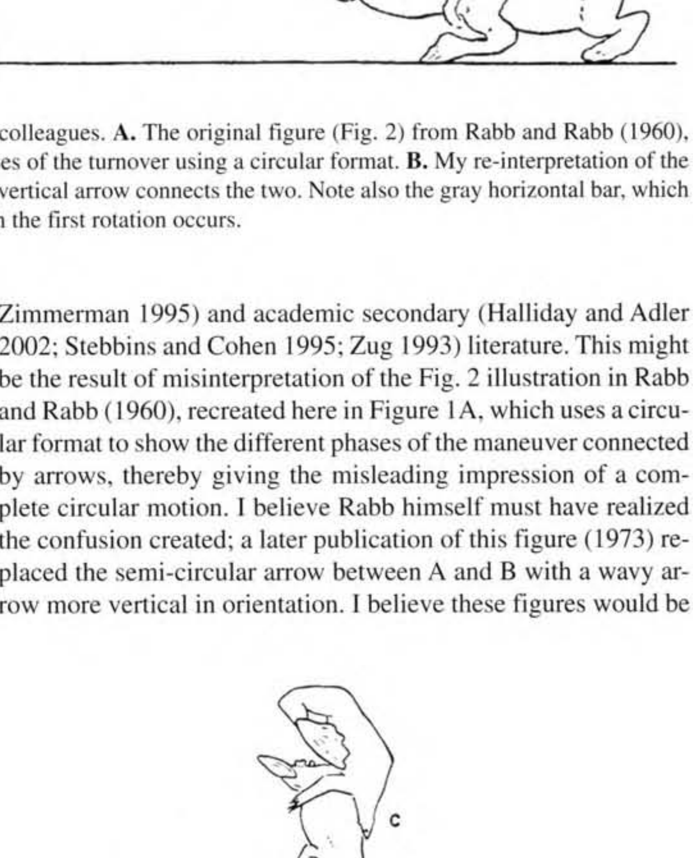

FIG. 2. The ovipositional turnover as observed by KCZ. Note that Position A has been omitted from this figure as it occurs largely in the same space as, and would be obscured by, Position B. That Position A occurs is assumed in this case; it would appear exactly as it does in Fig. 1. Oviposition occurs during the jerky backward movements transitioning Position B to C.

TABLE 2. A summary of growth and development data in captive Surinam Toads (*Pipa pipa*).

Time post emergence	Temp. (°C)	Length (mm)	Weight (g)	Sexual maturity	Reference
0	21–27		0.31–0.41 (mean = 0.36, N = 6)		Rabb and Snedigar 1960
0	24 ± 2	mean = 15.6 (N = 5)	mean = 0.41 (N = 5)		Iwasawa and Tanaka 1994
0	24	17			Drewes 1977
0	26 ± 2	18			Schüette and Ehrl 1987
0	23 ± 1	13–19			Palmer 1994
0	26–27	11–18			R. Haeffner, pers. comm.
70 days	26–27	57			R. Haeffner, pers. comm.
4 months	26–27	110		near adult size	R. Haeffner, pers. comm.
5 months	24 ± 2	81	57	spermatogenesis	Iwasawa and Tanaka 1994
6–8 months	26 ± 2	40–70			Schüette and Ehrl 1987
8 months	24 ± 2	90	62		Iwasawa and Tanaka 1994
1 year	26 ± 2	52–110 (mean = 75)			Schüette and Ehrl 1987
1 year				cloacal dimorphism	Schüette and Ehrl 1987
1 year	23 ± 1	50			Palmer 1994
1 year	24–27			males calling	K.C. Zippel, pers. obs.
15 months				males calling	Schüette and Ehrl 1987
2 years		77–210 (mean = 131)		oviposition	Schüette and Ehrl 1987
3+ years				males "capable of breeding"	Palmer 1994
6+ years				"maturity"	Rabb 1969

a more accurate reflection of Rabb's text if they used a truly vertical arrow to transition from Position A (on the substrate) to Position B (inverted) and had Position B directly above Position A. Thus, the movements include a longitudinal rotation during a direct vertical ascent, and a transverse rotation during a semicircular descent (Fig. 1B). Such a non-circular ovipositional maneuver occurs in other species of *Pipa* (Plunk 1996; Weygoldt 1976) and in some, but not all, non-pipine pipids (Rabb 1973; Salthe and Mecham 1974).

2. As a result of the circular somersault misconception, some authors have suggested that Surinam Toads require deep water for breeding to complete the "full circle" (e.g., Armburst 1979; Palmer 1994, Tenny 2002). Tenny recommended nearly 1 m of vertical water depth to allow for the ovipositional maneuvers; Palmer (1994) offered that anything less than 107 cm would result in failure of fertilization and implantation. This notion of required depth is also not uncommon in the zoo community. However, few of the successful breedings have had such depth available; in fact, most took place in surprisingly shallow water, not even twice the SVL of the adults. The original Brookfield breedings took place in a 70-liter tank (comparable to the industry-standard 20-gallon) (Rabb and Rabb 1960) and 28 cm of water depth (Rabb and Snedigar 1960). Drewes (1977) used a standard 15-gallon aquarium. The Toronto Zoo used a 150-liter tank with 25-cm deep water (B. Johnson, pers. com). Iwasawa and Tanaka (1993, 1994) offered 35 cm of vertical water. Armburst (1979), Schüette and Ehrl (1987), and the Denver Zoo (R. Haeffner, pers. com.) provided access to as much as 50 cm, while Palmer (1994) apparently offered ~120 cm. However, no other author described how much of the water column was actually utilized by the amplectant pair during breeding. I presented them 40 cm of water, of which they utilized only the lower 20 for their nuptial acrobatics. Palmer (1994) claimed annual success for 12 continuous years as a direct result of offering deeper water. He claimed that each ovipositional 'backflip' in deep water is accompanied by a close second backflip solely for fertilization, something which did not occur for him in shallow water. However, he offers no real data for comparison. This second fertilization maneuver has not been noted by anyone else working with *P. pipa*, other species of pipines (Plunk 1996; Weygoldt 1976), or other non-pipine pipids with nuptial acrobat-

TABLE 3. A summary of food items consumed by captive Surinam Toads (*Pipa pipa*). All whole-animal food items live unless otherwise noted.

Adults	Froglets	Reference
worms, fish		Sclater 1895
"frogs"[1]		Deckert 1917
strips of beef muscle and liver, guppies	tubifex, cyclops	Rabb and Snedigar 1960
goldfish, frozen smelt and whitebait	brine shrimp, tubifex	Drewes 1977
live and dead fish, earthworms, beef heart strips		Armburst 1979
earthworms, fish, fish fillets, rodent pups, freshwater shrimp	tubifex, daphnia, mosquito larvae, guppies	Schüette and Ehrl 1987
strips of pig liver, goldfish	tubifex	Iwasawa and Tanaka 1993, 1994
large nightcrawlers, live goldfish	small sections of redworms, guppies, slivers of liver	Palmer 1994
	blackworms, small guppies	Tenny 2002
goldfish, nightcrawlers	tubifex, daphnia; small goldfish and chopped nightcrawlers by 28 days	R. Haeffner pers. com.
worms, centrarchids and cyprinids ≤ 5 cm total length	blackworms, aquatic field sweepings	K.C. Zippel pers. obs.

[1] - the author was relating this information from a colleague maintaining the *Pipa* in the field in Trinidad and speculated that these were *Leptodactylus* sp., further stating that fish were offered but refused.

ics (Rabb 1973; Salthe and Mecham 1974).

3. In several hobbyist articles and books, authors have referred to an 'extensible ovipositor' in the female (e.g., Staniszewski 1995). The source of this falsehood comes from the 1896 paper by Bartlett, in which he unknowingly describes a pathologic condition of prolapse in one ovipositing female that died shortly after breeding. Although female *Pipa* spp. in breeding condition do show a distinct swelling of the cloacal lips, to 4 cm diameter (Schüette and Ehrl 1987), there is no cloacal tube with which the male maneuvers the eggs onto the dorsum of the female. Rabb and Snedigar (1960) made this point offering an illustration of a normal swollen female cloaca, and Rabb and Rabb (1960) and Schüette and Ehrl (1987) reaffirmed it, yet the misinformation continues to persist.

4. The eggs are not received *into* a honeycomb-like structure on the back of the female, as is sometimes reported in the hobbyist literature (e.g., Staniszewski 1995). Rather, they roll between the venter of the male and the slightly swollen dorsum of the female, where they adhere beginning near the vent and advancing anteriorly. The skin then swells up around the eggs and they sink into it, *forming* the individual chambers. This process can take as few as two (Iwasawa and Tanaka 1994) or as many as 10 days (Rabb 1961).

5. The stroking behavior of the amplectant male has been the subject of some speculation. Rabb and Rabb (1960) observed this behavior 11 times near the end of oviposition, both before a turnover and after a trip to the surface for air. The male was reported to swing his hind leg forward alongside the female's back, as far forward as the back of her head, and this movement was interpreted as stretching or a mechanical stimulus for inducing oviposition. It was observed again late in a subsequent breeding, after the female had gone into a swimming frenzy when frightened by a camera flash, and re-interpreted as an expression of dissatisfaction on the part of the male (Rabb and Rabb 1963a). In Sughrue (1969), it was called "a stimulating gesture." It was later shown in male *P. carvalhoi* that the stroking movements of the male's hind feet facilitate egg adpression (Mattison 1993; Weygoldt 1976; Zimmerman 1995). Eventually, this behavior was clearly observed in *P. pipa* as well: Jahn (1982) observed and provided photographs of "sweeping movements" of the hind legs of an amplectant male, movements which served to direct the eggs to "the right place" and "firm them down." [One otherwise reputable book reports that it is the hindlimbs of the female that distribute the eggs across her own back (Stebbins and Cohen 1995).] My observations of *P. pipa* agree with those of Jahn (1982): the amplectant male clearly used his hind feet to reach forward and adpress those eggs that fell onto the anterior portion of the female's dorsum. Rabb (1961) and Rabb and Rabb (1960) had previously attributed implantation of the eggs to the male's clasp and adpressed head, which is undoubtedly the case for the more posteriorly deposited eggs. However, as amplexus is inguinal, the anterior portion of the female's dorsum is not reached by the male's overlapping venter and chin. Indeed, Rabb and coworkers observed only two eggs deposited anterior to the midbody region, and thus this potential function of the stroke was not apparent them. This stroking behavior would be especially useful in pipines, and is in fact most frequently seen, late in the ovipositional period when eggs are being deposited furthest from the male's head, or before and after movements where egg loss is likely, such as those involved in breathing, turnovers, or

fright. Of course, the stroke might be multifunctional, also serving to stimulate or manipulate the female, as Rabb suggested. Indeed, the stroke is also seen in several non-pipine pipids (Rabb and Rabb 1963b) for which egg adpression is not a concern. The occurrence of the behavior in several genera in the small family suggests it might be a shared characteristic, perhaps for female stimulation or manipulation. However, for pipines, it would appear to be an exaptation that now assists with egg adpression.

6. Embryos do not receive sustenance from the female (e.g., Jahn 1982; Halliday and Adler 2002). Although froglets weigh more than eggs (Rabb and Snedigar 1960; Wyman 1854), their dry weights are the same (Rabb 1961). However, the embryos do appear to be receiving some essential substance or hormone from the brood pouch, as fertile eggs that fail to attach develop for approximately two days, to the same stage as eggs becoming enveloped at that time (Iwasawa and Tanaka 1994). In addition to not providing significant nutrition, the pouch might not be particularly well vascularized, as previously reported (Rabb and Snedigar 1960 and therein). Rather, it is lined with a hypertrophied epidermis (Iwasawa and Tanaka 1994), so the embryos might not even be exchanging respiratory gases with the female. Wyman (1854) observed in preserved specimens how the larvae tend to sit on top of the yolk, where they are nearest to the water and in an ideal location for external gas exchange. Iwasawa and Tanaka (1994) described how embryos sometimes protrude their highly vascularized transparent "tails" from the pouches late in gestation, possibly using the structure as a gill analogue. Rabb (1961) first described the highly vascularized tail and speculated on its possible role as a respiratory organ prior to its resorption three weeks before emergence. Rabb and Snedigar (1960) observed a similar structure in late abortions and early births, but were clear to state that this is not a tail, rather it is a vascularized sac protruding from the cloaca. However, Rabb (1969) no longer made the distinction and wrote "Respiration may be helped by a thin membranous out-pocketing from the cloaca, which possibly represents the remains of the tadpole tail."

7. *Pipa pipa* has incredibly small eyes. However, they are not blind or particularly visually impaired, as some authors suggest (e.g., Palmer 1994; Staniszewski 1995; see also comments in Armburst 1979). In fact they see quite well and respond to keepers peering into their enclosures without the vibrational cue of foot movement (pers. obs.). They will also come up to the surface to beg for food when they see a keeper and can readily learn to hand feed, gaping to receive their rations (Armburst 1979; Deckert 1917).

Husbandry Recommendations.—Breeding *Pipa pipa* in captivity has proven challenging. Given the right conditions, newly imported animals will readily engage in amplexus, but rarely oviposit. Unfortunately, most ovipositions that do occur end with all the eggs falling from the female's back. After a decade of working with the species, Brookfield only managed to produce offspring in two of eight breedings (Sughrue 1969). Toronto Zoo produced five offspring from a single fertile clutch, despite over a dozen breeding attempts by the frogs (B. Johnson, pers. comm.). Iwasawa and Tanaka (1994) managed success in only one of eight breedings. Even in full-term pregnancies, perfectly formed froglets sometimes die in or shortly after exiting the maternal chambers (Schüette and Ehrl 1987; pers. obs.). Rabb and Snedigar (1960) and Iwasawa and Tanaka (1993) tried using hormones to induce and maintain breeding condition, but met with negligible success. In the interest of promoting better husbandry to provide more opportunities for studying breeding behavior, I offer the following husbandry advice:

—Re-create a neotropical swamp. These large frogs need a lot of room to move around, and the more volume offered, the easier it will be to maintain water quality. A standard 55-gallon aquarium is minimal for a pair or maybe two if the filtration system is robust and sized to meet their biological filtration needs (see below). Cattle tanks or even small swimming pools are ideal for groups. Water depth is not so important (see misconception #2, above). Water should be warm (24–27°C), soft, acidic (pH = 6.5–6.9 using sphagnum or peat moss, tea bags, and/or oak leaves, which also beneficially stains the water with tannins), and murky (direct light limited). Excellent substrata include Java moss, sphagnum moss (slow to break down, but monitor pH), and leaf litter. The latter two take some time to waterlog, but provide excellent cover (psychological well being) for the frogs. Avoid putting heaters in the tank with the animals, as they might wedge themselves behind the tube and get burned when it activates. I have observed this in *P. parva* on more than one occasion. To avoid this risk, place the heater in a sump.

—Monitor water quality. pH can change, and biological wastes accumulate rapidly, especially in smaller tanks. Pipids generate copious amounts of ammonia (Cragg et al. 1961), which must be removed with manual water changes (can become a daily requirement) or with robust biological filtration. Aeration is not so important for pipids, which rely heavily on pulmonary respiration, but it is important to maintain adequate bacterial colonies in the biological filters (see Zippel 2001). A high dissolved oxygen content might also be required for the embryos (see below).

—Provide good food in abundance. Avoid strips of meat or organs and rodent pups (see Table 3), which seem unnatural. Feed live fish of the appropriate size, but avoid the exclusive use of goldfish, which are fatty and possibly cause hypervitaminosis D (Frye 1992). Also feed earthworms or nightcrawlers from clean sources (some are reported to be toxic [Schüette and Ehrl 1987]), and when they are available, one can supplement with freshwater shrimp, other crustaceans, and tadpoles.

—Odor is a very important breeding stimulus for *P. pipa* (Rabb and Rabb 1963a) and other pipids (Rabb 1963b). Try to maintain males in tanks isolated from the females and isolated from each other. This way, when animals are finally introduced, the encounters are novel and elicit the genuine responses that are gradually lost during the acclimation of cohabitation (pers. obs.). Isolated animals should be fed well, and kept in relatively shallow warm water. See Palmer (1994) regarding the use of cooler maintenance temperatures, although this paper offered so few data that it is difficult to gauge success relative to warmer temperatures. When they are to be introduced, put them into a deeper (preferably several feet, but 45 cm will suffice), cooler (to 21°C) tank to simulate conditions of flooding from the onset of the cool, rainy season. Schüette and Ehrl (1987) successfully used a similar temperature change regime, as did Rabb and Rabb (1963a), unintentionally. The Denver Zoo actually raised temperature (water level same) from 26 to 29°C to stimulate breeding.

—Light quality and duration have been shown to have a signifi-

cant effect on induction of spawning in two species of African pipids. Savage (1965) showed that *Xenopus laevis* spawns more readily in the presence of light vs. complete darkness. Rabb and Rabb (1963b) induced spawning in an inactive group of *Hymenochirus boettgeri* by moving them from under indoor artificial lighting to outdoor natural lighting. The effect of light, however, might occur indirectly via an increase in the concentration of an algal metabolite (Savage 1965). Commercial *Xenopus* breeders keep their isolated males under intense light to simulate the dry season insolation. Palmer (1994) claimed photoperiod decline is important to stimulate breeding in *P. pipa* but did not state how or to what extent it was manipulated.

—The role of auditory cues in inducing reproductive readiness has yet to be fully explored. Rabb (Rabb 1973; Sughrue 1969) was able to induce oviposition in isolated female *Xenopus laevis* and *Pipa parva* simply by playing back the calls of males. Most keepers realize that a metallic tap on the tank can induce calls from the males. Drewes (1977) commented on the role of a nearby garbage compactor in initiating amplexus in his animals. I have heard my males call vigorously in response to a nearby air conditioner, and especially in response to the low, rumbling frequencies of an electric bass guitar.

—The inclusion of certain snails, specifically Indian Tower Snails (*Melanoides tuberculata*), is not recommended, as these animals tend to attack the eggs before they can sink into the dorsum (Schüette and Ehrl 1987).

—Late-term deaths of froglets still in the pouches are not uncommon (e.g., Schüette and Ehrl 1987, pers. obs.). Drewes (1977) had eight such 'stillborns' out of 33 full term young. Schüette and Ehrl (1987) experienced some full-term deaths and even had fungus attack the female's dorsum. The froglets are moving around within the pouch at this stage, and will even feed on live prey (Rabb and Snedigar 1960). They are presumably relying on cutaneous respiration at this stage, so dissolved oxygen levels might be an important factor. Dead froglets should be manually removed from the maternal pouches to prevent infection of neighboring pouches and of the female systemically.

—Once froglets are free-swimming, they are very easy to raise. Feed them heavily on live food items (see Table 3) and watch water quality closely.

—The tadpole-bearing species will readily consume their own young (pers. obs.), while the froglet-bearers do not (Rabb 1961; Rabb and Snedigar 1960; Schüette and Ehrl 1987; pers. obs.). In *P. parva*, hungry cagemates will sometimes also eat newly deposited eggs off the back of a 'gravid' female (pers. obs.); feed heavily and isolate accordingly.

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NATURAL HISTORY NOTES

The Natural History Notes section is analogous to Geographic Distribution. Preferred notes should 1) focus on observations with little human intrusion; 2) represent more than the isolated documentation of developmental aberrations; and 3) possess a natural history perspective. Individual notes should, with few exceptions, concern only one species, and authors are requested to choose a keyword or short phrase which best describes the nature of their note (e.g., Reproduction, Morphology, Habitat, etc.). Use of figures to illustrate any data is encouraged, but should replace words rather than embellish them. The section's intent is to convey information rather than demonstrate prose. Articles submitted to this section will be reviewed and edited prior to acceptance.

Electronic submission of manuscripts is requested (as Microsoft Word or Rich Text format [rtf] files, as e-mail attachments). Authors without the ability to send manuscripts electronically may supply hard copy instead. Figures can be submitted electronically as JPG files, although higher resolution TIFF or PDF files will be requested for publication. If figures cannot be provided in this format, you may send them to the section editor for scanning. Additional information concerning preparation and submission of graphics files is available on the SSAR web site at: http://www.ssarherps.org/HRinfo.html. Manuscripts should be sent to the appropriate section editor: **Marc P. Hayes** (amphisbaenids, crocodilians, lizards, and *Sphenodon*; mhayesrana@aol.com); **Charles W. Painter** (amphibians; cpainter@state.nm.us); **Andrew T. Holycross** (snakes; holycross@asu.edu); and **James Harding** (turtles; hardingj@pilot.msu.edu).

Standard format for this section is as follows: SCIENTIFIC NAME, COMMON NAME (for the United States and Canada as it appears in Crother [2000. *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding*. Herpetol. Circ. 29:1–82; available online at <http://herplit.com/SSAR/circulars/HC29/Crother.html>]; for Mexico as it appears in Liner [1994, *Scientific and Common Names for the Amphibians and Reptiles of Mexico in English and Spanish*, Herpetol. Circ. 23:1–113]), KEYWORD. DATA on the animal. Place of deposition or intended deposition of specimen(s), and catalog number(s). Then skip a line and close with SUBMITTED BY (give name and address in full—spell out state names—no abbreviations). (NCN) should be used for common name where none is recognized. References may be briefly cited in text (refer to this issue for citation format).

Recommended citation for notes appearing in this section is: Lemos-Espinal, J., and R. E. Ballinger. 1994. *Rhyacosiredon leorae*. Size. Herpetol. Rev. 25:22.

CAUDATA

AMBYSTOMA T. TIGRINUM (Eastern Tiger Salamander). **PAEDOMORPHIC POPULATION.** Examples of paedomorphism can be observed in all caudate families (Duellman and Trueb 1986. Biology of Amphibians. Johns Hopkins University Press, Baltimore. 670 pp.). Paedomorphic individuals have been reported in several species of the genus *Ambystoma*, however paedomorphic *A. t. tigrinum* populations have only been reported in Michigan (Hensley 1964. Herpetologica 20:203–204). This subspecies occurs in bottomlands, open fields, and deciduous and coniferous forests in most of the mid-western and southeastern states (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington. 587 pp.), although records in East Texas are sparse (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station, 421 pp.). This is the first report of a population of paedomorphic *A. t. tigrinum* in Texas.

From 23 Nov to 8 Jan 2005, four paedomorphic *Ambystoma t. tigrinum* were captured in minnow traps placed in a permanent farm pond at Camp Tyler ca. 5 km N of Whitehouse, Smith County, Texas (32°15.267'N, 095°11.645'W). The pond is located in a horse pasture and is ca. 150 m from the closest forest edge. Of the individuals captured, two males were identified by the presence of swollen cloacal vents. The other captures were presumed to be

female due to the absence of swollen vents. This observation coincides with the breeding season of this subspecies that occurs from November through May. Bishop (1943. A Handbook of Salamanders. Comstock Publ., Ithaca, New York. 555 pp.) found that a population of metamorphosing *A. t. tigrinum* averaged 104 mm TL. The sampled individuals in this population were nearly twice as long (mean SVL 89.3 ± 3.2 mm; mean TL 171.3 ± 5.5 mm; mean mass 25.12 ± 2.12 g). Each individual was marked subcutaneously with a PIT tag, photographed, and returned to the pond.

From the same sampling effort, five fully metamorphosed *Ambystoma t. tigrinum* were captured (mean SVL 104.4 ± 8.8 mm; mean TL 207.8 ± 23.4 mm; mean mass was 287.6 ± 84.3 g). All were identified as males by their conspicuously swollen vents.

Previous experiments with hormones have suggested that low activity levels in the hypothalamus, pituitary, and thyroid glands influence the retention of larval characteristics in sexually mature salamanders (Duellman and Trueb, *op. cit.*). It is also known that various agricultural chemicals may cause abnormalities in amphibians (Pough et al., *op. cit.*), however no pesticides or herbicides are used on the vegetation around this pond (A. Byboth, pers. comm.). Therefore, the retention of larval characteristics in this population is likely natural. It has been hypothesized that natural selection might favor paedomorphic individuals when the terrestrial environment is unfavorable (Whiteman 1994. Quart. Rev. Bio. 69:205–221). Lack of refugia or significant leaf litter needed to sustain moisture may create a strenuous habitat to traverse. Selection pressures might therefore favor those individuals that retain larval characteristics and remain in the pond.

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CRYPTOBRANCHUS ALLEGANIENSIS (Hellbender Salamander). **LARVAL DIET.** Several studies document the diet of adult *Cryptobranchus alleganiensis* as consisting primarily of crayfish, but include fishes and their eggs, aquatic insect larvae and adults, worms, mollusks, amphibians (including hellbenders and their eggs), aquatic snakes, and scavenged material (Bishop 1941. The Salamanders of New York. New York State Mus. Bull. No. 324:1–365; Nickerson and Mays 1973. The Hellbenders: North American Giant Salamanders, Milwaukee Pub. Mus. Publ. Biol. Geol No. 1:1–106; Peterson et al. 1989. Southwest. Nat. 34:438–441). Dietary data of larval *C. alleganiensis* are lacking, except for those raised in captivity, which have successfully been reared on brine shrimp and black worms including *Tubifex* (R. Goellner, pers. comm.). This study was conducted to investigate the diet of larval *C. alleganiensis* in the Little River, Tennessee.

Diurnal skin-diving surveys of the Middle Prong and main body of the Little River in the Great Smoky Mountain National Park were conducted from 14 June to 30 July 2003, for a total of 118 h. Surveys were conducted between 0900 and 1930 h and involved 2–10 surveyors. Underwater observations coupled with rock turning were implemented for surveys. Stomach contents of Hellbenders were collected non-lethally via stomach flushing with a 5-cc plastic canula filled with river water; stomach contents were preserved in 70% ethanol. Hellbender larvae were anesthetized in a 0.1% tricaine methylsulfonate (MS-222) solution, weighed with an Ohaus CS-2000 compact scale, measured using a metric ruler for total (TL) and snout–vent (SVL) lengths, and marked via subcutaneous injection of acrylic polymers (Johnson and Wallace 2002. Herpetol. Rev. 33:29–32). Needles were sterilized in 95% ethanol before each use. Larvae were allowed time to fully revive from anesthetization before being released at their capture site. Global positioning satellite (GPS) locations were recorded at each capture site. Qualitative macroinvertebrate samples from each site were collected using a D-frame dip net with 500 µn mesh. Rocks immediately upstream of the net were brushed for macroinvertebrates. All samples were preserved in 70% ethanol. Stomach and macroinvertebrate samples were analyzed using a Bausch and Lomb 0.7x–3x dissecting scope.

One large gilled larval *C. alleganiensis* (13 cm TL, 9 cm SVL, 17 g) was captured in 80 cm deep water, 205 cm from the bank, at 20°C water temperature. It was found between two rocks that were ca. 8 x 34 x 22 cm and 15 x 48 x 27 cm. Stomach contents included remains of Megaloptera, Ephemeroptera (Ephemerellidae and Heptageniidae), Diptera pupae, and wings from unidentifed aquatic insects. A second non-gilled larval *C. alleganiensis* (15 cm TL, 9.5 cm SVL, 18 g) had an empty stomach.

The stomach sample suggests larger larval and adult aquatic insects as the main prey for larval *C. alleganiensis* in Little River. Further sampling will be required to further elucidate the diet of larval hellbenders.

This study was conducted under the Great Smoky Mountains National Park Permit GRSM-2003-SCI-0051. We thank K. Voorhis, GSMIT's staff and interns, Ripley's Aquarium of the Smokies staff, D. Robinson, and K. Landgon for providing continued support, and K. Krysko for manuscript critique.

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HEMIDACTYLIUM SCUTATUM (Four-toed Salamander). **MORPHOLOGY/PHENOLOGY**. Prior to our study *Hemidactylium scutatum* larvae had not been recorded in Maine, where the species is listed as Special Concern. We describe field characteristics to improve discrimination between *H. scutatum* and larvae of a co-occurring species, Red-spotted Newts (*Notophthalmus viridescens viridescens*) in the field. *Hemidactylium scutatum* larvae are adapted to lentic, low oxygen environments and are classified as "pond-type larvae," defined by large, bushy external gills and a long fin fold that extends well up onto the body near the shoulder region (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington. 587 pp.). *Ambystoma* spp. and *N. v. viridescens* are co-occurring species with pond-type larvae. *Ambystoma* spp. develop earlier than *H. scutatum* larvae in our area, but larval *N. v. viridescens* can co-occur with *H. scutatum* larvae, making field identification difficult. Newly-hatched *H. scutatum* lack balancers, distinguishing them from newly-hatched *N. v. viridescens* (Bishop 1941. The Salamanders of New York. New York State Mus. Bull. 324:11–17; 174–189; Richmond 1999. Ph.D. Diss. Univ.

Massachusetts, Amherst. 305 pp.). Balancers may be difficult to see in the field. Identification of larval *H. scutatum* is complicated by the variable number of toes (0–4) at different stages of development (Bishop 1941, *op.cit.*), however, older *H. scutatum* larvae have four toes on each rear foot, larval *N. v. viridescens* have five (Petranka 1998, *op. cit.*).

During 2001, we collected 2 *H. scutatum* eggs from a wetland in Acadia National Park (ANP), Maine, to identify distinguishing characteristics during larval development. We incubated eggs in *Sphagnum* sp. suspended above water in an aquarium, and we maintained them to hatching at ambient temperature in a shaded, un-airconditioned building. We also captured six larval *N. v. viridescens* from the same wetland and aquarium-raised the larvae for comparison with *H. scutatum* larvae. Organic matter and water from the natal pond provided food for the developing larvae. We also dipnetted wild larvae from small pools of water (11 in ANP; 3 in the University of Maine Demeritt Forest [DF]) in late July (i.e., near metamorphosis) 2002–2004 in wetlands with high numbers (i.e., 6–33) of *H. scutatum* nests.

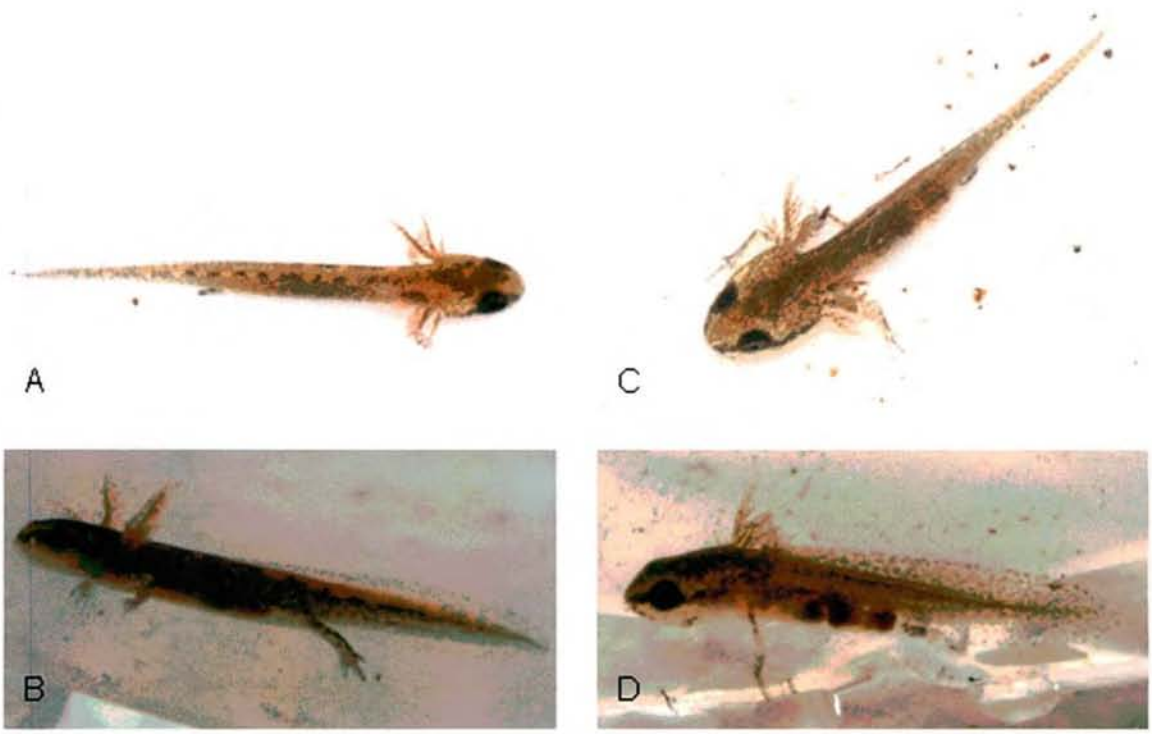

FIG. 1. Comparison of *H. scutatum* larvae (a) newly hatched (27 June 2004) and (b) near metamorphosis (22 July 2004) with *N. v. viridescens* larvae (25 July 2004) (c) and (d) in Maine.

Captive-hatched and captive-raised larvae.—We observed *H. scutatum* embryos hatching 18 June 2001 at 10 mm total length (TL), less than the 11–14 mm TL reported by Bishop (1941, *op. cit.*). By 9 July the *H. scutatum* larvae were 10 mm SVL and 18–19 mm TL, translucent yellow-brown, and one larva had toes on its rear limbs. By 17 July larvae were 19 mm TL and retained a dorsal fin extending onto the body. Larvae moved little, infrequently swimming and settling to the bottom with legs extended. Larvae metamorphosed (e.g., rusty dorsum, red gills, no dorsal fin) 38 and 42 days after hatching.

Wild larvae near metamorphosis.—Larval *H. scutatum* collected from ANP wetlands were 12.1 ± 0.56 mm SVL (N = 7; mean ± SD mm), and TL for larvae with uninjured tails was 21.1 ± 2.14 mm (N = 4). Size (18–23 mm uninjured TL; 3 mm head width; 1 mm body width) indicated they were near metamorphosis (pers. obs.; Blanchard 1923. Amer. Nat. 57:262–268).

A dark color surrounded the golden eyes with round, black pupils, and a dark line crossed the eye and extended onto the face (Fig. 1a, b). Chin and throat were a cream color that tapered off beyond the gills and front legs (Fig. 1b). The belly was no longer yellow. Gills were a rust color. A dark Y-shaped mark was on the head (Fig. 1a). The dorsum was rust colored, extending as a stripe under the fin to the tip of the tail (Fig. 1b), with rust spots alternating with dark mottles at the edge, and with tiny dark flecks throughout (Fig. 1a). Larvae had a thin, clear, speckled top fin on the tail that no longer extended onto the body (Fig. 1b). Each foot had four toes, and toes on the front feet were shorter (Fig. 1b) than those of *N. v. viridescens* (Fig. 1c). Larvae appeared exactly as drawn in Bishop (1941, *op. cit*) and closely resembled drawings in Parmelee et al. (2002. A Field Guide to Amphibian Larvae and Eggs of Minnesota, Wisconsin, and Iowa. U.S. Geol. Surv., Biol. Res. Div., Information and Technology Report USGS/BRD/ITR-2002-0004, Washington, D.C. iv + 38 pp.). Coloration resembled that of drawings in Dodd (2003. Monitoring Amphibians in Great Smoky Mountains National Park. U.S. Geol. Surv., Biol. Res. Div., Circ. 1258, Tallahassee, Florida vi + 127 pp.).

Distinguishing H. scutatum *from* N. v. viridescens *larvae.*—At TL < 18 mm, larvae of the two species resembled one another; both species were translucent, pale yellow-brown, without visible rear toes, and both had a tail fin that extended onto the dorsal surface of the body (Fig. 1a, c, d). However, *H. scutatum* larvae could be distinguished by a dark Y-shape mark on the head, rust dorsal mottles, with some dark mottles and short toes on the front

TABLE 1. Gender variation in snout–vent length (SVL), total length (TL), and mass for a gilled population of *Notopthalamus viridescens*.

Gender	N	SVL (mm)	TL (mm)	Mass (g)
Male	9	40.2 ± 2.8	84.7 ± 4.7	2.02 ± 0.35
Female	4	45.3 ± 5.7	94.3 ± 1.7	3.45 ± 1.06
Total	13	41.5 ± 4.0	87.1 ± 7.8	2.49 ± 0.88

feet (Fig. 1b), unlike *N. v. viridescens* larvae, which had no Y mark, few dorsal mottles, and longer toes (Fig. 1c, d). Coloration was a distinguishing feature when larvae were 18–23 mm TL: *N. viridescens* larvae continued to be yellow with a tall, thin keel on the tail (Fig. 1d), whereas *H. scutatum* larvae had a ruddy dorsum, mottled dark sides, pale belly, patterned head, and little or no keel on the tail (Fig. 1b). The eyeline was present at and just beyond the eye on *H. scutatum*, whereas on several *N. viridescens*, the eyeline extended into a stripe to the tip of the tail. *Notophthalmus viridescens* larvae were more active than *H. scutatum*, which were usually stationary except for occasional surfacing for air.

Phenology.—Larvae were observed hatching at field-located nests as early as 16 June and reached metamorphosis as late as 31 July in Maine (Chalmers. 2004. M.S. thesis. University of Maine, Orono, Maine. 109 pp.). The larval period ends soon after larvae reach a total length of ca. 18–23 mm and adult coloration develops. At the conclusion of our study, one *H. scutatum* larval reference specimen was deposited at the ANP museum.

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NOTOPTHALAMUS VIRIDESCENS LOUISISANENSIS (Eastern Newt). **POPULATION OF GILLED ADULTS.** The Eastern Newt can be found throughout the eastern United States and localities have been documented throughout most of East Texas (Dixon, 2000. Amphibians and Reptiles of Texas. Texas A&M University Press, College Station, 421 pp.). For most populations of *Notophthalmus viridescens*, following a period of aquatic development, the larvae transform into a terrestrial red eft stage. This juvenile stage may last for several years before the eft returns to a breeding site and transforms into an aquatic adult. Generally, aquatic adults lack gills and retain lungs from their terrestrial stage, however, some populations are comprised of gilled adults. In populations of gilled adult *N. viridescens*, the terrestrial eft stage is omitted and maturation occurs in an aquatic environment. These individuals experience partial metamorphosis but retain gills and structures associated with larvae, such as extensive tail fins (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington. 587 pp.). Reported populations of gilled adults are erratic within the species' range. Populations have been reported from Florida, Illinois, Indiana, Louisiana, Massachusetts, New Jersey, New York, North Carolina, and Tennessee (reviewed in Petranka, *op. cit.*). This article is the first documentation of a gilled population of *N. viridescens* in Texas.

On 8 Dec 2004, two gilled *Notophthalmus viridescens louisianensis* were collected from a minnow trap placed in a permanent farm pond at Camp Tyler ca. 5 km north of Whitehouse, Smith County, Texas (32°15.267'N; 095°11.645'W). The pond is located in a horse pasture and is ca. 150 m away from the closest forest edge. One female (2.9 g; 42 mm SVL; 89 mm TL) was identified by the lack of a swollen cloaca and the conspicuously distended body associated with gravid females. Another individual was identified as a male (1.8 g; 38 mm SVL; 78 mm TL) by a distinctly swollen vent, cornified toe tips, and hard black pads on the inner thighs indicative of males during their mating season (Petranka, *op. cit.*). Both individuals were morphologically similar to common aquatic adults despite the presence of gills. On 27 Jan 2005, another male and female were found amplexed in a minnow trap. The male was grasping the female just in front of her anterior limbs with his posterior limbs, similar to the beginning of *N. viridescens* courtship described by Hardy and Dent (1988. Copeia 1988:789–792). The amplexed pair was returned to the lab and on 29 Jan 2005, ca. 12 eggs were found in the bottom of their tank. This evidence of maturity and reproduction coincides with the breeding season of this species in the southern United States (Petranka, *op. cit.*). During the trapping period three gilled males were found dead in the mesh of minnow traps. These specimens were deposited in the University of Texas at Arlington (UTA A 56733–35). A total of 13 individuals were captured throughout the sampling period. Size variation for males and females is reported in Table 1.

It has been suggested that the probability of a gilled population of *Notophthalmus viridescens* includes both genetic and environmental factors (Petranka, *op. cit.*). When terrestrial conditions are too harsh, selection should favor individuals that remain in the aquatic habitat. The habitat surrounding the study pond is comprised of short vegetation and lacks refugia. This may create a habitat that is difficult for red efts to traverse or survive in resulting in selection for aquatic maturation (Whiteman 1994. Quart. Rev. Bio. 69:205–221). It has been shown that some agricultural chemicals might influence amphibian development (Pough et al. 2004. Herpetology. Pearson Prentice Hall. 726 pp.). However, at this site, no pesticides or herbicides are used on the vegetation (A. Byboth, pers. comm.), suggesting there is no anthropogenic influence on the physiology of this population.

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TARICHA GRANULOSA (Rough-skinned Newt). **SUMMER HABITAT AND AGGREGATION.** Terrestrial behavior and habitat associations of post-metamorphic *Taricha granulosa* are poorly understood (Oliver and McCurdy 1974. Can. J. Zool. 52:541–545; Pimentel 1960. Amer. Midl. Nat. 63:470–496). Chandler (1918. Oregon Agric. Coll. Exper. Sta. Bull. 152:6) referenced Fall *T. granulosa* aggregations in "cavities under stumps, logs, and stones," but does not present specific data. Pimentel (*op. cit.*) reported that *T. granulosa* constructed burrows in a terrarium and 1–3 adults of both sexes shared burrows for up to three months. Here, I describe two summer aggregations of *T. granulosa* from the Willow Creek Natural Area (WCNA) in the southern Willamette Valley, Oregon, USA. The WCNA includes wetlands (primarily seasonal), prairies, riparian forests of willow (*Salix* spp.), black cottonwood (*Populus trichocarpa*), and Oregon ash (*Fraxinus latifolia*), and patches of upland forest of Oregon white oak (*Quercus garryana*), California black oak (*Quercus kelloggii*), and Douglas fir (*Pseudotsuga menziesii*). *Taricha granulosa* commonly breed in old stock ponds and beaver impoundments on the site.

One *T. granulosa* aggregation was found between plywood sheets at a collapsed cabin on 18 July 1996 (UTM 10 485569E 4875494N; elev. 120 m). The aggregation was within a 7.3-ha stand of Oregon white oak (75–100 yrs old) with nonnative Himalayan blackberry (*Rubus armeniacus*) and scattered Douglas fir. This oak stand was bounded by a paved road, a gravel driveway, and upland prairie with a seasonally flooded swale. The aggregation included 30 *T. granulosa* of both sexes (range 35–70 mm SVL), which were tightly clustered and usually in contact with > 1 other individual. This aggregation likely contained multiple age classes. *Taricha granulosa* at WCNA metamorphose at 30–35 mm SVL, and adults at breeding sites in spring are 50–72 mm SVL (CAP, unpubl. data). Condensation between the plywood sheets indicated that interior humidity was noticeably higher than in leaf litter away from the woodpile. The nearest known *T. granulosa* breeding site was a temporary stock pond (20 x 20 x 0.5 m) located ca. 150 m ESE of the aggregation.

The second *T. granulosa* aggregation was found in a 0.86-ha stand of Oregon white oak (75–100 years old) on 04 August 1996 (UTM 10 486549E 4874884N; elev. 142 m). The aggregation of 10 *T. granulosa* included juveniles and adults of both sexes (size data not collected). The newts were curled closely with one another, and were very lethargic upon extraction. The aggregation site was in a cavity beneath a partially uprooted Oregon white oak stump, which was loosely filled with oak leaves, humus, silty/clay loam and cobbles. The aggregation site was ca. 50 m N of a permanent stock pond (20 x 10 x 0.7 m deep) that supports a large *T. granulosa* breeding population in spring (unpubl. data). The oak stand is bounded by a paved two-lane arterial road on one side (ca. 60 m upslope of the aggregation site and the pond); the remainder of the oak patch was bordered by > 10 ha of upland prairie beyond a narrow ring (5–10 m wide) of Himalayan blackberry. The distances between the two aggregations described here and their respective nearest potential breeding habitat are similar to those of Pimentel (1960, *op. cit.*), who estimated that > 90% of *T. granulosa* enter the ground within 200 yards (183 m) of their breeding ponds.

Aggregations of *T. granulosa* are common in aquatic breeding sites (Twitty 1942. Copeia 1942:65–76; Coates et al. 1970. Copeia 1970:177–179; Farner and Kezer 1953. Am. Midl. Nat. 50:448–462). Detailed descriptions of terrestrial aggregations of *T. granulosa* appear to be limited to those of Farner and Kezer (*op. cit.*; p. 452), who reported "large numbers under the rocks and driftwood along the shore" of Crater Lake. Similar to my observations, those *T. granulosa* groups ranged from "newly metamorphosed to large adults" (75–180 mm total length) and "appeared desiccated and sluggish" (Farner and Kezer, *op. cit.*; p. 452). My observations and those of Pimentel (*op. cit.*) and Farner and Kezer (*op. cit.*) indicate that *T. granulosa* aggregate on land and in water in groups that include multiple age classes and both sexes. These observations also may suggest that above- and below-ground microhabitats that are humid, thermally stable, and within 200 m to breeding sites may be valuable to *T. granulosa* in their terrestrial stages.

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ANURA

BUFO MARGARITIFER (South American Common Toad). **GEOPHAGY.** The *Bufo margaritifer* complex is widely distributed in Latin America, known throughout the Amazon Basin and parts of Panama (IUCN, Conservation International, and NatureServe. 2004. Global Amphibian Assessment. www.globalamphibians.org 27 Dec 2004). This taxon is abundant within the area of the Tiputini Biodiversity Station – Universidad San Francisco de Quito, Yasuní Biosphere Reserve, Napo Province, Ecuador (00°38'18"S; 76°08'56"W). The diet of this species consists primarily of large ants (> 17 mm) and beetles, along with other single prey items (Duellman 1978. Misc. Publ. Mus. Nat. Hist., Univ. Kansas 65:1–352). We observed the practice of geophagy, the consumption of soil, by *B. margaritifer* in the wild and this may represent the first report of geophagy in an anuran.

Geophagy has been observed in mammals, birds, reptiles, butterflies, and isopods on every continent except Antarctica (Brightsmith 2004. Wilson Bull. 116:134–145). On 2 Nov 2002 ca. 2100 h, a *B. margaritifer* was observed with its mouth open in a patch of mud along a trail in *terra firme* lowland rainforest (Fig. 1, top). The individual was observed closing and retracting the eyes into the orbit, in the typical fashion of anurans when swallowing. The individual was removed and placed ca. 1 m from the mud, it proceeded to return to the mud and continue consumption. It was photographed and low-res video taken of the behavior. Upon return, ca. 1.5 h later, the individual was in the same location and appeared to still be consuming the mud, although its head was now beneath the surface of the mud and hence, retraction of the eyes could not be observed. On 22 June 2004 at 1203 h, a second *B. margaritifer* was observed head down in a small mud puddle on a trail in *terra firme* lowland rainforest. The individual was observed raising its head from the surface of the water and then lowering it and placing its mouth at the edge of the mud puddle. On 06 July 2004 at 0031 h, a third *B. margaritifer* was observed with its head down in a mud puddle with hindlimbs dramatically vertical in the air along a trail in várzea (seasonally-flooded lowland rainforest). When removed from the mud puddle this same individual moved immediately back to the puddle and returned to the same position, forcibly pushing its head into the muddy bottom of the puddle using its forelimbs and hindlimbs (Fig. 1, bottom). On 11 Aug 2004 at 1740 h, a fourth *B. margaritifer* was observed in a mud puddle of a trail in várzea forest, its head pressed into the muddy edge just below the surface of the water.

Adult anurans are not known to drink water, except when subjected to particular physiological stresses in a laboratory situation (Duellman and Trueb 1994. Biology of Amphibians. The John Hopkins Univ. Press, Baltimore, Maryland, 670 pp.; Stebbins and Cohen 1995. A Natural History of Amphibians, Princeton University Press, Princeton, New Jersey, 316 pp.). In the genus *Bufo*, the highly vascularized dermis of the ventral pelvic region is the primary area identified for water absorption (Duellman and Trueb 1994, *op. cit.*). This morphological adaptation, the observed behavior and current explanations of geophagy lead to our working hypothesis that here, the practice of geophagy is for the purpose

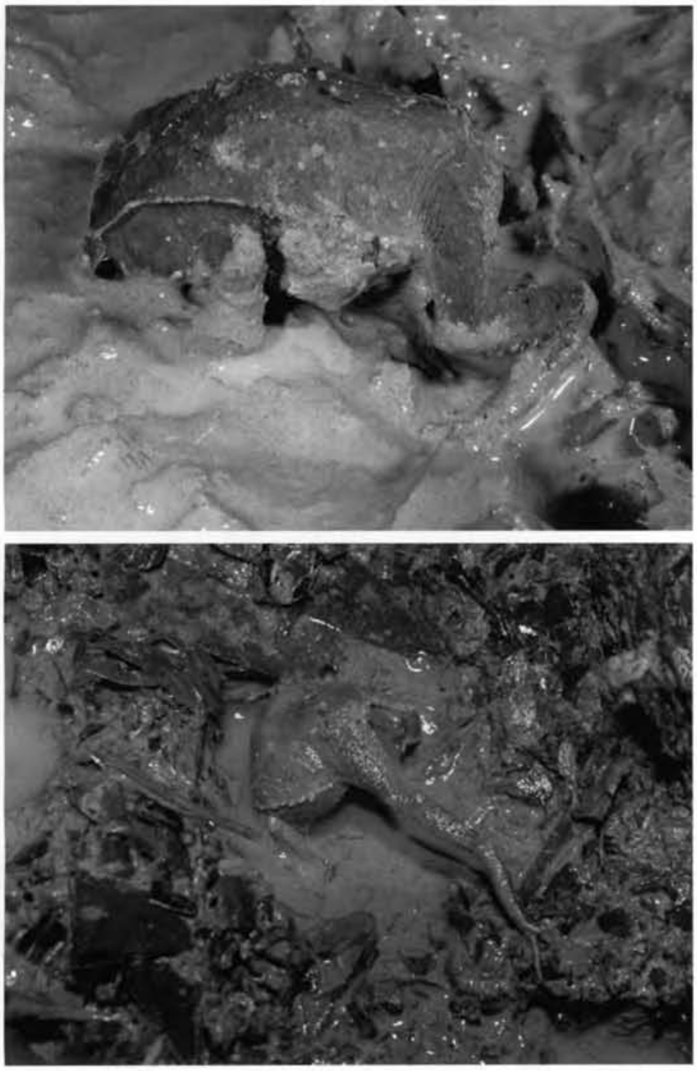

FIG. 1. Top: *Bufo margaritifer* consuming mud from a trail in *terra firme* lowland rainforest. Bottom: *B. margaritifer* returning to puddle after being removed and forcibly pushing its head into the muddy bottom of the puddle using its forelimbs and hindlimbs.

of neutralizing the toxins acquired in their primarily ant diet. Taxa within the order Hymenoptera, particularly ants, have been found to be the most toxic members of the insect world (Meyer 1996. Most Toxic Venom. Chapter 23 *in* University of Florida Book of Insect Records, 2005. <http://ufbir.ifas.ufl.edu/>). This may represent a mechanism for coping with ants as a primary dietary resource.

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CHIASMOCELIS CAPIXABA (NCN). **PREDATION**. Species of the genus *Chiasmocelis* breed at temporary ponds in forests (Cruz et al. 1997. Alytes 15:49–47). On 26 Dec 2002 a juvenile colubrid snake, *Liophis poecylogirus* (344 mm TL), was observed capturing a *C. capixaba* at a temporary pond inside a cocoa (*Teobroma cacao*) plantation with an alluvial forest on the left margin of the Doce River, near Povoação (19°33'S, 39°46'W, sea level), 30 km from the town of Linhares, Espirito Santo, Brazil. At this site several male *C. capixaba* were calling along with *C. schubarti*, *Stereocyclops incrassatus*, *Dasypops schirchi*, *Phrynohyas mesophaea*, and *Scinax argyreornatus*.

The snake was captured, and during transportation to the laboratory regurgitated 18 specimens of *C. capixaba* (mean SVL 14.1 mm; range 13.1–15.4 mm; SD 0.54 mm; N = 14) in different stages of digestion. There was no other prey in the stomach contents. Specimens were deposited at Museu de Biologia Mello Leitão – MBML, Santa Teresa, Espírito Santo (*C. capixaba*: MBML 2856–66; *L. poecylogirus* MBML 1427)

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DENDROBATES PUMILIO (Poison Frog). **POISONING.** During a field study of *Dendrobates pumilio* in the proximity of the NAIRI field station in Barbilla National Park, Costa Rica, I experienced what I believe to be poisoning from a dendrobatid frog. Within a minute of handling wild *D. pumilio* on 5 January 2001 I sat down to have lunch without first washing my hands. The first sign of poisoning was a burning sensation on the tongue and the palate. A feeling of soreness followed shortly thereafter. The sensation spread posteriorly through the palate to the throat and part of the nasal area. This was followed by numbness of the lips, which later changed to a pricking feeling similar to that experienced after the administration of local anesthesia. Intense pain and discomfort persisted for the remainder of the day, making it difficult for me to consume food or water. The following day the pain was reduced, but became amplified when I attempted to consume food or water. By the end of the third day all signs of poisoning were gone. Problems other than pain and discomfort in the mouth and throat were never experienced.

I believe that these symptoms represent ingestion of toxins from *D. pumilio* because of the high likelihood of transfer of these chemicals to my food and because my symptoms were similar to those described by Daly and Myers (1967. Science 156: 970–973). These authors have worked extensively with poison frogs and reported that *D. pumilio* from the Bocas del Toro archipelago in Panama "...secrete an unpleasant tasting, toxic milky fluid when injured..." and that "...small quantities of the purified toxic principles cause the human throat to tighten...". Dendrobatid frogs, including *D. pumilio*, contain a variety of alkaloids and there is great variation in the presence of alkaloids among populations of *D. pumilio*. Furthermore, the toxicity of the frogs is related to these variations in alkaloids and therefore some populations of *D. pumilio* are more

toxic than others (Daly and Myers 1967, *op. cit.*). The chemistry of the population that inhabits Barbilla National Park is not documented. However, my experiences may suggest that they are toxic enough to cause an unpleasant reaction in humans. Interestingly, human taste has been a widely used technique to detect the presence of chemical compounds in frog skins (Daly et al. 1987. Toxicon 25:1023–1095). However, based on my experiences I do not recommend this technique. Although I did not experience serious illness other than pain and discomfort, I strongly recommended that those working with dendrobatids wash their hands after handling these frogs and avoid situations in which toxins might enter the body via open wounds, the mouth, or thin membranes such as the eyes.

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ELEUTHERODACTYLUS BUCCINATOR (NCN). **COLOR VARIATION.** *Eleutherodactylus buccinator* occurs in lowland rainforests in southeastern and northeastern Perú (Rodríguez 1994. Alytes 12:49–63; Rodríguez and Knell 2003. *In* Pitman et al. [eds.], Perú: Yavarí, Rapid Biological Inventories Report 11, pp. 147–150. The Field Museum, Chicago, Illinois). Coloration in life is characterized by a copper-brown dorsal surface, brown-gray flanks, dull pink-orange groin and rear shanks, a cream venter, and light brown spots on the throat (Rodríguez 1994, *op. cit.*). Here, we report on color pattern variation in juvenile and adult individuals observed during a herpetofauna inventory (2001–2003) at Río Los Amigos Research Center (12°34'S, 70°06'W; 270 m elev.), Madre de Dios department, Perú.

Of 25 specimens observed, only 8 individuals (32%) matched the original color pattern description (Rodríguez 1994, *op. cit.*). The remaining individuals exhibited a variation from this pattern: 13 individuals (52%) exhibited pale brown-gray (instead of pink-orange) groin and rear shanks and 4 individuals (16%) exhibited yellowish cream arms (instead of brown arms) bearing 0–4 black spots. In addition, one of the latter individuals exhibited a yellowish cream spot below the tympanum and the same color on knees and heels. This variation is important because pink-orange groin and rear shanks were considered a diagnostic characteristic (Rodríguez 1994, *op. cit.*) and is the typical pattern observed at the type locality (Cocha Cashu Biological Station, ca. 150 km NW from Río Los Amigos Research Center). Individuals of the three color variants occurred in terra firme and floodplain forest, the two forest types that cover most of the area. This report increases the number of *Eleutherodactylus* species (more than 77) known to exhibit color or dorsal pattern polymorphism (Hoffman and Blouin 2000. Biol. J. Linn. Soc. 70:633–665).

Specimens were deposited in the herpetology collection at the Museo de Historia Natural Universidad Nacional Mayor de San Marcos (MHNSM 23100-23103), Lima, Perú. Photographic records will be deposited in the AmphibiaWeb digital collection, University of California, Berkeley.

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OSTEOPILUS SEPTENTRIONALIS (Cuban Tree Frog). **COLONIZATION OF THE BRITISH VIRGIN ISLANDS.** Native to Cuba, the Cayman Islands, and the Bahamas, *Osteopilus septentrionalis* is widely introduced in the Caribbean and elsewhere (Lever 2003. Naturalized Reptiles and Amphibians of the World. Oxford University Press, New York. 318 pp.). It has only been reported in the British Virgin Islands (BVI) once, from Necker Island (Lever, *op. cit.*). Here we document the ongoing spread of *O. septentrionalis* across the BVI. GPS points are based on the WGS84 datum and all specimens were verified by Jose Rosado, Museum of Comparative Zoology (MCZ).

The first record of *O.* septentrionalis in the BVI (MCZ A-135386) was collected on Tortola at the Road Town dock (18°25.8'N, 64°36.8'W) during Fall 1990 by Everton Henry. The species is currently abundant throughout the island. Because the frog breeds in cisterns providing residential water, it is considered a pest and attempts are made by the local health authorities to remove it from specific locations. The second oldest specimen (MCZ A-119258) was captured on Necker Island (18°31.6'N, 64°21.6'W) on 19 Oct 1993 by A. Miller. No population was established (Meshaka 1996. Herpetol. Rev. 27:37–40; unpubl. obser.). The first collection on Beef Island (MCZ A-136611) was made at Trellis Bay (near the international airport, 18°26.44'N, 64°32.08'W) on 15 Oct 2002 by Gad Perry and Kate LeVering. Additional sites with breeding populations have since been identified on Beef island, which is connected to Tortola by a bridge and frequent traffic. One of these sites is a nursery, which supplies ornamental plants to many BVI establishments. The following year marked the first record of the species on Virgin Gorda (MCZ A-136432). The specimen was collected by Jim Egelhoff on 27 Oct 2003 in Spanish Town (18°26.6'N, 64°26.2'W). More extensive work in 2004 revealed the presence of a breeding population in the town. Most recently, a collection (field tag JO166) was made on Peter Island (18°21.231'N, 64°34.317'W) by Jennifer Owen and Gad Perry on 13 Oct 2004. Frogs are established at several locations on the island, suggesting a breeding population.

There appears to have been multiple introductions of the frog in the BVI, primarily through movement of cargo and ornamental plants. The Necker Island specimen was associated with ornamental plants arriving from Miami (Meshaka, *op. cit.*). BVI resident Elvit Meyers (interviewed October 2002) reported frogs arriving in Cane Garden Bay, Tortola during April 2000, long after the initial specimen was collected there. The frogs were located in concrete block pallets arriving from Florida and local populations then rapidly expanded. Other populations, such as Beef Island and Peter Island, may be the result of spread within the BVI, although human assistance may have been involved. As *O. septentrionalis* preys on native species (Lever, *op. cit.*), the ongoing range expansion of the species is a source of concern.

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PEDOSTIBES TUBERCULOSUS (Malabar Tree Toad). **ADVERTISEMENT CALL AND DISTRIBUTION.** Advertisement call patterns of anurans provide insights into speciation, territoriality, evolution, and phylogeny as these patterns reveal the species identification and motivation to mate (Bridges and Dorcas 2000. Copeia 2000:587–592; Emerson 2001. *In* Ryan [ed.], Anuran Communication, pp. 36–43. Smithsonian Inst. Press. Washington, D.C.). Anuran acoustics have been studied for 20 of the 113 species known from Western Ghats (Gururaja 2004. Sahyadri Mandooka: Amphibians of Western Ghats; Kadadevaru and Kanamadi 2001. Curr. Sci. 80:1486–1487; Kuramoto and Joshy 2001. Curr. Herpetol. 20:85–95). Herein we report on advertisement call, explosive breeding behavior, and distribution of *Pedostibes tuberculosus*, endemic to Western Ghats.

Pedostibes tuberculosus is a medium-sized tree toad (mean SVL ± SE: 37.18 ± 0.44 mm; range: 36–38 mm; all male, N = 4, Fig. 1). Individuals have a distinct sub-gular vocal sac. Calls of four individuals (ca. 1.3 m above ground) were recorded at 15-minute intervals using an Olympus digital voice recorder W-10 as Differential Pulse Code Modulation at 15.5 kHz. Calls were recorded less than 30 cm from the specimen amidst evergreen-semi-evergreen forest (RH 97%, 23.6°C) adjacent to a small perennial stream (marked in Fig. 2).

FIG. 1. *Pedostibes tuberculosus* (male, 38 mm SVL) at Jakkanagadde, Shimoga, Karnataka. Scale bar: 10 mm.

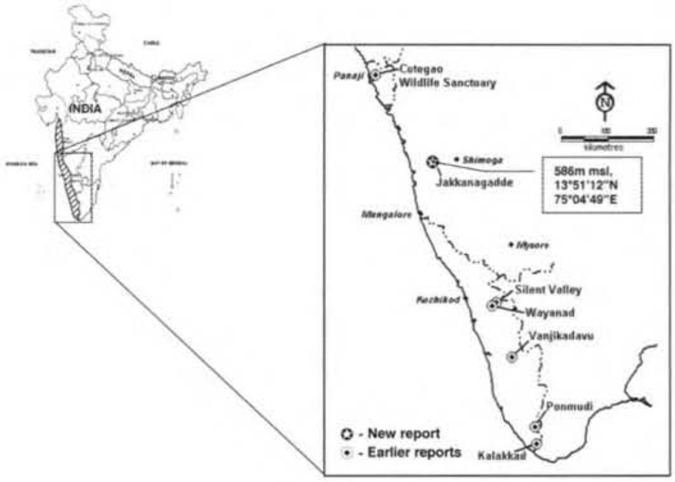

FIG. 2. Reported sightings of *Pedostibes tuberculosus* in Western Ghats.

Calls were single and chorus, and antiphonal, heard for a month with the onset of southwest monsoon (June 2004). Chorus calls were synchronous, starting with an individual's initiation. Single calls of *P. tuberculosus* were analyzed as per Littlejohn (2001. *In* Ryan [ed.], Anuran Communication, pp. 102–120. Smithsonian Inst. Press. Washington, D.C.). Each call lasted for 3–7 sec, and had 14–37 pulse groups (PG) of 3–11 pulses with the domination of 4–8 PG, of which PG 1–2 (N = 16) had a larger period (145.63 ± 21.72 ms) and interval (117.69 ± 22.09 ms) in the entire call series. Pulse frequency was 12.87–44.67 (34.82 ± 3.83). PG period was 61–134 ms. Amplitudes of the first and last pulses of the first and last pulse groups were low compared to others. Dominant frequency was 3782.13 ± 30.58 Hz. Pulse groups sounded like *Shchirrrrrr shirrrr shirrr shirrr shirrr.....*

Call structure of *P. tuberculosus* varies considerably from other bufonids in Western Ghats (Kanamadi et al. 1995. J. Adv. Zool. 16:5–11). Mean pulse rate of *Bufo melanostictus* was twice that of *P. tuberculosus*. However, similarity was noticed between the pulse rate of *B. fergusonii* and *P. tuberculosus*. The dominant frequency in *B. melanostictus* was 1450 Hz, in *B. fergusonii* it was 3175 Hz, and in *P. tuberculosus* 3782 Hz. Synchronous calls in *B. americanus*, *B. bombina*, *B. variegata*, *B. melanostictus*, and *B. fergusonii* are attributed to explosive breeding behavior (Duellman and Trueb 1986. The Biology of Amphibians. McGraw-Hill Book Inc., New York. 670 pp.; Kanamadi et al. 1995, *op. cit.*). The same can be implied for *P. tuberculosus* which has a similar call pattern. Even though its presence was predicted (Biju 2001. Indian Soc. Cons. Biol. 1:1–24; Das and Whitaker 1998. Herpetol. Rev. 29:173), there are no earlier reports of *P. tuberculosus* from Karnataka spanning over 400 km of Western Ghats (earlier reports are marked in Fig. 2). The new location is ca. 333 km N of Silent Valley (nearest southern range) and 222 km S of Cotegao Wildlife Sanctuary (nearest northern range).

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PRHYNOHYAS VENULOSA (Rana Lechera). **LARVAL CANNIBALISM.** During the nights of 23 May and 4 June 2004, in a permanent pond in the Sierra de Perijá, Zulia state, Venezuela, we found several dead *Phrynohyas venulosa* tadpoles (Stage 39, Gosner 1960. Herpetologica 16:183–190) being consumed by many conspecific tadpoles of similar size. Larval cannibalism in hylid frogs has been previously reported for *Hyla rosenbergi* (Kluge 1981. Misc. Publ. Mus. Zool. Univ. Michigan 160:1–170) and *H. faber* (Sèrigo and Assêncio 1999. Herpetol. Rev. 30:162), and conspecific egg predation by tadpoles in *P. resinifictrix* (Schiesari et al. 2003. Copeia 2003:263–272). Although the natural history of *P. venulosa* has been studied (Zweifel 1964. Copeia 1964:201–208), cannibalism has not been recorded. This is the first report of cannibalism in *P. venulosa* tadpoles. Some tadpoles were reared through metamorphosis to assure the identity of the material; these were deposited in the Museo de Biología de la Universidad del Zulia (MBLUZ-A-0222).

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RANA CASCADAE (Cascades Frog). **TADPOLE PREDATION**. Observations on anuran tadpole predation by birds is becoming more common (Bolitho and Retallick 1996. Herpetol. Rev. 27:140–141; McAlpine et al. 2001. Herpetol. Rev. 32:183–184; Castanho 2001. Herpetol. Rev. 32:103, Crump and Vaira 1991. Herpetologica 47:316–321). Furthermore, corvids have been documented preying on anuran tadpoles (Beiswenger 1981. Copeia 1981:459–460). Here I report predation on tadpoles of *Rana cascadae* by the Clark's Nutcracker (*Nucifraga columbiana*), a small corvid, observed in the Trinity Alps Wilderness, Trinity County, California, USA (40°55'30"N, 122°52'56"W; elev. 2195 m). These events occurred within 20 minutes during observations on 8 Oct 2004, initiated at 1740 h. Two *N. columbiana* were observed perching in trees near a drying pond (5 cm depth and 2 m^2 surface area) containing a high concentration of *R. cascadae* and Pacific Treefrog (*Hyla regilla*) tadpoles and metamorphosed individuals. I observed the birds with binoculars from a distance of 15 m. Shortly after observations began, both *N. columbiana* flew to the pond and began probing their beaks into the water. Each *N. columbiana* successfully captured a single *R. cascadae* tadpole. Since *R. cascadae* are much larger than *H. regilla* tadpoles, I was confident of a positive identification of tadpole species. Each bird then flew back to the tree where initially observed and consumed the tadpoles. One bird returned to the pond four minutes later and seized three more *R. cascadae* tadpoles, this time consuming them at the pond's margin.

Nucifraga columbiana typically relies on cached conifer seeds as a main source of nutrition for winter survival and breeding (Vander Wall and Balda 1977. Ecol. Monogr. 47:89–111). During the short autumn season in sub-alpine environments, many lentic water bodies containing amphibian larvae become very shallow or dry completely. Drying lentic water bodies can create high concentrations of amphibian larvae that become available as a food resource to terrestrial predators at the littoral margin. *Rana cascadae* larvae, and possibly recent metamorphs, may provide an important nutrition subsidy for *N. columbiana* just prior to the onset of winter.

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SCINAX ACUMINATUS (Mato Grosso Snouted Treefrog). **PREDATION**. The hylid *Scinax acuminatus* is distributed in southern Mato Grosso and Mato Grosso do Sul states in Brazil, Paraguay, Bolivia, and northern Argentina (Frost 2002. Amphibian Species of the World: An Online Reference V2.21). Despite this extensive distribution, life history data for this species are scarce. On 15 Feb 2005 at 2015 h we found an adult *S. acuminatus* (37.74 mm SVL; 3.5 g) in the stomach of the colubrid snake *Leptodeira annulata* (750 mm SVL; 27.4 g) in a *Ficus* sp. in the Brazilian Pantanal, Nhumirim Ranch (18°59'S, 56°40'W), Mato Grosso do Sul State. After regurgitating the frog (deposited as CEUCH 3553 in Coleção Zoológica de Referência do Campus de Corumbá), the snake was measured and released. That night many individuals of this frog and snake were found active in the same *Ficus* tree and in the palm *Attalea phalerata*, suggesting that *S. acuminatus* might be commonly preyed upon by *L. annulata* in the Pantanal.

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TURTLES

ACTINEMYS MARMORATA (Western Pond Turtle). **NEONATES.** *Actinemys marmorata* historically ranged from Oregon to Mexico west of the Cascade–Sierra axis (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Institution Press,

Washington, D.C. 578 pp.; Jennings and Hayes 1994. California Dept. of Fish and Game, Rancho Cordova Final Report, Contract 8023, 260 pp.; Storer 1930. Univ. California Publ. Zool. 32:429–441). Populations of *A. marmorata* in California's San Joaquin Valley are declining and it is currently listed as a California Species of Special Concern (Jennings and Hayes, *op. cit.*). However, we know little about the natural history of this species, especially the neonatal stage. Here, I report dates and locations of neonatal *A. marmorata* captures.

I trapped turtles at five sites in the northern San Joaquin Valley, California, USA, near the town of Los Baños. Los Baños Creek and Mud Slough North were in the China Island Unit of the North Grasslands Wildlife Area and Field 26, Field 42, and the Wasteway were in the Volta Wildlife Area. During 2003, Los Baños Creek was trapped from 4 April and 31 May, Mud Slough North from 5 April – 17 June, Field 26 from 1 April – 24 May, Field 42 from 22 June – 22 July, and the Wasteway from 21 May – 10 August. I captured neonate *A. marmorata* in modified eel pot traps (Casazza et al. 2000. Herpetol. Rev. 31:91–92) set to survey for Giant Garter Snakes (*Thamnophis gigas*) with 50 mm openings on either end. I placed traps 10 m apart along banks and tied them to emergent vegetation or stakes and checked them daily. I batch marked all captured neonates by clipping two V-shaped notches in the marginal scutes on each side of the nuchal scute prior to releasing them at the site of capture. I used dial calipers to measure the mid-line carapace length of three initial captures.

Mid-line carapace length of the initial 3 turtles captured were 23.8, 26.7, and 27.5 mm with additional captures being of comparable size and within the size range given for hatchling *A. marmorata* (Buskirk 2002. Radiata 11:3–30). The shells of all hatchlings caught had not yet hardened, further indicating they had emerged from the nest that year (Ernst et al., *op. cit.*). Neonate capture dates are as follows: Los Baños Creek (12 [2 captures], 20, 23 [1 recapture] April); Mud Slough North (19 April, 11 May, 12 June); Field 26 (13, 15, 19, 20 [2 captures], 22, 24, 29 [2 captures] April, 1 [recapture], 14 May); Field 42 (5 June); the Wasteway (27 June). Additional species captured included Giant Garter Snakes, Common Gartersnakes (*Thamnophis sirtalis*), Common Kingsnakes (*Lampropeltis getula*), Gopher Snakes (*Pituophis catenifer*), Bullfrog adults and tadpoles (*Rana catesbeiana*), and various unidentified voles, birds, minnows, and aquatic insects.

Because *A. marmorata* is a California Species of Special Concern it is critical to understand its life history and population dynamics. Earliest captures dates for *A. marmorata* at one site in central California (Alameda Co.) are consistent with our findings (Buskirk, *op. cit.*). Jennings and Hayes (*op. cit.*) reported no recruitment in *A. marmorata* populations in California's Central Valley. However, later research reported young turtles were caught throughout the Central Valley of California suggesting recruitment in these populations (Germano and Bury 2001. Trans. West. Sect. Wildl. Soc. 37:22–36). Understanding the habitat requirements and fates of neonates will improve future assessments of the age structure and stability of Central Valley populations.

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APALONE FEROX (Florida Softshell Turtle). **PREDATION.** During surveys for protected species at the site of a proposed development project in Lake County, Florida, USA, a series of burrows used by Burrowing Owls (*Athene cunicularia*) was located. Earlier in the season, one of the burrows had been used for nesting by the owls. On 4 October 2001 at 1500 h, the carcass of a hatchling *Apalone ferox* was located in the mouth of the nest burrow. The fresh carcass was missing its head, anterior right leg, left forefoot, internal organs, as well as a portion of the right anterior carapace. The rest of the carcass was intact. The maximum straight-line carapace length was 29.5 mm. The closest body of water to the burrow location was an ephemeral wetland, located ca. 600 m away, which was dry and vegetated with tall grass when the carcass was found. The closest permanent water sources were approximately 2.5 and 3.5 km away in opposite directions. The specimen (UF 141547) was deposited in the Florida Museum of Natural History, Gainesville, Florida.

Observations of owls consuming turtles are uncommon. Barn owls (*Tyto* sp.) prey upon juvenile Eastern Box Turtles, *Terrapene carolina* (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Inst. Press, Washington, D.C.). In addition, Great Horned Owls (*Bubo virginianus*) reportedly capture hatchling Loggerhead Seaturtles (*Caretta caretta*) as they exit their nest (Toland 1991. Fla. Field Nat. 19: 117–119). Burrowing Owls are known to consume various species of insects, crabs, crayfish, frogs, toads, lizards, and snakes, small rodents, and birds (Bent 1961. Life Histories of North American Birds of Prey, Part two. Dover Publications, New York. 482 pp.). To our knowledge, this is the first documentation of predation by *A. cunicularia* on a turtle.

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GOPHERUS AGASSIZII (Desert Tortoise). **DIET**. On 23 August 2004, an adult female Desert Tortoise was observed foraging on the scat of the Black-Tailed Jackrabbit (*Lepis californicus*) in the western Mojave Desert northeast of Barstow, San Bernardino County, California, USA. The tortoise was observed to eat three pellets, though it is unknown how many were consumed prior to initiation of observations. At widely separated locations within our study site, two separate observations of tortoise feces containing entire *L. californicus* scats were discovered, suggesting different individuals in each case. One tortoise scat was found in mid-October 2004 and contained one entire rabbit pellet. Another scat

was found on 4 November 2004 at the entrance to a female tortoise's hibernation burrow. This scat was fresh and contained three rabbit pellets, along with coarse plant fibers, seeds, as well as sand and small gravel.

In addition to native and exotic vegetation, *Gopherus agassizii* individuals have been observed to consume bones, stones, and soil (Esque and Peters 1994. *In* Bury and Germano [eds.], Biology of North American Tortoises. pp.105–111. Nat. Biol. Surv., Fish Wildl. Res. 13. Washington, D.C.). Observations on Desert Tortoise foraging behaviors have also included bird feathers, mammal hairs, snake and lizard scales, arthropod parts (Hansen et al. 1976. Herpetologica 32:247–251), and scat from Desert Woodrats (*Neotoma lepida*), lizards, and other Desert Tortoises (Henen 2002. Chel. Cons. Biol. 4:319–329). Ingestion of these various other items is suspected to be important for mineral and nutrient supplementation. The scats of rabbit are known to be nutritious (WallisDeVries 1996. J. Appl. Ecol. 33:688–702). This latter study found that cattle ate rabbit feces because it was of equal nutritive value to the sparse winter grasses and that the cattle could consume the feces at a faster rate than the sparse grass. The Texas Tortoise (*Gopherus berlandieri*) has also been observed consuming rabbit droppings (Auffenberg and Weaver 1969. Bull. Florida State Mus. 13:141–203) indicating that consumption of rabbit feces by tortoises is not an isolated event. Thus, the fibrous rabbit pellet may act as a food source for the Desert Tortoise from which trace elements or nutrients may be obtained and, if fresh, a small amount of water.

An alternate explanation for the consumption of feces, as demonstrated in Common Iguanas (*Iguana iguana*), is that intra-specific coprophagy is important in the transfer and inoculation of unique gut microbial symbionts which assists in digestion (Troyer 1982. Science 216:540–542). Intra-specific coprophagy, typically juveniles eating adult feces, is a well-documented behavior in reptiles (Montanucci 1999. Herpetol. Rev. 30:221–222; Troyer 1982, *op. cit.*) and has been observed in many species of tortoises (Ernst and Barbour 1989. Turtles of the World. Smithsonian Institution Press. Washington, D.C.), including the Desert Tortoise (Lance and Morafka 2001. Herpetol. Monogr. 15:124–134; Henen 2003, *op. cit.*). It is assumed that a similar inoculation function is present for the Desert Tortoise. Inter-specific coprophagy may play a similar role as many species of tortoise worldwide have been observed to consume feces (Ernst and Barbour 1989, *op. cit.*). Congeners of the Desert Tortoise have been observed consuming feces including: Gopher Tortoises (*G. polyphemus*) eating fox and their own scat (Anderson and Herrington 1992. Herpetol. Rev. 23:59; Macdonald and Mushinsky 1988. Herpetologica 44:345–353); Texas Tortoises eating Collared Peccary (*Tayassu tajacu*) feces (Mares 1971. Texas J. Sci. 23:300–301) as well as rabbit droppings and their own feces (Auffenberg and Weaver 1969, *op. cit.*); and Desert Tortoises have been observed eating scat from Desert Woodrats, lizards, Collared Peccaries, and other Desert Tortoises (Henen 2002, *op. cit.*; Hart et al. 1992. Unpubl. report to Arizona Game and Fish Dept. and U.S. Bureau of Land Management, Phoenix). Many of these observations involve the consumption of other herbivores' scats, which might aid in the transfer of gut microflora such as bacteria and fungi. Our observation of a Desert Tortoise eating the scat of another desert herbivore might provide the Desert Tortoise with nutrients and might also provide the tortoise with a unique gut microflora. To our knowledge these are the first reports of adult Desert Tortoises eating scat of *L. californicus*.

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GOPHERUS POLYPHEMUS (Gopher Tortoise). **COYOTE PREDATION.** *Gopherus polyphemus* is listed as a species of special concern by the state of Florida (Florida Wildlife Code Chap. 39 F.A.C.), and as a threatened species by the Florida Committee on Rare and Endangered Plants and Animals (Moler 1992. Rare and Endangered Biota of Florida: Volume III, Reptiles and Amphibians. University Press of Florida, Gainesville, Florida. 291 pp.). Coyotes (*Canis latrans*) are invasive to Florida with ranges that are expanding within the state (Schmitz and Brown 1994. An Assessment of Invasive Non-Indigenous Species in Florida's Public Lands. Florida Dept. Environmental Protection. Tallahassee, Florida. 283 pp.; Wooding and Hardinsky 1990. Florida Field Nat. 18:12–14), including the southeastern coast (Cunningham and Dunford 1970. Quart. J. Florida Acad. Sci. 33:279–280; Brady 1983. Florida Field Nat. 11:40–41; Hill et al. 1987. Wildl. Soc. Bull. 15:521–524; Wooding and Hardinsky, *op. cit.*). We report here evidence of Coyote predation on Gopher Tortoise hatchlings in southeastern coastal Florida.

Passive tracking index data used to monitor both exotic and native species on public lands (Engeman et al. 2001. Environ. Cons. 28:235–240) indicated an increasing presence of Coyotes on state and county public lands in the Palm Beach to Port St. Lucie areas (Engeman, unpubl. data), prompting us to opportunistically examine Coyote scats for evidence of Gopher Tortoise predation. On 3 April 2004, one of us (JAM) collected a Coyote scat with Gopher Tortoise remains from a path in a pine flatwoods greenway in the Abacoa development of Jupiter, Florida. The dried scat was 9 cm long and the gular projection of the plastron of a 2–3 yr old Gopher Tortoise was clearly visible, along with mammal fur, rodent bones, and grasshopper fragments. Hatchlings might be more vulnerable to predation than juveniles, but less noticeable in casual observation of scats. Efforts at the time to conduct larger surveys for evidence of Gopher Tortoises in coyote scats were made impossible by hurricanes Frances and Jeanne. Coyote predation on Gopher Tortoises is of concern because predation is a critical threat to endangered or locally rare species (Hecht and Nickerson 1999. Endangered Species Update 16:114–118), and predation losses can further stress populations already impacted by habitat loss and altered predator communities (Reynolds and Tapper 1996. Mammal Rev. 26:127–156), both of which apply to Gopher Tortoises in Florida.

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KINOSTERNON INTEGRUM (Mexican Mud Turtle). **SIZE.** *Kinosternon integrum* is one of the largest species in the genus (Pritchard and Trebau 1984. The Turtles of Venezuela. SSAR. 466 pp.) and males obtain larger sizes than females. The largest specimens reported in the literature were 202 mm carapace length (CL) (Ernst and Barbour 1989. Turtles of the World. Smithsonian Institution Press. 313 pp.) and 210 mm CL (Iverson et al. 1998. Cat. Amer. Amphib. Rept. 652:1–6). We found two males exceeding 210 mm CL in the municipality of Tonatico, Estado de México, México (18°45'04"N, 99°37'35"W) in April 2004. The first male was 223 mm CL with a mass of 662.9 g, and the second 220 mm CL and 810 g. This apparently represents the largest size (CL) reported to date for males of this species.

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TRACHEMYS GAIGEAE (Big Bend Slider). **REPRODUCTIVE CHARACTERISTICS.** Relatively little information has been published on reproduction in *T. gaigeae* (see review by Stuart and Ernst. 2004. Cat. Amer. Amphib. Rept. 787:1–6). Herein we provide descriptive statistics and other data for the subspecies *T. g. gaigeae* (following taxonomy of Seidel 2002. J. Herpetol. 36:285–292) obtained during field studies in the Rio Grande Valley, southern Socorro County, New Mexico, USA in 1996–1998. Collection methodology and locations were previously discussed by Stuart and Painter (2002. Bull. Maryland Herpetol. Soc. 38:15–22). Mensural data are presented as: mean ± standard deviation, range.

Twelve adult females (maximum straight-line carapace length [CL] = 242.2 mm ± 11.9, 228–266 mm; maximum straight-line plastron length [PL] = 228.3 mm ± 11.1, 213.5–247 mm; pre-oviposition mass = 1890.1 g ± 281.4, 1538–2364 g), captured in aquatic traps, were identified as gravid with shelled eggs based on abdominal palpation. Dates of collection were between 19 May and 11 July; no female captured before or after this period showed evidence of bearing shelled eggs. All 12 females were induced to oviposit within 24–48 h of capture by injection of oxytocin (Ewert and Legler 1978. Herpetologica 34:314–318) and were judged to be spent (devoid of shelled eggs) via abdominal palpation over a several day period post-oviposition. Eggs were incubated in moist vermiculite at 28–30°C in the laboratory, and hatchlings were retained alive for up to 12 months post-hatching.

Number of eggs per clutch (N = 12) averaged 15.4 ± 4.9, 6–22. Previous reports of clutch size in *T. g. gaigeae* ranged from 6 to 29 (reviewed by Morjan and Stuart 2001. Southwest. Nat. 46:230–234). Eggs (N = 170) were measured within 24 h after laying. Egg length averaged 35.0 mm ± 1.3, 31.6–37.7 mm; and width averaged 22.5 mm ± 0.9, 20.1–24.6 mm. Individual egg mass (N = 147, from 10 of the 12 clutches) averaged 10.7 g ± 1.1, 8.5–13.0 g.

Incubation period in the laboratory for 11 clutches averaged 60.8 days ± 2.4, 57–64 days, and hatching success rate was ca. 72%. Hatchlings (N = 123) were measured within one month after hatching: CL averaged 29.0 mm ± 1.4, 25.2–32.7 mm; PL averaged 27.4 mm ± 1.2, 24.1–30.6 mm; and mass averaged 6.0 g ± 0.8, 4.3–7.7 g. As noted by Morjan and Stuart (2001, *op. cit.*), the hatchling color pattern was similar to that of adults, although the reticulate pattern on the carapace was much more densely arranged, and the olive carapace and yellowish plastral colors were much paler and duller than in adults.

In 10 clutches, mean egg mass was significantly correlated with means of egg length ($r^2 = 0.77$, $F = 27.0$, $p < 0.001$), egg width ($r^2 = 0.84$, $F = 42.9$, $p < 0.001$), hatchling CL ($r^2 = 0.65$, $F = 15.0$, $p < 0.005$), and hatchling mass ($r^2 = 0.79$, $F = 30.9$, $p < 0.001$). Mean length and width of eggs were significantly correlated with mean hatchling CL ($r^2 = 0.56$, $F = 11.4$, $p < 0.01$; and $r^2 = 0.52$, $F = 9.8$, $p = 0.01$, respectively). Female CL and pre-oviposition mass were not significantly correlated with length, width, or mass of eggs; clutch mass or size; or hatchling CL or mass (r^2 values < 0.26, $p > 0.13$), possibly because of the small sample size. However, extensive variation in these reproductive characteristics has been observed in better-studied species of slider such as *T. scripta* in the U.S. (e.g., Tucker et al. 1998. J. Herpetol. 32:515–526).

Egg mass index (EMI; mean individual egg mass × 100/spent female mass) and relative clutch mass (RCM; clutch mass/spent female mass) were calculated for 10 females and their clutches. EMI averaged 0.65 ± 0.10, 0.55–0.86, and RCM averaged 0.10 ± 0.02, 0.05–0.14. The mean EMI for *T. g. gaigeae* fell between ratios reported for *Trachemys* spp. from the central U.S. (0.95) and Central America (0.41–0.49), whereas the mean RCM was comparable to that of *T. scripta* in the central U.S. (0.10) but lower than the ratio for *T. venusta* in Costa Rica (0.14) (Moll and Moll 1990. *In* J. W. Gibbons [ed.], Life History and Ecology of the Slider Turtle, pp. 152–161. Smithson. Instit. Press, Washington, D.C.; Moll 1994. Chelon. Conserv. Biol. 1:107–116). In terms of EMI, *T. g. gaigeae* appears to be intermediate between temperate and tropical populations of *Trachemys* spp.

Our data, although derived from a small number of gravid females and their offspring, suggest that *T. g. gaigeae* is similar in its reproductive characteristics to other species of *Trachemys*. We thank K. A. Buhlmann, J. D. Congdon, and J. M. Legler for comments, and J. B. M. Miyashiro for assistance. Fieldwork was funded in part by the New Mexico Department of Game and Fish, Share with Wildlife Program.

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TRACHEMYS SCRIPTA ELEGANS (Red-eared Slider). **REPRODUCTION**. The natural range of *Trachemys scripta elegans* extends from northern Illinois to the Gulf of Mexico, USA (Gibbons and Zug 1990. Life History and Ecology of the Slider Turtle. Smithsonian Books. 384 pp.). *T. scripta elegans* has been introduced and successfully reproduces in California (Lever 2003. Naturalized Reptiles and Amphibians of the World. Oxford University Press. 288 pp.). The northernmost known occurrence of *T. scripta elegans* in California occurs in Contra Costa Co., south of San Francisco (Stebbins 2003. A Field Guide to Western Reptiles and Amphibians, Houghton Mifflin Co., Boston, Massachusetts. 533 pp.). Here, I report the first occurrences and breeding success of *T. scripta elegans* in Marin County, California. This apparently represents the most northern occurrence of a breeding population of this non-native species in California to date. Assisted by two biologists from Garcia and Associates, I conducted a Western Pond Turtle (*Actinemys marmorata*) population study from April to August 2003 in the Mount Tamalpais Watershed, Marin Municipal Water District, Marin County. During that study, we captured numerous reproductive *T. s. elegans* males and females (palpation of eggs) at two lakes. We also captured sub-adults, juveniles, and five hatchlings. Juveniles and hatchlings caught were likely the offspring of adults released in the lakes, since juveniles under 10 cm in length are not legally available in the pet trade in the United States.

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CROCODYLIA

ALLIGATOR MISSIPPIENSIS (American Alligator). **FEEDING.** *Alligator missippiensis* is a large, abundant carnivore in marshes and swamps of the southeastern United States. Small *A. missippiensis* (< 1.5 m TL) eat what is locally available, consuming primarily invertebrates, small fish, and amphibians. As *A. missippiensis* grow larger, they eat larger fish and amphibians, snakes, turtles, birds, mammals, and shellfish (Mazzotti and Brandt 1994. *In* Davis and Ogden [eds.], Everglades: The Ecosystem and its Restoration, pp. 485–505. St. Lucie Press, Delray Beach, Florida). Reports of exotic snakes in Everglades National Park (ENP) include increased sightings of Burmese Pythons (*Python molurus bivittatus*; Snow and Oberhofer 2004. http://www2.nature.nps.gov/YearinReview/02_B.html). Sources of mortality of pythons include motor vehicles, mowing equipment, fire, and possibly alligators. Here, we confirm the latter with a report of an *A. missippiensis* feeding on a *P. m. bivittatus* (Fig. 1).

At 1015 h on 7 June 2005, an adult (ca. 2.4 m) *A. missippiensis* emerged from a well-used alligator trail into a box culvert pool along the south side of the Main Park Road (SR 9336) of ENP (25°24'13.1"N, 80°36'34.1"W, datum: NAD83; elev. ca. 1 m). This box culvert is 1.85 km W of the main entrance (fee booth) to the ENP. When first observed, the alligator had a subadult (ca. 2.6 m TL) *P. m. bivittatus* in its jaws. The alligator held the python just behind the head, and the snake was wrapped around the body of the alligator. The python's head was above water and the snake was obviously alive, with its tongue flicking. By 1215 h, the python was no longer wrapped around the alligator; the snake's head was submerged and its body appeared limp. At 1310 h, the alligator began to swallow the python, throwing its head back, "chomping," with lengthy rests in between. By 1410 h, the alligator had ca. 1.3 m of python trailing from its mouth, having swallowed the snake whole, head first. No further observations were made until 1507 h, at which time there was still ca. 1 m of visible snake. At 1556 h, the alligator continued to toss its head and "chomp," then rest with its head out of the water on the bank. At 1601 h, the *A. missippiensis* made another attempt to swallow more python, and then rested. At 1627 h, the alligator re-engaged in several bouts of swallowing with little progress. By 1642 h, the *A. missippiensis* had made some progress, with about 0.6 m of the snake remaining to be swallowed. At 1716 h, the alligator rested for 30 min with its head out of water on the bank edge. This was followed by more swallowing attempts and resting. Observations ceased at 1938 h with ca. 0.6 m of python still hanging out of the alligator's mouth.

The culvert was visited 5 times between 0715 h and 1715 h the following day. No observations of python or alligator were made. On 9 June 2005 at 0715 h, the same alligator was observed in the north side culvert pool with about 0.1 m of python's tail hanging out of its mouth (Fig. 1). The alligator left the culvert pool by 0945 h. This alligator was seen again at the culvert at 1445 h with no snake parts showing. The alligator has not been seen in more than 60 visits to that culvert pool since.

This is not the first observation of alligators encountering pythons in ENP. On 5 January 2003, a park visitor reported an alligator estimated to be over 2 m TL and a python estimated to be over 3 m TL battled for more than 24 h at Anhinga Trail. Although the alligator appeared to have subdued the python, the snake broke free and swam off into the marsh. On 3 February 2004, a small group of tourists at Pa-hay-okee Overlook reported that a large python (reported at over 6 m TL) had wrapped itself around an adult alligator (reported as 3.5 m TL). Photographs of the encounter suggest that the python was closer to 4 m TL and the alligator 2.5 m TL. The alligator had been reported to grab the python in its mouth and swim away.

The difficulty with which *A. missippiensis* had swallowing the python in the encounter we describe suggests that a limit to snake prey size exists. Spectacled Caiman (*Caiman crocodiles*) are re-

FIG. 1. American Alligator eating Burmese Python in Everglades National Park, Florida.

ported to kill Green Anacondas (*Eunectes murinus*) in the Venezuelan Llanos. Smaller snakes were eaten, but larger ones were not consumed (Rivas et al. 1999. Herpetol. Rev. 30:101). Rivas et al. (*op. cit.*, 1999) also reported that anaconda predation on caimans often occurs.

That three alligator-python battles have been reported over a 29-month period in ENP indicates either that these interactions are common or easily observed. More data on the ecology of Burmese Pythons in ENP is needed to evaluate extent and importance of interactions between these two species.

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PALEOSUCHUS PALPEBROSUS (Dwarf Caiman). **NESTING.** *Paleosuchus palpebrosus* is widely distributed in Brazil, but its reproductive biology remains poorly documented (Magnusson 1992. Cat. Am. Amphib. Rept. 554.1–554.2). Here, we add observations of *P. palpebrosus* nesting in northern Brazil to the limited reproductive data on this species.

We searched for nests around Cururu Lake, near the Solimões River (03°34'30.4"S, 60°40'03.3"W, datum: WGS84; elev. 80 m), State of Amazonas in November–December 2001 and 2002. We found two *P. palpebrosus* nests in the forest around lake. Nests were found in the forest seasonally flooded by the lake and small streams, at distances of 15–20 m from water, and were built from decaying leaves and twigs.

One nest, which was intact, was 55 cm high, 108 cm long, and 70 cm wide. We could not obtain precise dimensions on the second nest because a predator had disturbed it; pieces of eggshells were scattered about. The intact nest had 15 eggs, and we measured the length, width, and weight of 8 eggs. Mean egg length was 61.1 cm (SD = 2.0), mean egg width was 38.1 cm (SD = 1.5), and mean egg mass was 56.4 g (SD = 3.6). We captured a female *P. palpebrosus* (69.0 cm SVL, 8.0 kg) near the intact nest (Fig. 1).

Nests of this species have been reported from Colombia and Surinam (Medem 1981. Los Crocodylia de Sur America. Vol. 1. Colciencias, Bogota, Colombia. 354 pp.; Medem 1983. Los Crocodylia de Sur America. Vol. 2. Colciencias, Bogota, Colombia. 270 pp.), but this is the first nest reported from the Amazon region of Brazil. Nest structure and material was generally similar to nests found elsewhere, though some nests have also been recorded on floating vegetation mats in Surinam (Medem 1981, *op. cit.*). Clutch size in all three areas (13–15/nest) is similar, and the size of *P. palpebrosus* eggs reported by Medem (1981, *op. cit.*) is similar to the size of eggs we found.

FIG. 1. *Paleosuchus palpebrosus* nest in foreground with female *P. palpebrosus* (69 cm SVL) in background.

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RHYNCHOCEPHALIA

SPHENODON PUNCTATUS (Common Tuatara). **OPPORTUNISTIC PREDATION**. *Sphenodon punctatus* are opportunistic visual predators. In the wild, they feed primarily on invertebrates including weta (Orthoptera), beetles (Coleoptera), and isopods (*Oniscus* spp.) (Walls 1981. New Zealand J. Ecol. 4:89–97). Accounts also exist of tuatara feeding on vertebrate prey, including skinks (*Oligosoma* spp.), geckos (*Hoplodactylus* spp.), and frogs (*Leiopelma hamiltoni*) (Brown 1994. New Zealand J. Zool. 21:425–430). Adult *S. punctatus* occasionally feed on Fairy Prion (*Pachyptila turtur*) eggs, chicks (Wright 1961. Notornis 9:133) and adults (Walls 1978. New Zealand J. Ecol. 1:91–98), but this is not surprising as these colonial ground-nesting birds occur in large numbers, often sharing burrows with tuatara (Newman 1987. Herpetologica 43:336–344). However, no accounts exist of *S. punctatus* feeding on passerine birds. Hence, we report an observation of *S. punctatus* predation on a House Sparrow, *Passer domesticus*.

At ca. 1000 h on 23 March 2005, we encountered an adult (ca. 250 cm SVL) male *S. punctatus* with a *P. domesticus* in its mouth on the northeastern side of Stephens Island (Marlborough Sounds, New Zealand, 40°40'S, 174°00'E, datum: NZGD49; ca. elev. 215 m). The event occurred under the dense undergrowth directly beside a small shed that is ca. 5 m from the sliding glass door of one of the three houses on the island. The head had already been consumed, but the sparrow was clearly identifiable (Fig. 1). The sparrow was difficult to age due to it already having been partially consumed; however, based on feather and leg development, it was either an older juvenile or an adult (i.e., flight capable). After ca. 2 h, the *S. punctatus* managed to eat the sparrow whole, by very

FIG. 1. Adult male Common Tuatara (*Sphenodon punctatus*) in the process of consuming a House Sparrow (*Passer domesticus*) on Stephens Island, New Zealand.

slowly chewing down the length of the bird's body.

This is the first report of *S. punctatus* feeding on a passerine bird. It is unknown what enabled the capture of this sparrow, as passerine birds are not known to be a primary prey item for *S. punctatus*. As the incident occurred within 3 m of a glass door, the sparrow may have been captured opportunistically after having been stunned as a result of flying into the glass and subsequently attracting the tuatara's attention. However, if the bird had recently fledged, its inexperience could have enabled its capture. We expect that the ecology of House Sparrows, an introduced species in New Zealand, makes them only occasional prey for *S. punctatus*.

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LACERTILIA

AMEIVA AMEIVA (Giant Ameiva). **PREDATION.** *Ameiva ameiva* may be the most studied Brazilian lizard; selected aspects of its ecology, e.g., reproduction (Colli 1991. Copeia 1991:1002–1012) and diet and thermal ecology (Vitt and Colli 1994. Can. J. Zool. 72:1986–2008) are well known. Although *A. ameiva* is known to prey on other lizards and amphibians (Pianka and Vitt 2003. Lizards. University of California Press, Berkeley. 346 pp.), relatively few data on its predators exist, such as snakes (Martins and Oliveira 1998. Herpetol. Nat. Hist. 6:78–150), mammals (Yensen and Tarifa 2003. Mammalian Species 727:1–8) and introduced predators (Henderson 1992. Caribb. J. Sci. 28:1–10). Hence, we add to the limited data on *A. ameiva* predators with observations of *Pseudoboa* (snake) predation on *A. ameiva* from the Pantanal, Corumbá municipallity, Mato Grosso do Sul State, Brazil.

On 04 April 2001, we received a dead juvenile female *Pseudoboa nigra* (396 mm SVL) killed by locals from an urban area of Corumbá (18°58'48"S, 57°39'18"W, datum: WGS84; elev. 90 m); dissection revealed one hand (12.8 mm) and a tail (66.6 mm) of a subadult *A. ameiva* in the stomach. Dry forest dominated by Fabaceae, Euphorbiaceae, Apocynaceae, Rubiaceae, and Sapindaceae surrounds the area; *A. ameiva* is common in the vicinity (pers. obs.).

On 20 June 2001, we captured a juvenile (336 mm SVL) male *Pseudoboa neuwiedii* in a 50-m set of four 106-liter pitfall traps with drift-fences placed on Santa Cruz Hill (19°24'49"S, 57°22'47"W, datum: WGS84; elev. 800 m). Semi-deciduous forest dominated by Caesalpiniaceae, Euphorbiaceae, Mimosaceae, Rutaceae, and Bignoniaceae characterizes the area. Dissection revealed a subadult (148 mm tail length only) female *A. ameiva* in stomach.

We recorded a third instance of predation on *A. ameiva* when we received an adult female *Pseudoboa haasi* (1092 mm SVL) killed by local workers in the Pantanal region called Nhecolândia (18°59'S, 56°40'W; datum: WGS84; elev. 98 m). The region is characterized by a matrix of different Cerrado habitats in which Bignoniaceae, Arecaceae, and Malpighiaceae are dominant in the vegetation. Dissection revealed a foot (29.3 mm), shed skin, and pieces of tail of an adult *A. ameiva* in the stomach.

Previous studies on snakes report that *Pseudoboa* prey on lizards (Martins and Oliveira 1998. Herpetol. Nat. Hist. 6:78–150; Strussmann and Sazima 1993. Stud. Neotrop. Fauna Environ. 28:157–168). Our findings suggest that these snakes may be important predators of actively foraging lizards, such as *A. ameiva*. The three *Pseudoboa* specimens (CEUCH 874, 904, and 3550) and their respective stomach contents are deposited in the zoological reference collection, Laboratory of Zoology, Campus of Corumbá, Universidade Federal de Mato Grosso do Sul (UFMS). We thank Marc P. Hayes for comments and Mineração Corumbaense Reunidas for logistical support.

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***AMPHISBAENA DARWINII DARWINII*.** (NCN). **REPRODUCTION.** The maximum clutch size reported for *Amphisbaena d. darwinii* is three eggs (Cei 1993. Mus. Reg. Sci. Nat. Torino, Monograf. 14:1–949; Achaval and Olmos 2003. Anfibios y Reptiles del Uruguay. 2nd Edición corregida y aumentada. Graphis, Impresora, Montevideo, Uruguay. 136 pp.). Here, we report a larger clutch size from southern Uruguay.

Diego Nuñez collected a clutch of four *A. d. darwinii* eggs at Avenida de los Pinos 2787, Colonia Nicolich, Ruta 102, km 23.2, Departamento Canelones (34°48'55"S, 56°01'13"W, datum: YACAR; elev. 27 m) on 30 December 2002. The leathery eggs were found within an unoccupied anthill in grassland habitat. The four eggs had mean dimensions of 24.7 mm × 13.0 mm, ranges: 24.0–25.0 × 13.0–15.0 mm). One egg was broken during manipulation; the other three eggs were incubated. Three hatchlings were born, two on 25 January 2003 (total length = 68 mm, mass = 0.73 g; total length = 85 mm; mass = 0.90 g), the third one day later (total length = 74 mm; mass = 0.67 g).

The four eggs and two dead hatchlings were deposited in the Colección Zoología Vertebrados, Reptiles (ZVC-R), Facultad de Ciencias, Montevideo as ZVC-R 6080. We thank Diego Nuñez for specimen data.

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CNEMASPIS **(Oriental Dwarf Geckos). COMMUNAL OVIPOSITION.** Communal egg-laying is widely reported among squamate reptiles, including many geckos (e.g., Krysko et al. 2003. Amphibia-Reptilia 24:390–396; Oda 2004. Acta Amazonica 34:331–332). Among South Asian gekkonids, selected species in several genera show this behavior (e.g., Bauer and Das 2000. J. South Asian Nat. Hist. 5:25–35; Das 2003. A Photographic Guide to Snakes and Other Reptiles of India. New Holland Publishers, London. 144 pp.; Khan and Tasnim 1990. Herpetologica 42:146–148), including some members of the genus *Cnemaspis*. In *Cnemaspis,* three species are known to exhibit communal oviposition; *C. kandiana* from Sri Lanka (Deraniyagala 1953. A Colored Atlas of Some Vertebrates from Ceylon, Vol. 2, Tetrapod Reptilia. The Ceylon Government Press, Colombo. 121 pp.), *C. indica* from the Western Ghats of India (Bhupathy and Nikon 2002. J. Bombay Nat. Hist. Soc. 99:330–332), and *C. baueri* from Peninsular Malaysia (Das and Grismer 2003. Herpetologica 59:544–552). Here, we add to previous reports of communal oviposition in *Cnemaspis* with observations from the Western Ghats of southern India.

On 22 September 2004, SB observed three sites with clusters of eggs of *Cnemaspis cf. indraneildasii* in Anashi National Park (ANP). All sites were on partly moss-covered bridge walls above dry or flowing streams under the road connecting Anashi village and Anashi Nature Camp. Eggs were white to off-white in color, translucent, longer than wide (oval), flattened at their wall-attached end, and generally represented three categories; unhatched, recently hatched and previously hatched. Recently hatched eggs typically had only their apical ends broken with most of the egg shell remaining, whereas previously hatched eggs only had basal fragments of the shell attached to the wall. Site 1 (15°00'08"N, 74°13'39"E, datum: WGS84; elev. 540 m) had two clutches: 3 and 2 unhatched eggs within an area 15 cm in diameter with one isolated, recently hatched egg on either side. One unhatched egg was 5.3 mm wide; during measurement, this egg cracked (hence the length was unrecorded) whereupon an apparently healthy fully developed *C. cf. indraneildasii* (12.2 mm SVL, 13.2 mm tail) immediately emerged. At least 12 previously hatched eggs were also located near these unhatched eggs. An adult *C. cf. indraneildasii* and a juvenile *Hemidactylus prashadi* were noticed within 0.5 m and 0.8 m, respectively, on the same wall. Site 2 (15°00'06"N, 74°13'38"E; elev. 540 m) had 3 clutches of 2 recently hatched eggs. Below these eggs were 7 unhatched eggs (1 isolated egg and 3 clutches of 2). At least 10 previously hatched eggs were also located near these eggs. Site 3 (15°00'06"N, 74°13'31"E; elev. 540 m) had 3 separate aggregations of eggs. One aggregation had 3 unhatched eggs (1 isolated egg and a clutch of 2) with another clutch of 2 recently hatched eggs below them. Impressions of 2 previously hatched eggs were also present. An adult *C. cf. indraneildasii* was observed within 0.6 m of this cluster. The second aggregation had 4 unhatched eggs (2 single eggs and 1 clutch of 2). Remains of 17 previously hatched eggs were also present near these eggs. The third aggregation had 7 unhatched eggs (5 single eggs in lower right and 1 clutch of 2 in lower right of Fig. 1). The remains of 51 previously hatched eggs were also located all around the unhatched eggs (see Fig. 1). The distances between different categories of eggs were not recorded, but at all 3 sites, eggs were located within a ca. 1 m circle diameter. Egg(s) presumed to represent separate clutches were always laid in distinct clusters with the overall dispersion within a cluster as in Fig. 1. For previously hatched eggs, it was impossible to obtain accurate counts of clutch size as only their basal impressions were left and new eggs were frequently laid over older ones. Isolated egg groups (1–2 eggs) were rarely observed (N = 3) in other parts of ANP.

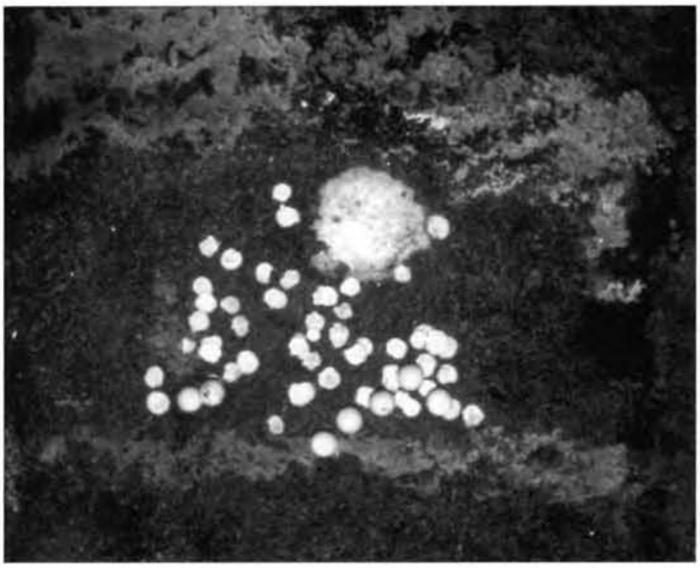

FIG. 1. Egg-laying of *Cnemaspis cf. indraneildasii* in Anashi National Park, Karnataka, India.

While studying reptiles in the Sengaltheri area of Kalakkad-Mundanthurai Tiger Reserve (KMTR), Tamil Nadu Forest, NMI observed aggregations *Cnemaspis* eggs. NMI located several *Cnemaspis* egg clusters (2–6 eggs) primarily in leaf litter, decaying logs, on the underside of tree bark, and under small stones during quadrat sampling. However, our description here refers to a site (08°31'45"N, 77°26'39"E; elev. 980 m) that harbored the largest aggregation of *Cnemaspis* eggs recorded from KMTR over the interval 1998–2000. The site was a 10-m wide rocky formation in a dense tree and canopy cover of mixed evergreen forest with minimal undergrowth. Except for ca. 2 months annually, the proximity of the Manimuttar River (15 m away) saturates the substrate. This site was ca. 1.5 m above ground in a narrow (ca. 1.5 cm wide) crevice due to one rock (ca. 1.5 m × 1 m × 2.5 m) sitting on a larger rock. Though the site is humid year-round, the environment in the crevice was not particularly moist. At least 50 unhatched and > 25 hatched eggs were recorded from this site. The area of visibility into the crevice was lined with eggs. Eggs were similar to those observed at ANP; other than *Cnemaspis*, no geckos recorded from KMTR (Ishwar et al. 2001. Current Sci. 80:413–418;

Murthy 1992. Rec. Zool. Surv. India 91:161–168) are likely to have similar-sized eggs. Only unhatched and previously hatched eggs were observed. Eggs seemed tightly packed into the crevice without obvious pattern, and several shell fragments were seen at the base of the crevice. *Cnemaspis* hatchlings observed in the nest eluded capture as they fled into the crevice when pursued. Three *Cnemaspis* species (*C. indica, C. ornata,* and *C. jerdoni*) were recorded in the vicinity with *C. indica* being most abundant.

Egg-laying was not observed, but oviposition by more than one individual is undoubtedly responsible for the large egg aggregations we describe (see Ananjeva and Orlov 1995. Russian J. Herpetol. 2:142–147; Bhupathy and Nikon, *op. cit.*). Moreover, the nest site at KMTR may be used by more than one species of *Cnemaspis* (see Krysko et al., *op. cit.*). *Cnemaspis* reproductive ecology is currently poorly described, but communal nesting in the genus may be more common than recorded (SB, NMI, unpubl. data from other areas). Hence, comparative information on the degree of site fidelity, frequency of multiple clutching, incubation time, and breeding season length will be needed to interpret the ecological and evolutionary context of oviposition aggregations.

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CTENOSAURA MELANOSTERNA (Black-chested Ctenosaur). **PREDATION.** At 1525 h on 19 July 2005, we saw a large (31.6 cm SVL, 51.5 cm tail, 996 g) *C. melanosterna* fall 4–8 m from the forest canopy on the island of Cayo Menor in the Cayos Cochinos (Islas de la Bahia, Honduras; 16°10'20"N, 86°30'10"W, datum: WGS84 ; elev. 8 m); a female *Boa constrictor* (133 cm SVL, 15.7 cm tail, 1267 g) was constricting the lizard. From the time the lizard and snake hit the ground, we could see no muscular activity in the lizard (including no obvious signs of respiration). The snake constricted the lizard for 34 min, then released the lizard and remained loosely coiled around it (and essentially motionless) for another 95 min. The snake then began to ingest the lizard, successfully swallowing the head and neck within 9 min. The snake then stopped, and again remained motionless. After 49 min, we placed the snake and lizard in a cloth bag and transported them to the lab. We placed both animals in a plastic storage bin (75 x 40 x 40 cm), hoping that the snake would finish eating the lizard. At 0800 h the next day, the snake and still unresponsive lizard were on opposite sides of the bin. At 1300 h the same day, we returned to the lab to find the snake on one side of the bin and the lizard alive and alert on the other. The lizard had been unresponsive for at least 21 h. We released the lizard at the point of capture the next day, whereupon it gave many aggressive head-bob displays before walking into the forest with no apparent ill effects.

Besides the observed predation attempt, we have found two adult female *B. constrictor* on Cayo Menor containing adult *C. melanosterna* (> 25 cm SVL). One female boa (117 cm SVL, 1661 g including prey) partially regurgitated a large *C. melanosterna*; the snake subsequently died in captivity. The other female (205 cm SVL, 5300 g including prey), discovered on 20 August 2004, contained a *C. melanosterna* (determined by palpation), and this snake subsequently was recaptured in good condition on 16 July 2005. These observations indicate that *C. melanosterna* might represent important prey for the insular boas. *Ctenosaura melanosterna* is known only from the Cayos Cochinos and Aguan Valley (Departamento de Yoro) in Honduras (Buckley and Axtell 1997. Copeia 1997:138–150). Little is known of *C. melanosterna* ecology, and although *B. constrictor* predation on adult *C. pectinata* has been recorded (Lemos-Espinal and Ballinger 1994. Herpetol. Rev. 25:26), this is the first report of snake predation on *C. melanosterna*.

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EUMECES LATICEPS (Broad-headed Skink). **FRUGIVORY; SEED DISPERSAL.** Most lizard species are exclusively carnivorous, yet herbivorous or omnivorous species are known from 11 lizard families (Cooper and Vitt 2002. J. Zool. 257:487–517). Of these, at least 8 families contain frugivorous species. The family Scincidae is one such example with 18 species known to be herbivorous or omnivorous. Furthermore, Cooper and Vitt (*op. cit.*) assert that plant matter may comprise a small component of the diet of many skinks that are primarily carnivorous. *Eumeces laticeps* may be one such species. Although this species typically consumes arthropods, snails, *Anolis* lizards, and even congenerics (Vitt and Cooper 1986. J. Herpetol. 20: 408–415), it is also the only North American scincid documented to consume fruit. Cooper and Vitt (*op. cit.*) report that *E. laticeps* has been known to eat grapes and berries, but provide no specific information on plant taxa nor viability of ingested seeds. Here we report an instance of frugivory by *E. laticeps*, provide positive identification of the species of fruit consumed, and evidence that this species could function as a seed disperser.

At ca. 1300 h on 10 June 2005, GGS and SMB captured an adult male *E. laticeps* (119 mm SVL, 247 mm TL, 35 g) beneath an abandoned doghouse. This observation was made in a rural setting in North Auburn, Alabama (32°38'55"N, 85°27'17"W, datum: WGS84; elev. 198 m). Upon capture, the lizard passed a fecal pellet which we preserved in formalin. This pellet contained

53 seeds and a receptacle with its attached pedicel from the aggregate fruit of *Morus rubra* (Moraceae). The lizard was held in captivity for one week during which time it passed 11 more seeds, another receptacle and pedicel. Because two receptacles (each with attached pedicels) were found in association with a large number of seeds, at least two fruits were eaten. Additionally, the presence of the combination of receptacles, pedicels, and partially aggregated seeds makes it unlikely that the seeds were ingested secondarily. The tree of this species closest to the lizard's refugium was within 3 m. The identity of the seeds was verified using a seed identification guide (Martin and Barkley 1961. Seed Identification Manual. University of California Press, Berkeley, California. 221 pp.) and by comparison to freshly collected fruit. Seed viability was confirmed by placing 6 seeds on moistened filter paper in a Petri dish and another 5 seeds in ca. 5 mm of finely ground peat moss in a Petri dish on 26 June 2005. Dishes were misted with water and checked for germination daily. One seed germinated in the peat moss on 3 August 2005. On 29 August, seeds were removed from the Petri dishes for tetrazolium testing. Seeds were cut in half, soaked for 1 hour in a 1% tetrazolium chloride solution, and then examined under a dissecting microscope for tetrazolium staining (indicating cellular respiration and hence viability). Four of the 6 seeds placed on the filter paper tested positive. The other 2 seeds from this dish and all 5 from the peat dish were found to be empty when cut open; the endosperm appeared rotted away. This may be an artifact of the germination trial rather than the digestive action of the skink because the seed coat was intact. This was further verified by cutting open 10 of the 53 seeds first passed by the lizard which had been placed in formalin. All seeds in this sample also had intact endosperm.

Eumeces laticeps frequents openings and edges of hardwood forests (Palmer and Braswell 1995. Reptiles of North Carolina, UNC Press, Chapel Hill, North Carolina. 412 pp.) which increases the likelihood that seed will be deposited in a site suitable for germination. Field work documenting seed germination from *E. laticeps* scat deposited *in situ* will be necessary to confirm this hypothesis.

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GYMNOPHTHALMUS SPECIOSUS **(Spectacled Lizard),** ***BACHIA HETEROPA*** **(Earless Lizard). PREDATION.** Falconiform bird predation on lizards is well documented. Martín and López (1990. Smithson. Herpetol. Info. Serv. 82:1–43) compiled information about predation on lizards by 23 species of falconiformes in southwestern Europe. Castro and Restrepo (1987 Actualidades Biológicas 16:31) found four specimens of *Leptotyphlops goudotti* in the stomach of *Falco sparverius*. Reptiles are also important prey of the Common Buzzard, *Buteo buteo* (Selás 2001 Can. J. Zool. 79:2086–2093), and West (1975. Condor 77:354) reported a case of predation of *Amphisbaena fuliginosa* by *Buteo nitidus*. In Venezuela, accipiters and the Black-Faced Hawk (*Leucopternis melanops)* have been mentioned as predators on reptiles (Phelps and de Schauensee 1978. Una Guía de las Aves de Venezuela. Gráficas Armitano. Caracas. 484 pp.), but documented reports of hawk predation on reptiles are generally scarce. The most substantial data are those of Rivas et al. (1998. Herpetol. Rev. 29: 238–239), who reported 9 species of Accipitridae birds, including *Buteo magnirostris*, as predators on Green Iguanas (*Iguana iguana*). Hence, we augment limited reports of hawk predation on reptiles with several observations from Venezuela.

During a faunal inventory conducted on 11 April 1989, members of the staff of Dirección General de Fauna del Ministerio del Ambiente y de los Recursos Naturales, Venezuela, captured an adult (350 g, 395 mm) female Roadside Hawk (*Buteo magnirostris*) in the road between Coloradito and Chaguaramas, Municipio Independencia, Anzoátegui State (08°48'N, 63°27'W; elev. 90 m). The specimen (EBRG 10424) was deposited in the Museo de la Estación Biológica de Rancho Grande. During the preservation process, RR found four lizards in the crop that apparently had been swallowed recently, as they were only partially digested. Two specimens were identified as *Gymnophthalmus speciosus* (115.0 and 95.0 mm total length [TL]) and two as *Bachia heteropa* (140.0 and 183.0 mm TL), and catalogued as vouchers EBRG 2332–2333 and EBRG 2330–2331, respectively.

This is the first *B. magnirostris* predation record on *Gymnophthalmus* and *Bachia*. Occurrence of 4 specimens of 2 different species supports the idea that small reptiles may be more than occasional prey for this species, previously reported to feed almost exclusively on insects (Phelps and de Schauensee, *op. cit.*). Diurnal, open area (savanna and forest edges) foraging, and use of relatively low perches (5–15 m; Phelps and de Schauensee, *op. cit.*) might facilitate *B. magnirostris* predation on small diurnal lizards.

Sergio Bermúdez and Marco Natera verified, respectively, the *B. magnirostris* and lizard identifications. We thank A. Mijares-Urrutia, I. Martínez-Solano, F. Bisbal, and J. Sánchez for suggestions.

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HEMIDACTYLUS FRENATUS **(Common House Gecko). REPRODUCTION.** That many gekkonid lizards have continuous reproduction with a fixed clutch size of two eggs is well known (Vitt 1986. Copeia 1986:773–786; Selcer 1990. Herpetologica 46:15–21), but nothing is known about reproduction of *Hemidactylus frenatus* from the Pacific Coast of Mexico (Ramírez-Bautista 1994. Manual y Claves Ilustradas de los Anfibios y Reptiles de la Región de Chamela, Jalisco, México. Universidad Nacional Autónoma de México, Ciudad de México, D.F., México. 127 pp.). Hence, this note provides preliminary data on *H. frenatus* reproduction in Pacific México.

During 1989, we studied reproductive activity in *H. frenatus* through the year in the Biological Reserve Estación de Biología Chamela. This area is located between 5 km N and 15 km S of the

Pacific Coast of Jalisco, México (19°30'N, 105°03'W, datum: WGS84; elev. 10 m). Habitat is tropical dry forest dominated by *Astronium graveolens*, *Thouinidium decandrum*, and *Couepia polyandra* (Bullock 1986. Archiv. Meteorol. Geophys. Bioclimat. 36:297–316); precipitation occurs June–October. Mean annual temperature is 24.9°C; mean annual rainfall is 748 ± 119 mm (Ramírez-Bautista and Vitt 1997. Herpetologica 53:423–431). *Hemidactylus frenatus* inhabits crevices of the buildings at this field station.

Eight females (mean SVL 52.6 ± 1.2 mm, range: 50.0–58.0 mm, N = 8) from January (N = 2), April (N = 3), and August (N = 3) were reproductively active. Females from January and April had vitellogenic follicles (VF) and eggs, and females from August had eggs and growing follicles. Females with VF (N = 3) averaged 55.7 ± 2.3 mm SVL and females with eggs (N = 5) averaged 50.8 ± 0.6 mm SVL. Volume of VFs averaged 68.8 ± 24.5 mm^3 (range: 28.3–112.8 ± mm^3, N = 3) whereas egg volume averaged 258.0 mm ± 26.6 mm^3 (range: 197.5–322.9 mm^3, N = 5). Females laid 2 clutches of two eggs.

The reproductively active condition of females in all months sampled implies that reproduction occurs year-round and that *H. frenatus* may produce 3–4 clutches a year similar to many other tropical gekkonid lizard species (Vitt 1986, *op. cit.*).

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HOPLODACTYLUS MACULATUS **(Common Gecko). TOXIN CONSUMPTION.** Anticoagulant poisons, particularly the second-generation anticoagulant brodifacoum, are used extensively both to eradicate pest mammals from offshore islands and to detect reinvasions (e.g., Dilks and Towns 2000. Developing Tools to Detect and Respond to Rodent Invasions of Sslands: Workshop Report and Recommendations, Science Internal Series 59, Department of Conservation, Wellington, New Zealand, 18 pp.). Conservation benefits of pest mammal eradication usually outweigh the costs of temporary population die-back of non-target natives (Innes and Barker 1999. New Zealand J. Ecol. 23:111–127). Considerable research documents brodifacoum poisoning of native bird species (reviewed by Eason et al. 2002. Ecotoxicology 11:35–48) and invertebrates (e.g., Spurr and Drew 1999. New Zealand J. Ecol. 23:167–173) following mammalian pest eradication. However, research on other taxa (e.g., reptiles) and on ecosystem-level effects of chronic brodifacoum use is sparse. Brodifacoum is a potent and persistent rodenticide, lasting for at least six months in organs and tissue, which exacerbates the risk of secondary poisoning of non-target species (e.g., Eason et al., *op. cit.*).

Potential risk of brodifacoum poisoning to reptiles is thought to be low, as reptiles have a blood coagulation chemistry distinct from that of mammals (Merton 1987. Dodo J. Jersey Wildl. Preserv. Trust 24:19–43). However, few studies have investigated anticoagulant bait consumption by reptiles in the wild (but see Merton, *op. cit.* and Thorsen et al. 2000. Biol. Conserv. 96:133–138).

Mana Island, Cook Strait, New Zealand (41°40'S, 174°00'E) underwent eradication of mammals in 1991 and has since been the focus of an intensive ecological restoration program. To protect Mana Island from mammal reinvasion, 42 wooden boxes baited with brodifacoum poison (Pestoff®; 20 ppm; which has a half-life of 157 days in soil) and peanut-oil flavored wax tags are deployed along the shoreline, and rebaited regularly (every 4–6 weeks). Common geckos (*Hoplodactylus maculatus*) regularly use the bait boxes as refugia (Hare and Hoare 2005. Herpetol. Rev. 36:179).

In May 2004, we surveyed *H. maculatus* from 14 bait boxes. Handling induced defecation by 16% (12 of 74) of geckos. We observed 3 adult (one male and two females; 69–81 mm SVL) geckos (25%) deposit bright blue-green fecal material, in contrast to normal, dark-brown feces. One other adult (73 mm SVL) male gecko exhibited blue/green spots inside the throat and abdominal skin. Blue-green fecal material deposited was the same color as the dyed brodifacoum bait within the boxes, which led us to infer consumption of the toxin by these geckos (based on Freeman et al. 1996. Wildlife Research 23:511–516). One of the three geckos that defecated bait was in the late stages of pregnancy with two embryos (as determined by palpation), which raises the question of whether anticoagulant poison might detrimentally affect offspring. Other than these obvious signs that geckos consume toxic bait, all appeared to be in good condition (body condition, defined as log(mass)/log(SVL), was 0.557 ± 0.086, and did not differ significantly from body condition of adult geckos that did not show signs of bait consumption 0.536 ± 0.079; $F_1 = 0.4946$, $P = 0.4839$), had few ectoparasites and no sores or open wounds. Only one gecko was found dead during the survey, a desiccated juvenile, with no evidence of brodifacoum consumption.

Our observation of bait consumption by *H. maculatus* in nature is the first to document both brodifacoum consumption by geckos and consumption of a toxin by reptiles when it is continuously provided. Only two published studies report reptile consumption of brodifacoum bait in the wild. Following pest mammal eradication on Round Island, Mauritius, Telfair's Skink (*Leiolopisma telfairi*) suffered mortality from consuming brodifacoum bait (Merton, *op. cit.*), and Wright's Skink (*Mabuya wrightii*) from Frégate Island, Seychelles, also consumed brodifacoum bait, though effects on these skinks were not studied (Thorsen et al., *op. cit.*).

Formulating management strategies to mitigate the potential effects of anticoagulants and other toxins on lizards is hampered by a lack of information (Spurr 1993. Conservation Advisory Notes 33, Department of Conservation, Wellington, New Zealand, 4 pp.). Published lethal dose (LD_{50}) data on acute toxicity of anticoagulants to reptiles do not exist. However, LD_{50} data for lizards exposed to sodium monofluoroacetate (1080) suggest that poisons are unlikely to induce mortality in lizards, as lethality would require vast quantities of toxin to be consumed (e.g., McIlroy et al. 1985. Austral. Wildl. Res. 12:113–118). The hypothesis that anticoagulant poisons are unlikely to pose lethal threats to reptiles is supported by a laboratory study of anticoagulant consumption by McCann's Skinks (*Oligosoma maccanni*). Skinks which consumed toxic pindone (a first-generation anticoagulant) bait (97%), showed no adverse short-term effects (Freeman et al., *op. cit.*). However, potential sub-lethal effects of anticoagulants include interference with reptiles' abilities to thermoregulate, which might prove fatal under conditions of environmental stress (Merton, *op. cit.*).

Traditionally, discussions concerning the risk of secondary poisoning to non-target native species have focussed on target (i.e., mammalian) prey species as vectors for anticoagulant transportation (e.g., Eason and Wickstrom 2001. Vertebrate Pesticide Toxicology Manual (Poisons) (2nd ed.), Technical Series 23, Department of Conservation, Wellington, New Zealand, 122 pp.). Our finding extends concerns for non-target species, as brodifacoum consumption by reptiles poses a risk of secondary poisoning, particularly to native avian predators of lizards. Brodifacoum is a highly potent and persistent anticoagulant; ecosystem-level research is required if continued use of brodifacoum is deemed an appropriate management option to detect rodent invasions.

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LEIOCEPHALUS CARINATUS ARMOURI (Northern Curlytail Lizard). **SCAVENGED ROAD-KILL.** Little is known about the vertebrate predators and scavengers of *Leiocephalus carinatus armouri* within its introduced range in Florida, with few of these consumers currently documented (e.g., Meshaka et al. 2004. The Exotic Amphibians and Reptiles of Florida, Krieger Publishing Company, Malabar, Florida. 155 pp.; Smith and Engeman 2004a. Herpetol. Rev. 35:169–170; Smith and Engeman 2004b. Florida Field Nat. 32:107–113; Dean et al. 2005. Herpetol. Rev. 36:451). Thus far, only one mammal in Florida has been verified, feral cats (*Felis catus*) (Smith and Engeman 2004b, *op. cit.*). Here we report Eastern Gray Squirrel (*Sciurus carolinensis*) scavenging of a road-killed *L. c. armouri* in Florida.

At 1155 h on 1 April 2005 (sunny, air temperature ca. 28.3°C), HTS observed an adult *S. carolinensis* at the Woolbright Road colony of *L. c. armouri* located in Boynton Beach, Florida (see previous colony site descriptions in Smith and Engeman 2003. Herpetol. Rev. 34:245–246), sitting on its haunches in the parking lot of the Woolbright Road site gnawing on a large, flattened, wafer-like object . Holding the "wafer" in its forelimbs, the squirrel spun it slowly while chewing off and swallowing the edge portions. This behavior was observed for 3–4 min, at which time the squirrel was more closely approached. The squirrel then nervously flicked its tail, gave two distress barking-chatters, and attempted to flee with the wafer in its jaws. The large and unwieldy size and shape of the wafer caused it to be dropped by the squirrel after it had moved only 5 m. The wafer was collected and identified as a road-killed, completely flattened, adult *L. c. armouri* (see Fig. 1).

Leiocephalus c. armouri, present at the Woolbright Road site since at least 1986 (Smith and Engeman 2003, *op. cit.*), has been intensively studied there since 1993 (Smith and Engeman 2004b, *op. cit.*) and road-kills are common. During regular morning walks around the site, *L. c. armouri* road-kills are often found, only to disappear within a day or two. Feral cats (*Felis catus*) and exotic rodents were previously thought largely responsible for these disappearances. However, *S. carolinensis* have always been the most common mammal at the colony site.

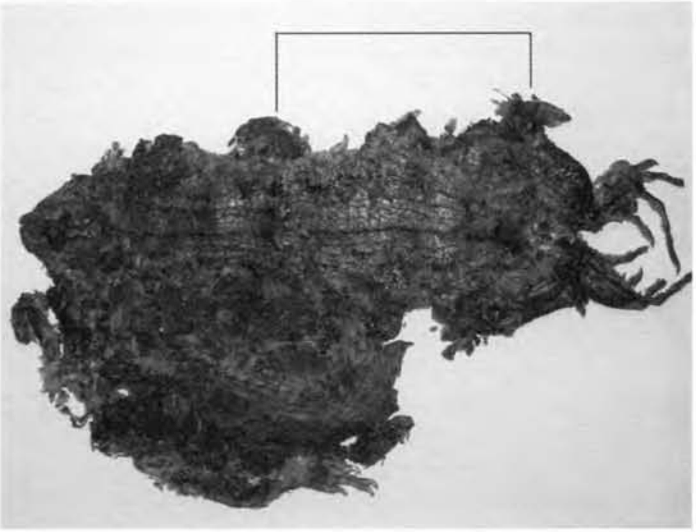

Fig. 1. Roadkilled *Leiocephalus carinatus armouri*; the bracket indicates the area chewed on by a *Sciurus carolinensis*.

In Florida, the diet of *S. carolinensis* generally consists of plant material including fruits, acorns, other mast and drupes, vegetative buds, bulbs, fungi, and staminate cones (Brown 1997. Mammals of Florida, Windward Publishing, Inc., Miami, Florida. 224 pp.; HTS, pers. obs.). However, *S. carolinensis* are also known to be carnivorous at some localities and times of the year, consuming insects, bird eggs, birds, and even chipmunks (Layne and Woolfenden 1958. J. Mammal. 39:595–596; Korschgen 1981. J. Wildl. Manage. 45:260–266; Faccio 1996. Can. Field Nat. 110:538). The relative abundance of *L. c. armouri*, alive and as road-kill, at the Woolbright Road colony may make it an important protein and trace element (e.g., calcium) dietary component of *S. carolinensis* at this location, especially during the bimodal squirrel breeding season peaks in Florida of late winter/early spring, and late spring/summer (Brown, *op. cit.*). Future observations/examinations/collections of *L. c. armouri* carcasses at this site will attempt to further clarify such a relationship.

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LIOLAEMUS OLONGASTA (NCN). **BODY TEMPERATURE.** *Liolaemus olongasta* is an oviparous lizard inhabiting the hot arid landscape of the Monte Phytogeographic Province in northern Argentina (Cabrera and Willink 1980. Biogeografía de América Latina. Washington, D.C. 109 pp.). Known from extreme western La Rioja Province and San Juan Province at elevations between 900 and 1600 m (Etheridge 1993. Museo Regionale di Scienze Naturali 11:1–199), data on its biology are sparse. Limited study

has been devoted to thermoregulation, sexual dimorphism, and time budgets (Cánovas et al. 2001. Congr. Argentina Herpetol. IV:32–33; Cánovas et al. 2002. XVI Reunión de Com. Herpetol. Asoc. Herpetol. Argentina XVI:45; Cánovas et al. 2003. Reunión de Com. Herpetol. Asoc. Herpetol. Argentina. XVII:38). Here, we add data addressing the thermal ecology of this species.

Field work was carried out in a dry streambed with a mosaic of flat boulders and patches of sand in La Laja, Departamento Albardon, Provincia de San Juan, Argentina (31°19'S; 68°41'W, datum: WGS84; elev. 700 m. Data were collected every 10 days from August 2000 to August 2001 by revisiting bushes and boulders across the study site at random. Each individual was hand-captured. Cloacal temperature (T_c), substrate temperature (T_s) and air temperature (T_a) were measured with a rapid reading Miller-Weber thermometer to the nearest 0.1°C. For each capture, we took T_s on the substrate at the exact point of observation, and T_a 1 cm above the substrate.

Mean body temperature was 32.1°C (s = 3.9°C, N = 55). We found no differences in T_c between males and females (ANOVA: $F_{1,53} = 2.77$, $P > 0.05$). Using size (as SVL) as the covariate, we also found no differences in T_c between gender groups (ANCOVA: $F_{2,51} = 2.02$, $P > 0.05$); a pattern similar to *Liolaemus pseudoanomalus* (Villavicencio et al. 2001. Congr. Argentina Herpetol. IV:81–82). However, using T_a as the covariate, we found interseasonal differences in T_c (ANCOVA: $F_{3,50} = 9$, $P < 0.05$); an *a posteriori* Tukey test revealed that T_c during winter (July to September) differed from other seasons. Cloacal temperature was correlated with each of T_s and T_a ($r = 0.64$, $P < 0.0001$; $r = 0.80$, $P < 0.0001$, respectively).

Liolamus olongasta appears more heliothermic that thigmothermic. This species thermoregulates in a manner similar to *L. wiegmanni* (Martori et al. 1998. Rev. Esp. Herpetol. 12:19–26), *L. sanjuanensis* (Acosta et al. 2004. Herpetol. Rev. 35:171), and *Liolaemus koslowsky* (Martori et al. 2002. Cuad. Herpetol. 1:78–99). These species move among shading vegetation during the warmer hours to lower their body temperature.

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LIOLAEMUS QUILMES (NCN). **LONGEVITY.** Little is known about longevity in Neotropical *Liolaemus*. Age at first reproduction or reproductive frequency can help estimate relative longevity. Tinkle (1969. Amer. Nat. 103:501–516) suggested that early maturing, multiple-brooded species tend to have shorter life expectancies than late-maturing, single-brooded species. Subsequent research (Stearns 1992. The Evolution of Life Histories, Oxford University Press, Oxford. 249 pp.; Roff 2001. Life History Evolution. Sinauer Associates, Sunderland, Massachusetts. 527 pp.) has generally borne this out. In *Liolaemus*, little information exists on age at first reproduction (e.g., ~12 months in *L. lutzae*, Rocha 1992. J. Herpetol. 26:17–23; 18 months in *L. signifer*, Pearson 1954. Copeia 1954:111–116). More data exist for reproductive effort. Two or 3 clutches may be produced each season (*L. koslowskyi*, 2 clutches, Aun and Martori 1998. Cuad. Herpetol. 12:1–9; *L. lutzae*, 2 or 3 clutches, Rocha 1990. Ciencia e Cultura 42:1203–1206; *L. multimaculatus*, 2 clutches, Vega 1997. Herpetol. J. 7:49–53; *L. scapularis*, 2 clutches, Ramirez Pinilla 1994. J. Herpetol. 28:521–524; *L. wiegmannii*, 2 clutches, Martori and Aun 1997. J. Herpetol. 31:578–581) or only one brood either every 1 or 2 years (*L. elongatus*, Ibargüengoytía and Cussac 1998. Herpetol. J. 8:99–105), or 2 or 3 years (*L. pictus*, Ibargüengoytía and Cussac 1996. Herpetol. J. 6:137–143). *Liolaemus quilmes* from northwestern Argentina produces one clutch per season (Ramirez Pinilla 1992. Acta Zool. Lilloana 42:41–49). This suggests that *L. quilmes* may have an intermediate life expectancy relative to other *Liolaemus*. Here I provide preliminary data on this life-history trait for *L. quilmes* that can ultimately be used to test the intermediate longevity hypothesis.

As part of a separate study (Halloy and Robles 2002. Bull. Maryland Herpetol. Soc. 38:118–129; Halloy and Robles 2003. Cuad. Herpetol. 17:65–71), *Liolaemus quilmes* was monitored over 6 austral spring and summers (October 1999–March 2005) at Los Cardones (26°40'1.5"S, 65°49'5.1"W, datum: WGS84; elev. 2700 m), Tucumán, Argentina. This diurnal, mainly insectivorous, and oviparous lizard occurs in semi-arid and arid habitats between 1600–3000 m (Etheridge 1993. Boll. Mus. Reg. Sci. Nat., Torino 11:137–199). Males are more colorful and slightly larger (mean SVL = 65 mm) than the less conspicuous, slightly smaller (mean SVL = 61 mm) females (Cei 1993. Mus. Reg. Sci. Nat., Torino Monogr. 14:1–949).

Lizards were captured within a 60 x 60-m grid (Halloy and Robles 2002, *op. cit.*). They were measured, weighed and individually marked with a combination of two colored beads attached to the base of the tail with surgical steel monofilament (Fischer and Muth 1989. Herpetol. Rev. 20:45–46). Marked lizards were released at the site of capture. Because of the risk to smaller lizards, only adults were marked. Young grow rapidly during their first two summers and can breed by the beginning of their third summer, at 20–21 months. Thus, I estimated adults captured to be ≥ 1.5–2 years old.

Over the study, 189 lizards (95 males and 94 females) were marked. Lizards sighted ≤ 3 times each summer (N = 51), and those marked during the last summer (N = 35) were excluded from the analysis. Remaining lizards (N = 103: 48 males, 55 females)

TABLE 1. Number of adult female (male) *Liolaemus quilmes* resighted over 5 years with respect to year (i.e., austral spring/summer = October–March) of capture.

Year of capture	Number of years resighted					
	1	2	3	4	5	Totals
1999–2000	2(1)	4(9)	1(4)	4(0)	1(1)	12(15)
2000–2001	0(1)	3(4)	3(4)	0(1)	2(1)	8(11)
2001–2002	0(0)	0(0)	0(1)	1(0)	0(0)	1(1)
2002–2003	2(5)	10(2)	7(5)	0(0)	0(0)	19(12)
2003–2004	0(2)	15(7)	0(0)	0(0)	0(0)	15(9)
Totals	4(9)	32(22)	11(14)	5(1)	3(2)	55(48)

represent animals periodically censused during the October–March interval over 84 days in the 6 years combined (Table 1).

Most lizards appeared to live at least 2 or 3 summers as breeding adults (75% males, 78.2% females; Table 1). No lizard marked during the first summer was found during the sixth summer. Of those marked during the first summer, 6.7% males and 8.3% females were found 5 years later. Of those marked during the second summer, 9.1% males and 25% females were found 5 years later. Only two lizards were marked during the third summer and they were resighted for 3 (a male) and 4 years (a female). Adding ca. 2 years since hatching before their first capture, this suggests that these lizards may live, on average, 4–5 years. Seven to 25% of individuals may attain 7 years of age. No significant difference was found between males and females in the pattern of years resighted (Wilcoxon-Mann-Whitney test: $W_x = 29$, $P > 0.05$; Siegel and Castellan 1988. Statistics for the Social and Behavioral Sciences. McGraw-Hill, Inc., New York, 399 pp.).

This temperate species seems to fall in a middle of a continuum between early-maturing species having multiple broods and short life expectancies and late-maturing species producing one brood and having high survivorship (Tinkle, *op. cit.*). However, longevity data obtained for other species of *Liolaemus* will be needed to unequivocally verify this supposition.

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LIOLAEMUS RUIBALI **(NCN). BODY TEMPERATURE.** *Liolaemus ruibali* is an ovoviviparous insectivorous lizard that inhabits the east slope of the Andean Cordillera and pre-Cordillera in central-western Argentina (Cei 1986. Museo Regionale di Scienze Naturali. Monografie IV. Torino. 527 pp.). *Liolaemus ruibali* has an ambiguous conservation status: defined as a species for which "insufficient knowledge" exists (Lavilla et al. 2000. Categorización de los Anfibios y Reptiles de la República Argentina. Asoc. Herpetol. Arg., 97 pp.). Data on its biology are sparse. The only published data are those of Villavicencio et al. (2004. Actas V Congr. Arg. Herpetol. pp. 64–65, San Juan), who made observations on its reproduction and diet. Here, we present preliminary data on *L. ruibali* thermal ecology.

On 14 April 2000, we conducted field work in the Reserva de Usos Múltiples Don Carmelo, Departamento Ullum, Provincia de San Juan (31°10'S, 69°46'W, datum: WGS84; elev. 3000 m). Located in the Puna Phytogeographic Province, *Stipa speciosa var. breviglumis, Lycium chanar, Artemisia mendocina, Ephedra breana,* and *Maihuniopsis glomerata* dominate the largely Andean flora (Cabrera and Willink 1980. Biogeografía de América Latina. Washington, D.C. 109 pp.). The data presented are based on 12 captures. To collect these data, we revisited a randomized selection of bushes and low rocks across the study site. Each individual was captured by hand, and its SVL was measured (to nearest 0.02 mm). For each capture, cloacal (T_c), substrate (T_s) and air (T_a) temperatures were measured (to nearest 0.1°C) with a rapid-reading Miller-Weber thermometer. We took T_s at the exact point of observation, and T_a 1 cm above the substrate, both immediately following capture.

Mean body temperature of the 12 *L. ruibali* was 24.4°C (SD = 6.2°C). Body size was unrelated to T_c (Spearman Rank Correlation: $r_s = 0.22$, $P = 0.47$). An ANOVA revealed significant differences between T_c (higher) and T_a ($F_{1,22} = 6.64$, $P = 0.01$). In contrast, neither T_c and T_s ($F_{1,22} = 1.54$, $P = 0.22$) nor T_a and T_s ($F_{1,22} = 2.26$, P = 0.14) differed significantly from one another. Cloacal temperature and each of T_s and T_a were correlated (Spearman Rank Correlation: $r_s = 0.90$, $P = 0.00005$; $r_s = 0.85$, $P = 0.0004$, respectively). All captured animals were basking near *Ctenomys* (rodent) burrows. Of the 12 animals, 5 attempted to escape into *Ctenomys* burrows.

Based on correlation coefficient similarity among T_c, T_s and T_a, thermoregulation likely occurs predominantly through conduction, similar to *L. pseudoanomalus* (Villavicencio 2004. Ecología Térmica y Actividad Espacio - Temporal de una Población de *Liolaemus pseudoanomalus* [Cei 1981] [Iguania: Liolaemidae] del Departamento de Albardón, San Juan, Argentina. Licenciatura dissertation. Unv. Nat. San Juan. 42 pp.). This differs from *L. wiegmanni* (Martori et al.1998. Rev. Esp. Herpetol. 12:19–26), *L. olongasta* (Cánovas et al. 2001. Congreso Arg. Herpetol. V:32–33), *L. koslowsky* (Martori et al. 2002. Cuad. Herpetol. 1:78–99), and *L. sanjuanensis* (Acosta et al. 2004. Herpetol. Rev. 35:171), which show a stronger relationship between T_c and T_a, implying that convection is more important.

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MABUYA BISTRIATA **(Trinidad Skink). REPRODUCTION.** *Mabuya bistriata* is generally described as being both terrestrial and arboreal, with females being slightly larger than males (Vitt and Blackburn 1991. Copeia 1991:916–927). Breeding has been noted as occurring as July–August for mainland and island populations (Murphy 1997. Amphibians and Reptiles of Trinidad and Tobago. Krieger Publishing Co., Malabar, Florida. 245 pp.). In this report, we augment information on its reproductive behavior with an instance of arboreal courtship in May at the end of the dry season in Trinidad.

On 28 May 2003 at 1000 h EST, we observed a pair of *M. bistriata* engaged in courtship on the side of a fiberglass wall of the shower 1.8 m above the ground at our base camp at Petit Tacaribe on the northern coast of Trinidad (10°47'48"N, 61°12'33"W; datum: WGS84; elev. 10 m). Local vegetation consists of a diverse assemblage of evergreen trees including several species of palms, bromeliads, and an understory dominated in many places by *Heliconia*. The male was partially astride the visibly larger female and grasping the ventrolateral skin just behind her left shoulder with his jaws (the female made no effort to resist the male). The animals were observed for 10 min and then an attempt

was made to capture them. The male (95.9 mm SVL) was collected; the female eluded capture.

Our observation indicates that mating in *M. bistriata* can occur outside of the rainy season (June–December) in Trinidad and might occur earlier in the year than previously reported. The male was deposited in the herpetological collection of the United States National Museum (USNM 561864) in Washington, D.C.

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MICROLOPHUS PERUVIANUS (Peruvian Pacific Iguana) **SAUROPHAGY**. *Microlophus peruvianus* occupies a broad geographic range in western South America from northern Ecuador to southern Peru (Dixon and Wright 1975. Los Angeles Co. Mus. Contri. Sci. 271:1–39). Inhabiting open, arid landscapes, *M. peruvianus* seems to prefer intertidal habitats such as sandy and pebbled beaches, cliffs and other near-shore structures. Herein, I report two observations of saurophagy in *M. peruvianus* from southern Peru, both involving *Phyllodactylus* geckos as prey.

At 1330 h on 19 July 2003, I captured a male *M. peruvianus* (90.8 mm SVL) on La Vieja Island, Paracas National Reserve, Department Ica (14°17'32.8"S, 76°10'31"W [datum: WGS84]; elev. < 5 m). The lizard was found near a South American sea lion (*Otaria flavescens*) carcass about 20 m away from the intertidal zone on a boulder and cobble beach. I flushed the stomach of the lizard with water and recovered the 25-mm piece of the tail of a *Phyllodactylus angustidigitus*. I also recovered parts of intertidal crab and isopods, a spider, and a fly. *Phyllodactylus angustidigitus* is the only gecko species known to occur on La Vieja. This species is often observed under sea lion carasses, a microhabitat frequently shared with *M. peruvianus*. For example, on 19 July 2003, I found two juvenile *P. angustidigitus* under the sea lion carcass close to where I captured the aforementioned *M. peruvianus*. This proximity may favor predation. After stomach flushing, the *M. peruvianus* was released at the point of capture.

On 18 December 2003, I watched a male subadult *M. peruvianus* (69.3 mm SVL) prey on a male of *Phyllodactylus microphyllus* (28.6 mm SVL). The interaction occurred along a streamlet facing a rocky beach near the western tip of the Illescas Peninsula, Departamento Piura (5°47'08.0"S, 81°04'17.4"W; GPS coordinates; elev. < 5 m). After noticing the moving gecko, the *M. peruvianus* made several attempts to catch it, repeatedly failing. After less than 2 minutes, the lizard finally caught and ingested the gecko headfirst. The gecko did not lose its tail during ingestion. I captured the *M. peruvianus* and flushed its stomach to collect data on the size of both lizards. The *M. peruvianus* was then released at the point of capture.

Saurophagy has been reported in members of the *Microlophus occipitalis* group from the Galapagos Islands (Schluter 1984. Oikos 43: 291–300; Stebbins et al. 1967. Ecology 48:839–851) and recently in members of the *peruvianus* group from Peru (Perez 2005. Herpetol. Rev. 36:63; Perez and Balta 2005. Herpetol. Rev. 36:63).

Florida International University Institutional Animal Care and Use committee (Protocol Approval Number 01-009) approved stomach flushing of the *M. peruvianus*.

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OEDURA MARMORATA (Marbled Velvet Gecko). **ENDOPARASITES.** *Oedura marmorata* is known from eastern, central, and northern Queensland, excluding northeastern Queensland; adults average 90 mm SVL (Cogger 1996. Reptiles & Amphibians of Australia, 6th Ed., Ralph Curtis Publ., Sanibel Island, Florida, 808 pp.). To our knowledge, no parasites have been reported from *O. marmorata*. The purpose of this note is to report the nematodes *Pharyngodon kartana* (in large intestine) and *Abbreviata* sp. (in body cavity), and the pentastome *Raillietella scincoides* (in lungs) in *O. marmorata*.

Three adult *O. marmorata* (mean SVL: 89 mm ± 12 SD, range: 75–97 mm) from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California were examined for endoparasites. Lizards (LACM 57001–57003) were collected October 1966 near Mt. Doreen (22°07'S, 131°21'E, datum: AGD66; elev. 750 m) Northern Territory, Australia. Lungs, small and large intestines were opened and their contents were examined using a dissecting microscope. Stomachs were unavailable for examination. Endoparasites were cleared in concentrated glycerol, identified and deposited in the United States National Parasite Collection (USNPC) as *Pharyngodon kartana* (96977), *Abbreviata* sp. (larvae) (96976) and *Raillietella scincoides* (96978).

Found were 24 *Pharyngodon kartana* (prevalence, infected lizards/lizards examined x 100 = 67%); mean intensity, mean number nematodes per infected lizard = 12.0 ± 7.1 SD; range:7–17; 4 *Abbreviata* sp. (prevalence, 75%, mean intensity 1.3 ± 0.58 SD, range 1–2; *Raillietiella scincoides* (prevalence 75%, mean intensity 4.0 ± 3.0 SD. range 1–7).

Goldberg and Bursey (2000. Trans. Royal Soc. South Aust. 124:127–133; and 2001. J. Roy. Soc. West. Aust. 84:23–27) reported other hosts for *Pharyngodon kartana*. This nematode species is restricted to Australian lizards. *Pharyngodon kartana* is an oxyurid nematode that has a direct life cycle that does not involve an intermediate host (Anderson 2000. Nematode Parasites of Vertebrates: Their Development and Transmission, 2nd Ed. CABI Publ. Oxon, UK, 650 pp.). Larvae of *Abbreviata* sp. are commonly found in the body cavities and viscerae of Australian lizards and snakes (Goldberg and Bursey 1995. J. Helminthol. Soc. Washington 62:237–238; Jones 1995. J. Wild. Dis. 31:299–306; Goldberg et al. 1999. J. Helminthol. Soc. Washington 66:89–92). Small lizards are thought to serve as intermediate hosts for some species of *Abbreviata* because mature individuals have not been found in these lizards; mature individuals are frequently found in large lizards and other carnivores which feed on small lizards (Goldberg and Bursey 1995, *op. cit.*). Ali et al. (1984. Syst. Parasitol. 6:147–160) described *Raillietiella scincoides* from *Tiliqua scincoides* and it was later reported from *Nephrurus laevissimus* (Bursey and Goldberg 1999. J. Helminthol. Soc. Washington 66:175–179). *Oedura marmorata* is the third reported host. Most pentastomids mature in reptiles; intermediate hosts include insects and other reptiles (Roberts and Janovy 2005. Gerald D. Schmidt & Larry S.

Roberts' Foundations of Parasitology. 7th Ed. McGraw Hill Higher Education, Boston, 702 pp.). *Oedura marmorata* represents a new host record for *Pharyngodon kartana*, *Abbreviata* sp., and *Raillietella scincoides*.

We thank Christine Thacker (LACM) for permission to examine *O. marmorata* and Amanda Woolsey for assistance with dissections.

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PHRYNOSOMA CORNUTUM (Texas Horned Lizard). **MORTALITY**. Human activities can dramatically increase mortality rates in many wildlife populations, but most documentation exists for mammals and birds. Among reptiles, varied impacts linked to human activities are thought to exist, but documentation is rare. For example, in *Phrynosoma cornutum*, skewed sex-ratios in road-collected animals in spring can result in male-biased road mortality (Sherbrooke 2002. Herpetol. Rev. 33:21–24) and might be responsible for regional declines (Sherbrooke 2003. Introduction to Horned Lizards of North America. Univ. California Press, Berkeley. 177 pp.). Hence, we report a human activity-linked observation of unusual mortality event in *P. cornutum* from northern Mexico .

During a study of *Gopherus berlandieri* demography in August 1997, we surveyed the herpetofauna of Nueva Casilla, municipalidad of Escobodo, Nuevo Leon (25°48'51"N, 100°16'35"W, datum: NAD27; elev. 618 m). Among habitats examined was a clandestine waste-disposal site with building materials, aluminum cans, plastics, and three old automobile tires. In one tire, we found the dried remains of four desiccated adult (range 90–111 mm SVL) *P. cornutum*.

The lizards probably entered the tire seeking refuge and were unable to escape once inside; the inwardly curving tire walls likely prevented escape. August daytime temperatures in the shade can reach 45°C (INEGI, Carta de Clima, 1986 Mexico), and daytime temperatures in such a well-insolated artificial habitat would likely exceeded that value, rapidly killing the lizards. This observation illustrates that better regulation of waste material disposal in Mexico, especially discarded tires, could easily avert this source of mortality.

We thank Wade C. Sherbrooke for his help with *Phrynosoma* work and for reviewing this note.

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PHRYNOSOMA DOUGLASII (Pigmy Short-horned Lizard). **COPULATORY POSITION.** Sherbrooke and Beltran-Sanchez (2005. Herpetol. Rev. 36:64–65) recently reviewed copulatory positions in the genus *Phrynosoma*. They described *P. asio* as using a distinctive position in which the male first grasps the female in the nuchal region (including cephalic spines) and then flips the female onto her back and grasps her with all four legs. This belly-to-belly position was described first for *P. coronatum* (Wood 1936. Copeia 1936:177) but is unknown in other *Phrynosoma* (Sherbrooke and Beltran-Sanchez, *op. cit.*). Here, I report a third species of *Phrynosoma* using a variant of this position.

During 1976 and 1977, I conducted a mark-recapture study of *Phrynosoma douglasii* and *Sceloporus graciosus* on a 1-ha study site in southeastern Idaho (Guyer and Linder 1985. Northwest Sci. 59:294–303; Guyer and Linder 1985. Great Basin Nat. 45:607–614; Guyer 1991. Amphibia-Reptilia 12:373–384). At 1110 h on 10 May 1977, I recaptured an adult (65 mm SVL) female *P. douglasii* on the dirt road leading to the site; she was released after a brief (< 1 min) processing interval. Upon leaving the study site at 1645 h, I re-encountered this female apparently copulating with an adult (53 mm SVL) male. The lizards were positioned belly-to-belly and on their sides, with the male biting the skin of the gular fold of the female while both sexes grasped each other with their limbs (Fig. 1a). A hemipenis of the male was everted but I could not confirm which side it was from or that it was inserted into the female's cloaca. Over a 5-min observation period the male instigated short (< 10 sec) bouts of activity during which both lizards moved their limbs, rotated their bodies on the ground, and alternately entwined and disentwined their tails. While taking photographs of the pair, I inadvertently startled the male, who disengaged from the female and fled about 5 m while the female righted herself and remained motionless.

As the male was unmarked, I captured and marked him and then (1650 h) returned him to the proximity of the female, who had not moved. The female immediately assumed a posture in which her body was held off the ground, but with her forequarters closer to the ground than her hindquarters. Her tail was curled over her back, exposing the cloacal area. The male did not move for ca. 5 sec and then rushed the female and bit her left forelimb. They thrashed violently for a few seconds until both were on their backs; the male then righted himself while still biting the female's forelimb. The female initiated a bout of activity that nearly succeeded in achieving the position observed at 1645 h, but they ended up with the female on her back and the male nearly righted but at a 45° angle to the female's left side (Fig. 1b). Over the next 40 min, the pair displayed 16 short bouts of activity (< 10 sec each) initiated by the male followed by 1–5 min periods of quiescence. The female waved her limbs during these bouts but never attempted to right herself and the male arched his back, forcing his cloaca into the ground. At 1729 h, my movements again frightened the male and he ran 1 m to the side of the road. The female remained on her back for ca. 2 min until I righted her.

These observations reveal the occurrence of a copulatory position in *Phrynosoma douglasii* similar to that observed in *P. asio* and *P. coronatum*. Sherbrooke and Beltran-Sanchez (*op. cit.*) speculated that this position and the behaviors leading to it indicate that female choice is limited and that the position can allow males to mate while avoiding potential damage from the female's cephalic

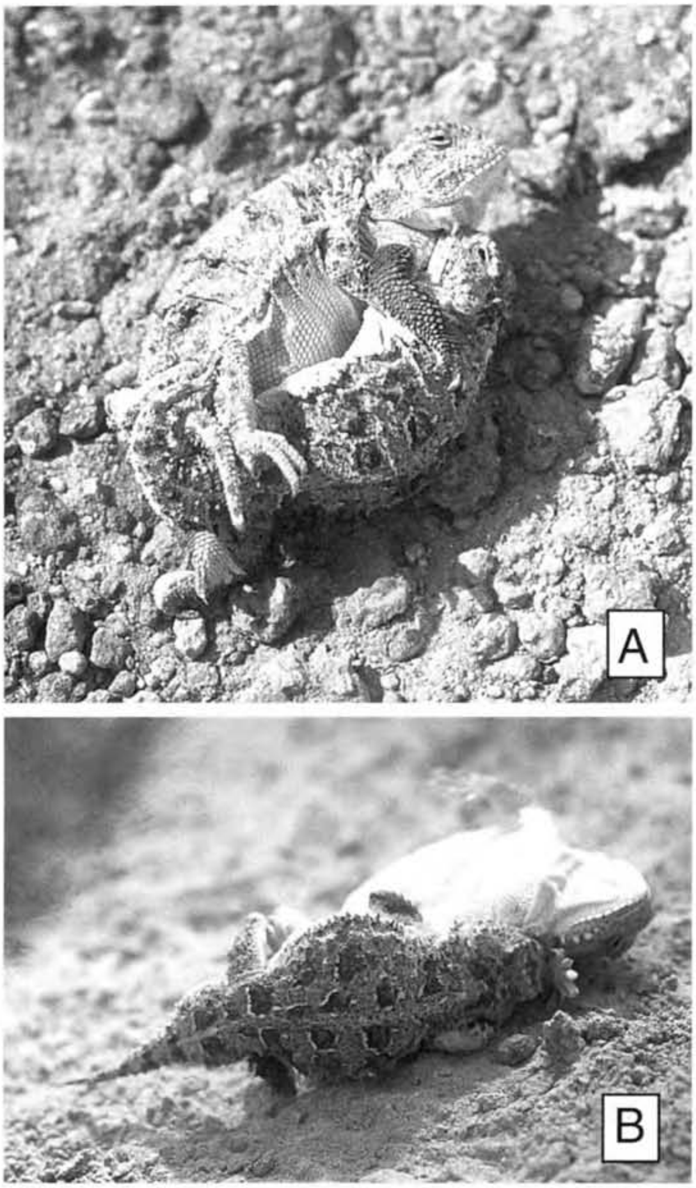

FIG. 1. Copulatory positions in *Phrynosoma douglassi*. A) Original position. B) position assumed when the male was reintroduced within close proximity of the female.

spines. Two details of my observation indicate that alternative explanations for the female's role in the behavior should be considered. First, the reaction of the female when the male was returned to her presence suggests active participation of the female in the mating process. Horned lizards occur in low densities and have large home ranges (e.g., Guyer 1991, *op. cit.*). Thus, opportunities to mate are likely to be infrequent, a condition that should make it equally advantageous for both sexes to participate actively in reproduction when the opportunity arises. Secondly, the female that I observed rarely initiated movements while in a copulatory position and seemed large enough to have avoided the male or righted herself during copulatory episodes. However, she was clearly less skittish than the male and relatively calm while on her back. Regardless of whether these behaviors are adaptive or not, the presence of this posture in *P. coronatum* and *P. asio*, two basal members of the *Phrynosoma* clade possessing large cephalic horns, and in *P. douglasii*, a derived species (Hodges and Zamudio 2004. Mol. Phylog. Evol. 31:961–971) possessing reduced cephalic horns, significantly broadens the phylogenetic distribution of this behavior within the genus.

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SCELOPORUS UNDULATUS HYACINTHINUS (Northern Fence Lizard). **FIRE AVOIDANCE BEHAVIOR.** Few direct observations of reptile response to encounters with fire exist, and most involve animals seeking subterranean refugia (Russell et al. 1999. Wildl. Soc. Bull. 27:374–384). Similarly, Bishop and Murrie (2004. Herpetol. Rev. 35:397–398) reported two *S. undulatus* that each dug a burrow in the side of a dirt mound at the approach of a prescribed burn fireline in a sandhill community in Florida, USA. Here, I report a different response to fire in the same species in a similar situation in North Carolina.

At 1115 h on 27 September 1998, I observed an adult (ca. 60 mm SVL) male *S. u. hyacinthinus* basking on the trunk of a Longleaf Pine (*Pinus palustris*) about 1 m off the ground in a sandhill community at Sandhills Game Lands, ca. 14.5 km NW Wagram, Scotland Co. (34°59'32"N, 79°27'50"W [WGS84]; elev. ca. 108 m) during a relatively low-intensity prescribed burn. Besides *P. palustris*, Turkey Oak (*Quercus laevis*) and other scrub oaks, and Wiregrass (*Aristida stricta*) dominated this sandhill habitat. When the advancing flames reached the base of its tree, the lizard rapidly and steadily ascended the trunk until it passed beyond my view into the canopy (10+ m). It did not reappear during the 10–15 min. that I observed the fire. The lizard's retreat appeared to be in response to the smoke and/or heat. At 1230 h on 3 October 1998, I observed what appeared to be the same individual (based on sex, size, coloration, and similarly regenerated tail) basking in virtually the same spot on the same tree.

Based on the contrast with Bishop and Murrie (*op. cit.*), my observation suggests that *S. undulatus* employ different fire avoidance strategies depending on the situation.

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SCINCELLA LATERALIS (Ground Skink) **AQUATIC BEHAVIOR**. *Scincella lateralis* is a small, terrestrial skink common throughout woodlands of the southeastern United States (Conant and Collins. 1998. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. 3rd ed., expanded. Houghton Mifflin Co., Boston, Massachusetts. 616 pp.), When approached this species commonly scurries under logs, rocks, or other debris found on the substrate of the forests and glades where it is often found (Trauth et al. 2004. Amphibians and Reptiles of Arkansas. University of Arkansas Press, Fayetteville. 421 pp.). Here, we report aquatic behavior in *S. lateralis* from northwest Louisiana, USA.

At 0200 h on 2 June 2004 (T = 35°C, sunny), a *S. lateralis* (TL

= 5–6 cm) was observed basking on a log near a stream. The stream was ca. 10 cm deep, 1 m wide, and crossed the Sugar Cane Trail located at Caney Lakes Recreation Area in the Kisatchie National Forest, about 3 km N of Minden (Webster Parish; 32°67'49"N, 93°30'52"W [datum: WGS84], elev. 98.2 m). On approach, the skink dove into the water. Folding its limbs laterally along the body, it swam across the water surface using a lateral serpentine motion. It held its head above the water's surface until it emerged on the opposite side of the stream. As the skink approached within 3–4 cm of the stream's edge, it extended all four limbs, which quickly slowed its speed and cushioned its contact with the opposite shore. Upon contacting the edge of the stream, the skink quickly crawled out of the water and scurried under a large log located a few centimeters from the edge.

Aquatic behavior has been reported in this species (Akin and Townsend 1998. Herpetol. Rev. 29:43) and in other typically terrestrial lizards (*Crotaphytus collaris*: McAllister 1983. Herpetol. Rev. 14:11; *Cnemidophorus sexlineatus*: Trauth et al. 1996. Herpetol. Rev. 27:20–21; *Eumeces anthracinus pluvialis*: Means. 1992. *In* Moler [ed.], Rare and Endangered Biota of Florida. Vol. III., pp. 291., Univeristy of Florida Press, Gainesville; *Sphenomorphus quoyii*: Daniels 1985. Copeia 1985:1074–1077). Our report mirrors that of Akin and Townsend (1998), but adds detail of swimming behavior. Ability to flee predators by controlled swimming across small water bodies enlarges understanding of the repertoire of *S. lateralis* anti-predator behaviors.

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SERPENTES

AIPYSURUS POOLEORUM (Shark Bay Sea Snake). **AVIAN PREDATION**. *Aipysurus pooleorum* is endemic to Shark Bay (Australia), although individuals have been found as far south as Perth. *Aipysurus pooleorum* was formerly treated as a subspecies of *A. laevis* from which they are distinguishable by smaller size, darker coloration, and tuberculate dorsal and ventral scales in males (Storr et al. 1986. Snakes of Western Australia. Western Australia Museum Publications. 187 pp.).

Around 0800 h in late November 2004 in the vicinity of Shark Bay (Redcliff, ca. 5 km N of Monkey Mia), a White-breasted Sea Eagle (*Haliaeetus leucogaster*) was spotted killing a snake on a sand bank ca. 800 m from shore at low tide. The snake was subsequently recovered and identified as a large female *A. pooleorum* (1360 mm TL). This record exceeds the maximum length previously known for this species (1140 mm TL; Heatwole 1987. Sea Snakes. The New South Wales University Press, Kensington, Australia. 85 pp.). Sea eagles (*H. leucogaster* and *Haliastur indus*) regularly eat true sea snakes. Sharks are also important predators (Heatwole et al. 1974. Copeia 1974:780–781). Other predators such as moray eels, groupers, sweetlip, and other fish, as well as the saltwater crocodile have been reported to eat true sea snakes in Australian waters (Heatwole 1987, *op. cit.*).

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AGKISTRODON PISCIVORUS LEUCOSTOMA (Western Cottonmouth). **DIET.** *Agkistrodon piscivorus* is an abundant snake in the swamps and bayous of Louisiana and other southern states (Conant and Collins 1991. Reptiles and Amphibians Eastern Central North America. Houghton Mifflin, Boston, Massachusetts. 450 pp.). It is also an opportunistic predator known to actively hunt and consume a wide variety of prey items including carrion (Campbell and Lamar 2004. Venomous Reptiles of the Western Hemisphere. Cornell University Press, Ithaca, New York. 870 pp.). An adult male *A. p. leucostoma* was collected on 24 July 1994 at 1930 h from Spring Creek (2.9 km W of the jct of county roads 309A and 321), Bosque County, Texas, USA. The fluid-preserved whole specimen (deposited in the University of Texas at Arlington, UTA R-40717) was recently skinned and skeletonized. Measurements of the skin suggest the snake was ca. 570 mm SVL and its tail was ca. 100 mm. The stomach contained the following items: a partially digested juvenile softshell turtle (*Apalone* sp., 50 mm carapace length), one fish (Cyprinidae, 63 mm total length), one freshwater snail (Viviparidae, 7.9 mm total length), one Asian mussel (*Corbicula* sp., 15 mm x 11 mm), and the elytra from two beetles (Dytiscidae, 3 mm). Invertebrates have been documented from the stomach contents of *A. piscivorus* and are mostly considered to be the result of accidental ingestion (Gloyd and Conant 1990. Snakes of the *Agkistrodon* Complex: A Monographic Review. Society for the Study of Amphibians and Reptiles, Oxford, Ohio. 614 pp.). The turtle, mussel, snail, and beetles all represent new food records for *A. piscivorus*, although the mussel, snail, and beetles may have been accidentally or secondarily ingested.

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CLELIA CLELIA (Mussurana, Zopilota). **DIET.** On 26 July 2004 at 1000 h we found a juvenile *Clelia clelia* within a stack of blankets on a shelf close to the floor inside Las Alturas field station (Las Tablas Protected Zone, San Vito de Java, Puntarenas, Costa Rica). The snake was induced (via palpation) to regurgitate a fledgling *Troglodytes aedon* (House Wren). The food item had been ingested head-first. *Clelia clelia* is mainly nocturnal but can be active during the day as well (Savage 2002. The Amphibians and Reptiles of Costa Rica. Univ. Chicago Press, pp. 527–529). The diet of *C. clelia* its well known throughout Costa Rica because of its ophiophagous habits. Savage (*op. cit.*) states that it feeds "primarily on other snakes including large pit-vipers ... but eats many lizards and mammals as well." This is the first record of *C. clelia* feeding on a bird of any kind. We suspect that the snake obtained its prey by foraging among nests in the roof of the building, but it is possible the snake opportunistically preyed on a fledgling that fell from one of these nests.

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Henderson, and R. Timm for revising the manuscript.

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CROTALUS BASILISCUS (Mexican West Coast Rattlesnake). **ENDOPARASITES.** Telford (1965. Japan. J. Exp. Med. 35:565–586) reported the occurrence of the nematode *Macdonaldius oschei* in *Crotalus basiliscus*. Herein, we report an additional species of nematode, *Hexametra boddaertii* and an acanthocephalan larva (oligacanthorhynchid cystacanth) in *C. basiliscus*.

Seventeen *C. basiliscus* (mean SVL = 957 ± 191 mm , range: 640–1280 mm) from the herpetology collections of the Natural History Museum of Los Angeles County (LACM) and the California Academy of Sciences (CAS), that had been collected between 1957–1976 from were examined. Methods for collecting helminths follow Goldberg and Bursey (2004. Herpetol. Rev. 35:75). One nematode (gravid female *H. boddaertii*) was found in LACM 7219, collected in Sinaloa, Mexico and one acanthocephalan (oligacanthorhynchid cystacanth) was found in CAS 147400, collected in Michoacán, Mexico. Both parasites were found in the body cavity. Prevalence (number infected snakes/number snakes examined x 100) for both *H. boddaertii* and the cystacanth was 6%. The *H. boddaertii* was deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland as USNPC 95371 and the acanthocephalan cystacanth as USNPC 95372.

Hexametra boddaertii was described from the colubrid *Mastigodryas boddaerti* occurrring in the West Indies (Kreis 1944. Rev. Suisse Zool. 51:227–252) and is restricted to viperid and colubrid snakes of the western hemisphere (Baker 1987. Occas. Pap., Mem. Univ. Newfoundland: 11:1–325). *Crotalus basiliscus* represents a new host record for *H. boddaertii* and Sinaloa, Mexico is a new locality record. Oligacanthorhynchid cystacanths have been reported in other North American viperid and colubrid snakes (Goldberg and Bursey 2004. J. Arizona-Nevada Acad. Sci. 37:83–84 and citations therein). *Crotalus basiliscus* represents a new host record for oligacanthorhynchid cystacanths and Michoacán, Mexico is a new locality record.

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NATRIX TESSELATA (Dice Snake). **MARINE HABITAT**. A *Natrix tesselata* was observed on 7 April 2004 between Georgioupoli and Petres on the northern shore of the Greek island of Crete. No rivers reach the sea within several km of the sighting. A large number of sea urchins (*Paracentrotus lividus*) were observed at this locality, indicating that the local salinity level does not fluctuate much, as echinoderms have a low tolerance for salinity fluctuations (Boolootian 1966. Physiology of Echinodermata. John Wiley & Sons, New York. 846 pp.). Galan (2004. Herpetol. Rev. 35:71) reported *Natrix maura* from marine environs. Occurrence of this genus in pure seawater is not always due to habitat choice by the snakes, but can also be the result of passive drift (Lenk 2002. Zeitschrift für Feldherpetologie 9:221–223). Whether the *N. tesselata* we observed drifted from an estuary or more permanently inhabited this locality is unknown. It was found hiding below a rocky outcropping (fully submerged) in a tide pool less then 2 m from the sea, with only its head visible. The water of the tide pool was considerably warmer than that of the sea and contained small fish (Gobidae) as possible prey. It seemed in good health and did not show any signs of malnourishment.

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OXYBELIS AENEUS (Brown Vinesnake). **DIET.** *Oxybelis aeneus* is a diurnal, arboreal specialist reported to feed mostly on lizards, but also on frogs, birds, small mammals, and some insects (Henderson 1982. Amph.-Reptl. 3:71–80; Henderson and Binder 1980. Milwaukee Publ. Mus. Contr. Biol. Geol. 37:1–38; Savage 2002. The Amphibians and Reptiles of Costa Rica. Univ. of Chicago Press, Chicago. 934 pp.). Anoline lizards appear to form a large part of its diet (Keiser 1982. Cat. Amer. Amph. Reptl. 305:1–4).

On 26 June 2004, while videotaping frog behavior along a tributary of the Rio Marta, Cocle Province, Panama, I observed a *O. aeneus* (1020 mm TL) with a fish struggling in its mouth. I briefly videotaped the snake and its prey, and then continued to observe the snake for about 5 minutes (the video clip has been deposited in the Museum of Biological Diversity at Ohio State University and may be downloaded at: http://www.biosci.ohio-state.edu/~eeob/hetherington/Snake.WMV. The snake had seized the fish just behind the head and most of the fish's body extended out of the snake's mouth. The snake continuously and rhythmically swayed back and forth and occasionally jerked its head and neck in an attempt to re-position its prey for swallowing. After finishing videotaping the frogs, I captured the snake in order to identify the fish. During capture, the snake dropped the fish, a 52 mm long member of *Rivulus* (Poeciliidae; W. Bussing, pers. comm.), that appeared to be abundant in the stream.

When captured the body of the snake was not wet, suggesting that it had seized the fish while suspended above the pool rather than while swimming. The fish had numerous small lacerations just behind the head. The fish swam slowly and awkwardly within a plastic bag filled with river water and after ca. 5 minutes it showed no signs of respiration and appeared dead. Whether its death was related to envenomation by the snake, physical trauma, or oxygen deprivation could not be determined. However, the snake was

holding the fish in the posterior portion of its jaws when observed, so envenomation by this rear-fanged snake was possible.

To my knowledge, this is the first published report of an arboreal snake capturing a fish. The capture of the fish may have been an opportunistic feeding event by an individual hunting lizards and frogs. Many species of the anoline lizard genus *Norops* and a variety of frogs (e.g., *Eleutherodactylus* sp.) were observed among the vegetation and rocks alongside and in the stream. Vine snakes suspended over the stream could be well-positioned to capture such prey. Alternately, the snake might have been hunting specifically for these fishes in the shallow stream pools.

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PITUOPHIS CATENIFER (Gopher Snake). **DIET**. The wide-ranging *Pituophis catenifer* has been documented to consume a large variety of prey items, including small mammals, birds, bird eggs, squamates, squamate eggs, frogs, frog eggs, turtle eggs, and insects (Rodríguez-Robles 2002. Biol. J. Linn. Soc. 77:165–183, and references therein). Rodríguez-Robles (*op. cit.*) examined the stomach contents of over 2,600 specimens of *P. catenifer* and reviewed published and unpublished dietary records, and found that mammals comprised the bulk of the prey items consumed (74.8%). Among these, only one record was of a carnivorous mammal (*Mustela frenata*).

On 13 August 2002 we collected an adult *Pituophis catenifer* (1370 mm SVL) on a rocky hillside in lower encinal woodland (ca. 1800 m elev.) on the eastern slope of the Sierra San Luis, Chihuahua, México. The following morning the snake regurgitated the mostly digested remains of a skunk (unidentified species). This represents the second record of predation upon a potential mammalian predator, and the first record of consumption of a skunk, by *P. catenifer*.

We thank R. Hibbitts and R. Queen for field assistance.

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THAMNOPHIS PROXIMUS RUBRILINEATUS (Western Ribbon Snake). **PREDATION.** *Thamnophis proximus rubrilineatus* is usually found in brushy habitats in close conjunction with aquatic situations (swamps, marshes, ponds, lakes, rivers, creeks, and desert springs) (Rossman et al. 1996. The Garter Snakes: Evolution and Ecology. University of Oklahoma Press. 332 pp.). The introduced fire ant (*Solenopsis invicta*) is widespread throughout most of the southeastern United States and is often found in the same habitats as *T. proximus*. When disturbed, *S. invicta* is well known for aggressive behavior hallmarked by several individuals simultaneously biting and stinging.

On 3 October 2004, at 1800 h, a juvenile *T. p. rubrilineatus* (183 mm SVL, 50 mm tail, 2.5 g) was found on the banks of a creek in Mills County, Texas (31°22.714'N, 098° 39.635'W, 598 m). The specimen was exposed when first observed and did not move when we approached nor did it resist capture. Instead the snake slowly moved the anterior portion of its body from side to side and opened its mouth. The mandibles of two *S. invicta* were found embedded in the badly damaged tail. The snake was euthanized and deposited in the University of Texas at Arlington (UTA R-52940). During previous outings in similar habitats in Hood and Palo Pinto Counties (Texas) one of us (CJF) encountered two juvenile *T. p. rubrilineatus* displaying the aforementioned lethargy and mouth gaping and both had noticeably injured tails. These observations also occurred in areas where *S. invicta* were active. Based upon these observations, it appears that *S. invicta* could negatively influence the survival of *T. p. rubrilineatus*.

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THAMNOPHIS SAURITUS SAURITUS (Eastern Ribbon Snake). **MAXIMUM SIZE.** On 12 July 2004 we encountered a female *Thamnophis sauritus sauritus* (680 mm SVL, 1040 mm TL) near a small backwater slough (30.98°N, 87.92°W), in the Mobile-Tensaw Delta Wildlife Management Area, Baldwin County, Alabama, USA. The snake was beginning to consume a large female Bronze Frog (*Rana clamitans*). After the snake finished swallowing the frog (ca. 15 minutes) we captured and measured it. We captured a second female *T. s. sauritus* (685 mm SVL, 1021 mm TL) at approximately the same location on 5 July 2004. Both of these snakes exceed the maximum recorded total length of 1018 mm for *T. sauritus* (Ernst and Ernst 2004, Snakes of the United States and Canada. Smithsonian Institution Press, Washington and London. 680 pp.). Both snakes were marked and released as part of an ecological study.

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UROMACERINA RICARDINII (Vine Snake). **REPRODUCTION**. Highly arboreal snakes have a very slender body, long tail, and low mass which may enhance crypsis and facilitate support on small branches (Lillywhite and Henderson 1993. *In* Seigel and Collins [eds.], Snakes: Ecology and Behavior, pp. 1–48. McGraw-Hill, New York). However, slender body form may restrict reproductive output by limiting egg or clutch size (Marques 1998. Composição Faunística, História Natural e Ecologia de Serpentes da Mata Atlântica, na Região da Estação Ecológica Juréia-Itatins, São Paulo, SP. Ph.D. Dissertation. Univ. de São Paulo. 135 pp.). Data on relative reproductive effort in arboreal snakes are necessary to confirm this hypothesis (Lillywhite and Henderson, *op.*

cit.). Here, I report a reproductive event in *Uromacerina ricardinii*, a diurnal and arboreal snake occurring principally in Atlantic Forest in southeastern Brazil (Amaral 1978. Serpentes do Brasil. Melhoramentos Univ. São Paulo, Brazil. 246 pp.; Cunha and Nascimento 1982. Bol. Mus. Par. Emilio Goeldi, n.s. Zool. 113:1–9).

A gravid female (522 mm SVL, 415 mm tail, 28.5 g) was found on 9 November 2003 in Atlantic forest near Núcleo Santa Virginia (Parque Estadual da Serra do Mar, São Paulo, Brazil; 23°20'S, 45°08'W; ca. 810 m elev.) and maintained in captivity. On 12 November 2003, she laid five eggs between 2300–2400 h. These eggs averaged 24.8 ± 2.4 mm in length (range 22.4–28.8 mm), 10.2 ± 0.3 mm in diameter (9.9–10.8) mm, and 1.6 ± 0.1 g (1.5–1.8 g). Total clutch mass was 8.1 g and the female weighed 20 g after ovipositing, resulting in a relative clutch mass (RCM) of 40.5%. Relative reproductive effort (Lemen and Voris 1981. J. Anim. Ecol. 50:89–101), obtained by dividing the total clutch mass by female pre-oviposition mass, is 28.4%. The eggs were incubated in moist vermiculite (22–28°C). Hatching occurred between 25–28 January 2004 and the neonates were immediately weighed and measured. Four neonates (136.7 ± 4.7 mm SVL, range 131–142 mm; 103.5 ± 3.7 mm tail length, 102–105 mm; 1.12 ± 0.01 g, 1.12–1.14 g) hatched after an incubation period of 84–87 days. After twenty days the fifth egg was opened and a dead embryo was discovered. The female died seven days after ovipositing and was vouchered in the Instituto Butantan collection (IB69144).

Morato and Bernils (1989. Acta Biol. Leopol. 11:273–278) report a small clutch (three eggs) with oviposition in November and hatching in the end of January. Marques (1998, *op. cit.*) reported a gravid female with six eggs in November and two vitellogenic (follicles > 5 mm) females in August. Collectively, these observations suggest a seasonal reproductive cycle for *U. ricardinii*, with oviposition in the beginning of the rainy season (November–December) and hatching occurring in the end of the rainy season (February–March). *Uromacerina ricardinii* has the slender body typical of arboreal species but the RCM seems similar to that of terrestrial colubrids (Seigel and Ford 1987. *In* Seigel et al. [eds.], Snakes: Ecology and Evolutionary Biology, pp. 184–209. Macmillan Publ. Co., New York).

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GEOGRAPHIC DISTRIBUTION

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These geographic distribution records will be accepted in a **standard format** only, and all authors *must* adhere to that format, as follows: SCIENTIFIC NAME, COMMON NAME (for the United States and Canada as it appears in Crother 2000. *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding*. SSAR Herpetol. Circ. 29:1–82, available online at <http://herplit.com/SSAR/circulars/HC29/Crother.html>; for Mexico as it appears in Liner 1994, *Scientific and Common Names for the Amphibians and Reptiles of Mexico in English and Spanish*. Herpetol. Circ. 23:1–113), LOCALITY (use metric for distances and give precise locality data), DATE (day-month-year), COLLECTOR, VERIFIED BY (*cannot* be verified by an author—curator at an institutional collection is preferred), PLACE OF DEPOSITION (where applicable, use standardized collection designations as they appear in Leviton et al. 1985, *Standard Symbolic Codes for Institutional Resource Collections in Herpetology and Ichthyology*, Copeia 1985[3]:802–832) and CATALOG NUMBER (required), COMMENTS (brief), CITATIONS (brief), SUBMITTED BY (give name and address in full—spell out state or province names—no abbreviations).

Some further comments. This geographic distribution section does not publish "observation" records. Records submitted should be based on preserved specimens which have been placed in a university or museum collection (private collection depository records are discouraged; institutional collection records will receive precedence in case of conflict). A good quality color slide or photograph may substitute for a preserved specimen *only* when the live specimen could not be collected for the following reasons: it was a protected species, it was found in a protected area, or the logistics of preservation were prohibitive (such as large turtles or crocodilians). Color slides and photographs *must* be deposited in a university or museum collection along with complete locality data, and the color slide catalog number(s) must be included in the same manner as a preserved record. Before you submit a manuscript to us, check Censky (1988, *Index to Geographic Distribution Records in Herpetological Review: 1967–1986*; available from the SSAR Publications Secretary) to make sure you are not duplicating a previously published record. The responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extensions unless a thorough literature review has been completed.

Please submit any geographic distribution records in the **standard format only** to one of the Section Co-editors: **Alan M. Richmond** (USA & Canadian records only); **Jerry D. Johnson** (Mexico and Central America, including the Caribbean Basin); **Indraneil Das** (all Old World records); or **Gustavo J. Scrocchi** (South American records). Short manuscripts are discouraged, and are only acceptable when data cannot be presented adequately in the standard format. **Electronic submission of manuscripts is required** (as Microsoft Word or Rich Text format [rtf] files, as e-mail attachments). Refer to inside front cover for e-mail addresses of section editors.

Recommended citation for new distribution records appearing in this section is: Schmitz, A., and T. Ziegler. 2003. Geographic distribution. *Sphenomorphus rufocaudatus*. Herpetol. Rev. 34:385.

CAUDATA

AMBYSTOMA MACULATUM. (Spotted Salamander). USA. TENNESSEE: Fayette Co.: Wolf River Wildlife Management Area managed by the Tennessee Wildlife Resources Agency located in the SE Moscow Quad (35.029000° N., -89.265350° W; NAD 83). 06 January 2005. Brandon Wear of the Tennessee Wildlife Resources Agency. Austin Peay State University Museum of Zoology, APSU 18051 (color photo). Verified by A. Floyd Scott. One specimen found in a drift fence in bottomland hardwoods. Temperature at collection was 6° C. New county record that extends the range of the species in Tennessee into the eastern portion of Fayette Co. (Redmond and Scott. 1996). Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology,

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Iguanidae or Iguaninae? A Taxonomic Summary and Literature-Use Analysis

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The contemporary increase in character data, especially the advent of rapid DNA sequencing, has provided taxonomists new tools for delimiting monophyletic groups. However, controversy concerning analytical techniques or data interpretation, as well as resistance to modifying established uses of names, may delay the acceptance of new phylogenies or taxonomic reclassifications. Additionally, new or revised classifications may take years to become established because of the time lapse between publication date and widespread use. Consequently, the proliferation of novel phylogenies and taxonomic revisions may prove confusing to comparative biologists, ecologists, and students.

The taxonomy of the lizard lineage Iguanidae (sensu lato Boulenger 1884; Camp 1923; Etheridge and de Queiroz 1988) has been both dynamic and controversial in the last 15 years. Since 1989, two familial taxonomic revisions (Frost and Etheridge 1989; Macey et al. 1997) and two expansions (Frost et al. 2001; Schulte et al. 2003), have been published for Iguanidae (sensu lato), and the current scientific literature is replete with conflicting taxonomies concerning this family. It may be bewildering to students when contemporary herpetology textbooks (e.g., Pough et al. 2001, 2004; Zug et al. 2001) report a particular classification scheme when other classifications might be more prominent in the literature. Further confusion ensues when the taxonomy of iguanid lizards in herpetological peer-reviewed journals often does not adhere to a consistent classification scheme—even in the same issue.

In an attempt to clarify the taxonomic record of Iguanidae (sensu lato), we summarize the taxonomic history and current status of the lineage. Additionally, because some authors of reclassifications have defended their taxonomic revisions by claiming that they have "widespread recognition and usage" (Frost et al. 2001: p. 13), we test this by analyzing nomenclature use in the scientific literature since 1990. Another interesting artifact of a dynamic taxonomic history is the time lapse between reclassifications and widespread adoption among biologists. To test this phenomenon, we statistically compare the use of different classifications (Boulenger 1884; Frost and Etheridge 1989; Frost et al. 2001; Macey et al. 1997) in terms of their citation frequency per year and by journal type.

Taxonomic Summary.—Iguanidae (sensu lato Boulenger 1884; Camp 1923; Etheridge and de Queiroz 1988) is the largest (ca. 51 genera and 908 species; Pough et al. 2001) and most widely distributed family of lizards in the Western Hemisphere. Iguanids are found throughout the Americas including the West Indies and Galápagos Archipelago. Two extralimital genera occur on Madagascar and the Comoro Archipelago, and another in the Fiji and Tonga Islands (Etheridge and de Queiroz 1988). The disjunct distribution of the family was thought to be a potential artifact of paraphyly (Frost and Etheridge 1989) because morphological evidence of either monophyly or paraphyly for Iguanidae* was ambiguous, and the family was thus considered a metataxon (denoted with an asterisk; Estes et al. 1988).

Etheridge and de Queiroz (1988) were the first to attempt a phylogenetic reconstruction of iguanid lizards using outgroup comparisons and modern character-based phylogenetic methods. Their analysis of morphological characters suggested that iguanid species could be placed in one of eight major groups (Anoloids, Basiliscines, Crotaphytines, Iguanines, Morunasaurs, Oplurines, Sceloporines, Tropidurines). However, they acknowledged that they could not identify any synapomorphies for Iguanidae (sensu lato) indicating that it may be paraphyletic.

Based on a cladistic analysis of morphological characters, Frost and Etheridge (1989) did not find evidence of monophyly for Iguanidae (sensu lato). They also failed to resolve the intergroup relationships within iguanids, but claimed that their data supported monophyly for the previously recognized informal groups of Etheridge and de Queiroz (1988). With intent to reform named but potentially misleading groupings, they recognized as families (sedis metabilis) the largest historical groups that were consistent with the strict consensus tree generated by their phylogenetic analysis of Iguania (Table 1). The iguanines, consisting of the extant genera *Amblyrhynchus* and *Conolophus* (Galápagos Islands), *Cyclura* (West Indies), *Brachylophus* (Fiji), *Dipsosaurus*, *Sauromalus*, *Ctenosaura*, and *Iguana* (southwestern North America, the latter two extending south to Central America and Northern South America, respectively) were elevated to Iguanidae (sensu stricto). This cladistic reanalysis, along with the new taxonomy for Iguanidae, proved highly controversial because of its principles, methodology, interpretations, and its direct challenge to deeply entrenched informal nomenclature (see Lazell 1992; Schwenk 1994; Frost and Etheridge 1993). Nevertheless, their study proved instrumental in providing workable hypotheses for subsequent systematic investigations.

Macey et al. (1997) performed a phylogenetic analysis of Iguanidae (sensu lato) and Acrodonta (Agamidae + Chamaeleonidae) using mtDNA sequences and the morphological data of Frost and Etheridge (1989). Analyzed separately, the morphological and molecular data suggested different phylogenetic hypotheses with the morphological data recovering a weakly paraphyletic Iguanidae (sensu lato), and the sequence data recovering a strongly supported monophyletic Iguanidae (sensu lato). The monophyly of the family, however, also was supported by (1) separate analyses of protein-coding and t-RNA-coding subsets of the DNA sequences; (2) analysis of amino acids from protein-coding regions; (3) analysis of the total DNA sequence data with silent transitions removed from the protein-coding sequences; and (4) use of transversion parsimony on the total DNA sequence data. Although their sampling was not adequate to establish monophyly of Frost and Etheridge's (1989) eight families, these authors sug-

TABLE 1.—Taxonomic names for groups of the family Iguanidae (sensu lato Boulenger, 1884) respectively proposed by Etheridge and de Queiroz (1988) for informal groups, Frost and Etheridge (1989) for families and subfamilies, Macey et al. (1997) for subfamilies, Frost et al. (2001) for families and subfamilies, and Schulte et al. (2003) for an unranked taxonomic scheme. Names correspond to others in successive columns. Clarification is provided where names may be ambiguous.

Etheridge and de Queiroz (1988)	Frost and Etheridge (1989)	Macey et al. (1997)	Frost et al. (2001)	Schulte et al. (2003)
Anoloids	Polychridae	Polychrinae	Polychrotidae[e,f]	Polychrotinae*[p]
			Leiosauridae[g]	Leiosaurini[k]
			Leiosaurinae[h]	Leiosaurae[l]
			Enyaliinae[i]	Anisolepae[m]
				Anolis[n]
				Polychrus[o]
Basiliscines	Corytophanidae	Corytophaninae	Corytophanidae	Corytophaninae
Crotaphytines	Crotaphytidae	Crotaphytinae	Crotaphytidae	Crotaphytinae
Iguanines	Iguanidae	Iguaninae	Iguanidae	Iguaninae
Morunasaurs	Hoplocercidae	Hoplocercinae	Hoplocercidae	Hoplocercinae
Oplurines	Opluridae	Oplurinae	Opluridae	Oplurinae
Sceloporines	Phrynosomatidae	Phrynosomatinae	Phrynosomatidae	Phrynosomatinae
Tropidurines	Tropiduridae[a]	Tropidurinae		Tropidurinae*[p]
	Leiocephalinae[b]		Leiocephalidae	*Leiocephalus*
	Liolaeminae[c]		Liolaemidae	Liolaemini
	Tropidurinae[d]		Tropiduridae[j]	Tropidurini

[a] Containing the subfamilies Leiocephalinae, Liolaeminae, and Tropidurinae.
[b] Restricted to *Leiocephalus*.
[c] Contains *Ctenoblepharys*, *Liolaemus*, and *Phymaturus*. See Frost and Etheridge (1989) for comments.
[d] Contains "*Ophryoessoides*," *Plica*, *Proctotretus*, "*Stenocercus*," *Strobilurus*, *Tapinurus*, "*Tropidurus*," *Uracentron*, and *Uranoscodon*. See Frost and Etheridge (1989) for comments.
[e] Restricted to *Anolis* and *Polychrus*.
[f] Spelling corrected (Böhme 1990; pers. comm.) after the wrong name formation was applied to the genitive case of Polychrotos in Frost and Etheridge (1989).
[g] Containing the subfamilies Enyaliinae and Leiosaurinae.
[h] Contains "*Leiosaurus*" (see Frost et al. [2001] for taxonomic discussion), *Diplolaemus*, and *Pristidactylus*.
[i] Contains *Enyalius*, and the para anoles (*Anisolepis* and *Urostrophus*).
[j] Excluding the former subfamilies Leiocephalinae and Liolaeminae of Frost and Etheridge (1989).
[k] Corresponds with Leiosauridae of Frost et al. (2001).
[l] Corresponds with Leiosaurinae of Frost et al. (2001).
[m] Corresponds with Enyalinae of Frost et al. (2001).
[n] *Anolis* of Jackman et al. (1999) including *Chamaeleolis*, *Chamaelinorops*, *Norops*, and *Phenacosaurus*.
[o] *Polychrus* of Peters and Donoso-Barros (1970; including *P. peruvianus* [Noble 1924]).
[p] Monophyly is statistically equivocal based on the combined morphologic and molecular data of Schulte et al. (1998), thus these authors recommend retaining the subfamily as a metataxon(*) for taxonomic convenience.

gested a return to the classic taxonomy (sensu Boulenger 1884), with the eight major lineages within Iguanidae (sensu lato) recognized as subfamilies (Table 1).

Frost et al. (2001) examined the relationships within Polychrotidae (sensu Frost and Etheridge 1989) using both molecular and morphological data. Data from the combined analysis suggested that the Polychrotidae, as hypothesized by Etheridge and de Queiroz (1988) and Frost and Etheridge (1989), is not monophyletic because Corytophanidae (sensu Frost and Etheridge 1989) was nested within it. Substantial evidence also suggested that leiosaurs and the austral para-anoles formed a monophyletic group, which was elevated to Leiosauridae containing the subfamilies Leiosaurinae and Enyaliinae. Frost et al. (2001) suggested resurrecting the name Pleurodonta (Cope 1864) for the monophyletic group formally known as Iguanidae (sensu lato) because such a classification provided symmetry with its sister taxon, Acrodonta (Cope 1864). The authors stated further that if pleurodont iguanian monophyly is falsified or found dubious (under the approach advanced by Macey et al. 1997), the need for subsequent major changes to the taxonomy would be nullified.

Frost et al. (2001) also considered the results of Macey et al. (1997) and acknowledged having no scientific reason to dispute their reclamation of Iguanidae (sensu lato), yet suggested that their family-group names (sensu Frost and Etheridge 1989) had achieved widespread acceptance and usage. Frost et al. (2001: p. 13) also suspected that additional investigations into the fossil record would

further cloud phylogenetic evidence for monophyly of the Iguanidae (sensu lato), claiming that "the canon of monophyly is not violated," and that their subjective choice of ranks (Table 1) would lead to the least confusion, facilitate progress, and impart the best current hypothesis for understanding the phylogeny of the group.

Most recently, Schulte et al. (2003) used previously published morphological characters (in Frost and Etheridge 1989; Schulte et al. 1998) and molecular data (Macey et al. 1997; Schulte et al. 1998, 2000), with new molecular sequences to reexamine relationships among the major lineages of iguanid lizards. The monophyly of Iguanidae (sensu lato) was strongly supported by the molecular and combined data sets. Schulte et al. (2003) advocated recognizing Iguanidae (sensu lato) as a monophyletic group because monophyly was strongly supported by their data and with previous analyses of combined morphological and sequence data, as well as sequence data alone (Harris et al. 2001; Macey et al. 1997; Schulte et al. 1998). These authors proposed an unranked taxonomic scheme for all the supraspecific taxa of Iguania, whereas they associated Iguanidae with the clade composed of all eight major groups defined by Etheridge and de Queiroz (1988), which correspond with Pleurodonta of Frost et al. (2001; Table 1).

Literature-Use Analysis.—We analyzed the frequency of use for Iguanidae (sensu lato) from 1990 through 2004 by performing a general topic search in titles, abstracts, and keywords for the terms "Corytophanidae or Corytophaninae or Crotaphytidae or Crotaphytinae or Enyaliinae or Hoplocercidae or Hoplocercinae or Iguanidae or Iguaninae or Leiocephalidae or Leiocephalinae or Leiosauridae or Leiosaurinae or Liolaemidae or Liolaeminae or Opluridae or Oplurinae or Phrynosomatidae or Phrynosomatinae or Polychridae or Polychrinae or Polychrotidae or Tropiduridae or Tropidurinae" using the Thomson ISI–Web of Science® (WOS) Internet search engine. The WOS search engine was used because of its large database and convenience over other electronic means of searching the literature. We also performed a separate search from 1990 through 1999 using the Caribbean Journal of Science (CJS) website because the Iguanidae (sensu lato) is represented abundantly in the region and pre-2000 citations of this journal are not included in the WOS. A post-hoc search for Polychrotinae in WOS yielded only three citations within the study time frame, none of which were excluded from the previous search.

Citations were categorized as adopting one of the following taxonomic schemes: Boulenger (1884), Frost and Etheridge (1989), Frost et al. (2001) or Macey et al. (1997). Papers were examined first hand if taxonomic use was ambiguous from titles or abstract listing in the WOS or CJS results. Of these, papers that did not reference a specific family, subfamily, or taxonomic authority were not included in the analyses. Because extant iguanine lizards (sensu Etheridge and de Queiroz 1988; *Amblyrhynchus*, *Brachylophus*, *Ctenosaura*, *Conolophus*, *Cyclura*, *Dipsosaurus*, *Iguana*, and *Sauromalus*) cited as "Iguanidae" could be attributed to either Boulenger (1884) or Frost and Etheridge (1989), these were also excluded unless authors stated the taxonomy followed in their paper.

In some instances, the classification schemes used in post-1997 articles could pertain to one of two classifications. For example, a 1999 article assigning *Anolis* to Iguanidae could fall under either Boulenger (1884) or Macey et al. (1997). In these cases, we assumed the authors followed the most recent revision and scored citations as Macey et al. (1997). Additionally, post-2001 references involving lizards in clades with the same taxon names as in Frost and Etheridge (1989) (e.g., Phrynosomatidae, Polychrotidae, Tropiduridae, etc.) also could be included under Frost et al. (2001). In these cases, we also assumed that the authors intended to use the most-recent revision, so we scored these references as Frost et al. (2001). To analyze journal-specific trends in taxonomic use, citations also were categorized by one of four journal types: (1) Biology/Ecology, (2) Herpetology, (3) Medical/Parasitology, and (4) Molecular/Systematics.

We used chi-square tests of independence to test for trends between taxonomic scheme and their frequency of citation by year and journal category. If tests were significant, we described trends by comparing individual cell-observed frequencies to cell frequencies expected under a hypothesis of independence. Trend description was limited to cells that provided a large contribution (i.e., large individual chi-square value) to the overall significance of the chi-square (SAS OnlineDoc®, V. 8, Cary, NC: SAS Institute Inc. 1999). We used exact tests when 25% or more of the expected cell counts in a contingency table were less than five.

Results of Literature-Use Analysis.—Of the 520 articles found by our combined WOS and CJS literature search, 428 (representing 89 journals) were used in our analysis. From 1990–1997, use of the two available taxonomies was not statistically independent by year (χ^2 test, $P < 0.0001$; Table 2). From 1990–1992, chi-square values for individual cells revealed that a greater number of authors than expected (if random) followed the taxonomy of Boulenger (1884), whereas fewer than expected adopted that of Frost and Etheridge (1989). From 1993–1997, the opposite trend emerged as a smaller number of authors used the classification of Boulenger (1884) and more than expected adopted that of Frost and Etheridge (1989; Table 2).

From 1998–2001, we assigned 17 papers to Iguanidae sensu Macey et al. (1997) that might otherwise have been classified as following Boulenger (1884). During this period there was no sig-

TABLE 2. Observed and expected observations followed by individual cell chi-square values for the competing Iguanidae (sensu lato) taxonomies from 1990–1997. Note the change in observed relative to expected values between classifications in 1993 (in bold).

Taxonomy	χ^2 parameters	1990	1991	1992	**1993**	1994	1995	1996	1997
Boulenger (1884)	Observed	18	19	18	**5**	14	7	5	1
	Expected	7.65	9.66	11.68	**10.88**	15.31	10.07	12.49	9.26
	Cell χ^2	13.99	9.01	3.42	**3.17**	0.11	0.33	4.49	7.37
Frost and Etheridge (1989)	Observed	1	5	11	**22**	24	18	26	22
	Expected	11.35	14.33	17.32	**16.13**	22.69	14.93	18.51	13.74
	Cell χ^2	9.44	6.08	2.31	**2.14**	0.08	0.63	3.03	4.97

TABLE 3. Observed and expected observations followed by individual cell chi-square values for the competing Iguanidae (sensu lato) taxonomies from 2002–2004. Cells that have the largest influence on the chi-square value are in bold.

Taxonomy	χ^2 parameters	2002	2003	2004
Frost and Etheridge (1989)	Observed	**17**	9	**2**
	Expected	**11.87**	8.2174	**7.913**
	Cell χ^2	**2.2176**	0.0745	**4.4185**
Macey et al. (2001)	Observed	7	4	7
	Expected	7.6304	5.2828	5.087
	Cell χ^2	0.0521	0.3114	0.7194
Frost et al. (2001)	Observed	**15**	14	**17**
	Expected	**19.5**	13.5	**13**
	Cell χ^2	**1.0385**	0.0185	**1.2308**

nificant trend in taxonomic use (Fisher's Exact test, $P = 0.77$) and cell chi-square values indicate that, according to our scoring method, the two competing taxonomies (Frost and Etheridge 1989; Macey et al. 1997) were used as frequently as expected in proportion to the number of times that they were used throughout this four-year period. Although no significant trend was found, more authors published papers adhering to the taxonomy of Frost and Etheridge (1989; Fig. 1A).

From 2002–2004, 30 papers were assigned to Frost et al. (2001) despite being potentially attributable to Frost and Etheridge (1989). Likewise, 11 papers were assigned to Macey et al. (1997) despite being potentially attributable to Boulenger (1884). One paper adhering to the taxonomic expansion of Schulte et al. (2003) was found in 2004. During this period, the three available taxonomies (Frost and Etheridge 1989; Frost et al. 2001; Macey et al. 1997) were not used as frequently as expected (χ^2 test, $P = 0.04$; Table 3) relative to the number of times that each was used throughout the sample years. In 2002, chi-square values for individual cells revealed that more authors than expected adopted the taxonomy of Frost and Etheridge (1989), whereas fewer than expected adopted that of Frost et al. (2001). In 2004, the opposite trend emerged with fewer authors using the taxonomy of Frost and Etheridge (1989) and more than expected adopting that of Frost et al. (2001). The taxonomy of Macey et al. (1997) was used as frequently as expected throughout this sample period (Table 3). In addition to the trends noted above, overall more papers were published adhering to the taxonomy of Frost and Etheridge (1989) and Frost et al. (2001) than to Macey et al. (1997; Fig. 1A).

The four competing taxonomic classifications used in publications were not independent of journal category (χ^2 test, $P = 0.0004$; Table 4). Cell chi-square values illustrate that under a hypothesis of independence, Boulenger (1884) was used more than expected in biology/ecology journals, but less than expected in herpetology and molecular/systematics journals. Both Frost and Etheridge (1989) and Frost et al. (2001) were represented more than expected in herpetology journals, whereas Frost et al. (2001) was used more than expected in parasitology/medical journals, but less than expected in biology/ecology journals. The taxonomy of Macey et al. (1997) was used less than expected in herpetology journals, but more than expected in molecular/systematics journals (Table 4).

Literature-Use Discussion.—Our results reveal a three-year time lapse before the reclassification of Frost and Etheridge (1989) became the most commonly used taxonomy in the scientific literature. Frequency data indicate that the taxonomy of Frost and Etheridge (1989) peaked in 1996, representing 84% of publications that year (Fig. 1B). This lag could be an artifact of the highly controversial nature of the reclassification (see Schwenk 1994), the result of less advanced communication technology (i.e., email and Internet), or the often-lengthy lag from manuscript acceptance to time of publication.

The lack of a statistical trend favoring any particular classification scheme from 1998–2001 suggests that the taxonomy of Macey et al. (1997) was met originally with acceptance. Interestingly, a trend was uncovered post-2001 indicating a transition from Frost and Etheridge (1989) to Frost et al. (2001), whereas the taxonomy of Macey et al. (1997) was represented in the literature as expected (Table 3). This suggests a loyal following of the Frost and Etheridge (1989) taxonomy and a willingness to adopt the new Frost et al. (2001) taxonomy within two years.

Iguanids are models for comparative behavioral, ecological, morphological, and physiological studies, which is reflected in the journal data. From 1990–2004, a total of 89 journals published

TABLE 4. Observed and expected observations followed by individual cell chi-square values for the competing Iguanidae (sensu lato) taxonomies for the four journal categories. Cells that have the largest influence on the chi-square value are in bold.

Journal Category	χ^2 parameters	Boulenger (1884)	Frost and Etheridge (1989)	Macey et al. (1997)	Frost et al. (2001)
Biology/ Ecology	Observed	**56**	106	20	**13**
	Expected	**39.638**	116.64	17.769	**20.958**
	Cell χ^2	**6.7541**	0.9698	0.2802	**3.0217**
Herpetology	Observed	**16**	**89**	**7**	**19**
	Expected	**26.629**	**78.355**	**11.937**	**14.079**
	Cell χ^2	**4.2423**	**1.4461**	**2.0418**	**1.7197**
Medical/ Parasitology	Observed	13	32	5	**9**
	Expected	11.993	35.29	5.3762	**6.3411**
	Cell χ^2	0.0846	0.3067	0.0263	**1.1149**
Molecular Biology/ Systematics	Observed	**2**	29	**7**	5
	Expected	**8.7407**	25.72	**3.9182**	4.6215
	Cell χ^2	**5.1983**	0.4184	**2.4239**	0.031

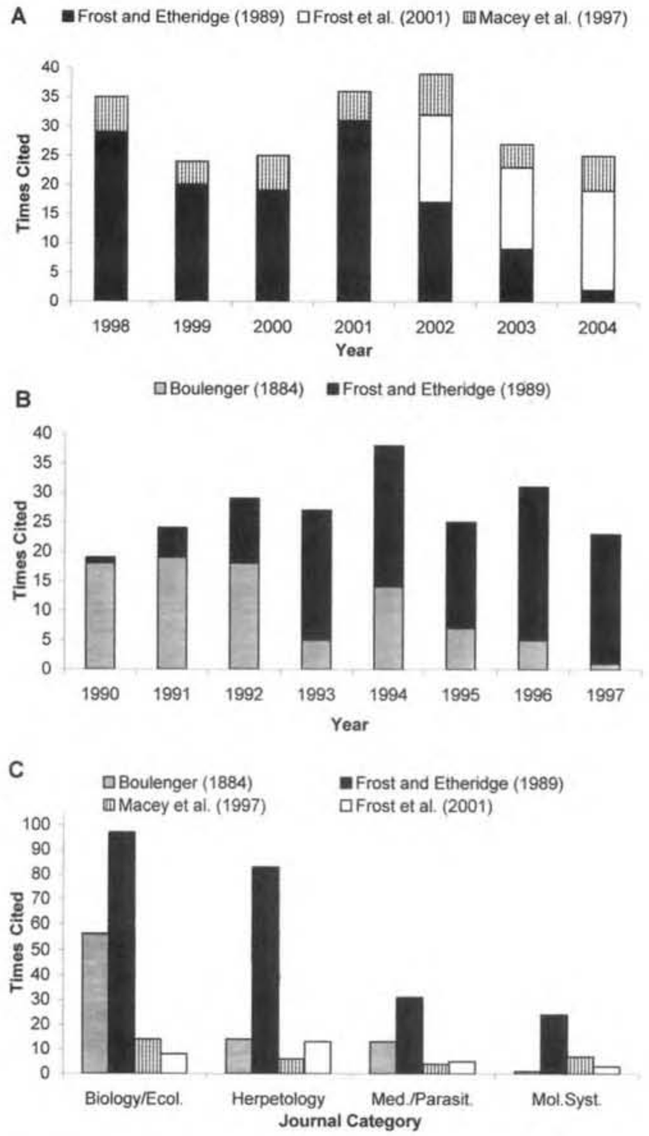

FIG. 1. (A) Number of citations from 1998–2004 referencing the three possible classifications. Post-1997 articles (N = 28) were defaulted to Macey et al. (1997) despite being potentially attributable to Boulenger (1884). Post-2001 references (N = 30) were attributed to Frost et al. (2001) despite being potentially attributable to Frost and Etheridge (1989). See text for details. (B) Number of citations from 1990–1997 following Boulenger (1884) and Frost and Etheridge (1989). (C) Number of citations from 1990–2004 adhering to the four taxonomic possibilities and stratified by journal category.

articles referencing iguanid taxonomy. Many of these journals are biology/ecology oriented and our data demonstrate a higher reference usage of the older monophyletic Iguanidae (sensu Boulenger 1884) taxonomy within these journals, and a lower than expected usage in herpetology journals. The literature summarized here suggests that the discrepancy may be due to greater awareness of the most current classification by manuscript reviewers and editorial boards. It is interesting that articles published in herpetology oriented journals appear to be favoring more often the taxonomy of Frost and Etheridge (1989) and the more recent Frost et al. (2001) over the Macey et al. (1997) taxonomy and its subsequent modifications (e.g., Schulte et al. 1998, 2003) (Fig. 1C; Table 4).

Conflicting opinions exist in the herpetological community concerning the usage of the taxonomic revisions and subfamily classifications proposed by Frost and Etheridge (1989) and Macey et al. (1997), respectively. Frost et al. (2001: p. 13) defended the eight-family taxonomy of Frost and Etheridge (1989) by claiming that it had "widespread recognition and usage," whereas Schulte et al. (2003: p. 415) countered that "The eight-family taxonomy of Frost and Etheridge was proposed in 1989, was never fully accepted, and subsequently rejected by Macey et al. (1997)." Our literature-use analysis indicates that the taxonomy of Frost and Etheridge (1989) has been supported by continued widespread use four years subsequent to publication (Fig. 1B) despite not being featured in a herpetology textbook (Zug et al. 1993) until nine years after publication (Pough et al. 1998). Although the Macey et al. (1997) classification scheme of a monophyletic Iguanidae with multiple subfamilies is featured in recent herpetology textbooks (e.g., Pough et al. 2001, 2004; Zug et al. 2001), our data indicate that it has not been adopted as widely in the scientific literature as has Frost and Etheridge (1989) or even the more recent Frost et al. (2001) taxonomic recommendations (Fig. 1A). However, we recognize that more time may be required to detect taxonomic influences educed by these recent textbooks especially in light of several taxonomic choices.

A question worth addressing concerns the lack of widespread adoption of the eight-subfamily Macey et al. (1997) phylogenetic reclamation of Iguanidae (sensu lato). Macey and colleagues published compelling evidence for the clade, which was supported subsequently by Schulte et al. (1998), Harris et al. (2001), and Townsend et al. (2004). Furthermore, Frost et al. (2001) acknowledged having no scientific reason to dispute the recovery of Iguanidae (sensu lato). Therefore, it is surprising that the Macey et al. (1997) subfamily taxonomy is underrepresented in the literature, whereas the more recent Frost et al. (2001) revision has received broader acceptance.

Conclusions.—In biological nomenclature, communication is most effective if taxon names are universal and stable. The association between a name and a taxon should be unequivocal; all biologists should use the same name for the same taxon, and a name should not designate different taxa, or a taxon assigned different names at different times (de Queiroz and Gauthier 1994). Consequently, researchers should exercise caution, evaluate alternative nomenclature, and adopt classifications that promote stability or accurate testing of hypotheses (K. de Queiroz, pers. comm.). Although differences of opinion facilitate debate and research, inconsistent use of nomenclature can promote spurious interpretations of comparative data across higher taxa. Minimally, authors should therefore reference their choice of classification schemes, especially when testing evolutionary hypotheses.

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Habitat Use and Activity Patterns of Two Green Ratsnakes (*Senticolis triaspis*) in the Chiricahua Mountains, Arizona

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Although *Senticolis triaspis* is distributed from Costa Rica to the southwestern United States its behavior and activity patterns are not well-documented (Price 1991; Schulz 1996; Stebbins 2003). Here I report on movements, use of habitat, and behaviors of two females (*S. t. intermedia*) during radiotelemetry studies in a Sierra Madrean mountain range in southeastern Arizona, at the northern limit of the species' range.

Materials and Methods.—On 21 July 1994, an adult female *Senticolis triaspis* (Snake #1) was collected at 1900 h on Cave Creek Canyon Road (USFS Road #42) between Stewart and Sunny Flat Campgrounds (elevation 1540 m), Chiricahua Mountains, Coronado National Forest, Cochise County, Arizona, USA. The snake measured 953 + 232 mm (SVL + tail length) and weighed 182 g (Pesola™ scale). On 23 July the snake was anesthetized with isoflurane (Forane™) to allow surgical implantation of a Holohil™ transmitter BG-2G (2.8 g) in the coelomic cavity (Reinert and Cundall 1982). The snake was released the following morning (0900 h), 30 m S of the collection point. On 24 August 1999, a second adult female *S. triaspis* (Snake #2; 690 + 162 mm, 82 g) was collected at 0900 h on the same road, but 100 m below Cazier Bridge (elevation 1616 m). Surgical procedures for implanting a Holohil™ transmitter BD-2G (1.85 g) and tracking were as with Snake #1, except the anesthesia was sevoflurane (Ultane™). Snake #2 was released, at 0820 h on 25 August 1999, 30 m S of where collected. Both snakes were subsequently radio-tracked using a Telonix™ receiver (TR-2) and antenna (RA-2A). Distances between sites were measured with a 50 m tape (except as noted), boulder and tree dimensions and heights were determined with the aid of tape and extendable measuring pole, sites were photographed (all 1994, most 1999–2000) and marked with flagging tape, and observations of visible snakes were aided by 9×35 binoculars. Sites were only visited during daylight hours. Searches were more frequent in the afternoon than in the morning (116 versus 43) and the number of hours in a day during which searches occurred were more numerous in the afternoon (morning, 0600–1200 h = 6 h; afternoon, 1201–2100 h = 9 h). Each time a snake was located I, or an assistant, recorded the date, time (MST), distance and direction (compass points) from last encounter location (if changed), occurrence of rain within the last 24 h period (at site or from records at Southwestern Research Station, 4 mi SW Por-

tal; < 5 km from tracking sites), site habitat and microhabitat notations, and air temperature (AT; with a shaded rapid-adjusting mercury thermometer (Schultheis™ 0–50°C; Weber & Miller, Queens, New York).

The entire field site occurs within a Madrean Evergreen Woodland (Brown 1982) community. The Cave Creek riparian community includes Arizona Sycamore (*Platanus wrightii*) and Arizona Walnut (*Juglans major*). Canyon terraces and slopes facing north and northwest support an oak-juniper-pine community, while south- and southeast-facing slopes are characterized by bare rock slides with islands of shrub/oak vegetation. Steep canyon walls are lichen-covered rhyolite lava (Oligocene), with many rock outcrops and sheer cliffs along the upper portions, and Holocene gravels fill Cave Creek (Drewes et al. 1995).

Results.—Snake #1 was located 79 times between 24 July and 3 October 1994 at 13 distinct sites. Six of these sites were subterranean refuges; three were occupied for periods of > 21, > 19, and > 8 days (beneath boulders; 540 × 190 × 320 cm, 710 × 475 × 366 cm, 465 × 280 × 228 cm, respectively), and three were occupied >2<10 days. During 72 days Snake #1 was observed active above ground five times (three times at underground location sites) and was located at ten subterranean sites. Rock dimensions at other measured underground sites were as follows: 90 × 70 × 30 cm to 27 × 30 × 10 cm, 135 × 70 × 30 cm, 313 × 96 × 84 cm, 88 × 96 × 84 cm, and 80 × 55 × 60 cm. The total measured distance moved was 573 m, plus an unmeasured distance (when the animal was temporarily lost) estimated (from a topographic map) to be over a kilometer. Thus, the estimated total straight-line distance traveled was 1573 m, for a mean distance of 161 m between locations. Omitting the estimated 1 km movement, the mean distance between locations was 48 m (range = 2–215 m).

On 25 July Snake #1 was observed (1430 h) sunning on a 4 cm diameter dead branch at 4 m high in a *Quercus arizonica*. On 5 September it was 1 m from a massive boulder underground-site in shade, between 1350–1514 h (AT 30°C); an accumulation of acorns and a rodent hole had been noted earlier at the base of this boulder. The snake retreated beneath the boulder where it had been since 17 August. It moved by the following afternoon, following rain on 3 and 5 September and a stay of >19 days. On 6 September (1530 h; AT 30°C) the snake was on the ground partially beneath a small log, head up, with <5% of its body in the sun. Later it was located (1700 h; AT 30°C) stretched out in a small < 1 m tall *Quercus hypoleucoides* that had been exposed to the setting sun's rays. The snake descended and proceeded up slope; forward motion was accomplished by a series of short advances of the head, with each advance followed by a slightly shorter retreat (slow-motion jerky advances). At 1745 h the snake stopped forward locomotion when discovered by a juvenile Mexican Jay (*Aphelocoma ultramarina*). The bird departed after 2–3 min when other members of its flock were not recruited by its calls near the snake. At 1824 h visual contact was again lost as the snake passed a boulder flanked by dense shrubs. After about 5 min, a deer mouse (*Peromyscus* sp.) ran up and over the boulder, escaping into vegetation. Examination revealed a rodent hole next to the upper end of the boulder. Apparently the snake entered the hole and caused the mouse to flee. Subsequent radio signals (8 daily visits through 14 September) suggested underground movements to positions 3–4 m from the boulder. On 13 September the snake was again seen at an edge of this boulder (AT 31°C), immediately retreating into the rodent hole. Within two days it departed the site, occupied for >8<10 days.

Snake #1 occupied ten subterranean sites, of which seven were inhabited for less than 27 h 10 min, and three were respectively inhabited for 21 days, 19–20 days, and 8–10 days. Thus the snake spent 48–51 of the 72 days (66–71%) in long-term sites. The three short-term subterranean sites (>2<10 days) bring the total occupation days for these sites up by at least six days. The snake's positions were determined repeatedly (2–34 times) at five sites. At three sites (duration of occupancy >11.5<24.5 h; >11.5<25.5 h; >22 days) no positional changes were recorded. Additionally (two sites), its position was determined 34 times (>21 days occupancy) with internal site movements of 1 (7), 3 (1), or 0 (25) m, and 9 times (>8<10 days occupancy) with internal site movements of 1 (1), 3 (2), 4 (1), and 0 (4) m.

On 23 September Snake #1 was located 20 m to the south of a major ridge it had crossed. This drainage translocation placed the snake in a separate basin of Cave Creek on a south-facing slope, whereas its former activity was on north-facing slopes. At two subsequent sites, Snake #1 was located on a steep talus slope, lacking vegetation except for isolated islands, composed of very angular rocks (surface 5 × 20 cm; some larger, 40 × 70 cm). Such slopes dominated the landscape.

In three of thirteen location changes (periods between encounters >24 h) time of day is unknown, and in two cases both nocturnal and diurnal periods occurred between observations. But in eight of the site moves, snake site-location times were of sufficient frequency to provide data on dial movements, all diurnal or crepuscular. Three diurnal moves could not be limited to morning or afternoon (0900–1440 h; 0635–1430 h; 0955–1920 h). One move occurred in the morning (0650–1120 h). And, four of the moves occurred in the afternoon (1440–1990 h; 1430–1920 h; 1530–1700 h; 1722–1824 h).

Snake #1 vacated one site within a few hours after rain. Five rain events occurred while the snake was at the subsequent site, but it did not move until six days after the last rain. Then it vacated its new site after rain the previous night. Later, three rain events occurred while the snake was at a long-term site, but it only moved two or three days after the last rain.

Following release in the canyon bottom, Snake #1 remained in the lower areas (24 July–15 August) before beginning a multiply-site climb in a southeasterly direction over largely northwest-facing slopes (6 September–14 September). From 14 to 23 September the snake's location was not determined as it crossed over a very steep ridge to descend onto a south-facing slope (23 September-3 October). Search efforts between 7 October and 10 November were unsuccessful, and the study was terminated.

Mean daily movement of Snake #1 over the study period, between 24 July and 3 October, was 21.8 m/d. During the period 24 July through 14 September the snake moved 350 m, 6.6 m/d over 53 days. It then moved an estimated 1000 m or more over 10 days, increasing its elevation ca. 500 m. Once relocated to a south-facing slope, the snake then moved twice, 215 and 8 m, during 11 days, for a mean distance of 20.3 m/d. Between 14 September and 3 October (21 days) it moved 223 m plus 1 km, estimated (1223 m; 78% of the total moved, 1573 m), 37 m/day.

Snake #2 was located 80 times (usually daily, twice on five days,

except when hibernating) over 147 days between 25 August 1999 and 18 January 2000, after which the transmitter signal failed. Of 31 sites, nine were occupied on multiple visits indicating the presence of the snake for, >24 h , > 32 h, >22 h, >19 days, > 7 days/20 h < 10 days, >22 h, > 45 h, >30< 36 days, >41 days. Thus four sites were occupied < 48 h, and four were occupied for periods of about eight to >41 days.

Observation of the snake above ground allowed determination of activities at nine sites: 3 September (1425 h), 1 m up the west side of a *Yucca schottii*, <5% of body in the sun, not moving (AT 26°C); 4 September (1115 h) immobile inside a rock crevasse 6 m above ground level (AT 24°C); 9 September (1515 h) elevated 10 cm in branches of a low tree, 20% in sun (AT 28°C); 10 September (1700 h) 2 m above ground in *Pinus leiophylla* (AT 28°C); 11 September (1715 h) 15 cm above ground in branches of *Quercus hypoleucoides*, 0% sun (AT 25°C); 8 October (1450 h) coiled on the ground under a dead oak stump (0% sun); 9 October (0835 h) inside a 20 cm opening under a rock (0% sun; AT 14°C); 10 October (1335 h) exposed on leaf litter, crawling (26°C); 21 October (1520 h) in creek bed where it was apparently undergoing a lengthy move northward, 106 m from last site and 24 m to next recorded site.

In the creek bed it was watched (1520–1710 h; AT 18–15°C) as it moved 12.5 m, with 3–5 min periods of non-movement, apparently in response to the presence of the observer. Snake movements were similar to those observed with Snake #1 (6 September 1994): moved with jerky forward-backward movements, head back and forth in short jerky motions, but tail moved at slow, relatively uniform pace.

The subterranean position of Snake #2 was determined multiple times at nine sites. Distance of short within-site changes in location were noted (dates and duration of site occupancy): (25–26 August; > 24 h), 3, 4, and 2 m; (27–28 August; >34 h) 1, 0, and 4 m; (7–8 September; >22 h) 2 m; (12 September–1 October; >19 days) position determined 18 times, one 2 m move; (10–18 October; > 7 days) 1 and 4 m; (22 and 23 October; >22 h), 2 m; (26–28 October; >45 h) 0 and 0 m; (1 November–1 December; >30<36 days), 12 observations, with four movements of, 1, 1, 1, and 2 m; (8 December–18 January; >41 days) five observations with one movement of 4 m.

Many of the sites were steep rocky slopes with angular rock rubble and talus, all well or partially vegetated. Seventeen sites were recorded as having talus rock and three as having boulder complexes. One site (12 Sepetember–1 October; >19 d) was reoccupied (8 December–18 January; >41 d). Therefore, the snake spent at least 41%, >60 of 147 d, of its time, in two seasonally-distinct occupancies of this site. Two other sites were occupied for periods longer than 48 h, (10–18 October, >7 d 20 h<10 d) and (1 November–1 December; >30 d<36 d).

When the snake was located twice in a day, movements to new sites occurred twice during daylight hours, between 0835–1740 h and 1335–1635 h. In both cases visual contact had been made at the earlier time, potentially influencing the snake's behavior. Times and air temperatures of observed surface activity of Snake #2 at other sites were as follows: 1425 h, 26°C; 1115 h, 24°C; 1515 h, 28°C; 1700 h, 25°C; 1715 h, 25°C; 1450 h, no AT; 0835 h, 14°C; 1335 h, 26°C; 1520–1715 h, 18–15°C. Eleven encounters involved diurnal surface activity.

Snake #2 moved location twice following rains on 28 and 29 August, but failed to move during a daily rainy period 14–18 September, following a heavy rain on 22 September, and after a lighter rain on 23 September. Light rains on 16 October and 24 December failed to result in immediate site relocation.

Following release on 25 August, Snake #2 remained on lower terrace slopes before proceeding southward on 29 August up a steep north-facing slope which it continued to climb until 4 September when it reversed general direction to move northward across Cave Creek where it climbed the south-facing slope and occupied its first long-term site on 12 September. It then returned to lower slopes and crossed to the south side of the Creek where it was at another long-term site by 10 October. On 21 October it was at the Creek and subsequently again moved up the south-facing slopes before settling on 1 November. It remained at this site until at least 1 December, when it relocated 57 m to reoccupy an earlier site (12 September–1 October) where it remained until lost in late January, 30–31. The final two sites were on steep south-facing slopes.

During 147 days, Snake #2 made a mean daily distance relocation of 13.5 m/d. The thirty movements between sites involved a total distance of 1987 m, for an approximate mean distance of 66 m/move (range = 4–175 m). Between release on 25 August and 12 September the distance covered was 1267 m in 19 d, 66.7 m/d, 64% of the total distance moved. Then the snake was resident for >19 days before resuming frequent movements between 4 October and 1 November. These renewed movements (15) of 663 m over 29 days resulted in a mean daily movement of 22 m/d, or 44.2 m/move. After 1 November the snake moved once, 57 m, through 18 January; daily movement during this period was 0.7 m/d.

Discussion.—Above ground observations suggest that Green Ratsnakes do not spend significant amounts of time in the canopies of trees. While actively moving on the ground surface they only seek low objects to increase their elevation. This non-arboreal behavior is in agreement with Schulz (1996). Use of low vegetative perches might be facilitated by the snake's greenish coloration, acting as camouflage. Based on snake body exposures to sunlight, snakes appear to be using these perches as basking sites. Green Ratsnakes and Sonoran Whipsnakes (*Masticophis bilineatus*) are syntopic in Cave Creek, though the extent of overlap in their diets and use of arboreal habitats remains unclear.

Both ratsnakes were observed to exhibit similarly unusual forward-retreat locomotion. Comparable movement has been noted in the Australian Thorny Devil, *Moloch horridus* (Sherbrooke 1999, 2005) and in at least two snakes, the Neotropical Vine Snake (*Oxybelis aeneus*; Fleishman 1985) and the Ridge-nosed Rattlesnake (*Crotalus willardi*, H. W. Greene and D. L. Hardy, Sr., pers. comm.). This slow, forward-retreat behavior for locomotion could be associated with the collection of visual and/or chemical cues used in orientation during surface movements. Or, it could be a method for reducing the likelihood of detection by potential predators, reducing the reactions of motion sensors in the predator's retinal/brain complex, thus inhibiting the processing and identification of visual images.

Both snakes remained at some locations for periods greater than a week. Given the large size of boulders under which these snakes spend a great portion of their lives, it seems that collectors seek-

ing Green Ratsnakes should avoid turning rocks or small boulders, and should consider snakes inaccessible when not exposed. Similarly, these microhabitats probably afford the snakes protection from predators. The evidence of rodent occupation or use at two of three long-term sites used by Snake #1 suggests that such sites might be associated with prey capture and/or digestion; within site movements may facilitate thermoregulation for digestion. Green Ratsnakes readily eat rodents in captivity (Schultz 1996), and rodents are part of the natural diet (Stebbins 2003). Alternatively, Snake #2's use of its last two long-term sites, after 1 November, might be better interpreted as being associated with seasonal inactivity.

Of the 26 diurnal movements of the two snakes, 18 were afternoon, four were morning, and four were undetermined. It appears that surface activity might be most frequent after noon, and probably extends into evening. Schulz (1996) suggested afternoon and evening activity for this subspecies, and a 25°C preferred body temperature for the species (within the range here recorded in Cave Creek). For both snakes, surface activities and movements between sites were not clearly linked to rainfall events.

Snake #1 appears to have been actively foraging with three interrupted periods of site residency before making a long distance move to sites with south-facing exposures, on deep talus slopes. It seems possible that movements during the summer were largely motivated by food acquisition, whereas later in the season the snake was moving to an area for potential hibernation. There are several possible explanations for the disappearance of the snake's signal after 3 October: predation, transmitter failure, movement out of range, or the snake may have moved into a talus slope, or surrounding rocky areas, preventing effective signal transmission. Snake #2 appears to have also been actively foraging with two interrupted periods of longer site residency. Beginning 1 November it may have entered a pseudo-hibernation stage, from which it emerged in early December to move to another south-facing slope where it remained, although active under the surface, through at least 18 January. Subsequently the signal and snake were lost, but excavation of the final undisturbed site (31 January 2000) did not lead to recovery of the transmitter or snake, suggesting that the snake had moved. Transmitter batteries might have failed. Movements during December and January by Snake #2 suggest that a single hibernation site may not be selected, but rather that snakes might continue to relocate during winter.

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Effects of Shoreline Vegetation on Visibility of American Crocodiles (*Crocodylus acutus*) During Spotlight Surveys

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Determining status and trends of crocodilian populations is a top priority of crocodile conservation and management programs (Bayliss 1987; Thorbjarnarson 1992). A variety of crocodilian survey methods have been developed (Bayliss 1987; Magnusson 1982). Spotlight surveys have been used successfully and have proven effective throughout the world to evaluate crocodilian populations (Bayliss 1987; Chabreck 1966; Hutton and Woolhouse 1989; King et al. 1990; Magnusson 1982; Mazzotti 1983; 1999; Thorbjarnarson 1988; Webb et al. 1987; Woodward and Moore 1993). Spotlight surveys (also termed night counts or eyeshine surveys) are environmentally versatile, relatively inexpensive, and take advantage of nocturnal crocodilian behavior patterns and enhanced visibility due to eyeshine (light reflected from the *tapetum lucidum*) (O'Brien 1990). Surveys are usually conducted with a spotlight from a boat, but can also be done from other vehicles or on foot. Spotlight surveys report an encounter rate of crocodiles, usually as animals per distance of shoreline or river, as an index of relative density (Wood et al. 1985).

Selection of specific survey methods depends greatly upon biology of the species under study and other considerations such as habitat, cost, logistical constraints, and goals of the study (Chabreck 1966; Magnusson 1982). Regardless of method used, factors that

influence interpretation of survey results need to be considered, and controlled or estimated if possible (Bayliss 1987; Graham and Bell 1969). The proportion of animals visible (sightability or detectability) during surveys is an important variable (Gardner and Baard 1999; Nichols et al. 2000; Woodward et al. 1996). The probability of observing a crocodile is dependant upon several factors. Environmental variables such as water temperature, water depth, wave action, and tidal fluctuations can affect the number of crocodilians observed during a spotlight survey (Bayliss 1987; Montague 1983; Murphy 1977; Woodward and Marion 1978). Habitat conditions, such as shape and complexity of the shoreline, width of river or pond, and presence and density of vegetation also affect visibility of crocodiles (Thorbjarnarson 1988; Wood et al. 1985). Furthermore, visibility of crocodilians may be affected by survey craft size and speed, light source (power, color, and location with respect to the observer), and observer skill (Bayliss 1987; Woodward et al. 1996). Finally, wariness of individuals to the observer (e.g. escape distance) and population density can affect results of spotlight surveys (Pacheco 1996; Webb and Messel 1979). In this study we examined the effect of shoreline vegetation on visibility of crocodiles during spotlight surveys.

Materials and Methods.—Two experiments were designed to imitate a crocodilian spotlight survey. Surveys were conducted along Red Mangrove (*Rhizophora mangle*) shorelines within habitat of the American Crocodile (Mazzotti 1999), Long Sound, Monroe County, Florida, USA. Artificial reflectors were used to mimic the presence of crocodiles floating at the surface. One piece of 13 × 13 mm red reflective tape was attached to 1-inch diameter polyvinychloride (PVC) pipes, which were painted black (termed reflectors).

Reflectors were positioned at randomly selected points along transects by individuals who did not participate in the surveys. Total number of reflectors was calculated with a power analysis using a 95% confidence interval and a probability that 80% of reflectors visible during the survey would be observed. Half of the reflectors (exposed) were placed along the shoreline, at the mangroves' edge. PVC pipes used in this treatment group were approximately 75 cm in length and were inserted into the mud substrate, leaving the reflective tape just above the waterline. The remaining reflectors (concealed), 10 cm in length, were placed among mangrove roots approximately 1.75 m inland from the vegetation edge along the shoreline. In both concealed and exposed groups, reflectors were placed so that they would be available for spotlighting during a survey. The location of each reflector was recorded using a global positioning system (GPS) receiver.

In Experiment 1, 121 reflectors (59 concealed and 62 exposed) were placed along the same 6 km stretch of shoreline at randomly selected points. A boat driver and an observer conducted the survey from a 4.6 m skiff. The skiff traveled parallel to the shoreline, approximately 50 m offshore, at a speed ranging from 24–27 km/h. A 200,000-candle power spotlight was used in a back and forth sweeping motion on the side of the boat facing the shoreline. When a reflector was observed the boat slowed to approach the shoreline and identify each reflector as either concealed or exposed.

In Experiment 2, 110 reflectors, evenly divided between exposed and concealed, were placed along two separate 6.4 km shorelines (half as dense as Experiment 1). The survey was performed in the same manner as in Experiment 1, except only a waypoint was recorded with the GPS unit, rather than slowing to approach the reflector. Since exposed and concealed treatments were located on separate shorelines we knew reflector locations for each and only needed to record a GPS coordinate. Waypoints were also taken to ensure that only reflectors were counted rather than incidental reflective objects (false positives or actual crocodiles). The location of reflectors recorded by each observer during a single run along the shoreline was verified by overlaying each observer's waypoints with the known positions of all reflectors, using a geographic information system. A Two-Sample t-Test was performed to analyze differences between numbers of reflectors observed.

We hypothesized the effect of shoreline vegetation depth on visibility of crocodiles by drawing a sigmoid curve through the mean proportion of reflectors counted by observers in Experiment 2. We assumed that the sighting proportion would continue to decline at a similar rate until it approached zero. Under this hypothesis, few animals would be sighted further than 5 m from shoreline.

Results.—Four observers who participated in Experiment 1 located all 62 (100%) exposed reflectors, with two observing 54 (92%) and two observing 57 (97%) concealed reflectors (Table 1). A significant difference was found between the number of reflectors observed that were concealed and those that were exposed ($p = 0.0003$). Approximately 26% fewer reflectors (Table 1, $p = 0.0014$) were observed in concealed positions (range 24–65%) than exposed positions (range 69–91%). Figure 1 is a hypothetical curve of loss of visibility of crocodiles inland from the edge of shoreline vegetation.

Discussion.—Shoreline vegetation decreased visibility of reflectors during surveys. With one exception the proportion of reflectors sighted was consistent within treatments. In the exception (24%

TABLE 1. Number (percentage) of reflectors (experimental eyeshines) spotted by each observer. N equals the number of reflectors available. Exposed reflectors were placed along a mangrove shoreline and concealed reflectors were placed 1.75 m into mangrove vegetation. The difference between exposed and concealed reflectors observed was significantly different for both experiments ($p < 0.01$, Two-Sample t-Test).

	Experiment 1			Experiment 2	
	Exposed	Concealed		Exposed	Concealed
Observer	N = 62	N = 59	Observer	N = 55	N = 55
1	62(100)	57(97)	1	45(82)	13(24)
2	62(100)	54(92)	2	49(89)	34(62)
3	62(100)	57(97)	3	50(91)	33(60)
4	62(100)	54(92)	4	41(75)	35(64)
			5	45(82)	36(65)
			6	49(89)	35(64)
			7	38(69)	30(55)

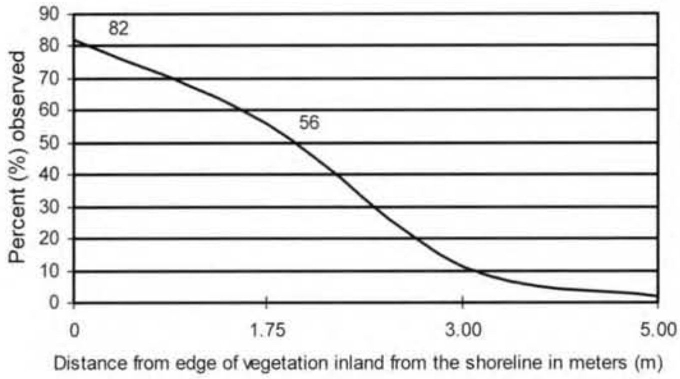

FIG. 1. Hypothetical curve of crocodiles observed during spotlight surveys relative to distance inland from vegetation edge. Figures on the curve reflect results from this study.

concealed observed in Experiment 2) the observer missed several reflectors at the beginning of the survey bringing down the overall score. Although many studies acknowledge that decreased sightability of crocodiles can occur in vegetated areas (Bayliss 1987; Da Silveira et al. 1997; Magnusson 1982; Woodward et al. 1996), even possibly to the point of rendering spotlight surveys ineffective (Graham and Bell 1969), few have quantified effects of vegetation. In addition, the further the crocodilian is within vegetation, the less visible it is (Fig. 1). However, even 5 m inland of the mangroves' edge allows for eyeshine detectability. Thorbjarnarson (1988) found that in Haiti, shoreline vegetation prevented 50% of the crocodiles present from being observed.

While the results may be intuitive (animals whose eyeshine is unobstructed to the observer are more likely to be seen), accounting for effect of decreased detection probability is essential for developing robust and reliable indices of relative population density (Bayliss 1987; Gardner and Baard 1999). It may not always be possible to get an accurate assessment of detectability (Graham and Bell 1969), but as long as bias is consistent, the index of relative density is stable relative to the true count (Da Silveira et al. 1997). When bias cannot be accurately estimated it should be minimized through standardized survey design (Graham and Bell 1969; Magnusson 1982; Wood et al. 1985; Woodward and Marion 1978).

In addition to vegetation, density of animals and speed of survey may have affected detectability. In Experiment 1, we found that survey speed affected the number of crocodiles observed. As a reflector was approached to determine its placement, additional reflectors were sighted that might have otherwise gone unnoticed had the boat not slowed to approach the shoreline. Hutton and Woolhouse (1989) reported that observer error was much lower when the survey was performed at slower speeds. Importantly, this suggests that especially at low densities the more crocodiles there are, the more likely they are to be observed and that although detectability may be consistent among observers it is not constant relative to other conditions. Therefore, in habitats where crocodiles are rare and/or vegetation is dense, animal counts might be more accurate at slower boat speeds, if not occasional pauses. Certainly, approaching individuals to identify species and make size estimates increases the likelihood of sighting nearby animals.

There was relatively little variation in vegetation within shoreline areas chosen for these experiments when compared to variation in vegetation throughout crocodile habitat in northeastern Florida Bay, Everglades National Park (Mazzotti 1983, 1999). In some areas the edge of shoreline vegetation extended inland 10–15 m and seaward 25–30 m. Density of shoreline vegetation ranged from absent (0% cover) to impenetrable (100% cover). We assume that sightability of crocodiles varies with width and density of vegetation as expressed in Fig. 1. Under these conditions a correction factor for the presence of vegetation is not appropriate. A better strategy here is to minimize the effect of vegetation. To minimize impact of vegetation on visibility of crocodiles in Florida, we recommend that surveys for relative density of crocodiles be conducted during low water levels of the spring dry season.

Bayliss (1972) put goals of crocodile management into three main categories: conservation of rare species, harvesting for sustained yield, and control of unacceptable crocodiles. In South Florida a new category of "indicator of ecosystem integrity" is emerging as the most important objective of crocodilian studies (RECOVER 2004; Rice et al. 2005). All of these goals require monitoring of long-term trends in population size. Due to constraints of time and money, monitoring of crocodilians will depend on using indices of population parameters such as density and abundance. This underscores the importance of increasing confidence in estimates of relative population density by estimating or controlling potential sources of bias during surveys.

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Alternative Ontogenetic Pathways to Color Pattern Class B in a Newly Discovered Population of Parthenogenetic *Aspidoscelis neotesselata* (Squamata: Teiidae)

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Several parthenogenetic species of *Aspidoscelis* have clonal divergence characterized by distinctive color patterns, with one example being *A. tesselata* (Taylor et al. 1996, 2003; Walker et al. 1997; Zweifel 1965). *Aspidoscelis tesselata* is a diploid parthenogenetic species originating from a recent (Densmore et al. 1989; Reeder et al. 2002) single hybridization event (Cordes and Walker 2003; Maslin 1967) between *A. marmorata* and *A. gularis septemvittata* (Dessauer and Cole 1989; Dessauer et al. 1996; Neaves 1969; Parker and Selander 1976). A second example is *A. neotesselata* (Walker et al. 1997), a triploid parthenogenetic species (Wright and Lowe 1967) originating from an *A. tesselata* x *A. sexlineata* hybridization event (Dessauer and Cole 1989; Neaves 1969; Neaves and Gerald 1969; Parker and Selander 1976). The three pattern classes presently identified in *A. neotesselata* (A, B, and C) are described and illustrated by Walker et al. (1997). Although the geographic ranges of *Aspidoscelis neotesselata* and *A. tesselata* are largely allopatric, these species share similar distributional characteristics—small, disjunct groups, with an element of unpredictability in their locations within expanses of apparently similar or suitable habitats (Hammerson 1999; Walker et al. 1997; Zweifel 1965).

An unreported population of *Aspidoscelis neotesselata* of Pattern Class B was discovered in 1999 by RJR and JS during ecological studies at the Pueblo Chemical Depot (PCD), Pueblo County, Colorado. The purpose of the present study was to document the presence of *A. neotesselata* at PCD, describe its unusual color pattern variation, illustrate the ontogenetic convergence of a color pattern variant on Pattern Class B, and place the PCD population in the geographical context of other populations of *A. neotesselata* in its vicinity.

Typical habitats utilized by *A. neotesselata* at PCD were associated with Chico Creek (a shallow, ephemeral tributary of the nearby Arkansas River), particularly the west bank and "islands" of low relief in its dry, braided channel. Collecting sites were characterized by a sandy substrate with one or more of the following features: open stands of Sand Sagebrush (*Artemisia longifolia*), Rabbitbrush (*Chrysothamnus nauseosus*), Siberian Elm (*Elmus pumila*), and Tamarisk (*Tamarix ramosissima*), or dead, prostrate cottonwood (*Populus deltoidea*) trunks, limbs, and other flood

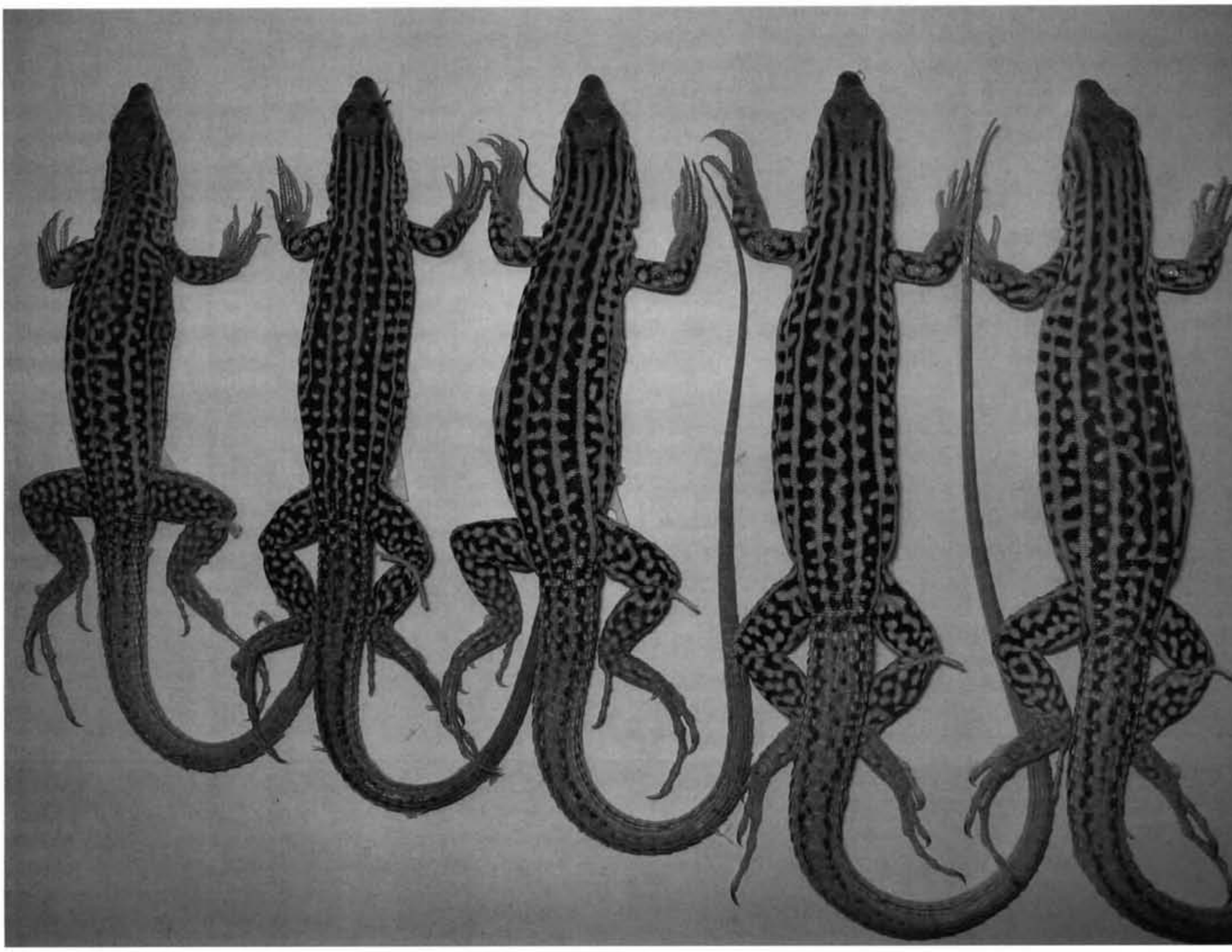

FIG. 1. Color pattern variation among representatives of *Aspidoscelis neotesselata* from Pueblo Chemical Depot, Pueblo County, Colorado. Left to right: Novel color pattern: HLT 2 (78 mm SVL); examples of Pattern Class B (PCD-B), left to right: HLT 5 (81 mm SVL), HLT 20 (88 mm SVL), HLT 34 (97 mm SVL), HLT 33 (101 mm SVL).

debris. These sites were also used by *A. sexlineata*, the paternal progenitor of *A. neotesselata*.

The PCD sample (Appendix I) can be divided into three groups based on color pattern differences. The first group, PCD-B (Fig. 1), was represented by 14 of 26 individuals fitting the description of Pattern Class B of *A. neotesselata* (Walker et al. 1997). These individuals had the vertebral (middorsal) dark field occupied by either a single zigzagged line or by a line anteriorly and a linear series of spots posteriorly. Vertebral line and spots were white, gray, or tan and of similar intensity and hue.

The second group, PCD-B2 (Fig. 2), comprised 11 of 26 individuals. Juveniles had an essentially continuous, tightly undulant vertebral line with a subdued tan central region and contrasting white or gray lateral elements or spots associated with the apices of the zigzags. For comparison, a representative of Pattern Class B, similar in size to HLT 38 (Fig. 2), is illustrated by Walker et al. (1994, their Fig. 2). In PCD-B2, the initial high contrast between vertebral line and lateral elements diminishes with growth until the principal difference between large individuals of PCD-B and PCD-B2 is a thicker vertebral line in the latter (Figs. 1 and 2).

TABLE 1. Principal component loadings used to generate scores for depicting the pattern of meristic variation among individuals of *Aspidoscelis neotesselata* from Pueblo Chemical Depot, Pueblo County, Colorado. Abbreviations follow Appendix II.

Character	PC1	PC2
PV-breaks	–0.793	0.464
ILS	0.723	0.267
GAB	0.717	0.208
L-breaks	–0.701	0.619
DL-breaks	–0.698	0.546
FP	0.267	0.816
COS	0.394	0.813
PV	0.152	0.354
LSG	0.473	0.489
SDLT-4	0.299	0.061
Eigenvalues	3.206	2.705
Total variance explained	32.1%	27.0%

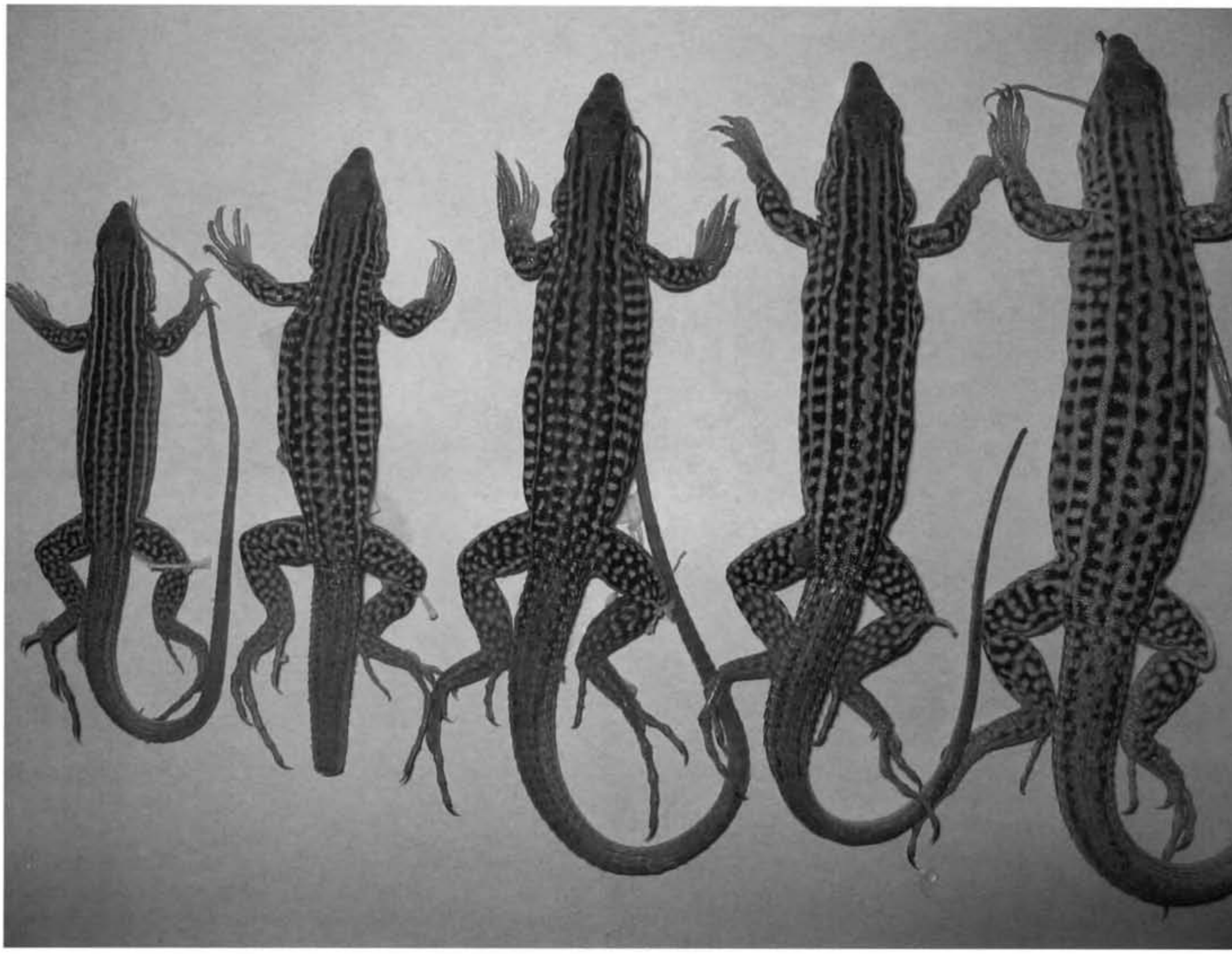

FIG. 2. Color pattern variation among representatives of *Aspidoscelis neotesselata* from Pueblo Chemical Depot, Pueblo County, Colorado. Examples of the Pattern Class B variant (PCD-B2), left to right: HLT 38 (57 mm SVL), HLT 6 (68 mm SVL), HLT 1 (80 mm SVL), HLT 13 (84 mm SVL), HLT 107 (97 mm SVL). Note the wider vertebral line in this variant of Pattern Class B.

The third group consisted of a single individual with a novel color pattern (HLT 2) collected approximately 635 m east of the nearest Chico Creek collecting site (Appendix I). Aberrant color pattern elements included medially displaced, disrupted paravertebral stripes on the neck, transverse tan bars compromising the integrity of the paravertebral stripes posteriorly, and the absence of a vertebral line at midbody (Fig. 1).

Although *A. neotesselata* at PCD was assignable to Pattern Class B based on the final color pattern attained, PCD-B and PCD-B2 differed in their color pattern transition from juveniles to large adults. Unlike isolated cases of novel color patterns that occasionally appear within a known pattern class (e.g., HLT 2, Fig. 1; Walker and Cordes 2003), the pattern class denoted as PCD-B2 was represented by individuals of different size (age) classes—thus by different cohorts. The most parsimonious hypothesis is that genetically based color pattern alternatives are being inherited in a clonal pattern at PCD. The alternative hypothesis would require the action of some unknown epigenetic factor or factors to produce PCD-B2 individuals on an annual basis. Representatives of both PCD-B and PCD-B2 were found at all Chico Creek collecting sites. One feature of Pattern Class B (the extension of dorsal dark fields onto the tail, Walker et al. 1997) was highly variable in the PCD population, ranging from essentially absent to prominent (Figs. 1 and 2).

We summarized the pattern of morphological variation in the PCD population of *A. neotesselata* by principal components analysis (PCA), with the PCA model (Table 1) based on a correlation matrix of 10 meristic characters (Appendix II). With two notable exceptions, the PCD sample appeared to represent a single morphological entity as depicted by an ordination of principal component scores. Scores for two specimens fell outside the 95% confidence ellipse of sample variation (Fig. 3). One outlier (Fig. 2, HLT 1) was an individual expressing an extraordinary number of breaks (by dark bars) in the lateral stripe (29 total), dorsolateral stripe (8 total), and paravertebral stripe (18 total). The second outlier (HLT 2, Fig. 1) was characterized by low counts for GAB (77), FP (34), COS (9), and PV (6), all well below the lowest values for the balance of the sample. Because PCD *A. sexlineata* (N = 12) had

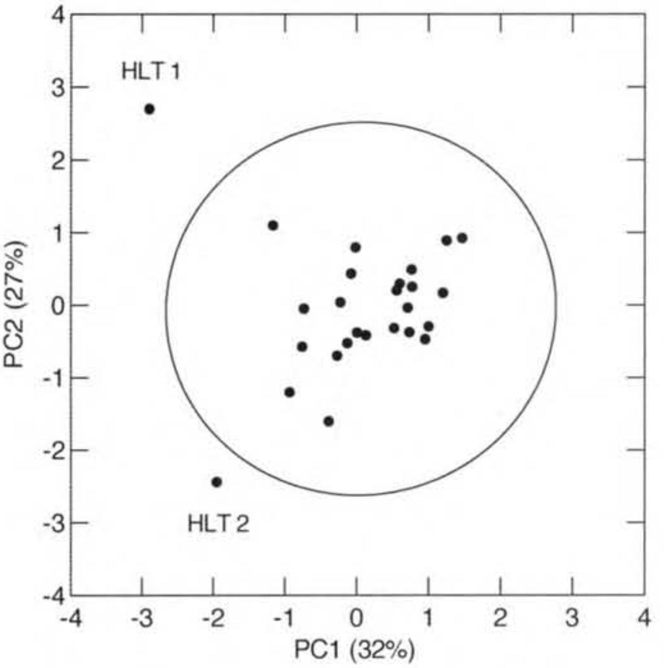

FIG. 3. Pattern of morphological variation in *Aspidoscelis neotesselata* from Pueblo Chemical Depot, Pueblo County, Colorado. Ordination of principal component scores for 26 specimens on the first two principal components (Table 1). The ellipse defines 95% of the sample variation (the two outliers are described in the text).

low counts for these characters (GAB, 75.7; FP, 32.5; COS, 6.2; PV, 10.1), we considered the possibility that this individual was a tetraploid hybrid between *A. neotesselata* and *A. sexlineata*. This hypothesis was rejected based on the apparent fertility of HLT 2, an individual with a developing clutch of three vitellogenic ovarian follicles of 6, 6.1, and 5.7 mm diameter and oviducts that were expanded and fully functional.

Because Pattern Class B is the only pattern class of *A. neotesselata* in syntopic contact with both parental species (local contact in the vicinity of Higbee, Colorado; Walker et al. 1990, 1995), we hypothesize, presuming a single hybridization event in the origin of *A. neotesselata* (Walker et al. 1997), that Pattern Class B represents the ancestral color pattern. This would imply that Pattern Class B2 originated by mutation in Pattern Class B at PCD. Other populations of *A. neotesselata* in the PCD vicinity (Walker et al. 1997), and their linear distances from the PCD population are Pattern Class B (27 km south at Huerfano Canyon), Pattern Class A, (27 km west at Pueblo Nature Center), and Pattern Class C (27 km southwest at the historic townsite of Lime). All color pattern classes described for *A. neotesselata* are in closest proximity in this small area. These populations will be particularly important in resolving patterns of evolutionary divergence in *A. neotesselata*.

Acknowledgments.—We are grateful to the U.S. Army, Pueblo Chemical Depot, for permission to conduct this study at PCD and K. M. Canestorp, U.S. Fish and Wildlife Service, for coordinating access to the site. The study was made possible by Scientific Collecting Licenses 03-HP772 and 04-HP772A1 issued to HLT by Colorado Division of Wildlife and by TSSC and SPARC summer research grants awarded to HLT by Regis University. We thank C. J. Cole, T. W. Reeder, and R. E. Espinoza for comments and suggestions that improved the manuscript.

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APPENDIX I
Specimens Examined

Aspidoscelis neotesselata: Pueblo Chemical Depot, Pueblo County, Colorado, USA. Along south boundary fence, east of Chico Creek, HLT 2 (UTM 13S 555537, 4236036); west side Chico Creek (1): HLT 4–6, 11–13, 22, 107, 136 (UTM 13S 554843, 4236110); (2) HLT 1, 3, 14, 21 (UTM 13S 554856, 4236332); (3) HLT 18–20, 33–38, 133–135 (UTM 13S 554734, 4237814).

APPENDIX II
Meristic Characters

GAB = number of granular dorsal scales in a single row around midbody (the 15th ventral scale posterior to the axilla established the point for beginning this count); COS = bilateral total of circumorbital scales; LSG = sum of lateral supraocular granules on both sides of the head (the count includes all scales between the supraoculars and superciliary scales, anterior to the suture line between the third and fourth supraoculars); FP = sum of femoral pores on both thighs; L-breaks = total number of interruptions by black pigment of the lateral stripes; DL-breaks = total number of interruptions by black pigment of the dorsolateral stripes; PV-breaks = the total number of interruptions by black pigment of the paravertebral stripes; PV = number of scales between paravertebral stripes at midbody; SDL-T4 = number of subdigital lamellae on the fourth toe of one foot (right was chosen unless damaged); ILS = all interlabial scales between the lower labials and sublabials counted anterior to the suture line between 5^{th} and 6^{th} lower labials; SVL = length of body from tip of snout to posterior edge of preanal scales (in mm).

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Diet of *Pipa carvalhoi* (Amphibia, Pipidae) is Not Influenced by Female Parental Care

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Costs of parental care may include increased risk of predation, reduced mating opportunities, and reduced food intake (Crump 1995). The latter cost is particularly important to females as they have a large gametal investment compared to males. Consequently, reduced food intake may limit future clutches, reduce the number of eggs per clutch, and retard growth rate which, indirectly, also may decrease fecundity as it is correlated with female size (Salthe and Duellman 1973).

The benefits of parental care to reproductive success have been documented for certain species, but the costs have been rarely quantified (Crump 1995). Simon (1983) reported reduced feeding in *Cophixalus parkeri* (Microhylidae) and Townsend (1986) found similar results for *Eleutherodactylus coqui* (Leptodactylidae). Parental care in these species requires that the parent remain near the clutch; this behavior may negatively affect foraging activity (Crump 1995).

Crump (1995) suggested that the cost of parental care is reduced in species that transport eggs because carrying eggs adhered to the body does not preclude foraging activity and causes no reduction in the feeding efficiency. Transport of eggs is known in four anuran families: Discoglossidae, Hylidae, Pipidae, and Myobatrachidae (Duellman and Trueb 1986). Female *Pipa* carry eggs in the dorsal skin, where either tadpoles or juveniles emerge, according to the species (Trueb and Cannatella 1986).

Data concerning the diet of *Pipa carvalhoi* (Miranda Ribeiro, 1937) are scarce and anecdotal. The species is aquatic but Myers and Carvalho (1945) observed some individuals leaving a lake during and after a rain, apparently foraging for insects. Weygoldt (1976) described the feeding behavior of *Pipa carvalhoi*, and also reported some types of prey. Nevertheless, his study was performed in the laboratory and, therefore, the number of available kinds of prey was limited. There are no studies analyzing food items in the diet of this species under natural conditions.

We studied the diet of *Pipa carvalhoi* in seminatural conditions and compared the diet of females carrying developing eggs on their backs to the diet of males and females without eggs, in order to analyze the influence of this kind of parental care on feeding.

Materials and Methods.—Specimens were collected by U. Caramaschi on 11 March 1986 at the campus of Comissão Executiva do Plano da Lavoura Cacaueira -CEPLAC, Municipality of Ilhéus, State of Bahia, Northeastern Brazil. Specimens were collected in a fishfarm pool with no fish at the time of collecting (U. Caramaschi, pers. comm.). All specimens are deposited in the herpetological collection of Museu Nacional, Rio de Janeiro, Brazil (MNRJ 19527, 19529–30, 19533, 19535–36, 19538, 19540–19550, 19554–19559, 19566, 19573, 19589–90, 19596–97, 19605, 19608, 19610, 19612, 19620, 19633, 19645, 19676, 19685, 19698, 19701, 19704, 19707–19709, 19711, 19714, 19717, 19719, 19728, 19741, 19749, 19760, and 19766). In 2003, 54 specimens were analyzed and grouped into three classes: six females transporting eggs, 20 females without eggs, and 28 males. The snout–vent length (SVL) and the mouth width (MW) of each specimen were measured with calipers (nearest 0.05 mm). The stomachs were removed and food items were identified and counted under a stereomicroscope. Stomach contents were dried in an oven and weighed on an electronic balance (nearest 0.001 g).

Numeric frequency ($\%n_i = n_i / \sum n_{1\text{-}n}$ where n_i is the number of prey of category i) and occurrence frequency ($\%oc_i = oc_i / N$, where oc_i is the number of stomachs with category i and N is the total number of analyzed stomachs) were calculated based on the prey categories found in the stomach contents of each class. Statistical analyses were performed after testing for assumptions (homocedasticity, normality, and parallelism); when appropriate, non-parametric techniques were employed. Analyses of covariance (ANCOVA) were conducted to compare the mass of stomach contents among classes, using SVL as the covariant variable to remove the effect of size difference among classes. The non-parametric Kruskall-Wallis test was performed to compare the

TABLE 1. Total number of prey (N), numeric frequency (%n), and occurrence frequency (%oc) of prey categories in the diet of each class of *Pipa carvalhoi*. NI indicates unidentified items. M (Q_1;Q_3) show the median, first and third quartiles in the distribution of the number of prey per specimen.

	Females carrying eggs			Females without eggs			Males		
Category	N	%n	%oc	N	%n	%oc	N	%n	%oc
Chironomid larvae	288	98.3	100	816	98.1	70.0	1103	99.2	82.1
Diptera – adult	1	0.3	16.7				1	0.1	3.6
Other Diptera Larvae				1	0.1	5.0	2	0.2	3.6
Formicidae	1	0.3	16.7						
Amphipoda				11	1.3	15.0	3	0.3	14.3
Arachnids	2	0.7	33.3						
Pipa tadpole				1	0.1	5.0			
Odonata Larvae				1	0.1	5.0	2	0.2	7.1
NI Arthropoda				2	0.2	10.0			
NI Larvae	1	0.3	16.7				1	0.1	3.6
Fragmented material and grains of sand			66.7			50.0			53.6
M (Q_1;Q_3)	41.5 (16.0;78.0)			17.0 (1.0;45.0)			22.5 (2.0;62.0)		

number of prey in the stomach contents and the number of categories ingested by different classes. Similarity among diets of the different classes was calculated by Pianka's Overlap Index (Krebs 1989).

Results.—Aquatic arthropods were the most frequent prey items we found in *Pipa carvalhoi* stomachs (Table 1). Chironomid larvae represented most of the prey (> 98%) and were found in nearly all specimens of the three classes (%oc varied from 70 to 100%). Fragmented material and grains of sand were also a dominant component of the stomach contents (%oc 50% or higher).

There was no difference in mass of stomach contents among the three classes ($F_{2,44} = 0.94$; $p = 0.40$). There were also no differences among classes in number of prey per stomach (H [2, N = 44] = 0.68, p = 0.71) or the number of prey categories per stomach (H [2, N = 54] = 5.23, p = 0.07). The diet of the three classes was qualitatively similar (Overlap Index approximately 0.9999 considering all possible combinations), probably due to the high numeric frequencies of chironomid larvae in all classes.

Discussion.—Our results show that female *Pipa carvalhoi* carrying eggs at this site had no difference in food ingestion compared to males or females without eggs. It suggests that carrying eggs in *Pipa carvalhoi* is a kind of parental care that does not affect diet, at least in the studied population, probably because it does not interfere with the mobility of parents, supporting the hypothesis suggested by Crump (1995).

All three classes appeared to feed mainly in water. If these frogs leave the water to forage, as suggested by Myers and Carvalho (1945), this habit was not frequent in the studied population.

According to Weygoldt (1976), *Pipa carvalhoi* captures chironomid larvae together with sediment and sand, sucking the larvae into the mouth. This author observed that although the frog discards some of the sand before ingesting the larvae, much of the sand and sediment is ingested with the prey. This behavior might explain the high frequency of fragmented material and grains of sand found in the stomach contents of the three analyzed classes.

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Observations of Courtship, Copulation, and Gestation in the Wet Tropical Endemic Skink *Carlia rubrigularis*

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Carlia rubrigularis (Ingram and Covacevich 1989) is a small (maximum 55 mm SVL; Cogger 2000), ground dwelling, heliothermic skink, endemic to the Wet Tropics region of north Queensland, Australia. Adults are sexually dimorphic, with females averaging heavier (3.1 g) and longer (50 mm SVL) than males (2.6 g, 46 mm SVL). Though morphologically conservative in scalation and other taxonomically important characters, members of the genus *Carlia* are highly variable in color (Cogger 2000). Presence of a distinctive red flush on the throat that extends around the neck and forearms in breeding males distinguishes *Carlia rubrigularis* from other members of its genus.

Carlia rubrigularis is an oviparous seasonal breeder, mating occurring at the onset of the wet season in September (Wilhoft 1963a). Like all congeners for which it is known, *C. rubrigularis* lays two eggs per clutch (Cogger 2000; Greer 1990); and multiple clutching is likely (Wilhoft 1963a; 1963b). Only one brief observation of courtship exists, where a male was seen to grasp a female in his jaws just behind her right forelimb and attempt copulation, but the female broke free and fled (Wilhoft 1963a). Scant data on reproductive behavior in *C. rubrigularis* led me to summarize observations I made in the field and during the course of mate choice trials.

During 30 mate choice trials conducted in the austral spring and summer (September to February) 2000–2001, I observed 19 courtship episodes when an adult female was placed in a 375-liter tank (100 x 75 x 50 cm) with two adult males that were tethered to different sides of the tank, partly divided by an opaque plastic partition. Two additional observations of courtship were made in the field at Gillies Lookout, an open eucalypt woodland in the Wet Tropics District (17°10'13"S, 145°41'15"E; elev. 720 m). Both courting pairs were observed in the undergrowth, near dense grassy tussocks ca. 50 cm high. Only one of these 21 interactions resulted in a successful copulation.

Courtship.—Both sexes initially investigated their conspecific using tongue flicks to the body, as seen in other lizards (Carpenter and Ferguson 1977; Mason 1992) and other species of *Carlia* (Langkilde and Schwarzkopf 2003; Whittier 1993), implying a role for pheremonal cues in sexual identification and stimulation. The courting male then performed a body shudder/spasm, involving jerking, quivering and twitching movements of the whole body. Head bobbing, tail twitching and a steady approach of the female accompanied the body shudder behavior at least 80% of the time. This behavior lasted between 4 sec and 6 min and could occur intermittently over the 30 min interval of the mate choice trial. Non-receptive females either fled, flicked their tails rapidly, or laterally presented to the male by orienting the longitudinal axis broadside while flattening the body dorsoventrally. After several seconds of tail flicking or lateral presentation the male either ceased performing the shudder behavior and approaching or, if he continued his approach, the female moved beyond his tethered reach. Lateral presentation is generally considered to be an aggressive/rejection behavior (Whittier 1993), as is tail flicking (Langkilde and Schwarzkopf 2003). If the female remained in a fixed position, allowing the male's approach, the male attempted to grasp her at the lateral mid-body region in his jaws. At this stage, the one receptive female became limp, whereas all other females bit the male repeatedly until able to escape his grasp.

Observations made in the field were largely consistent with those made in the lab, except that the initial investigative tongue flicks were to the air rather than to the body region and the body shuddering and approach towards the female occurred extremely quickly in the field, with the entire episode lasting less than one minute in both cases. In the field, one female rejected the male by laterally presenting; the second female rejected the male by fleeing.

Copulation.—When the one receptive female became limp within the jaws of the male, he carried her to a corner of the tank and manipulated his cloaca into contact with hers by pushing her sideways while bringing the base of his tail up and under hers. The right hemipene was intromitted and the copulation lasted 6 min and 47 sec. This is similar to the 3–4 min copulatory interval reported in *Carlia jarnoldae* (Langkilde and Schwartzkopf 2003) and the 3–5 minutes reported in *Carlia rostralis* (Whittier 1993). Throughout the copulatory interval, the female remained immobile in the jaws of the male, with the male positioned roughly crossways on top of her and with the end portion of his tail undulating in front of her head. When copulation ceased, the male loosened his grip and the female fled to another part of the tank.

Gestation.—I captured 52 female *C. rubrigularis* between 19 September and 29 October 2000, over 75% of which were gravid, and all of which were housed with female conspecifics. The last clutch of eggs laid by this group of females was on 11 December 2000. Although their mating dates are unknown, this indicates a gestation period of at least 43 days. The aforementioned successful copulation occurred on 23 November 2000 and this female laid two eggs on 3 January 2001. This 41-day gestation is roughly congruent to the 43-day estimate.

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Unexplained Amphibian Mortalities in the Secluded Mountains of the Venezuelan Guayana: Is There Evidence of Chytridiomycosis?

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Amphibian species disappearances, population declines and massive mortalities have been among the most enigmatic global biodiversity problems in recent decades (Blaustein and Kiesecker 2002). The discovery of chytridiomycosis, a cutaneous disease caused by the chytrid fungus *Batrachochytrium dendrobatidis* (Berger et al. 1998; Daszak et al. 2003), has assumed a prominent place in current investigations on the possible causes of many of these events.

Despite its recent discovery, chytridiomycosis now has been reported in 39 countries, on six continents (Woodhams et al. 2003), including Venezuela (Bonaccorso et al. 2003; Hanselmann et al. 2004). One hypothesis that explains the worldwide distribution of this pathogen argues that it has recently originated and dispersed through naive populations by human activities. Alternatively, *B. dendrobatidis* may have been a widespread organism associated with amphibians, but recent global environmental changes altered this pre-existing relationship, favoring the occurrence of epidemics in different parts of the world (Berger et al. 1998; Daszak et al. 1999). The low genetic variability among geographic strains (Morehouse et al. 2003) and the presence of the pathogen in amphibians of the trade market (Hanselmann et al. 2004; Mazzoni et al. 2003) have favored the former hypothesis (Daszak et al. 2001; Weldon et al. 2004). Nonetheless, the presence of *B. dendrobatidis* in many so-called 'pristine' habitats, relatively removed from human impact, continues to be puzzling.

One corollary to the hypothesis of human-mediated translocation of *B. dendrobatidis* is that the pathogen should be absent from areas isolated from human influence. The presence of the pathogen in such areas, therefore, would challenge this hypothesis. This corollary, however, is extremely difficult to refute because the probability of detecting declines in these areas is very low; very few amphibian studies are carried out in remote locations with a history of limited human contact.

Retrospective analysis of herpetological museum notes revealed amphibian mortalities at the Chimantá Massifs and Auyán-tepui in the Venezuelan Guayana region, South America (Ayarzagüena et al. 1992; Gorzula and Señaris 1998). These two reports are similar to many others in three aspects; they occurred at high altitudes (>1800 m), in pristine habitats, in the late 1980's. However, in contrast to other sites where unexplained mortalities were reported, these sites are located in remote areas that have been visited by humans only during a few scientific explorations. Not only are they difficult to reach and unsuitable for human occupation, but Amerindian communities have long believed that these are places forbidden for humans. Chimantá Massif is an assemblage of 10 sandstone table mountains with a summit area of 1470 km^2. The first expedition was recorded in 1946, and seven more were documented between 1946 and 1978 (Huber 1992). In contrast, Auyán-tepui is a large mountain of ca. 700 km^2. Although these are some of the best explored of all table mountains in the Venezuelan Guayana region, these visits have been restricted to few locations mostly in the south-central areas (Huber 1995). Between 1983 and 1986, a group of scientists conducted expeditions to the highlands of these mountains (Huber 1992). Historical records indicate that this particular site was only previously visited in 1946. Many dead adult frogs of *Tepuihyla edelcae*, an endemic species of the summits of these two massifs, were observed at Chimantá, Akopán-tepui (Ayarzagüena et al. 1992) and Auyán-tepui during 1984 (Gorzula and Señaris 1998). Our objective was to determine whether *B. dendrobatidis* could be associated with these mortalities.

Herein, we examined histological samples prepared from 37 specimens of *T. edelcae* deposited at Museo de Historia Natural La Salle (MHNLS), Caracas, collected during expeditions to these localities (Table 1). All animals were alive at the time of collection, except for specimens MHNLS 11002 and MHNLS 11003, both collected on 27 March 1984 at Chimantá XI and XII. Six of the specimens collected alive were found at nearby sites and within two days (25–28 March 1984) of the collection date of the two dead animals. Four toe clips including interdigital membranes and one piece of ventral skin were obtained from each individual. Tissue samples were washed in phosphate buffer, dehydrated through a graded alcohol series, embedded in paraffin wax, sectioned at 5mm and stained with haematoxylin and eosin (Berger et al. 1999). A total of 12 sections, three for each toe clip, were examined on a light microscope for each frog.

No empty or developing zoosporangia of *B. dendrobatidis* or skin lesions were observed in any of the 444 histological sections examined. Some sections of the specimens found dead showed signs of sloughing, but we found no evidence of the pathogen. This pathogen may go undetected in populations with a very low infection rate because histological analyses tend to underestimate the prevalence of *B. dendrobatidis* (Boyle et al. 2004). Although some frog communities that suffered drastic declines showed a low prevalence of infection (15–28%), this was recorded eight years post-decline (Retallick et al. 2004). During disease-induced

population crashes, the prevalence is expected to be much higher. In the Andean region, *B. dendrobatidis* was detected in 67% of *Atelopus* specimens, all caught alive, at the time of population declines (Lampo et al., *in press*). If *B. dendrobatidis* had infected these populations and produced mortalities in many adult frogs, the probability of not detecting infection in 37 specimens would be relatively low. We therefore conclude that the mortality events recorded in 1984 at the Chimantá Massifs and Auyán-tepui were likely not a result of chytridiomycosis. Observations carried out in later expeditions indicated that the mortality events observed during 1984 were not common. What caused these mortalities remains unclear, although global climatic changes seem a reasonable candidate because most of these sites have not been subjected to direct human disturbances. Pounds et al. (1999) hypothesized that warm episodes of El Niño/Southern Oscillations produced a higher elevation cloud base in tropical mountains in Costa Rica during 1983. The possible effects of this phenomenon on the local weather of these summits are unknown. These highlands, characterized mostly by montane shrublands, meadows and open rock communities with forests restricted to large depressions or streamsides, are covered by clouds most of the year. Local climate data are unavailable and weather patterns are totally different from those at adjacent lowlands, with up to 23°C daily variations in temperature. These variations, however, are likely to be amplified during warm years.

The link between chytridiomycosis, human activity and climate change is one fundamental question in amphibian conservation. Although the data presented here cannot be conclusive in demonstrating the absence of *B. dendrobatidis* in frog populations of *T. edelcae*, the accumulation of evidence pointing to the absence of this pathogen from secluded areas is important in evaluating the hypothesis of human mediated dispersal of this pathogen.

TABLE 1. Collection data of *Tepuihyla edelcae* examined from Museo de Historia Natural La Salle (MHNLS).

Catalog Number	Location	Elevation (m)	Latitude	Longitude	Collection Date
MHNLS 10625	Auyán-tepui	1970	5°58'N	62°29'W	5/25/1984
MHNLS 10628	Auyán-tepui	1970	5°58'N	62°29'W	5/25/1984
MHNLS 10629	Auyán-tepui	1970	5°58'N	62°29'W	5/25/1984
MHNLS 10632	Auyán-tepui	1630	6°02'N	62°40'W	11/13/1984
MHNLS 10633	Auyán-tepui	1630	6°02'N	62°40'W	11/13/1984
MHNLS 10634	Auyán-tepui	1630	6°02'N	62°40'W	11/13/1984
MHNLS 10731	Auyán-tepui	1900	6°01'N	62°26'W	1/17/1986
MHNLS 10733	Auyán-tepui	1900	6°01'N	62°26'W	1/17/1986
MHNLS 10747	Chimantá XV	2100	5°08'N	62°07'W	3/4/1986
MHNLS 10748	Chimantá XV	2100	5°08'N	62°07'W	3/4/1986
MHNLS 10749	Chimantá XV	2100	5°08'N	62°07'W	3/4/1986
MHNLS 10780	Auyán-tepui	1950	5°57'N	62°25'W	8/27/1983
MHNLS 10781	Auyán-tepui	1950	5°57'N	62°25'W	8/27/1983
MHNLS 10782	Auyán-tepui	1950	5°57'N	62°25'W	8/27/1983
MHNLS 10785	Auyán-tepui	1950	5°57'N	62°25'W	8/27/1983
MHNLS 10787	Auyán-tepui	1950	5°57'N	62°25'W	8/27/1983
MHNLS 10959	Chimantá V	2200	5°12'N	62°19'W	2/1/1984
MHNLS 10961	Chimantá V	2200	5°12'N	62°19'W	2/1/1984
MHNLS 10972	Chimantá VIII	2250	5°15'N	62°01'W	2/10/1984
MHNLS 10976	Chimantá VIII	2250	5°15'N	62°01'W	2/12/1984
MHNLS 10977	Chimantá VIII	2250	5°15'N	62°01'W	2/12/1984
MHNLS 10978	Chimantá VIII	2250	5°15'N	62°01'W	2/12/1984
MHNLS 10980	Chimantá VIII	2250	5°15'N	62°01'W	2/12/1984
MHNLS 10982	Chimantá VIII	2250	5°15'N	62°01'W	2/12/1984
MHNLS 10996	Chimantá VIII	2250	5°15'N	62°01'W	3/26/1984
MHNLS 10998	Chimantá VIII	2250	5°15'N	62°01'W	3/26/1984
MHNLS 11007	Chimantá VIII	2250	5°15'N	62°01'W	3/28/1984
MHNLS 11009	Chimantá VIII	2250	5°15'N	62°01'W	3/28/1984
MHNLS 10761	Chimantá XVII	2150	5°19'N	62°12'W	3/14/1986
MHNLS 10763	Chimantá XVII	2150	5°19'N	62°12'W	3/14/1986
MHNLS 10994	Chimantá XVII	2249	5°15'N	62°01'W	3/25/1984
MHNLS 10676	Chimantá XIII	1950	5°12'N	62°05'W	2/10/1985
MHNLS 10986	Chimantá IX	1920	5°11'N	62°02'W	11/15/1984
MHNLS 10991	Chimantá IX	1920	5°11'N	62°02'W	2/16/1984
MHNLS 11001	Chimantá X	1960	5°13'N	62°05'W	3/27/1984
MHNLS 11002	Chimantá XI	2000	5°12'N	62°06'W	3/271984
MHNLS 11003	Chimantá XII	1800	5°00'N	61°59'W	3/27/1984

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TECHNIQUES

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Quantifying Nest Site Choice in Reptiles Using Hemispherical Photography and Gap Light Analysis

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Nest site choice in reptiles has received increasing attention in the last 10 years, and several studies have linked maternal choices with nest temperatures (Kolbe and Janzen 2002; Weisrock and Janzen 1999), moisture (Miller et al. 1987; Packard 1991), embryonic survival (Doody et al. 2004; Wilson 1998), offspring sex (Doody et al. 2004; Roosenberg 1996), and other offspring phenotypes (Allsteadt and Lang 1994; Shine and Harlow 1996). The recent finding that reptile mothers may allocate sex (Olsson and Shine 2001) further highlights the importance of future studies of nest site choice in reptiles, and emphasizes the importance of the links among nest site choice, nest temperatures, and the developing embryo.

Quantifying nest site choice in the field, however, has not always been straightforward for several reasons. First, traditionally most studies measure attributes of nest sites that likely explain less variation in nest temperatures than would openness (e.g., aspect, slope, substrate, distance from vegetation). Second, (arguably) the most important structural attribute of nest sites—openness—is often poorly estimated. At worst openness has been estimated by eye, at best with a spherical densiometer, and nest sites are often lumped in into 'shaded' and 'unshaded or exposed' categories, which might obscure important factors influencing nest site choice (Pringle et al. 2003). For example, in species with temperature-dependent sex determination that nest only in open areas, a small difference in canopy openness between two nests, undetected by the method of classifying both as 'unshaded', can be the chief determinant of hatchling sex. Third, despite the importance of openness to nest temperatures, openness should not be used as a surrogate for incident radiation received by the nest site. Depending on the location of canopy gaps relative to the sun's path, there is often substantial variation in incident radiation intensity and hence temperature among sites with the same openness (Pringle et al. 2003), especially at sites with topographic relief (pers. obs.). Finally, incident radiation intensity is often not directly measured at the nest site because of the cost of monitoring a large number of nest sites with solar radiation data loggers.

Herein, we describe the use of hemispherical photography (HP) and gap light analysis (GLA) as an efficient and precise way to quantify nest site choice in reptiles. Specifically, this method quantifies canopy openness and incident radiation intensity for each

TABLE 1. Example output from Gap Light Analyzer. The italicized rows refer to incident (solar) radiation. Low latitude = Cairns; high latitude = Highlands of southern New South Wales, Australia. Dates reflect typical incubation times and periods for the sites. The two key output data rows are emboldened. Trans = transmitted; Extra = extraterrestrial.

Attribute	Output			
	nest photograph from low latitude site (Fig. 1, top) run for 15 Sep–15 Dec	nest photograph from high latitude site (Fig. 1, bottom) run for 20 Dec–20 Mar	nest photograph from low latitude site (Fig. 1, top) run at high latitude	nest photograph from low latitude (Fig. 1, top) run for 1 Jan–1 Apr
% Sky Area	100	100	100	100
% Mask Area	0	0	0	0
% Canopy Openness	**21.23**	**52.25**	**21.23**	**21.23**
% Site Openness	21.23	52.25	21.23	21.23
LAI 4 Ring	1.93	0.25	1.93	1.93
LAI 5 Ring	2.61	0.51	2.61	2.61
Units	MJ m-2 d-1	MJ m-2 d-1	MJ m-2 d-1	MJ m-2 d-1
RB	1	1	1	1
RD	1	1	1	1
Extra (Wm-2)	456.46	461.93	439.12	332.46
Above Direct	10.5	10.51	10.17	7.06
Above Diffuse	10.5	10.51	10.17	7.06
Above Total	21	21.02	20.34	14.12
Above Direct Mask	10.5	10.51	10.17	7.06
Above Diffuse Mask	10.5	10.51	10.17	7.06
Above Total Mask	21	21.02	20.34	14.12
Trans Direct	6.73	9.85	4.42	3.14
Trans Diffuse	3.74	7.84	3.62	2.51
Trans Total	**10.46**	**17.69**	**8.04**	**5.65**
% Trans Direct	64.06	93.72	43.5	44.51
% Trans Diffuse	35.57	74.62	35.57	35.57
% Trans Total	49.81	84.17	39.53	40.04

nest site (Frazer et al. 1999). In most cases, we believe that these two attributes would be the most influential and therefore most important contributors to nest temperatures, although we acknowledge the potential importance of other attributes (e.g., aspect, Janzen 1994; slope, McCune and Keon 2002). Using these two techniques we determined openness and incident radiation for > 300 nests of the water dragon, *Physignathus leuseurii* and several nests of the southern forest dragon *Hypsilurus spinipes*. These agamid lizards inhabit eastern Australia and excavate a shallow nest typical of many lizards, turtles, the tuatara, and some crocodilians.

The technique involves the use of a camera in the field and a computer analysis of the resultant images. We used a Nikon Coolpix® 995 digital camera with a Nikon FC-E8® fisheye converter lens to take hemispherical photographs. The camera was placed on a level surface at the nest site at ground level, and oriented to magnetic north. This orientation allows the computer program to track the sun's path across the sky (through the canopy) for estimation of incident radiation. Care was taken to make sure the observer was not in the photograph (or at least blocking any sky). This was achieved by taking the photograph while lying on the ground. An alternative method would be to employ a short tripod (e.g., 18 cm tall, Pringle et al. 2003), but the researcher would need to demonstrate that this would not introduce additional error. Because reflection of incident radiation off leaves introduces considerable error in estimating canopy cover or openness, photographs should be taken during the first two hours after dawn or the last two hours before dark, or at any time on overcast days.

Hemispherical photographs were analyzed using the program Gap Light Analyzer Version 2.0 (Frazer et al. 1999; available for free download at http://www.rem.sfu.ca/forestry/downloads/gap_light_analyzer.htm). This program estimates canopy cover (openness), and incident radiation at the site. The program uses location and season data (the user inputs latitude, elevation, and dates of interest) to plot the sun's pathway through the canopy and thereby estimate incident radiation at the site of interest per unit time. Because we were interested in latitudinal variation in openness and incident radiation on nest sites and how these attributes influenced nest temperatures, we input 90 days into the analysis to approximate incubation time.

Several other specific inputs can be adjusted depending on the analysis required. For example, we calculated a cloudiness index (Kt) for each site for each month (instead of using the default of 0.5) because we were concerned that this could vary appreciably among sites (i.e., one of our sites was in rainforest). We calculated Kt using the formula $Kt = H/H_0$, where H = the amount of global radiation incident at the ground, and H_0 = the amount of extrater-

FIG. 1. Hemispherical photographs from *Physignathus* nest sites in (top) a tropical rainforest site near Cairns, and (bottom) a cold temperate mountain site near Canberra.

restrial radiation incident on a horizontal surface outside the earth's atmosphere (Frazer et al. 1999). We calculated H_0 using Gap Light Analyzer, and we estimated H using the number of sunshine hours per day (Iqbal 1983). For this we used $H = H_0[0.24 + 0.47(n/M)]$ where n = mean sunshine hours, and M = day length. We obtained n and M for each site from the Australian Bureau of Meteorology records (unpublished data). This equation is one of several that allow estimation of global radiation incident at the ground using sunshine hours data routinely collected by meteorology services. While an appropriately calibrated model can estimate absolute incident radiation (or potentially temperature), using the program's defaults will provide a relative index to radiation among sites (see manual).

The combination of hemispherical photography and gap light analysis (HP & GLA) has been used to quantify nest site choice in only two previous studies (Harlow 2001; Shine et al. 2003), but HP has been commonly used to measure gap size and radiation in forestry studies (e.g., Whitmore et al. 1993), and both were recently used to quantify the thermal effects of canopy structure in a habitat selection study of a snake (Pringle et al. 2003). In our research we used the technique to quantify nest site choice in water dragons, a species with temperature-dependent sex determination. Specifically, HP & GLA allowed us to determine how these lizards, which span environmental extremes, were compensating for climate differences to produce viable sex ratios. Our major findings (Doody et al., *in press*), were that both openness and incident radiation intensity at the nest site were both positively related to latitude, minimum and maximum mean monthly air temperatures, and soil temperature. Table 1 (columns 1 and 2) gives an example of the difference in openness between high and low latitude nests (nests at the lowest latitude site averaged around 20% compared to near 50–60 % for the highest latitude sites. A spherical densiometer estimates only canopy openness, while HP & GLA combine to give both openness and incident radiation at the nest site. This distinction is important, because openness is not necessarily a surrogate for incident radiation at the nest site. Two nest sites can have the same openness but very different radiation intensities, as demonstrated in Table 1. The same openness (photograph = Fig. 1, top) produced very different radiation intensities when run through GLA for different latitudes (Table 1, column 1 vs. 3) or different times of the year (Table 1, column 1 vs. 4). Finally, estimating canopy openness using a densiometer does not take into account more proximate shading vegetation such as grasses, whereas HP & GLA does.

In our opinion the technique was superior to the other methods for quantifying nest site choice for the abovementioned reasons. We agree with an anonymous reviewer that our technique would also facilitate developing a mechanistic model of nest temperatures based on openness, radiation, cloudiness, slope, aspect (and any other influences on nest temperatures). The only pitfall of these techniques is the expense. The total cost of our equipment was US $1133, including camera ($675), fisheye lens (FC-E8, $398), memory card 128 MB ($19), and memory card adaptor ($41).

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Efficacy of Marking Snakes with Disposable Medical Cautery Units

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In many situations, marking snakes for recapture purposes is fraught with difficulty. Toe clipping has obvious drawbacks for snakes, and externally attached tags are easily lost via shedding or abrasion against surface objects. Passive integrated transponders (PIT tags) have near 100% reliability and are typically permanent if correctly implanted (Gibbons and Andrews 2004). However, PIT tags are expensive (a minimum of US $3.50 per tag if purchased in large numbers) and in many field studies the recapture rates of snakes are too low to justify their use. Even if funding is unlimited, the limited girth of some neonates and small species precludes the use of PIT tags (Gibbons and Andrews 2004).

Alternatively, snakes can be marked externally by a number of methods. The most commonly-employed technique is clipping of ventral scales anterior or posterior to the vent, in a pattern that varies with the researcher (Brown and Parker 1976; Ferner 1979; Woodbury 1956). These marks are of variable permanence (Shine et al. 1988), and difficulties with readability of marks or mortality of animals often arise if the marks are applied with too little or too much enthusiasm. Clipping scales leaves an open wound subject to possible infection, and marking small snakes is especially difficult (Weary 1969). Freeze-branding has been used by some researchers (Lewke and Stroud 1974; Measey et al. 2001), but this method requires availability of liquid nitrogen, Freon, or similar fluids that may be difficult to transport in field situations.

Heat branding has been used to mark reptiles and amphibians by a number of researchers (Clark 1971; Ehmann 2000; Ferner 1979). Methods of branding have been extremely varied, and equipment has included pyrographic needles (Weary 1969), resistance wire heated by Bunsen burners (Clark 1971) or by electricity (Ehmann 2000), and soldering irons (Ehmann 2000). The majority of this equipment has been improvised from a variety of materials, a task that may be beyond the abilities of the typical herpetologist. These units may also require electrical current from a wall socket, or require use of bulky and/or potentially explosive equipment to heat wires.

Herein, we report on the use of disposable medical cautery units ("Aaron Medical Change-A-Tip cautery units;" Aaron Medical, St. Petersburg, Florida 33710, USA; www.aaronmed.com) as an efficient means of marking snakes. These units are small, inexpensive, field-portable, and capable of quickly and precisely marking even very small snakes. Marks on most species are easily seen for at least two years.

Medical cautery units are designed for a variety of surgical applications and are available in two temperature classes. We have successfully used both high-temperature units (1204°C; ~US $25, available with two different handle styles [one operates on 2 C alkaline batteries, the other on 2 AA alkaline batteries]) and low-

Fig. 1. Medical cautery units used to heat-brand snakes. From top to bottom: high-temperature, 2 CC battery handle; high-temperature, 2 AA battery handle; low-temperature, 1 AA battery handle.

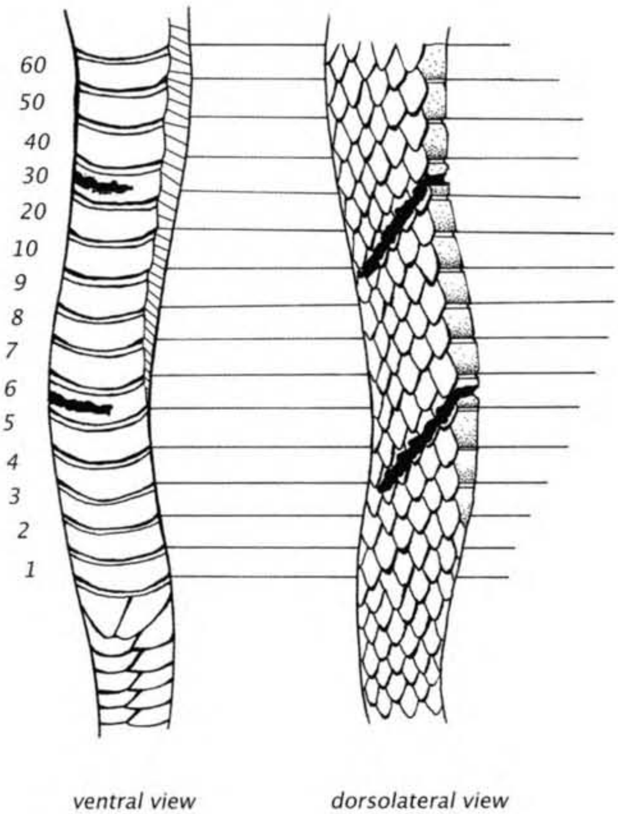

FIG. 2. Illustration of a snake heat-branded with ID # 36. For each mark, we branded the anterior portion of the ventral scale and extended the mark diagonally onto adjoining lateral scales. Illustration drawn by Rebecca Taylor.

temperature units (704°C; operates on 1 AA alkaline battery; ~US $20) designed for ophthalmological applications (Fig. 1). Both units are small and field-portable (Fig. 1). We have used individual units for over a year, marking hundreds of snakes. We replace broken/worn out tips (US $3.50 each) as necessary. Batteries last longer when marking small snakes, but in general batteries must be replaced fairly frequently. Due to the high temperature of the cautery units, marks should be applied with caution whenever fresh batteries are used.

From June 2002 to May 2005, we used medical cautery units to individually mark snakes as part of a long-term mark-recapture study of semi-aquatic snakes on the Department of Energy's Savannah River Site in the upper coastal plain of South Carolina. We also marked a smaller number of individuals of other species, which were not part of any extensive mark-recapture study, to demonstrate the utility of this technique for small and terrestrial species. On each snake, we branded 1–3 ventral scales anterior to the anal plate, forming a unique numerical code (Fig. 2). For each mark, we branded the anterior portion of the ventral scale and extended the mark diagonally onto adjoining lateral scales. We used high-temperature cautery units to mark medium and large snake species, such as Black Swamp Snakes (*Seminatrix pygaea*), Cottonmouths (*Agkistrodon piscivorus*), Racers (*Coluber constrictor*), watersnakes (*Nerodia* spp.), and Timber Rattlesnakes (*Crotalus horridus*), and low temperature units to mark juveniles and small species (e.g., *Cemophora coccinea*, *Lampropeltis triangulum*, *Tantilla coronata*). We found heat branding to be faster than traditional scale clipping for small-bodied snakes.

TABLE 1. Summary of recapture (RC) data for snakes branded with disposable medical cautery units on the Savannah River Site, South Carolina.

Species	N	RC Interval Range (days)	Mean RC Interval (days)
Seminatrix pygaea	105	5–784	320
Agkistrodon piscivorus	37	9–778	259
Coluber constrictor	22	9–785	135
Nerodia fasciata	32	5–1058	183
Farancia abacura	8	4–744	187
Lampropeltis triangulum	3	32–420	164
Elaphe obsoleta	3	41–201	127
Tantilla coronata	2	18–576	—
Crotalus horridus	2	14–59	—
Thamnophis sauritus	1	221	—
Nerodia taxispilota	1	41	—
Cemophora coccinea	1	27	—
Lampropeltis getula	1	26	—
Heterodon platirhinos	1	19	—
Regina rigida	1	17	—

An important assumption of capture-mark-recapture studies is that marks are permanent. In the field it is virtually impossible to determine if brands may be lost in some individuals or species, unless a second marking technique (e.g., PIT tags) is used or researchers can maintain a 100% recapture rate in the field. Alternatively, a laboratory colony of snakes can be maintained to determine mark retention rates over time. We chose this second method to asses the reliability of the brands. In spring 2002, we marked 36 neonate *Antaresia childreni* and *A. maculosa* from four different litters, and have kept them in the laboratory since that time (minus four individuals that were sacrificed for various reasons).

We have recaptured 220 heat-branded snakes of 15 species (Table 1) on the Savannah River Site, suggesting that this technique works well for a variety of taxa. The longest recapture interval was 1058 days, and we recaptured individuals of nine species after an interval > 200 days (Table 1). Additionally, long-term recaptures in small species (e.g., *Tantilla coronata*, 576 days; *Lampropeltis triangulum*, 420 days) attest to the effectiveness of marking delicate snakes with low-temperature cautery units. In general the brands were readily observable, even after greater than two years between captures and bouts of substantial growth (e.g., *Agkistrodon piscivorus*, grew 30.1 cm snout–vent length [SVL]; *Seminatrix pygaea*, grew 16.4 cm SVL). Similarly, the brands on *Antaresia childreni* and *A. maculosa* have remained obvious and readable in the laboratory for over three years, even as the snakes have tripled in length and increased many-fold in mass: no snake displayed marks that were appreciably faded. In combination, these results demonstrate that heat-branding with medical cautery units is an effective, dependable, and inexpensive technique for multi-year mark-recapture studies of snakes.

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An Inexpensive Video Surveillance Technique for Wildlife Studies

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Most wildlife behavioral studies require time consuming direct observations of animals (Altmann 1974) or the use of expensive closed-circuit television (CCTV) cameras and time-lapse video equipment (Wratten 1994). Direct observation of animals is limited by how practical observations are of the species and how easily the species is habituated to an observer (Stewart et al. 1997). The use of video applications in wildlife research has been well documented as a useful technique (Pulliainen 1971; Stewart et al. 1997; Sykes et al. 1995; Wratten 1994) and video surveillance equipment has been used increasingly in studies (Hughes and Shorrock 1998; Jury et al. 2001; McQuillen and Brewer 2000; Roberts and Anderson 2002; Shivik and Gruver 2002; Stevens 2002). However, the technique has not been exploited to its full potential by biologists, due primarily to the high initial cost and length of time to extract data from cassettes (Stewart et al. 1997; Sykes et al. 1995). Time-lapse video is widely used by developmental biologists (Kulesa and Fraser 1998; Peppo et al. 2001; Rezaie et al. 2002) but has enormous scope in applications for wildlife research and until recently has been cost prohibitive. The advantages of a video surveillance system include gaining a permanent record of events that can be replayed as many times as necessary to retrieve data, reduction in observer bias and missed observations, easy habituation by the study animal and the ability to document events that are not easily detected using direct observations. Video surveillance can be used to record activity at a focal site (such as entrance or exit to a shelter site or burrow, the removal of baits by target and non-target species), identify individuals, document predation events, and detect nocturnal, crepuscular or elusive species (Brown 1997; Deufel and Cundall 1999; Stewart et al. 1997; Tobler and Schwierin 1996).

Equipment and set-up.—I used inexpensive miniature monochrome (MINI-M20A) video surveillance cameras attached to an existing PC computer via a 4 channel PC digital surveillance recording system (Go Video DVR4, PCI PC capture card and software) available from Allthings Sales and Service (Kelmscott, Western Australia; www.allthings.com.au). Allthings Sales and Service economically and reliably ship worldwide via airmail or EMS speed post, with typical airmail rates to the USA for a 0.5–2kg package ranging from $US 8 to $27 depending on weight. The entire system can be purchased as a complete package and attached to an existing IBM compatible computer from as little as $US 210; the system (discussed below) consists of a 4 channel PCI PC capture card, software, 4 monochrome cameras, and a Plug-in DIY AV 20 meter cable/adaptor set for 4 cameras. Several optional color camera upgrades are also available from $US 60 to $140. Alternatively, each component can be purchased separately and a system

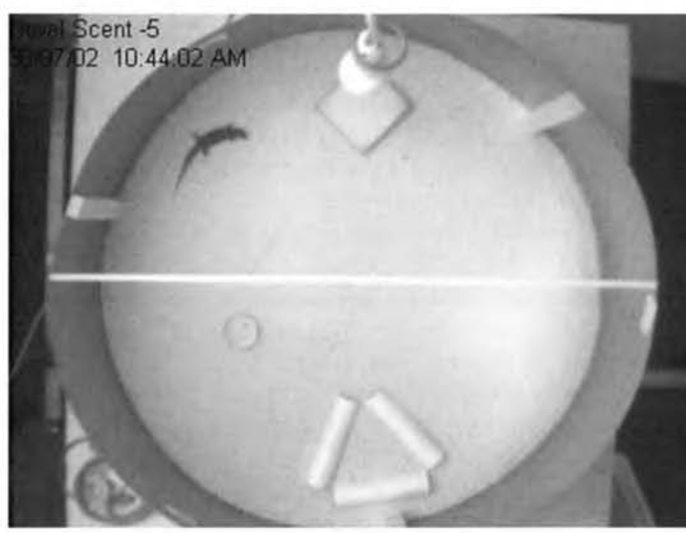

Fig. 1. Snapshot image of experimental enclosure showing camera identification, date and time display.

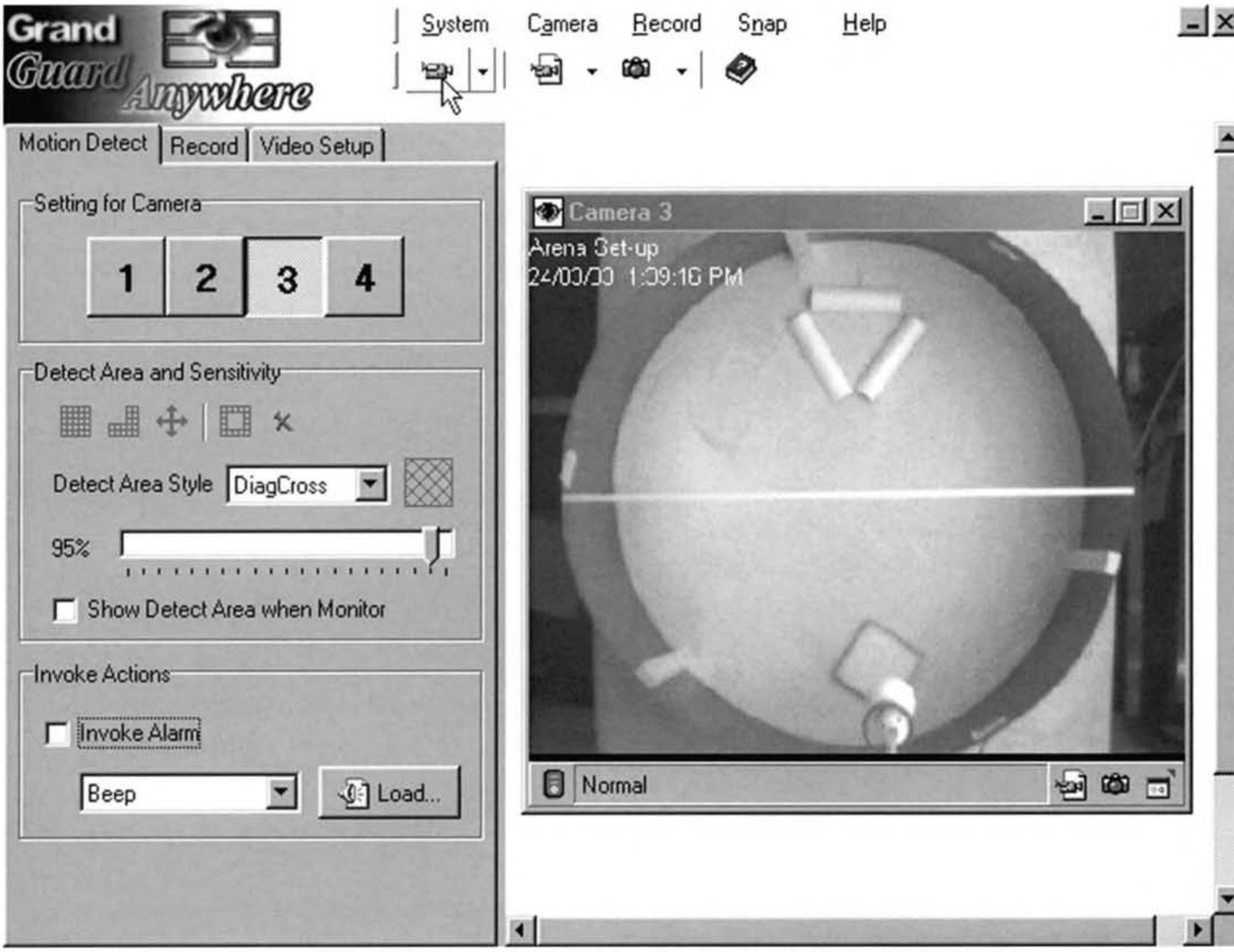

FIG. 2. On screen view of one camera (1–4 cameras can be viewed simultaneously) with set-up menu for motion detect.

built to suit individual or experimental needs. By comparison, quotations supplied by closed circuit television and surveillance system specialists for the identical system ranged from $US 1,782 to $4,048.

Equipment details.—Go Video-DVR4 consists of a PCI PC capture card and Grand Guard Anywhere software (Grandtec, Taiwan) that allows connection of up to four video cameras (capture cards are also available for up to 16 cameras) to display/record simultaneously on a IBM compatible PC computer. The surveillance system is motion sensitive, with adjustable detection sensitivity for each channel (if continuous recording is required motion detect sensitivity is set at 100%). Areas not to be observed or disregarded for motion detect can be defined by masking an area onscreen and audible warnings can be set for each channel to notify of movement. Each video input can be adjusted for brightness, contrast, saturation, hue, image quality and configured to record camera identification, date and time. The system allows high resolution recording [384 lines (H) × 288 lines (V) resolution or 110,592 pixels per camera] in comparison to conventional 4 channel quad/VCR recording system [VHS VCR: 160 lines (H) × 288 lines (V) resolution or 46,080 pixels per camera; SUPER-VHS VCR: 265 lines (H) × 288 lines (V) resolution or 76,320 pixels per camera]. Video capture rate is 3–5 frames/sec and is dependent upon computer hardware, number of channels in use, and image size. The frame rate can be increased when being replayed to speed up data gathering. Video is captured as AVI files that can be compressed and saved on the computer hard drive for later analysis. A snap shot option captures still images that can be saved as BMP or JPEG images (Fig 1). The system requires a Pentium 200 microprocessor or faster (Pentium 500 or above recommended by manufacturer), PCI 2.1 compliant mother board, at least 64 MB RAM, Microsoft windows 95 or 98 operating system (capture cards are also available for other Windows operating systems, e.g., ME/2000/XP), one PCI slot, and at least 1GB hard disk space per camera.

MINI-M20A cameras are 1/4-inch low smear image sensor monochrome infrared sensitive surveillance cameras with wall or ceiling mount. They come complete with a 3.6 mm lens, but you can choose the lens that best suits your application.

Plug-in DIY AV 20 m cable/adaptor set includes 20 m of audiovisual cable with all the appropriate molded plugs and sockets required for self-installation.

I tested the video set-up using three separate temperature controlled rooms with cameras mounted to the ceiling ca. 1.3 m above experimental enclosures. I placed medium-sized scincid lizards (*Eulamprus tympanum,* 130–150 mm total length) in 1 m diameter enclosures and recorded the lizards' behavior from 0900 to 1700 h on 95% motion detect (Fig. 2). To test the suitability of the set-up for my purposes, I chose to record position of lizards at 5 minute intervals and estimate activity rate by dividing the enclosures in half with a piece of string and recording the number of times the lizard crossed this line (Fig. 2). The clarity of the picture was more than sufficient for the purpose of this experiment. Each AVI file was compressed (zipped) and saved on compact disc for storage and later analysis. The software included with the surveillance package (Presto! Video Works, Newsoft®) was used for video replay and data collection. During replays, the video frame rate was adjusted to 10 frames per second to speed up the scoring process.

Discussion.—The use of miniature cameras and video surveillance software has wide applications for wildlife and behavioural research. Previously, the major disadvantage with this technology has been the initial set-up cost and the time required to playback video tapes for data collection. New technologies have developed inexpensive cameras and computer software equipped with motion detect sensing to eliminate periods of no activity that in turn speed up data retrieval upon playback. A compact disc burner is recommended to burn all compacted (zipped) AVI files for storage and later data analysis to reduce storage requirements on the hard drive and to ensure a safe back-up should a different analysis or further analysis be required.

The entire set-up could be modified or components upgraded to collect field data by running on a computer in weather proof housing or a laptop computer with a USB video capture box using a portable power source (generator, batteries, or solar power). Cameras can be placed in weatherproof housings or upgraded to outdoor surveillance cameras. There is also the option of wireless cameras and receivers.

A video surveillance technique for wildlife has not been exploited to its full potential in behavioural and ecological studies despite a history of documented use in such studies (Sykes et al. 1995; Wratten 1994). Rapid improvements in low cost equipment have made the technology readily accessible to biologists, and may result in more widespread application of the technique.

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Hyla geographica. Colombia: Amazonas: Leticia. Illustration by Fernando Vargas Salinas.

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Addressing Error in Identification of *Ambystoma maculatum* (Spotted Salamanders) Using Spot Patterns

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Numerous capture-recapture studies of amphibians have used the unique color patterns of certain amphibian species to "mark" individuals, recording pattern information with sketches, photographs, or a coding system (Andreone 1986; Forester 1977; Gill 1978; Kurashina et al. 2003; Marvin 1996; Nace et al. 1973; Nijhuis and Kaplan 1998; Tilley 1980). Such non-invasive techniques are preferred over physical alteration of an animal, which may include toe-clipping, visual implant elastomer, or other added marks (Bailey 2004; McCarthy and Parris 2004; Murray and Fuller 2000; but see Funk et al. 2005). Regardless, bias associated with any individual identification method should be assessed and reported, though this has been infrequent in amphibian capture-recapture studies (but see Bailey 2004; McCarthy and Parris 2004; Muths et al. 2000).

For long term capture-recapture studies to be successful, marks must not be lost over time; this is assumed to be true for natural patterns that serve as marks (Gill 1978). More importantly, marks should not be overlooked or misidentified by observers. Reduction of observer bias in mark recognition is paramount in studies that estimate population sizes and document long term trends.

The goals of our study were to: 1) quantify error rates in individual identification through specific pattern mapping approaches; 2) address sources of error by developing a modified pattern mapping method; 3) compare bias associated with these two methods and identify which method minimizes observer bias in both pattern mapping in the field and individual identification in the lab; and 4) determine the search effort necessary to find all individuals in a dataset. We assessed bias in pattern matching of the Spotted Salamander (*Ambystoma maculatum*), a mole salamander with conspicuous and distinctive yellow spot patterns.

Materials and Methods.—We used data from March–April 2002 and 2004 for this study. To capture migrating spotted salamander adults we used artificial cover objects (61 × 122 cm plywood boards) and a drift fence completely encircling Laura's Pond, a semipermanent fishless pond in Beltsville, Maryland (USA). We digitally photographed the dorsal patterns of each salamander on a flat surface using a Nikon® Coolpix 995 digital camera, in the shade using the integrated flash to reduce glare. We did not sedate or restrain salamanders.

Between 03 March and 08 April 2002, we employed a multi-parameter (MP) method of pattern mapping (Table 1) based on a modification of the Loafman method (Loafman 1991). All pattern mapping was done in the field. We counted any spot > 1 mm spanning two body areas once (in the area which contained the majority of the spot). Twenty observers (2–10 per visit) participated in recording pattern data for 654 salamander captures. We entered and sorted all pattern data in Microsoft® Excel™ spreadsheets; each record represented one capture occasion and was associated with its digital photograph. We used Microsoft® Photo Editor™ to view multiple photographs at once. In the lab, we sorted spot counts by the six body areas (Table 1). Individuals were identified by comparing and matching digital photographs among these grouped records. Of 378 individuals identified, 136 were captured more than once. We noted that for some of these individuals, recorded pattern data varied among capture occasions. Because we had digital photos from each capture, we were able to verify that discrepancies were due not to pattern changes, but rather to errors in field data collection using the MP method.

We tested the hypothesis that the variation in field data recorded using the MP method differed among areas of the body (e.g., head, each leg, and body + tail). We selected at random a set of 50 individuals with multiple captures (mean number of captures per individual = 3.82, range = 2–13), and assessed the variation in recorded spot counts by body area between observations of each individual. We hypothesized that head pattern data would have the lowest observer bias based on Doody (1995), who observed that head patterns often were sufficient to distinguish individual Spotted Salamanders.

We compared the efficiency of the MP method to a reduced parameter (RP) method of pattern mapping (Table 1) which we hypothesized would facilitate pattern mapping in the field and individual identification in the lab. As in the MP method, a spot spanning two body areas was counted only once. Other supporting pattern data also were recorded, including a categorical assessment of the spots anterior to the gular fold [i.e., eye code, where 0 = no spots by either eye, 1 = spot(s) by one eye only, 2 = spot(s) by both eyes; see Nace et al. 1973], eye spot symmetry (yes/no) and gular spot symmetry (yes/no), where symmetry describes the same number of spots in mirror orientation across an anterior–posterior midline.

To assess laboratory error, we tested whether the method of pattern mapping (MP vs. RP) influenced the ability of observers to identify individuals by matching pattern data and associated photographs. We also tested whether the ability of observers to identify matches varied based on the number of records. Two sets each of 50 and 100 capture records were chosen at random from the 2002 (MP) data; individuals were manifested in these "test datasets" as one record (one capture), or as a set of >1 records (multiple captures or "matches"). The number of matches per dataset was known; individuals were identified and verified in the full set of pattern data. Based on the associated photos, a copy of each file was then altered by one of the authors (EHCG) to show only the parameters pertaining to the RP method (Table 1). Five observers were presented with the same 8 test datasets (2 MP and 2 RP datasets each of 50 and 100 records).

The observers identified matching records in the lab, recording elapsed time between finding matches, as well as total time spent on each test dataset. We created an "observer performance" matrix (modeled after a traditional capture history matrix) where rows represented each salamander capture record, and columns represented the classification results from each observer for each salamander. Classifications were designated as either "correct" (match-

TABLE 1. Descriptions of two pattern mapping methods used to distinguish individual Spotted Salamanders, *Ambystoma maculatum*.

	Method	
Character	Multi-parameter (MP)	Reduced parameter (RP)
Spot definition	Any yellow or orange spot >1.0 mm maximum length or width	Any yellow or orange spot, regardless of size
Body areas counted	Six body areas: 1) total head spot count, 2) total body (torso+tail) spots 3–6) separate counts for each leg	Two body areas: 1) total head spot count, 2) sum of counts from the front legs
Description of head spot pattern	No additional descriptors for head spot location	Additional descriptor codes for head spot location and symmetry

ing records or unique records correctly identified as such) and received a value of "1," or "incorrect" (failure to detect matching records when present) and received a value of "0." We combined the observer matrices from all test datasets for each method, and tested whether the binomial probability of correct classification differed between: 1) the two methods (MP vs. RP); 2) the number of records presented to each observer (50 or 100); and 3) observers, using the program CONTRAST (Hines and Sauer 1989). We also calculated the average time to find a match for each method, and estimated the number of searches through a full dataset necessary to identify all matches correctly by $(1\text{-p})^t$, where p is the probability of correct classification and t is the number of searches by one observer.

We employed the RP method during 08 March to 14 April 2004 because fewer parameters were collected, thereby reducing field handling time per salamander. We recorded a total of 592 capture occasions of Spotted Salamanders. One observer searched the data for matches, eliminating all secondary captures from the data set (leaving only presumed initial captures and those records representing salamanders presumed to have been captured only once) before searching again. We counted the actual number of search iterations necessary to identify all individuals and compared this to our estimated number of iterations based on the average classification probability of five observers from the test datasets.

Results.—Within the 50 Spotted Salamander individuals with multiple captures from the preliminary assessment of the MP method, the mean and variation in recorded spot counts for the head (mean = 0.48, var = 0.51, range = 0–5 spots) and legs (mean = 0.88, var = 0.58, range = 0–3 spots) were smaller across capture occasions than for the body (mean = 1.48, var = 1.01, range = 0–6 spots).

Comparing the MP and RP methods in the test datasets, the probability of correct classifications was high for all observers between both method [p_{MP} = 0.97 (SE = 0.005), p_{RP} = 0.96 (SE = 0.005); χ^2 = 0.88, P = 0.35] and the number of records presented to the observers [p_{50} = 0.97 (SE = 0.006), p_{100} = 0.96 (SE = 0.004); χ^2 = 0.51, P = 0.48]. Observers did not differ in their ability to classify records correctly (mean $p_{\text{test datasets}}$ = 0.96; χ^2 = 5.86, P = 0.21), although actual correct classification varied (MP: mean = 80 + 23 %, range = 33 to 100 %; RP: mean = 74 + 27 %, range = 0 to 100 %). Of 1500 total records (5 observers × 2 sets × [100 + 50 salamanders]) in test datasets per method, observers incorrectly classified 52 (3.5%) MP and 60 (4.0%) RP records. The amount of time spent searching for matches did not explain the proportion of correct classifications (Fig. 1). Assuming that the mean observer detection probability (p) does not change as observers find more matches in a dataset, we estimated that a minimum of four searches through the data are necessary to identify all individuals (Fig. 2).

Comparing these results to our 2004 data collected using the RP method, we found that the actual probability of correct classification was less than our estimate (p_{2004} = 0.90 vs. $p_{\text{test datasets}}$ = 0.96, Fig. 2), and the number of iterative searches necessary was greater than our estimate (t = 8 searches, Fig. 3). The probability of incorrect classification decreased over the 8 searches (1-p; Fig. 3).

Discussion.— The MP and RP methods were comparable in efficiency and accuracy in identifying individuals in the lab, and the probability of correct classification was independent of method, number of records, or observer. This suggests that the method of pattern mapping does not affect the ability of observers to match individuals in small datasets, provided that supporting data allows records to be grouped. Observer performance, measured by number of incorrect classifications, was slightly better using the MP

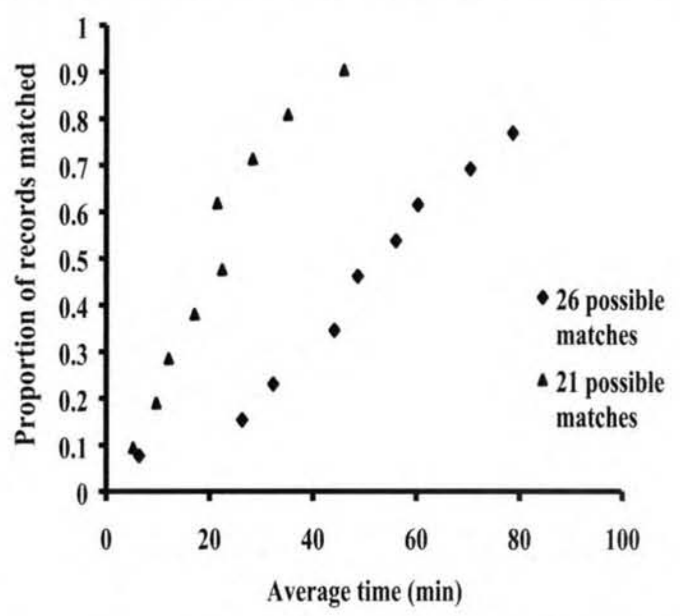

FIG. 1. The proportion of records matched (where a "match" is defined as >1 records representing multiple captures of an individual) vs. time spent by 5 independent observers using Spotted Salamander (*Ambystoma maculatum*) pattern data from Laura's Pond in Beltsville, Maryland, USA. Each series represents one of two replicates from the 2002 test datasets (MP method) with 100 individuals each. One dataset had 21 possible matches, while the other had 26 possible matches. Not surprisingly, a greater number of potential matches present in a data set requires a longer amount of time to identify the complete set of matches.

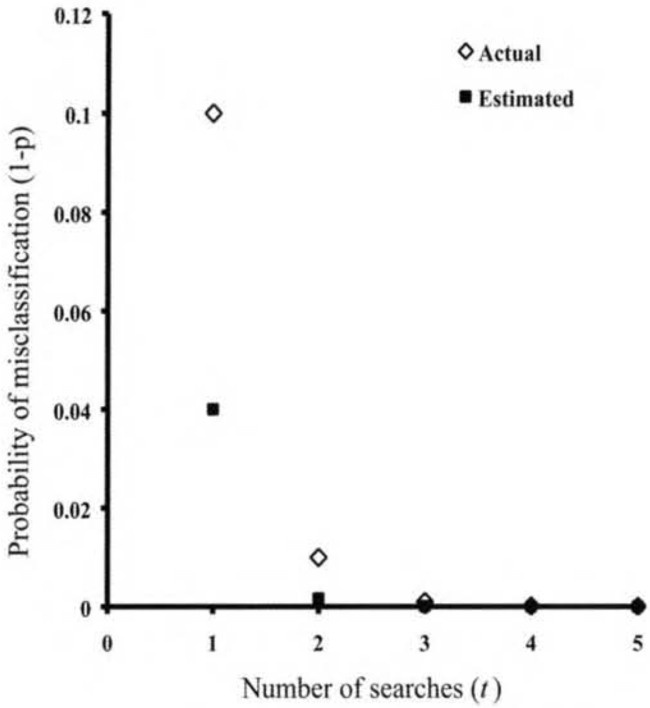

FIG. 2. The estimated (using test datasets) and actual probability (using 2004 field data) of incorrect classification (1-p), or missed matches, in Spotted Salamander pattern data. The number of searches represents iterations necessary for one observer to search a data set and identify all possible individuals, estimated by $(1\text{-p})^t$, where p is the probability of classifying a record correctly and does not change, and *t* is the number of searches. The mean value $p_{\text{test datasets}} = 0.96$ was estimated from 5 independent observers searching 8 test datasets, and the value $p_{2004} = 0.90$ represents the actual classification probability from the first iterative search of the 2004 RP data collected in the field.

method. However, we observed that the RP method reduced the time to handle and record pattern data in the field. This likely reduced stress on the animal, particularly those captured multiple times, and therefore we prefer the RP method.

Inconsistent pattern mapping in the field (field error) prevented some records representing the same individual from becoming grouped when sorted in the spreadsheet, and thus matches within these groups may have been missed. Variation in pattern data over multiple captures of the same individual may have partially resulted from our size-restricted "spot definition" (Table 1) in the MP method; this restriction was removed in the RP method. Field error due to transpositions of spot counts for right versus left or front versus rear leg were eliminated in the RP method by summing spot counts for both front legs. Out-of-focus pictures, poor lighting/contrast, and photos that did not show the entire pattern clearly also could have resulted in missed matches. Problems in field photography were not addressed here, but could be eliminated by using standardized photographic procedures (e.g., Doody 1995; Ravela and Gamble 2004).

To identify all individuals from capture records, we found that multiple searches through the data by one observer were necessary. Eliminating one record from each matching pair in the data set after each search reduces the number of capture records to compare. The number of individuals represented by multiple records in a data set will naturally affect the amount of time necessary to detect all individuals (Fig. 1). In our 2004 data set, 8 iterations of sorting and matching records were necessary to identify all individuals (Fig. 3). However, the presence of a small amount of error in classification may not severely affect the estimates of population size (Miller et al. 2002). An assessment of the relative contribution of the two types of error investigated here (i.e., field error vs. laboratory error resulting from missed matches in the dataset) can contribute to decisions regarding whether a small amount of error in detecting matching records in the lab can be tolerated. Our results suggest that the probability of false matches (classifying records as matches when they are not) is probably small. The probability of incorrect classification fell below p = 0.02 after 3 searches through the data set (Fig. 3), suggesting that fewer searches may not appreciably affect population estimates.

Previous studies have used counted parameters alone (Loafman 1991) or photographs alone (Bailey 2004; Kurashina et al., 2003) to identify individuals using pattern data. Incorporating supporting information with photos or drawings helps to increase the efficiency of identifying individuals (Gill 1978; Nace et al. 1973). We summarize pattern data in spreadsheet software, which allows us to sort the data and group records with similar characteristics (e.g., number of head spots), and then compare photos within groupings. In studies where relatively large numbers of salamander captures are possible, this combination of data types may facilitate the identification of individual salamanders by narrowing the number of records to compare, and digital photos allow the confirmation of matches. This approach is specific to discrete and enumerable pattern features such as spots, though it might be ap-

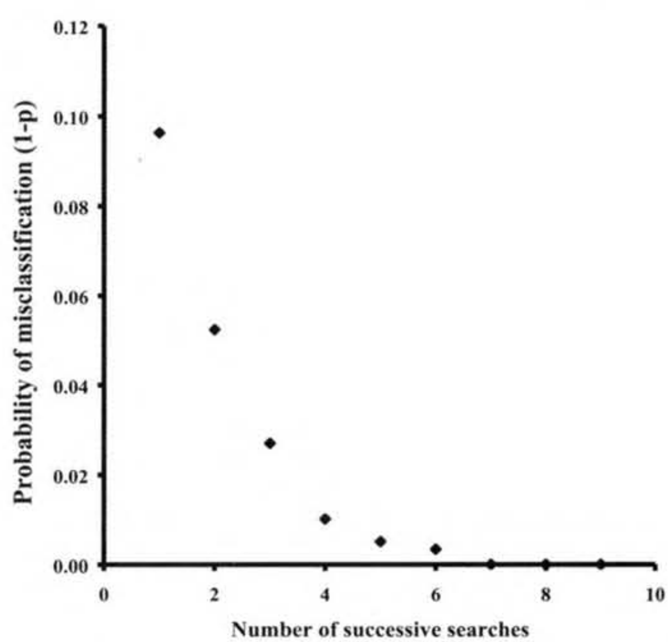

FIG. 3. The observed probability of incorrect classification by the number of searches of the 2004 field-collected data using the RP method. After each search, any records designated as secondary captures were removed from the data set prior to a subsequent search (leaving only presumed initial captures and those salamanders presumed to be observed only once). The probability of incorrect classification (i.e., missed matches) decreases with successive searches through the data. All individuals were identified by the 8th iteration of the successive searches; the 9th search confirmed that no additional matching records were present.

plicable to other elements of pattern. Future advances in technology (i.e., ambystomatid pattern-recognition software, Ravela and Gamble 2004; D. Church, pers. comm.) will automate the process of identifying individuals. Pattern recognition research is progressing in the field of facial recognition (Zhao et al. 2000), and this emerging body of literature (and associated products) can have practical applications for wildlife biology. Even with automated pattern recognition, a subset of computer-determined individuals may require validation using methods similar to the process we present (see also Whitehead 1990; whale fluke identification). Regardless of method, some assessment of bias is useful in evaluating whether a technique violates the assumptions of capture-recapture modeling (specifically 1) that marks are not lost during the period of study and 2) observers can recognize marked individuals, and do not designate marked individuals as new captures). Validation of data subsets can allow investigators to evaluate a marking approach, and thereby qualify the derived estimates of population size or trend.

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HERPETOLOGICAL HUSBANDRY

Herpetological Review, 2006, 37(1), 60–68.

Further Observations of Oviposition in the Surinam Toad (*Pipa pipa*), with Comments on Biology, Misconceptions, and Husbandry

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Although the Surinam Toad (*Pipa pipa*) was originally described in 1758 (as *Rana pipa* by Linnaeus), published information on the biology of this species has been slow to accumulate. The limited information available has been derived largely from preserved materials and observations of a few captive specimens. This note reviews the biology of the species, details original observations on reproductive behavior in captivity, aims to dispel some persistent misconceptions, and offers recommendations for captive husbandry in the interest of stimulating further research.

The Surinam Toad occurs widely throughout northern South America and is certainly one of the strangest and most fascinating of all anurans. From its morphology to its reproductive mode, this species is strikingly different from what we think of as "typically anuran." *Pipa pipa* is extremely depressed (dorso-ventrally flattened) and has a broad, triangular head with several fleshy sensory protuberances, a huge mouth, and tube-like nostrils. These traits combine to produce a bizarre appearance uncannily similar to that of the Mata Mata Turtle, as noted by Rabb (1969) and Armburst (1979). At 10–20 cm body length, their size is equally

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SOCIETY FOR THE STUDY OF AMPHIBIANS AND REPTILES

www.ssarherps.org

The Society for the Study of Amphibians and Reptiles, the largest international herpetological society, is a not-for-profit organization established to advance research, conservation, and education concerning amphibians and reptiles. Founded in 1958, SSAR is widely recognized today as having the most diverse society-sponsored program of services and publications for herpetologists. Membership is open to anyone with an interest in herpetology—professionals and serious amateurs alike—who wish to join with us to advance the goals of the Society.

All members of the SSAR are entitled to vote by mail ballot for Society officers, which allows overseas members to participate in determining the Society's activities; also, many international members attend the annual meetings and serve on editorial boards and committees.

ANNUAL DUES AND SUBSCRIPTIONS: Annual membership dues for the year 2006 in the Society for the Study of Amphibians and Reptiles are as follows: **REGULAR** membership US$60 (Student $30)—includes *Journal of Herpetology* and *Herpetological Review*; **PLENARY** membership US$80 (Student $45)—includes *JH*, *HR*, and annual subscription to the *Catalogue of American Amphibians and Reptiles*; **INSTITUTIONAL SUBSCRIPTION** $115—includes JH and HR. Additional fee for airmail postage outside USA $35 for one year. Additional membership categories available on the SSAR webpage: http://www.ssarherps.org/pages/membership.html.

All members and institutions receive the Society's primary technical publication, the *Journal of Herpetology*, and its news-journal, *Herpetological Review*; both are published four times per year. Members also receive pre-publication discounts on other Society publications, which are advertised in *Herpetological Review*.

Payment must be made in USA funds, payable to "SSAR," or by International Money Order, or with VISA or MasterCard (account number and expiration date must be provided). Payment should be sent to: Breck Bartholomew, SSAR Membership Office, P.O. Box 58517, Salt Lake City, Utah 84158, USA. Fax: (801) 453-0489; e-mail: ssar@herplit.com.

Future Annual Meetings

2006 — New Orleans, Louisiana, 12–17 July (with ASIH, HL)
2007 — Saint Louis, Missouri (with ASIH, HL)

About Our Cover: *Boiga dendrophila*

Dutch herpetologist Nelly de Rooij (1883–1964) is one of the more remarkable figures in 20th century herpetology, given the obstacles she overcame to establish herself as a scientist. Her most prominent work, "The Reptiles of the Indo-Australian Archipelago" (Leiden, 2 vols.; 1915, 1917), remains the definitive source on the area nearly a century later. Under then-existing Dutch law, she was not allowed to attend university following high school, so she went to Switzerland. She completed her Ph.D. degree in 1907 at the University of Zurich. (Additional biographical details are provided in Adler's "Contributions to the History of Herpetology." SSAR Contributions to Herpetology, No. 5, Oxford, Ohio, pp. 76–77).

The artist of our cover illustration is Mr. Joan François Obbes (1869–1963), a well-known Dutch artist of botanical and zoological subjects. He drew all 249 illustrations in De Rooij's classic book. Obbes was a naval officer and a cartographer for the Department of the Navy, spending a short time in the Netherlands East Indies during the Atchin War near the end of the 19th century. Later, he prepared numerous illustrations for the Amsterdam Zoological Museum, including those for the De Rooij volumes, as well as for the first ten volumes of "The Fishes of the Indo-Australian Archipelago" (issued 1911–1953).

With reference to Obbes' work, it has not been previously recorded that at least some of his line drawings used in the De Rooij volumes, including the figure shown on this page, were based on watercolors likely prepared using live specimens shipped to him from Java. In this case, the original watercolor (depicted on our cover) measures 29 × 41 cm and is in the private collection of Kraig Adler; it has not been published previously.

Our cover subject, *Boiga dendrophila* (Mangrove Snake), is a relatively well-known snake today, both to herpetologists and to the hobbyists who maintain this species in captivity. The cover specimen is typical of the many-banded Javanese race (*B. d. dendrophila*), referred to in the De Rooij work as *Dipsadomorphus dendrophilus*. The most recent review of this species is by Gaulke et al. (2004. Herpetofauna 25[143]:5–16), who describe *B. d. levitoni* from the Philippines, and recognize a total of nine subspecies. See also Vogel (2000. Sauria 22[1]:27–43). The genus *Boiga* comprises 33 presently recognized species, several of which have been described within the last decade. For a current checklist, as well as pdf reprints of several recent papers, consult Gernot Vogel's website:

<http://www.gernot-vogel.de/index.php?target=checklist>

Editor's note.—We are grateful to Kraig Adler for providing the cover illustration and portrait of De Rooij, as well as to L. B. Holthuis for biographical information and portrait of Obbes.

Figure 76 (page 198) from De Rooij (1917), based on the watercolor drawing by Obbes reproduced on the cover.

SSAR BUSINESS

Announcing the SSAR Relations with Herpetologists at Zoological Parks Committee Forum

http://www.ssarherps.org/forum

Forum Goals.—The primary purpose of this forum shall be to facilitate communication between academic and zoo herpetologists regarding areas of mutual interest. The forum should serve as a platform for discussing ideas about basic research, collaborative field projects, etc., and also as a "bulletin board" for making known various resources available to both parties.

Criteria for Membership.—Membership is exclusive, and restricted to those individuals who are affiliated with a university, zoological park or scientific or government institution. General public intrusion will not be allowed. When registering, it is helpful to use your last name as your username. Also, you are required to list your institutional affiliation.

Committee Mission Statement.—The Relations with Herpetologists at Zoological Parks Committee will encourage and facilitate participation and communication among members of the Society for the Study of Amphibians and Reptiles and zoo herpetologists for the enhancement of both parties.

General Goals.—1) Increase participation of zoo herpetologists in the SSAR through membership and events; 2) Strive to make various zoo and university resources readily known and accessible to zoo and academic herpetologists; 3) Assist and direct communication between members of both parties; 4) Disseminate information regarding current and/or potential studies of interest to both parties; 5) Identify possible opportunities for collaborative research.

SSAR Henri Seibert Awards for 2006

The Henri Seibert Awards were initiated in 1992 to provide recognition for the best student papers presented at the annual meeting of the SSAR. To be eligible, the presented paper must be the result of research conducted by the individual making the presentation. The research must have been conducted while the student was enrolled in either an undergraduate or graduate degree program. Please refer to Herpetological Review 28(4):175 and the SSAR website for recommendations to students entering the Henri Seibert Competition. Students entering the competition must be members of SSAR. The presentations will be judged by the SSAR student prize committee. One Henri Seibert Award of US $200 may be given in each of the following **four** categories: **Systematics/Evolution, Ecology, Physiology/Morphology, and Conservation**. Students may win the award only one time. Please indicate the appropriate category for which you are applying on the abstract submission form. Announcement of winners will be made at the **SSAR Business Meeting**. All participants should be present at the business meeting. Contact Margaret Gunzburger for further information, margaret_gunzburger@usgs.gov.

NEWSNOTES

The Libraries and Specimen Collections of Dr. Garl Gans

Dr. Carl Gans retired as Professor of Biology and former Department Chair at the University of Michigan in 1997, moving to the University of Texas in Austin as Adjunct Professor. Since then he has donated his extensive libraries, scientific correspondence, and specimen collections in the field of herpetology to various universities and research institutions. These donations were made with the express purpose of making these materials available for study and research by students and scientists. Gans, who is perhaps best known as editor of the *Biology of the Reptilia* series is a former President of SSAR. He transferred sponsorship of the *Biology of the Reptilia* to SSAR in 1995, and Volume 20 in the series is now being readied for publication. Following is a synopsis of the distribution of the Gans libraries and collections.

The Herpetology Library of Carl Gans.—Now at the Ben-Gurion University of the Negev (Israel), comprising more than 20,000 publications, including a number of rare books. Contact: Librarian (e-mail: libboker@bgu.ac.il) or Curator Amos Bouskila (e-mail: bouskila@bgu.ac.il).

The Scientific Correspondence of Carl Gans.—Ben-Gurion University of the Negev (Israel), comprising 13 five-drawer filing cabinets of scientific correspondence between Gans and colleagues with whom he collected specimens on five continents and co-authors of his many publications, including the many volumes of the Biology of the Reptilia. Included are extensive slide and film collections used in his studies of functional morphology. Contact information as above.

The Lancelet Reprint Collection.—Scripps Institute of Oceanography, University of California, San Diego (USA), comprising ca. 2900 items published between 1774 and 1995. Contact: Peter Brueggeman, Head Scripps Librarian (e-mail: Pbrueggeman@ucsd.edu).

Bound Set of Gans' Publications and Herpetological Specimen Collection.—Department of Herpetology, Museum of Comparative Zoology, Harvard University, Cambridge (USA). The Department library has a bound set of all of Gans' published works; these are available for use by students and visiting scholars. Herpetological specimens number approximately 2500, obtained during the period 1960–1980 from Bolivia, Costa Rica, Nicaragua, Mexico, Kenya, Tanzania, and Somalia. Contact: Curator James Hanken (e-mail: hanken@oeb.harvard.edu) or Collection Manager José Rosado (e-mail: jrosado@oeb.harvard.edu).

Herpetological Specimen Collection.—Carnegie Museum of Natural History, Pittsburgh (USA), comprising about 4000 specimens collected by Gans between 1944 and 1998. Contact: Stephen P. Rogers, Collection Manager (tel. 412/622-3255).

Specimen Collection of Amphisbaenia.—Division of Amphibians and Reptiles, Field Museum of Natural History, Chicago (USA). The collection of 1450 specimens, representing over 75 species, was accumulated over three decades by Gans. In addition to pickled specimens, the collection includes series of histological slides, and skeletal and cleared/stained specimens. Contact:

Maureen Kearney, Associate Curator (e-mail: Mkearney@fieldmuseum.org).

Specimen Collection of Uropeltid Snakes.—Department of Herpetology, California Academy of Sciences, San Francisco (USA). The collection of 1824 specimens includes seven of the eight recognized genera and 31 of the 47 known species. It is considered the most comprehensive uropeltid collection in the world. Contact: Jens Vindum, Collection Manager (e-mail: jvindum@calacademy.org).

Reprints Available for Distribution.—Reprints of many of Gans' publications are available. Several volumes of the *Biology of the Reptilia* are available for sale. List of these publications and instructions for requests may be found at:

<http://wwwtest.utexas.edu/tmm/vpl>

Leidy Award Presented to David Wake

On 23 January 2006, The Academy of Natural Sciences (Philadelphia) named a Berkeley scientist who first called attention to the worldwide disappearance of amphibians to receive its prestigious award named for one of the first scientists to call attention to dinosaurs.

Dr. David Wake, professor of integrative biology and curator of herpetology at the University of California, Berkeley, received the Joseph Leidy Award at a ceremony at The Academy of Natural Sciences in February. Wake has studied amphibians for more than 40 years. "We selected Dr. Wake for the award in recognition of his ground-breaking work in conservation biology, with a particular focus on the worldwide disappearance of amphibians and for his many outstanding contributions to systematics and evolutionary biology," said Academy President and CEO Dr. D. James Baker.

Established in 1923 in honor of Dr. Joseph Leidy (1823–1891), anatomist, paleontologist and Academy president, the award consists of a bronze medal and a $5,000 prize. Leidy helped popularize dinosaurs when he described the first dinosaur discovered in America, *Hadrosaurus foulkii,* which became the first mounted dinosaur when it went on display at the Academy in 1868. Past recipients of the Leidy medal include ornithologist James Bond, biologist G. Evelyn Hutchinson and entomologist Edward O. Wilson.

SSAR congratulates Dr. Wake on this recognition.

MEETINGS

First Announcement: 8th Conference of the Herpetological Association of Africa 24–27 November 2006

Herpetologists are invited to join us for the 8th Conference of the Herpetological Association of Africa (HAA), to be hosted by North-West University in Potchefstroom, South Africa in 2006. The HAA is the premier herpetological association on the African continent and publishes African Journal of Herpetology. The 2006 Conference will span four days, including three days of sessions and a special workshop on amphibian declines. The tentative registration fee is R750 for professionals and R600 for students, about US $125 and US $100, respectively. Registration includes attendance at all sessions, lunch and tea breaks, three evening social events, and all conference materials. Accommodation will be available on the North-West University campus, will be within easy walking distance of the sessions, and will be reasonably priced (approx. US $25 per night). Social events will include a braai (barbecue), a banquet, and, for the brave, a mampoer tasting at a local distillery. Mampoer is a locally-brewed, strong, brandy-like moonshine made from fruit mash. The North-West University in Potchefstroom is less than two hours from South Africa's largest airport, Johannesburg International (JNB). Direct flights from Europe and the United States land daily at JNB, which is served by several rental car companies. A call-for-abstracts for oral and poster sessions will be forthcoming. Sessions will take place on 25–27 November. Digital data projectors will be available for MS PowerPoint slideshows, as will carousel projectors. Additional information can be found at www.wits.ac.za/haa/2006conf.htm. To express interest in attending the 8th Conference of the HAA and to receive the second circular, please download the intention form from the conference website and e-mail the completed form to Ms. Cecile Van Zyl, drkcdvz@puk.ac.za.

SSAR Treasurer Vacancy

The Society for the Study of Amphibians and Reptiles seeks applicants for the office of Treasurer. This is a non-paid position with funds available for work-study assistance. Term length is open-ended. Duties are as follows: maintain fiscal records of the Society; make monetary disbursements; coordinate payment to printers for costs of publications after approval by respective editors; invoice reprint orders; interact with Publications Secretary/Membership Office relative to stocks of publications and counts of current number of members; submit annual report which includes budget request for following year to the Secretary prior to annual meeting of the Board. Membership management, investment management, and IRS reports are not part of current duties. The office provides an important contribution toward continuity of information within the Society, thus, attendance at the annual meetings is mandatory. Individuals interested in the position should contact Kirsten E. Nicholson at knicholson@biology2.wustl.edu no later than 16 July 2006.

Meetings Calendar

Meeting announcement information should be sent directly to the Editor (rwh13@csufresno.edu) well in advance of the event.

13–15 April 2006—53rd Annual Meeting of the Southwestern Association of Naturalists (SWAN), Universidad de Colima, Colima, Mexico. Information available at: http://www.biosurvey.ou.edu/swan/ or from Dr. Stanley Fox, SWAN President-elect (e-mail: foxstan@okstate.edu).

20–21 April 2006—Northeast Natural History Conference IX, New York State Museum, Albany, New York, USA. Featured symposium: "Direct and Indirect Effects of Roads on Amphibians and Reptiles." Information: http://www.nysm.nysed.gov/nhc

21–24 June 2006—30th Annual Meeting, International Herpetological Symposium, San Antonio, Texas, USA. Information: http://www.kingsnake.com/ihs/

17–19 July 2006—49th Annual Meeting, Society for the Study of Amphibians and Reptiles, together with The Herpetologists' League and the American Society of Ichthyologists and Herpetologists. New Orleans, Louisiana, USA. Information: http://www.dce.ksu/jointmeeting/.

6–9 November 2006—9th Reunión Nacional de Herpetología México, hosted by the Mexican Herpetological Society. Universidad Autónoma de Nuevo León, Monterrey, Nuevo León, México. Information: http://www.sociedadherpetologicamexicana.com/.

24–27 November 2006—Herpetological Association of Africa 8th Conference. Potchefstroom campus of the North-West University, South Africa. Information available from the conference website: www.wits.ac.za/haa/2006conf.htm.

CURRENT RESEARCH

The purpose of **Current Research** is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, **María del Rosario Castañeda** or **Michele Johnson**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can be found at: http://www.herplit.com/contents.

Watersnakes Have Unlearned Tendency to Take Smaller Meals

Mammals have been the central focus of appetite studies, and one generalization that has emerged from this work is that meal size is strongly influenced by learned satieties. However, the trophic biology of snakes is dramatically different from that of mammals, as snakes are precocial soon after birth or hatching, consume prey whole, and take large meals much less often than mammals (who eat small meals multiple times daily). The authors performed an experimental study using the northern watersnake (*Nerodia sipedon*) to determine the consequences of these traits on meal size in neonates at their first feeding episode. In the first experiment, neonates were presented with either an abundance of small prey ($N = 21$) or a single huge ($N = 19$) prey item, and results showed that the meal sizes of animals in the small prey group were significantly lower than those in the huge prey group. Further, to determine where along the prey size axis snake feeding behavior changed, a second experiment in which neonates were assigned to one of four groups (huge, large, medium, or small prey; $n=10$ per group) was performed. This experiment showed that when the average relative prey mass (RPM) was 20% of the snake's size or less, total meal size was ~27% RPM, but when relative prey mass was 40%, snakes consumed a single prey item of approximately 40% RPM. Therefore, this study indicated that when hungry snakes had a choice of how much to eat, they selected smaller meals, but when they had no control over prey size, they consumed a huge meal. Because neonates in the study had not previously eaten, this is not the result of learned meal size. The authors also compared their findings to stomach contents of wild-caught snakes, and discussed the implications of meal size on individual fitness.

Andreadis, P. T., and G. M. Burghardt. 2005. Unlearned appetite controls: watersnakes (*Nerodia*) take smaller meals when they have the choice. Journal of Comparative Psychology 119:304–310.

Correspondence to: Paul T. Andreadis, Department of Biology, Denison University, Granville, Ohio 43023, USA; e-mail: nerodia@denison.edu.

Functional Link Between Morphology and Swimming Speed in Tadpoles

Many developmental, behavioral, and morphological differences exist among anuran larvae across predator regimes, but the functional relationship between swimming speed, morphology, and mortality remains unstudied. The authors examined larvae of *Scaphiopus holbrookii* (Eastern Spadefoot), a species that uses ephemeral pools, and *Rana sphenocephala* (Southern Leopard Frog), a species occurring in more permanent sites, to determine differences in activity level, susceptibility to predation by dragonfly larvae, burst speed, and morphology. Tadpoles were collected in eastern Texas as eggs, and all trials were performed in the laboratory. Results showed that *S. holbrookii* tadpoles were significantly more active, were more susceptible to predation, and exhibited slower burst speeds than *R. sphenocephala* tadpoles. Morphometric analyses using digitized landmarks revealed many shape differences (e.g., tail depth and body size) between the species. The authors also found that body shape was significantly correlated with burst speed for both species, with deeper tails and smaller bodies contributing to faster speeds. These traits may help tadpoles not only to avoid predatory attacks, but also might allow them to escape attacks after they are initiated. This morphology-speed relationship may be a general ecomorphological pattern in tadpoles.

DAYTON, G. H., D. SAENZ, K. A. BAUM, R. B. LANGERHANS, AND T. J. DEWITT. 2005. Body shape, burst speed and escape behavior of larval anurans. Oikos 111:582–591.

Correspondence to: Gage H. Dayton, Section of Ecology and Evolutionary Biology, Department of Wildlife and Fisheries Sciences, Texas A&M University, Tamus 2258, College Station, Texas 77843-2258, USA; e-mail: gdayton@tamu.edu.

Predictability of Anuran Community Assemblages Influenced by Anthropogenic Disturbance

A significant amount of research has focused on predicting the species assemblages of given communities, but changes in community structure as a result of human disturbance are poorly understood. The authors investigated leaf litter amphibians in primary (i.e., undisturbed) and secondary (i.e., disturbed) rainforest at Taï National Park in the Ivory Coast to assay the predictability of the anuran communities in these habitats. They established ten 600-m transects (six in primary forest, four in secondary forest) and characterized 25-m subunits of the transects using 14 habitat variables. In 15 months (including both dry and wet seasons), they found 3843 individuals of 24 anuran species. Using Mantel tests to measure predictability of assemblages based on matrices of species distributions, environmental characteristics, and geographic distance, the authors found that when all data were pooled, all pairwise correlations among these matrices were significant. When data were partitioned by season and disturbance regime, they found no seasonal differences, but primary and secondary forests differed substantially. The anuran composition in primary forests could be predicted based on the geographic distances among sites, suggesting local stochastic recruitment from the regional species pool. In contrast, secondary forest communities could be predicted based on environmental characteristics, a result likely due to the restrictive microclimates available in disturbed areas that limit the species that may survive in such sites. The differences in community predictability between primary and secondary forests indicate that human disturbances not only affect species composition, but also might strongly influence community dynamics.

ERNST R., AND M. RÖDEL. 2005. Anthropogenically induced changes of predictability in tropical anuran assemblages. Ecology 86:3111–3118.

Correspondence to: Mark-Oliver Rödel, Theodor-Boveri-Institute, Biocenter of the University, Department of Animal Ecology and Tropical Biology (Zoology III), Am Hubland, D-97074 Würzburg, Germany; e-mail: roedel@biozentrum.uni-wuerzburg.de.

Bias in Sex Ratio Causes Population Extinction in Lizards

A predominant view in population biology holds that fluctuations in adult sex ratio (ASR) are limited by intrasexual competition, yet this hypothesis remains largely untested. The authors used the common lizard (*Lacerta vivipara*) in southern France to determine the consequences of biased ASR for individual and population dynamics. They established experimental populations of juveniles, yearlings, and adults in 12 enclosures and monitored these populations over one year to measure mortality, dispersal via one-way enclosure corridors, fecundity, and body condition. The 12 enclosures contained 6 female-biased populations (4 adult males, 14 adult females) and 6 male-biased populations (14 adult males, 4 adult females). Results showed that while male emigration and mortality did not differ by treatment, females emigrated more frequently in female-skewed populations, and female mortality was significantly higher in male-skewed populations. Increased female mortality under male excess was likely the result of male aggression during mating, as the percentage of females with mating scars and back injuries in male-biased populations was approximately three times that of female-biased populations. Further, fecundity was significantly lower in male-biased populations. Consequently, population size decreased in male-biased populations but increased in female-biased populations. To determine the possible long-term effects of male-biased ASRs, the authors constructed a stage-structured stochastic population model that confirmed a major population extinction risk under male excess.

LE GALLIARD, J., P. S. FITZE, R. FERRIÈRE, AND J. CLOBERT. 2005. Sex ratio bias, male aggression, and population collapse in lizards. Proceedings of the National Academy of Sciences 102:18231–18236.

Correspondence to: Jean-François Le Galliard, Laboratoire Fonctionnement et Evolution des Systèmes Ecologiques, Centre National de la Recherche Scientifique, Unité Mixte de Recherche 7625, Ecole Normale Supérieure, 46 Rue d'Ulm, 75230 Paris Cedex 05, France; e-mail: j.f.l.galliard@bio.uio.no.

Bone-by-Bone Skull Morphology of Spade-Headed Amphisbaenian

Amphisbaenians are a group of fossorial, mostly limbless squamates that are difficult to collect and therefore remain poorly-studied. Four basic cranial morphotypes exist within amphisbaenians: shovel-headed, round-headed, keel-headed, and spade-headed, that relate to their different head-first burrowing behaviors. Recent molecular work suggested that these morphotypes are not monophyletic, but may have evolved multiple times in independent lineages. In this study, the authors provided the first detailed cranial description of a spade-headed species, *Diplometophon zarudnyi*. Using nondestructive high-resolution x-ray computed tomography (HRXCT) on a single museum specimen from Saudi Arabia, the authors described the three-dimensional structure of the skull as a whole, as well as each individual cranial element. The authors also compared the detailed cranial anatomy of *Diplometopon* with two other previously described amphisbaenians, the shovel-headed *Rhineura hatcherii* and the round-headed *Amphisbaena alba*, which revealed that similar structures in different taxa were constructed in different ways. This bone-by-bone morphological data may contribute to greater resolution of the amphisbaenian phylogeny.

MAISANO, J. A., M. KEARNEY, AND T. ROWE. 2006. Cranial anatomy of the spade-headed amphisbaenian *Diplometopon zarudnyi* (Squamata, Amphisbaenia) based on high-resolution x-ray computed tomography. Journal of Morphology 267:70–102.

Correspondence to: Jessica Anderson Maisano, Jackson School of Geosciences, The University of Texas at Austin, Austin, Texas 78712, USA; e-mail: maisano@mail.utexas.edu.

Population Genetics Of Sympatric Garter Snakes

Many evolutionary and ecological factors might influence the population genetic structure of a species, and similar species in the same environment might experience factors leading to parallel patterns of population differentiation. Using microsatellite markers, the authors compared the population structure of two sympatric garter snake species, *Thamnophis elegans* and *T. sirtalis*, around Eagle Lake in northern California, to determine whether sharing a common landscape has led to similar patterns of genetic differentiation in these competing species. Tissue samples were collected from 858 individuals of *T. elegans* (20 populations) and 433 individuals of *T. sirtalis* (13 populations) at 22 sites. Each individual was genotyped at 11 microsatellite loci, three of which were developed for this study. Relative abundances of the species differed, with *T. elegans* being the more abundant, but their effective population sizes and bidirectional migration rates were comparable. Both species also displayed low but significant population differentiation, with *T. sirtalis* exhibiting more differentiation (i.e., a higher F_{ST}) and stronger isolation by distance. Also, large source populations and likely sinks were identified for each species, suggesting that local population extinction and subsequent recolonization are frequent events in the study area. Using two measures of genetic structure, pairwise F_{ST}s for shared populations and bidirectional migration rates, the authors found a weak but significant correlation between the two species, highlighting the important role of landscape and ecological factors in determining population genetic structure.

Manier, M. K., and S. J. Arnold. 2005. Population genetic analysis identifies source-sink dynamics for two sympatric garter snake species (*Thamnophis elegans* and *Thamnophis sirtalis*). Molecular Ecology 14:3965–3976.

Correspondence to: Mollie K. Manier, Hopkins Marine Station, Oceanview Blvd., Pacific Grove, California 93959-3094, USA; e-mail: manier@stanford.edu.

Natural Selection on Lizards Across an Ecological Transition Zone

Studying populations that occur across ecological transition zones (i.e., ecotones) provides an opportunity to determine the relative roles of local adaptation and gene flow in the evolution of phenotypic variation. In this study, the author examined how the entire lizard fauna at White Sands National Monument in New Mexico has responded to selection across a common ecotone. Three species of lizards—*Holbrookia maculata* (Lesser Earless Lizard), *Sceloporus undulatus* (Eastern Fence Lizard), and *Aspidoscelis inornata* (Little Striped Whiptail)—were sampled (N = 41–65/species) in white sand and dark soil localities, and the transition zone between the two. Body coloration was determined using spectrophotometric techniques, and genetic variation across the ecotone was characterized by sequencing the mitochondrial ND4 gene. Results showed that the three species displayed convergence of blanched coloration, but that species differed in the degree to which they matched white substrates and in their coloration at the ecotone. Also, patterns of population subdivision as measured by mitochondrial variation differed among the species, with interspecific differences corresponding to varying genetic connectivity across the ecotone. Overall, the species that had the greatest phenotypic response to substrate differences (*H. maculata*) also displayed the strongest population structure, with *S. undulatus* and *A. inornata* exhibiting intermediate and low levels of these traits, respectively. Matrix correspondence tests revealed that coloration corresponded with habitat similarity, but not genetic similarity, for these lizard species. Together, the results indicated that convergent phenotypic evolution reflects divergent selection on the three species, and that adaptation in this community is moderated by gene flow across the ecotone.

Rosenblum, E. B. 2006. Convergent evolution and divergent selection: lizards at the White Sands ecotone. American Naturalist 167:1–15.

Correspondence to: Erica Bree Rosenblum, Museum of Vertebrate Zoology, University of California, Berkeley, California 94720, USA; e-mail: rosenblum@berkeley.edu.

Prosauropod Dinosaur Had Variable Life Histories

The long bones of most dinosaurs indicate that these animals had growth and metabolic rates much higher than modern reptiles, and that there was little final size variation among individuals within a species. However, histology of long and girdle bones of a common early prosauropod dinosaur, the large-bodied *Plateosaurus englehardti*, revealed that individual growth rates and life histories of this species were influenced by environmental factors, as in extant ectothermic reptiles. The authors determined that *P. englehardti* specimens from two sites, Trossingen (N = 32) and Frick (N = 9), could be grouped into three categories based on growth cycles of the fibrolamellar bone and the patterns of lines of arrested growth: fast-growth, slow-growth, and fully grown. To their surprise, fully grown individuals spanned the entire size range of the specimens, and fast-and slow-growth individuals covered a large size range as well. Additionally, there was a weak correlation between body size and age. Therefore, growth rate and final size appeared to vary widely among individuals of this dinosaur species, evidence of strong developmental plasticity that contrasts with most other dinosaurs and is a reversal to the ancestral condition of ectothermy. The authors speculated that *P. engelhardti* might represent the first stage of the evolution of endothermy in dinosaurs.

Sander, P. M., and N. Klein. Developmental plasticity in the life history of a prosauropod dinosaur. Science 310:1800–1802.

Correspondence to: P. Martin Sander, Institut für Paläontologie, Univeristät Bonn, Nussallee 8, D-53115 Bonn, Germany; e-mail: martin.sander@uni-bonn.de.

Seasonal Differences In Rattlesnake Hormones

Closely-related species often exhibit marked variation in mating systems, even when they occur in sympatry. One example of this situation involves *Crotalus atrox*, the Western Diamond-backed Rattlesnake, and *Crotalus molossus*, the Black-tailed Rattlesnake,

which co-occur in the southwestern United States and Mexico, but differ in the frequency and timing of their mating periods. The authors examined these species to determine whether males display seasonal patterns of plasma sex steroids and whether these hormones are most abundant during each species' mating season. Using radioimmunoassay techniques, they measured testosterone, 5α-dihydrotestosterone, and 17β-estradiol in blood samples collected at monthly intervals from wild-caught adults of each species. Results showed that the annual cycles of these hormones significantly differed in the two rattlesnake species, with *C. atrox* displaying a bimodal hormone abundance pattern that corresponded to its two mating seasons, while *C. molossus* had a single hormone peak during its single mating season. The authors also discussed between-year differences in hormone levels, the influence of body condition on sex hormone production, and possible causes of the hormone cycles observed in this study.

SCHUETT, G. W., D. L. HARDY, SR., H. W. GREENE, R. L. EARLEY, M. S. GROBER, E. A. VAN KIRK, AND W. J. MURDOCH. 2005. Sympatric rattlesnakes with contrasting mating systems show differences in seasonal patterns of plasma sex steroids. Animal Behaviour 70:257–266.

Correspondence to: Gordon W. Schuett, Department of Integrated Natural Sciences, Arizona State University West, P.O. Box 37100, Phoenix, Arizona 85069-7100, USA; e-mail: gschuett@asu.edu.

Reproductive Isolation of Salamander Morphs

Reproductive isolation (RI) is a prerequisite to sympatric speciation, but few studies have investigated potential incipient species. The authors performed field observations of two natural populations of facultatively paedomorphic salamanders (*Ambystoma talpoideum*) in which individuals become either terrestrial metamorphic adults or aquatic paedomorphic morphs depending on the environment experienced during development. Both morphs may coexist in the same population, but there are a number of morphological, behavioral, and ecological differences between the two. The authors used drift fences and pitfall traps surrounding each population and minnow traps in ponds to measure temporal and spatial breeding separation and body-size variation between morphs. Results showed that paedomorphic males and metamorphic females have essentially no reproductive isolation, but that metamorphic males and paedomorphic females had considerable RI. This asymmetry in RI might be the result of factors such as morph abundance, rainfall, and depth of breeding ponds. Spatial isolation played a more important role in RI than temporal isolation, mostly because the morphs generally occur at different water depths. These results suggested that there is limited potential for sympatric speciation within these salamander populations, but the asymmetric RI might cause fitness differences between the morphs that could influence the persistence of this polymorphism.

WHITEMAN, H. H., AND R. D. SEMLITSCH. 2005. Asymmetric reproductive isolation among polymorphic salamanders. Biological Journal of the Linnean Society 86:265–281.

Correspondence to: Howard H. Whiteman, Department of Biological Sciences, Murray State University, Murray, Kentucky 42071, USA and Savannah River Ecology Laboratory, Drawer E, Aiken, South Carolina 29802, USA; e-mail: howard.whiteman@murraystate.edu.

OBITUARIES

Herpetological Review, 2006, 37(1), 7–10.

Michael Allyn Ewert
1938–2005

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Michael Ewert, whose work in the field of chelonian developmental biology influenced researchers around the globe, passed away from multi-focal renal cell carcinoma on 7 June 2005, at the age of 66. Until only a week earlier, extended hospice care had allowed Mike to live independently, and though his last months were uncomfortable, he managed to maintain nearly his normal schedule and concentrate on finishing projects. As a self-described loner, Mike had consciously made the decision not to seek extraordinary means to extend his life, but rather to use his remaining time to live as he always had and complete as much of his legacy of work as possible.


PHOTO BY DALE JACKSON

Mike Ewert holding a 36 kg adule male Alligator Snapping Turtle along the Apalachicola River, Florida, October 1993.

Mike learned that he had a potentially terminal disease in December 2003, but he chose to tell almost no one, so as not to cause any needless stress or concern or alter the nature of ongoing relationships. He informed my wife Ghislaine and me (with request to tell no one) in February 2005, as it had become obvious to him that it might fall on me to complete several joint papers without him (he was senior author), he expressed his desire for me to write his herpetological obituary, and he wanted my wife to have some of his artistic treasures and favorite turtles. We immediately made plans to drive to Indiana to see him; following his advice, we waited until after mid-March for winter to depart, and visited during the first week of April. The timing was fortuitous, as warm sunny weather even allowed Mike to show us two of his favorite nearby collecting localities, Griffy Lake Nature Preserve and Yellowwood State Forest, where we saw basking red-eared and painted turtles.

Mike's life was an academic one, and his work with turtle eggs led to global recognition as one of the premier developmental bi-

ologists in his field. Despite some recent forays with alligator eggs, to most of us, Mike and turtles were synonymous. In fact, turtles had been a passion since boyhood. Interestingly, though, his early scientific career focused on other taxa.

Michael Allyn Ewert was born 26 July 1938 in Cambridge, Massachusetts. He was the second of four children and the only son of Margaret Moore Ewert and Earl E. Ewert, M.D. His mother was a homemaker who enjoyed art, especially sketching and painting, and his father was a urologist at Lahey Clinic in Boston. Sister Gail (Abigail) was only two years his senior, while Barbara and Gretchen followed Mike by six and 11 years.

Young Mike developed his interests in animals early. When he was four, his family moved into a house with a backyard pool, and it was this first aquatic ecosystem that seemed to kindle the spark. He recalled at age five catching dytiscid beetles in the pool as the neatest thing he'd ever done to that time, and shortly thereafter he was chasing dragonflies with a net bought by his mother. A few wayward painted turtles picked up from the roads followed. Summer camps allowed him to further hone his skills at turtle collecting. Though he enjoyed keeping turtles, for Mike, the greatest excitement was simply in finding them.

Despite his keen mind, Mike encountered severe problems in public elementary school. Reading and writing were difficult, friends were few, and his teachers seemed just to pass him along to the next grade rather than trying to help. Although not well understood at the time, Mike suffered from the learning disability known today as dyslexia. Possibly associated with his being left-handed and possessing an artistic bent, the condition not only made learning hard but also shaped his personality. Rather than developing the assertiveness and aggression of many young boys, Mike learned to evaluate and assess situations carefully, watching rather than participating. He preferred to spend long hours alone and found it difficult to form close social bonds. However, things improved when he was taken from public school and educated for three middle grades by reading specialists at Boston University. At the same time, his mother tutored him in geography and mathematics.

From 1952–1957, Mike attended private boarding schools: first The Fessenden School, and then The Choate School, where at least a few teachers were better qualified to meet his challenge. Though he despised the first year, the schools taught him that he could succeed, and his subsequent years were more enjoyable. He gravitated toward woodshop, where he was able to express his artistic side thanks to a supportive, elderly shopkeeper. Although schedules were regimented, Mike still found time to pursue turtles. At one school set in the Connecticut countryside, he even built rock holding structures in the wooded streams, where he stashed wood turtles destined to be packed back to his Massachusetts home hidden in a suitcase of dirty laundry, along with a few spotted and box turtles.

Following high school graduation, Mike wanted to leave New England. The sight of palm trees on California's Stanford University catalog convinced him that this was where he should go for undergraduate study, and his father agreed to pay the rather low tuition at the time. Three courses taught by Paul Ehrlich, including Entomology and Evolution, were especially formative. Annual journeys from Stanford back home to Massachusetts became cross-country collecting opportunities. One highlight was the capture of a juvenile smooth softshell turtle in southeastern Colorado, a record for the state but never officially documented. He also recalled with pleasure the capture of spiny softshells in Iowa, and his amazement at the brilliant colors of his first western painted turtles, caught near Socorro, New Mexico. In 1961, Mike received his B.A. in Biology (Chemistry minor) from Stanford.

It was during his high school and undergraduate years that Mike focused on a secondary interest unknown to most of his later colleagues....art, and especially sculpture. In fact, when he entered Stanford, he had a difficult time determining whether he wanted to be a biology major or an art major. On the first evening of our visit, my wife and I were amazed as we watched him unearth many of his works from boxes, nooks, and crannies in his crowded office and even more crowded house. Wood carvings of mammals preceded a brass Chinese dragon phase, with a few paintings thrown in for good measure. Our favorite, which he bequeathed to Ghislaine for her love of softshell turtles, was a splendid rosewood *Apalone ferox*.

For graduate studies, Mike moved to the University of Minnesota. Despite his burgeoning turtle interests, the combination of his insect-chasing childhood, Ehrlich's influence, and funding opportunities funneled Mike into entomology. In 1965 he was granted an M.S. in Entomology with a Botany minor. His thesis, "Factors Affecting the Distributions of Three Species of Coccinellidae (Coleoptera) in their Microhabitat," was a carefully conducted ecological study of local ladybird beetles. It was also in 1965 that Mike married Barbara Corbett, known to many in the herpetological profession through their use of her company's (AVM Instrument Co.) radiotelemetry equipment. Although the relationship lasted little more than three years, Mike and Barbara later resumed a friendship marked by genuine mutual respect.

While working on his Master's thesis, Mike discovered that the Entomology Department had a bevy of excellent laboratory incubators. Having already found a prime painted turtle nesting area near campus, he took advantage of the situation to begin exploring the factors that determine hatchling emergence (was a cold period vital?). Despite not publishing his results, turtle eggs and their development would become his primary research focus for the next four decades.

Although remaining at Minnesota to pursue a Ph.D., a declining relationship with his thesis professor prompted Mike to leave entomology and study under Dr. John Tester, who had funding to support a field project on toads. His 1969 dissertation, "Seasonal Movements of the Toads *Bufo americanus* and *B. cognatus* in Northwestern Minnesota," yielded a Ph.D. in Wildlife Management, again with a Botany minor. While monitoring hibernating toads on wind-whipped mid-winter nights with temperatures as low as -34°C, Mike (with help from fellow graduate student Jeff Lang), managed to record some painted turtle nest temperatures as well. This stimulated him to examine super-cooling of turtle eggs and hatchlings in the lab, though equipment limitations precluded any major breakthroughs.

Upon graduation in 1969, Mike was hired to teach general zoology, ecology, and human anatomy and physiology at the University of Wisconsin Center System, West Bend Campus. He and one botanist comprised the entire Biology Department. His complete lack of prior teaching experience, coupled with an introverted personality born of dyslexia, made teaching a difficult and unreward-

ing experience, and he stayed only two years. During this time, however, he continued to capture turtles and incubate eggs. His research was facilitated by his discovery that eggs could be induced from gravid females with oxytocin (Ewert and Legler 1978), so that he could now reduce the number of turtles sacrificed and the potential impacts on small populations.

After leaving UWCS in 1971, and with no particular place to go but a desire to be in a research setting, Mike accepted the offer of his graduate school friend, Kelly Williams, to share his large abode in Bloomington, Indiana. Mike shortly established a relationship with Dr. Craig Nelson in the Biology department of Indiana University, and Craig invited him to bring his 80 turtles and share his ample lab space and conduct research there. Though surely both viewed the arrangement on a trial basis, it worked; Mike never left, and more than three decades later, he remained intimately associated with the Nelson lab. While he found formal work conducting a variety of biological field surveys through IU's School of Public and Environmental Affairs, Mike used the 1970s to develop a pioneering program in turtle embryology, much of which he summarized in two lengthy and highly acclaimed book chapters (Ewert 1979, 1985). By the early 1980s he had become especially intrigued by temperature-dependent sex determination (TSD) and was producing huge numbers of hatchling turtles for gonadal examination (a technique elucidated to him by Richard Vogt). Results were summarized in Ewert and Nelson (1991). For the next two decades, as a Postdoctoral Associate in the Department of Biology, Mike served as an inspiration, colleague, and part-time mentor to many IU students who passed through the Nelson lab.

In addition to his academic pursuits, Mike made important contributions to reptile conservation. For the past 15 years he was an active member of the Indiana Department of Natural Resource's Technical Advisory Committee for Amphibians and Reptiles. He also authored or co-authored numerous species accounts for incipient books on global turtle conservation as well as the conservation and biology of Florida turtles.

Like most herpetologists, Mike enjoyed traveling. During our interview, he recalled with joy his journeys to Mexico (in 1961 with his mother, and later for meetings and to collect turtles with John Iverson and myself), Australia (including a 1997 appointment as Distinguished Visiting Scholar at the Australian National University, Canberra), Venezuela (with Craig Nelson and son), India (with sister Gretchen to visit herpetologist R. J. Rao and the Madras Crocodile Bank), and England (1989 World Congress of Herpetology).

Mike is survived by his three sisters, Abigail Winston Ewert and Gretchen S. Ewert, both of New Mexico, Barbara Ewert Taylor, of New Hampshire, and by his good friend and ex-wife Barbara Corbett Kermeen, of Chicago Park, California..

Mike was a tireless, dedicated, and meticulous researcher who produced an extensive body of scientific research that garnered the attention of biologists worldwide. Though never in a position to direct students formally, he gave freely of his time and knowledge; upon learning of his passing, many such students as well as former colleagues shared heartfelt sentiments with me and noted the influence Mike had on their professional lives. Despite his introverted nature and often irreverent disdain for society's expectations, Mike was a truly remarkable and sensitive man. Those of us who knew him will miss his uninhibited laugh, his enthusiasm, and his presence in our lives.

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ZOO VIEW

Herpetological Review, 2006, 37(1), 10–13.

Wild and Ferocious Reptiles in the Tower of London

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The Tower of London is best known as a prison where human inmates were subjected to harsh and cruel punishments so it might be surprising that this forbidding venue also served as a repository for wild animals. The Royal Collection of Wild and Ferocious Beasts kept at the Tower of London Menagerie spanned ca. 600 years, beginning in 1245 (Loisel 1912; Keeling 1992; Hahn 2004; Fig. 1). During that time, leopards, lions, tigers, ostriches, wolves, kangaroos, zebras, elephants, polar bears, monkeys, baboons, eagles and other birds of prey, macaws and other psittacines, and a stunning variety of other creatures could be found in the Tower as tourist attractions. Although seemingly not an ideal facility for reptiles with its stone walls and barred dens, at various times over the span of six centuries, the rattlesnake, the Indian boa, the anaconda, and the alligator lived in a large outdoor enclosure surrounded by a moat. All of these reptiles are illustrated in Edward Turner Bennett's book, "The Tower Menagerie: Comprising the Natural History of the Animals Contained in that Establishment, with Anecdotes of Their Characters and History. Illustrated by Portraits of Each, Taken from Life, by William Harvey, and Engraved on Wood by Branston and Wright" in 1829. Bennett described the difficulties in drawing animals, "The whole of the drawings are from the pencil of MR WILLIAM HARVEY, who, in seizing faithful and characteristics portraits of animals in restless and almost incessant motion, has succeeded in overcoming difficulties which can only be appreciated by those who have attempted similar delineations."

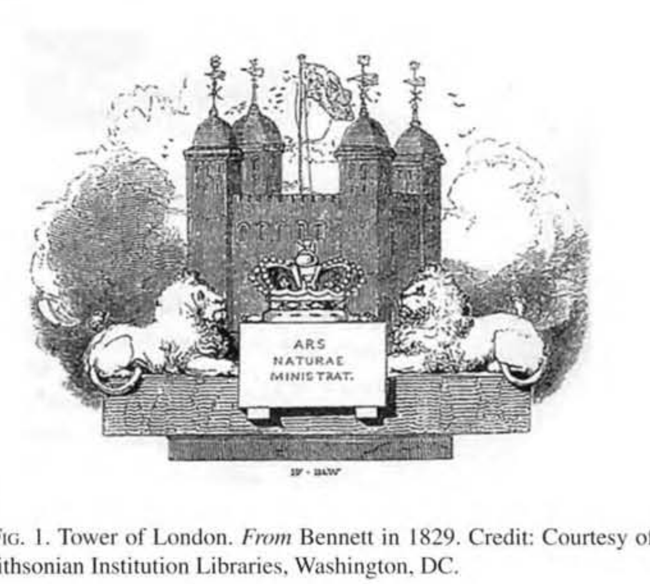

FIG. 1. Tower of London. *From* Bennett in 1829. Credit: Courtesy of Smithsonian Institution Libraries, Washington, DC.

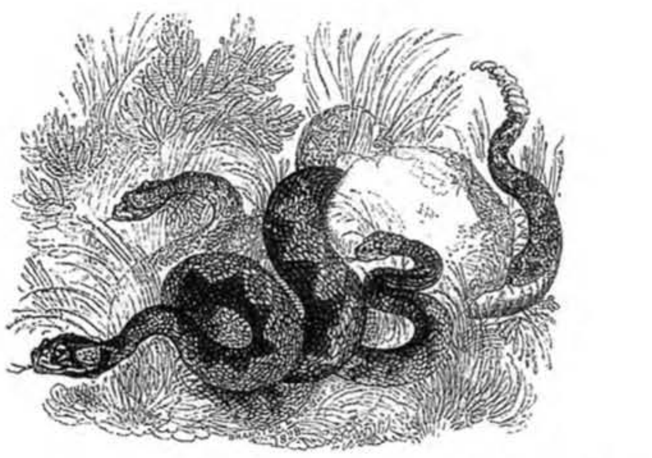

FIG. 2. Over 100 rattlesnakes (*Crotalus horridus* Linn.) lived in the Tower of London. *From* Bennett in 1829. Credit: Courtesy of Smithsonian Institution Libraries, Washington, DC.

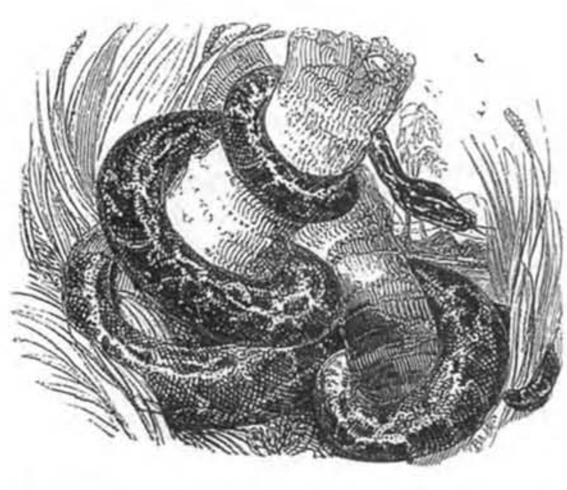

FIG. 3. Tower python, called Indian Boa (*Python Tigris* Daud., now *Python molurus*) by Bennett (1829), laid a clutch of 14–15 eggs which did not hatch. Credit: Courtesy of Smithsonian Institution Libraries, Washington, DC.

Alfred Cops worked at the Exeter 'Change in the Strand but left this job in 1822 to take charge of the Royal Menagerie at the Tower. Daniel Hahn (2004) described his skills as an animal caretaker, "Cops was a professional zoologist and an expert on animal behavior, a man with extensive training and experience looking after captive animals . . . It was expected that such a man would be able to expand and improve the Menagerie, making it exciting and competitive in a way that it had not been for some years, and at the same time improve the animals' living conditions sufficiently to satisfy the newly fashionable anticruelty lobbies."

Given that rattlesnakes may be delicate to keep in captivity, it is amazing that over 100 rattlesnakes (identified *Crotalus horridus* Linn. by Bennett) survived sea voyages from the New World to be cared for by Cops in the Tower; perhaps their survival is a testament to Cops' ability (Fig. 2).

Here is Bennett on rattlesnake behavior, "It was long believed, and the notion is still popularly current, that they possessed the power of fascinating their victims, which were thought to be so completely under the influence of their glance as to precipitate themselves of their own accord into the open throat of their enemy; but the truth appears to be that they actually inspire so great a degree of terror that the animals selected for their attacks are commonly rendered incapable of offering such resistance as might otherwise be in their power, or even of attempting to escape from their pursuit."

Cops nearly bred the Tower python, called Indian Boa (*Python Tigris* Daud., now *Python molurus*) by Bennett (Fig. 3). The python laid a clutch of eggs which did not hatch. Bennett described the event, " The individual figured at the head of the present article is a female; a fact which was proved by the remarkable circumstance of her producing in May last, after having been more than two years in the Menagerie, a cluster of eggs, fourteen or fifteen in number, none of which, however, were hatched, although the mother evinced the greatest anxiety for their preservation, coiling herself around them in the form of a cone, of which her head formed the summit, and guarding them from external injury with truly maternal solicitude." This account is certainly one of the first to describe brooding behavior in pythons. Three years later, naturalist Lamarre-Picquot lectured before the Academie de France about the brooding of a *Python molurus bivittatus* in the Jardin des Plantes in Paris (Fig. 4) and claimed that the female not only coiled around the clutch but produced "noticeable warmth," a finding expressed again in a note in 1842. This observation was widely criticized as speculative, hazardous, and questionable by members of the Academie, especially Auguste Duméril (1842). The thermogenesis controversy was finally settled over 130 years later when sophisticated temperature and gas exchange recording devices were available. Victor H. Hutchison, Herndon G. Dowling, and Allen Vinegar published two important papers on metabolism, energetics and thermoregulation in brooding female pythons at the New York Zoological Society (Hutchison et al. 1966; Vinegar

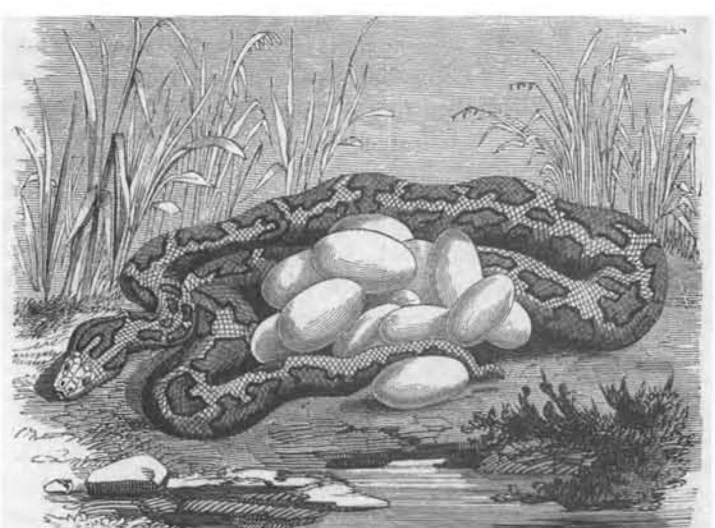

FIG. 4. Indian python (*Python molurus*) incubating eggs at Menagerie Jardin des Plantes. Illustration reproduced from S. G. Goodrich's "Johnson's Natural History, Comprehensive, Scientific, and Popular, Illustrating And Describing The Animal Kingdom With Its Wonders And Curiosities, From Man, Through All The Divisions, Classes, And Orders, To The Animalculae In A Drop of Water; Showing The Habits, Structure, And Classification Of Animals, With Their Relations To Agriculture, Manufactures, Commerce, And The Arts. Volume 2 in 1870." Credit: Courtesy of Smithsonian Institution Libraries, Washington, DC.

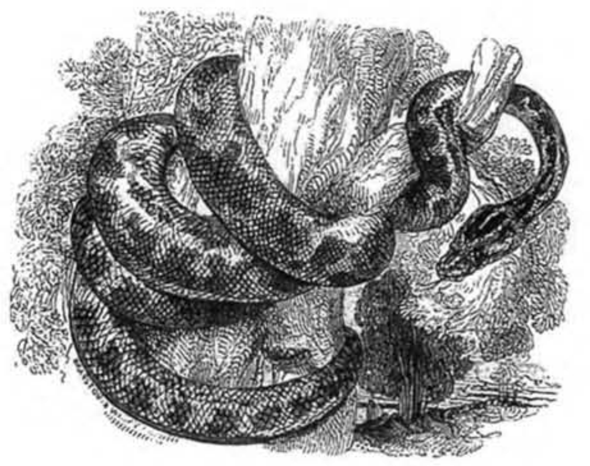

FIG. 5. The Anaconda, called *Python Tigris* Var. by Bennett, were likely Ceylonese pythons, *Python molurus pimbura*. Credit: Courtesy of Smithsonian Institution Libraries, Washington, DC.

et al. 1970). The abstract in the first paper reads: "At varying environmental temperatures, measurements of body temperatures and gas exchange of a female Indian python (*Python molurus bivittatus*) show that during the brooding period this animal can regulate its body temperature by physiological means analogous to those in endotherms. Ambient temperatures below 33°C result in spasmodic contractions of the body musculature with a consequent increase in metabolism and body temperature."

The Anaconda, called *Python Tigris* Var. by Bennett, were likely Ceylonese pythons, *Python molurus pimbura* (Fig. 5). Cops discovered that captive snakes may have impressive feeding responses when one of his pythons grabbed his hand and threw two coils around his neck while being fed. Bennett told the story, "His own exertions, however, aided by those of the under keepers, at length disengaged him from his perilous situation; but so determined was the attack of the snake that it could not be compelled to relinquish its hold until two of its teeth had been broken off and left in the thumb."

Coote (2001) speculated that the first American Crocodile, *Crocodylus acutus*, received by the London Zoological Society in

FIG. 6. Tower "Alligator" called *Crocodilus lucius* Cuv. by Bennett in 1829. Note the abnormally small head. Credit: Courtesy of Smithsonian Institution Libraries, Washington, DC.

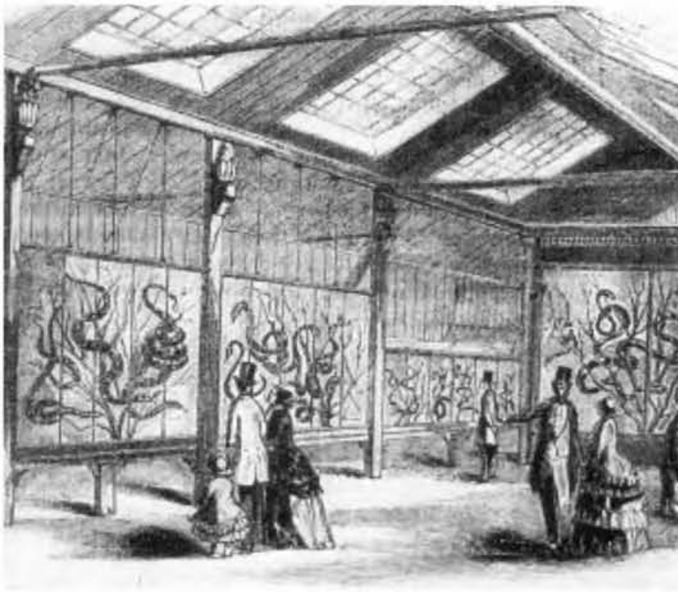

FIG. 7. Description of London Zoo reptile building from *The Illustrated London News* on 2 June 1849. The beginning of the article reads as follows: "The new reptile house in the Gardens of the Zoological Society in the Regent's Park will ultimately form one of the most instructive, as it is the most novel and original feature in this delightful institution. The collection already contained in it is so unexpectedly brilliant, considering the small number of reptiles previously exhibited in the Menagerie, that we cannot but anticipate the most important results in the study of this singularly interesting division of the animal kingdom." Credit: illustration provided by Kraig Adler.

1831, may have been the Tower "Alligator" (Fig. 6). However, the drawing by William Harvey looks like an American alligator and is called *Crocodilus lucius* Cuv., an early name for the alligator. Robert Huish's drawing in 1830 also appears to be an alligator (see Fig. 2 in *Herpetological Review* 36(3):230). In both illustrations, the alligator's head is abnormally small.

The Tower collection of animals was presented by the King to the Zoological Society of London in 1831 (Peel 1903:180). Eighteen years later, the London Zoo in Regent's Park opened the world's first zoo reptile building (Fig. 7).

Acknowledgments.—Smithsonian National Zoological Park Librarian Alvin Hutchinson, and Leslie Overstreet and Daria Wingreen in the Joseph F. Cullman 3rd Library of Natural History (from the SI Special Collections Department) helped locate historical literature. Judith Block and Jon Coote reviewed early drafts of this manuscript. I thank Kraig Adler for providing the illustration of the reptile building at London Zoo.

This contribution is dedicated to Jon Coote, who has expanded our understanding and appreciation of early herpetocultural practices through his writings.

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ARTICLES

Herpetological Review, 2006, 37(1), 13–20.

Reproduction and Growth of Seven Species of Dwarf Geckos, *Sphaerodactylus* (Gekkonidae), in Captivity

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A diversity of reproductive, growth, and survival strategies (Shine and Charnov 1992) have made lizards model organisms in the investigation of how environmental factors and phylogenetic constraints shape life-history traits (Clobert et al. 1998; Dunham 1978; Shine and Greer 1991; Sinervo and Adolph 1994; Tinkle et al. 1970). However, ecological studies on the family Gekkonidae, the second most speciose family of lizards (Uetz 2000), are few (see Vences et al. 2004 and references therein). Small and usually invariant clutch sizes (Kluge 1987, but see Colli et al. 2003; Shine and Greer 1991), nocturnal activity, and microhabitats that are usually not conducive for easy field observation and manipulation may have biased researchers against selecting geckos for life-history study. The lack of life history information is even more evident in dwarf geckos, genus *Sphaerodactylus* (Krysko et al. 2003; López-Ortiz and Lewis 2002). However, some dwarf gecko species are believed to reach the highest known population densities of terrestrial vertebrates in some areas (Rodda et al. 2001). Miniaturization in *Sphaerodactylus* has led to even more secretive habits and, thus, amplified the problems of tractability.

Because most *Sphaerodactylus* species are typically parapatrically distributed, are similar in shape, and published descriptions of their microhabitat are usually general, they have been assumed to be ecologically similar (but see Thomas et al. 1992). Still there may be important differences in ecological factors that have been overlooked. For instance, selection acting on a gecko that inhabits and defends the underside of a rock should be different from those acting on a congeneric inhabiting the adjacent leaf litter; likely, they would face different predators, hunt different prey, and experience different social environments, but have been reported simply as living in the leaf litter.

The major objective of this study is to describe reproduction and growth in seven *Sphaerodactylus* species kept in captivity. Although data from captive populations may be different from wild populations (e.g., growth rates/clutch sizes may vary in relation to proximate climate factors and food availability [Stamps and Tanaka 1981]), they may be useful for uncovering differences among related species that could generate testable hypotheses, suggest field research projects, and help interpret field data.

Sphaerodactylus nicholsi, *S. townsendi*, and *S. roosevelti* were collected from backyards and dumpsites on the southwestern coast of Puerto Rico (Guanica, Ensenada, Punta Verracos, Punta Pestillo, Paso Seco, and Salinas) in 1995, 1997, and 1999. Individuals of *S. nigropunctatus granti*, *S. argus*, and *S. pimienta* were obtained from eggs collected in eastern Cuba (Holguín, Belic, and El Yarey, respectively). *S. savagei* adults, from the northeastern of Dominican Republic, were obtained from a South Florida dealer in 2001. The natural history for most of these species is summarized by Schwartz and Henderson (1991). Nothing is known about the natural history of *S. pimienta*.

Lizards were housed individually or in male-female pairs in plastic containers (1.9 L), kept indoors, and were exposed to natural light cycles (through open windows) typical of South Florida. Containers were provided with a substrate made of soil and peat moss, a few small rocks, dead leaves and pine bark. Enclosures were misted with water three times a week and exposed to daily and seasonal temperature and humidity changes. Mean air temperature ranged from 24°C to 33°C from April through October and from 14°C to 23°C from November through March, from 1996 to 2001. Vitamin and mineral-dusted insect larvae and adults (fruit flies, humpback flies, crickets, and ants) were provided at two or three day intervals.

Containers were inspected weekly to find newly laid eggs, usually under leaves, bark, or in the substrate 1–2 cm below the surface. The largest and smallest egg diameters were measured to the nearest 0.1 mm with an ocular micrometer. Eggs were placed individually in small plastic containers (30 cc) with a sterile soil/peat moss substrate and incubated in a plastic box (20 x 20 x 30 cm) in the same room, exposed to daily and seasonal temperature fluctuations. Eggs were checked every week during the first month of incubation, and later in the study every day. To explore the potential effect of temperature on incubation duration (Andrews 2004), individual records for each species were pooled into two groups: eggs incubated during May–October (high temperature)

and eggs incubated during the Nov–April (low temperature). Incubation duration and snout-vent length (SVL) of neonates, measured to the nearest 1 mm with a plastic ruler, were recorded. For females that survived at least until November in a year, I estimated oviposition frequency (days) and annual egg production.

Snout–vent length of all individuals was measured monthly, but also when I noticed the first sign of sexual maturity: the escutcheon, a triangular group of discolored scales on the posterior abdominal region of males, and the first oviductal egg in females. Four of the taxa (*S. nicholsi*, S. *n. granti*, *S. savegei*, and *S. roosevelti*) exhibit sexual dichromatism, all or some males develop a different color pattern than females. As the change in male coloration started several weeks after the emergence of the escutcheon, SVL was also recorded at this time. Finally, a sexual size dimorphism index (SDI) for each species was calculated following Lovich and Gibbons (1992) as: (mean asymptotic size of females/mean asymptotic size of males) - 1. Asymptotic size (Stamps and Andrews 1992) was estimated as the SVL of individuals that survived at least six months in captivity and did not grow during this period.

Growth characteristics were described by fitting data from captive-born individuals using the logistic-by-length model (Schoener and Schoener 1978), $L = a/(1 + be^{-kt})$, where L is the SVL at time t (in months), a is the maximum (asymptotic) length, e is the base of natural logarithm, k is the intrinsic growth rate or rate of approach to a, and b is related to hatchling size. Data for each gender were analyzed separately using CurveExpert (Hyams 2003). To explore the influence of temperature on growth rate, monthly relative growth rate was calculated for all individuals as the difference in SVL between two measurements divided by the SVL at the first measurement.

Mean, standard deviation, range, and sample size for each trait are presented in Tables (1–3), but medians are compared in box plots when extreme outliers are present. Pearson's correlation coefficient (r) was estimated to show the relationship between variables. No statistical test was performed to compare those statistics between genders or species because of the small sample sizes.

Relationships between egg traits and female and hatchling SVL were similar to other geckos (Vitt 1986). For example, the mean egg diameters and offspring size covaried at species level with mean asymptotic size of females (Tables 1, 2; Fig. 1A, B, C). Also, no intraspecific correlation between egg size or hatchling SVL and female SVL was found in any species (Okada et al. 2002). However, as annual egg production was usually higher in the second year of life when most females reached their asymptotic size (Table 1), annual egg production may be positively related to female SVL. Moreover, some females in four species (*S. nicholsi*, *S. argus*, *S. roosevelti*, and S. *pimienta*) oviposited fertile eggs after spending six or more months alone, illustrating the potential for sperm storage suggested for other geckos (Bou-Resli et al. 1981).

The oviposition frequency varied within and among species (Table 1), and its median seemed related to species asymptotic size: approx. 20 days among the smallest species and 30 days in the medium to largest species (Fig. 1D). Most species concentrated their reproductive output in the warmer and more humid months of the year, but *S. argus* laid eggs almost continuously throughout the year (Fig. 2A). In all species, periods of almost continuous egg-laying activity were interspersed with resting periods of different duration. *Sphaerodactylus* may be capital breeders like many lizards (Bonnet et al. 1998), but the energy, proteins, and calcium stored in their small bodies might not sustain their annual egg production and, thus, might require rest periods to replenish energy and nutrient reserves to continue laying eggs.

All species had the typical clutch size of the genus (Kluge 1987), i.e., one egg. However, a few females of *S. nicholsi*, *S. argus*, and *S. nigropunctatus* occasionally showed two large-shelled eggs, al-

TABLE 1. Female egg and incubation data for seven species of *Sphaerodactylus*. Mean ± SE (range; N).

Species	Egg diameters (mm)		Annual egg production		Oviposition frequency (days)	Incubation duration (days)
	Largest	Smallest	1st yr of life	2nd yr of life		
S. nicholsi	5.3 ± 0.1 (4.9–6.1; 8)	4.3 ± 0.1 (3.9–4.9; 8)	8.6 ± 0.7 (6–12; 9)	11.8 ± 2.4 (5–16; 4)	19.5 ± 0.7 (10–50; 17)	62.5 ± 2.4 (53–78; 26)
S. townsendi	5.9 ± 0.1 (5.4–6.2; 7)	4.3 ± 0.2 (3.3–4.8; 7)	5.3 ± 0.9 (4–7; 3)		19.4 ± 1.1 (13–33; 8)	76.6 ± 10.2 (58–93; 3)
S. argus	7.2 ± 0.1 (6.9–7.5; 7)	5.4 ± 0.0 (5.1–5.6; 7)	6.8 ± 1.6 (4–12; 5)		29.3 ± 2.6 (10–60; 6)	64.0 ± 2.0 (53–80; 15)
S. savagei	6.4 ± 0.2 (5.8–7; 6)	5.1 ± 0.1 (48–5.6; 6)	7.0 (1)		32.3 ± 7.1 (11–73; 5)	86.0 ± 4.8 (74–98; 5)
S. n. granti	7.4 ± 0.1 (7–8.1; 1)	5.8 ± 0.1 (5.4–6.2; 1)	3.0 (1)	9.0 (1)	22.2 ± 3.6 (11–59; 2)	81.0 ± 6.4 (74–94; 3)
S. roosevelti	8.6 ± 0.1 (8.5–8.6; 2)	6.2 ± 0.2 (6–6.4; 2)	5.0 (1)	5.0 (1)	26.8 ± 2.3 (21–31; 4)	67.0 ± 13.0 (54–80; 2)
S. pimienta	9.1 ± 0.1 (8.6–9.6; 9)	7.0 ± 0.1 (6.6–7.4; 9)	2.8 ± 0.3 (2–4; 6)	5.7 ± 0.9 (4–7; 3)	45.0 ± 5.6 (17–121; 7)	76.3 ± 4.1 (53–125; 20)

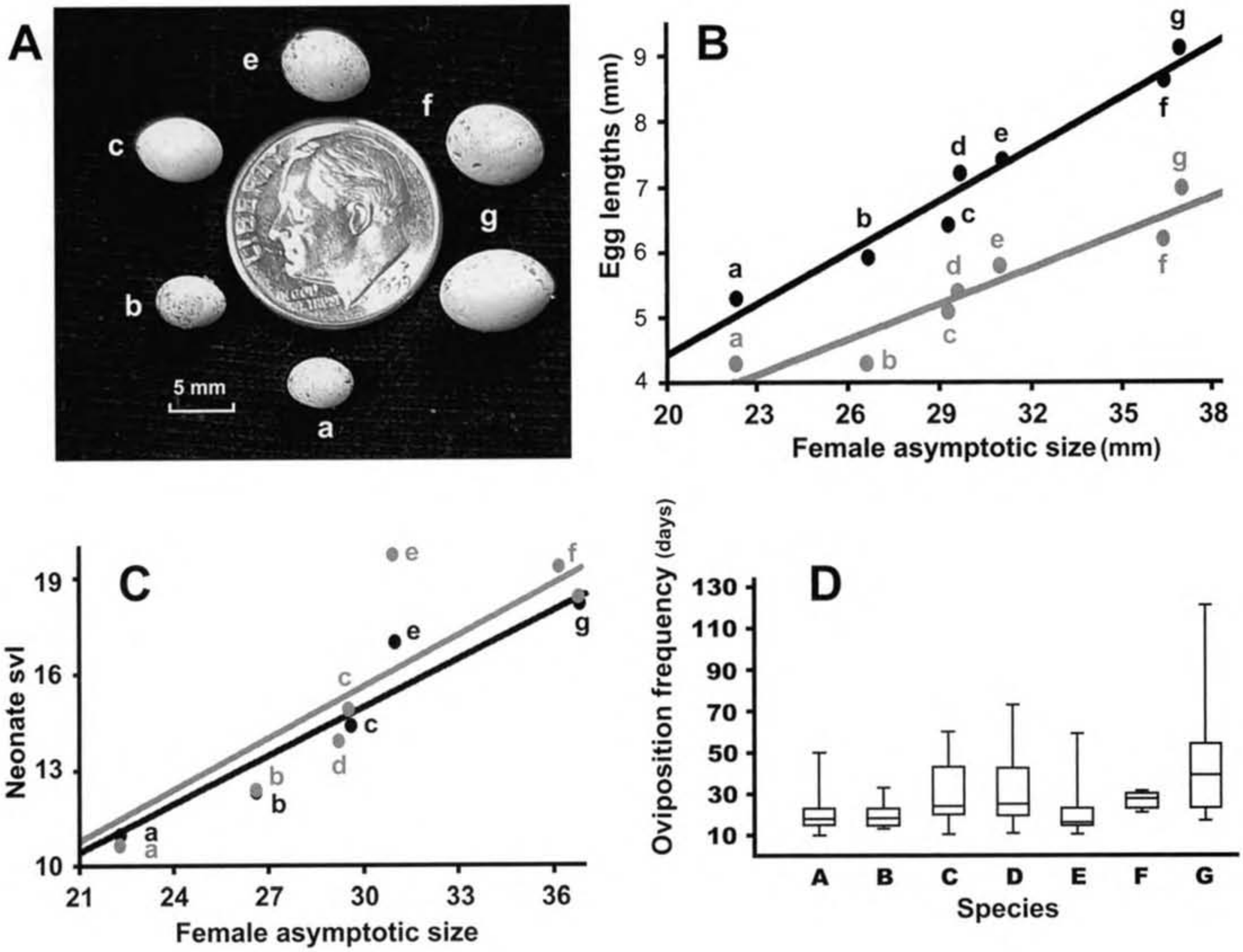

Fig. 1. A: Eggs of six species of *Sphaerodactylus*; a = *S. nicholsi*, b = *S. townsendi*, c = *S. argus*, e = *S. nigropunctatus granti*, f = *S. roosevelti*, g = *S. pimienta*. B: Interspecific relationship between female asymptotic size and egg diameters (black = largest, r = 0.9; gray = smallest, r = 0.9); all symbols as in Fig. 1A, except d = *S. savagei*. C: Interspecific relationship between female asymptotic size and neonate size (black = male, r = 0.9; gray = female, r = 0.8); all symbols as in Fig. 1B. D: Interspecific variation of oviposition frequency (days). The 25th and 75th percentiles are drawn using a box. Median is shown with a horizontal line inside the box. Minimum and maximum values are shown with vertical lines, all symbols as in Fig. 1B.

most in the same stage (Fig. 2B). Beebe (cited by Fitch 1970) found a wild female *S. molei* that also had two eggs ready to be oviposited. Also, L.M. Díaz (pers. comm.) observed a female *S. nigropunctatus lissodesmus* laying two eggs sequentially and manipulating them with the hind limbs (Fig. 2C). Hence, it appears that females in some *Sphaerodactylus* species have the ability to synchronize the activities of both ovaries which may increase annual egg production, perhaps when environmental conditions are most favorable.

The mean egg incubation duration was highly variable within and among species (Table 1), and it did not seem correlated to female asymptotic size. As expected, incubation duration was affected by air temperature. In the warmer months, most eggs hatched in about two months, but incubation could last up to four months in the colder months (Fig. 2D).

Growth patterns were similar to other lizards (Andrews 1982), including geckos (Kratochvíl and Frynta 2003; Okada et al. 2002), i.e., both genders matured at a small size and continued growing asymptotically (Fig. 3; Tables 2, 3). Intrinsic growth rates showed no intergender difference and seemed to be inversely correlated with neonate and asymptotic size. Sexual size dimorphism was only appreciable in *S. nicholsi* and *S. townsendi* (Table 2) and was the result of postmaturational events (i.e., both genders grew similarly until maturation started, afterwards, females grew at faster rates than males, Fig. 3). Whereas the slow growth rates in *S. argus* were an expected artifact because several individuals hatched in the winter months, the slow growth rates in *S. nigropunctatus* (km = kf = 0.17) could be the result of inbreeding depression (Lacy et al. 1993). Low fecundity and survival were evident in most young individuals after three or four generations, but were more prominent in *S. n. granti*.

Furthermore, relative growth rates were highly influenced by temperature (Fig. 4A, B). Typically, whereas individuals born during the summer showed fast relative growth rates during the first

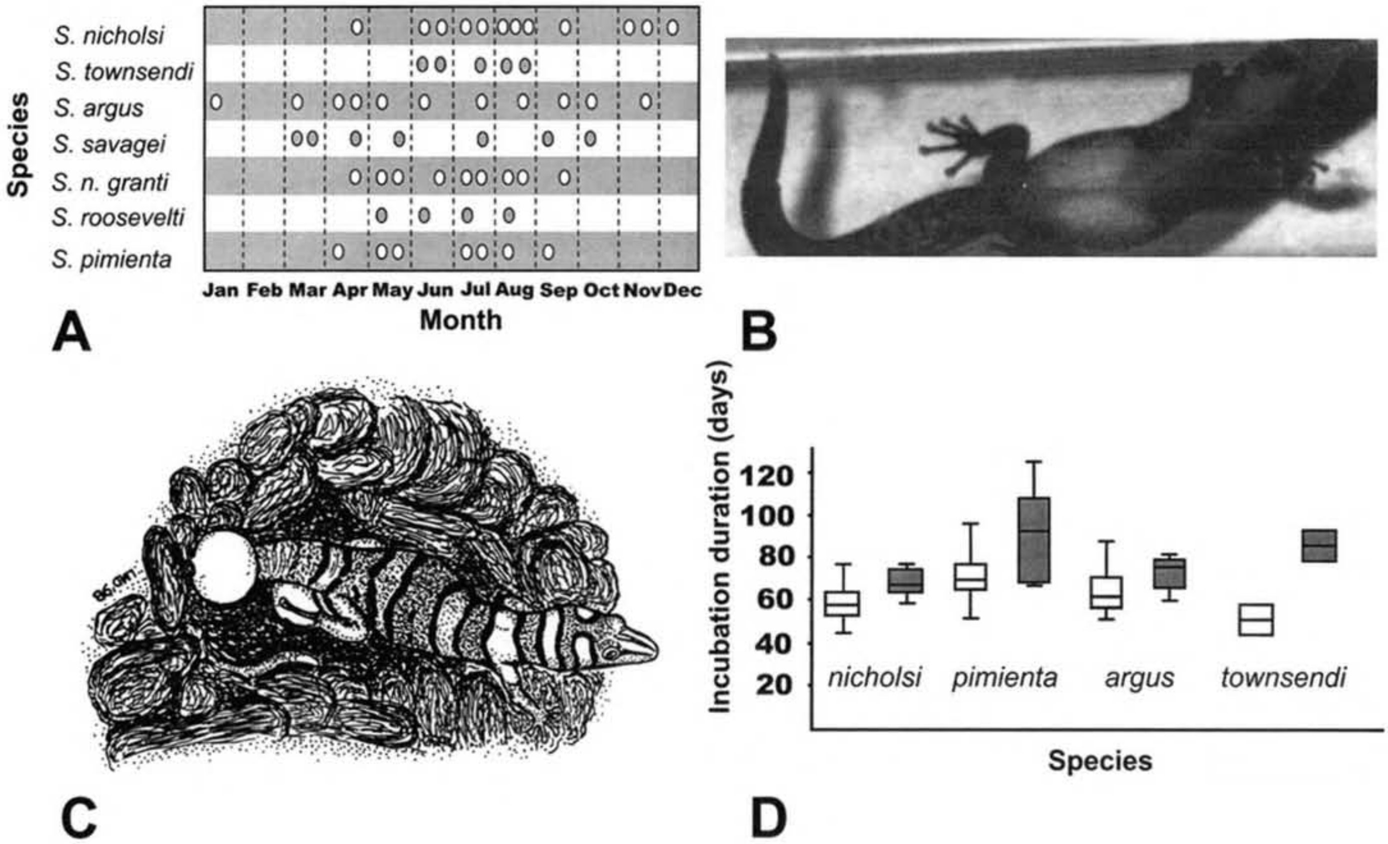

Fig. 2. A: Oviposition records of single females that survived at least one year; dots represent eggs and approximate date of laying, in half months. B: Female *S. argus* showing two eggs. C: Female *S. nigropunctatus lissodesmus* laying two eggs. D: Interspecific variation of incubation duration; clear boxes for eggs incubated during May–October, gray boxes for eggs incubated during November-April, all symbols as in Fig. 1D.

TABLE 2. Snout–vent lengths of seven species of *Sphaerodactylus*. Mean ± SE (range; N).

Species	Male SVL at hatching	Female SVL at hatching	SVL at escutcheon onset	SVL at first oviductal egg	Male asymptotic SVL	Female asymptotic SVL	SDI
S. nicholsi	11.0 ± 0.0 (2)	10.7 ± 0.2 (10–11; 9)	17.9 ± 0.3 (16–19; 15)	20.1 ± 0.1 (20–21; 8)	20.7 ± 0.7 (19–22; 18)	22.3 ± 0.3 (20–24; 18)	0.08
S. townsendi	12.3 ± 0.3 (12–13; 3)	12.5 ± 0.5 (12–13; 2)	20.6 ± 0.3 (19–23; 13)	22.5 ± 0.5 (22–23; 2)	24.4 ± 0.2 (24–26; 9)	26.6 ± 0.3 (26–28; 8)	0.09
S. argus	14.4 ± 0.5 (13–16; 5)	15.0 (1)	22.6 ± 0.4 (22–24; 5)	26.0 ± 0.3 (25–27; 5)	29 ± 0.7 (28–31; 4)	29.6 ± 0.2 (29–30; 5)	0.02
S. savagei		14.0 ± 0.0 (2)	24.7 ± 0.2 (24–25; 7)		29.8 ± 0.6 (28–31; 4)	29.3 ± 0.5 (28–30; 4)	0.02
S. n. granti	17.0 ± 0.0 (2)	20.0 (1)	23.8 ± 0.5 (23–25; 4)	28.0 (1)	30.3 ± 0.5 (30 - 31; 3)	31.0 ± 0.0 (2)	0.02
S. roosevelti		19.5 ± 2.5 (17–22; 2)	29.0 ± 0.0 (2)	32.5 ± 0.5 (32–33; 2)	37.0 ± 0.0 (3)	36.3 ± 0.7 (35–37; 3)	0.02
S. pimienta	18.2 ± 0.2 (19–17; 15)	18.6 ± 0.2 (18–19; 8)	29.5 ± 0.3 (28–31; 13)	32.5 ± 0.5 (32–33; 2)	37.2 ± 0.3 (36–38; 6)	36.8 ± 0.2 (36–37; 6)	0.01

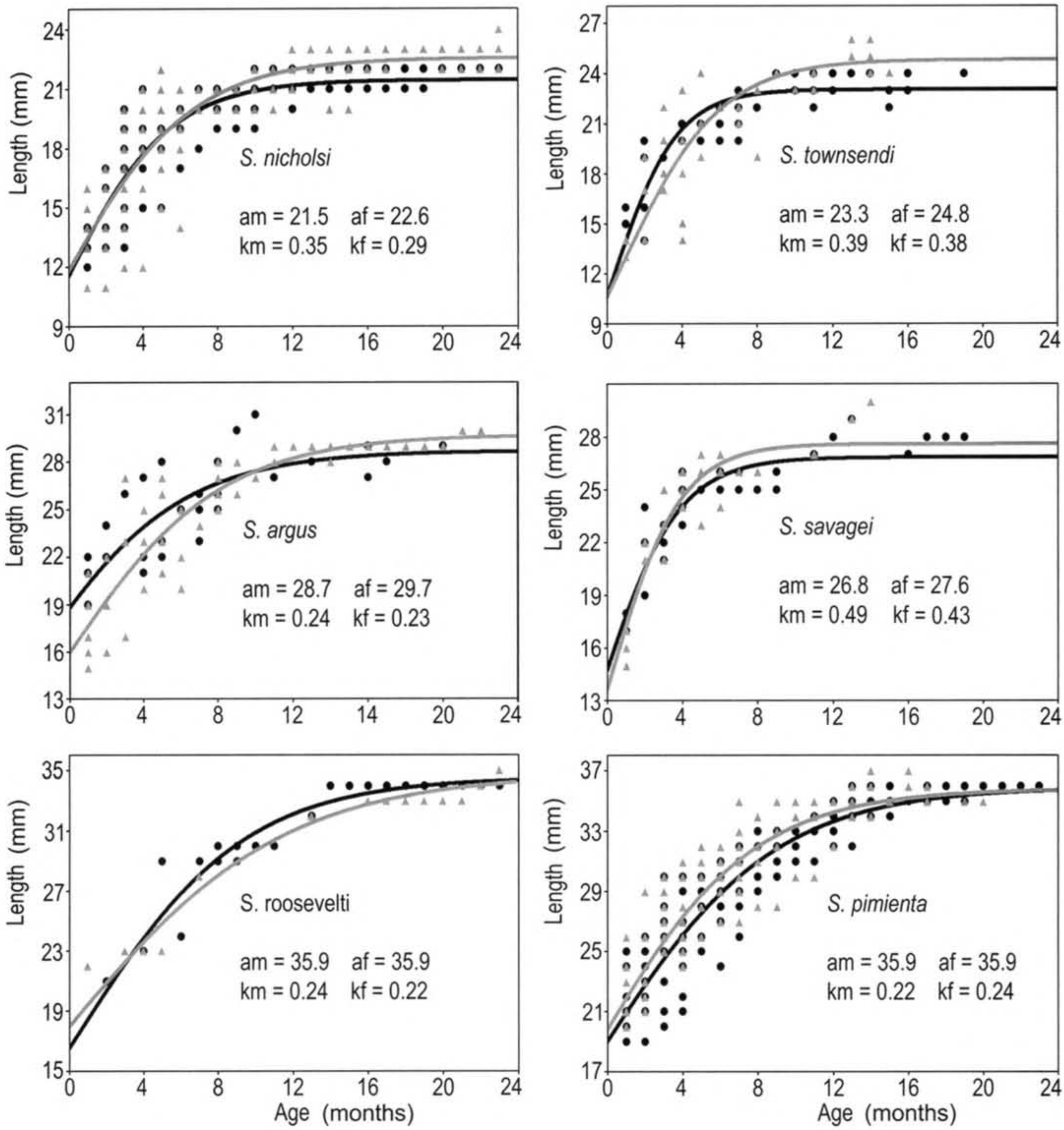

FIG. 3. Changes in SVL of seven *Sphaerodactylus* species during the two first years of life. Dark dots represent males, gray triangles females. *S. nicholsi*, N = 18/29 (males/females); *S. townsendi*, N = 7/11; *S. argus*, N = 6/9; *S. savagei*, N = 5/5; *S. roosevelti*, N = 2/2; *S. pimienta*, N = 15/12. am/af and km/kf represent the maximum length and the intrinsic growth rate for males and females, respectively, estimated from the logistic-by-length model.

three or four months of life; individuals born during the winter practically did not grow during the same period. However, these individuals showed a capability to catch up by growing at relatively fast growth rates later.

Although male and female SVL were similar at hatching (Table 2), males of all species showed a sign of maturation onset (i.e., escutcheon development) before females. However, the size of the escutcheon increases with age (Menchel and Maderson 1975). For example, the escutcheon of *S. nicholsi* and *S. pimienta* first appeared as a small triangular area, but it reached the invariant adult size, which extends onto the thighs (Fig. 4D), in about 2 to 3 weeks and 2 to 4 months, respectively. Thus, using the onset of

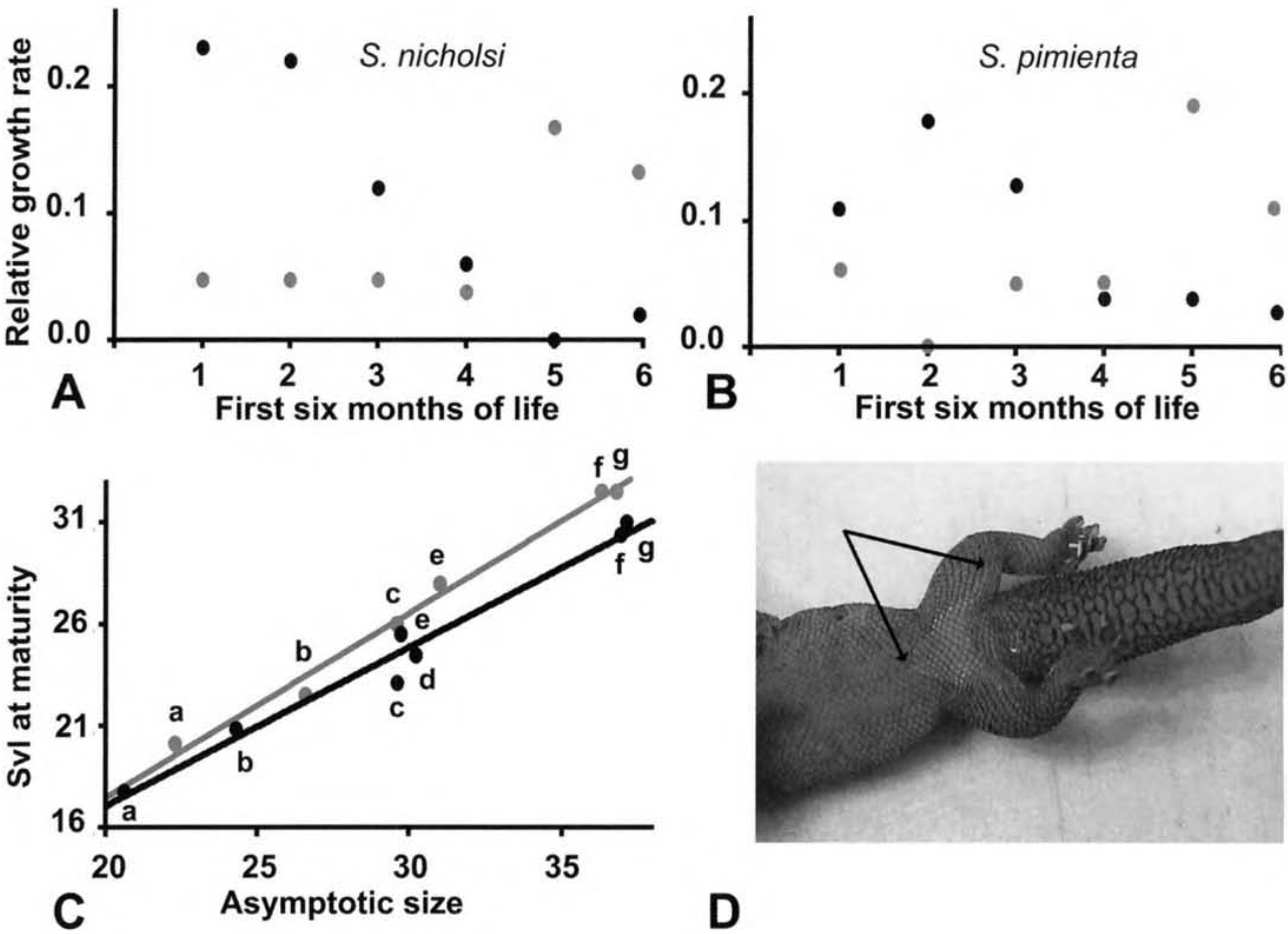

FIG. 4. A, B: Effect of temperature on relative growth rate for two species of *Sphaerodactylus*. Black dots stand for the average relative growth rate of individuals hatched in May–October during their first six months of life; gray dots for individuals hatched in November–April. C: Interspecific relationship between size at maturity and asymptotic size; black for males (r = 0.9), gray for females (r = 0.9); all symbols as in Fig. 1B. D: Escutcheon of an adult male *S. pimienta* extends onto the thighs.

escutcheon development to estimate the age and SVL at maturity in males may underestimate both statistics. Besides, the onset of escutcheon development does not necessarily indicate young males are capable of successful mating and reproduction. Even though I found that escutcheon development coincided with the onset of male-specific courtship displays, young males may not compete successfully with other males for territories or receptive females or may be physiologically unable to produce viable sperm. A lag between the onset of the escutcheon and the onset of male specific color patterns in dimorphic species (Table 3) supports this hypothesis. Furthermore, given that the sign of female maturation probably appeared one or two weeks after the first ovary cycle and that change of male pattern started at almost the same age of the first oviductal egg (Table 3), both genders may mature at the same time.

As expected (Stamps et al. 1998), size and age at maturity were positively correlated with asymptotic size among species (Tables 2, 3; Fig. 4C). Whereas *S. nicholsi* and *S. townsendi* were mature and started reproducing after their fifth or sixth month of life, it took a year to start reproduction in *S. roosevelti* and *S. pimienta*. Moreover, usually the first clutches of these last two species had high oviposition frequencies and usually failed to hatch.

Longevity of most individuals in all species commonly exceeded two years, and living more than four years was frequent in *S. nicholsi*, S. *argus*, S. *savagei*, S. *n. granti*, and *S. pimienta*. Decreased longevity in *S. townsendi* and *S. roosevelti* was probably the result of a diminished adaptation to captivity instead of innate species-specific differences. Colonies of these latter two species never thrived like the other species. Given that the maximum SVL recorded for wild-caught individuals in all species (see Schwartz and Henderson 1991) is similar or usually higher than the asymptotic sizes found in this study, it seems likely that the lifespan of some individuals in the wild may extend beyond a year in the five small species and two years in *S. roosevelti* and *S. pimienta*.

Information obtained on reproduction and growth of captive *Sphaerodactylus* may be useful in explaining data from field studies. For instance, López-Ortiz and Lewis (2001) reported the presence of gravid females and hatchlings in all months in a wild population of *S. nicholsi*, which agrees with my observations, and attributed a lag between the peak abundances of both stages (gravid

Table 3. Age at Different Stages of Seven Species of *Sphaerodactylus*. Mean ± SE (range; N). Age is in months.

Species	Age at first escutcheon	Male age at pattern change	Female age at first oviductal egg	Male age at asymptotic SVL	Female age at asymptotic SVL
S. nicholsi	5.8 ± 0.5 (4–8; 10)	8.5 ± 1.6 (6–13; 4)	8.4 ± 0.5 (6–10; 9)	16 ± 2.8 (6–24; 6)	18.8 ± 2.6 (6–32; 9)
S. townsendi	5.8 ± 0.4 (5–7; 6)			13.5 ± 0.8 (11–16; 6)	13.3 ± 0.7 (12–14; 5)
S. argus	4.6 ± 0.8 (3–7; 5)		8.8 ± 0.7 (6–10; 6)	13.3 ± 4.1 (7–21; 3)	18 ± 1.8 (12–25; 6)
S. n. granti	4.7 ± 0.3 (4–5; 3)	7.7 ± 0.9 (6–9; 3)	8.0 (3)	19.7 ± 4.3 (14–28; 3)	37.0 (1)
S. roosevelti	7.5 ± 2.5 (5–10; 2)	16.5 ± 1.5 (15–18; 2)	19.5 ± 0.5 (19–20; 2)	28.0 (1)	24.0 (1)
S. pimienta	8.1 ± 0.5 (5–11; 14)		10.3 ± 0.6 (8–12; 6)	33.3 ± 1.9 (25–37; 7)	26.8 ± 3.4 (16–46; 8)

females in July and hatchlings in January) to incubation durations two times greater than the ones I recorded for this species. However, a relatively larger number of hatchlings would also be expected after a few months in recently founded populations. In a small population founded during the spring by a few individuals, early maturation, allowing two generations a year, coupled with a shorter incubation time and fast growth rates would result in an increasing number of reproductive adults by late summer or early fall. Considerable egg laying could continue through early November and could result in a population of eggs that start hatching in December and January, swamping the population with neonates. Alternatively, life-history traits of the population studied by López-Ortiz and Lewis (2001) could be different from the one described here; indeed, some evidence of morphological and behavioral differences has been recorded (Regalado unpublished). Another difference between findings of our studies relates to neonate size. As the asymptotic size of *S. nicholsi* from Cabo Rojo is higher than the asymptotic size of *S. nicholsi* from Guanica, the extremely low values found for neonate and gravid female SVL in the first population are not expected and are difficult to explain.

Some differences in asymptotic sizes between this study and literature records may be accounted for by interpopulation variation and biased age distribution of small samples. For instance, asymptotic size in *S. n. granti* was around 30 mm, whereas Schwartz and Henderson (1991) reported a maximum SVL of 40 mm for *S. nigropunctatus*. The discrepancy between both estimates arises because Schwartz and Henderson's comprehensive review includes *S. n. ocujal*, which individuals are much larger. Furthermore, maximum sizes reported for males and females of *S. pimienta* (Thomas et al. 1998) are lower than the asymptotic sizes I recorded. The escutcheon size and the SVL of the only male these authors described indicate it was young, probably less than a year old. However, although the eggs used to start my *S. pimienta* colony came from a site only 21 km away from the population described by Thomas et al. (1998), there is a color difference between individuals from both populations, dark gray in El Yarey and tan in La Pimienta.

The high variation in oviposition frequency and incubation duration, as well as a small variation in clutch size, suggest two caveats for field studies. First, estimates of incubation duration of eggs found in the wild may be inaccurate. Second, the proposition that in *Sphaerodactylus*, and other species with a minimum clutch size, nests with a small number of eggs represent intraspecific communal nesting (Oda 2004) may also be invalid. One female could possibly lay 5 or 6 eggs in two months before the first egg laid completed incubation and hatched.

This study suggests that considerable interspecific variation exists in the life-history traits of captive *Sphaerodactylus* that could reflect adaptive species differences. All seven species studied here seem to follow typical lizard life histories: growth rates decline with age; age at maturity and survival covary positively, and both parameters covary negatively with fecundity (Clobert et al. 1998; Shine and Charnov 1992). Consequently, *Sphaerodactylus* species may range along a gradient of small, early-maturing, high-fecundity, and short-lifespan species to relatively large, late-maturing, low-fecundity, and longer-lifespan species.

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Field Observations on Movements of the Mountain Chameleon (*Chameleo montium*)

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Chamaeleo montium is a medium sized arboreal chameleon found in southwestern Cameroon at elevations of 500–1200 m (Hofer et al. 2003; Mertens 1938). It is reported from forest, gallery forest, hill forest, and farm bush (Klaver and Böhme 1986; Lawson 1993). This species is early maturing and reproduces continuously with an approximately two-month gestation period. The majority of the behavioral information known regarding this species is from observations of captive individuals. The few in situ studies found in the literature expound upon its diet and elevational range (Hofer et al. 2003), individual perch height (Harbort and Herrmann 2002; Lawson 1993), or reproduction (Herrmann and Herrmann 2005; Herrmann and Solèr-Kühni 2005). Studies involving movements or territory investigations are entirely lacking. Here we report on movements involving six chameleons (3 males, 3 females) which we observed for up to twenty-week periods. These observations detail microhabitat usage and provide the first insight into home range and territory.

The study site was a 30 x 37 m cultivated garden adjacent to secondary forest and farm bush in the village of Nyasoso (4°49' 289"N, 9°40'826"E; elev. 850 m), at Mt. Kupe, Southwest Province, Cameroon. Buildings included two large two-story houses, encircled and connected by verandas on the second floor which facilitated the observations of chameleons when they were up in trees. Additional structures were small or limited to trellises for vines; plants were numerous, including several trees. The grass interspaces were kept cut uniformly short. The structure and canopy provided here is less than what a forest or farmbush habitat would usually provide, however, this species is commonly found in very open habitat (pers. obs.).

The study period comprised mid-November 2002 to the beginning of April 2003 which encompasses all of the dry season. For

climatic data for this period see Herrmann and Herrmann (2005).

We caught 20 chameleons and individually marked them with nail polish during the 20-week study period. The nail polish color was shed upon ecdysis, however, subsequent epithelial layers were stained by the polish leaving a 'water mark' which was easily read, allowing for the chameleons to then be repainted. Three mature female and three mature male chameleons were sighted repeatedly and allowed for a detailed study of their behavior. The remaining 14 chameleons were sighted only a few times before disappearing for long periods of time, or disappearing altogether from the study area and thus are not considered in this report. No juvenile chameleons < 6 cm snout–vent length were encountered.

We opportunistically conducted focal observations during day and night. Chameleons found interacting or in the vicinity of other chameleons were checked repeatedly throughout the day. We recorded the location of the chameleons using a two-dimensional map, thus all distances are aerial straight-line distances and do not take the measurement of height (i.e., trees) into consideration; this often significantly underestimates the actual distance traveled by a chameleon. Straight-line distances were measured from tree trunk to tree trunk in the case of isolated trees where a crossing via canopy was not possible. The chameleons appeared to be unaffected by our presence.

We observed three female chameleons (#'s 01–03), two for 20-week periods, the third for a 51-day period. Two of the females were quite sessile for the period observed, while the third ranged broadly (Fig. 1). We observed Female #01 for 20 weeks, beginning 16 November, during which she was courted and mated two times by a male (#06) (see Herrmann and Solèr-Kühni 2005). The female inhabited a 4 x 5 m area, consisting of a large bush (*Penianthus* sp.) and a guava tree (*Psidium* sp.), which was bordered on one side by the larger house. The only departure from this area involved a one-week venture at which point she crossed ca. 10.5 m of open grass to reside in a small, isolated apple bush (*Eugenia* sp.). At this time she was gravid, presumably from the 10 November mating with Male #06, but was being courted, unsuccessfully, by a male (#04) which had recently taken up residence in her original bush ca. one week prior to the female's departure. This female was observed dark in color and chasing the male away a few days prior to her move. It is possible that his presence influenced her leaving. One week after taking up residence in the apple bush, the female returned to her original bush. Although the male (#04) was still in the vicinity, further interactions were not observed. In summary, 95% of the 20-week period for this female (#01) was spent in the 4 x 5 m area. For detailed reproductive behavior involving this female see Herrmann and Solèr-Kühni (2005).

We observed a second female (#02) for 51 consecutive days, beginning 25 November, which also showed high site fidelity. Her appearance and departure at the site, which required a series of 2-m crossings of open grass, were abrupt. However, for the time period during which she remained at the site her activities were confined to a 2 x 3 m area of passion fruit vine (*Passiflora* sp.) which was located adjacent to the larger house. This female was never observed interacting with any other chameleons, although at mid-stay an additional female (#03) also utilized the vine area for ca. one week. Female #02 was never relocated post departure.

The scenario presented by Female #03, which we observed for a 20-week period, beginning 16 November, provides an opposite extreme to the previous. This female executed her activities within a 20 x 30 m plot, navigating several human structures and crossing up to 6-m expanses of open grass repeatedly. Her movements followed a somewhat circuitous route involving four primary locations. The first location was the 2 x 6 m crown of a leukazia tree (*Leucaena* sp.), adjacent to the smaller house, where she spent 25% (five consecutive weeks) of the study period. The second location was in the 4.5 x 3.5 m canopy of a leukazia tree where she then remained 5% of the study period (one week) with the exception of two days mid week during which she was found again at location one. This female then traveled ca. 20 m to a third location, the passion fruit vine growth adjacent to the larger house where Female #02 was in residence. No interactions were observed between the two females. At this time Female #03 could be observed at close range and appeared to be very gravid. However, we did not abdominally palpate to confirm this observation. Female #03 then spent ca. 15% (ca. three weeks) of the study period in this 3 x 8 m area. Because of the protected, brushy nature of this site and the advanced gravid state of Female #03, it is possible that egg deposition occurred during this time. An unknown male was observed one day near this female, but no interactions were observed.

Female #03 was next found at location two where she then spent ca. three weeks before we found her in another leukazia tree, location four. Access to this site entailed a travel of 20 m and required crossing open areas of grass; this distance was traversed in one afternoon. By evening this female was found attended by an unknown male which remained near her for three days. After ca. one

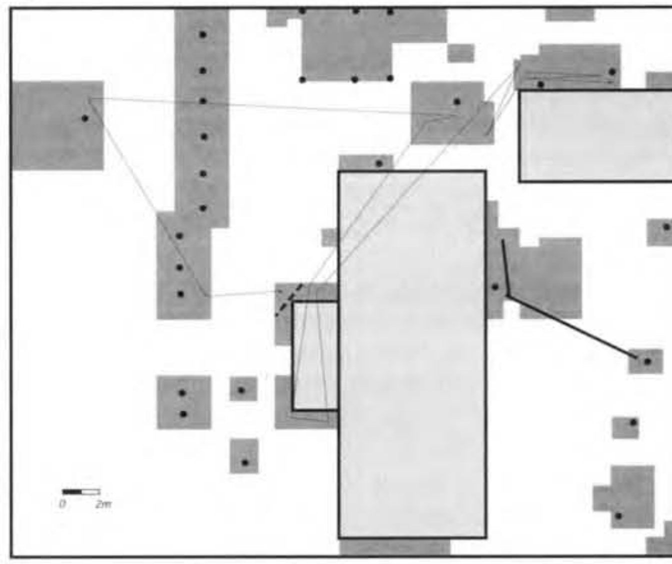

Fig. 1. Map of the 30 x 37 m study area and female chameleon movement lines. Dark gray areas indicate approximate foliage canopy area. Black dots indicate tree trunks whereby chameleons must ascend trunk (dot) to access canopy habitat. White areas indicate open grass or other nonhabitat areas. Light gray areas indicate the two houses; chameleon movement lines which cross these areas indicate the direction of and not the actual movement path of the chameleons which had to circumnavigate these structures. Female #1 is represented by the broad solid line. Female #2 is represented by the thin solid line with an arrow to show direction of movement. Female #3 is represented by the dashed line.

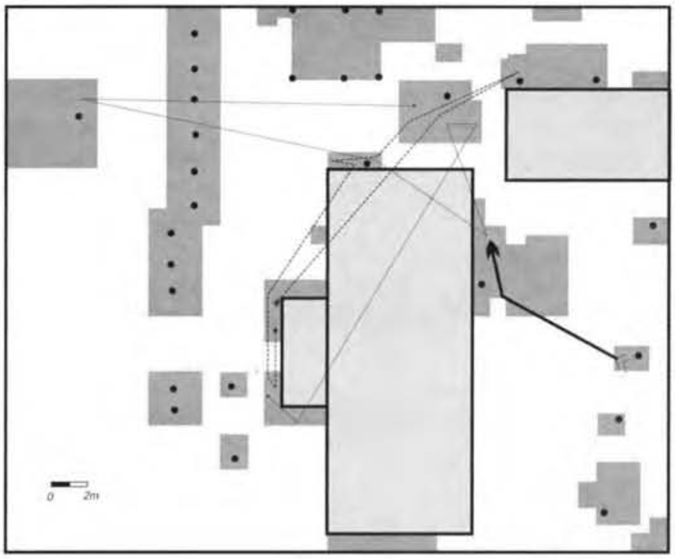

FIG. 2. Map of the 30 x 37 m study area and male chameleon movement lines. Dark gray areas indicate approximate foliage canopy area. Black dots indicate tree trunks whereby chameleons must ascend trunk (dot) to access canopy habitat. White areas indicate open grass or other nonhabitat areas. Light gray areas indicate the two houses; chameleon movement lines which cross these areas indicate the direction of and not the actual movement path of the chameleons which had to circumnavigate these structures. Male #1 is represented by the dark broad line. Male #2 is represented by the broad broken line. Male #3 is represented by the thin solid line. Arrows indicate movement direction.

week at this location, this female was not found for four weeks, representing 20% of the 20-week study period. Most likely the female had moved beyond the boundaries of the study plot. She was later discovered once again at location three where she stayed for the remaining three weeks of the study period.

In contrary to these females, the males (#04–06) represent a rather uniform group. We observed the males over a time period ranging from 31 to 35 days during which their sole objective appeared to be locating and pursuing females.

Male #04 was first found in a small isolated apple bush and then observed for 31 days consecutively (Fig. 2), beginning 31 December. This chameleon was dramatically disfigured, apparently by a native's machete. Both its front and hind legs were cleaved off on the right side of its body and the right horn was severely attenuated. The healed scarring ruled out birth deformities. Nonetheless, this animal was large, robust, and after a two-day pause, successfully crossed the 10.5 m exposed grass expanse to the bush/tree location of Female #01. This male spent 29 days in a 2 x 5 m area alternately attempting courtship, unsuccessfully, with Female #01, which was gravid at the time. After this, this male was not found again.

We observed Male #05 for a period of 35 days, beginning 16 November, during which this male transversed 13 m along the shrubbery of the house, then followed a 19 m trajectory which involved climbing three trees, requiring descents and crossings of open ground of six and five meters. This chameleon was most often observed moving, appearing to systematically search vegetation. He slept in a different location every night. The only time we observed this male to be sessile was during his attendance of an unknown female for a three-day period. In three separate instances, for a total of 19 days, this animal was not located. It is likely that it had exited the boundaries of the study plot. Overall this male retraced its movements and was last seen at its site of discovery.

We observed Male #06 for a total of 34 days, beginning 2 January, during which we made actual sightings on only 11 days. This male was very active, traversing a 20 x 23 m area, and often crossing up to 7+ m expanses of open grass. In movements it routinely utilized the barren wood floors of the second story veranda as a walkway. Outside of the observation period it was once found bisecting the obstacle of the house via a 6-m walk through the living room, which opened to the opposite veranda. We observed this male mating with Female #01 on two separate occasions (one outside of its 34 day observation period); for a detailed account see Herrmann and Solèr-Kühni (2005). It was also observed attending an unknown female at another location.

Although the number of chameleons and duration of these observations limit conclusions, several trends can be noted. Our observations on *C. montium* are similar to those of Hebrard and Madsen (1984). While working with *Chameleo dilepis*, a chameleon species from a wooded grassland, they found that although both sexes moved between shrubs, females were more sedentary than males. They report females residing in one bush for up to 48 days, though the area of the bush is not presented. In comparison, *C. montium* Female #01 resided in her 4 x 5 m tree/bush area for 133 out of 140 days. Female #02 resided a 2 x 3 m vine growth area for 51 consecutive days. This suggests that the prey base available there was sufficient to meet their needs. Less energy expenditure, devoted to travel, should be advantageous for other needs such as egg production. Additionally, the risk to predators would be reduced by a more sessile existence.

The motivation for Female #03 to relocate repeatedly is perplexing. She was observed in the vicinity of both male and female chameleons, however, did not relocate immediately; thus, being 'run off' seems unlikely.

Neças (1995) reports that in general male chameleons tend to have territories that are respected. In contrast, all three male *C. montium* in this study shared their territory with at least one of the other study males. Hebrard and Madsen (1984) note that the size and shape of a *C. dilepis* male's home range is determined largely by the number and location of females with whom the males interacted. Cuadradro (2001) found that *Chameleo chameleon* males guard receptive females and follow them throughout their habitat. For females that moved long distances, they defined the male's territory as an 'umbrella territory' which consisted of what ever area the guarded female was occupying. Male *C. chameleon* often guard their females for periods of up to 20 days, or even longer. In comparison, *C. montium* guard their females for a relatively short period of time, three days. However, our observations suggest that here too the females are the guarded territory rather than the actual area. No male-male interactions were observed through out the duration of this study.

Movements across open habitat are recorded for chameleons such as *C. dilepis* (Hebrard and Madsen 1984) and for *C. chameleon* (Cuadrado 2001), which can travel distances of up to several hundred meters per day; however, these are open habitat species, thus across the ground movements are assuredly a necessity.

Though dietary analysis has suggested *C. montium* to occasionally forage near the ground (Hofer et al. 2003) and it is known that females must descend for egg laying, our observations of this forest species to readily and routinely utilize such barren expanses is somewhat surprising. Total territory estimates for this species must be executed with caution because of the tendency for some animals to remain stationary for extended periods of time and then spontaneously relocate to distances relatively far. Models based upon movements of lizards and mathematical formulas used to interpret the number of sightings required to determine home range of lizards (Christian and Waldschmidt 1984; Rose 1982; Stone and Baird 2002) might not fit for this species.

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Distinct Architectures of Subterranean Nests in the Genus *Leptodactylus* of the *fuscus* Group (Anura, Leptodactylidae)

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Nest construction requires time and energy investment and different defensive strategies are known for the protection of these structures. In social insects like termites, some species invest a great amount of energy constructing nests that are resistant to the attack of vertebrate predators, while other species show low investment in building activities, but nest fortification and nest defense is accomplished by toxic soldier secretions (Coles and Howse 1983). Among vertebrates with nests built solely or mainly by one sex, several features of the construction may reveal or amplify characteristics of the builder to potential mates (see Barber et al. 2001).

Frogs of the *Leptodactylus fuscus* group comprise about 25 species (Frost 2004) that build subterranean chambers used for the deposition of eggs enclosed in foam (Heyer 1969). However, the architecture of the subterranean nests has been described for only a few species (e.g., Crump 1995; Giaretta and Kokubum 2004; Martins 1988; Sazima 1975; Sazima and Bokermann 1978). The evolution of such specialized nest structures in anurans is generally related to avoidance of aquatic predators on eggs and embryos, prevention of desiccation of eggs and larvae, and protection of adults from visually-oriented predators (e.g., Haddad and Sawaya 2000; Heyer 1969; Prado et al. 2002). We describe the subterranean nests of three *Leptodactylus* species in the *fuscus* group: *L. fuscus*, for which nests are well-known from several South American regions; and *L. notoaktites* and *L. mystaceus*, for which we describe nests for the first time.

Methods.—Nests of *L. fuscus* were recorded in the southern Pantanal, municipality of Corumbá (19°34'S, 57°00'W), State of Mato Grosso do Sul, southwestern Brazil, in November 1997 and November 2000. Nests of *L. notoaktites* were recorded in the State of São Paulo, southeastern Brazil, in the municipalities of Barra do Turvo (24°56'S, 48°25'W) and between Iporanga and Apiaí (24°33'S, 48°40'W) in September 2003, and Ribeirão Branco (24°21'S, 48°44'W) in January 2004. Nests of *L. mystaceus* were recorded in the municipalities of Areia (06°58'S, 35°41'W), State of Paraíba, northeastern Brazil, in April 1993, and Rio Claro (22°16'S, 47°42'W), State of São Paulo, southeastern Brazil, in October 2001.

Results.—Nests of *L. fuscus* in the Pantanal (N = 2) were observed being constructed by males on muddy soil at the edge of temporary ponds. They had an access tunnel 5–30 cm long and 2.5 cm wide ending in an oval chamber (4.5 cm high, 5.4 cm wide). On 05 November 2000, males started to call at late afternoon (1900 h) from the muddy edge of a puddle. The first nest was built by a male between 2000 and 2055 h, in the same way described by Martins (1988). Then, this male started to emit advertisement calls at a distance of about 1.0 m from the nest access opening. The second nest was built by another male between 2100 and 2130 h; subsequently it started to call at a position 1.5 m from the nest. The distance between these nests was about 0.5 m and the whole process lasted 55 and 30 min, respectively. On 14 November 1997 we found a nest access near a calling male. Digging along the access tunnel we found an empty chamber (5.0 cm high, 5.5 cm wide). We dug a little more and found a second chamber (5.1 cm high, 5.3 cm wide) containing foam with tadpoles. After further digging we found two additional chambers, with similar sizes, also with foam and tadpoles. We could not find any access to these three chambers with tadpoles and they seemed completely closed.

Nests of *L. notoaktites* (N = 3) had two chambers. The first one was smaller (6.5 cm long, 3.0 cm wide, 1.8 high) than the second (7.5 cm long, 7.5 cm wide, 5.5 cm high) and both were interconnected; although no tunnel was present, these chambers were adjacent to each other with a constriction between them. The males apparently were emitting advertisement calls from the first, smaller chamber. These nests had only one opening measuring 1.9 cm wide.

For *L. mystaceus*, we recorded two nests. One was found in northeastern Brazil and exhibited a complex structure (Fig. 1). It had one access opening and three chambers connected by tunnels. In this subterranean system, the first two chambers were empty and foam containing eggs was in the last chamber (Fig. 1). This subterranean nest was built during the first rains on muddy and wet soil in a temporary pond in an upland forest, before the pond had filled. The second nest was observed in southeastern Brazil. It consisted of one access opening and an oval chamber without a tunnel.

Discussion.—Similar to the *L. fuscus* nests we report in the Pantanal, Martins (1988) observed subterranean nests of this species in the State of Roraima, northern Brazil. These nests consistently are comprised of a single access and a tunnel connecting the opening with a subterranean chamber. The tunnel is large enough to allow the entrance of only one individual, whereas the size of the chamber permits the occurrence of amplex and oviposition. Sazima (1975) and Gonsales (2004) described the same nest structure for *L. fuscus* (referred as *L. sibilatrix* by Sazima 1975) from different populations in the State of São Paulo, southeastern Brazil. Due to the highly territorial nature of these frogs, the most likely explanation for the "four-chambered" nest we describe is that the four chambers were dug out by the same male, and sealed after egg-laying.

Although not observed in the Pantanal, females of *L. fuscus* were recorded sealing the nest opening after oviposition in the State of São Paulo (Gonsales 2004). For *L. bufonius* in Argentina, females

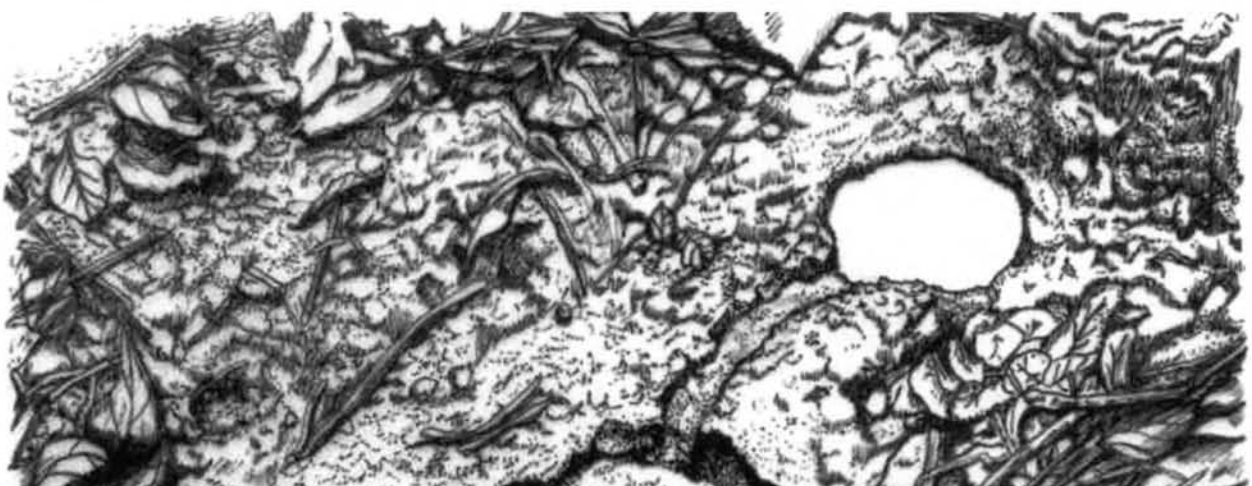

FIG 1. A cross-sectional view of an excavated subterranean nest of *Leptodactylus mystaceus*, showing one access tunnel (arrow) and three chambers connected by tunnels. Note that only the last chamber (right) is filled with a foam nest.

also were recorded sealing the nest opening after oviposition (Crump 1995, Reading and Jofré 2003). Sealing of the nest tunnel after oviposition was recorded for a few nests of *L. camaquara*, which digs its nest under rock slabs, as well as for *L. cunicularius*, which builds a globular nest and seals the roof access after oviposition takes place (Sazima and Bokermann 1978, I. Sazima pers. comm.). However, the sex responsible for the sealing in these two species was not documented.

Nest building by *Leptodactylus* of the *L. fuscus* group may occur in different soil types, such as sand (Arzabe and Almeida 1997) or mud (Reading and Jofré 2003). We found that nest digging took 30 and 55 min. Martins (1988) also recorded one nest being dug over 40 min by a *L. fuscus* male on muddy soil. The time spent in building activities varies from 10 min in *L. troglodytes* on sand (Arzabe and Almeida 1997) to 90 min in *L. bufonius* on mud (Reading and Jofré 2003). It appears that construction of nests on mud takes longer. We suggest that total time needed to dig a nest is related with soil type and nest architecture.

The nest architecture varies considerably among the species of the *L. fuscus* group. The presence of at least one additional chamber, as described here for *L. notoaktites* and one nest of *L. mystaceus*, also has been recorded for other *Leptodactylus* species, such as *L. albilabris*, *L. latinasus*, and also may occur in *L. fuscus* nests (see Solano 1987). The nest of *L. mystacinus* is an elliptical chamber with a short tunnel and access opening partly or totally sealed (Sazima 1975). The nests of five *Leptodactylus* of the *fuscus* group from open areas in southeastern and central Brazil were described by Sazima and Bokermann (1978). *Leptodactylus furnarius* builds a half oval nest with no tunnel and seals it at the top after egg-laying; *L. jolyi* builds a sinuous corridor connecting the chamber and does not seal the access; *L. cunicularius*, *L. camaquara,* and *L. tapiti* dig their nests under rock slabs, the two latter species with the chamber connected to a short tunnel with the opening facing streams at sites subject to periodical floods (Sazima and Bokermann 1978, I. Sazima pers. comm.). The nest of *L. cunicularius* has a long tunnel compared to the other four above-mentioned species, and is dug in slopes far from temporary streamlets, to which the tadpoles are carried by water draining the slopes (Sazima and Bokermann 1978, I. Sazima pers. comm.). The nest of *L. troglodytes* that lives in open areas has two access openings (Arzabe and Almeida 1997). The nest of *L. bufonius* is described as cone-shaped and extends up to 5.5 cm above the ground, with an opening in the upper part of the cone (Crump 1995).

Subterranean nests and their variable nest architectures may serve several purposes, including an antipredation function. Several invertebrates and vertebrates prey on frogs, mainly during their reproductive activity (e.g., Haddad and Bastos 1997, Prado 2003, Toledo 2003). Hawks and snakes have been reported preying on adults of *Leptodactylus* species of the *fuscus* group at reproductive sites (Arzabe and Almeida 1997, Giaretta and Kokubum 2004). Giaretta and Kokubum (2004) recorded a colubrid snake inside a nest chamber of *L. furnarius*; it was a juvenile *Liophis meridionalis* which contained 17 tadpoles in its stomach. Gonsales (2004) observed eggs and tadpoles of *L. fuscus* and *L. mystacinus* being eaten by ants of the genus *Camponotus* that were inside the chambers. The hylid *Hyla leucopygia* also builds subterranean chambers, and Haddad and Sawaya (2000) observed a colubrid snake, *Liophis miliaris*, preying on a pair of adults inside the chamber. Haddad and Sawaya (2000) commented upon the evolution of this specialized reproductive mode in hylids, and suggested that adults, eggs, and embryos are probably more protected from strictly aquatic predators and from visually oriented terrestrial predators in these subterranean nests. However, predators oriented by olfaction, such as snakes, can find concealed subterranean nests (Haddad and Sawaya 2000). Additionally, several invertebrates, such as ants (Gonsales 2004), spiders (Villa et al. 1982), and fly larvae (Downie et al. 1995) also seem to be important predators within concealed subterranean nests of *Leptodactylus* species. The presence of two access openings, as recorded for one nest of *L. troglodytes* (Arzabe and Almeida 1997), may allow the frog to escape from a predator entering the subterranean chamber. The presence of two or more chambers in the nests of *L. notoaktites* and *L. mystaceus* may be built to accommodate additional clutches, as reported for *L. fuscus* in this study, but additionally may have evolved into a more complex structure, increasing the frog's chances of fleeing from predators.

Calling from within the nest, as recorded herein for *L. notoaktites*, as well as for *L. fuscus* (Martins 1988), and *L. bufonius* (Reading and Jofré 2003), may protect males from predators during calling activity, when they are exposed to predation. It is also important to note that the construction of the subterranean chambers may initiate both after or before female approach, depending on the species (Sazima 1975, Martins 1988). Sazima (1975) suggested that when nest initiation occurs after female approach, the distance kept among males is apparently smaller compared to species that build the nests before the approach of the female. This suggests that when nests are built before female approach, as observed here for *L. fuscus* and *L. notoaktites*, nests may have other functions than only protecting the foams, such as shelter sites, reinforcing territorial behavior in these species.

Another selective pressure molding nest architecture in *Leptodactylus* may be related to habitat type. Open or forested areas may exert different selective pressures during breeding. These may include the exposure of frogs to visually-oriented predators, as recorded for rodents by Jackson (2000). Also, thermal differences and different soil types may be other factors related to nest architectures of species in the *L. fuscus* group.

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Sexual Maturity of Farm-Released *Caiman latirostris* (Crocodylia: Alligatoridae) in the Wild

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One strategy to enhance small populations of crocodilians is to release captive-reared individuals into the wild. However, information is scarce on the success of relocated and translocated animals (Dodd and Siegel 1991). There are concerns about released animals and their ability to hunt for food and adapt to their environment (Blake and Loveridge 1975) that might result in low survivorship following release. Low survivorship would result in very poor recruitment of captive-reared animals as compared to wild crocodilians.

Despite these concerns, successful recruitment of captive-reared females into wild breeding populations has been demonstrated for *Crocodylus palustris* (Choundhury 1981), *C. porosus* (Kar 1996), *C. intermedius* (J. Thorbjarnarson, pers. comm.), and *Alligator mississippiensis* (Elsey et al. 2000a, 2000b). In most of these programs animals are released at 1.0–1.5 m total length (TL), after 2–4 years of captive rearing.

Sexual maturity is an important variable in population dynamics and is a useful datum for conservation programs, such as Proyecto Yacaré (MAGIC/MUPCN), that are attempting to facilitate the recovery of crocodilian populations. Since 1990, Proyecto Yacaré (*Caiman* Project), has been working to enhance the wild population of *Caiman latirostris* in Santa Fe Province, Argentina. We collect eggs from wild nests soon after laying (December–January) and artificially incubate the eggs. Hatching occurs during February and March. Hatchlings are marked by removing selected caudal scutes (indicating hatching year and nest of origin). Hatchlings are raised in concrete pools until November; therefore animals are kept in captivity for a maximum of nine months, and reach an average size of 45 cm TL prior to release. They are then reintroduced in the same place where the eggs were collected. While in captivity, animals are fed chicken *ad libitum*, supplemented with vitamins and minerals, three times a week (for details see Larriera 1993).

Caiman latirostris reaches maximum latitudinal range in Argentina at Santa Fe Province, Argentina (31°S, 60°W). Crocodilian growth rates vary among habitats (Magnusson and Sanaiotti 1995), and latitudinally (Ferguson 1985). In a species such as *C. latirostris* with wide latitudinal distribution, reaching the border between Paraíba and Rio Grande do Norte states in northeastern Brazil (7°S) to Rio Grande do Sul (southernmost point of Brazil, 34°S; Verdade et al. 2003); if size is a determinant for reproduction, then more equatorial populations would grow faster and possibly reproduce earlier than higher latitudinal ones.

Limited data are available on age at sexual maturity in crocodilians. Available information about age of first reproduction in *C. latirostris* is limited to two papers recently published, but they referred to captive animals in São Paulo (Verdade and Sarkis 1998; Verdade et al. 2003). The earlier study suggested nine years as the minimum age for reproduction. The later study documented reproduction at an age of five years for a female kept in a greenhouse from day 55 of age to day 430. After that, the female was moved to an open outdoor enclosure. At first reproduction, this female was 81.0 cm (snout–vent length), 19.8 kg (body mass, Verdade et al. 2003), and aged five years (4 years, 11 months, 27 days).

Materials and Methods.—We captured 14 females at their nests in the wild in San Cristóbal County, Santa Fe Province, Argentina (30°15'S, 60°50'W), during summer 2001–2002. Animals were snared while displaying defensive behavior at their nests. Of those 14 animals, seven were marked females of known age and part of the released stock of *C. latirostris* from Proyecto Yacaré. We assumed that a female caiman attending a nest was the maternal parent of the clutch in the respective nest. Recent results confirmed the assumption that attending alligators are maternal parents of the respective nests (Davis et al. 2001).

Once caught, the farm-released females were measured to the nearest cm in total length (TL) and weighed with a 0.1 kg precision scale. We did not weigh the wild females, because they exceeded the maximum capacity (20 kg) of our scale. The eggs from the nest were collected and transported to the laboratory where we weighed each clutch and calculated mean egg mass (clutch weight/clutch size; precision 0.05 kg). Eggs were incubated at 31.5°C and 95% relative humidity until hatching.

In this paper we present information on female age, body mass (BM), total length (TL), clutch mass, clutch size, egg mass, and hatching success (# of hatchlings/clutch size). We also compared female TL and body mass (known age females and unknown age captured females), clutch size of the seven females and a subset (N = 31 nests) from the total nests harvested in the season (N = 196) and hatching success of the seven females vs. a subset of eleven nests of the same season with a non-parametric ANOVA (Kruskal-Wallis test). Because hatching success could be affected by inappropriate handling during collection (Larriera 1995; Woodward et al. 1989), in this comparison we used only nests that were collected at the same locations, at the same time, such that all eggs were subjected to the identical conditions before, during, and after collection.

Results.—Five of the previously marked females were nine years old, the remaining two were ten years old (Table 1). Females nested within 1 km of their release point nine or ten years earlier. No female moved far from the place were it was released, although there are many lagoons and rivers in the area.

Clutch size of the seven released females was similar to a subset of data from wild clutches ($H = 1.28$; $P = 0.257$), and there was no difference in hatching success ($H = 0.00218$; $P = 0.6114$). The 'head-started' females captured were shorter than the other seven unmarked females captured (152 ± 6 cm vs. 178 ± 17 cm; $H = 6.53$; $P = 0.0082$). Females in this study weighed less than those reported by Verdade and Sarkis (1998) and Verdade et al. (2003), with a body mass of 15.7 ± 3.2 kg vs. 24.8 ± 5.1 kg ($H = 7.01$, $P = 0.0065$). The largest wild female captured in this study was as heavy as the smallest female (five years old) in Verdade et al. (2003).

Discussion.—Our results indicate that releasing yearling *Caiman latirostris* can successfully provide a source of recruitment of breeders to the wild populations. Half of the females we caught this season were reintroduced by Proyecto Yacaré. Although the marked females were smaller in total length than wild females, because clutch size and hatching success was similar to unknown-age females, we speculate that the 'head-start' females may be competent reproducers in the wild. This is the first report of reproduction of wild farm-released female *C. latirostris* of known age.

Female age at sexual maturity in the wild, after nine months of 'head-start' rearing, was the same as previously reported by Verdade and Sarkis (1998) for captive *Caiman latirostris*. In Verdade et al. (2003), one female was five years at first reproduction, but it was kept in a greenhouse during the first two winters.

TABLE 1. Data for seven marked, known-age females caught during nest defense. In the last row we present averages ± St. Dev. BM = body mass; TL = total length; egg mass = clutch mass/clutch size; and hatching success = # of hatchlings/clutch size.

Nests	Body mass (kg)	TL (cm) (g)	Clutch mass (mean, g)	Clutch size	Egg mass (mean, g)	Hatching success (%)	Age (years)
1	17.0	154	2100	36	58.3	83.33	10
2	18.5	156	2050	37	55.4	48.65	10
3	19.8	163	2700	41	65.9	85.37	9
4	12.4	147	1700	30	56.7	66.67	9
5	12.8	148	1850	30	61.7	43.44	9
6	13.6	148	No data	26	No data	69.23	9
7	17.0	151	2050	35	58.6	100	9
Mean	15.7 ± 3.2	152.4 ± 5.7	2075 ± 342	33.6 ± 5.1	59.4 ± 3.8	70.96 ± 20.33	9.3 ± 0.5

In a wild population Moulton et al. (1999) suggested a conservative snout vent length of 75 cm, and 8.6 to 15 years for *C. latirostris* to first reproduction. The females in our study are of comparable age, and of the same size (assuming SVL = 0.5 TL). Based on the data of this study as well as Verdade and Sarkis (1998) and Verdade et al. (2003), mature female *Caiman latirostris* are at least five years old and weigh at least 12.4 kg.

Farm-reared female *Alligator mississippiensis* released when one year old and 79–99 cm TL, began to reproduce at around seven years, but females that were 132–142 cm TL at release reproduced at around six years (Elsey et al. 2000b). Hatchlings produced in the wild, with no 'head-start' could take longer to breed, because many farm-released juvenile alligators grew faster than wild ones (Elsey et al. 1992, 2000). If maturity is related to growth rate, then the farm-released animals would more quickly become breeding stock in the wild population than wild-hatched animals.

Size classes regularly used for monitoring *Caiman latirostris* populations are based on the ones proposed for *Caiman crocodilus* by Gorzula (Waller and Micucci 1993). In this system, class III animals range from 1.3 to 1.7 m total length and include sexually mature males and females. Class IV should only include mature males, but not females. Because we captured a wild female that was 1.95 m, we suggest that this size class system is not appropriate for *Caiman latirostris*. We propose a class III size range of 1.3 to 1.95 m for *Caiman latirostris*. We also recommend that all crocodilian species subject to hunting of class IV animals based on size classes determined for other species be evaluated in order to avoid hunting the biggest females, since they produce bigger clutches with bigger eggs (Larriera et al. 2004).

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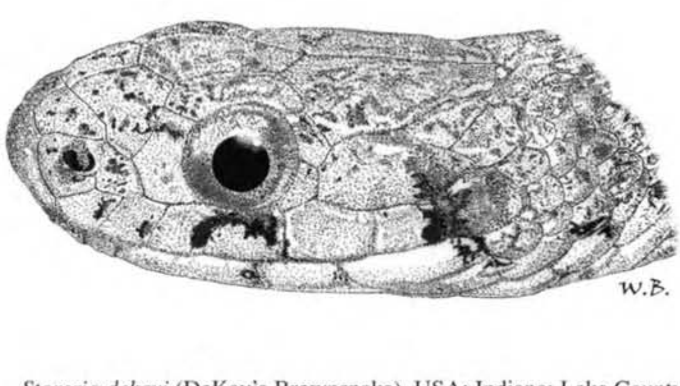

Storeria dekayi (DeKay's Brownsnake). USA: Indiana: Lake County. Pen and ink illustration by Will Brown (http://www.blueridgebiological.com/).

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SEMINATRIX PYGAEA (Black Swamp Snake). **REPRODUCTION.** Previous reports of litter size in *Seminatrix pygaea* range from 2 to 15 and were determined primarily by counting the number of enlarged follicles or embryos during palpation or dissection (Gibbons and Dorcas 2004. North American Watersnakes: A Natural History. University of Oklahoma Press, Norman. 438 pp.). During July 2004, three of 15 pregnant females gave birth to record size litters (16, 19, and 22). Pregnant *S. pygaea* were collected between 27 May and 1 June 2004 from Ellenton Bay (Savannah River Site, South Carolina) using aquatic minnow traps. All snakes were housed individually in the laboratory at 27°C and offered salamander larvae (*Ambystoma talpoideum*) every 7–10 days until they gave birth. Within 24 h of parturition I measured the mass (nearest 0.01 g), SVL (nearest mm), and tail length (nearest mm) of the mother and all neonates. Total litter mass (TLM, all neonates together) was measured and used to calculate reproductive investment (relative clutch mass) by dividing the post-partum maternal mass by the total litter mass (Shine 1980. Oecologia 46:92–100). All neonatal values are presented as mean ± 1 SE. Because of their small size at birth, it was not possible to safely sex the neonates by probing; therefore I relied on relative tail length to sex the neonates (Dodd 1993. Can. J. Zool. 71:1281–1288). On 17 July a female (post-partum mass = 33.90, SVL = 363) gave birth to 22 neonates (TLM = 28.36, mass = 1.29 + 0.02; SVL = 108.9 ± 0.62; 9 Females: 13 Males). On 20 July a litter of 16 neonates (TLM = 22.41, mass = 1.40 ± 0.03; SVL = 112.8 ± 0.75; 7F: 9M) was born to a second female (post-partum mass = 29.23, SVL = 354). Lastly, on 25 July a female (post-partum mass = 33.25, SVL = 383) gave birth to 19 neonates (TLM = 18.81, mass = 0.99 ± 0.02; SVL = 101.5 ± 0.93; 13F: 6M). All three mothers expended a large reproductive effort as indicated by high relative clutch masses (0.84, 0.77, and 0.57 respectively). None of the litters contained stillbirths and all snakes were returned to their original point of capture.

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GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 36, Number 1 (March 2005). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extension reports unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA MACULATUM (Spotted Salamander). USA: TENNESSEE: Hamilton Co.: Volunteer Army Ammunitions Plant (35°06'17"N, 85°07'49"). 17 March 2004. Thomas P. Wilson and Chris Manis. Verified by Kerry Hansknecht. University of Tennessee at Chattanooga Museum of Natural History (UTCA/GMU 4146). New County Record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94pp. [Hard copy and Internet versions, the latter of which includes links to information on Tennessee herpetology published since 1996], http://www.apsu.edu/amatlas/, accessed 12 May 2004)

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AMBYSTOMA OPACUM (Marbled Salamander). USA: GEORGIA: Whitfield Co: Dalton Middle School Campus (34°47'32.9"N, 84°56'33.1"W). 15 May 2005. Collected from a drift fence adjacent to wooded wetland. Chris Manis and John Patrick. Verified by John Jensen. University of Tennessee at Chattanooga Museum of Natural History. UTCA/GMU 4630. New county record (Williamson and Moulis 1994. Distribution of Amphibians and Reptiles in Georgia. Savannah Sci. Mus. Spec. No. 3, 712 pp.).

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AMBYSTOMA TIGRINUM TIGRINUM (Eastern Tiger Salamander). USA: TENNESSEE: Hamilton County: Volunteer Army Ammunition Plant (35°06'17"N, 85°07'49"). 17 March 2004. Thomas P. Wilson. Verified by Kerry Hansknecht. University of Tennessee at Chattanooga Museum of Natural History. UTCA/GMU4169. New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No.12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

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CRYPTOBRANCHUS ALLEGANIENSIS ALLEGANIENSIS. (Eastern Hellbender). USA: TENNESSEE: ROBERTSON CO.: Springfield, Sulfur Fork Creek off Memorial Boulevard (36°31'14"N,86°53'08"W). 01 July 2005. Ricky Mantlo. Austin Peay State University Museum of Zoology (APSU 17882, color photo). Verified by A. Floyd Scott. One adult (total length 560 mm) in shallow water near shore where smaller stream enters creek. New county record that fills gap between records from Montgomery and Sumner counties. (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Miscellaneous Publication No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee, hard copy and Internet versions [http://www.apsu.edu/amatlas/], the latter of which includes links to information on amphibians in Tennessee that has appeared since 1996, accessed 2 August 2005).)

Submitted by **DALE MCGINNITY**, Nashville Zoo, 3777 Nolensville Rd., Nashville, Tennessee 37080, USA; e-mail: dmcginnity@nashvillezoo.org

DESMOGNATHUS FOLKERTSI (Dwarf Black-bellied Salamander). USA: GEORGIA: GILMER CO.: Chattahoochee National Forest, Coosa-Tallapoosa Drainage, Conasauga Creek. 8.7 miles NW of Ellijay and 0.1 miles E on Mulberry Gap Road (34.7950N, 084.6033W). 06 November 2004 and 05 February 2005. Voucher specimen University of Alabama Herpetological Museum (ALA 14878). Collected by Jessica Wooten, Zachary Felix, Deborah Merritt, and Bill Sutton. Verified by mitochondrial DNA sequences with specimens from the type locality (West Fork of Wolf Creek) in Union Co., Georgia (Camp et al. 2002. Herpetologica 58[4]:471–484). This is a range extension and new county record for this recently described species known from only six streams in Georgia (Camp 2004. Cat. Amer. Amphib. Rept. 782.1–782.3). This site was typical for this species with numerous large boulders with cascading riffles followed by still pools. Mitochondrial DNA sequences were obtained from five individuals, This specimen was collected under a scientific collecting permit (#29-WMB-03-197) issued to LJR by the Georgia Department of Natural Resources.

Submitted by **JESSICA A. WOOTEN** (e-mail: woote009@bama.ua.edu) and **LESLIE J. RISSLER** (e-mail: rissler@bama.ua.edu), Department of Biological Sciences, Box 870344 University of Alabama, Tuscaloosa, Alabama 35487, USA.

DESMOGNATHUS FUSCUS FUSCUS (Northern Dusky Salamander). USA: MICHIGAN: TUSCOLA CO: Murphy Lake State Game Area (43°17'12.9"N, 83°27'13.86"W). 26 September 2004. Collected by Teresa Carlson and Laura Cochran. Verified by James Harding. Michigan State University Museum (MSUM) HE.14494. First state record (Harding 1997. Amphibians and Reptiles of the Great Lakes Region. The University of Michigan Press, Ann Arbor, Michigan). The salamanders were found at two locations along the same stream that were 1.5 mi. apart. Juveniles and adults were found at both locations, demonstrating that there is an extensive breeding range along the stream.

Submitted by **TERESA A. CARLSON** (e-mail: teresay@umflint.edu) and **ERNEST J. SZUCH** (e-mail: szuch@tds.net), Department of Biology, University of Michigan-Flint, Flint, Michigan 48502, USA.

DESMOGNATHUS MONTICOLA (Seal Salamander). USA: TENNESSEE: MARION CO: Hudgen's Cave, 4.2 km W of Marion County Line on US 41. 18 June 1997. Tim Gaudin. Verified by Kerry Hansknecht. University of Tennessee at Chattanooga Museum of Natural History. UTCA35. New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No.12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

Submitted by **CHRIS MANIS, TIM GAUDIN, ROBERT MINTON**, and **THOMAS P. WILSON,** Department of Biological and Environmental Sciences, University of Tennessee at Chattanooga, 215 Holt Hall, Department 2653, 615 McCallie Avenue, Chattanooga, Tennessee 37403, USA.

EURYCEA LONGICAUDA LONGICAUDA (Long -tailed Salamander). USA: GEORGIA: WHITFIELD CO: Dalton Middle School Campus (34°47'32.9"N, 84°56'33.1"W). 15 May 2005. Collected from a drift fence adjacent to a two-acre wetland. Chris Manis and John Patrick. Verified by Kerry Hansknecht and John Jensen. University of Tennessee at Chattanooga Museum of Natural History. UTCA/GMU 4631. New county record (Williamson and Moulis. 1994. Distribution of Amphibians and Reptiles in Georgia. Savannah Sci. Mus. Spec. No. 3, 712 pp.).

Submitted by **CHRIS MANIS**, Department of Biological and Environmental Sciences, University of Tennessee at Chattanooga, 215 Holt Hall, Department 2653, 615 McCallie Avenue, Chattanooga, Tennessee 37403, USA; **JOHN PATRICK**, Dalton Middle School, 1250 Cross Plains Trail, Dalton, Georgia 30721, USA; **ROBERT MINTON**, Department of Biological and Environmental Sciences, University of Tennessee at Chattanooga, 215 Holt Hall, Department 2653, 615 McCallie Avenue, Chattanooga, Tennessee 37403, USA; and **THOMAS P. WILSON**, Department of Biological and Environmental Sciences, University of Tennessee at Chattanooga, 215 Holt Hall, Department 2653, 615 McCallie Avenue, Chattanooga, Tennessee 37403, USA.

HEMIDACTYLIUM SCUTATUM (Four-toed Salamander). USA: MAINE: WASHINGTON CO: 44°38'12"N, 67°58'41"W. 20 May 2005. Bryan Windmiller et al. Verified by Phillip deMaynadier (Maine Dept. Inland Fisheries and Wildlife). Digital photos deposited at Harvard Museum of Comparative Zoology (MCZ-K-951–953). New county record (Hunter et al. 1999. Maine Amphibians and Reptiles. University of Maine Press, Orono. 252 pp.). Two adult females and five clutches of eggs (egg counts: 35, 26, 2, 48, 11) found in sphagnum moss overhanging water of small, isolated vernal pool (max. depth = 41 cm, surface area ca. 350 m^2, pH = 5.3) in mixed spruce-hardwood forest east of the West Branch of the Narraguagus River, in the town of Cherryfield. Also found in the same wetland were 32 egg masses of *Ambystoma maculatum*.

Submitted by **BRYAN WINDMILLER**, Hyla Ecological Services, 336 Baker Avenue, Concord, Massachusetts 01742, USA; **LINDA WEIR,** USGS Patuxent Wildlife Research Center, 12100 Beech Forest Road, Laurel, Maryland 20708, USA; **BRUCE BAR-**

BER, Town of Yorktown Town Hall, 363 Underhill Avenue, Yorktown Heights, NewYork 10598, USA; **KEN BLAZEJ,** USDA Natural Resources Conservation Service, Bangor Field Office, 967 Illinois Ave. Suite #3, Bangor, Maine 04401, USA; **GLEN MITTELHAUSER** and **PEPIN MITTELHAUSER**, Maine Natural History Observatory, 327 Guzzle Road, Gouldsboro, Maine 04607, USA; and **KEELY ROEN**, Wildlife Technology Department, Penn State DuBois, College Place, DuBois, Pennsylvania 15801, USA.

PLETHODON GLUTINOSUS (Northern Slimy Salamander). USA: ILLINOIS: St. Clair Co.: Sugar Loaf Township (T1S R10W, northwest quarter of section 13). 14 May 2004. Robert Weck. Verified by Chris Phillips. Illinois Natural History Survey (INHS 19541). New county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, 300 pp.). Adult specimen found under a log in a mature oak forest, within a region of karst topography. Four other specimens have since been observed in the same area, one within a small cave.

Submitted by **ROBERT WECK**, Department of Biology, Southwestern Illinois College, 2500 Carlyle Avenue, Belleville, Illinois 62221, USA; e-mail: bob.weck@swic.edu.

ANURA

BUFO PUNCTATUS (Red-spotted Toad). USA; TEXAS: Jones/Shackleford Co. line. Jones/Shackleford County Road 204 just S of Lueders (32°47.486'N, 99°36.752'W). 9 May 2005. J. R. Dixon. Verified by J. R. Dixon, Texas A&M University, Texas Cooperative Wildlife Collection. TCWC 89760. New county record (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M University Press, College Station, Texas. 421 pp.) Ten male *Bufo punctatus* were calling below rock ledges, in the evening at Lake Shackleford dam and spillway. One individual was retained as a voucher. These are the first recorded specimens found on the Jones/Shackleford County line.

Submitted by **MELISSA JONES, SUSANNAH REILLY, M. R. J. FORSTNER,** and **J. R. DIXON**, Department of Biology, Texas State University at San Marcos, San Marcos, Texas 78666, USA; e-mail: mj46953@txstate.edu.

GASTROPHYRNE CAROLINENSIS (Eastern Narrow-mouthed Toad). USA: ARKANSAS: Calhoun Co.: Forested area 6.4 km N. of Hampton, Arkansas (Sec. 8, T13S, R13W). 19 May 2005. H. W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 29399). Verified by Stanley E.Trauth. New county record in south-central Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

Submitted by **HENRY W. ROBISON** and **JANET RADER**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA (e-mail: hwrobison@saumag.edu).

HYLA ROSENBERGI (Medium Gladiator Treefrog). VENEZUELA: ESTADO TACHIRA: Municipio Uribante, 17 km S of Pregonero; Doradas River (7°53'N, 71°45'W), 650 m. Colección de Vertebrados Universidad de Los Andes, Mérida, (CVULA-IV 3573). ESTADO BARINAS: Sector Miraflores, 3 km from Barinitas, 600 m. (CVULA-IV 6294). Verified by G. Ollarves. Previously reported from northwestern Costa Rica, through western Panamá and western Colombia to northwestern Ecuador (Kluge 1979. Occas. Pap. Mus. Zool. Univ. Michigan 688:1–24; Duellman 2001. The Hylid Frogs of Middle America. SSAR, 1180 pp.). Presence of this species in Tachira state is not surprising because this area is connected with the lowlands of Central America and Amazonia by the Caparo Corridor (Yerena 1994. Corredores Ecológicos en los Andes de Venezuela. Parques Nacionales y Conservación Ambiental Nº 4, Editorial Torino, Caracas. P. XI +186 pp.). This is the second report of a *Hyla boans* group species from the Pacific lowlands of lower Central America in this corridor (Chacón-Ortiz et al. 2004. Rev. Acad. Colomb. Cienc. 28[108]:391–402). The specimen CVULA-IV 3573 was previously reported as *Hyla boans* in western Venezuela (Barrio 1999. Herpetol. Rev. 30:230). The first country record and easternmost known locality extends the range 700 km from Choco Department, Colombia (Lynch and Suarez 2001. Caldasia 23[2]:491–507) to Venezuela.

Submitted by **ANDRES CHACÓN-ORTIZ, CARMEN GARCIA,** and **EMMA CAMACHO**, Laboratorio de Ecología y Genética de Poblaciones, Centro de Ecología, Instituto Venezolano de Investigaciones Científicas (IVIC), Apartado Postal 21827, Caracas 1020-A, Venezuela (e-mail: aecortiz@ivic.ve; cgarcia@ivic.ve; ecamacho@ivic.ve); and **AMELIA DÍAZ DE PASCUAL**, Facultad de Ciencias, Universidad de Los Andes, Mérida, Venezuela (e-mail: adiaz@ula.ve).

HYLA SQUIRELLA (Squirrel Treefrog). USA: SOUTH CAROLINA: Pickens Co.: South Carolina Department of Natural Resources Clemson Office (153 Hopewell Road, Pendleton, South Carolina, USA). 17 June 2004. John G. Garton. Bob Campbell Museum of Natural History, Clemson University (CU 2233). Verified by Richard R. Montanucci. New county record (Martof et al. 1989. Amphibians and Reptiles of the Carolinas and Virginia. University of North Carolina Press, Chapel Hill, North Carolina). Extends the range of the species at least 120 km from nearest known localities in the lower piedmont of South Carolina (Edgefield, Richland, and Laurens counties). Specimen was collected on side of DNR building. At least two other individuals were heard calling at this locality.

Submitted by **COREY E. ROELKE**, PO Box 19498, Department of Biology, The University of Texas at Arlington, Arlington, Texas 76019, USA; e-mail: croelke@uta.edu.

PHRYNOHYAS CORIACEA (Suriname Golden-eyed Treefrog). GUYANA: POTARO-SIPARUNI: Kaieteur National Park (05°10'23"N, 59°28'52"W, ca. 350 m elevation). August 2004. Collected by local people. Royal Belgian Institute of Natural Sciences, Brussels, Belgium (IRSNB 13672). Verified by C. Lac-Hair. Adult male (60.8 mm SVL) collected in primary submontane forest of the Pakaraima uplands on white sands (ter Steege 2001. National Vegetation Map of Guyana, Guyana Forestry Commission, Georgetown). First described from Suriname, the species is also known to occur in the upper Amazon Basin in Ecuador, Peru, Bolivia, downstream to Manaus, Brazil, and in French Guiana (De

la Riva et al. 2000. Rev. Esp. Herpetol. 14:19–164; Frost 1985. Amphibian Species of the World - A Taxonomic and Geographical Reference. Allen Press and the Assoc. of Syst. Coll., Lawrence, Kansas. 732 pp.; Lescure and Marty 2000. Atlas des Amphibiens de Guyane. SPN/MNHN, Paris, Patrim. Nat. 45:1–388 ; Peters 1867. Monatsber. Preuss. Akad. Wiss. Berlin 1867:703–712; Zimmerman and Rodrigues 1990. *In* Gentry [ed.], Four Neotropical Rainforests, pp. 60–74. Yale Univ. Press, New Haven). First country record, and westernmost locality for the species on the Guiana Shield and northernmost locality in South America. This location extends the range of *P. coriacea* ca. 500 km W of the previously westernmost known locality in Suriname ("Spoorbaan") (Duellman 1971. Occ. Pap. Mus. Nat. Hist. Univ. Kansas 4:1–21).

Submitted by **PHILIPPE J. R. KOK,** Department of Vertebrates, Royal Belgian Institute of Natural Sciences, 29 rue Vautier, B-1000 Brussels, Belgium (e-mail: Philippe.Kok@naturalsciences.be); **GODFREY R. BOURNE,** Department of Biology, University of Missouri-St. Louis, 8001 Natural Bridge Road, St. Louis, Missouri 63121-4499, USA, and National Science Foundation, Division of Integrative Organismal Biology, Behavioral Systems Cluster, 4201 Wilson Boulevard, Arlington, Virginia 22230, USA (e-mail: gbourne@nsf.gov); **HEMCHANDRANAUTH SAMBHU,** Iwokrama International Centre for Rainforest Conservation and Development, 77 High Street, Kingston, Georgetown, Guyana (e-mail: hsambhu@iwokrama.org); and **GEORGES L. LENGLET,** Department of Vertebrates, Royal Belgian Institute of Natural Sciences, 29 rue Vautier, B-1000 Brussels, Belgium (e-mail: Georges.Lenglet@naturalsciences.be).

PSEUDACRIS BRACHYPHONA (Mountain Chorus Frog). USA: TENNESSEE: Sullivan Co.: Cherokee National Forest on USFS Road 87A 100 m S of intersection with Flatwoods Roads (36°29.199'N, 82°04.303'W). 22 April 2005. Kevin Hamed. Verified by A. Floyd Scott, Austin Peay State University Museum of Zoology, APSU 17699 (voucher specimen and photo of live individual). Many individuals were calling from vegetation at the edge of a small pool created when a pit was dug to block a logging road at the intersection with USFS Road 87A. First record from Sullivan County and second record from upper East Tennessee (Redmond and Scott. 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. (Hard copy and Internet versions, the latter of which includes links to information on amphibians in Tennessee having appeared since 1996], http://www.apsu.edu/amatlas/, accessed 29 June 2005).

Submitted by **M. KEVIN HAMED**, Virginia Highlands Community College, P.O. Box 828, Abingdon, Virginia 24212, USA; e-mail: khamed@vhcc.edu.

PSEUDACRIS TRISERIATA (Western Chorus Frog). USA: ARKANSAS: Cleveland Co: Roadside ditch 6.7 km NE of Kingsland (Sec. 27, T9S, R11W). 20 March 2005. H. W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 29400). Verified by Stanley E. Trauth. New county record in south-central Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

Submitted by **HENRY W. ROBISON** and **JANET RADER**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA; e-mail: hwrobison@saumag.edu.

RANA FABER. THAILAND: CHANTABURI PROVINCE: Pong Nam Ron, Khao Soi Dao Tai Mountain, 1000 m elev., 27 November 1971, Sukhum Pongsapipatana. FMNH 191467–77. Verified by Robert F. Inger. First country record. Known previously only from Phnom Aural in Kampong Speu Province (type locality) and the Bokhor Mountains (= Bokor) in Kampot Province, Cambodia (Ohler et al. 2002. Raffles Bull. Zool. 50:465–481; Chuaynkern et al. 2004. Nat. Hist. J. Chulalongkorn Univ. 4:1–13). Khao Soi Dao Tai in southeastern Thailand is in a mountain range contiguous with Phnom Aural and Bokor in southwestern Cambodia, and so this record is not surprising.

Submitted by **BRYAN L. STUART,** The Field Museum, Department of Zoology, 1400 South Lake Shore Drive, Chicago, Illinois 60605-2497, USA; e-mail: bstuart@fieldmuseum.org.

RANA PALUSTRIS (Pickerel Frog). USA: ARKANSAS: Craighead Co.: County Road 762, 3.2 km W jct with Arkansas State Highway 49, ca 4.0 km NW Brookland. 29 August 2005. Jonathan W. Stanley. Verified by Chris T. McAllister. Arkansas State University Museum of Zoology Herpetology Collection (ASUMZ 29381). New county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville, 421 pp.).

Submitted by **JONATHAN W. STANLEY** (e-mail: jonathanw.stanley@smail.astate.edu) and **STANLEY E. TRAUTH**, Department of Biological Sciences, P.O. Box 599, State University, Arkansas 72467, USA (e-mail: strauth@astate.edu).

RANA PALUSTRIS (Pickerel Frog). USA: GEORGIA: Whitfield Co: Dalton Middle School Campus (34°47'32.9"N, 84°56'33.1"W). 23 September 2005. Collected from a drift fence line adjacent to Mill Creek and wooded wetland. Allison Hunt. Verified by John Jensen. University of Tennessee at Chattanooga Museum of Natural History. (UTCA/GMU 4400). New county record (Williamson and Moulis 1994. Distribution of Amphibians and Reptiles in Georgia. Savannah Sci. Mus. Spec. Publ. No. 3, 712 pp.).

Submitted by **CHRIS MANIS**, **ROBERT MINTON**, and **THOMAS P. WILSON**, Department of Biological and Environmental Sciences, University of Tennessee at Chattanooga, 215 Holt Hall, Department 2653, 615 McCallie Avenue, Chattanooga, Tennessee 37403, USA; and **ALLISON HUNT**, Dalton Middle School, 1250 Cross Plains Trail, Dalton, Georgia 30721, USA.

SCAPHIOPUS HOLBROOKII (Eastern Spadefoot). USA: ILLINOIS: St. Clair Co.: Sugar Loaf Township (T1S, R10W, NW qtr of Sec. 12). 30 July 2004. Robert Weck. Verified by Chris Phillips. Illinois Natural History Survey (INHS 19542). The specimen is one of eight newly transformed juveniles observed after heavy rains. This new county record represents a northern extension of the previously known range of the species in Illinois (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, 300 pp.).

Submitted by **ROBERT WECK**, Department of Biology, South-

western Illinois College, 2500 Carlyle Avenue, Belleville, Illinois 62221, USA; e-mail: bob.weck@swic.edu.

SCINAX ARGYREORNATUS. BRAZIL: SANTA CATARINA: Municipality of Florianópolis: Ilha de Santa Catarina, Pântano do Sul (27°46'S, 48°31'W). 07 December 2004. A. Kwet, A. F. Cordeiro, and A. Zillikens. Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil (MCP 8239–40). Verified by M. Di Bernardo. All specimens were observed in a small ditch with shallow water. This species was known from the coastal region of southeastern Brazil, from the states of Bahia and Espírito Santo to Rio de Janeiro and São Paulo (Silvano and Pimenta 2001. Herpetol. Rev. 32:273). A recent comment (IUCN, Conservation International, and NatureServe. 2004. Global Amphibian Assessment. <www.globalamphibians.org>. Accessed on 15 October 2004) indicates that *S. argyreornatus* might also occur in the state of Santa Catarina. However, this distribution does not include the island Ilha de Santa Catarina, and to date there are no voucher specimens cited for this state. This new record extends the distribution range about 400 km S from previous published localities.

Submitted by **AXEL KWET**, Zoologie, Staatliches Museum für Naturkunde Stuttgart, Rosenstein 1, D-70191 Stuttgart, Germany (e-mail: kwet.smns@naturkundemuseum-bw.de); and **ANNE ZILLIKENS**, Zoologisches Institut der Universität Tübingen, Med.- Naturwissenschaftliches Forschungszentrum, Ob dem Himmelreich 7, D-72074 Tübingen, Germany (e-mail: anne.zillikens@uni-tuebingen.de).

SCINAX AROMOTHYELLA. URUGUAY: DEPARTAMENTO DE TREINTA Y TRES: Surroundings of Quebrada de los Cuervos (32°52'S; 54°28'W; 252 m elev.). 19 April 2005. C. Borteiro, C. Prigioni, and M. Tedros. Verified by D. Baldo. Colección de Batracios, Sección Zoología - Vertebrados, Facultad de Ciencias, Universidad de la República, Montevideo, Uruguay (ZVCB 11520–11521). Previously known only from Argentina: Misiones: Departamentos Guaraní, San Pedro, and Iguazú (Faivovich 2005. Herpetologica 61:69–77). First country record, extends the known range ca. 750 km S from those localities.

Submitted by **CARLOS PRIGIONI**, Secretaría de Medio Ambiente, Intendencia Municipal de Treinta y Tres, Uruguay; **CLAUDIO BORTEIRO**, Departamento de Fisiología, Facultad de Veterinaria, Universidad de la República, Uruguay; **MARCELO TEDROS,** China 2202, 12800, Montevideo, Uruguay; and **FRANCISCO KOLENC**, Cátedra de Bioquímica y Biofísica, Facultad de Odontología, Universidad de la República, Uruguay (e-mail: kolenc@adinet.com.uy).

SCINAX STAUFFERI (Stauffer's Treefrog). MEXICO: CHIAPAS: Municipality of Ocosingo, Km 140 on road from Palenque to Crucero Corozal, near border of Monte Azules Biosphere Reserve (16°45'37.1"N, 91°00'27.3"W), 151 m elev. 10 October 2004. Ricardo Paredes-León and Jorge Cime-Castillo. Colección Nacional de Anfibios y Reptiles, Instituto de Biología, UNAM (CNAR-IBH 15656–57). Verified by Elisa Cabrera Guzmán and Edmundo Pérez-Ramos. First record for the Lacandona region (Lazcano-Barrero et al. 1992. *In* Vásquez Sánchez and Ramos Olmos [eds.], Reserva de la Biósfera Montes Azules, Selva Lacandona: Investigación para su Conservación, pp. 145–171. Publ. Espec. ECOSFERA No. 1, Centro Estud. Conserv. Rec. Nat., A. C.), extending its range in Chiapas ca. 75 km SE of Palenque and ca. 52.5 km NE of Lagunas de Montebello, and ca. 85 km W of La Libertad, El Petén, Guatemala (Duellman 2001. Hylid Frogs of Middle America, 2 Vols. SSAR Contrib. Herpetol. Vol. 18, 1158 pp.). The specimens were collected from a pool in a pasture.

Submitted by **RICARDO PAREDES LEÓN**, Colección Nacional de Ácaros, Instituto de Biología, UNAM and Laboratorio de Acarología, Facultad de Ciencias, UNAM, Ciudad Universitaria, Mexico, D.F. 04510 (e-mail: skarabajo8@yahoo.com.mx); and **VICTOR-HUGO REYNOSO**, Colección Nacional de Anfibios y Reptiles, Instituto de Biología, UNAM, Ciudad Universitaria, México, D.F. (e-mail: vreynoso@ibunam.ibiologia.unam.mx).

SMILISCA CYANOSTICTA (Blue-spotted Smilisca). MÉXICO: TABASCO: Parque Estatal Agua Blanca, ca. 85 km SW from Villahermosa (17°37'10.5"N, 92°28'19.8"W; 17°37'10.2"N, 92°28' 15.1"W), ca. 80 m elev. 3 April and 21 May 2004, respectively. Marco Antonio Torrez Pérez. Colección de Anfibios y Reptiles de Tabasco, Universidad Juárez Autónoma de Tabasco (CART-00506, 00508). Verified by Marco Antonio López Luna. First record from Tabasco and a range extension of ca. 100 km NW from nearest locality, 8 km S of Palenque, Chiapas (Lee 1996. The Amphibians and Reptiles of the Yucatán Peninsula. Comstock Publ. Assoc., Cornell Univ. Press, Ithaca, New York. 500 pp.).

Submitted by **MARCO ANTONIO TORREZ PERÉZ** and **MARÍA del ROSARIO BARRAGÁN-VÁZQUEZ**, División Académica de Ciencias Biológicas, Universidad Juárez Autónoma de Tabasco, Km. 0.5 Carretera Villahermosa-Cárdenas, entronque con Bosques de Saloya, C. P. 86090, Tabasco, México; e-mail: barragan@cicea.ujat.mx.

SPHAENORHYNCHUS PLANICOLA. BRAZIL: ESPÍRITO SANTO: ANCHIETA: Mãe-Bá lagoon (20°46'S, 40°35'W). 13 January 2000. R. L. Teixeira, G. I. Almeida, and A. Anastácio. Museu de Zoologia Prof. Mello Leitão, Santa Tereza, Espirito Santo, Brazil (MBML 2609–12). 28 August 2004. R. L. Teixeira. (MBML 3418–20). Verified by U. Caramaschi. Frost (2004. Amphibian Species of the World: An online reference. Version 3.0, http://research.amnh.org/herpetology/amphibia/index.html) mentions this species as occurring only in coastal lowlands of the state of Rio de Janeiro. Nevertheless, Carvalho-e-Silva et al. (2000. *In* Esteves and Lacerda [eds.], Ecologia de Restingas e Lagoas Costeiras, pp. 89–97. NUPEM/UFRJ, Macaé, Brazil) and Izecksohn and Carvalho-e-Silva (2001. Anfíbios do Municipio do Rio de Janeiro. Editora UFRJ, Rio de Janeiro) reported that *S. planicola* occurs in the states of Rio de Janeiro and Espírito Santo, though they did not give specific localities or documented records for the latter state. This note presents the first vouchered records of *S. planicola* for the state of Espírito Santo, and extends its distribution ca. 80 km northward from the northern border of Rio de Janeiro State.

Submitted by **ROGÉRIO L. TEIXEIRA**, Museu de Biologia Prof. Mello Leitão, Av. José Ruschi 4, 29650-000, Santa Teresa, ES, Brazil (e-mail: rogeteix@terra.com.br); and **DAVOR**

VRCIBRADIC, Departamento de Ecologia, Instituto de Biologia, Universidade do Estado do Rio de Janeiro, 20550-011, Rio de Janeiro, RJ, Brazil (e-mail: davor@centroin.com.br).

TELMATOBIUS CARRILLAE (Ancash Water Frog). PERU: DEPARTAMENTO LIMA: Provincia Huarochiri: Distrito Chicla: Ticlio (11°35'58.5"S, 076°11'36.6"W, 4818 m elev.). 15 February 2005. M. Lundberg. Museo de Historia Natural de San Marcos, Lima, Peru (MHNSM 19509–19516 and MHNSM 19522–23). Verified by V. Morales. Previously known only from Peruvian departments of Ancash and Huanuco (Morales 1988. Rev. Bras. Zool. 5[4]:603–608; Lehr and Fuentes 2000. Herpetol. Rev. 31:183). First department record and southernmost locality, extends the distribution ca. 180 km S from Huanuco (Lehr and Fuentes 2000, *op. cit.*).

Submitted by **CESAR AGUILAR,** Museo de Historia Natural, Departamento de Herpetología, Universidad Nacional Mayor de San Marcos, Av. Arenales 1256, Jesús María, Ap. 14-0434, Lima, Perú; and **MIKAEL LUNDBERG**, Staatliche Naturhistorische Sammlungen Dresden, Museum für Tierkunde, Königsbrücker Landstrasse 159, D-01109 Dresden, Germany.

TRIPRION PETASATUS (Yucatecan Casqueheaded Treefrog). MÉXICO: CHIAPAS: Municipality of Ocosingo, 140 km SE on the Palenque-Crucero Corozal road near Guatemalan border, 11 km S Frontera Corozal (16°45'57.3"N, 90°58'01.5"W), 171 m elev. 20 August 2004. Ricardo Paredes-León. Colección Nacional de Anfibios y Reptiles, Instituto de Biología, UNAM (CNAR-IBH 15655, CNAR-RF 22). Verified by Elisa Cabrera-Guzmán and Edmundo Pérez-Ramos. First record for Chiapas and southernmost record for México, extending range 85 km E from La Libertad, El Petén, Guatemala and 210 km from its nearest Mexican record, 7.5 km W Escárcega, Campeche (Duellman 2001. Hylid Frogs of Middle America, 2 Vols. SSAR Cont. Herpetol. Vol. 18, 1158 pp.). The specimen was collected ca. 70 cm above ground on a bush in regenerated tropical rainforest.

Submitted by **RICARDO PAREDES LEÓN**, Colección Nacional de Ácaros, Instituto de Biología, UNAM and Laboratorio de Acarología, Facultad de Ciencias, UNAM, Ciudad Universitaria, México, D. F. 94510 (e-mail: skarabajo8@yahoo.com.mx); and **VÍCTOR-HUGO REYNOSO**, Colección Nacional de Anfibios y Reptiles, Instituto de Biología, UNAM, Ciudad Universitaria, México, D.F. 04510 (e-mail: vreynoso@ibunam.ibiologia.unam.mx).

TESTUDINES

ACANTHOCHELYS MACROCEPHALA (Pantanal Swamp Turtle). BRAZIL: MATO GROSSO DO SUL: Corumbá (Nhumirim Farm: 18°57'S, 56°37'W) and Aquidauana (Rio Negro Farm: 19°34'S, 56°14'W). 1–15 October 2002. M. A. Kinas and F. L. Souza. Verified by A. S. Abe. Zoological Collection of Department Biology, Universidade Federal de Mato Grosso do Sul, Brasil (ZUFMS-CHEL: 0001–0007). Intact carapace and plastron as well as bones found around bays and salt lagoons. These are the first species records for the Mato Grosso do Sul State, better defining the Paraguay River basin as the core geographical distribution area for this species. These records are ca. 260 km straight line S from Mato Grosso State and 290 km N Puerto Casado, Paraguay, the closest locality records (Rhodin et al. 1984. Herpetologica 40:38–46).

We thank Universidade Federal de Mato Grosso do Sul and Empresa Brasileira de Pesquisa Agropecuária for financial support.

Submitted by **MARCO AURÉLIO KINAS**, Universidade Federal de Mato Grosso do Sul, Centro de Ciências Biológicas e da Saúde, Departamento de Biologia, 79070-900, Campo Grande, Mato Grosso do Sul, Brazil; **RODINEY DE ARRUDA MAURO**, Empresa Brasileira de Pesquisa Agropecuária, Caixa Postal 154, 79002-970, Campo Grande, Mato Grosso do Sul, Brazil; and **FRANCO LEANDRO SOUZA**, Universidade Federal de Mato Grosso do Sul, Centro de Ciências Biológicas e da Saúde, Departamento de Biologia, 79070-900, Campo Grande, Mato Grosso do Sul, Brazil; e-mail (FLS): flsouza@nin.ufms.br.

DOGANIA SUBPLANA (Malayan Softshell Turtle). PHILIPPINES: PALAWAN PROVINCE: Quezon; Barangay; Panitian; Isapa Creek. 9 December 2004. Pierre Fidenci. California Academy of Sciences Photo Voucher (CAS-HPV 37). Verified by Michelle Koo. First confirmed record for the Philippines. Two adults and two juveniles were observed at night in shaded primary forest creek (4 m wide and 0.1–0.5 m deep) with a mixture of sand, silt, gravel, and boulder as substrate. It is thus likely that this softshell turtle occurs in this region as a breeding population. Previous record of *Dogania subplana* in the Philippines was questionable because of the lack of voucher and wild populations have never been reported before (de Rooij 1915. The Reptiles of the Indo-Australian Archipelago. I. Lacertilia, Chelonia, Emydosauria, E. J. Brill, Leyden; Taylor 1920. Philippine turtles. Philippine J. Sci. 16:130–133; Iverson 1992. A Revised Checklist with Distribution Maps of the Turtles of the World. Privately Published, Richmond, Indiana).

Submitted by **PIERRE FIDENCI**, GANDA, 1 Saunders Ave, San Anselmo, California 94960, USA; e-mail: pfidenci@garciaandassociates.com.

PSEUDEMYS GORZUGI (Rio Grande River Cooter). USA: TEXAS: Brewster Co.: Rio Grande Village, Big Bend National Park (29°10.712N, 102°57.24W, 1861 ft. elevation). 19 June 2005. L. A. Bailey, J. Duvall, A. Ferguson, M. R .J. Forstner, D. Hahn, J. Jackson, V. Radhakrishnan, and S. Reilly. Verified by J. A. Campbell. University of Texas at Arlington, Amphibian and Reptile Diversity Research Center, UTA Slide Nos. 33296–33299. New county record (Dixon 2000. Amphibians and Reptiles of Texas. Second Edition. Texas A&M University Press, College Station, Texas, 421 pp.). Blood was drawn and placed in the frozen tissue collection at Texas State University (MF 17889). The adult male specimen was photo vouchered using Fujichrome Provia 100 slide film and released at the capture site, a small pond near the Rio Grande River. The specimen had a carapace length of 249 mm, a plastron length of 212 mm, a shell depth of 87 mm, and weighed 2120 g. The specimen presented reticulate melanism, a carapacial patterning found in the large males of this species. Four additional adult individuals (3M and 1F) were collected from this location during three subsequent survey months.

Submitted by **LINDLEY BAILEY, JAKE JACKSON, ADAM FERGUSON,** and **MICHAEL R.J. FORSTNER**, Department

of Biology, Texas State University, 601 University Drive, San Marcos, Texas 78666, USA and **JAMES R. DIXON**, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, Texas 77843-2258, USA; e-mail [LB]: lb1122@txstate.edu.

PSEUDEMYS NELSONI (Florida Red-bellied Turtle). BRITISH VIRGIN ISLANDS: Road Town, Tortola: Botanical Gardens (18°25'38.6"N, 64°37'22.1"W). 27 July 2004. Jennifer Owen and Gad Perry. MCZ R-184121. Verified by Jose Rosado. First record for this introduced species in the British Virgin Islands (Powell et al. 1996. *In* Powell and Henderson [eds.], Contributions to West Indian Herpetology: A Tribute to Albert Schwartz, pp. 51–93. SSAR Contrib. Herpetol. Vol. 12). The turtle was collected in a man-made pond that also contained introduced Red-eared Slider Turtles, *Trachemys scripta*.

The Conservation Agency, H. Lavity Stoutt Community College, and Texas Tech University supplied funding support for this project.

Submitted by **JENNIFER OWEN** and **GAD PERRY** (e-mail: gad.perry@ttu.edu), Department of Range, Wildlife, & Fisheries Management, Texas Tech University, Box 42125, Lubbock, Texas 79409-2125, USA; **JAMES LAZELL**, The Conservation Agency, 6 Swinburne Street, Jamestown, Rhode Island 02835, USA; and **CLIVE PETROVIC**, H. Lavity Stoutt Community College, P.O. Box 3097, Road Town, Tortola, BVI.

PSEUDEMYS NELSONI (Florida Red-bellied Turtle). USA: FLORIDA: Jefferson Co.: Wacissa River, Big Blue Spring (Scott et al. 2004. Florida Geol. Surv. Bull. No. 66); 30°19'39.8"N, 83°59'05.4"W. 12 May 2005. Dale R. Jackson, Brett Stearns, and Nancy Stearns. Verified by Kenneth L. Krysko. Florida Museum of Natural History Herpetology Department photographic archive (UF 144233, five photographic vouchers). Adult male (292 mm maximum CL, 279 mm PL) caught while basking at 1330 h, released following photography. First documented record for county and Aucilla River drainage..

This specimen is the first recorded from the large distributional hiatus that remains between the Ochlockonee and Suwannee rivers (Big Bend region of Florida). Although the collection locality is a popular recreational area, the fact that the specimen was an aggressive adult casts doubt on its having been a released captive animal.

Submitted by **DALE R. JACKSON**, Florida Natural Areas Inventory, 1018 Thomasville Road, Suite 200-C, Tallahassee, Florida 32303, USA (e-mail: djackson@fnai.org); and **BRETT C. STEARNS**, California Academy of Sciences, 875 Howard Street, San Francisco, California 94103, USA.

TERRAPENE CAROLINA TRIUNGUIS (Three-toed Box Turtle). USA: ARKANSAS: Hempstead Co.: 6.4 km W of Ozan, on U.S. Hwy 276 (Sec. 29, T10N, R26W). 30 June 2005. H. W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection photograph (ASUMZ 29337). Verified by Stanley E. Trauth. New county record in southwestern Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

Submitted by **HENRY W. ROBISON** and **JANET RADER**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA; e-mail: hwrobison@saumag.edu.

TRACHEMYS DECUSSATA ANGUSTA (Cuban Slider). CUBA: GUANTÁNAMO PROVINCE: Alejandro Humbold National Park, Baracoa Section, 500 m S of Bahia de Toca, elevation ca. 20 m. 27 November 2003. Pierre Fidenci. California Academy of Sciences Photographic Collection (CAS HPV 2). Verified by Jens Vendum. First record for Alejandro Humbold National Park, and an approximate 100 km range extension W from the closest known provincial record (Seidel 1988. Amer. Mus. Nov. 2918:1–41). Three turtles were basking at 1150 h on a log in a large pond.

Submitted by **PIERRE FIDENCI**, GANDA, 1 Saunders Ave, San Anselmo, California 94960, USA; e-mail: pfidenci@garciaandassociates.com.

LACERTILIA

ANOLIS CAROLINENSIS CAROLINENSIS (Northern Green Anole). USA: ARKANSAS: Perry Co.: 1.6 km E. of Perryville (Sec. 2, T4N, R17W). 8 August 2005. H. W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 29398). Verified by Stanley E.Trauth. New county record in west-central Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

Submitted by **HENRY W. ROBISON** and **JANET RADER**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA; e-mail: hwrobison@saumag.edu.

ANOLIS (NOROPS) OCELLOSCAPULARIS (NCN). HONDURAS: CORTÉS: Sierra de Omoa, Parque Nacional El Cusuco, Guanales Camp (15°48'55"N, 88°23'26"W), 1225 m elev. 27 July 2004. Sara M. Hughes. UF 144266. Verified by Larry David Wilson. A new record for Cortés and a ca. 75 km range extension NE of the type locality in the Department of Copán, Honduras, in Parque Nacional Cerro Azul (Köhler et al. 2001. Herpetologica 57:247–255; McCranie 2005. Herpetol. Bull. 90:10–21).

Submitted by **JOSIAH H. TOWNSEND**, Tropical Conservation and Development Program, Center for Latin American Studies, University of Florida, and Division of Herpetology, Florida Museum of Natural History, Gainesville, Florida 32611, USA (e-mail: jtownsend@flmnh.ufl.edu); **SARA M. HUGHES**, Department of Fisheries and Wildlife, Michigan State University, East Lansing, Michigan 48824, USA; and **T. LYNETTE PLENDERLEITH**, 18, Northmead, Ledbury, Herefordshire, HR8 1BE, United Kingdom.

ANOLIS (NOROPS) PETERSII (Peters' Anole). HONDURAS: SANTA BARBARA: Sierra de Omoa, Parque Nacional El Cusuco (15°29.976'N, 88°17.228'W), 1300 m elev. 3 July 2005. Josiah H. Townsend and T. Lynette Plenderleith. UF 144333. Verified by Larry David Wilson. First record from Santa Barbara, the Sierra de Omoa, and Parque Nacional El Cusuco. The nearest reported locality lies near Parque Nacional Cerro Azul, ca. 75 km to the southwest in Departament of Copán, Honduras (McCranie and Wilson 1985. Herpetol. Rev. 16:107–108). The lizard was asleep

in a tree ca. 3.5 m above a tributary of Río Quebrada La Ruidosa, near an edge between an agricultural clearing and broadleaf forest.

Submitted by **JOSIAH H. TOWNSEND**, Tropical Conservation and Development Program, Center for Latin American Studies, University of Florida, and Division of Herpetology, Florida Museum of Natural History, Gainesville, Florida 32611, USA (e-mail: jtownsend@flmnh.ufl.edu); and **T. LYNETTE PLENDERLEITH**, 18, Northmead, Ledbury, Herefordshire, HR8 1BE, United Kingdom.

ANOLIS SAGREI: (Brown Anole). USA: GEORGIA: Baldwin Co.: (83°13'44"W, 33°4'59"N). 13 July 2005. Voucher specimen in Georgia College & State University Herpetological Collection (GC-H 4755). This locality represents the first county record, extending species range in Georgia ca. 86 km north (Parmley 2002. Georgia J. Sci. 60:191–193).

Submitted by **CHRIS SKELTON** and **DENNIS PARMLEY**, Georgia College & State University, Milledgeville, Georgia 31061, USA; e-mail: chris.skelton@gcsu.edu.

ANOLIS SAGREI (Brown Anole). ST. VINCENT AND THE GRENADINES (SVG): shores of Camden Bay and Kingstown deepwater wharf. 6 May 2005. FitzRoy Springer. MPM 33972, MPM-P 730. Verified by A. C. Echternacht. First record for SVG. The species has been previously recorded in the Lesser Antilles only from Grenada (Green et al. 2002. Carib. J. Sci. 38:270–272). Lizards at both sites were associated with shipyards and shipping containers, but their origins are unknown.

Submitted by **ROBERT W. HENDERSON**, Section of Vertebrate Zoology, Milwaukee Public Museum, Milwaukee, Wisconsin 53233, USA (e-mail: rh@mpm.edu); and **ROBERT POWELL**, Department of Biology, Avila University, Kansas City, Missouri 64145, USA (e-mail: powellr@avila.edu).

CNEMIDOPHORUS SERRANUS. ARGENTINA: SANTIAGO DEL ESTERO: Parque Nacional Copo, in an old growth forest (25°39'45.5"S; 61°47'50.10"). 13 December 2002. F. Lobo and I. Martínez Oliver. Verified by J. M. Díaz Gómez. Museo de Ciencias Naturales, Universidad Nacional de Salta, Salta, Argentina (MCN 1150). Previously known from Sierras de Córdoba and Ambargasta in Santiago del Estero province (Cei 1993. Reptiles del Noroeste, Nordeste y Este de la Argentina. Mus. reg. Sci. nat. Torino, Monogr. 14: 949 pp.). Present record extends range ca. 500 km N from Ambargasta, Santiago del Estero the nearest locality known (Cei and Martori 1991. Boll. Mus. Reg. Sci. Nat. Torino 9[1]:33–38).

Submitted by **FEDERICO ARIAS** and **FERNANDO LOBO,** Cátedra de Anatomía Comparada, Facultad de Ciencias Naturales, Universidad Nacional de Salta, Avda. Bolivia 5150- 4400- Salta, Argentina; e-mail: flobo@unsa.edu.ar.

CROTAPHYTUS COLLARIS COLLARIS (Eastern Collared Lizard). USA: ARKANSAS: Franklin Co.: Rattlesnake Canyon Road, Backbone Narrows (UTM: N3898240 E405631). 24 June 2004. Arkansas State University Museum of Zoology (ASUMZ 28643). Verified by Chris T. McAllister. New county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 254 pp.).

Submitted by **J. PHILLIP STEWART, ROBERT G. NEAL,** and **CHARLES R. MCDOWELL,** Department of Biology, Arkansas State University, State University, Arkansas 72467, USA; e-mail: strauth@astate.edu.

EUMECES FASCIATUS (Five-lined Skink). USA: ARKANSAS: Mississippi Co.: Gosnell city limits. 29 April 2005. H. W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 29329). Verified by Stanley E.Trauth. New county record in southeastern Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

Submitted by **HENRY W. ROBISON** and **JANET RADER**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA; e-mail: hwrobison@saumag.edu.

EUMECES SEPTENTRIONALIS SEPTENTRIONALIS (Northern Prairie Skink). USA: WISCONSIN: Portage Co.: Stevens Point, 0.8 km N Mead Park, W shore of Wisconsin River. (44.52803°N, 89.60351°W). 13 May 2004. Sarah A. Orlofske, Sabrina Leahy, and Chris G. Anderson. Verified by Erik R. Wild. Department of Biology, University of Wisconsin- Stevens Point (UWSP 4003: adult female, 70 mm SVL, 164 mm TL; UWSP 4004: 15 September 2004, juvenile tail regenerating, 36 mm SVL and 57 mm TL). All specimens found under rocks on sandy bank of wetland neighboring but separate from the Wisconsin River. Species first observed on 28 April 2004 with additional observation made between 16 May 2004 and 22 May 2004. Tissues were collected from two individuals. New county record, with no county records present for immediately adjacent counties (Christoffel et al. 2002. Turtles and Lizards of Wisconsin. 44 pp.; Casper 1996. Geographical Distributions of the Amphibians and Reptiles of Wisconsin. 47 pp.; Vogt 1981. Natural History of Amphibians and Reptiles of Wisconsin). Easternmost record for species, extending range ca. 100 km E from nearest county with record.

Submitted by **SARAH A. ORLOFSKE** and **CHRIS G. ANDERSON,** Department of Biology, University of Wisconsin-Stevens Point, Stevens Point, Wisconsin 54481, USA; e-mail: Tadpole364@hotmail.com.

HEMIDACTYLUS FRENATUS (Common House Gecko). MÉXICO: CHIAPAS: Municipality of Ocosingo, Frontera Corozal, Museo Regional de Frontera (16°49'16.6"N, 90°53'14.1" W), 101 m elev. 1 May 2004. Ricardo Paredes-León. Colección Nacional de Anfibios y Reptiles, Instituto de Biología, UNAM (CNAR-IBH 15663–65). Verified by Elisa Cabrera-Guzmán and Edmundo Pérez-Ramos. First record for the Lacandona region, extending its known range 140 km NW of Palenque, Chiapas (Lee 1996. The Amphibians and Reptiles of the Yucatán Peninsula. Comstock Publ. Assoc., Cornell Univ. Press, Ithaca, 500 pp.). The specimens were collected at night on walls of the museum.

Submitted by **RICARDO PAREDES-LEÓN**, Colección Nacional de Ácaros, Instituto de Biología, UNAM, Ciudad Universitaria, México, D.F. 04510 (e-mail: skarabajo8@yahoo.com.mx); and **VÍCTOR-HUGO REYNOSO**, Colección Nacional de Anfibios y Reptiles, Instituto de Biología, UNAM, Ciudad Universitaria, México, D.F. 04510 (e-mail:

vreynoso@ibunam.ibiologia.unam.mx).

HEMIDACTYLUS MABOUIA (Cosmopolitan House Gecko). BAHAMAS: LONG ISLAND: Stella Maris (23°35.377'N, 75°15.764'W). 25, 26, 28 April 2005. Kenneth L. Krysko and Andrew P. Borgia. UF 144023–28. Verified by Josiah H. Townsend. First record for Long Island (Buckner and Franz 1994. Herpetol. Rev. 25:164). This species has also been found recently on Great Exuma Island, New Providence Island, and San Salvador Island (R. Franz, pers. comm.). Specimens were collected under bark of Australian pine trees (*Casuarina equisetifolia*) during the daytime and on building walls at night.

Submitted by **KENNETH L. KRYSKO**, Division of Herpetology, Florida Museum of Natural History, Dickinson Hall, University of Florida, Gainesville, Florida 32611, USA (e-mail: kenneyk@flmnh.ufl.edu.); and **ANDREW P. BORGIA**, P.O. Box 4346, Key West, Florida 33041, USA.

HEMIDACTYLUS MABOUIA (Cosmopolitan House Gecko). URUGUAY: DEPARTAMENTO RIVERA: Local del CeRP, km 495.500, Ruta 5, Ciudad de Rivera (30°54'S, 55°32'W). 2 August 2000. S. Umpierrez. Colección Zoología Vertebrados, Reptiles, Facultad de Ciencias, Montevideo (ZVC-R 5735, juvenile); 9 August 2001. S. Umpierrez (ZVC-R 5799, juvenile); 1 November 2001 (ZVC-R 5801, adult female) all associated with human settlements. Verified by M. D. Meneghel. The species is distributed thoroughly in South America, in Colombia, Venezuela, Guyana, Brazil, Ecuador, Peru, and Argentina (Kluge 1969. Misc. Publ. Mus. Zool., Univ. Michigan [138]:1–78; Peters and Donoso-Barros 1970. U.S. Natl. Mus. Bull. 297:1–293; Vanzolini 1978. Papéis Avulsos Zool., S. Paulo 31[20]:307–343; Cei 1993. Museo Regionale di Scienze Naturali, Torino, Monografía 14. 949 pp.). The species was recorded occasionally from Montevideo by accidental introduction from other countries (Achaval and Gudynas 1983. Bol. Soc. Zool. Uruguay, 2a. ép., 1:7–10; Achaval 1997. PEDECIBA, Facultad de Ciencias, Universidad de la República, Montevideo. 693 pp.). Vanzolini (1978, *op. cit.*) doubted the species presence in Uruguay and suggested that its southern limit was probably Rio Grande do Sul. This is the first record from Rivera and the presence of juveniles suggests a stable population in northern Uruguay. Extends known range more than 300 km from the nearest locality in Brazil (São Lourenço do Sul, pers. obs.) and more than 400 km from Porto Alegre, Brazil (Vanzolini 1978, *op. cit.*).

Submitted by **SANTIAGO CARREIRA** (e-mail: carreira@fcien.edu.uy) Sección Zoología Vertebrados, Facultad de Ciencias, Iguá 4225, CP 11400, Montevideo, Uruguay; **FEDERICO ACHAVAL** (e-mail: achaval@fcien.edu.uy) Sección Zoología Vertebrados, Facultad de Ciencias, Iguá 4225, CP 11400, Montevideo, Uruguay; and **SILVIA UMPIERREZ**, CeRP – Centro Regional de Profesores del Norte, Ruta 5, km 495.500, Rivera, Uruguay.

HOMONOTA UNDERWOODI (Underwood's Marked Gecko). ARGENTINA: RIO NEGRO: GENERAL ROCA: Villa Regina. 22 January 2005. C. H. F. Perez. Museo de La Plata herpetological collection (MLP.S 2575, 2585). Verified by J. C. Acosta. Previously known from localities in the Monte region of Catamarca, La Rioja, San Juan, San Luis, Mendoza, and La Pampa provinces (Cei 1993. Reptiles del Norte, Centro-este y Este de la Argentina. Mus. Reg. Sci. Nat. Mon. IV. 929 pp.). First provincial record and southernmost record for the species, extends the known distribution ca. 200 km S from the nearest record in La Pampa Province (Tiranti and Avila 1997. Bull. Maryland Herpetol. Soc. 33:97–117).

Submitted by **DANIEL R. PEREZ**, Universidad Nacional del Comahue, Buenos Aires 1400, 8300, Neuquén, Argentina; **CRISTIAN HERNAN FULVIO PEREZ**, Agustin Alvarez 1182 A, 8000, Bahia Blanca (Buenos Aires), Argentina; and **LUCIANO JAVIER AVILA**, CENPAT-CONICET, Boulevard Almirante Brown s/n, U9120ACV, Puerto Madryn (Chubut), Argentina (e-mail: avila@cenpat.edu.ar).

SCELOPORUS SERRIFER (Blue Spiny Lizard). MÉXICO: CHIAPAS: Municipality of Ocosingo, Frontera Corozal (16°48' 32.5"N, 90°52'44.1"W), 124 m elev. 3 May 2004. Ricardo Paredes-León and José Luis Castelo-Calvillo. Colección Nacional de Anfibios y Reptiles, Instituto de Biología, UNAM (CNAR-IBH 15662). Yaxchilán archeological site (16°54'08.3"N, 90°58'00.5"W), 219 m elev. 15 July 2004. José Luis Castelo-Calvillo. CNAR-RF 23 (photographic voucher). Both verified by Norberto Martínez-Méndoza and Edmundo Pérez-Ramos. First records for Chiapas and Lacandona region, although Lee (1996. The Amphibians and Reptiles of the Yucatán Peninsula. Comstock Publ Assoc., Cornell Univ. Press, Ithaca, 500 pp.) mentions several records close to our localities directly across the Usumacinta River in Guatemala; the closest Mexican record is 77 km N at Tenosique, Tabasco. Previous records of *S. serrifer* in Chiapas refer to a highland species, *S. prezygous* (Wiens and Reeder 1997. Herpetol. Monog. 11:1–101). Both specimens were found in uninhabited buildings.

Submitted by **RICARDO PAREDES LEÓN**, Colección Nacional de Ácaros, Instituto de Biología and Laboratorio de Acarología, Facultad de Ciencias, UNAM, Ciudad Universitaria, México, D. F. 04510 (e-mail: skarabajo8@yahoo.com.mx); and **VÍCTOR-HUGO REYNOSO**, Colección Nacional de Anfibios y Reptiles, Instituto de Biología, UNAM, Ciudad Universitaria, México, D. F. 04510 (e-mail: vreynoso@ibunam.ibiolgia.unam.mx).

AMPHISBAENIA

LEPOSTERNON WUCHERERI (Wucherer's Worm Lizard). BRAZIL: MINAS GERAIS: Between Municipalities of Nanuque and Serra dos Aimorés (17°50'S, 40°21'W and 17°47'S, 40°14'W, 104 and 209 m elev., respectively). From 30 October to 6 November 2001. R. R. Carvalho-Jr. Museu de Ciências Naturais, Pontifícia Universidade Católica de Minas Gerais, Belo Horizonte, Minas Gerais (MCNR 279–425). Verified by J. Duarte de Barros-Filho. *Leposternon wuchereri* was known just from the coastal area of northeastern Brazil; at Bahia state, the southern locality of *L. wuchereri* distribution is Mucuri municipality (Porto et al. 2000. Boletim do Museu Nacional 412:1–10). First state record extends known distribution ca. 85 km airline W in southeastern Brazil, and this is the furthest occurrence from the coast.

Submitted by **RONALD REZENDE DE CARVALHO JÚNIOR** and **LUCIANA BARRETO NASCIMENTO**,

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SERPENTES

BOTHROPS LEUCURUS (White-tailed Lancehead). BRAZIL: MINAS GERAIS: Between Municipalities of Nanuque and Serra dos Aimorés (17°50'S, 40°21'W and 17°47'S, 40°14'W, 104 and 209 m elev., respectively). From 30 October to 6 November 2001. R. R. Carvalho-Jr. Verified by Giselle Agostini Cotta. Fundação Ezequiel Dias, Belo Horizonte, Minas Gerais (FUNED 1458). *Bothrops leucurus* was known from the northeastern Brazilian coast in Ceará, Pernambuco, Alagoas, Sergipe, and Bahia states (Porto and Teixeira 1995. Herpetol. Rev. 26:156; Duarte et al. 2003. Herpetol. Rev. 34:168). In Bahia state, the southernmost locality for *B. leucurus* is Porto Seguro municipality (Franco et al. 1998. Répteis na Estação Veracruz, Santa Cruz de Cabrália e Porto Seguro, 41 pp. Publicação técnico-científico). First state record extends known distribution ca. 200 km airline W in southeastern Brazil, and the furthest occurrence from the coast.

Submitted by **RONALD REZENDE DE CARVALHO JÚNIOR** and **LUCIANA BARRETO NASCIMENTO**, Pontifícia Universidade Católica de Minas Gerais, Museu de Ciências Naturais, Av. Dom José Gaspar 290, Coração Eucarístico, 30536-610, Belo Horizonte, MG, Brazil; e-mail: rcjunior.bh@terra.com.br

CEMOPHORA COCCINEA LINERI (Texas Scarletsnake). USA: TEXAS: San Patrico Co.: Ingleside Naval Station (27.833295°N; -97.200334°W; 6.04 m elev.). 28 June 2005. C. M. Duran. Verified by J. A. Campbell. University of Texas at Arlington, Amphibian and Reptile Diversity Research Center, UTA Slide Nos. 33288–33291. New county record (Dixon 2000. Amphibians and Reptiles of Texas. Second Edition. Texas A&M University Press, College Station, Texas, 421 pp.). Blood was drawn and placed in the frozen tissue collection at Texas State University-San Marcos (MF 17944) and the adult male specimen was photo vouchered using Fujichrome Provia 100 slide film. The specimen had a snout–vent length of 474 mm, and a tail length of 83 mm.

Submitted by **JAKE JACKSON, M. R. J. FORSTNER**, Department of Biology, Texas State University, 601 University Drive, San Marcos, Texas 78666, USA (e-mail : jj1161@txstate.edu); and **C. M. DURAN**, Texas Nature Conservancy, 2246 Versailles Drive, Corpus Christi, Texas 78418, USA (e-mail: mduran@tnc.org).

LAMPROPELTIS CALLIGASTER CALLIGASTER (Prairie Kingsnake). USA: TEXAS: Guadalupe Co.: 4.3 km N Jct FM 1978 and Old Seguin Road on Old Seguin Road (29°47'33"N, 97°56'12"W). 4 July 2005. Adam W. Ferguson. Verified by Jonathan A. Campbell. University of Texas at Arlington, Amphibian and Reptile Diversity Research Center. UTA Slide Nos. 33292–33295. New county record (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M University Press, College Station, Texas. 421 pp). This adult female was captured in a funnel trap placed along a permanent drift fence array at our study site in Guadalupe County, Texas. The specimen had a snout–vent length of 832.0 mm, a tail length of 132.0 mm, and weighed 186 g. Blood was drawn and placed in the frozen tissue collection at Texas State University-San Marcos (MF 17943) and the specimen was photo vouchered using Fujichrome Provia 100 slide film.

Submitted by **ADAM W. FERGUSON** and **M. R. J. FORSTNER**, Department of Biology, Texas State University, 601 University Drive, San Marcos, Texas 78666, USA; e-mail (AWF): af1021@txstate.edu.

LAMPROPELTIS TRIANGULUM TAYLORI (Utah Milk Snake) USA: NEVADA: Elko Co.: Alt Route 93, 25 miles NE of Lages Station. ca. 1765 m elev. August 2003. Paul Lynum. Verified by Barry Sinervo. Museum of Vertebrate Zoology (MVZ 249826, three photo vouchers). Live specimen is currently being maintained at the University of California, Santa Cruz. This animal was found on the road at night during the monsoon season, in an area of mostly flat to gently rolling grassland with patches of sagebrush. First documented record for the state of Nevada. Scale meristics: dorsal scale rows 23, ventrals 204, subcaudals 49, supralabials 7, infralabials 8, triads 34. This specimen exhibits color pattern and scale meristics typical of *L. t. taylori* (Stebbins 2003. Western Reptiles and Amphibians, Houghton Mifflin Co., Boston, Massachusetts. 533 pp.). This specimen probably represents a population associated with those in western Utah.

Submitted by **MITCHELL MULKS**, Department of Ecology and Evolutionary Biology, University of California at Santa Cruz, Santa Cruz, California 95064, USA; e-mail: mulks@biology.ucsc.edu.

MASTICOPHUS SCHOTTI SCHOTTI (Schott's Whipsnake). USA: TEXAS: Wilson Co.: Eagle Creek Ranch Subdivision, nr intersection of Wild Flower and Palo Alto; 29°15.339'N, 98°12.668'W. 4 Aug 2005. Dead adult collected at 0730 h on road (Palo Alto). TNHC 64145. Verified by Travis LaDuc. First county record; fills gap along northeastern edge of range between Karnes and Bexar counties (Dixon 2000. Amphibians and Reptiles of Texas, 2nd edition, Texas A&M University Press, 421 pp.). Author has observed, but was unable to collect, two live *M. s. schotti* adults in the immediate vicinity of this location since 2001. Werler and Dixon (2000. Texas Snakes. University of Texas Press, Austin, Texas 437 pp.) report the range of this taxon is restricted to the mesquite savannah and thornbrush woodland of the Rio Grande Plain of South Texas. The Wilson County specimens occurred in a strip of Post Oak savannah that follows the outcrop of the Carrizo Sands formation through Wilson, southeastern Bexar, and into Atascosa counties. Werler and Dixon (2000, *op. cit.*) depict location records for this species in southeastern Bexar County, within ten miles of this Wilson County location.

Submitted by **FRANZ J. SCHMIDT**, 562 Cherry Ridge, Floresville, Texas 78114, USA.

NERODIA ERYTHROGASTER (Red-bellied Watersnake). USA: SOUTH CAROLINA: Anderson Co.: Approximately 2.5 km W of intersection of Dobbins Bridge Rd. and Lebanon Rd, Pendleton. 18 June 2004. Corey E. Roelke. Bob Campbell Museum of Natural History, Clemson University (CU 2199). Verified by Richard R. Montanucci. New county record. Extension of known range of the species into the Piedmont of South Carolina west and north of

previous records in Greenville and Abbeville counties, South Carolina (Martof et al. 1989. Amphibians and Reptiles of the Carolinas and Virginia. University of North Carolina Press, Chapel Hill, North Carolina). Specimen was found basking near a garden pond at a rural residence, at least 0.75 km from the nearest other permanent water.

Submitted by **COREY E. ROELKE**, PO Box 19498, Department of Biology, The University of Texas at Arlington, Arlington, Texas 76019, USA; e-mail: croelke@uta.edu.

PHALOTRIS RETICULATUS. BRAZIL: SÃO PAULO: Caetetuba, Município de Atibaia (23°07'01"S, 46°33'01"W, 803 m elev.), in the Serra da Mantiqueira Range. 04 May 1928. L. S. Clara. Instituto Butantan, São Paulo, Brazil (IB4501). MINAS GERAIS: Município de Munhoz (22°36'47"S, 46°21'38"W, 1235 m elev.), in the Serra da Mantiqueira Range. 03 September 2003 and 02 March 2004. M. De Lauro (IB 69436; IB 70322); 26 October 2004. T. Nagao (IB 71925). All verified by Valdir J. Germano. The record from Caetetuba confirms the only previous unvouchered state record (mentioned as *Elapomorphus bilineatus* by Amaral 1977. Serpentes do Brasil. Ed. Melhoramentos/ Ed. USP, São Paulo). Records from Minas Gerais are the first state records and the northernmost for the species, and extend the range ca. 480 km NE from the nearest known records (Ferrarezzi 1993. Unpubl. Ms. Dissert., Universidade de São Paulo, São Paulo, Brazil; Puorto and Ferrarezzi 1994. Mem. Inst. Butantan 55[1]:39–46; Moratto 1995. Unpubl. Ms. Dissert., Universidade Federal do Paraná, Curitiba, Brazil) in the Araucaria Plateau of Paraná state (Palmeira, Museu de Historia Natural Capao da Imbuia, Curitiba, Paraná (MHNCI 336, 1300, 1480); Pinhão-UHE Segredo (MHNCI 5027–5028); Ponta Grossa (MHNCI 2969, 3672); Porto Amazonas (MHNCI 4556). These records indicate that *P. reticulatus* exhibits the same pattern of geographical disjunction (Araucaria Plateau/ Serra da Mantiqueira) found in several upland species or sister taxa endemic to the Araucaria domain.

Submitted by **HEBERT FERRAREZZI** (hferrarezzi@butantan.gov.br), **MYRIAM E. VELLOSO CALLEFFO** (myevcalleffo@butantan.gov.br), **TIAGO M. CASTELLAR,** and **MÔNICA DE LAURO,** Laboratório de Herpetologia, Instituto Butantan, Av: Vital Brazil, 1500, CEP 05503-900, São Paulo, SP, Brazil.

REGINA GRAHAMII (Graham's Crayfish Snake). USA: TEXAS: JONES/SCHACKLEFORD Co. line. Jones/Schackleford County Road 204 just S of Lueders (32°47.486'N, 99°36.752'W). 9 May 2005. J. R. Dixon. Verified by J. R. Dixon, Texas A&M University, Texas Cooperative Wildlife Collection. TCWC 89761. New county record (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M University Press, College Station, Texas. 421 pp.). The male specimen (229 mm SVL, 56 mm tail length, 9 g) was collected in a minnow trap located below the spillway on the south side of Lueders dam.

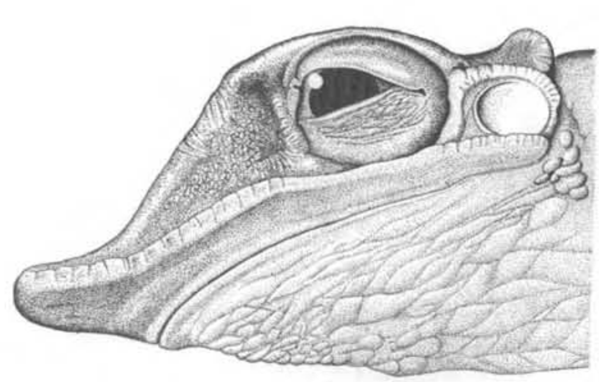
Submitted by **MELISSA C. JONES** (e-mail: mj46953@txstate.edu), **SUSANNAH REILLY**, **M. R. J. FORSTNER**, and **J. R. DIXON**, Department of Biology, Texas State University at San Marcos, San Marcos, Texas 78666, USA.

RHADINAEA FLAVILATA (Pine Woods Littersnake). USA: NORTH CAROLINA: DUPLIN Co.: 2 mi SW Magnolia on E side Hwy 903 (34°53'5.7"N, 78°4'24.8"W). 22 May 2005. Kevin M. Enge. Adult male collected under roofing tin at abandoned homesite. UF 144336. Verified by Kenneth L. Krysko. New county record (Palmer and Braswell 1995. Reptiles of North Carolina. Univ. of North Carolina Press, Chapel Hill. 412 pp.).

Submitted by **KEVIN M. ENGE**, Florida Fish and Wildlife Conservation Commission, 5300 High Bridge Road, Quincy, Florida 32351, USA; e-mail: kevin.enge@myfwc.com.

SISTRURUS MILIARIUS STRECKERI (Western Pigmy Rattlesnake). USA: ARKANSAS: COLUMBIA Co.: 3.2 km N of Magnolia (Sec. 30, T16S, R20W). 9 May 2005. H. W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 29330). Verified by Stanley E.Trauth. New county record in southern Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

Submitted by **HENRY W. ROBISON** and **JANET RADER**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA; e-mail: hwrobison@saumag.edu.



Triprion petasatus (UMRC 79-306), ventrolateral view. Mexico: Yucatán, Tecoh. Illustration by Julian C. Lee.

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Additional Reptile and Amphibian Range Extensions for Milne Bay Province, Papua New Guinea

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The southeasternmost region of Papua New Guinea is contained within Milne Bay Province, which consists of the southern extremity of the Owen Stanley Mountains, the adjacent Cloudy Mountains, and a variety of far-flung offshore islands. The herpetological collecting history of this region has briefly been summarized by Kraus and Allison (2004), who also presented a large number of range extensions and new island records for the region's herpetofauna.

The Louisiade Archipelago is the outermost island group within Milne Bay Province and has been poorly surveyed for reptiles and amphibians. It consists of three major islands – Misima (formerly known as "St. Aignan"), Sudest (also referred to as "Tagula"), and Rossel (also referred to as "Yela") – as well as a number of smaller islands lying more or less between the first two. Misima attracted early missionaries and served as the source of a handful of specimens described in the late 19th Century (Boulenger 1898a, b). More recently it has received collecting attention from biologists at the Australian Museum, South Australian Museum, and Bishop Museum, and some of the results of those efforts were presented by Kraus and Allison (2004). Similarly, Sudest and Rossel islands, farther to the southeast, were the source of occasional small collections that found their way to museums in the late 19th Century and were subsequently reported on (Boulenger, 1890, 1903; de Vis, 1892; Parker, 1934; Sprackland, 1991). Later, the Fifth Archbold Expedition collected some herpetological specimens on both Rossel and Sudest in late 1956 (Brass, 1959). Many of these specimens were subsequently described as new species by McDowell (1969), Tyler (1968), and Zweifel (1958, 1963, 1972, 2000), or included within broader taxonomic treatments (McDowell, 1967, 1972, 1979, 1984; Greer and Parker, 1974; Brown, 1991; Smith et al., 2001). Nonetheless, these collections were incidental to sustained efforts focused on plants and mammals and were not extensive. Most recently, Hiaso (2002) described a new species of *Cophixalus* collected during a short University of Papua New Guinea excursion to Sudest Island in 1992.

So as to better fill in the record of herpetological diversity within Milne Bay Province, we conducted surveys of Sudest and Rossel islands in April and May 2004. Incidental to this, we were also able to visit Nimowa Island, just north of the western tip of Sudest, for two days. This effort resulted in the discovery of a large number of species new to science (N = ~30) but also in a number of new island records for previously described species. We herein report on the latter records and add a couple of additional records left out of the earlier report for Milne Bay Province (Kraus and Allison, 2004). All GPS points use the AGD66 datum.

Austrochaperina yelaensis. SUDEST ISLAND: along Gesirava River, 11.4918°S, 153.4126°E, 130 m. 16–20 April 2004. F. Kraus, G. Shea, and J. Slapcinsky. Bernice P. Bishop Museum (BPBM) 20118–123; N side Mt. Rio, 11.5082°S, 153.4309°E, 730–800 m. 23 April 2004. F. Malesa. BPBM 20124–125. First record for island; previously known only from type locality near summit of Mt. Rossel, Rossel Island (Zweifel 2000).

Boiga irregularis. SUDEST ISLAND: along Gesirava River, 11.4902°S, 153.4198°E, 150 m. 22 April 2004. F. Kraus. BPBM 20790–791. First record for Louisiade Islands (O'Shea 1996).

Cyrtodactylus loriae. MT. SIMPSON: Siyomu, 10.0145°S, 149.5970°E, 1300 m. 24 February 2003. Native collector. BPBM 17255; Bunisi, 10.0171°S, 149.6002°E, 1420 m. 27 February 2003. Native collectors. BPBM 17256–257. First records for province and range extension of ~220 km (Bauer and Henle 1994).

Dendrelaphis salomonis. SUDEST ISLAND: Araeda, 11.4362°S, 153.4301°E, 10–20 m. 11 April 2004. J. Slapcinsky. BPBM 20837; Vutha, 11.4918°S, 153.3846°E. 24 April 2004. Native collector. BPBM 20838. Specimens are of the same melanistic variety known from Misima Island. First record for island; previously known in PNG only on Misima Island (McDowell 1984; O'Shea 1996).

Emoia atrocostata. NIMOWA ISLAND: SW portion of island around Sofuwo Mission station, 11.3161°S, 153.2335°E, 0–5 m. 7–8 May 2004. G. Shea. BPBM 19979–980. SUDEST ISLAND: Araeda, 11.4362°S, 153.4301°E, 0–5 m. 10–29 April 2004. F. Kraus and native collectors. BPBM 19970–978. First record for each island (Brown 1991; Mys 1988).

Emoia kordoana. SUDEST ISLAND: Bwagimogimo, 11.4366°S, 153.4313°E. 11 April 2004. Native collector. BPBM 19999; along Gesirava River, 11.4918°S, 153.4126°E, 130 m. 17–25 April 2004. F. Kraus and G. Shea. BPBM 20000–001. First records for any offshore island of Milne Bay Province (Brown 1991; Mys 1988).

Emoia obscura. SUDEST ISLAND: between Araeda and Mt. Rio, 11.4540°S, 153.4237°E, 145 m. 21 April 2004. F. Malesa and M. Samson. BPBM 19990; 11.4648°S, 153.4232°E, 170 m. 27 April 2004. F. Kraus. BPBM 19991. First records for Louisiade Islands (Brown 1991; Kraus and Allison 2004; Mys 1988).

Gehyra mutilata. NIMOWA ISLAND: SW portion of island around Sofuwo Mission station, 11.3161°S, 153.2335°E, 0–5 m. 7–8 May 2004. G. Shea. BPBM 19756–758. ROSSEL ISLAND: Cheme, 11.3231°S, 154.2429°E, 0–5 m. 2–3 May 2004. F. Kraus and G. Shea. BPBM 19752, 19755; Damunu, 11.3650°S, 154.0014°E, 0–40 m. 1 May 2004. G. Shea. BPBM 19753–54. SUDEST ISLAND: Araeda, 11.4362°S, 153.4301°E, 0–5 m. 11–29 April 2004. F. Kraus, F. Malesa, G. Shea, and J. Slapcinsky. BPBM 19745–750. First records for each island (Bauer and Henle 1994).

Gehyra oceanica. NIMOWA ISLAND: SW portion of island around Sofuwo Mission station, 11.3161°S, 153.2335°E, 0–5 m. 7–8 May 2004. G. Shea. BPBM 19770. SUDEST ISLAND: Araeda, 11.4362°S, 153.4301°E, 0–5 m. 11–28 April 2004. F. Kraus, F. Malesa, G. Shea, and J. Slapcinsky. BPBM 19759,

19762–763; ridge above Gesirava River, 11.4864°S, 153.4148°E. 26 April 2004. Native collectors. BPBM 19760–761. First records for each island (Bauer and Henle 1994).

Gekko vittatus. SUDEST ISLAND: Araeda, 11.4362°S, 153.4301°E, 0–10 m. 12–28 April 2004. F. Kraus and J. Slapcinsky. BPBM 19773–777. First record for island (Bauer and Henle 1994).

Hemidactylus frenatus. NIMOWA ISLAND: SW portion of island around Sofuwo Mission station, 11.3161°S, 153.2335°E, 0–5 m. 7–8 May 2004. G. Shea. BPBM 19790–793. First record for island (Bauer and Henle 1994; Kraus and Allison 2004).

Lamprolepis smaragdina. NIMOWA ISLAND: SW portion of island around Sofuwo Mission station, 11.3161°S, 153.2335°E, 0–5 m. 7–8 May 2004. G. Shea and native collectors. BPBM 20006–008. SUDEST ISLAND: Araeda, 11.4362°S, 153.4301°E, 0–10 m. 29 April 2004. Native collector. BPBM 20005. First record for each island (de Rooij 1915; Mys 1988).

Lepidodactylus lugubris. NIMOWA ISLAND: SW portion of island around Sofuwo Mission station, 11.3161°S, 153.2335°E, 0–5 m. 7–8 May 2004. G. Shea. BPBM 19822. ROSSEL ISLAND: Cheme, 11.3231°S, 154.2429°E, 0–5 m. 2–4 May 2004. F. Kraus, G. Shea, and native collectors. BPBM 19805, 19807–821; Damunu, 11.3650°S, 154.0014°E, 0–40 m. 1 May 2004. G. Shea. BPBM 19806; Jinjo, 11.3179°S, 154.2353°E, 0–20 m. 3 May 2004. F. Malesa and G. Shea. BPBM 19801–804. SUDEST ISLAND: Araeda, 11.4362°S, 153.4301°E, 0–10 m. 12–29 April 2004. F. Kraus. BPBM 19799–800. First records for each island (Bauer and Henle 1994).

Lepidodactylus orientalis. SUDEST ISLAND: Araeda, 11.4362°S, 153.4301°E, 0–10 m. 28 April 2004. F. Kraus. BPBM 19794. First record for province and range extension of ~700 km from previous records around Port Moresby (Bauer and Henle 1994; Brown and Parker 1977).

Litoria infrafrenata. SUDEST ISLAND: Araeda, 11.4362°S, 153.4301°E, 0–10 m. 21 April 2004. F. Malesa. BPBM 20600. First record for island (Tyler 1968).

Sphenomorphus jobiensis. ROSSEL ISLAND: Damunu, 11.3650°S, 154.0014°E, 0–40 m. 1 May 2004. G. Shea and native collectors. BPBM 20047; S slope Mt. Rossel, 11.3555°S, 154.2246°E, 720 m. 8 May 2004. F. Kraus and native collectors. BPBM 20048–049; 11.3551°S, 154.2239°E, 640–700 m. 8 May 2004. BPBM 20050; along Wabu River, 11.3419°S, 154.2192°E, 320 m. 11 May 2004. Native collectors. BPBM 20052; along Rupu River, 11.3354°S, 154.2247°E, 280 m. 11–16 May 2004. Native collectors. BPBM 20053–054. First records for island (de Rooij 1915; Mys 1988).

Sphenomorphus minutus. SUDEST ISLAND: N slope Mt. Rio, 11.5°S, 153.4281°E, 440–630 m. 23 April 2004. F. Malesa. BPBM 20057. First record for island (Kraus and Allison 2004; Mys 1988).

Sphenomorphus solomonis. NIMOWA ISLAND: SW portion of island around Sofuwo Mission station, 11.3161°S, 153.2335°E, 0–5 m. 7–8 May 2004. G. Shea. BPBM 20084-085. First record for island (Greer and Parker 1974; Mys 1988).

Varanus finschi. MT. SIMPSON: Omunsa, 10.0290°S, 149.6266°E, 1280 m. 14 February 2003. Native collector. BPBM 17250. First record for Papuan Peninsula (Böhme et al. 1994; Ziegler et al. 1999).

Varanus indicus. MISIMA ISLAND: Liak, 10.6594°S, 152.6941°E, 0–80 m. 20 January 2003. Native collector. BPBM 17249. ROSSEL ISLAND: East Point, 11.3859°S, 154.2811°E, 0 m. 18 May 2004. Native collector. BPBM 20840–843. SUDEST ISLAND: Wele River above Kolkol Waterfall, 11.4462°S, 153.4312°E, 30 m. 13 April 2004. Native collector. BPBM 20839; ALOTAU: 4.7 km W Alotau, 10.2994°S, 150.4018°E, 10 m. 12 August 2002. F. Kraus and B. Yawi. BPBM 16054. First records for Louisiade Islands and first reliably identified mainland Milne Bay Province record since recognition of sibling species complex (Böhme et al. 1994; Ziegler et al. 1999).

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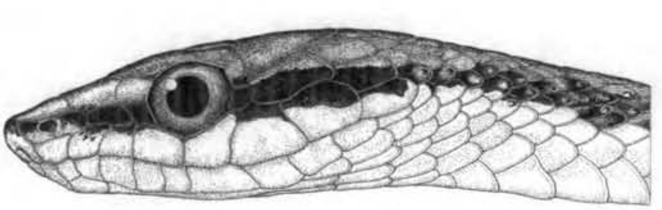

Leptophis mexicanus (UMRC 85-20; 706 mm SVL). Mexico: Campeche: 2.1 km N Checkubúl. Illustration by Julian C. Lee.

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New Frog Records from Laos

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The frog fauna of Laos (Lao People's Democratic Republic) is poorly known relative to that of neighboring Thailand, China, and Vietnam. Bourret's (1942) regional monograph remains the major work on the frog fauna of Laos. Stuart (1999) compiled a list of the frog species and the general regions and habitats in which they were known to occur in the country, and Teynié et al. (2004) reported on a collection from southern Laos. Seven new species of frogs from Laos have been recently described based on new and old collections (Inger and Kottelat 1998; Ohler 2003; Bain and Nguyen 2004; Ohler et al. 2004; Stuart and Heatwole 2004; Stuart and Chan-ard 2005; Stuart et al. 2005).

I conducted herpetological fieldwork throughout Laos between February 1998 and December 2000, and specimens were deposited at the Field Museum of Natural History (FMNH). Herein, country and provincial records of 46 species of frogs are reported. Some of the earlier records were listed in Stuart (1999), but voucher numbers and detailed locality information were not provided. Therefore, those records are presented again here with such information, and identifications are corrected where needed. Records reported by Stuart (1999) are treated here as first country records only if other authors have not reported them since.

FAMILY MEGOPHRYIDAE

Brachytarsophrys intermedia. XE KONG PROVINCE, Kaleum District, Xe Sap National Biodiversity Conservation Area: FMNH 258093-096, 16°04'10"N 106°58'45"E, 1200–1300 m elevation, rocky streams in wet evergreen forest, 07–08 July 1999, B. L. Stuart. Males were calling day and night. Three males (FMNH 258093–094, 258096) were calling from under partly submerged rocks or rock crevices in streams, and one male (FMNH 258095) was floating in a stream pool next to a boulder pile at the base of small cascade. One male (FMNH 258094) was in a rocky stream guarding a large clutch of eggs (FMNH 258902) that were adhered to the underside of a partly submerged 1 x 1 m rock adjacent to the back of the calling male. The eggs were uniformly yellow, without a pigmented hemisphere, and 4.5–5.0 mm in diameter. First country record.

Leptobrachium banae. XE KONG PROVINCE, Kaleum District, Xe Sap National Biodiversity Conservation Area, near Houay Alung Stream: FMNH 258079, 16°00'32"N 106°55'31"E, 920–1000 m elevation, on leaf litter in evergreen forest, 30 June 1999, B. L. Stuart. In life, upper iris light blue, limbs with orange crossbars, and flank with scattered orange flecking. First country record.

Leptobrachium chapaense. BOLIKHAMXAY PROVINCE, Khamkeut District, Nape border area: FMNH 258065, 258067–

071, wet evergreen forest, 17–19 March 1997, D. Davenport. In life, upper iris light blue. Reported as *L. pullum* in Stuart (1999). Reported from Bokeo Province (Dubois and Ohler 1998). First provincial record.

Leptobrachium smithi. SAYABOURY PROVINCE, Phiang District, west of Mekong River: FMNH 258091–092, 258097, 258101–106, near 18°54'08"N 101°34'30"E, 250–400 m elevation, disturbed evergreen forest, 01 September 1999, M. Baltzer. VIENTIANE PROVINCE, Xanakham District: FMNH 263263, near 18°07'57"N 101°29'30"E, 300–600 m elevation, gallery evergreen mixed with bamboo and deciduous forest, November 2000, T. Hansel. First country record.

Leptolalax bourreti. PHONGSALY PROVINCE, Phongsaly District, Phou Dendin National Biodiversity Conservation Area: FMNH 258052–056, near Nam Ou River, 22°05'38"N 102°12'50"E, 600 m elevation, on leaf of herbaceous plant, dirt bank, or rock near small rocky streams in hill evergreen forest, 07–11 October 1999, B. L. Stuart and H. F. Heatwole; FMNH 258057, near Nam Khang River, near 22°09'04"N 102°12'19"E, 600 m elevation, on leaf of herbaceous plant 3 m from stream in hill evergreen forest, 14 October 1999, B. L. Stuart and H. F. Heatwole; FMNH 258058, 258060, 258066, confluence of Nam Ou and Houay Han Streams, 22°05'31"N 102°06'19"E, 600–800 m elevation, on rocky bank at edge of swift stream in hill evergreen mixed with bamboo forest, 19 October 1999, B. L. Stuart and H. F. Heatwole; FMNH 258059, 258061–064, Houay Han Stream, near Nam Ou River, near 22°05'31"N 102°06'19"E, 600–800 m elevation, on tree root, rocks, or leaf litter on bank of small rocky stream in hill evergreen forest, 19–21 October 1999, B. L. Stuart and H. F. Heatwole. BOLIKHAMXAY PROVINCE, Khamkeut District, Nape border area: FMNH 258035–045, wet evergreen forest, 15–18 March 1997, D. Davenport. Reported as *L. pelodytoides* (part) in Stuart (1999). First country record.

Leptolalax oshanensis. PHONGSALY PROVINCE, Phongsaly District, Phou Dendin National Biodiversity Conservation Area, near confluence of Nam Ou and Nam Sa Rivers: FMNH 258077, near 22°05'31"N 102°06'19"E, 600 m elevation, under leaf litter in hill evergreen forest, 20 October 1999, B. L. Stuart and H. F. Heatwole. BOLIKHAMXAY PROVINCE, Khamkeut District, Nape border area: FMNH 257989–992, wet evergreen forest, 15–19 March 1997, D. Davenport. KHAMMOUAN PROVINCE, Navang: FMNH 257986–988, 26 February 1997, D. Davenport. Reported as *L. pelodytoides* (part) in Stuart (1999). First country record.

Megophrys major. PHONGSALY PROVINCE, Phongsaly District, Phou Dendin National Biodiversity Conservation Area: FMNH 258571–575, near Nam Ou River, 22°05'38"N 102°12'50"E, 600 m elevation, on mid-stream rock and on rocks and branches along bank of small rocky streams in hill evergreen forest, 07–11 October 1999, B. L. Stuart and H. F. Heatwole; FMNH 258576, near Nam Khang River, near 22°09'04"N 102°12'19"E, 600 m elevation, hill evergreen forest, 12 October 1999, B. L. Stuart and H. F. Heatwole; FMNH 258577, Houay Han Stream, near Nam Ou River, near 22°05'31"N 102°06'19"E, on rock next to 3 x 3 m pool at base of 2-m high waterfall in hill evergreen forest, 600–800 m elevation, 19 October 1999, B. L. Stuart and H. F. Heatwole; FMNH 258578, near Houay Aw Stream, near Nam Ou River, near 22°05'44"N 102°08'10"E, 600–800 m elevation, on sandy bank among boulders 1 m from swift stream in hill evergreen forest, 24 October 1999, B. L. Stuart and H. F. Heatwole. HUAPHAHN PROVINCE, Vieng Tong District, Phou Louey National Biodiversity Conservation Area, Phou Louey Mountain: FMNH 255542, 20°14'N 103°12'E, 1200 m elevation, on rock on bank of swift stream in hill evergreen forest, 03 May 1998, B. L. Stuart. BOLIKHAMXAY PROVINCE, Khamkeut District, Ban Nape border area: FMNH 258539–541, 258543, wet evergreen forest, 17–19 March 1997, D. Davenport. KHAMMOUAN PROVINCE, Nakai District, Nakai-Nam Theun National Biodiversity Conservation Area: FMNH 256440, near Houay Ting Tou Stream, 17°58'N 105°34'E, 700 m elevation, calling from leaf of herbaceous plant 2 m above stream in evergreen forest, 07 November 1998, B. L. Stuart; FMNH 256441, near Houay Duen Stream 17°57'N 105°34'E, 700 m elevation, submerged at rocky bank of stream in evergreen forest, 10 November 1998, B. L. Stuart. XE KONG PROVINCE, Kaleum District, Xe Sap National Biodiversity Conservation Area: FMNH 258545, near Houay Alung Stream, 16°00'32"N 106°55'31"E, 920–1000 m elevation, on leaf litter of forest floor away from water in wet evergreen forest, 30 June 1999, B. L. Stuart; FMNH 258544, 258546, near Houay Batay Stream, 16°01'30"N 106°55'40"E, 780–900 m elevation, on leaf litter bank 5–8 m above small rushing stream in disturbed evergreen forest, 29 June 1999, B. L. Stuart; FMNH 258547–548, near 16°04'10"N 106°58'45"E, 1200 m elevation, under rock ledge and on log next to small rocky stream in wet evergreen forest, 07 July 1999, B. L. Stuart. CHAMPASAK PROVINCE, Pakxong District, Dong Hua Sao National Biodiversity Conservation Area, Bolaven Plateau: FMNH 258549–551, 258553–55, near 15°04'37"N 106°08'15"E, 1000 m elevation, on and under leaf litter in forest away from water, on ground in coffee plantation away from water, and on mid-stream rock of rushing stream in wet evergreen forest with coffee plantation clearings, 11–13 September 1999, B. L. Stuart and H. F. Heatwole; FMNH 258563, 258565–570, near 15°03'55"N 106°13'03"E, 1200 m elevation, on and under leaf litter in forest away from water and on rock bank 1 m from stream in wet evergreen forest, 21–23 September 1999, B. L. Stuart and H. F. Heatwole; FMNH 258556, near 15°02'48"N 106°10'45"E, 400 m elevation, on large boulder 6 m from stream in wet evergreen forest, 18 September 1999, B. L. Stuart and H. F. Heatwole; FMNH 258557–562, near Ban Nongluang Village, near 15°04'07"N 106°12'03"E, 1100 m elevation, 20 September 1999, B. L. Stuart and H. F. Heatwole. Reported as *M. lateralis* in Stuart (1999). First country record.

Megophrys palpebralespinosa. PHONGSALY PROVINCE, Phongsaly District, Phou Dendin National Biodiversity Conservation Area, near Nam Ou River: FMNH 258098–100, 22°05'38"N 102°12'50"E, 600 m elevation, under leaf litter or along rocky streams in hill evergreen forest, 07–09 October 1999, B. L. Stuart and H. F. Heatwole. First country record.

Megophrys parva. PHONGSALY PROVINCE, Phongsaly District, Phou Dendin National Biodiversity Conservation Area, near Houay Aw Stream, tributary of Nam Ou River: FMNH 258578, near 22°05'44"N 102°08'10"E, 600–800 m elevation, on sandy bank among boulders 1 m from swift stream in hill evergreen forest, 24 October 1999, B. L. Stuart and H. F. Heatwole.

HUAPHAHN PROVINCE, Vieng Tong District, Nam Et National Biodiversity Conservation Area, near Houay Louen Stream: FMNH 255543, in leaf litter on stream bank, 30 April 1998, D. Showler. First country record.

Ophryophryne gerti. CHAMPASAK PROVINCE, Pakxong District, Dong Hua Sao National Biodiversity Conservation Area, Bolaven Plateau: FMNH 258564, near 15°03'55"N 106°13'03"E, 1200 m elevation, in shallow water of 1 x 1 m side pool of stream in wet evergreen forest, 22 September 1999, B. L. Stuart and H. F. Heatwole. One paratype from "Huey Sapan, Pak Maat, Mekong, Laos" (Ohler 2003), but this precise locality has not been found (Ohler 2003). First provincial record.

Ophryophryne hansi. BOLIKHAMXAY PROVINCE, Khamkeut District, Nape border area, Nape Stream: FMNH 258001–007, 258072–073, wet evergreen forest, 15–18 March 1997, D. Davenport. KHAMMOUAN PROVINCE, Nakai District, Nakai-Nam Theun National Biodiversity Conservation Area, near Houay Ting Tou Stream: FMNH 256448, 17°57'N 105°34'E, 700 m elevation, on fern growing from rock face 2 m above stream pool in evergreen forest, 09 November 1998, B. L. Stuart. XE KONG PROVINCE, Kaleum District, Xe Sap National Biodiversity Conservation Area: FMNH 258009–010, 258046–051, 16°04'10"N 106°58'45"E, 1100–1300 m elevation, on leaves, logs, rocks, and boulders along small rocky streams and stream pools in wet evergreen forest, 06–09 July 1999, B. L. Stuart; FMNH 258008, near Houay Alung Stream, 16°00'32"N 106°55'31"E, 920–1000 m elevation, on rock ledge 15 cm above small stream in wet evergreen forest, 30 June 1999, B. L. Stuart. Reported as *O. poilani* in Stuart (1999). First country record.

FAMILY BUFONIDAE

Bufo galeatus. KHAMMOUAN PROVINCE, Boualapha District, Hin Nam No National Biodiversity Conservation Area: FMNH 255315, 255322–325, 17°20'N 105°41'E, 500 m elevation, near pools in temporary stream bed in dry evergreen mixed with deciduous forest, 24–25 February 1998, B. L. Stuart. KHAMMOUAN PROVINCE, Nakai District, Nakai Nam Theun National Biodiversity Conservation Area, near Houay Dreng Stream: FMNH 256442–445, 17°50'N 105°35'E, 600 m elevation, near side pools of stream in wet evergreen forest, 03 December 1998, B. L. Stuart. First country record.

Bufo macrotis. VIENTIANE MUNICIPALITY, Vientiane: FMNH 257916–917, 17°58'41"N 102°39'16"E, 190 m elevation, on road at night during rain, 09 June 1999, B. L. Stuart. CHAMPASAK PROVINCE, Mounlapamok District, Dong Khanthung National Biodiversity Conservation Area, near Xe Lepou River: FMNH 255316–320, near Ban Thakang Village, grassland with deciduous dipterocarp forest, 14°07'N 105°40'E, 60 m elevation, on exposed branches and floating sticks in flooded deciduous dipterocarp forest, 06 July 1998, B. L. Stuart; FMNH 255321, 14°07'N 105°29'E, 60 m elevation, on sandy trail in grassland with deciduous dipterocarp forest and dry evergreen forest, 12 July 1998, B. L. Stuart. First country record.

Bufo melanostictus. PHONGSALY PROVINCE, Phongsaly District, Phou Dendin National Biodiversity Conservation Area, near Nam Khang River on Nam Kaw Stream: FMNH 257948–949, near 22°09'39"N 102°11'07"E, 600 m elevation, on pebble bank 3 m from stream in hill evergreen forest, 15 October 1999, B. L. Stuart and H. F. Heatwole. SAYABOURY PROVINCE, Phiang District, west of Mekong River: FMNH 257945, near 18°54'08"N 101°34'30"E, 250–400 m elevation, disturbed evergreen forest, 01 September 1999, M. Baltzer. BOLIKHAMXAY PROVINCE, Khamkeut District, Lac Xao: FMNH 254555–557, on road at night, near building, and near pond in dry evergreen forest, 01–14 October 1996, D. Davenport and H. F. Heatwole. Reported from throughout Indochina but without specific localities in Laos (Bourret 1942), and in Laos from Vientiane Municipality (Teynié et al. 2004), Khammouan Province (Stuart and Davidson 1999), and Champasak Province (Teynié et al. 2004). First provincial records.

FAMILY MICROHYLIDAE

Kalophrynus interlineatus. KHAMMOUAN PROVINCE, Boualapha District, Hin Nam No National Biodiversity Conservation Area: FMNH 255124, 17°30'N 105°51'E, 200 m elevation, near pool at entrance of limestone cave in dry evergreen mixed with deciduous forest, 15 February 1998, B. L. Stuart. Reported as *K. pleurostigma* in Stuart (1999). Reported from Champasak Province (Teynié et al. 2004). First provincial record.

Kaloula pulchra. VIENTIANE MUNICIPALITY, Vientiane: FMNH 257912, 17°58'24"N 102°36'57"E, 190 m elevation, on road at night during rain, 09 June 1999, B. L. Stuart. BOLIKHAMXAY PROVINCE, Thaphabat District, Phou Khao Khouay National Biodiversity Conservation Area, Houay Kay River near That Xay Waterfall: FMNH 255129, 18°27'N 103°10'E, 300 m elevation, on rock ledge 1 m above ground 2 m from river, 27 June 1998, B. L. Stuart. KHAMMOUAN PROVINCE, Boualapha District, Hin Nam No National Biodiversity Conservation Area: FMNH 255127, 17°34'N 105°50'E, 200 m elevation, on bank of flat stream near limestone karst in dry evergreen mixed with deciduous forest, 10 February 1998, B. L. Stuart. Reported from throughout Indochina but without specific localities in Laos (Bourret 1942), and in Laos from Champasak Province (Teynié et al. 2004). First provincial records.

Microhyla berdmorei. PHONGSALY PROVINCE, Phongsaly District, Phou Dendin National Biodiversity Conservation Area: FMNH 257920-923, near Nam Ou River, near 22°05'38"N 102°12'50"E, 600 m elevation, hill evergreen forest, 09–11 October 1999, B. L. Stuart and H. F. Heatwole; FMNH 257924–926, near Nam Khang River, near 22°09'04"N 102°12'19"E, 600 m elevation, hill evergreen forest, 13–14 October 1999, B. L. Stuart and H. F. Heatwole. BOLIKHAMXAY PROVINCE, Khamkeut District, Lac Xao: FMNH 254602–603, 254606–607, 254610–617, 28 September–29 October 1996, D. Davenport and H. F. Heatwole. KHAMMOUAN PROVINCE, Nakai District, Nakai-Nam Theun National Biodiversity Conservation Area: FMNH256446, along Houay Ting Tou Stream, 17°58'N 105°34'E, 700 m elevation, on sand bank of stream in disturbed evergreen forest, 08 November 1998, B. L. Stuart; FMNH 256447, along Houay Duen Stream, 17°57'N 105°34'E, 700 m elevation, on rocky bank of stream in evergreen forest, 10 November 1998, B. L. Stuart. SAVANNAKHET PROVINCE, Tapanthong District, Dong Sithovane Production Forest: FMNH 258078, 16°07'41"N 105°54'53"E, on rocky flats near stream pools, 17 January 2000, R. Boonratana. ATTAPEU PROVINCE, Sanamsai District, Ban

Mai Village, Nong Khe Wetlands: FMNH 262656, 14°42'35"N 106°28'00"E, 100 m elevation, along rocky shoreline of marsh in deciduous forest, 17 September 2000, B. L. Stuart. Reported from Champasak Province (Teynié et al. 2004). First provincial records.

Microhyla butleri. HUAPHAHN PROVINCE, Vieng Tong District, Phou Louey National Biodiversity Conservation Area, near Ban Houay Sa abandoned village: FMNH 255072, 20°13'N 103°15'E, 1000 m elevation, under log at edge of 3 x 4 m buffalo wallow ca. 6 m from stream, 25 April 1998, B. L. Stuart. BOLIKHAMXAY PROVINCE, Khamkeut District, Lac Xao: FMNH 254599, on leaf litter of dry evergreen forest, 06 October 1996, D. Davenport. KHAMMOUAN PROVINCE, Nakai District, Phou Hin Poun National Biodiversity Conservation Area: FMNH 255066–071, 255225, 17°51'N 104°52'E, 220 m elevation, on leaf litter of temporary stream bed in dry evergreen mixed with deciduous forest, 17–20 March 1998, B. L. Stuart and T. Chan-ard. Reported from Champasak Province (Teynié et al. 2004). First provincial records.

Microhyla fissipes. BOLIKHAMXAY PROVINCE, Khamkeut District, Lac Xao: FMNH 254587, 254598, dry evergreen forest, 07 October and 13 November 1996, D. Davenport and H. F. Heatwole. CHAMPASAK PROVINCE, Mounlapamok District, Dong Khanthung National Biodiversity Conservation Area, near Ban Thakang Village: FMNH 255130–131, near Ban Thakang village, on Xe Lepou River, 14°07'N 105°40'E, 60 m elevation, at edge of 2 x 3 m puddle in grassland with deciduous dipterocarp forest, 06 July 1998, B. L. Stuart. Recently resurrected from the synonymy of *M. ornata* by Matsui et al. (2005). Reported as *M. ornata* from "Tra-ninh (Xieng-khouang)" in Xieng Khouang Province (Bourret 1942), Vientiane (Bourret 1942), and Khammouan Province (Stuart and Davidson 1999). First provincial records.

Microhyla heymonsi. HUAPHAHN PROVINCE, Vieng Tong District, Phou Louey National Biodiversity Conservation Area: FMNH 255085–086, near Ban Houay Sa abandoned village, 20°13'N 103°15'E, 1000 m elevation, under log at edge of 3 x 4 m buffalo wallow approximately 6 m from stream, 25 April 1998, B. L. Stuart; FMNH 255087, near Nam Poung River, 20°14'N 103°16'E, 985 m elevation, in marsh in clearing of hill evergreen forest, 28 April 1998, B. L. Stuart. SAYABOURY PROVINCE, Phiang District, west of Mekong River: FMNH 257985, near 18°54'08"N 101°34'30"E, 250–400 m elevation, near village in disturbed evergreen forest, 01 September 1999, M. Baltzer. BOLIKHAMXAY PROVINCE, Khamkeut District, Nape border area: FMNH 257974–983, wet evergreen forest, 15–19 March 1997, D. Davenport. KHAMMOUAN PROVINCE, Boualapha District, Hin Nam No National Biodiversity Conservation Area: FMNH 255076–081, near Ban Dou Village, 17°31'N 105°49'E, 200 m elevation, on leaf litter in dry stream bed in dry evergreen mixed with deciduous forest, 09 February 1998, B. L. Stuart. CHAMPASAK PROVINCE, Pakxong District, Dong Hua Sao National Biodiversity Conservation Area, Bolaven Plateau: FMNH 257984, near 15°03'55"N 106°13'03"E, 1200 m elevation, under leaf litter in wet evergreen forest, 25 September 1999, B. L. Stuart and H. F. Heatwole. CHAMPASAK PROVINCE, Mounlapamok District, Dong Khanthung National Biodiversity Conservation Area: FMNH 255074-075, near Houay Khiem Stream, 14°08'N 105°22'E, 60 m elevation, on sandy road through grassland with deciduous dipterocarp forest, 20–21 July 1998, B. L. Stuart. First country record.

Microhyla pulchra. KHAMMOUAN PROVINCE, Yommalat District, Bang Vieng Village: FMNH 255090-093, 17°20'N 104°57'E, 200 m elevation, under dry mud of buffalo wallow, 31 March 1998, B. L. Stuart. KHAMMOUAN PROVINCE, Boualapha District, Hin Nam No National Biodiversity Conservation Area: FMNH 255089, 17°34'N 105°50'E, 200 m elevation, on bank of wide stream in dry evergreen mixed with deciduous forest, 10 February 1998, B. L. Stuart. SAVANNAKHET PROVINCE, Tapanthong District, Dong Sithovane Production Forest: FMNH 257998–999, 16°02'05"N 105°43'22"E, near dirt road, 16 January 2000, R. Boonratana; FMNH 258000, 16°07'40"N 105°54'53"E, on rocky flats near stream pools, 17 January 2000, R. Boonratana. CHAMPASAK PROVINCE, Mounlapamok District, Dong Khanthung National Biodiversity Conservation Area: FMNH 255094–096, 14°09'N 105°39'E, 100 m elevation, on grassy bank of 3 x 10 m buffalo wallow in grassland with deciduous dipterocarp forest, 08 July 1998, B. L. Stuart. CHAMPASAK PROVINCE, Khong District, Ban Sonlavieng Village: FMNH 257993–996, 14°01'56"N 105°54'15"E, 100 m elevation, in rice paddy, 26 January 2000, B. Phommachat. Reported from "N.-Laos: Samneua (Muong-het)" in Huaphanh Province (Bourret 1942). First provincial records.

Micryletta inornata. BOLIKHAMXAY PROVINCE, Khamkeut District, Lac Xao: FMNH 254600–601, dry evergreen forest, 02 October and 10 November 1996, D. Davenport and H. F. Heatwole. KHAMMOUAN PROVINCE, Boualapha District, Hin Nam No National Biodiversity Conservation Area: FMNH 255120, Phou Khaonok Mountain, 17°23'N 105°45'E, 545 m elevation, on leaf litter in dry evergreen mixed with deciduous forest, 21 February 1998, B. L. Stuart; FMNH 255121, 17°17'N 105°41'E, 240 m elevation, on leaf litter among limestone boulders in dry evergreen mixed with deciduous forest, 27 February 1998, B. L. Stuart; FMNH 255122, 17°20'N 105°41'E, 500 m elevation, on leaf litter at base of tree in dry evergreen mixed with deciduous forest, 26 February 1998, B. L. Stuart; FMNH 255221, 17°30'N 105°51'E, 200 m elevation, under log in deciduous forest, 16 February 1998, B. L. Stuart. KHAMMOUAN PROVINCE, Nakai District, Phou Hin Poun National Biodiversity Conservation Area: FMNH 255123, 17°51'N 104°52'E, 220 m elevation, on leaf litter of temporary stream bed in dry evergreen mixed with deciduous forest, 17 March 1998, B. L. Stuart and T. Chan-ard. Reported as *Microhyla inornata* in Stuart (1999). First country record.

Family Ranidae

Amolops cremnobatus. VIENTIANE MUNICIPALITY, Kasi District, east of Mekong River, near Ban Namon Village: FMNH 258376–377, 19°04'39"N 102°08'44"E, 200–300 m elevation, M. Baltzer, 01 September 1999. BOLIKHAMXAY PROVINCE, Khamkeut District, Ban Nape border area: FMNH 258367–375, on vertical moss-covered rocks in splash zone of large waterfall in wet evergreen forest, 19–20 March 1997, D. Davenport. The type locality is in Khammouan Province (Inger and Kottelat 1998). First provincial records.

Huia nasica. HUAPHAHN PROVINCE, Vieng Tong District, Phou Louey National Biodiversity Conservation Area, Phou Louey Mountain: FMNH 255399, 20°14'N 103°12'E, 1200 m elevation,

on rocky bank of stream in hill evergreen forest, 03 May 1998, B. L. Stuart. BOLIKHAMXAY PROVINCE, Khamkeut District, Ban Nape border area: FMNH 258221, wet evergreen forest, 17 March 1997, D. Davenport. KHAMMOUAN PROVINCE, Nakai District, Nakai-Nam Theun National Biodiversity Conservation Area: FMNH 256470–471, 256491, along Houay Dreng Stream, 17°50'N 105°35'E, 600 m elevation, along small rocky stream in wet evergreen forest, 01–02 December 1998, B. L. Stuart; FMNH 256472–478, 17°58'N 105°34'E, 700 m elevation, on rocks and vegetation along cascading stream in evergreen forest, 06–07 November 1998, B. L. Stuart. FMNH 256470 and 256491 were in amplexus at the bottom of a stream pool under 75 cm of water. The Huaphahn specimen was reported as *Rana montivaga* in Stuart (1999). First country record.

Hoplobatrachus rugulosus. CHAMPASAK PROVINCE, Mounlapamok District, Dong Khanthung National Biodiversity Conservation Area: FMNH 255191, 255200, near Houay Khiem stream, 14°08'N 105°22'E, 60–100 m elevation, on bank of stream and on road in mosaic of dry evergreen forest and grassland with deciduous dipterocarp forest, 19–20 July 1998, B. L. Stuart; FMNH 255192, near Ban Nong Som Hong Village, 105°40'E 14°17'E, 100 m elevation, on sandy road away from water, 25 July 1998, B. L. Stuart; FMNH 255193–194, near Ban Thakang Village on Xe Lapou River, 14°07'N 105° 40'E, 60 m elevation, in road puddle in grassland with deciduous dipterocarp forest, 06 July 1998, B. L. Stuart; FMNH 255197–199, 14°07'N 105°29'E, 60 m elevation, in puddle in grassy area and on mud bank of pond in mosaic of dry evergreen forest and grassland with deciduous dipterocarp forest, 11–13 July 1998, B. L. Stuart. CHAMPASAK PROVINCE, Khong District, Ban Sonlavieng Village: FMNH 258192–193, 14°01'56"N 105°54'15"E, 100 m elevation, in rice paddy, 18 July 1999, B. L. Stuart. Reported from throughout Indochina at low elevations but without specific localities in Laos (Bourret 1942), and in Laos from Khammouan Province (Stuart and Davidson 1999). First provincial record.

Limnonectes gyldenstolpei. VIENTIANE PROVINCE, Xanakham District: FMNH 261874–877, near 18°07'57"N 101°29'30"E, 300–600 m elevation, gallery evergreen mixed with bamboo and deciduous forest, November 2000, T. Hansel. Reported from "Muang Liep, Huey Kan Luang and Pon Pissay in French Laos on the Upper Mekong" (Smith 1922; as *Rana pileata*). Muang Liep is in Sayaboury Province, but I have not found the other localities. First provincial record.

Occidozyga lima. BOLIKHAMXAY PROVINCE, Khamkeut District, Lac Xao, near Lake Nam Bua: FMNH 254657, in grassy puddle at edge of dry evergreen forest, 14 October 1996, D. Davenport and H. F. Heatwole. KHAMMOUAN PROVINCE, Yommalat District, Bang Vieng Village: FMNH 255138, 17°20'N 104°57'E, 200 m elevation, on bank of small stream through rice paddy, 30 March 1998, B. L. Stuart. CHAMPASAK PROVINCE, Mounlapamok District, Dong Khanthung National Biodiversity Conservation Area: FMNH 255136, near Houay Khiem Stream, 14°08'N 105°22'E, 60 m elevation, in flooded grassland with deciduous dipterocarp forest, 20 July 1998, B. L. Stuart; FMNH 255137, near Nong Tum Pond, 14°16'N 105°20'E, 100 m elevation, in 10 x 10 m pond in grassland with deciduous dipterocarp forest, 24 July 1998, B. L. Stuart; FMNH 255139, 14°07'N 105°29'E, 60 m elevation, at edge of 20 x 20 m pond in dry evergreen forest, 11 July 1998, B. L. Stuart. CHAMPASAK PROVINCE, Khong District, Ban Sonlavieng Village: FMNH 258392–408, 14°01'56"N 105°54'15"E, 100 m elevation, in rice paddy, 18 July 1999 and 26 January 2000, B. L. Stuart and B. Phommachat. Reported from "Haut-Laos: Muong Ouneua" in Phongsaly Province (Bourret 1942). First provincial records.

Occidozyga martensii. VIENTIANE PROVINCE, Xanakham District: FMNH 261826, near 18°07'57"N 101°29'30"E, 300–600 m elevation, November 2000, T. Hansel. BOLIKHAMXAY PROVINCE, Khamkeut District, Lac Xao: FMNH 254670, 254681, on path through dipterocarp forest and in elephant footprint in dry evergreen forest, 08 and 29 October 1996, D. Davenport and H. F. Heatwole. ATTAPEU PROVINCE, Sanamsai District, Ban Mai Village, Nong Khe Wetlands: FMNH 261823–825, 14°42'35"N 106°28'00"E, 100 m elevation, along rocky shoreline of marsh in deciduous forest, 17 September 2000, B. L. Stuart. Reported from Khammouan Province (Stuart and Davidson 1999) and Champasak Province (Teynié et al. 2004; as *Phrynoglosssus martensii*). First provincial records.

Rana attigua. CHAMPASAK PROVINCE, Pakxong District, Dong Hua Sao National Biodiversity Conservation Area, Bolaven Plateau: FMNH 258251, 258348–349, near 15°04'37"N 106°08'15"E, 1000 m elevation, on vegetation along stream in wet evergreen forest or on ground in coffee plantation away from water in wet evergreen forest with coffee plantation clearings, 10–13 September 1999, B. L. Stuart and H. F. Heatwole; FMNH 258253–257, 258350, Ban Nongluang Village, near 15°04'07"N 106°12'03"E, 1100 m elevation, 20 September 1999, B. L. Stuart and H. F. Heatwole; FMNH 258264–265, 258258, near 15°03'55"N 106°13'03"E, 1200 m elevation, under leaf litter in wet evergreen forest, 21–23 September 1999, B. L. Stuart and H. F. Heatwole. XE KONG PROVINCE, Kaleum District, Xe Sap National Biodiversity Conservation Area: FMNH 258247, along Houay Alung Stream, 16°00'32"N 106°55'31"E, 920–1000 m elevation, on herbaceous leaf above side pool of large rushing stream in evergreen forest, 30 June 1999, B. L. Stuart; FMNH 258248, near 16°04'10"N 106°58'45"E, 1100–1280 m elevation, on rock 15 cm from small stream in wet evergreen forest, 06 July 1999, B. L. Stuart. First country record.

Rana chapaensis. XIENG KHOUANG PROVINCE, Pek District, Phonsavan Market: FMNH 256531–532, offered for sale alive in food market (probably collected nearby), 12 February 1999, B. L. Stuart. SALAVAN PROVINCE, Samoy District, Xe Sap National Biodiversity Conservation Area, near Ban Bee Hi Village: FMNH 262576–577, 16°08'46"N 106°56'50"E, 1220 m elevation, slow-moving muddy stream with palm trees, 04 March 1999, T. Chanard. First country record.

Rana daorum. HUAPHAHN PROVINCE, Vieng Tong District, Phou Louey National Biodiversity Conservation Area, Phou Louey Mountain: FMNH 255353–355, 20°14'N 103°12'E, 1200 m elevation, along small rocky stream in hill evergreen forest, 02–03 May 1998, B. L. Stuart. First country record.

Rana johnsi. BOLIKHAMXAY PROVINCE, Khamkeut District, Ban Nape border area: FMNH 258278, wet evergreen forest, 19 March 1997, D. Davenport; FMNH 254701–702, floodplain of

Nam Pheo River, 8 km NE of Nape, 2 km SW of Vietnam border, under stones on river floodplain through wet evergreen forest, 13 November 1996, D. Davenport and H. F. Heatwole. KHAMMOUAN PROVINCE, Nakai District, Nakai-Nam Theun National Biodiversity Conservation Area: FMNH 256511, along Houay Duen Stream, 17°57'N 105°34'E, 700 m elevation, on blade of plant 25 cm above rocky stream bank, 1 m from water, 10 November 1998, B. L. Stuart; FMNH 256512–515, along Houay Mae Stream, 17°57'N 105°35'E, 600 m elevation, on stream bank in degraded evergreen forest, 14 November 1998, B. L. Stuart; FMNH 256516, along Houay Dreng Stream, 17°50'N 105°35'E, 600 m elevation, wet evergreen forest 100 m from stream, 03 December 1998, B. L. Stuart. KHAMMOUAN PROVINCE, Boualapha District, Hin Nam No National Biodiversity Conservation Area: FMNH 255402, 17°20'N 105°41'E, 500 m elevation, on leaf litter near pool in temporary stream bed in dry evergreen mixed with deciduous forest, 25 February 1998, B. L. Stuart. First country record.

Rana lateralis. BOLIKHAMXAY PROVINCE, Khamkeut District, Lac Xao: FMNH 254713, on leaf litter in dry evergreen forest, 04 October 1996, D. Davenport and H. F. Heatwole. CHAMPASAK PROVINCE, Mounlapamok District, Dong Khanthung National Biodiversity Conservation Area: FMNH 255345–346, 14°09'N 105°39'E, 100 m elevation, away from water in grassland with deciduous dipterocarp forest, 08 July 1998, B. L. Stuart: FMNH 255403, near Houay Khiem Stream, 14°08'N 105°22'E, 60 m elevation, 100 m from pond on sandy road through grassland with deciduous dipterocarp forest, 21 July 1998, B. L. Stuart. First country record.

Rana maosonensis. BOLIKHAMXAY PROVINCE, Khamkeut District, Ban Nape border area: FMNH 258474–483, wet evergreen forest, 14–19 March 1997, D. Davenport. KHAMMOUAN PROVINCE, Nakai District, Nakai-Nam Theun National Biodiversity Conservation Area: FMNH 256517–518, along Houay Dreng Stream, 17°50'N 105°35'E, 600 m elevation, on rocky bank of stream in wet evergreen forest, 01 December 1998, B. L. Stuart; FMNH 256519–522, along Houay Ting Tou Stream, 17°58'N 105°34'E, 700 m elevation, on rocky or sandy bank of stream in evergreen forest, 06–09 November 1998, B. L. Stuart; FMNH 256523, along Houay Mae Stream, 17°57'N 105°35'E, 600 m elevation, on herbaceous leaf 0.5 m over stream in degraded evergreen forest, 14 November 1998, B. L. Stuart; FMNH 256524, along Houay Balong Stream, 17°56'N 105°34'E, 600 m elevation, on leaf litter at edge of dry stream bed in evergreen forest, 16 November 1998, B. L. Stuart. First country record.

Rana taipehensis. KHAMMOUAN PROVINCE, Nakai District, Phou Hin Poun National Biodiversity Conservation Area: FMNH 255205, 17°51'N 104°52'E, 220 m elevation, on mud bank of small pond in grassy marsh, 19 March 1998, B. L. Stuart and T. Chanard. Reported from Champasak Province (Teynié et al. 2004). First provincial record.

Family Rhacophoridae

Chirixalus doriae. HUAPHAHN PROVINCE, Vieng Tong District, Phou Louey National Biodiversity Conservation Area, near Nam Poung River: FMNH 255213–216, 20°14'N 103°16'E, 985 m elevation, calling from blades of grass above marsh fed by small stream in clearing of hill evergreen forest, 28 April 1998, B. L. Stuart. SAYABOURY PROVINCE, Phiang District, west of Mekong River: FMNH 257937, near 18°54'08"N 101°34'30"E, 250–400 m elevation, disturbed evergreen forest, 01 September 1999, M. Baltzer. Reported from Champasak Province (Teynié et al. 2004). First provincial record.

Chirixalus nongkhorensis. VIENTIANE PROVINCE, Phou Panang Hill Range: FMNH 263102–107, near 18°04'19"N 102°26'46"E, 300 m elevation, in bamboo near large puddle in trail through disturbed forest mixed with scrub and bamboo, 12 September 2000, B. L. Stuart and T. Hansel. VIENTIANE MUNICIPALITY, near Ban Danxang Village: FMNH 257892–894, 257898, 18°05'27"N 102°40'02"E, 190 m elevation, on vegetation above grassy marsh next to road, 13 June 1999, B. L. Stuart and D. Davenport. Reported from Champasak Province (Teynié et al. 2004). First provincial record.

Chirixalus vittatus. VIENTIANE MUNICIPALITY, near Ban Danxang Village: FMNH 257895–897, 18°05'27"N 102°40'02"E, 190 m elevation, on vegetation above grassy marsh next to road, 13 June 1999, B. L. Stuart and D. Davenport. HUAPHAHN PROVINCE, Vieng Tong District, Phou Louey National Biodiversity Conservation Area, near Nam Poung River: FMNH 255217, 20°14'N 103°16'E, 985 m elevation, calling from blade of grass above marsh fed by small stream in clearing of hill evergreen forest, 28 April 1998, B. L. Stuart. First country record.

Philautus parvulus. XE KONG PROVINCE, Kaleum District, Xe Sap National Biodiversity Conservation Area: FMNH 257938–941, near 16°04'10"N 106°58'45"E, 1200–1300 m elevation, calling from leaves of herbaceous plants or tree trunk 1–2.5 m above ground in wet evergreen forest, 07–08 July 1999, B. L. Stuart. First country record.

Rhacophorus bipunctatus. SAYABOURY PROVINCE, Phiang District, west of Mekong River: FMNH 257899, near 18°54'08"N 101°34'30"E, 250–400 m elevation, disturbed evergreen forest, 01 September 1999, M. Baltzer. First country record.

Rhacophorus calcaneus. XE KONG PROVINCE, Kaleum District, Xe Sap National Biodiversity Conservation Area: FMNH 257905–907, 257932-933, near 16°04'10"N 106°58'45"E, 1200–1300 m elevation, on leaves and branches of bushes and tree over rocky streams in wet evergreen forest, 08 July 1999, B. L. Stuart. First country record.

Rhacophorus dennysi. KHAMMOUAN PROVINCE, Nakai District, Nakai-Nam Theun National Biodiversity Conservation Area, Houay Mae Stream: FMNH 256449–450, 17°57'N 105°35'E, 600 m elevation, on herbaceous plants over stream in degraded evergreen forest, 13–14 November 1998, B. L. Stuart. Reported as *Polypedates feae* in Stuart (1999). First country record.

Rhacophorus feae. PHONGSALY PROVINCE, Phongsaly District, Phou Dendin National Biodiversity Conservation Area, Nam Sa Stream, near confluence of Nam Ou and Nam Sa Rivers: FMNH 257910, near 22°05'31"N 102°06'19"E, 600 m elevation, on 30 cm diameter mid-stream rock in 2 m wide swift rocky stream in hill evergreen forest, 20 October 1999, B. L. Stuart and H. F. Heatwole. First country record.

Rhacophorus orlovi. KHAMMOUAN PROVINCE, Nakai Dis-

trict, Nakai-Nam Theun National Biodiversity Conservation Area: FMNH 256455–457, along Houay Dreng Stream, 17°50'N 105°35'E, 600 m elevation, on rock and vegetation near stream in wet evergreen forest, 01–02 December 1998, B. L. Stuart; FMNH 256458, along Houay Ting Tou Stream, 17°58'N 105°34'E, 700 m elevation, on tree twig 5 m above waterfall in evergreen forest, 06 November 1998, B. L. Stuart; FMNH 256459–461, along Houay Deun Stream, 17°57'N 105°34'E, 700 m elevation, on vegetation in evergreen forest, 11–12 November 1998, B. L. Stuart; FMNH 256462–465, along Houay Dreng Stream, 17°50'N 105°35'E, 600 m elevation, on rock face or vegetation along stream in wet evergreen forest, 03–05 December 1998, B. L. Stuart. Reported as *R. calcaneus* in Stuart (1999). First country record.

Rhacophorus reinwardtii. HUAPHAHN PROVINCE, Vieng Tong District, Phou Louey National Biodiversity Conservation Area, near Nam Poung River: FMNH 255305, 20°14'N 103°16'E, 985 m elevation, on branch 3 m above marsh fed by small stream in clearing of hill evergreen forest, 27 April 1998, B. L. Stuart. SAYABOURY PROVINCE, Phiang District, west of Mekong River: FMNH 257901, near 18°54'08"N 101°34'30"E, 250–400 m elevation, disturbed evergreen forest, 01 September 1999, M. Baltzer. KHAMMOUAN PROVINCE, Boualapha District, Hin Nam No National Biodiversity Conservation Area, Phou Khaonok Mountain: FMNH 255304, 17°23'N 105°45'E, 545 m elevation, in puddle on forest floor in dry evergreen mixed with deciduous forest, 19 February 1998, B. L. Stuart. First country record.

Theloderma asperum. VIENTIANE PROVINCE, Xanakham District: FMNH 261897, near 18°07'57"N 101°29'30"E, 300–600 m elevation, November 2000, T. Hansel. KHAMMOUAN PROVINCE, Boualapha District, Hin Nam No National Biodiversity Conservation Area: FMNH 255379, 17°20'N 105°41'E, 500 m elevation, on leaf 25 cm above ground along temporary stream bed in dry evergreen mixed with deciduous forest, 23 February 1998, B. L. Stuart. Reported as *Philautus asperrimus* in Stuart (1999). First country record.

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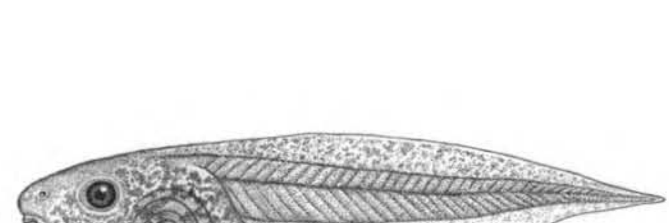

Agalychnis callidryas tadpole (KU 60006; 29 mm TL). Guatemala: El Petén: Toocog. Illustration by Julian C. Lee.

BOOK REVIEWS

Herpetological Review, 2005, 36(4), 480–482.

Reptiles de Los Andes de Venezuela. Catálogo Zoológico de Venezuela, Volumen 2, by Enrique La Marca and Pascual J. Soriano. 2004. Fundación Polar, Conservación Internacional, CODEPRE-ULA, Fundacite Mérida, BIOGEOS. Available from Enrique La Marca, BIOGEOS, Apartado postal 116, Mérida 5101-A. Venezuela (e-mail: lamarca1@telcel.net.ve). 173 pp. Softcover. US $35.00. ISBN 980-379-083-8.

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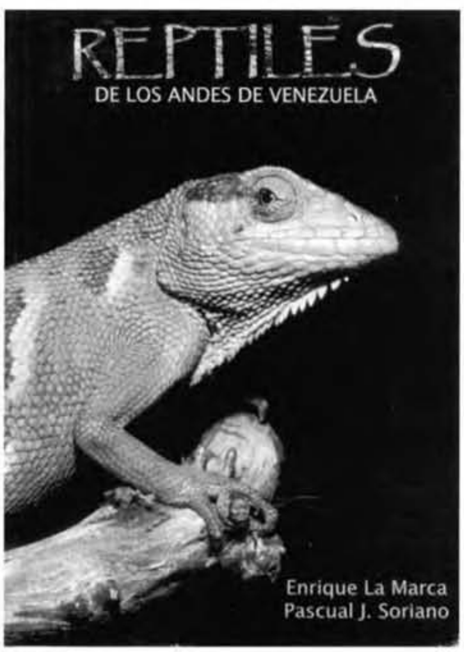

Venezuela is considered the ninth most diverse country on earth in reptile diversity (Aguilera et al. 2003) but, as in all tropical countries, much research remains to be done. Venezuela is also one of the most diverse countries with respect to bioregions, having seven (Barrio-Amorós 1998), one of which is the Andes, which in Venezuela reach their northernmost extent. The Venezuelan Andes are approximately 450 km long by 80 km wide in a northeasterly direction, with many peaks reaching almost 5000 m.

Herpetological investigation in this area began in the 19th century, and has continued slowly to the present day. The Venezuelan Andes are in general considered depauperate, especially compared with their southern counterpart in Colombia, which may harbor the most diverse herpetofauna on earth (particularly with respect to amphibians), and is not yet completely studied. The Venezuelan Andes consist of three main ranges (four if the Coastal Range is considered part of the Andes, see Duellman 1999). The principal one is called the Cordillera de Mérida, and is the branch going northeast from the Cordillera Oriental de Colombia. A small part of the Cordillera Oriental de Colombia is also present in Venezuela, where it is called the Tamá Massif. The last range is the Serranía de Perijá, another branch of the Cordillera Oriental which extends northwards. Its watershed constitutes the political border between Venezuela and Colombia. Neither of these two last ranges of the Venezuelan Andes are, however, treated in this book; despite its all inclusive title, the authors considered only the Cordillera de Mérida. Only very briefly, in Appendix II (Registros complementarios de la Sierra de Perijá, el Macizo de Tamá y de bajas elevaciones: "Complemetary records form Sierra de Perijá, Tamá Massif, and lowlands") are some additional species from these areas commented upon.

The book starts with a general physiographic map of northwestern Venezuela and northeastern Colombia. This is followed by a prologue by J. Celsa Señaris, and a presentation by the authors. The introduction discusses the Reptilia as a class, with some generic details. There the authors explain that only reptiles occurring above 1000 m are considered Andean, and thus, treated in the book. Thus, the Andean foothills, with canyons, deep creeks, waterfalls, and other typically montane habitats are excluded. To us, a crystalline, rocky stream, at even 200 m, surrounded by hills and covered by lush forest, where it is possible to find such Andean elements as the dendrobatid frog *Mannophryne collaris*, is indeed part of the Andes, but this definition is up to each author. As a result of this restrictive definition used in the book, many species that are known to inhabit the Andes are not represented in the book. However, strangely, some species that are only known from below 1000 m in the Andes have their own account, like *Hemidactylus palaichthus*, *Bachia heteropa*, *Ameiva ameiva*, and *Liophis reginae zweifeli*.

Next follows a chapter on ecological units of the Andes, by M. Ataroff and L. Sarmiento, which explains the situation of the area, provides a brief geological history, and formally presents the different ecological units, such as humid submontane forest, dry montane forest, cloud forest, Páramos, dry evergreen montane forest, and thorny shrub. Thereafter follows the section containing the species accounts, beginning with Amphisbaenia and Sauria. The use of dichotomous keys is explained and the accounts follows in the familial order: Amphisbaenidae, Gekkonidae, Iguanidae (we are not sure if they regard Iguanidae in the same sense as Schulte et al. (2003), as they do not recognize the families Polychrotidae and Corytophanidae (sensu Frost et al. 2001); when alternative classifications are in use the authors should justify their usages), Gymnophthalmidae, Teiidae and Scincidae. Snakes follow, in the order: Boidae, Colubridae, Anomalepididae, Leptotyphlopidae, Elapidae, and Viperidae. A very short literature section of just 37 titles, without any link to the principal text, but rather chosen subjectively as the best references for Andean reptiles, is given. Finally, there are three appendices: one on snake venoms and their treatment (very basic and obsolete), with no mention of the particular venomous species that can be a problem in the Andes!; the above mentioned appendix II on complementary species form Perijá, Tamá and the lowlands (we will treat this below); and a short glossary of technical terminology.

We found a variety of inconsistencies in the species accounts. Treating *Anolis jacare*, the authors say that it is known from Colombia; this is possible, but we are not aware of any published records. They may be refering to specimens found in the Tamá Massif and earlier considered to be *Phenacosaurus nicefori* (La

Marca 1995). Information on color change and altitudinal range in this taxon is also lacking. When treating *Polychrus marmoratus*, the text claims that its change of color is in consonance with the color of the substratum, which obviously is false. The Andean Chamaleon (*Polychrus* sp.) cannot change the color to match its substrate, but rather does so in relation to emotional state, from the original emerald green to dark brown or gray.

In the introductory text to the family Gymnophthalmidae three genera are mentioned, while in the account and key there are four (*Anadia*, *Bachia*, *Gymnophthalmus* and *Proctoporus*). *Bachia heteropa* does not live exclusively in the Sierra de Perijá and Cordillera Oriental de Colombia; Dixon (1973) reported it from Grenada Island, Trinidad and Tobago, and from the northern Venezuelan coast to the Andean Piedmont. *Proctoporus inanis* (Doan and Schargel 2003) is a species from 1450 m in the Cordillera de Mérida, clearly described and stated to be an Andean species. However, the authors treated this species with only a short comment. *Ameiva provitaae* (sic!) is a typical case of nomenclatural confusion. The first use of the name was in Rodríguez and Rojas-Suárez (1995), as *A. provitai* sp. nov., and a beautiful color drawing accompanied the text. Thus the authors should be Rodríguez and Rojas-Suárez (1995) and not García-Pérez (1995). La Marca and Soriano incorrectly spell the specific epithet *provitaae* and *provitae*. In any case, further investigations must be done in comparison with *A. bifrontata*.

A more extended comment on the *Cnemidophorus lemniscatus* complex, especially about the apparently parthenogenetic Andean populations is lacking and would have been appropriate. We do not understand why the authors state that *Atractus univittatus* is similar to *A. badius*, as the two have proved to be quite different (see Hoogmoed 1980; Starace 2000).

The real local name for *Chironius monticola* in the Andes is "perica." The names presented in this book (lora, verdegallo, machete) are perhaps applicable in other regions or to other green snakes. The authors claim that the type locality of *Dipsas latifrontalis* is the only record known from Venezuela (Aricagua, Mérida state, Venezuelan Andes), although their close collaborators recently published several new localities (Manzanilla et al. 2001) and Fig. 46 shows a specimen of *D. "latifrontalis"* from Cerro Platillón, Guarico (central coastal range). More investigation is needed to clarify the taxonomic status of this snake. We do not know any reference to a *Drymarchon melanurus* of 4 m. The record for the species is 2950 mm (Duellman 1960). If such a reference does exist, it would be valuable to cite it explicitly.

The key for *Erythrolampus* is wrong as the term "triad" is used improperly. A triad-type coloration consists of set of three black rings separated by white-yellow, usually narrower, rings; each triad is separated from the following by a red band (Roze 1996). Both species of *Erytholampus* in the Andes lack triads, and while *E. pseudocorallus* has black single rings surrounded by narrow white rings and separated from the next white-black-white set by a wide red band, *E. bizona* has the contrary coloration, white single rings surrounded by black narrow rings and equally separated from the next set by a wide red band (Roze 1966; see pictures in Campbell and Lamar (2004) and Murphy (1997), for example). The *E. "bizona"* photographed by them is, in fact, an *E. pseudocorallus*.

In the generic information about *Imantodes*, the authors say that there is only one species in Venezuela (*I. cenchoa*); they must not be aware of the citation of *I. lentiferus* by McDiarmid and Paolillo (1988) from Neblina, and by Donnelly and Myers (1991) from Guaiquinima. Contrary to what the authors state, *Lampropeltis triangulum andesiana* (as all species in the genus) are aglyphous snakes, not opistoglyphous (e.g., Williams 1988). On the other hand, the authors neglect to mention that *Liophis* is capable of causing severe envenomations (e.g., Barrio-Amorós 2003 for a case or an envenomation by *Liophis poecilogyrus* in Venezuela; Salomão et al. 2003 and Santos Costa and Di Bernardo 2001 about envenomation by *L. miliaris* in Brazil), stating that *Liophis* is unable to bite. Not to mention a subject so important in a popular book, addressed to people who could be attracted to handling snakes (including children), shows a grave lack of judgement.

The key for *Liophis* is useless; the dorsolateral line in the posterior part of the body mentioned is present in *L. melanotus* (depending how one defines this character) and is not present in *zweifeli* (not the contrary, as stated); one of the important characters to separate species is the immaculate venter of females, but they do not specify how to distinguish between sexes! Although the authors state that *L. reginae zweifeli* can be present at 1000 m, there are no published references to support this.

Later the authors state that there is no information about feeding habits of the species in the genus *Oxyrhopus*. However, Cunha and Nascimento (1993), Duellman (1978) and Murphy (1997), among others, report lizards and small mammals in the diet of snakes of this genus.

Regarding *Liotyphlops albirostris*, in the text the authors say (our translation): "The aspect of this animal is very similar to the previous species". The previous species in the book is *Tantilla semicincta*, a species with no similarities to *L. albirostris*. Perhaps "the next" species, which is *Leptothyphlops affinis*, was intended.

They also seem to defend the old interpretation of not accepting the genus *Leptomicrurus* (see a modern view in Campbell and Lamar 2004). In another coral snake account they state that *Micrurus mipartitus anomalus* ranges in altitude from 500 to 2000 m, although Barrio-Amorós and Calcaño (2003) previously reported three specimens from 250 m asl.

Bothrops asper just reaches central Mexico, not northern, as the authors state (Campbell and Lamar 2004). Lastly, a surprising species to comment on is *Crotalus maricelae*, which was synonymized with *C. durissus cumanensis* by the first author and collaborators recently (Esqueda et al. 2001); furthermore, in the introductory text about the genus *Crotalus*, the authors say that there is only one species of rattlesnake in South America; thus, we don't understand why they recognize the specific status of a "subspecies" that hwas already be to relegated to synonymy. We note the absence of at least three species: *Leptophis ahaetulla*, a species known to inhabit both slopes of the Andes, up to 1400 m, *Thamnodyastes* sp, which occurs in the Lagunillas area (about 1000 m) and *Typhlops reticulatus*, known from the area of La Azulita, at 1400 m. *Norops biporcatus*, mentioned from the Andes of Táchira and Sierra de Perijá (Williams 1966), and recently reported from the Cordillera de Mérida (Rivas and Barrio-Amorós 2003), was not even mentioned in the lowland section.

In several places the authors repeatedly state that data on reproduction do not exist for some species, such as *Leptodeira annulata ashmeadi*, *Liophis reginae zweifeli*, *Masticophis mentovarius suborbitalis*, *Ninia atrata*, *Tantilla melanocephala* and *Epicrates*

maurus, even though that information (hatchling periods and reproduction in captivity) is well known in the literature for Venezuelan populations of these species (Battiston 1996; Silva and Valdez 1989; Muñoz et al 1997), and for others species outside the country (e.g., Censky and McCoy [1988] for *Oxybelis aeneus* and Savage [2002] for *Gonatodes albogularis*).

A book about Andean reptiles would be much more useful if altitudinal ranges for all species are provided (with references to vouchers). A last incongruence we found is the photo of an *Ameiva a. ameiva* from Suriname, although this subspecies is very abundant in many parts of Venezuela. Although the use of photos of extralimital specimens of rare or difficult to find animals is understandable, it is strange that a local guide would not use photos of common species from the area covered.

After all these errors and evidence of misinformation (we could be even more critical!) we doubt that this book accomplishes its aims. Perhaps it is a good introduction for non- professionals, students and the general public, but it is of almost no interest for professionals. In some cases, the authors give some advice about captive feeding, and almost always animals (especially lizards) are fed with *Tenebrio mollitor* larvae, which are known to be a very poor food source.

A major highlight (perhaps the only original highlight) of the book are the pictures, some of very good quality, others not so good, but enough for a visual recognition. We think that a price of about US $35 (plus shipping) is not justified, given the end product. In the future, if these authors want to work on other projects, we suggest that they acknowledge and incorporate a good deal more of the relevant information available in the literature.

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Amphibians and Reptiles of the Bay Islands and Cayos Cochinos, Honduras, by James R. McCranie, Larry David Wilson, and Gunther Köhler. 2005. Bibliomania!, Salt Lake City, Utah (www.herplit.com). xiv + 210 pp. Hardcover. US $29.95. ISBN 1-932871-05-5.

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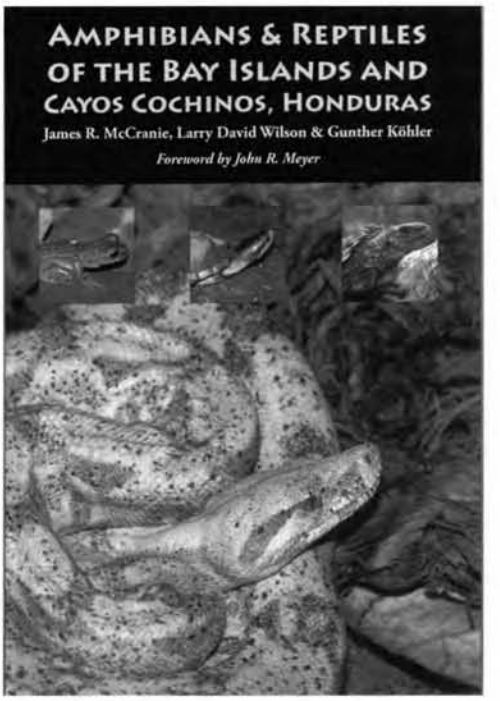

The Honduran department of Islas de la Bahía consists of two groups of islands—the Bay Islands (258 km^2) and Cayos Cochinos (2.28 km^2), both of which lie just north of the northern coast of Honduras. The authors of *Amphibians and Reptiles of the Bay Islands and Cayos Cochinos, Honduras* (hereafter abbreviated as BICC) discuss 55 species, of which 12 are endemic to the islands. The main goal of the book is to increase local understanding and awareness about the ecological value of the amphibians and reptiles that occur on the islands. Written in the style of a field guide, the authors explain that, "the descriptions we provide are as untechnical as possible" to allow lay readers to understand and use the book to identify species. Because tourism, development, and the human population are increasing on the islands, all of the endemic species are potentially threatened with extinction. The authors bring decades of expertise with the Honduran herpetofauna (e.g., McCranie and Wilson 2002) to an informative and well-illustrated book that showcases the beauty of the animals with a simultaneous plea for measures to conserve them.

Following a brief foreword by John Meyer, who accompanied Larry David Wilson on his first trip to the Bay Islands in 1967, the book begins with two brief (1–2 pages) Introduction and Materials and Methods sections. These sections are followed by 18 pages of brief descriptions of the islands (with excellent maps), climate, habitats, and very interesting social history. Archaeological sites suggest the islands were first inhabited in pre-Columbian times, and subsequent occupants included Columbus (1502), slave-raiding Spaniards (1516), French, English and Dutch raiders (starting in 1536), British pirates (ca. 1640), British military (1742), and 4000 "Black Caribs" (marooned in 1797) whose English-speaking descendants live on the islands to this day. In 1872, the Islas de la Bahía officially became a department of Honduras, but many residents continued to claim British nationality as recently as 1955.

A six-page section with two tables entitled "The Herpetofauna" summarizes the taxonomic and geographic composition of the 55 species. The following 136 pages include general information for classes, orders and families, keys to major groups (e.g., lizards), and species accounts for the herpetofauna, including seven anurans, one crocodile, five turtles (of which three are marine), 23 lizards (of which seven are endemic), and 19 snakes (of which five are endemic). The keys utilize excellent line drawings and photographs to illustrate specific morphological features used for identifications. Because the University of Kansas collection has numerous specimens from Islas de la Bahía (many collected by Larry David Wilson), I was able to successfully test the keys with the following 25 species: *Hyla microcephala, Smilisca baudinii, Leptodactylus melanonotus, Rana berlandieri, Kinosternon leucostomum, Phyllodactylus palmeus, Sphaerodactylus millepunctatus, S. rosaurae, Anolis allisoni, Norops sagrei, N. lemurinus, Basiliscus vittatus, Ctenosaura oedirhina, C. similis, Gymnophthalmus speciosus, Cnemidophorus lemniscatus, Leptotyphlops goudotii, Boa constrictor, Coniophanes bipunctatus, C. imperialis, Mastigodryas melanolomus, Oxybelis wilsoni, Pseudelaphe flavirufa, Tretanorhinus nigroluteus,* and *Micrurus ruatanus.*

Each species account is 1–2 pages long and includes subheadings for common names, description, similar species, general geographic distribution, distribution on Las Islas de la Bahía, natural history comments, and remarks. The descriptions are one paragraph in length, and include sufficient detail (e.g., modal webbing formulas and scale counts) to be useful to professional herpetologists. The natural history comments involve observations of breeding, diet, predation, and habitat preference from Islas de la Bahía, and the remarks sections include comments about introductions and exploitation by humans, recent taxonomic changes, and local myths—my personal favorite is that *Micrurus ruatanus* will become venomous only after eating toads. Although they are not necessarily incorrect, two taxonomic recognitions in the species accounts require some comments. First, on pg. 138, no citation is provided for the recent recognition of *Drymarchon melanurus,* but it is consistent with taxonomic changes suggested by Wüster et al. (2001). Based on a Principal Components Analysis that included eight Central American specimens (one from Honduras), these authors recognized *D. corais melanurus* as a distinct species. This change was not recognized by Köhler (2003). Second, Dixon and Tipton (2004) recognized *Mastigodryas* as the valid genus for all species of *Dryadophis,* but this change was not incorporated into the BICC; perhaps the authors do not agree with this change, or the paper was not published in time to be incorporated into the book.

The species accounts are followed by several short sections (2–6 pages each) that explore the geographic distribution, habitat preference, conservation status, and future of the islands' herpetofauna. The first section, entitled Ecological Distribution and Relation-

ships of the Herpetofauna, includes a table that lists each species with respect to the following habitats: hardwood forest, pine forest, mangrove forest, coconut groves, ironshore formation, swamps and marshes, estuaries, marine, and urban. A second table uses a Coefficient of Habitat Resemblance (CHR) to compare these major habitats. In the section on Biogeographic Relationships and Significance, a third table is used to compare Coefficients of Biogeographic Resemblance (CBR) among the Bay Islands, Cayos Cochinos, and mainland Honduras. The authors do a good job of discussing trends in similarity among the islands and mainland Honduras, although some biologists might question whether other variables such as the target area effect, rescue effect, and small island effect could also influence island diversity and endemism (Brown and Lomolino 1998). In this same section, the authors point out a close affinity to mainland Honduras in their discussion of the "closest relationships" of the 12 endemic species of the islands, but at least some of these hypotheses have not been subjected to a modern phylogenetic analysis and statements that suggest sister relationships should be interpreted with caution. In the next section on Conservation Status, the authors use the environmental vulnerability score of Wilson and McCranie (2004) to categorize each species as low, medium, or high vulnerability. Their results are mostly consistent with threat classifications of the Global Amphibian Assessment (IUCN et al. 2004) and IUCN Red List for Honduras (IUCN 2004). It was alarming to see that all 12 endemic reptile species were listed in BICC as "high vulnerability," a fact that is made more troubling by the lack of management plans, personnel, and research in most protected areas of the islands. An additional high-vulnerability species, *Ctenosaura melanosterna,* has a limited distribution on mainland Honduras. The Conservation Efforts section describes the formidable challenges faced by proponents of functioning protected areas, although some private landowners have managed to preserve crucial hardwood forest habitats. Two sections entitled Conservation Project Utila Iguana and Cayos Cochinos Biological Reserve explain conservation efforts to protect *Ctenosaura bakeri* and the Cayos Cochinos archipelago, respectively. The last section on the future of the herpetofauna involves a sobering discussion of unchecked human population growth on the islands and Honduras as a whole, and the inevitable effects on natural habitats and the animals that need them to survive. Tourism, land speculation, and transmigration from mainland Honduras are putting increasing pressure on existing protected areas. The ten-page glossary preceding the index is an excellent source for explanations of terms that may be unfamiliar to non-biologists. All citations in the 14-page index were cross-referenced to the text.

My overall impression of the book is very positive. However, I would be remiss if I didn't mention a few minor problems and errors. Several of the photographs are fuzzy, accompanied by captions in colors that make them difficult to read, and the color correction is off in some places, resulting in a dark bluish hue. I noticed some color ink smudging on the text and edges of some photos on my copy. On page 128, pythons are listed as members of the family Boidae. Although the authors do not provide a citation, this view is shared by Pough et al. (2004), who considered Phythoninae as a subfamily of Boidae. However, the BICC authors list ten genera (41 species) for Boidae and cite McDiarmid et al. (1999), who considered Boidae (8 genera, 41 species) and Pythonidae (8 genera, 26 species) as separate families. Grammatical errors and typos were difficult to find, but I noticed a few: pg. 5: "The group consist of two major islands…"; pg. 15: "without monuments, are almost always are found on"; pg. 105: "*Norops lemurinus* a diurnal species…"; lower caption on pg. 81 says *S. millipunctatus* instead of *S. millepunctatus*; and pg. 165 "swamps and marches." In Table 4, I believe the N symbol should be Coefficient of Habitat Resemblance (not Coefficient of Biogeographic Resemblance) to make it consistent with the table legend. However, the CHR is based on the CBR formula.

These minor problems aside, *Amphibians and Reptiles of the Bay Islands and Cayos Cochinos, Honduras* is reasonably priced for the excellent information and wonderful illustrations (over 200 color photos). The sturdy binding and small size (6.25×9.25 in) make it ideal for use in the field. This book will make a fine addition to the libraries of herpetologists interested in Central America and island biogeography. With luck, the book will generate renewed interest in conserving the Bay Islands, which are in need of urgent protection if their endemic species are to survive.

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Herpetological Review, 2005, 36(4), 485.

Les Tortues de l'Indochine avec une Note sur la Peche et l'Élevage des Tortues de Mer par F. Le Poulain [Facsimile Reprint], by René Leon Bourret, with an Introduction by Indraneil Das. 2005. Society for the Study of Amphibians and Reptiles (www.herplit.com/SSAR/). i-xiv + 1–235 pp., 48 black and white pls., 6 color pls. Hardcover. US $65.00. ISBN 0-91684-64-8.

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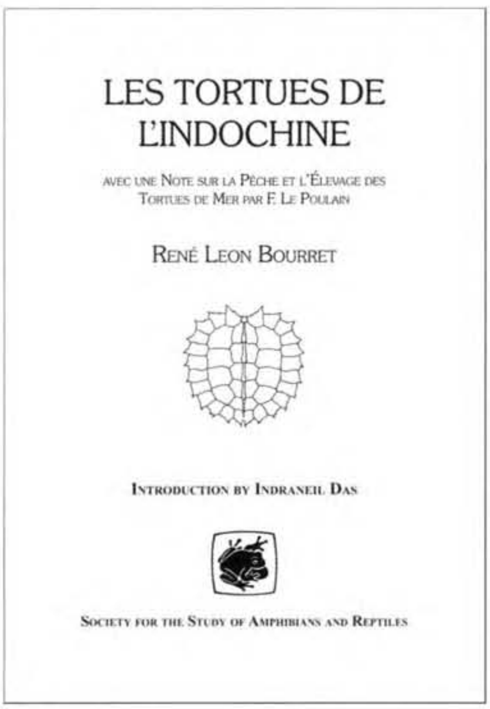

By the standards of today, Bourret's book is odd. It might have been odd even when it was originally published over 60 years ago. And yet there is much to recommend the book. Furthermore, because of the crisis now facing the turtles of Southeast Asia, it is especially appropriate that it is reprinted now. The well-intentioned description of new species that are now known to be hybrids provides another rationale for reprinting Bourret's idiosyncratic volume (Parham et al. 2001; Dalton 2003).

What makes this book odd? Most obvious is its organization, beginning with the position of the table of contents at the end of the book. Strange choices and redundancy provide the reader with all the different ways that information on turtles could be organized. Thus, when identification keys could be provide in one form, Bourret provided keys in at least five different contexts – overkill, but still useful. This redundancy would be eliminated today.

The first half of the volume is a review of the turtle fauna of southeastern Asia. The historical introduction is a mostly chronological recitation of names from relevant sources. The literature section for the entire work appears next. The third chapter is a morphological description of turtles customized by reference to the particular turtles under consideration. More on skulls and limbs is included than in most other studies of this vintage. Next, Bourret included a short chapter that today would be entitled "Distribution." This peculiar chapter starts with description in outline form appended by three tables differently describing the distribution of the same species. Another table summarizes the regional composition of the fauna. A tabulation of the altitudinal distribution of turtles in northern and southern Indochina ends the chapter. Bourret ends the first section with dichotomous keys. Separate keys are provided for external characters, heads and limbs, carapaces, plastra, and skulls.

The second major section of the book is arranged species by species. All the accounts are numbered but the system of numbering is hard to discern and on the surface seems both inconsistent and unnecessary. The accounts themselves are loaded with information that is, to this day, very useful. Although museum specimen numbers are lacking, Bourret often provides locality information on the specimens he examined and identifies the institution from whence they came. Each account includes a synonymy, a description, measurements taken (usually from a specimen with a known locality), and information on the location of the type(s) and other specimens figured or referenced by earlier authors. A plate was provided for all species including line drawings of the animal in life, the plastron with and without scutes, the dorsum of the manus, a dorsal and lateral view of the head, a lateral view of the skull and mandible, a ventral view of the cranium, and a dorsal view of the carapace without scutes. Scale bars are provided for the shell drawings, but not for other figures. A dotted line indicates the position of the orbits in the drawings of the ventral cranium.

A short note by Poulain on sea turtles is appended to Bourret's main work, followed by a systematic index, a list of figures and, finally – I said the book was odd, a table of contents. I have taken more trouble than usual to describe the contents of this volume even though the strangeness of the book is only partly revealed in description. The introduction by Das indulges in some of the same description, but in a gentlemanly way, he avoids calling Bourret's book strange. Das has kindly included a table that provides current names for all the names used by Bourret. I hope I am right in noting that Das and I share an admiration for what Bourret did.

Critically speaking, this book could be significantly shorter if various redundancies were omitted and if the data were reported in a more economical layout. But the book would lose its unique qualities and some of its quaint charm (which I believe it had the day it was published). Even some of its scientific importance would have been dissipated if it had been a bit more critically crafted. This book is so useful partly and precisely because it is an anachronism. It is for this reason that the SSAR should be congratulated and the sponsors and patron thanked for bringing Bourret's work to a 21[st] century audience. It will benefit all those interested in the turtles of Southeast Asia to obtain and refer to Bourett's odd book.

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PARHAM, J. F., W. B. SIMISON, K. H. KOZAK, C. R. FELDMAN, AND H. SHI. 2001 New Chinese turtles: endangered or invalid? A reassessment of two species using mitochondrial DNA, allozyme electrophoresis and known-locality specimens. Anim. Conserv. 4:357–367.

PUBLICATIONS RECEIVED

A Field Guide to Amphibians and Reptiles of Maricopa County, by Thomas C. Brennan and Andrew T. Holycross. 2005. Arizona Game and Fish Department, Phoenix, Arizona (www.azgfd.gov/_e/publications.shtml). iv + 68 pp. Softcover. US $5.00. ISBN 0-917563-52-2.

This slender guide provides a concise introduction to the herpetofauna of Maricopa County, the south central Arizona county that includes the city of Phoenix. The county is dominated by Sonoran Desertscrub communities, but also includes montane chaparral and woodlands. The fauna includes 79 native species (14 anurans, 1 salamander, 2 chelonians and 31 species each of lizards and snakes) as well as several introduced forms—surely one of the richest herpetofaunas of any American county. Among these are seven species of rattlesnakes, the Sonoran Coralsnake, and the Gila Monster. Each species is illustrated by a good quality portrait photograph (or several photos in the case of markedly poltypic species or those with distinctive juvenile patterns) and is accompanied by a single paragraph of text (with information on size, identification, and natural history), and a shaded map showing known or expected distribution in Maricopa County and, in some cases historical distribution (mostly for species now extirpated from greater Phoenix). The accounts are prefaced by short sections on viewing amphibians and reptiles, snakebite and toad toxins, and maps of recreation areas and community types, as well as a series of habitat photos. The book closes with a glossary and combination checklist and index. This inexpensive and well illustrated field guide will be a handy reference for anyone visiting Phoenix or the Sonoran Desert.

Vernal Pools, Natural History and Conservation, by Elizabeth A. Colburn. 2004. The McDonald & Woodward Publishing Company, Granville, Ohio (www.mwpubco.com). xiii + 426 pp., 16 pls. Softcover. US $29.95. ISBN 0-939923-91-2. Hardcover. US $39.95. ISBN 0-939923-92-0.

This volume is a complete guide to the natural history of vernal pools of the northeastern United States and eastern Canada. After introducing the hydrology and physical characteristics of vernal pools, the book catalogues the organisms that are associated with these wetland habitats, emphasizing invertebrate groups (especially crustaceans, insects, and other arthropods) and amphibians. The amphibian chapter occupies 43 pages and discusses the identifying features, life histories, eggs, larve, migration, home ranges, and mortality of 18 species of frogs and salamanders that are as-

sociated with vernal pools in the area under consideration. A short chapter discusses other terrestrial vertebrates, providing some data on four turtles and mentioning a few snake species that are sometimes associated with ephemeral wetlands. Ecosystem processes in vernal pools are outlined in a chapter on energy flow, community composition, and seasonal cycles. The remaining text is devoted to the conservation of vernal pools and treats issues such as threats, regulation, and conservation strategies and priorities. The main text is supplemented by an extensive glossary and a 64 page appendix of the fauna of temporary pools and ponds conclude the book. The latter is extensively annotated and contains much relevant information about vernal pools faunas beyond the focal area of the book. *Vernal Pools* is fully referenced, with a bibliography of about 1000 items, including nearly 200 relating to amphibians alone. The book concludes with a subject index and includes a 16 page insert of color plates (five depicting amphibians and reptiles) of varying quality. This book will be useful for herpetologists, entomologists, ecologists and other naturalists throughout the cool temperate regions of eastern North America. It would make an especially valuable adjunct to courses on field ecology or natural history and its extensive bibliography makes it useful for even those already intimately familiar with the fauna of vernal pools and temporary ponds.

Terrarien Atlas. Band 2, Frösche, by Hans-Joachim Hermann. 2004. Mergus Verlag GmbH für Natur- und Heimtierkunde, Melle, Germany (www.mergus.com). 1099 pp. Hardcover. 42,00 Euro (approx. US $53). ISBN 3-88244-073-2.

At almost 1100 pages, this frog atlas is nearly as thick as it is wide. It provides species accounts for hundreds of frogs, including nearly all that are regularly kept in terraria as well as many less common species. Each account provides scientific name and describer, German common name, original scientific name, and statements about distribution, habitat, type of terrarium required, diet in captivity, reproduction, and occasionally additional (often taxonomic) remarks. Representatives of the Bufonidae, Dendrobatidae, Hylidae, Centrolenidae, Leptodactylidae, Myobatrachidae, Hyperoliidae, Rhacophoridae, Mantellidae, Ranidae, Microhylidae, and Nasikabatrachidae are featured. There are typically two accounts per page and, in most cases, the species discussed are illustrated by color photos on the facing page. In many instances, however, additional species are illustrated and for some species habitats, eggs and larvae are also shown. Nearly all the photos are sharp, well composed, appropriately cropped, and large enough to give the reader a good idea of what each frog looks like. Although not all species or even families are covered, more than 1500 species are depicted, making this a very representative guide. The atlas is aimed at herpetoculturalists and will no doubt be a useful reference for those looking for a basic guide to parameters important for husbandry. However, the huge collection of photographs presented in the book make it a useful resource even for professional herpetologists, allowing anyone to "put a face with a name." For this reason this book should be attractive even to those who cannot read the German text.

Information for Contributors

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ARTICLES

TECHNIQUES

The habituation curves of the rattle response for subjects D1, D3, and D12 are shown in Fig. 2. Note the high probability of response in the first 50 trials for all three individuals (mean ± SE = 0.99 ± 0.007 for all three individuals combined). Following the dishabituating stimulus, all snakes responded. It is evident that the rattlebox is useful in consistently eliciting a rattle response and in detecting individual differences in rattling behavior.

In addition to habituation, the rattlebox can also be used to study classical conditioning in rattlesnakes. Our laboratory has just begun to test classical conditioning in rattlesnakes in which the opening and closing of the box serves as an aversive unconditioned stimulus. To serve as a conditioned stimulus, we have mounted a 60 W incandescent light on the inside of the box. Temporarily turning on the light serves as a conditioned stimulus.

We have also designed an operant procedure that utilizes the rattlebox. In operant conditioning, a subject's response is reinforced by its consequences. By placing the rattlebox in a cold room and positioning a heat lamp inside wired to a voice-activated relay, each rattle response is rewarded with an increase in ambient temperature. Because rattling typically does not occur spontaneously, it can be shaped by gently prodding the snake with a snake hook through the keyhole.

The results presented here demonstrate the utility of the rattlebox in studies of learning in rattlesnakes. Specifically, Western Diamondback Rattlesnakes repeatedly exposed to an aversive yet harmless stimulus show a learned decrease in rattling. Furthermore, the box is relatively inexpensive and can be built in one day. Extension of the rattlebox to studies of classical and operant conditioning is also easily accomplished. We hope this apparatus will shed light on the perceptual world of rattlesnakes and stimulate further research in the area of learning in snakes.

Acknowledgments.—Development of the apparatus was funded by a grant from the East Texas Herpetological Society to AJP. B. Baker, B. Wilson, and H. Schlothower provided the snakes. N. Birnbaum, N. Faught, and L. Hyde assisted in data collection. An anonymous reviewer made helpful comments on an earlier version of the manuscript.

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NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 36, Number 1 (March 2005).

CAUDATA

AMBYSTOMA OPACUM (Marbled Salamander). **SPERMATOPHORE DEPOSITION.** On 4 Nov 2000, a lone male *Ambystoma opacum* was observed depositing a spermatophore at Ginger's Bay, a small Carolina Bay on the Savannah River Site in Aiken Co., South Carolina. The nearest conspecific, another male, was more than 3 m away during deposition, too great a distance to have influenced the sexually active male by female mimicry (Arnold 1976. Z. Tierpsychol. 42:247–300). Because spermatophore deposition in *A. opacum* occurs very rapidly, with certain individuals achieving as many as 4 depositions in as short as 30 seconds (pers. obs.), there was not sufficient time for another salamander to have interrupted normal courtship with this male, leaving him alone to be observed in an attempt to finish mating. A search of the immediate vicinity yielded no other spermatophores. Previous reports of courtship in *Ambystoma* have emphasized the tendency for males to deposit spermatophores repeatedly, but only in the presence of other courting individuals (e.g., Noble and Brady 1933. Zoologica 11:89-132; McWilliams 1992. Behaviour 121:1–19). These lines of evidence strongly suggest that this individual was engaging in spermatophore deposition in the absence of courtship or influence by either past or present male sexual activity. Males of congeneric species have been reported to deposit in solitude but only after being initially stimulated by mating aggregations or courtship behavior by conspecifics (Anderson 1961. Copeia 1961:132–139; Arnold 1976. *op. cit.*; McWilliams 1992. *op. cit.*). Because males presumably are limited in the number of spermatophores they can produce in a breeding season (Verrell 1986. J. Comp. Psych. 100:291–295; Verrell 1988. J. Herpetol. 22:394–400), selection should strongly favor male mating strategies that result in successful insemination of females. Thus, if isolated spermatophore

deposition is common, we might expect some female *A. opacum* to select previously deposited spermatophores without submitting to ritualized mating. Courtship avoidance may be advantageous for females if substantial costs are incurred by participating in mating aggregations (e.g., increased predation risk, Koga et al. 1998. Proc. Roy. Soc. Lond. B 265:1385–1390). Others have indicated that males sometimes deposit spermatophores when only other males are present and that females may accept spermatophores in the absence of courtship (Scott 2005. *In* Lannoo [ed.]., Amphibian Declines: The Conservation Status of United States Species, pp. 627–632. University of California Press, Berkeley, California). These observations suggest that *A. opacum* may exhibit two different mating strategies: 1) courtship either in the terrestrial habitat or in dry pond basins (Krenz and Scott 1994. Herpetologica 40:46–50) and 2) courtship avoidance in which males deposit spermatophores in isolation or on the periphery of aggregations and females search for spermatophores that have been left behind by unsuccessful courtship encounters and random depositions. Detailed experimental and observational studies are needed to determine the importance and frequency of these mating behaviors in marbled salamanders.

Submitted by **DEAN A. CROSHAW**, Savannah River Ecology Laboratory, Drawer E, Aiken, South Carolina 29802, USA and Department of Zoology, University of Oklahoma, 730 Van Vleet Oval, Norman, Oklahoma 73019, USA; e-mail: croshaw@srel.edu.

CRYPTOBRANCHUS ALLEGANIENSIS (Hellbender). **DISPLACEMENT BY A FLOOD.** Hellbenders maintain small home ranges, usually occupying an area of ca. 90–346 m² (Peterson and Wilkinson. 1996. Herpetol. Rev. 27:126–127; Coatney 1982. MS Thesis, Southwest Missouri State Univ.; Hillis and Bellis 1971. J. Herpetol. 5:121–126; Humphries and Pauley, unpubl. data). In one study (Nickerson and Mays 1973. The Hellbenders: North American Giant Salamanders. Publ. Biol. Geol., Milwaukee Public Mus. 106 pp.), an intercapture distance of over 900 m by one Hellbender was recorded, and another individual covered a roundtrip distance of 1050 m over a several-month period. Large floods could dislodge Hellbenders from a hiding rock, possibly displacing them long distances downstream from their home range. On 10 Sept 2004, western North Carolina experienced massive flooding resulting from the remnants of Hurricane Francis. Some areas received over 50 cm of rain over a two-day period. I was contacted by a resident of Black Mountain, North Carolina who found an adult Hellbender in a drying puddle in her front yard. Flat Creek (Buncombe County), which usually averages 2–3 m in width, flooded the houses along the floodplain, leaving the hellbender stranded in the yard. The hellbender was described as "almost dead" by the homeowner. The homeowner provided a photograph of the hellbender, measured it, and determined its gender based on swelling of the cloaca. It was an adult female with a total length of >50 cm. This observation suggests that large floods can displace or lethally strand some hellbenders.

Submitted by **W. JEFFREY HUMPHRIES**, Department of Forestry and Natural Resources, Clemson University, Clemson, South Carolina 29634, USA.

CRYPTOBRANCHUS ALLEGANIENSIS (Hellbender). **CANNIBALISM.** Hellbenders prey mainly on crayfish, though a variety of other invertebrates and vertebrates are sometimes taken (Nickerson and Mays 1973. The Hellbenders: North American Giant Salamanders. Milwaukee Public Mus. Press, 106 pp.). Hellbenders have also been known to feed on eggs and larvae of their own species (Smith 1907. Biol. Bull. 13[1]:5–39). Here we report an adult Hellbender having eaten a smaller conspecific in Pisgah National Forest, Transylvania County, North Carolina. On 22 June 2004, we captured an adult male Hellbender (SVL = 23.6, TL = 37.2 cm) that regurgitated another Hellbender (SVL = 12.6, TL = 18.5 cm) during data collection. The population of Hellbenders in this particular stream is very dense, and consists of all size classes (Humphries, unpubl. data). Taber et al. (1975 Copeia 1975:633–639) suggested that cannibalism might be an important population control mechanism. Though cannibalism of larval Hellbenders has been documented, our finding of a small adult eating an immature adult half its size is noteworthy.

Submitted by **W. JEFFREY HUMPHRIES**, Department of Forestry and Natural Resources, Clemson University, Clemson, South Carolina 29634, USA; **MAURICIO SOLIS** and **CLAIRE CARDWELL,** Department of Biological Sciences, University of Missouri-Rolla, Rolla, Missouri 65409, USA; and **AMY SALVETER,** U.S. Fish and Wildlife Service, Ecological Services, 101 Park DeVille Drive, Suite A, Columbia, Missouri 65203, USA.

EURYCEA NEOTENES (Texas Salamander). **HABITAT UTILIZATION.** Populations of the Texas Salamander are thought to be restricted to cave waters or the immediate vicinity of springs that flow from limestone formations (Sweet 1982. Herpetologica 38:430–444). The following observation was made in a pool within close proximity to a river separated from any immediate detectable seepage or other source of water flowing into the river. On 29 April 2001 at 1200 h, three adult *Eurycea neotenes* were found on the south bank of the Sabinal River in Lost Maples State Park, Bandera County, Texas. All three specimens were observed in an isolated pool near the river's edge at depths 5–20 mm. Fallen and submerged sycamore leaves (*Platanus* sp.), were near all individuals. Air temperature was ca. 14.4°C and the water temperature was noticeably warmer, but exact water temperature was not available. Several springs and seepages are present along the Sabinal River and were possibly the origin of these salamanders. Two specimens were creamy white and closely matched the color of the limestone pebbles. *Eurycea neotenes* typically displays brownish hues. The paler coloration could be the result of polymorphism, age, or environmental adaptation. None of the specimens were collected as they escaped by burrowing into the matrix of riverbed gravel upon the slightest disturbance of the water. Several tadpoles of Blanchard's Cricket Frog (*Acris crepitans*), Gulf Coast Toad (*Bufo nebulifer*), and Rio Grande Leopard Frogs (*Rana berlandieri*) were present in the pool as were Large Spring Gambusia (*Gambusia geiseri*). This observation documents the presence of adult *Eurycea neotenes* in close association with a river, and also demonstrates a means by which they move through their rocky microhabitat in both troglobitic and riverine settings.

Submitted by **CARL J. FRANKLIN**, Amphibian and Reptile

Diversity Research Center. The University of Texas at Arlington, Department of Biology. Arlington, Texas 76019, USA (e-mail: Franklin@uta.edu); and **DAVID C. KILLPACK,** Illumination Studios, 5924 Woodoak Drive, Dallas, Texas 75249, USA (e-mail: David@illuminationstudios.com).

PLETHODON GLUTINOSUS (Slimy Salamander). **PREDATION.** The published list of predators of *P. glutinosus* is short. This may be due in part to the sticky skin secretions that are the namesake of this species (Brodie et al. 1979. Copeia 1979:270–274). Cannibalism occurs as well (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 587 pp.). Here we report an instance of predation on *P. glutinosus* by an aquatic vertebrate.

During the night of 11 May 2003, a Blue Catfish (*Ictalurus furcatus*) ca. 75 cm TL was caught on hook and line. The stomach contents included two *P. glutinosus*, one was mostly digested and the other was an intact adult. This fish was caught ca. 0.5 km upstream of the confluence of Channahatchee Creek and the Tallapoosa River (Yates Reservoir) in Elmore County, Alabama USA. The diet of the Blue Catfish is largely comprised of invertebrates such as mollusks and crayfish; known vertebrate prey includes fish and frogs (Jenkins and Burkhead 1994. Freshwater Fishes of Virginia. American Fisheries Society, Bethesda, Maryland. 1079 pp.).

May 2003 was characterized by unusually heavy precipitation, with rainfall on 9 May resulting in severe flooding upstream of Yates Reservoir. A comparison of USGS average flow rates (measured ca. 55 km upstream at Horseshoe Bend) for this time of year (9013 cfs) and those experienced during this event (116100 cfs), illustrate the magnitude of this flood. It is assumed that the inundation of the riparian zone of the Tallapoosa River and the impoundments along its length made it possible for an aquatic vertebrate to prey upon an entirely terrestrial amphibian.

Thanks to P. A. Newton for logistical support. We are grateful to C. Guyer and S. M. Boback for their comments on this manuscript.

Submitted by **GEOFFREY G. SORRELL** (e-mail: sorregg@auburn.edu), **SHAWN D. LINDEY** (e-mail: lindesd@hotmail.com), and **CHRISTOPHER R. NEWTON** (e-mail: crnewt02@yahoo.com), Department of Biological Sciences, 331 Funchess Hall, Auburn University, Auburn, Alabama 36849-5414, USA.

PSEUDOTRITON RUBER (Red Salamander). **REPRODUCTION**. Few nests of the Red Salamander have been found. Bishop (1925. Nat. Hist. 25:385–389) described the first known clutch of eggs for this species. Based on the date of discovery (3 October) and advanced developmental stage of the embryos, Bishop (1941. New York St. Mus. Bull. 324:1–365) suggested oviposition occurs as early as mid-September in the northern portion of the range. As further support of this suggestion, Bishop (1941, *op. cit.*) reported that Twitty and Hutchinson found 290 eggs of this species during the first week of November. The embryos ranged from "near hatching to less advanced," suggesting to Bishop that the eggs were laid during late fall and early winter months, and that they represented several clutches from different females. Since these early accounts, only Fowler (1962. Bull. Virginia Herpetol. Soc. 31:4) reported finding nests of *P. ruber*. Clutch size, as determined from the aforementioned natural clutches and counts of mature oviducal eggs (Bruce 1978. Copeia 1978:417–423), ranges from 29–130 and is positively correlated with female SVL. Here, we report a nest of the Red Salamander found in the twilight zone of a cave located along the banks of the Caney Fork River in DeKalb County, Tennessee.

On 19 Sept 2004, we found a clutch of sixty-three eggs packed together tightly and attached by a slender stalk to the undersurface of a rock (Fig. 1) located in the center of a small, out-flowing cave stream. The rock was partially embedded in gravel; water flowed around the edges, but not over the upper surface. The lower surface of the rock sat above a shallow, water-filled depression; the eggs dangled into the depression and were bathed in low-velocity subsurface flow. Two adult *P. ruber* inhabited the depression, possibly in attendance of the eggs. The eggs were white and cleavage planes were not discernible, indicating that the eggs had been laid recently.

This is the first record of a nest of *P. ruber* in Tennessee and helps support the claims of others (Pfingston and Downs [eds.] 1989. Salamanders of Ohio. Ohio Biol. Surv. Bull. New Ser. Vol. 7) that oviposition occurs deep in springs (here a cave stream).

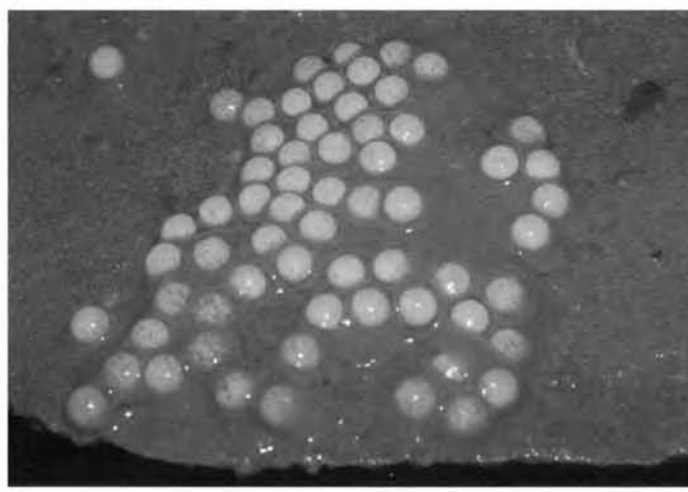

FIG. 1. Eggs of the Red Salamander from Dekalb County, Tennessee.

Submitted by **BRIAN T. MILLER** and **MATTHEW L. NIEMILLER**, Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee 37132, USA; e-mail (BTM): bmiller@mtsu.edu.

ANURA

BUERGERIA JAPONICA (Ryukyu Kajika Frog). **OVIPOSITION BEHAVIOR.** *Buergeria japonica* is a small (25–37 mm), terrestrial rhacophorid that occurs on the Ryukyu Archipelago of Japan and Taiwan. The species ranges from maritime lowlands to montane forests, where it deposits small (1.2–1.4 mm diam) eggs in lentic and lotic waters (Maeda and Matsui 1989. Frogs and Toads of Japan. Bun-ichi Sogo Shuppan, Tokyo, pp. 170–173). *Buergeria japonica* is known to deposit eggs in small clusters, but detailed

reports of the oviposition sequence are lacking. Hence, I describe two oviposition sequences for *B. japonica* from the island of Okinawa, Japan.

Observations were made in a small (1–15 cm deep x 0.7–8.7 m wide) coastal stream in the northern part of Okinawa (26°50'N, 128°17'E, elev. < 1 m) at an area near the sandy beach at its mouth. In this area, limited weedy vegetation exists along the stream; the substrate is largely pebbles, sand, and coral fragments. The study site encompassed an area from the stream mouth to ca. 230 m upstream. The seawater prism usually moves only about 100 m upstream from the mouth at high tide.

All observations were made during moonlit nights on 1 and 13 Sept 2002. At 0319 h on 1 Sept, I encountered an amplectic pair (Pair 1) motionless on the ground ca. 30 cm from the stream edge and ca. 180 m upstream from the stream mouth. The pair remained motionless for several minutes, and began moving at 0330 h. After the pair had made 4 short (< 1 m) moves between the stream and bank, the female backed into the stream and began to lay eggs at 0345 h. While laying eggs, the female pressed eggs against the streambed using her hindlimbs. Egg laying continued for ca. 1 min. At 0346 h, the pair moved to a new spot ca. 20 cm away, and the female again laid eggs. The pair repeated this general movement-oviposition sequence until I lost sight of them (0409 h). However, the female did not deposit eggs every time the pair returned to the stream; sometimes the female stayed motionless for several seconds and then moved to a new spot. I observed 14 distinct bouts of oviposition and 19 movements during my 50 min observation of this pair. During an oviposition bout, 1–6 eggs were deposited in each cluster.

At 0308 h on 13 Sept, I found another amplectic pair (Pair 2) in the stream ca. 190 m upstream from the mouth. Oviposition behavior was similar to that of Pair 1. Until the male left the female at 0408 h, Pair 2 had engaged in 9 bouts of oviposition and 14 movements. The number of eggs in each cluster ranged from 1–6. In the early morning of the day after I observed each pair, I counted the number of eggs within a 1 m^2 area in the vicinity of the oviposition observations. The search area scale reflected the movement scale of each pair, which was well within a unique 1 m^2 area. As I saw no other pairs lay eggs in these areas each night, egg counts are thought to reflect that of each pair. Eggs counted within each 1 m^2 were 38 and 53 for Pairs 1 and 2, respectively.

A closely related species, *B. buergeri*, also lay eggs in several clusters, but the number of eggs in each cluster ranged from 50–80 (Maeda and Matsui, *op. cit.*), and the species is much larger than that of *B. japonica.*

As several abiotic factors such as high salinity (Beebee 1985. Herpetol. J. 1:14–16; Viertel 1999. Amphibia-Reptilia. 20:161–171), desiccation, and occasionally increasing flow might place *B. japonica* eggs at risk in maritime reproductive habitats, partitioning clutches into small clusters of eggs may increase opportunities for offspring survival.

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BUFO CRUCIFER (Striped Toad). **JUVENILE SPATIAL DISTRIBUTION.** *Bufo crucifer* is a neotropical toad with a wide distribution through Missiones, Argentina; northeastern, eastern, and southeastern Brazil; and eastern Paraguay (Frost 2002. Amphibian Species of the World – an online reference, July, 2002. V2.21). Although *B. crucifer* is a common toad in Brazilian flooded habitats, there is little information about its reproductive biology or natural history (Haddad and Bastos 1997. Amphibia-Reptilia 18:295–298; Haddad and Sazima 1992. *In* Morellato org., História Natural da Serra do Japi: Ecologia e Preservação de uma Área Florestal no Sudeste do Brasil, pp. 188–211. Campinas, Editora UNICAMP). Here we present new information on the ecology of this poorly known neotropical toad: the possible influence of physical environment, and body size in the spatial distribution of *B. crucifer* juveniles.

During three consecutive days in September 2002 (dry season) we documented the spatial distribution of *B. crucifer* juveniles (including newly metamorphosed specimens) in a permanent pond (about 1320 m^2) located in a cleared area inside Atlantic rain forest domains (*sensu* Ab'Saber 1977 Geomorfologia 52:1–23) on Reserva Biológica União (22°31'S, 41°56'W), municipality of Casimiro de Abreu, State of Rio de Janeiro, southeastern Brazil. Data were recorded using a belt transect of 0.5 m x 2.0 m (Brower and Zar 1984. Field & Laboratory Methods for General Ecology. Wm. C. Brown Publishers, Iowa. 226 pp.) along 62 sites at the edges of the pond (from water to a distance of 6.0 m from water). We captured all juveniles observed, recorded the distance from water, and habitat features including substrate type (soil moisture: flooded, muddy, moist-firm ground, and dry ground) and vegetative cover (none, scarce, and abundant) of the microhabitat. In each capture juvenile SVL was measured to the nearest 0.1 mm with calipers, recording the individuals with tail remnants. After measurements the juveniles were released at the capture site.

We investigated associations between juvenile capture location

TABLE 1. Median and range value of SVL of *Bufo crucifer* juveniles along a pond shoreline according to distance class, substrate type, and vegetation cover, and Kruskal-Wallis test.

Categories of	Median SVL (N) (mm)	SVL Range (mm)	Kruskal-Wallis test (χ^2; p value)
distance (m) / sampled sites			
0 – 1 / 12	8.0 (N = 228)	6.5 – 9.9	110.11; 0.00001
1 – 2 / 12	8.6 (N = 96)	6.8 – 12.8	
2 – 3 / 12	9.1 (N = 83)	7.6 – 13.0	
3 – 4 / 10	8.6 (N = 68)	7.2 – 12.0	
4 – 5 / 8	(N = 0)		
5 – 6 / 8	14.2 (N = 6)	11.4 – 19.0	
substrate type			
dry ground	9.8 (N = 50)	8.0 – 13.0	107.51; 0.00001
moist-firm ground	8.6 (N = 216)	6.8 – 19.0	
muddy	8.2 (N = 81)	6.8 – 9.9	
flooded	7.9 (N = 134)	6.5 – 9.2	
vegetation cover			
none	8.0 (N = 18)	6.8 – 9.6	17.26; 0.0002
scarce	8.0 (N = 69)	6.8 – 13.0	
abundant	8.4 (N = 394)	6.5 – 19.0	

TABLE 2. Multiple regression parameters explaining the variance in *Bufo crucifer* juvenile SVL. For each predictor variable, the parameters shown are the slope ± standard errors, t-test, and significance level.

Variables	Slope ± s.e.	t (476)	p-level
Distance from water	0.001 ± 0.0005	3.05	0.002
Substrate type	-0.492 ± 0.063	-7.79	< 0.0001
Vegetation cover	0.593 ± 0.099	5.95	< 0.0001

and habitat features with juvenile SVL through non-parametric Spearman correlation coefficient (r_s) (Zar 1984. Biostatistical Analysis. Englewood Cliffs, Prentice-Hall, London. 718 pp.). For each 1 m interval we calculated the median and range of SVL, recognizing six distance classes, and examined differences between classes with a Kruskal-Wallis test. The relationship between physical factors (distance from water, substrate type, and vegetation cover) and juvenile SVL was examined with stepwise multiple regression (Zar 1984, *op.cit.*).

A total of 481 juvenile *B. crucifer* were captured along the transects. Juvenile SVL was positively correlated with distance from water ($r_s = 0.52$; $p < 0.0001$) and vegetation cover ($r_s = 0.24$; $p < 0.0001$), and negatively correlated with substrate type (flooded, muddy, moist-firm, and dry ground, in that order; $r_s = -0.56$; $p < 0.0001$), indicating that the smallest individuals were found in microhabitats with scarce vegetation cover and higher soil moisture. Substrate type was negatively correlated with distance from water ($r_s = -0.78$; $p < 0.001$; N = 511). Median and range values of juvenile SVL for each distance class, substrate type, and vegetation cover are presented in Table 1.

Regarding the relationship between such physical factors and juvenile SVL, the three predictor variables were selected by the forward step-wise model, explaining only 30% of variance in juvenile SVL ($F [3,476] = 62.71$; $p < 0.000001$; N = 480) (Table 2). As the tolerance of each variable in the regression was not small (substrate type = 0.59; vegetation cover = 0.97; distance from water = 0.57), the regression could be evaluated, and the contribution of each variable to the regression analysis was not redundant.

According to Duellman and Trueb (1986. Biology of Amphibians, McGraw-Hill, New York. 670 pp.), movement patterns probably reflect age-specific variation in life history strategies with subsequent differences in ecological requirements. Thus, it is expected that newly metamorphosed juveniles will be found in sites with higher soil moisture and nearer water, as we found in the distribution data. On the other hand, the largest juveniles tended to depart from the water body and search for vegetation cover, which can be associated with capture of prey, protection from solar exposure, or predation avoidance.

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BUFO MARINUS (Cane Toad). **AMPLEXUS DISPLACEMENT.** Studies of sexual selection in anurans are mainly based on the relationship between reproductive success and body size, which could overlook the role of sexual selection on specific body parts (Howard and Kluge 1985. Evolution 39:260–277; Heatwole and Sullivan 1995. Amphibian Biology, Vol. 2, Surrey Beatty & Sons). For example, in *Bufo marinus* (to 230 mm SVL) sexual selection benefits the reproductive success of larger mature males, which have larger forelimbs that allow a strong amplexus (Lee 2001. Copeia 2001:928–935). It has also been proposed that sexual selection might act on reproductively larger males which have larger hind limbs allowing them to defend the amplexus position against unpaired males (Lee and Corrales 2002. J. Herpetol. 36:502–505). Unfortunately, most of the knowledge on the reproductive behavior in *B. marinus* is based on anecdotes or on measurements of preserved specimens (Lee 2001, *op. cit.*; Lee and Corrales 2002, *op. cit.*), thus providing only partial evidence in favor of larger hind limbs in *Bufo* as the result of sexual selection. Here I document details of amplexus displacement in *B. marinus* in the field.

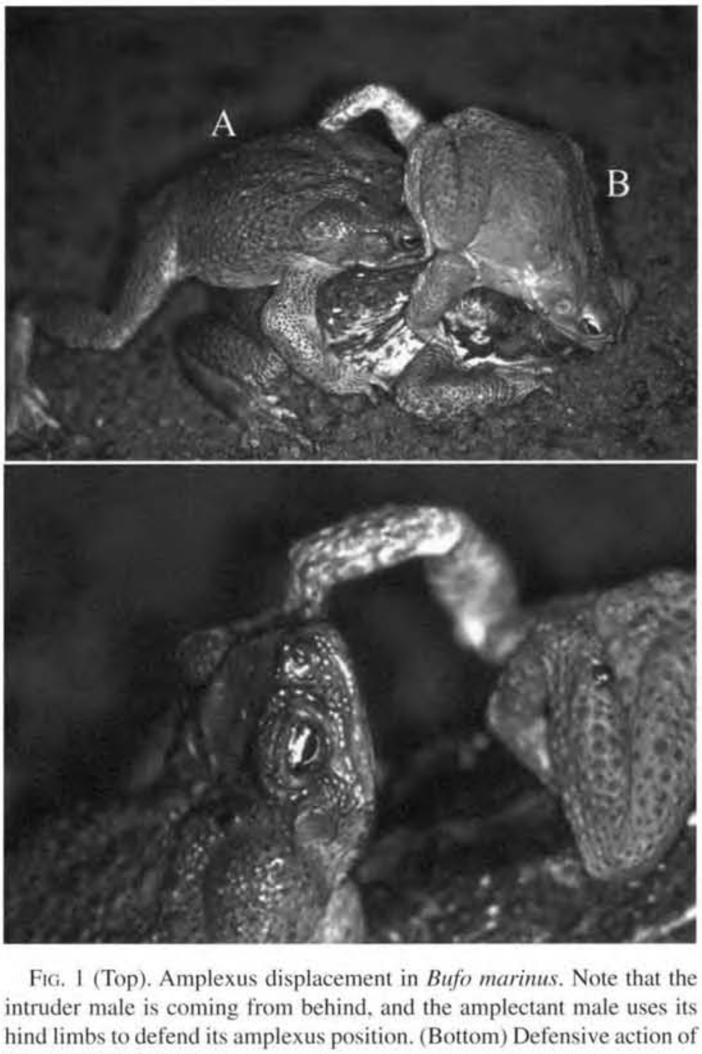

FIG. 1 (Top). Amplexus displacement in *Bufo marinus*. Note that the intruder male is coming from behind, and the amplectant male uses its hind limbs to defend its amplexus position. (Bottom) Defensive action of the amplectant male.

On 27 Aug 2003 at 0345 h, I observed a male (115.5 mm SVL, 48.79 mm hindlimb length [HL], 15.1 mm hindlimb thickness[HT]) attempting amplexus displacement of an amplectant male (105 mm SVL, 41.2 mm HL, 13.31 mm HT) from the dorsum of a female (140 mm SVL) in a semi-permanent pond in Region San Antonio, Quebradillas, northwestern Puerto Rico (18º25.113'N; 66º54.266'W). The intruder male approached the amplectant male from the posterior end and the amplectant male kicked the intruder with its hindlimb and emitted a liberation call. The intruder male ("A" in Fig. 1 top) continued amplexus displacement by pushing its head between the abdomen of the amplectant male ("B" in Fig. 1 top) and the female's dorsum (Fig. 1 top). The intruder male pushed its head forward and embraced the female posterior-laterally with its forelimbs while getting firm support on the ground with its hindlimbs. The amplectant male pushed the intruder male in the head with its hindlimb (Fig. 1 bottom). After a break, the intruder pressed its head firmly against the dorsum of the female. After 56 minutes of fighting and defense, the intruder displaced the smaller amplectant male from the female dorsum. The female was crawling slowly throughout the process of amplexus displacement without hesitation or attempting escape. The last ten minutes of a second successful amplexus displacement was observed that night (intruder male 120 mm SVL, 48.77 mm HL, 16.09 mm HT; amplectant male 106.5 mm SVL, 41 mm HL, 14.25 mm HT; female 113 mm SVL). The pattern of amplexus displacement was similar to the one described here.

These events of amplexus displacement are consistent with the idea of sexual selection resulting in sexual dimorphism of hindlimbs in *B. marinus* (Lee and Corrales 2002, *op. cit.*). It is expected that in other anurans with amplexus displacement, sexual selection might promote sexual dimorphism of morphological traits.

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BUFO OCCIDENTALIS (Pine Toad). **ALTITUDINAL DISTRIBUTION.** This endemic Mexican toad is widely distributed in the Sierra Madre Occidental of Sonora and Chihuahua southward through the Transvolcanic Zone, including the states of Veracruz, Puebla, Tlaxcala, Morelos, and Mexico (Santos-Barrera 1995. Tesis Maestría en Ciencias. UNAM). It has been recorded from 2000 m elevation in Aguascalientes and Jalisco (Chrapliwy 1956. Herpetologica 12:121–124). In spite of being a relatively common species, few natural history data are available.

We collected specimens at 2310 m elev. on the plateau of Cerro Chacatecas, Municipio Zapotitlán Salinas, Puebla. A female (LOL field series 146, SVL 55.5 mm) was found 9 April 2004, at 0530 h within a few meters of a cabin. Another female (LOL field series 157, SVL 41.8 mm) was caught at the same place on 7 May 2004, at 1341 h inside a pit (1.0 x 0.8 m, 40 cm deep). In the same pit a male *Eleutherodactylus nitidus* (LOL field series 155, SVL 30 mm) and a male *Spea multiplicata* (LOL field series 156, SVL 49.2 mm) were found, both very emaciated.

Apparently *Bufo occidentalis* can move long distances, as known for some other species of the genus; Heusser (1968. Rev. Suisse Zool. 75: 927–982) mentioned that *B. bufo* moves and forages up to 3 km from its home refuge. Where the present specimens were found there were no permanent ponds within a radius of several kilometers; the nearest is almost 1 km below the plateau of Cerro Chacatecas, and the intervening topography is very rugged.

The *B. occidentalis* are in the Laboratorio de Ecología, UBIPRO, UNAM as UBIPRO 13846–13847.

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BUFO TERRESTRIS (Southern Toad). **DIET AND SCAVENGING BEHAVIOR.** On the night of 25 Sept 2004, during intermittent rain and moderate wind preceding Hurricane Jeanne, we were photographing juvenile River Frogs (*Rana heckscheri*) as they migrated across a paved campground road from a large pond (Ocean Pond, Osceola National Forest, ca. 4.2 km NNW Olustee, Baker County, Florida, USA). Several of the juvenile *R. heckscheri* had been killed by vehicles, and we noticed a moderately large adult *B. terrestris* sitting on the pavement, focused intently on the flattened carcass of one. Several small ants of undetermined species were feeding on the dead frog, and we presumed the toad to be attempting to feed on the ants. The toad was removed from the pavement to prevent its death in the event that a vehicle came. A few min. later, it had returned to its original position and was again focused on the frog carcass. We turned our attention elsewhere for less than 1 min., and looked back to discover that the toad had swallowed the carcass—probably accidentally as it responded to the movement of the few ants feeding on it. One hind foot of the frog was still visible, protruding from the toad's mouth. After less than 1 min., the toad moved off and out of sight into the roadside grass. Juvenile *R. heckscheri* have been reported to be toxic or distasteful to some predators (Behler and King 1985. The Audubon Society Field Guide to North American Reptiles and Amphibians. Alfred A. Knopf, New York. 743 pp.). We do not know if the toad suffered ill effects or regurgitated the frog later. *Bufo terrestris* is an indiscriminate feeder, but to our knowledge there are few if any reports of scavenging in the species, and no others of its taking *R. heckscheri* as food. Such apparent "accidental scavenging" may be more common than reports indicate among anurans that are relatively indiscriminate feeders.

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ELEUTHERODACTYLUS ALBIPES (NCN). **REPRODUCTION.** *Eleutherodactylus albipes* is only known from the Sierra Maestra of eastern Cuba (Estrada and Ruibal 1999. *In* Crother [Ed.], Caribbean Amphibians and Reptiles, pp. 31–62. Academic Press, San Diego, California; Hedges 1999. *In* Duellman [Ed.], Patterns of Distribution of Amphibians, A Global Perspective, pp. 211–254. Johns Hopkins University Press, Baltimore and London). It inhabits the leaf litter of cloud forests above 800 m (Schwartz and Henderson 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History. Florida Univ. Press, Gainesville, 720 pp.). In this paper we provide the first data on clutch size and parental care in this endemic Cuban frog.

During a herpetological expedition to the Pico Turquino in the Sierra Maestra during June 2003, we found an adult female *Eleutherodactylus albipes* (Fig. 1 [top]; SVL = 31.25 mm) in the bushy forest of the Pico Turquino summit (19°59'20.8"N; 76°50'09,8"W, NAD27 for Cuba, 1974 m). The frog was underneath a stone in a small cavity (70 x 40 mm), with a clutch of 42 eggs (mean 4.3 mm diam). Developmental stage was 11 or 12 of the table developed by Townsend and Stewart (1985. Copeia 1985:423–436) for *E. coqui*. The grayish embryos showed great mobility, conspicuous eyes, and the legs were visible (Fig. 1 bottom). However these results should be considered carefully because *E. albipes* belongs to a different subgenus (*Euhyas*) than *E. coqui* (*Eleutherodactylus*).

Fig. 1. Adult female of *Eleutherodactylus albipes* (top) and her nest with visible embryos (bottom).

When we removed the stone and leaves, the female remained over the nest in a protective posture, which could be evidence of parental care. *Eleutherodactylus albipes* appears to be a "ground nester" and a "good species" according to Townsend (1996. *In* Powell and Henderson [Eds.], Contributions to the West Indian Herpetology: A Tribute to Albert Schwartz, pp. 229–239. SSAR Contributions to Herpetology. Vol. 12, Ithaca, New York). Our find corroborates this characterization, considering that the nest was discovered in a hole in soil under a rock, and the adult female refused to abandon the nest when disturbed.

Juan Llamacho and Alexis (Turquino guide) helped with fieldwork. Photographs were taken by Julio Larramendi. The Spartakus Foundation of Finland and the Instituto de Ecología y Sistemática and the Centro Oriental de Ecosistemas y Biodiversidad (BIOECO) from Cuba, partly funded the field expedition. Special thanks also to the workers of the Turquino National Park for their hospitality and help during the field expedition.

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ELEUTHERODACTYLUS WIGHTMANAE (Coquí Melodioso). **REPRODUCTION.** *Eleutherodactylus wightmanae* is a small frog (22.5 mm SVL maximum for females), found in the interior uplands of Puerto Rico. Females are found on the forest floor and males call from vegetation up to 0.6 m above ground (Joglar 1998. Los Coquíes de Puerto Rico: Su Historia Natural y Conservación,

Fig. 1. *Eleutherodactylus wightmanae* egg clutch inside a folded *Cecropia* leaf.

Editorial de la Universidad de Puerto Rico, San Juan, 232 pp.). Herein we provide the first data on clutch size, egg size, and nesting site of *E. wightmanae*. One clutch found 8 April 2003 in the Carite Forest Reserve in Eastern Puerto Rico contained four eggs and was inside a folded *Cecropia* leaf on the forest floor. An adult *E. wightmanae* was also found inside the leaf, suggesting parental care. A second clutch (Fig. 1) was found on 5 Sept 2004 at Las Casas de la Selva, Patillas close to the Carite Forest Reserve. This clutch contained five eggs (mean 4.39 mm diam; 4.31–4.52; N = 3) and was also inside a folded *Cecropia* leaf on the forest floor. The clutch was deposited in the herpetology collection of the Museo de Biología, Universidad de Puerto Rico–Río Piedras (UPR–RP 6273). No adult was found guarding this clutch but parental care in the form of male attendance has been reported for the species (Townsend 1996. *In* Powell and Henderson [Eds.], Contributions to the West Indian Herpetology: A Tribute to Albert Schwartz, pp. 229–239. SSAR Contributions to Herpetology. Vol. 12, Ithaca, New York).

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HYALINOBATRACHIUM COLYMBIPHYLLUM **(Glass Frog). EGG MASS DEFENSE.** Males of the centrolenid frog *Hyalinobatrachium colymbiphyllum* remain near their aerial egg masses that are laid on vegetation above streams. Protection of nonaquatic eggs and developing embryos from predators is one benefit of this form of parental care (McDiarmid 1978. *In* The Development of Behavior: Comparative and Evolutionary Aspects, pp. 127–147. Garland STPM Press, New York). A number of insect predators of nonaquatic amphibian egg masses have been reported, including dipterans on *Hyperolius* (Vonesh 2000. Copeia 2000:560–566), other centrolenids (Villa 1977. J. Herpetol. 11:317–322; Villa and Townsend 1983. J. Herpetol. 17:49–68), and rhacophorids (Yorke 1983. J. Herpetol. 18:235–241), as well as hymenopterans on *Agalychnis* (Warkentin 2000. Anim. Behav. 60:503–510). Herein we provide a previously unreported account of *H. colymbiphyllum* defending its egg masses from predation by vespid wasps.

At about 0900 h on 25 May 2000, we observed a male *H. colymbiphyllum* defend two egg masses from vespid predation for about 10 min. in the headwaters of the Río Guabal in Parque Nacional Omar Torríjos Herrera, Coclé Province, Panamá. The male was in a sleeping position, with eyes open, on top of a small leaf overhanging the stream, ca. 1.8 m above the water surface. There was an egg mass on the underside of the same leaf, located about midlength of the leaf and slightly to one side of the midvein. A second egg mass was similarly positioned on the underside of another leaf ca. 8 cm above the frog. A third leaf, devoid of egg masses, was situated midway between these two leaves, with all three leaves arranged in a staircase fashion.

While we were observing the male *H. colymbiphyllum*, a black and yellow vespid wasp (*Polybia* sp.) flew within 10 cm of the frog and the two clutches of eggs. When the wasp flew closer to the frog, the frog kicked at the passing wasp twice, using its left hind leg. The wasp landed on the middle leaf within a few centimeters of the upper egg mass and the alert frog. The frog grabbed the wasp in its mouth and immediately released it. A second, similar wasp approached the upper egg mass, and the frog pursued it by walking onto the middle leaf, where it remained until the wasp flew off several seconds later; the frog returned to its original position on the lower leaf. A third wasp landed near the upper egg mass, walked to the underside of the leaf, and began to consume the gelatinous portion of the egg mass while the other wasps flew within 30–40 cm of the frog and egg masses. The frog continued to defend its egg masses while we captured and preserved one of the wasps for identification. We were unable to witness the subsequent interactions between the frog and wasps, but the frog and both egg masses were absent the following morning, suggesting that the wasps were successful in their predation attempts.

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HYLA GRATIOSA **(Barking Treefrog). WINTER RETREAT.** An adult male *Hyla gratiosa* (6.5 cm SUL) was found at 1530 h (EST) on 27 Dec 2003 in a shallow body pit in the soil under a piece of oak bark. The retreat was located in a disturbed oak-pine hammock on the east shore of Putnam Prairie, 1.5 km SE of Putnam Hall, Putnam County, Florida. A second, unused depression of similar dimensions was also found under the same bark ca. 10 cm from the frog's current retreat. The depressions were 60 m upslope from an ephemeral pond that had been used the previous summer by this species for breeding.

Upon discovery, the frog was completely visible in the body pit. Its skin was moist, covered with sand, and dark in color (characteristic spots barely discernible). The frog felt cold to the touch. The eyes were closed, and the front legs were tucked forward under the chin. The body pit measured 6 x 7 cm, with a maximum depth of 4 cm. The frog's body nearly filled the cavity. Soil temperature at 4 cm depth adjacent to the body pit was 13.9°C.

The frog was still visible in its pit at 1330 h on 28 Dec 2003, but disappeared from view by 1410 hrs on 29 Dec, moving into a short burrow that extended laterally from the body pit. Although not visible, the frog could be felt in its burrow with a finger. Soil temperatures at this time had increased to 15.6°C. The frog was checked irregularly 43 times day and night during the 70-day period that it spent in this retreat. During this period, soil temperatures ranged from 8.0–21.4°C, and there were five major rain events associated with cold fronts moving through north Florida. There was no evidence that the frog had left its retreat during its entire

internment. The frog disappeared sometime between 1730 h on 5 March 2004 and 0800 h the next morning. The soil temperature had risen to 22.4°C at the time of its final occupancy. Distant choruses of *Hyla gratiosa* could be heard calling from Tucker Pond on the other side of Putnam Prairie, beginning on March 3. They called each night for the next four days, including the night the frog disappeared. The choruses fell silent when air temperatures fell to near freezing during a late season cold front that moved through north Florida on 8 March. The abandoned burrow measured 7 cm in length and had a maximum depth of 4 cm. The burrow was checked daily for the 20 days following the frog's departure, but the frog failed to return.

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LEPTOPELIS ULUGURUENSIS (NCN). **DIET**. While conducting research in the Uzungwa Scarp Forest Reserve (Kilombero District, Udzungwa Mountains, Tanzania), we collected data on the diet of *Leptopelis uluguruensis*, a treefrog endemic to Usambara, Uluguru, and Udzungwa mountain forests in Tanzania (Schøtz 1999. Trefrogs of Africa. Editions Chimaira, Frankfurt am Main. 350 pp.). Sampling was conducted in closed canopy forest in the Kiwege Valley at ca. 850 m asl (UTM 36L0829714; 9070938) from 22–25 August 2004, during the dry season. In the region there had been no rainfall for at least 10 days before and during the study period. Treefrogs were found by night on vegetation surrounding Kiwege stream up to 2 m above ground. Thirty-nine *Leptopelis uluguruensis* (21 males and 18 females and/or juveniles) were stomach flushed (Fraser 1976. Ecology 57:238–251). Males were identified by the presence of blue color on the throat (Schøtz 1999, *op. cit.*). Treefrogs were considered to have empty stomachs if no prey were obtained after two consecutive stomach flushings. Animals were released at the capture site with the exception of voucher specimens preserved in 70% ethanol and deposited in collections of the Museo Tridentino di Scienze Naturali (Trento, Itlay). Prey items were preserved in 70% ethanol and later identified under a dissecting microscope in the laboratory. Prey was obtained from 6 males and 6 females or juveniles (31% of the sample); the mean number of prey per stomach was 1.3 (Table 1). Plant material was also present and consisted of leaf remains. The high percentage of treefrogs with empty stomachs and the low diversity of prey taxa was probably a consequence of the reduced activity of treefrogs and forest arthropods during the study period.

TABLE 1. Diet of *Leptopelis uluguruensis* from the Kiwege Valley, Uzungwa Scarp Forest, Tanzania.

Items	Males (N = 6)	Females + juveniles (N = 6)	Total sample (N = 12)
ARACHNIDA			
Araneida	1	—	1
INSECTA			
Coleoptera (Dermaptera)	1	—	1
Heteroptera	3	—	3
Lepidoptera (larvae)	1	2	3
Diptera	1	1	2
Unidentified Arthropoda	1	4	5
MISCELLANEOUS			
Plant remains (% of stomach contents)	50	50	50
TOTAL	8	7	15

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MANTIDACTYLUS MAJORI (NCN). **MALE EGG GUARDING.** Among the endemic Malagasy frogs of the family Mantellidae, the genus *Mantidactylus* is characterized by a wide variety of reproductive modes. In all species, as far as known, eggs are initially deposited outside of the water. Few data are available on reproduction of species in the subgenus *Ochthomantis*, except that they live along streams, mainly in rainforest, and have

FIG. 1. Adult male *Mantidactylus majori* guarding a clutch of eggs at Maharira Forest, Ranomafana, Madagascar, 24 January 2004.

specialized tadpoles with reduced keratinized parts of the oral disk (Blommers-Schlösser 1979. Beaufortia 29:1–77). On 24 Jan 2004, ca. 21 h, we observed *Mantidactylus (Ochthomantis) majori* on a clutch of 16 pigmentless eggs ca. 2.5–3 mm in diameter. The clutch was about 150 cm above the water of a small, slow-moving stream (ca. 3 m in width), on a leaf of a tall bush (Fig. 1), at Maharira Forest, 21°19.547'S, 47°24.147'E, ca. 1250 m elev., Ranomafana National Park, Madagascar. Upon capture we verified that the species was an adult male by its distinct femoral glands. Unfortunately it managed to escape and therefore could not be preserved. The finding is remarkable because *Ochthomantis* belong to a clade of stream-dwelling *Mantidactylus* that usually deposit their eggs on the ground, next to water bodies, whereas egg-deposition on leaves overhanging the water is only known from the phylogenetically distant subgenera *Blommersia, Guibemantis,* and *Spinomantis* (Glaw and Vences 1994. A Fieldguide to the Amphibians and Reptiles of Madagascar, 2nd ed. Vences and Glaw, Köln. 480 pp.). Although females of the latter three subgenera are known to remain, after egg deposition, on their clutches for a short time, usually of several minutes to hours, only in a few species of *Mantidactylus (M. argenteus, M. bicalcaratus, M. punctatus)* is male egg guarding known, in some cases at least until late phases of embryonic development and probably until their hatching (Glaw and Vences 1994, *op. cit.*; Lehtinen 2003. J. Herpetol. 37:766–768). Our data for *M. majori* confirm unpublished observations on this species mentioned in Lehtinen (2003, *op. cit.*) and highlight the plasticity of evolution of reproductive modes in the genus *Mantidactylus,* stressing the need for a reliable phylogenetic hypothesis to understand the evolution of life-history traits in mantellids.

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PHRYNOHYAS RESINIFICTRIX (Amazon Milky Frog). **ADVERTISEMENT CALL.** *Phrynohyas resinifictrix* is known to utilize water-filled tree cavities as egg deposition sites. This large tree frog inhabits primary rain forest and old growth secondary forest in Brazil, Colombia, Ecuador, Guiana, and Peru. Water-filled tree cavities serve as ideal sites for ovipositioning and refuge, and as a means by which males can greatly amplify their three to five note bark-like advertisement call. When calling, males often respond to many other sounds by repeating the advertisement call. The advertisement call of *Phrynohyas resinifictrix* (Fig. 1), was recorded on 2 Jan 2000 at 2115 h in old-growth secondary rainforest at the Madre Selva II Biological Reserve in Loreto, Peru (3°37'2"S, 72°14'8"W); when air temperature was 25°C. The location of the specimen was revealed by its advertisement call. During one instance, the specimen ended its advertisement call before it was located. More vocalizations were elicited by imitating the frog's simple three note call. Upon reaching the tree where the frog was hiding, a final series of imitation calls were made. Instead of responding with the typical *BONK-BONK-BONK,* the frog performed

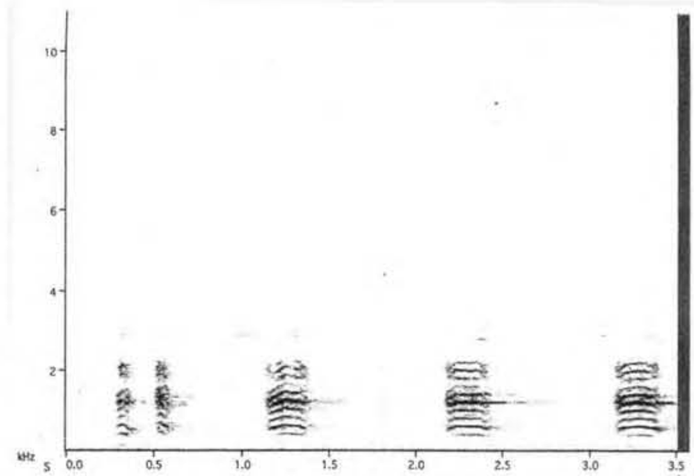

FIG. 1. A spectrographic analysis of an advertisement call from a male *Phrynohyas resinifictrix*. Loreto, Peru. 25°C.

a low pitched, two-note chuckle followed by a lower pitched *whhrrr*. The specimen (42 mm SVL) occupied an ooze-filled, stagnant pool ca. 20 cm deep in the axis of a tree ca. 1.5 m above the ground. Recordings were made in the field using a Marantz ™ PMD 430 magnetic tape recorder and a Radio Shack ™ Dynamic Unidirectional microphone. The call was analyzed using CANARY 1.2.1 (Cornell Bioacoustics station).

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PHRYNOHYAS VENULOSA (Veined Treefrog). **REPRODUCTION**. In Trinidad, choruses of *P. venulosa* have been reported from June to December (Kenney 1969. Studies on the Fauna of Curacao and Other Caribbean Islands 29:1–78) and generally occur after periods of heavy rain (Murphy 1997. Amphibians and Reptiles of Trinidad and Tobago. Krieger Publ. Co. 245 pp.). Here we report early breeding that occurred in late May, at the end of the dry season. On 30 May at 0900 EST, we heard several *P. venulosa* calling from exposed sites at the base and top of a small waterfall that was approximately 0.25 km E of our base camp at Petit Tacaribe on the northern coast of Trinidad (10°47'48"N, 61°12'33"W; elev. 15 m). The waterfall had a small pool of water (ca. 2 m diam, and 2–10 cm deep) at its base that was lined with loose rocks. As we approached, several adult frogs scattered and hid amongst the rocks. In the pool, we discovered thousands of eggs and dozens of tadpoles. We caught and preserved 16 tadpoles and determined their stages of development. The average Gosner stage (GS) of development for these individuals was 27.4 (Gosner 1960. Herpetologica 16:283–190), with tadpoles occurring in developmental stages ranging from GS 26 through GS 29 (GS 26, N = 2; GS 27, N = 7; GS 28, N = 6; GS 29, N = 1). These specimens were deposited into the natural history collection at Mercer University, Macon, Georgia as MU 121.

Our observation indicates the *P. venulosa* has the capacity to initiate breeding outside of the traditional wet season if sufficient water is available. Prior studies of this species indicate that hatch-

ing occurs within 24 h of oviposition at GS 20, with individuals typically requiring 6 weeks to complete metamorphosis (Kenney 1969, *op. cit.*). Thus, the collection of tadpoles at GS 26–29 indicates that breeding at the waterfall had occurred several days prior to our observation.

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PHRYNOHYAS VENULOSA (Veined Treefrog). **PREDATION**. Arthropod predation upon small vertebrates has been observed in a variety of aquatic and terrestrial systems (McCormick and Polis 1982. Biol. Rev. Camb. Philos. Soc. 57:29–58). Although ecological interactions between large spiders and frogs have been empirically investigated (Formanowicz et al. 1981. Herpetologia 37:125–129; Moore and Townsend 1998. Oikos 81:329–336; Rubbo et al. 2003. J. Zool. Lond. 261:1–5), there have been relatively few observations of predation by crustaceans upon amphibians or reptiles (Voris and Jeffries 1995. J. Trop. Ecol. 11:569–576; Maitland 2003. J. Crust. Biol. 23:241–246). On Tobago, predation by amphibious Manicou Crabs, *Eudaniela garmani,* upon three species of small terrestrial snakes has been reported (Maitland 2003, *op. cit.*). On Trinidad, predation by crabs upon two species of frogs, *Hyla minuta* and *Physalaemus pustulosus*, has also been observed (Murphy 1997. Amphibians and Reptiles of Trinidad and Tobago. Krieger Publish. Co. 245 pp.). Here, we describe predation by Manicou Crabs on adult *P. venulosa* in Trinidad.

On 30 May 2003 at 0900 EST, we discovered two adult *P. venulosa* with severe leg injuries and a partially eaten carcass at the base of a small (2 m high) waterfall that was ca. 0.25 km E of Petit Tacaribe on the northern coast of Trinidad (10°47'48"N, 61°12'33"W; elev. 15 m). The waterfall had a relatively slow moving, small stream of water passing through it and a small pool of water (ca 2 m diam x 2–10 cm deep) at its base. The waterfall and the streambed were lined with large, loose rocks.

On our approach to the waterfall, we observed several adult frogs scatter among the rocks. One individual was missing its left rear leg below the femur and was bleeding from the wound, while the left hind foot of another frog was broken and connected to the ankle by a small amount of muscle and skin. Within 1 m of the pool of water, we found a partially eaten frog that was missing the skin and most of the muscle from the hind legs and dorsum. In the crevices between the rocks, we observed several large Manicou Crabs (70–100 mm carapace width). We captured the injured frog (93.03 mm SVL) with the missing leg (USNM 561850).

The injuries of the frogs are consistent with those that can be inflicted by the large chela of adult Manicou Crabs. The condition of the carcass is also consistent with that reported for prey following feeding by Manicou Crabs (Maitland 2003, *op. cit.*). Our observation indicates that large, terrestrial crabs might be important predators of adult amphibians on Trinidad and Tobago as well as other areas where these crustaceans are known to occur (e.g., northern Venezuela).

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PLEURODEMA BUFONINA (Gray Four-eyed Frog) and ***PLEURODEMA THAUL*** (Chile Four-eyed Frog). **OOPHAGY**. Oophagy is a common form of cannibalism in amphibians, most commonly practiced by tadpoles and less often by adults (Crump 1992. *In* Elgar and Crespi [eds.], Cannibalism: Ecology and Evolution Among Diverse Taxa. Oxford Univ. Press). In this note we report the first observation of oophagy in tadpoles of the Patagonian anurans *Pleurodema bufonina* and *P. thaul*. On 15 Nov 2003 during a journey across the Bernal stream (41°06'S 71°10'W), near San Carlos de Bariloche city airport (Rio Negro Province, Argentina) I found several ponds with high densities of *P. bufonina* tadpoles. In these ponds I observed a group of tadpoles feeding on eggs (Gosner Stages 16–18) of the same species. On 28 Dec 2004 between 1400–1800 h, I transferred three segments of a gelatinous string, each containing 50 eggs, into three small ponds (1, 1.2, and 1.6 m^2) with a high density of Gosner Stage 36–39 tadpoles, temperature was 25°C (± 3°, range 20–26°C). I observed the behavior of tadpoles in one pond for four hours. About 10 minutes after I placed the eggs into the pond, tadpoles began to move toward the eggs, and after 30 minutes there were 25 tadpoles feeding on the eggs. After 4 h, 70% of the eggs still survived. Oophagy in *P. bufonina* tadpoles has been observed under natural conditions by Weigandt (pers. comm.), and seems to occur frequently.

On 28 Dec 2004, during surveys in a permanent pond ca. 5 km W of San Carlos de Bariloche city, I observed *P. thaul* tadpoles (Gosner Stages 38–40) feeding on eggs of the same species. The eggs were Gosner Stages 18–20, and some were colonized with fungus.

Pleurodema bufonina and *P. thaul* reproduce from early spring through early summer in temporary and semi-permanent environments, therefore eggs and tadpoles in different developmental stages often share the same pond. Additional observations of oophagy in these species are important to help in the understanding of oophagy as source of mortality and its influence in the choice of oviposition sites.

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RANA BERLANDIERI (Rio Grande Leopard Frog). **SALINITY TOLERANCE**. Few species of amphibians are typically found in marine-influenced habitats (Shoemaker and Nagy 1977. Ann. Rev. Physiol. 39:449–71). With few exceptions (e.g., *Rana sphenocephala* [Bockstanz and Cannatella 2000. http://www.zo.utexas.edu/research/txherps/]), North American ranids are also not recorded in coastal, marine-influenced habitats. Bently and Schmidt-Nielsen (1971. Comp. Biochem. Physiol. A 40:547–48) found that exposure to seawater resulted in death of post-metamorphic *Rana pipiens* (*sensu lato*).

During periodic marine fisheries related surveys, I noted the presence of post-metamorphic *R. berlandieri* at the Port Mansfield State boat ramp, 26°33'24"N, 97°25'44"W, Willacy County, Texas. This site is in the Port Mansfield harbor in the Lower Laguna Madre, a hypersaline lagoon. Frogs were observed (N = 100+) beneath the pier (on land) and beneath bait tanks inside the bait shop. In July, a sample was captured (N = 5), identity confirmed, measured (mean SVL 35 mm, range 30–50 mm), and released. All frogs observed were in this size range and probably represent a single cohort. The frogs were initially noticed on 21 July 2004, noted again 6 August, 21 August, and 1 Sept but were gone by 20 Sept 2004, persisting almost two months. Salinities were measured with a hand-held refractometer (39 o/°° on all dates). Frogs were actively foraging and frequently made excursions into sunlit areas to feed on insects attracted to rotting vegetation (*Halodule* sp.) and fish carcasses. Although frogs were not observed sitting in seawater, they were sitting upon piles of *Halodule* within 0.1 m of the waters edge. Frogs beneath the pier were frequently moistened by wave action and by water sluicing off boats and trailers being pulled out at the ramp. These observations suggest that marine-mediated habitats are not absolute barriers to certain ranid activities and movements through these less than optimal habitats.

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RANA BOYLII (Foothill Yellow-legged Frog). **COLORATION.** *Rana boylii* has been characterized as possessing variable amounts of yellow in the groin and the lower surfaces of the hind limbs (Zweifel 1955. Univ. California Publ. Zool. 54:207–292; Stebbins 2003. A field guide to western reptiles and amphibians. 3rd ed, revised, Houghton Mifflin Co., Boston. 544 pp.). Among western North American *Rana* belonging to the *Rana boylii* group (*sensu* Macey et al. 2001. Mol. Phylog. Evol. 19:131–143), *R. aurora*, *R. draytonii*, *R. luteiventris*, *R. muscosa*, and *R. pretiosa* have been reported to have either orange or red on ventral body surfaces in moderate to high frequencies in some or all of their known populations (Altig and Dumas 1972 [*sic.* 1974]. Cat. Am. Amphib. Rept. 160.1–160.4; Stebbins, *op. cit.*). Zweifel (*op. cit.*) indicated that some individuals of *R. boylii* had some red pigment on the dorsolateral folds, but made no mention of orange or red pigment on lower body surfaces. Hence, we report here on color morphs of *R. boylii* that possess orange or red on lower body surfaces from three localities in California.

One of us (MRJ) made observations on over 1000 postmetamorphic *R. boylii* from Salt Creek on a reach 3–8 km W of Newville (Glenn Co.; 39°47'58"N, 122°33'34"W; elev. 200 m to 39°47'00"N, 122°35'17"W; elev. 265 m) and on Thomes Creek, ca. 1.6 km SW of Paskenta (Tehama Co.; 39°52'22"N, 122°33'30"W; elev. 229 m) between March and November 1981, and we both made observations on 24 individuals from Del Puerto Creek at Frank Raines Regional Park, 25.4 km (by road) W of Interstate 5 (Stanislaus Co.; 37°25'16"N, 121°22'23"W; elev. 332 m).

About 5% of the *R. boylii* from Salt and Thomes Creeks had orange or red pigment on the undersurfaces of the hindlimbs, and all individuals with this coloration were uniformly the largest females. Individuals with orange were at least three times as frequent as those with red, which was of a hue intermediate between brick and scarlet. At Del Puerto Creek, 22 (10 females, 10 males, and 2 subadults; range: 28–47.5 mm SVL) of 24 *R. boylii* possessed a citrus orange color on the medial three-fourths of the lower surfaces of the thighs. The orange varied in intensity from bright to faded, being much more developed in the largest adults, and was clearly distinguishable from the more typical lemon-yellow pigment (*fide* Zweifel, *op. cit.*) on the lateral fourth of the lower surfaces of the thighs, the groin, the calves, and the back of the knees. All except four individuals having orange on their thighs had an orangish tinge on their feet, and five of those individuals also had orange on the edges of the belly or in the axillae.

These observations are significant because increasing numbers of misidentified *R. boylii* have been reported in recent years based solely on visual color observations (MRJ, unpubl. data). Notably, cases of unusually large, orange or red-colored *R. boylii* have been reported to agency personnel as representing the federally-listed *R. draytonii* that were later recanted after visual inspection of photographs taken of these frogs. These observations are also significant beyond simply documenting the variation found in *R. boylii* since possession of orange or red coloration seems to vary ontogenetically. The related *R. aurora* and *R. draytonii* are well known to show a marked yellow to red ontogenetic transition (Stebbins, *op. cit.*). Ontogenetic color transition helped define relationships among some dendrobatid frogs (Myers et al. 1978. Bull. Am. Mus. Nat. Hist. 161:307–366), so it may be useful in assessing the phylogenetic relationship of *R. boylii* within the *R. boylii group*, whose position has been contested on the basis of at least two contrasting hypotheses (Green 1986. Syst. Zool. 35:283–296; Hayes and Krempels 1986. Copeia 1986:927–936; Macey et al., *op. cit.*).

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RANA BOYLII (Foothill Yellow-legged Frog). **PREDATION.** Mallard Ducks (*Anas platyrhynchos*) are known to consume ranid frogs; yet to our knowledge, only three ranid species have been reported as prey: *Rana temporaria* (Mjelstad and Saetersdal 1989. Fauna Norvegica Series C 12:47–48), *R. sylvatica* (Eaton and Eaton 2001. Can. Field-Nat. 115:499–500), and *R. aurora* (Hayes and Rombough 2004. Herpetol. Rev. 35:375–376). Here, we add a fourth ranid species, *Rana boylii*, to the list of *A. platyrhynchos* prey.

We made these observations along the South Santiam River, 10 km E of Sweet Home, Linn County, Oregon (44°40'97"N, 122°56'54"W; elev. 192 m). As described elsewhere (Rombough and Hayes 2004, *op. cit.*), site geology is distinctive. Hard competent tuffs compose a relatively flat bedrock surface within which

seams of softer conglomerates have been eroded into a series of troughs and scour pools. *Rana boylii* occupy the troughs and pools during most of their active season. Observations reported here occurred during oviposition, when adult *R. boylii* are generally more visible than at other times of the year. River width was 100–120 m, and water depth over the flat, about half of which is submerged, averaged 15–20 cm.

During surveys for *R. boylii* egg masses, at 1500 h on 12 June 2003, AMS and CJR observed one *A. platyrhynchos* pair (drake and hen) feeding ca. 70 m away in a bedrock pool. The *A. platyrhynchos* seemed to be probing the pool shallows. As AMS, CJR, and JC approached indirectly over ca. 3 min, the ducks dabbled in the pool, and at least twice appeared to frantically chase prey around the large (30 cm diam) cobbles bordering the pool. Following the second of these chases, the drake was seen to have a prey item in its bill. The drake tilted its head back, attempted to manipulate the prey, then lowered its head behind a rock. At this point, the observers, continuing to approach slowly, were within 50 m, and flushed the hen; the drake subsequently dropped his prey and followed. Minutes later, JC found an injured, adult male (52.5 mm SVL, 15.2 g) *R. boylii* lying upside down in the pool that the *A. platyrhynchos* had vacated. The frog's body was flattened; its head, besides being markedly flattened, had a 3 mm puncture wound located between and just behind the eyes. The head and anterior portion of the frog was covered with small (1–5 mm) lacerations, and the skin and muscle tissue was removed from about half the left forearm (a 10 x 6 mm area). When found, the frog showed faint signs of life (weakly moving its limbs and nictitating membranes); efforts to revive it failed. The frog was preserved and deposited in the herpetology collection at Oregon State University (OSUMNH 11341).

On 22 June 2004 at 0822 h, three *A. platyrhynchos* (two drakes, one hen) were observed foraging intensively in a series of trough pools that held a breeding aggregation of male *R. boylii*. The *A. platyrhynchos* allowed CJR to approach to within 30 m before swimming away. Seven adult male *R. boylii*, all submerged or partially emergent in the shallows at that location, were captured and measured during the hour after the ducks left. Although *A. platyrhynchos* is known to breed downstream, over four years of observation, *A. platyrhynchos* have only been observed in abundance at the site during June (CJR, pers. obs.), coincident with *R. boylii* oviposition.

Mallards are omnivorous, and opportunistically exploit animal food (Nummi 1985. Suomen Riista 32:43–49; Sugden and Driver 1980. J. Wildl. Manage. 44:707–709). Invertebrates represent most animal prey in *A. platyrhynchos* diet, but the comparatively higher digestibility of many vertebrates might account for part of this relative scarcity (see Hayes and Rombough, *op. cit.*); frogs (e.g., *R. temporaria*) are sometimes important as prey (Mjelstad and Saetersdal, *op. cit.*). During some times of the year (e.g., fledging and yolking of eggs), *A. platyrhynchos* are known to seek out higher protein foods (Collias and Collias 1963. Wilson Bull. 75:6–14; Nummi 1993. Can. J. Zool. 71:49–55; Perret 1962. The spring and summer foods of the Common Mallard [*Anas platyrhynchos platyrhynchos* L.] in south central Manitoba. MSc Thesis, University of British Columbia, Vancouver, BC. 82 pp.). In such cases, vertebrates, notably amphibians, might provide an important protein resource.

Animals were handled under a permit from the Oregon Department of Fish and Wildlife.

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RANA CATESBEIANA (American Bullfrog). **DIET**. On 6 Nov 2003, a male *Rana catesbeiana* (177.4 g w/o stomach contents, 12.1 SUL, 15.1 cm girth) was discovered dead, floating in a 250 gallon plastic-lined pond in the northern part of Anderson County, Tennessee. Protruding from the frog's mouth were the rear legs and tail of a mammal. Having seen chipmunks in the area, the discoverer assumed the frog had choked to death on a chipmunk. After freezing it, she donated the frog to the Clinton High School ecology class, which performed a necropsy with the following results.

The mammal was a small, 35.5 g, Grey Squirrel (*Sciurus carolinensis*) with body length of 12.3 cm and tail length 7.7 cm. The squirrel was easily removed from the frog's mouth by simply pulling it out. In the process, the stomach inverted, emptying its contents.

Stomach contents (w/o squirrel) weighed 5.2 g, and included: a millipede (*Alpheloria montana*), two small snails, a sunflower seed, the elytra from two beetles (possibly click beetles), small bits of bark and grass, and the wrapper from a "beef log." Although the cause of death was speculated to be choking on the squirrel, another explanation could be cyanide toxicity from the millipede.

We thank Richard Hoffman of the Virginia Museum of Natural History for identifying the millipede, Dr. Edmund Brodie III for discussions, and Virginia Stooksbury for providing the specimen.

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RANA CLAMITANS (Green Frog) and ***RANA CATESBEIANA*** (American Bullfrog). **REPRODUCTION.** Green Frogs and American Bullfrogs often share the same habitat. Interactions between the two species are common, but studies have focused mainly on the effect of competition and on predatory interactions (Werner et al. 1995. J. Herpetol. 29:600–607; Hecnar and M'Closkey 1997. Am. Midl. Nat. 137[1]:145–150).

Here I report an instance of mating interaction between the two species. In July 2004, I visited a pond at Basket Wildlife Research Area (Boone County, Missouri, USA). A chorus of *R. clamitans* was well established, and I quickly found a pair of ranids in amplexus, which at first I considered to be *R. clamitans*. However, the pair was composed of a male *Rana clamitans* and a female *R.*

FIG. 1. Male *Rana clamitans* in amplexus with a female *R. catesbeiana*, found in central Missouri.

catesbeiana. Although some American Bullfrogs were calling that night, they were greatly outnumbered by *R. clamitans*, and the resulting high competition for conspecific females may have contributed to the mating mistake of the *R. clamitans* male.

Between-species amplexus may incur several costs for both participants. Besides lost feeding opportunity and increased risk for predation there is also the cost of lost reproductive effort. This is especially severe in the case observed above, since crosses between male *Rana clamitans* and female *R. catesbeiana* produce inviable hybrid offspring (Elinson 1981. Dev. Biol. 81[1]:167–176).

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RANA CLAMITANS MELANOTA (Northern Green Frog). **PREDATION**. Crayfish have been known to prey on eggs and larvae of several species of amphibians (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Inst. Press, Washington, D.C. 587 pp.; Axelsson et al. 1997. Amphibia-Reptilia 18:217–228). However, few instances of crayfish preying on adult amphibians exist. Here we report observations of a stream crayfish preying on an adult *R. c. melanota*.

On 18 July 2004 at 1035 h, an adult male *R. c. melanota* (ca. 50 mm TL) was found moving erratically within a mat of aquatic vegetation (ca. 10–20 cm deep) growing in a stream resurgence located at the bottom of a sinkhole entrance to Snail Shell Cave in Rutherford County, Tennessee. Upon further inspection, we observed the frog's left hind leg caught in the left cheliped of a crayfish (*Cambarus* sp. ca. 75 mm TL) that was concealed in the vegetation. The frog repeatedly attempted to free itself by rapidly extending its hindlegs. We observed the interaction for ca. 5 min, when the frog escaped and move ca. 20 cm away from the crayfish. A few seconds later, the crayfish bolted from its position, grasped the frog by its left hind limb once again, and pulled it back towards the vegetation. During the scuffle we noticed that the frog's foot was mangled and nearly half ingested. We observed this interaction for another 5 min before heading into the cave. Research was supported by a grant to BTM from the Tennessee Wildlife Resources Agency (Contract Num. ED-04-01467-00).

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TESTUDINES

ACTINEMYS MARMORATA (Western Pond Turtle). **SIZE**. The largest recorded carapace length for *Actinemys marmorata* is a length of 216 mm (Stebbins 2003. A Field Guide to Western Reptiles and Amphibians, Peterson Field Guide Series; Jennings and Hayes 1994, Amphibian and Reptile Species of Special Concern in California. California Department of Fish and Game, Sacramento). I captured a male with a 223 mm carapace length and a 193 mm plastron length on 20 August 2003 during a population study at Lake Lagunitas, Mount Tamalpais Watershed, Marin County, California. I measured the straight-line carapace and plastron length by using a caliper. The male was basking on a log before being captured. This specimen represents the largest *Actinemys marmorata* yet recorded. This study was conducted under California Fish and Game Scientific Collection Permit no. 801154-05 and was funded by the Marin Municipal Water District..

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APALONE FEROX (Florida Softshell). **PREDATION.** While mainly thought of as piscivores, Bald Eagles (*Haliaeetus leucocephalus*) include reptiles, specifically turtles, and mammals in their diets (Mabie et al. 1995. J. Raptor Res. 29:10–14). Bald Eagles are reported to eat turtles of several species (Clark 1982. J. Field Ornithol. 53:49–51; Mabie et al., *op. cit.*), although the literature is incomplete regarding eagle predation on the family Trionychidae. When trionychid turtles are noted as Bald Eagle prey, the names listed have been limited to group names and genera, with no reference to species (e.g., "soft shell" or "soft shelled" turtles; see Clark, *op. cit.*; Mabie et al., *op. cit.*).

On 16 February 2005 at Lake Nona, Orange County, Florida, I found the shell of an *Apalone ferox* underneath a Bald Eagle nest. The nest was located along the edge of the lake in a wetland in the snag of a large pine tree. The carapace length was ca. 10 cm, but a more accurate measurement was unavailable because of the condition of the shell. The body was decayed, and the carapace had a large gash running across it. The skull of an adult Virginia Opossum (*Didelphis virginiana*) was also found underneath the nest.

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CHELONIA MYDAS (Green Sea Turtle) and ***ERETMOCHELYS IMBRICATA*** (Hawksbill Sea Turtle). **NESTING ACTIVITY**. Two species of marine turtles nest on Guam, Mariana Islands, *Chelonia mydas* and *Eretmochelys imbricata* (Wiles et al. 1995. Micronesica 28:31–49). Marquez (1990. FAO Species Catalog 11.

TABLE 1. Nesting sites, dates, and number of nests/digs of sea turtles on Guam, Mariana Islands. Nesting sites arranged from south (Cocos Island) to north (Tarague). * Includes Uruno and Ritidian areas. Data from 1975–79 and 1983–86 courtesy of Division of Aquatic and Wildlife Resources, Government of Guam. Data from 1990–91 from personal observations (twice monthly, island wide surveys). All sites can be located using USGS (1978. Topographic map of Guam, Mariana Islands, scale 1:50,000. United States Geological Survey, Denver, Colorado).

Location (Nesting Sites)	Year(s)	Months	Observations (N)
Cocos Island	1975–79	?	1
	1983–86	August	1
Sella Bay	1975–79	?	1
	1975–79	June	6
Nomna Bay	1990–91	May	1
Inarajan Bay	1983–86	May	1
Ipan Beach	1975–79	March	3
Togcha Beach	1983–86	May	2
Ylig Bay	1975–79	?	1
	1990–91	May	2
	1990–91	July	1
Tagachan	1983–86	April	1
Tarague Beach*	1975–79	?	3
	1983–86	April	1
	1983–86	May-June	3
	1983–86	June-July	9
	1990–91	May	1
	1990–91	June	2
	1990–91	July	2
	1990–91	August	1

Sea Turtles of the World. 81 pp.) did not specify nesting periods for either *E. imbricata* or *C. mydas* in the Mariana Islands and Wiles et al. (*op. cit.*) did not identify nesting areas on Guam. Historical information on Guam nesting sites is presented in Table 1. Identification to species was not recorded, as nesting or hatching was generally not observed and nests or false nests were usually not excavated. Although Guam has apparently never been systematically surveyed specifically for marine turtle nesting activity, it is clear that nesting, albeit at at low levels, has occurred for at least several decades. Based on the records presented here, nesting for both species occurs between March and August in the southern Mariana Islands.

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EMYDOIDEA BLANDINGII (Blanding's Turtle). **BODY MASS AND SIZE.** We examined body mass and body size parameters of 37 (17 female, 20 male) adult *Emydoidea blandingii* captured in southeastern (Strafford and Rockingham counties) and central New Hampshire (Merrimack and Hillsborough counties) during the active season (May–November) from 2000 to 2002. We note variations between New Hampshire *E. blandingii* and other populations.

We recorded body mass and size at initial capture. We weighed each turtle to the nearest 5 g, and measured maximum straight-line distances for carapace width (CW), carapace length (CL), plastron width (PW), plastron length (PL), and shell height to the nearest 1 mm with calipers. We counted plastral scute rings to estimate age in *E. blandingii* < 20 years of age (Congdon and van Loben Sels 1991. Can. J. Zool. 69:239–245), and determined sex by presence or absence of plastral concavity and distance from the cloacal opening to the carapacial margin (Ernst et al. 1994. Turtles of the United States and Canada, Smithsonian Institution Press, Washington, D.C.). We categorized turtles 16 years as adults based on the following: 1) we observed reproductive activity in one 18 year-old male and four females (16, 17, 18, 19 years), in addition to several turtles ≥ 20 years-old, and 2) physical traits (e.g., plastral concavity) associated with maturation in males were evident in males 16 years of age. Although we captured three juvenile *E. blandingii* (10 years, 158 mm PL; 7 years, 107 mm PL, 8 years, 108 mm PL), we captured no turtles 11 to 15 years of age. We used a Mann-Whitney U test to determine whether our population exhibited evidence of sexual dimorphism.

We detected differences in body measurements between the sexes. Male *E. blandingii* exhibited wider (range: 133–159 mm) and longer (range: 205–240 mm) carapaces than females (CW, range: 122–153 mm, $p < 0.001$; CL, range: 181–199 mm, $p < 0.001$). We did not find significant differences between other morphological parameters, although male *E. blandingii* frequently exhibited heavier body mass (range: 825–1775 g) and wider plastrons (103–126 mm) than females (mass, range: 1050–1900 g, $p = 0.19$; PW, range: 97–123 mm, $p = 0.14$). In addition, female *E. blandingii* frequently exhibited higher shells (range: 73–90 mm) than males (range: 72–90 mm, $p = 0.09$). Plastron length did not differ significantly between the sexes (female, range: 175–227 mm; male, range: 184–226 mm, $p = 0.78$).

We detected sexual shape dimorphism in our New Hampshire populations. Sexual size and shape differences between sexes have been shown in other populations. Females frequently exhibit wider plastrons and higher shells for a given carapace length than males (sexual shape dimorphism) and males often exhibit longer plastrons and heavier body mass than females (sexual size dimorphism; Congdon and van Loben Sels 1991, *op. cit.*; Germano et al. 2000. Chelonian Cons. Biol. 3:611–617; Graham and Doyle 1979. J. Herpetol. 13:125–127; Pappas et al. 2000. Chelonian Cons. Biol. 3:557–568). However, in some *E. blandingii* populations sexual size or sexual shape dimorphism is not evident (Joyal et al. 2000. Chelonian Cons. Biol. 3:580–588; Rowe 1992. Can. J. Zool. 70:1690–1965).

New Hampshire *E. blandingii* body measurements reported here are similar to those from other populations in the eastern portion of its range (Maine: Joyal et al. 2000, *op. cit.*; Massachusetts: Graham and Doyle 1979, *op. cit.*; Nova Scotia, Canada: McMaster and Herman 2000. Chelonian Cons. Biol. 3:602–610), but are generally larger than those from the Midwest and Great Lakes Region (southeastern Michigan: Congdon et al. 1986. Amer. Midl. Nat. 115:165–173; southwestern Michigan: Gibbons 1968. Can. J. Zool. 46:288–290; Ontario, Canada: MacCulloch and Weller 1988. Can. J. Zool. 66:2317–2319). In western Nebraska, where sexual shape dimorphism was most apparent, CL and body mass of females were smaller and males were similar to those of New Hampshire (Germano et al. 2000, *op. cit.*). *Emydoidea blandingii* in north-

western Minnesota were substantially larger than any reported elsewhere (Sajwaj et al. 1998. Final Rept. Non-game Wildlife Office, MN Department NR, Brainerd, MN).

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GOPHERUS POLYPHEMUS (Gopher Tortoise). **JUVENILE USE OF GOPHER TUNNEL.** Mammals occasionally make use of Gopher Tortoise burrows (Frank and Lips 1989. Florida Field Nat. 17:20–22) and in some instances they may be closely associated with the burrows (e.g., Jones and Franz 1990. Florida Field Nat. 18:45–68). However, to our knowledge, only a single record exists of Gopher Tortoises using structures excavated by mammals, the record being a description of an adult Gopher Tortoise nesting in a pocket gopher (*Geomys pinetis*) mound (Epperson and Wendland 1997. Herpetol. Rev. 28:87).

On 2 November 2004 at 1001 h, we visited the burrow of a hatchling tortoise that had emerged from its nest on 5 September 2004 (SLCL = 53.08 mm, SLPL = 53.43 mm, mass = 38.06 g), and fitted with a radio-transmitter and released on 6 September 2004 at the Joseph W. Jones Ecological Research Center in Baker County, Georgia (USA). The hatchling had been tracked to its burrow the previous day at 1420 h and no disturbance had been observed. However, on 2 November, the burrow was found to have fresh dirt filling the entrance and emerging onto the apron. We radio tracked the hatchling to an area ca. 11.6 m straight line distance from its burrow and the signal was coming from below ground. We excavated the area to determine the status of the hatchling and it was located alive, ca. 37 cm below ground in a pocket gopher tunnel. Approximately two minutes after excavation, a pocket gopher began to back-fill the exposed portion of the tunnel. Eight pocket gopher mounds were observed within about 5 m of the location. The habitat surrounding the site consisted primarily of Wiregrass (*Aristida beyrichiana*) with sandy soils, and an open Longleaf Pine (*Pinus palustris*) canopy. From our observations, we conclude that a burrowing pocket gopher intersected the tortoise burrow and the tortoise proceeded along the newly constructed, adjoining pocket gopher tunnel. Over the previous 54 days, this individual had been tracked 26 times and had traveled a total straight line distance of only 10.1 m as compared to this recorded movement of more than 11 m. Juvenile Gopher Tortoises do possess the ability to dig out of occluded burrows (Diemer 1992. J. Herpetol. 26:158–165), so pocket gopher activity would not necessarily lead to increased tortoise mortality.

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KINOSTERNON BAURII (Striped Mud Turtle). **SIZE AND REPRODUCTION.** *Kinosternon baurii* occurs in the floodplain swamp along the lower Apalachicola River in Franklin and Gulf Cos., Florida (Ewert et al. 2004. Herpetol. Rev. 35:80). Two of eight females from the previously reported sample were larger than any documented for any *K. baurii* or *K. subrubrum* (Conant and Collins 1998. A Field Guide to Reptiles & Amphibians, Eastern and Central North America, third ed., expanded. Houghton Mifflin Co., Boston, Massachusetts. 616 pp.). The longest (UF 143962), found 18 August 1991 (max. CL = 138 mm, max PL = 129 mm, CW = 95 mm, non-gravid mass = 398.8 g) contained 7 eggs (RCM = 0.134), and the heaviest, found 7 May 1991 (max CL = 135 mm, max PL = 128 mm, CW = 97 mm, non-gravid mass = 401.0 g) contained 6 eggs (RCM = 0.101). Both females were on land, presumably to nest, near the upstream end of Forbes Island in the Apalachicola River (29.9451°N, 85.0166°W, WGS84/NAD83).

In all, we found seven gravid females, two intact nests, and several eggshells from depredated nests. Mean clutch size was 4.7 eggs (range 3–7, N = 9). Mean egg size was 6.8 (range 4.6–8.1) g and 29.9 (range 25.0–32.3) mm x 18.9 (range 17.0–20.4) mm. One larger viable egg produced in captivity was 8.6 g, 34.5 x 19.4 mm, and two depredated eggshells were ~35 mm long. Five gravid females were nesting or on land during mid-late mornings 7–17 May and 16–18 August, which occurred within brief periods of field work (~12 d April–May, ~5 d August). Thus, nesting could occur from spring into the late summer.

These data suggest that locally, at least, eastern *Kinosternon* more closely approach in body size several species from west of the Mississippi River (review in Iverson 1991. Herpetol. Monogr. 5:1–27) than prior measurements had indicated. Although the sample size is small, *K. baurii* from along the lower Apalachicola River appear to lay larger clutches of larger eggs than do populations in peninsular Florida (Wilson et al. 1999. Copeia 1994:958–968; Meshaka and Blind 2001. Chelon. Cons. Biol. 4:75–80).

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MAUREMYS RIVULATA (Balkan Terrapin). **ENDOPARASITES.** *Mauremys rivulata* is a freshwater turtle that ranges through southeastern Europe, Bulgaria, western Turkey, coastal Syria, Lebanon and Israel (Ernst and Barbour. 1989. Turtles of the World, Smithsonian Institution Press, Washington, D.C. 313 pp). To our knowledge there are no reports of helminths from *M. rivulata*. The purpose of this note is to report two species of Digenea and two species of Nematoda in *M. rivulata* from Turkey.

Sixteen *M. rivulata* (mean carapace length = 17.9 cm ± 3.1 SD, range: 9–24 cm) were collected in 1996, 1999–2003 in Turkey. Eleven were from Görükle (40°15'N, 28°49'E), four were from Kayapa (40°10'N, 28°52'E), one was from Nilufer Çayi (40°16'N, 29°02'E). Terrapins were sacrificed with an overdose of sodium pentobarbital. The esophagus, stomach, small and large intestines were opened and examined for helminths. Digeneans were fixed

in 70% ethanol, stained with iron-carmine and studied as whole mounts. Nematodes were fixed in 70% ethanol, cleared in a drop of glycerol and examined as wet mounts. Voucher terrapins were deposited in the Department of Biology, Uludag University, Bursa, Turkey. Helminths were deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland.

Found in the large intestines were two species of Digenea, *Patagium lazervai* (prevalence: number infected/sample examined x 100 = 6%; mean intensity $\pm$ 1 SD: mean number helminths per infected individual = 14) and *Telorchis stossichi* (prevalence = 88%; mean intensity = 39.6 $\pm$ 66; range = 1–198) and two species of Nematoda in the small intestines, *Falcaustra armenica* (prevalence = 69%; mean intensity = 2.5 $\pm$ 16.4, range = 1–53) and *Serpinema microcephalus* (prevalence = 81%; mean intensity 12.8 $\pm$ 13.8; range = 1–45). Voucher helminths were deposited in the United States National Parasite Collection as: *Patagium lazervai* (USNPC 94734), *Telorchis stossichi* (USNPC 94735), *Falcaustra armenica* (USNPC 94736), *Serpinema microcephalus* (USNPC 94737).

Both *Patagium lazervai* and *Telorchis stossichi* were originally described from *E. orbicularis* collected in Armenia and Europe, respectively, and until now were not known from any other host. *Falcaustra armenica* has been reported from *Emys orbicularis* and *Mauremys caspica* from Macedonia and Russia and *Serpinema microcephalus* has been reported from *E. orbicularis* and *M. caspica* from Europe, Russia and North Africa and the lacertid lizard, *Eremias arguta* from Russia (see Baker 1987. Mem. Univ. Newfoundland, Occas. Pap. Biol. 11:1–325). *Mauremys rivulata* represents a new host record for *Patagonium lazervai, Telorchis stossichi, Falcaustra armenica* and *Serpinema microcephalus*. Turkey is a new locality record for each species.

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PSEUDEMYS GORZUGI (Rio Grande River Cooter). **MAXIMUM SIZE.** On June 5, 2004, while collecting ecological data in the Devil's River, Val Verde County, Texas, we collected a female *P. gorzugi* with a carapace length of 372 mm, a plastron length of 335 mm, and a total weight of 5600 g. The individual was observed on the river bottom and was hand collected. This is the largest specimen of this species ever collected based on published literature (Ward 1984. Special Publications The Museum Texas Tech University. 21:31; Ernst 1990. Cat. Amer. Amph. Rept. [461]:1–2). This animal was marked prior to release by drilling holes in her marginal scutes for permanent identification. This allowed incorporation of this individual within a long-term mark and recapture study being conducted on this species in Texas by MRJ Forstner and JR Dixon. All work conducted is allowed by Texas Parks and Wildlife Department permit number SPR-0102-191 to MRJF.

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TERRAPENE ORNATA (Ornate Box Turtle). **DIET**. On 20 June 2004, we observed a female *Terrapene ornata* eating the skin and entrails of an adult *Bufo cognatus* (Great Plains Toad) killed on the road the previous night. The turtle was located on a gravel road approximately 1/10 of a mile inside the gate at the Mescalero Sands Study Area, Chavez County, New Mexico. *T. ornata* are omnivorous and known to consume carrion (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 578 pp.; Kolbe 1998. Herpetol. Rev. 29:235; Legler 1960. Univ. Kansas Publ. Mus. Nat. Hist. 11[10]:527–669) including remains of venomous snakes (Jensen 1999. Herpetol. Rev 30:95). A captive *T. ornata* was observed eating *Spea multiplicata* tadpoles; however an adult *S. multiplicata* was released after capture, followed by the turtle wiping its mouth with its forepaw (Norris and Zweifel 1950. Nat. Hist. Misc. 58:1–4). In the case reported here, the turtle consumed the remains of an anuran species known to have significant skin toxicity.

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LACERTILIA

AMEIVA AMEIVA (Giant Ameiva). **PREDATION.** The teiid *Ameiva ameiva* is among the most broadly distributed Neotropical lizards, occurring from Panama to south-central Brazil (Vitt and Colli 1994. Can. J. Zool. 72:1986–2008). Available records of predation on *A. ameiva* are by snakes (*Crotalus durissus*: Santos and Germano 1996. Herpetol. Rev. 27:143; and *Oxybelis fulgidus*: Fischer and Gascon 1996. Herpetol. Rev. 27:204). Here we add to the predator set known for *A. ameiva* with a report of predation by the Burrowing Owl, *Athene cunicularia* (Aves: Strigidae) from southeastern Brazil.

At 2100 h (nighttime) on 20 August 2003, we observed an *A. cunicularia* handling a lizard along an unpaved road that crosses an area of pristine "campo sujo" (shrubby grassland) at Itirapina Ecological Station (IES; 22°12'30"S, 47°54'45"W [datum: Corrego Alegre]); elev. 760 m), municipality of Brotas, State of São Paulo. On our approach, the owl flew off, leaving the lizard on the ground. Examination revealed the lizard completely decapitated with a few wounds on the body. It was an adult male *A. ameiva* (estimated at 93 mm SVL; 142 mm tail length). *A. cunicularia* is known to use head attack sometimes involving decapitation on dangerous snakes (see Valdujo and Nogueira 2000. Herpetol. Rev. 31:45; Martins et al. 2001. Herpetol. Rev. 34:147–148).

Considering the reported diurnal habit of *A. ameiva* (Vitt and Colli, *op. cit.*), this predation event is interesting. As *A. ameiva* generally occupies concealed locations in crevices or burrows at night (Vitt and Colli, *op. cit.*), this report suggests that either the lizard was resting at an exposed location or was active at an atypi-

cal time. Regardless of the alternative, this event indicates that *A. ameiva* might sometimes be vulnerable to nocturnal predators such as mammal and birds.

The *A. ameiva* voucher (MZUSP 94110) is deposited in the Museu de Zoologia da Universidade de São Paulo. D. Zanchetta and Instituto Florestal staff facilitated our IES fieldwork. We thank Jivanildo P. Miranda, Cristiano Nogueira, and Marc P. Hayes for lizard identification and/or suggestions on the manuscript. FAPESP (00/12339-2) and CNPq (470621/2003-6) provided funding. This is publication Number 22 of the project Ecology of the Cerrados of Itirapina.

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AMPHISBAENA IBIJARA (NCN). **PREDATION.** Amphisbaenians are secretive, so little is known of their natural history. *Amphisbaena ibijara*, a small amphisbaenian (98–249 mm total length; Rodrigues et al. 2003. Phyllomedusa 2:21–26) endemic to the municipality of Urbano Santos (3°12'28"S, 43°21'12"W [datum: South America 69]; elev. 41 m), State of Maranhão, northeastern Brazil is no exception. To date, the only recorded predator is a coral snake, *Micrurus ibiboboca* (Gomes et al. 2005. Herpetol. Rev. 36:170). Here, we add to the predator list with an observation of predation by the colubrid snake *Apostolepis pymi*.

At 1700 h on 10 March 2004, while excavating in gallery forest habitat, we found an adult *A. pymi* (575 mm SVL, 41 mm tail length; 29 g) that was buried in soil ca. 12 cm deep. The snake was accidentally severed, exposing its stomach containing prey. Dissection of the preserved snake revealed the hindquarters of an adult *A. ibijara*. The amphisbaenian was largely digested, with only a 12.9 mm tail remnant remaining.

Apostolepis pymi is fossorial and known to feed on small snakes and amphisbaenians (Cunha and Nascimento 1978. Publ. Av. Bol. Mus. Para. Emílio Goeldi, Sér. Zool., Belém, 31:1–218), but this report adds a new species to its prey list.

We deposited the snake [IB 72503] in the herpetological collection of the Instituto Butantan in São Paulo, SP. Hebert Ferrarezzi verified the snake's identity.

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ANOLIS CRISTATELLUS WILEYAE (Virgin Islands Crested Anole). **SAUROPHAGY.** *Anolis cristatellus* primarily feeds on invertebrates, but has been recorded feeding on fruit (Lazell and Perry 1997. Herpetol. Rev. 28:150), *Sphaerodactylus* geckos (Schwartz and Henderson 1991. Amphibians and Reptiles of the West Indies. University of Florida Press, Gainesville, 720 pp.) and juvenile conspecifics (GP, unpubl. data). However, predation on lizards is uncommon, and feeding on *Hemidactylus* geckos is unreported. Hence, here we report *A. cristatellus* feeding on *H. mabouia* from the British Virgin Islands.

An adult male *A. cristatellus wileyae* (ca. 70 mm SVL) was observed capturing a juvenile *H. mabouia*, (ca. 25 mm SVL; Fig. 1) at 1000 h on 4 October 2004 on the side of a shed at the H Lavity Stout Community College, Paraquita Bay, Tortola (18°25'24.816N, 64°34'44.287W [datum: WGS84]; elev. < 1 m). When first discovered, the *Hemidactylus* was alive, writhing in the mouth of the *Anolis*. The anole proceeded to struggle with the gecko for the next 4 min, at which point the pair moved out of sight.

This observation expands the reported diet of *A. cristatellus*. *Hemidactylus mabouia* are generally nocturnal, whereas *A. cristatellus* are generally diurnal (but see Perry and Lazell 2000. Herpetol. Rev. 31:247). However, the shed pictured is a nocturnal foraging site for *H. mabouia*, which presumably also use it for shelter during the day, when *A. cristatellus* inhabit the same structure.

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FIG. 1. *Anolis cristatellus wileyae* predation on *Hemidactylus mabouia*, British Virgin Islands. Photograph by Jennifer Owen.

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BAVAYIA CYCLURA (Forest Bavayia). **PREDATION**. Limited data available on the New Caledonian skink, *Lioscincus nigrofasciolatum*, indicates that it preys on cockroaches, other large insects, and smaller skinks (e.g., *Caledoniscincus* sp.; Bauer and Sadlier 2000. The Herpetofauna of New Caledonia, Society for the Study of Amphibians and Reptiles. 310 pp.). Here, we add to the data on its prey base with an observation of predation on the gecko, *Bavayia cyclura*.

We made the observation at 0900 h on 3 December 2002 during a field study on laticaudine sea snakes conducted during November-December on Îlot Porc-Epic (22°19'S, 166°34'E [datum: IGN 72]; elev. 36 m). We captured an adult specimen (estimated at 90 mm SVL) of *L. nigrofasciolatum* on a tree trunk about 6 m from the shoreline, on the edge of the open forest following the beach. It regurgitated a recently dead adult (49 mm SVL) female *Bavayia cyclura*.

The skink was photographed and released; the gecko (MNHN 2002.0763) was deposited in the herpetological collection of the National Museum of Natural History, Paris, France. Handling of the lizards was done under Permit N° 6034-3588/DRN issued to Ivan Ineich by Direction des Ressources Naturelles de la Province Sud, New Caledonia.

Submitted by **IVAN INEICH**, Muséum National d'Histoire Naturelle, Département de Systématique et Evolution, UMS 602 Taxinomie et Collections (Reptiles), Case courrier n° 30, 25 rue Cuvier, F-75005 Paris, France (e-mail : ineich@mnhn.fr); and **XAVIER BONNET**, CEBC-CNRS UPR 1934, Centre d'Etudes Biologiques de Chizé, F-79360 Villiers en Bois, France.

CARLIA MUNDA (NCN). **PREDATION; FIRE RESPONSE**. Few accounts of predation on Australian lizards exist that identify predator and prey to a species level. Moreover, sparse data exist on the response of most Australian reptiles to fire, despite its widespread occurrence and importance in shaping vegetation associations (see reviews in Gill et al. [eds.] 1981. Fire and the Australian Biota. Australian Academy of Science, Canberra. 582 pp.; Jacobs 1984. *In* Cogger and Cameron [eds.], Arid Australia, pp. 131–142. Australian Museum, Sydney; Bowman 2003. *In* Abbot and Burrows [eds.], Fire in Ecosystems of South-west Western Australia, pp. 108–118. Backhuys Publishers, Leiden). Data are notably poor for species inhabiting Porcupine Grass (*Triodia* spp.) hummock grasslands, a structurally distinctive vegetation unique to Australia (Suijdendorp 1981. *In* Gill et al. [eds.], Fire and the Australian Biota. pp. 417–424. Australian Academy of Science, Canberra; Jacobs, *op. cit.*) that frequently dominates reptile habitats in arid zones on sandy and rocky substrates. Hence, here we document a predation event on the lygosomine skink, *Carlia munda*, and its apparent relationship to fire in a *Triodia*-dominated vegetation near the northwest edge of the Great Sandy Desert in Western Australia.

At 1930 h (night) on 21 December 1985, MP observed a freshly road-killed mature Brown Falcon, *Falco berigora berigora*, in close association with two dead but intact *C. munda* on the NW coastal Hwy 6.7 km S of Cane River Crossing (22°04'S, 115°34'E [datum: AUS84]; elev. 30 m). One *Carlia* had only its tail protruding from the falcon's beak; the other was on the road 10 cm from the head of the dead bird; both lizards exhibited no evidence of external injury. A fire, visible from 2–3 km away, was still slowly burning in a northeasterly direction through the scrub and grassland within 10 m of the west side of the road; the burnt area next to the road extended for hundreds of meters. The habitat consisted of *Triodia* hummocks with scattered *Acacia* bushes on a stony plain with low stony ridges. Three additional lizard species were found on the road during a thorough search of the ~100 m along which the fire front moved over the next hour. These comprised: 1 adult *Delma nasuta* (Pygopodidae); 4 adult *Cyclodomorphus melanops melanops* (Scincidae: Lygosominae), of which 1 female later gave birth to 2 live young; and 1 adult *Heteronotia binoeii* (Gekkonidae). These animals were moving from the burning side towards the opposite side of the road; as no other reptiles were seen on the road on either side of the fire-affected stretch, all were probably fleeing the fire. Additionally, one adult *Lophognathus longirostris* (Agamidae) was found active on the ground among the blackened *Acacia* stems remaining next the road. Except for the two *Carlia*, all animals were uninjured.

The falcon probably obtained the *C. munda* from foraging at the margins of the fire. This and other smaller raptor species such as Black Kites, *Milvus migrans*, are well-known attendants of fires by day in the Australian arid zone (e.g., Olsen et al. 1993. Birds of Prey and Ground Birds. The National Photographic Index of Australian Wildlife/Angus and Robertson, Sydney. 200 pp.), occasionally in aggregations of hundreds (pers. obs.), and fire-margin foraging by opportunistic predators is documented in other ecosystems (e.g., Secretary Birds, *Sagittarius serpentarius*, in African veld; Steyn 1982. Birds of Prey of southern Africa. David Philip, Cape Town). Similarity in the condition of both *C. munda* implies that both were prey. This record also implies nocturnal foraging by the typically diurnal *F. b. berigora* might occur where fire provides 'artificial' light; Olsen et al. (*op. cit.*) also report flying and calling at night. Both *D. nasuta* and *C. melanops melanops* are intimately associated with *Triodia*, so our observations suggest that at least some individuals flee burning habitat; whether these individuals would use loose soil or burrow refuges, when available, is unknown. As fires in hummock grassland might be extensive, sometimes lasting for months and passing over hundreds of square kilometers (Suijdendorp, *op. cit.*; pers. obs.), raptor performance as lizard predators on advancing fire lines in such habitats and its effect on post-fire lizard populations might have special interest.

The two *C. munda* were deposited as vouchers in the collection of the Western Australian Museum (R94385-6); the bird was discarded. Brenda Coulson assisted in the field. Marc Hayes critically reviewed the manuscript.

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CHAMAELEO GRACILIS (Graceful Chameleon). **REPRODUCTION IN FLORIDA.** Florida and Hawaii are the two states in the United States with the most severe invasive species problems (U.S. Congress 1993. Harmful Non-indigenous Species in the United States. Office of Technology Assessment, OTA-F-565,

Government Printing Office, Washington, D.C. 155 pp.). Over the last 50 years, increasing numbers of exotic lizard populations have been documented as established in Florida, with the number of non-native species breeding in the state now exceeding the number of native species (Meshaka et al. 2004. The Exotic Amphibians and Reptiles of Florida, Krieger Publishing Company, Malabar, Florida. 155 pp.). Among the many exotic lizard species known to have breeding populations in Florida, only one true chameleon, *Chamaeleo calyptratus*, is recorded as established (http://wld.fwc.state.fl.us/critters/exotics). Hence, we provide here an observation that may indicate that *Chamaeleo gracilis* also is reproducing in Florida.

At ca. 0930 h on 10 December 2004, an adult female *C. gracilis* (ca. 120 mm SVL) was captured walking on the center line of Citrus Blvd. in Palm City (27°02.507'N, 80°22.701'W, [datum: NAD27]; elev. 3 m). This represents the 2nd capture of a *C. gracilis* in this area, and several other sightings have been documented (Harold Parker, pers. comm.). The lizard seemed dehydrated and physically distressed, and was clearly gravid. After treatment by a veterinarian, it laid 22 eggs, about half of which seemed viable. After oviposition, the chameleon remained enlarged with additional eggs, but died before it could lay the remaining eggs. The overall number of eggs (~45) this specimen contained was towards the upper range recorded for the species (Spawls et al. 2002. A Field Guide to the Reptiles of East Africa. Academic Press, London. 543 pp.).

Multiple sightings of *C. gracilis* in the same area that includes a gravid female with viable eggs suggests that natural reproduction of this species might be occurring in Palm City, Florida.

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EGERNIA FORMOSA (Goldfields Crevice-skink). **ENDOPARASITES.** *Egernia formosa* is a medium-sized (adults 80 mm SVL) skink known from the interior of Western Australia (Cogger 1996. Reptile & Amphibians of Australia, 6th ed., Ralph Curtis Publ., Sanibel Island, Florida. 808 pp.). To our knowledge, no previous reports of parasites exist for *E. formosa.* The purpose of this note is to report the cestode *Oochoristica piankai* and the nematode *Pharyngodon hindlei* from *E. formosa.*

We examined 4 *E. formosa* (LACM 56427, 56431–56433; mean SVL = 92 mm ± 8.4 SD, range: 83–101 mm) collected January 1968, 70 km SW Wiluna, Western Australia, (27°05'S, 119°37'E, [datum: AGD66]; elev. 503 m) in the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California. The stomachs had previously been removed; the small and large intestines and body cavity were examined for helminths. Found in the small intestine of one skink (LACM 56432) were 15 *O. piankai* (prevalence: number infected/number examined x 100 = 25%). All 4 skinks contained *P. hindlei* in the large intestines (prevalence = 100%), mean intensity (mean number helminths per infected lizard) = 62.8 ± 25.9 SD, range: 26–82. Parasites were deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland as *Oochoristica piankai* (USNPC 96231) and *Pharyngodon hindlei* (USNPC 96232).

Bursey et al. (1996. J. Helminthol. Soc. Washington 63:215–221) described *Oochoristica piankai* from *Moloch horridus*. Cestodes require two hosts (intermediate and definitive) for completion of their life cycle (Roberts and Janovy 2005. Gerald D. Schmidt & Larry S. Roberts' Foundations of Parasitology, 7th ed., McGraw Hill Higher Education, Boston 702 pp.). The intermediate host of *O. piankai* is unknown; however, Hickman (1963. Pap. Proc. Royal. Soc. Tasmania 97:81–104) reported a tenebrionid beetle served as the intermediate host of *Oochoristica vacuolata. Oochoristica piankai* has previously been reported from *Ctenophorus fordi, C. isolepis, C. reticulatus,* and *Nephrurus laevissimus* (Bursey and Goldberg 1999. Comp. Parasitol. 66:175–179; Goldberg et al. 2000. Comp. Parasitol. 67:108–114). Baylis (1930. Ann. Mag. Nat. Hist. 10:354–366) previously reported *Pharyngodon hindlei* in the skink *Tiliqua scincoides. Pharyngodon hindlei* is a member of the Oxyuroidea all of which have direct life cycles that do not involve an intermediate host (Anderson 2000. Nematode Parasites of Vertebrates. Their Development and Transmission, 2nd ed., CABI Publishing, Oxford, United Kingdom. 650 pp.). Infection likely occurs by exposure to substrate that has been contaminated with feces containing eggs. *Egernia formosa* is the second host recorded for this nematode. *Egernia formosa* represents a new host record for both *O. piankai* and *P. hindlei.*

We thank Christine Thacker (LACM) for permission to examine *E. formosa* and Dustin Goto (Whittier College) for assistance with dissections.

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EGERNIA STRIATA (Elliptical-eye Skink). **ENDOPARASITES.** *Egernia striata* is a medium-sized (100 mm SVL adults) skink widely distributed through the interior of western to southwestern Northern Territory and northwestern South Australia (Cogger 1996. Reptiles & Amphibians of Australia, 6th ed., Ralph Curtis Publ., Sanibel Island, Florida, 808 pp.). To our knowledge, the only parasites previously reported from *E. striata* are the nematodes: *Parapharyngodon kartana, Pharyngodon tiliquae, Wanaristrongylus ctenoti* (Goldberg and Bursey 2000. Trans. Royal Soc. S. Aust. 124:127–133), *Johnpearsonia egerniae* (Durette-Desset et al 1994. Parasite 1:153–160), *Physalopteroides filicauda, Skrjabinoptera goldmanae,* and *Wanaristrongylus papangawurpae* (Jones 1995. Aust. J. Zool. 40:115–126). The purpose of this note is to report the pentastome *Kiricephalus* from *E. striata.*

One pentastome nymph was found in the body cavity of one female *E. striata* (95 mm SVL) from the herpetology collection of the Natural History Museum of Los Angeles County (LACM) collected 4 January 1968, 34 km W. Lorna Glen Homestead (26°14'S, 121°13'E, [datum: AGD66]; elev. 500 m), Western Australia; the *E. striata* was catalogued as LACM 56562. The

pentastome nymph was cleared in cederwood oil and identified as *Kiricephalus* sp.; it was deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland as USNPC 95509.

Nymphs of *Kiricephalus* sp. have been reported from anurans and snakes, but only two species of lizards: *Hemidactylus frenatus*, *Japalura swinhonis* (Bursey and Goldberg 2004. J. Parasitol. 90:1428–1433). Intermediate hosts include insects. After ingestion by a lizard, *Kiricephalus* larvae hatch, whereupon they metamorphose into nymphs that are infective to a final host that preys on the lizard (Roberts and Janovy 2005. Gerald D. Schmidt & Larry S. Roberts' Foundations of Parasitology, 7th ed., McGraw Hill Higher Education, Boston, 702 pp). *E. striata* is a new host record and Australia is a new locality record for *Kiricephalus* sp. We thank Christine Thacker (LACM) for permission to examine *E. striata*.

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FURCIFER OUSTALETI, FURCIFER RHINOCERATUS (NCN). **DENSITY.** Habitat destruction and collection pressure due to herpetocultural popularity threatens many Malagasy chameleons (Jenkins et al. 1999. Oryx 33:37–45). Fieldwork has focused on needed species inventories, but sparse attention has been devoted to estimating population densities, data required to reliably estimate the effects of habitat destruction and direct exploitation on chameleon populations (Jenkins et al., *op. cit.*). In particular, data on the genus *Furcifer* are notably sparse. Hence, we provide density data on *Furcifer oustaleti* and *F. rhinoceratus* from western Madagascar.

Our estimates of density and relative abundance were obtained in a dry deciduous forest habitat during a six-week survey (July-August 1997) on chameleons in Ampijoroa (46°19'E, 16°23'S [datum: WGS72]; elev. ~300 m). A total of 8 km was surveyed that comprised 288 different 30-m transects in two different forest subtypes: low canopy (*lc*) and high canopy (*hc*). We distinguished these categories visually, respectively, as corresponding to a canopy < 12 m versus ≥ 12 m. Transects were run using headlamps starting at dusk until all transects were surveyed; this usually spanned the period 1900–2300 h. Twelve different transects were surveyed each night for 24 nights. Relative abundances were estimated as the total number of individuals of each species seen divided by distance covered. We tested for differences in relative abundance between the forest subtypes using a Mann-Whitney test; each sample night was a data point. Absolute densities were estimated using distance sampling (Buckland et al. 1993. Distance Sampling: Estimating the Abundance of Ecological Populations. Chapman and Hall, London. 446 pp.).

A total of 111 individuals were located. Forty of 53 *F. rhinoceratus* were in high canopy forest; similarly, 50 of 58 *F. oustaleti* were in the same forest subtype. We found no significant difference in species composition between forest subtypes ($\chi^2 = 5.99$, $P = 0.23$), so the species were grouped for further analysis. Relative abundance in high canopy habitat (mean = 1.6 individuals/100 m, $N_{hc} = 17$) was significantly higher than in low canopy habitat (mean = 0.8 individuals/100 m, $N_{lc} = 8$; $P < 0.05$). Densities (confidence intervals in parens) ranged from an average of 5.8 (3.3–10.2) individuals/ha in the low canopy subtype to 13.9 (7.4–26.2) individuals/ha in the high canopy subtype.

Our density estimates are considerably lower than estimates for similar rainforest species obtained using similar methods (~33 individuals/ha; Jenkins et al., *op. cit.*). The ecological basis of underlying differences between the canopy subtypes we examined, and between rainforest and deciduous dry forest habitats are not known, but may be related to abundance of chameleon prey items which are likely to be sensitive to microhabitat conditions.

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FURCIFER OUSTALETI, FURCIFER RHINOCERATUS (NCN). **PREDATION.** About half of all known chameleon species are from Madagascar (Glaw and Vences. 1994. 2nd Edition. Zoologisches Forshunginstitut und Museum Alexander Koenig, Bonn. 480 pp.), and many of these are threatened by habitat destruction (Raxworthy et al. 2003. Nature 426:837–841). Details of their spatial distribution are increasingly well described (Raxworthy et al., *op. cit.*), but almost nothing is known about their role in Malagasy food webs. Hence, we report observations of predation events on two species of *Furcifer* by three different predators, and indirect evidence of predation by a fourth predator. We made all observations in a dry deciduous forest habitat during a six-week survey (July–August 1997) in Ampijoroa (46°19'E, 16°23'S [datum: WGS72]; elev. ~300 m).

On 2 July 1997, we encountered an adult Big-eyed Snake, *Mimophis mahafalensis* (ca. 80 cm total length) along a forest path entwined around an adult male *Furcifer rhinoceratus* (~180 mm total length). Although the chameleon was still alive, it had lost its colouration and was almost completely white. The chameleon ceased struggling ca. 5 min after the initial detection, whereupon the snake began to ingest it headfirst. Complete ingestion of the chameleon was quite rapid and took a little less than 10 min. *M. mahafalensis* is a common, mostly terrestrial opisthoglyphous colubrid common in dry habitats (Glaw and Vences, *op. cit.*; Henkel and Schmidt 2000. Amphibians and Reptiles of Madagascar and the Mascarene, Seychelles, and Comoro Islands, Krieger Publishing Co., Malabar, Florida. 316 pp.), so it may have encountered the chameleon while the latter was crossing the forest path.

On 9 July, soon after its release, we observed a juvenile female

F. rhinoceratus (~80 mm total length) captured by a previously unobserved large adult male *F. oustaleti* (~600 mm total length). The larger chameleon was on a bush about 0.5 m high, and extended its tongue over at least 0.3 m to make the capture. The smaller chameleon's skull was crushed instantly between the predator's jaws. *F. oustaleti* is the largest of all known chameleon species (Glaw and Vences, *op. cit.*; Henkel and Schmidt, *op. cit.*), and this observation substantiates other reports that small vertebrates, as well as the more typical insect fare, are dietary components for this species.

On 12 July 1997, an adult Crested Coua, *Coua cristata,* was observed capturing a female adult *F. oustaleti* (~300 mm total length). The interaction had begun prior to our encountering the chameleon. The chameleon clung to a slender stem ca. 0.5 m off the ground. The *C. cristata* pecked at the chameleon four times, at roughly one minute intervals, hopping backwards between pecks. The chameleon rose in a defensive position to meet each peck with its two forelegs outstretched and its mouth wide open, its tail wrapped around the stem for balance. After being pecked the fourth time, it fell to the ground; the *C. cristata* picked it up in its beak and ran off into the undergrowth. Crested Couas are known to feed by carefully searching dense foliage and inspecting branches (Langrand 1990. Guide to the Birds of Madagascar. Yale University Press, New Haven, Connecticut. 364 pp.); such detailed investigative behavior might explain how it detected the cryptic chameleon.

During July 1997, we found > 17 skulls of *F. oustaleti* beneath the nest of a buzzard, *Buteo brachypterus,* in a large tree. The skulls were clean, not in regurged pellets. *Buteo brachypterus* often sit on observation posts in forests (Langrand, *op. cit.*). This may reflect survey behavior that could contribute to this raptor's apparent success as a chameleon predator despite their crypsis.

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GAMBELIA WISLIZENII **(Leopard Lizard). OPHIOPHAGY.** Predation on vertebrates is well known in leopard lizards (*Gambelia*). Other lizards comprise most vertebrate prey (Pack 1922. Proc. Biol. Soc. Washington 35:1–4, Knowlton and Thomas 1936. Copeia 1936:64–66, McCoy 1967. Amer. Midl. Nat. 77:138–146, Tanner and Krogh 1974. Herpetologica 30:63–72, Pianka and Parker 1976. Herpetologica 32:95–114), but small mammals are also occasionally eaten (Pietruszka et al. 1981. J. Herpetol. 15:249–250). Notably, unlike the closely related *Crotaphtyus collaris*, which are known to eat snakes (Best and Pfaffenberg 1987. Southwest Nat. 32:415–426; Baird 2000. Herpetol. Rev. 31:104), *Gambelia wislizenii* is not recorded as being ophiophagous. Here, we document an instance of *G. wislizenii* having taken a Western Shovel-nosed Snake, *Chionactis occipitalis*.

At ca. 1000 h on the 29 May 2003, we captured an adult male *G. wislizenii* on the Barry M. Goldwater Range (BMGR), Yuma Co., Arizona (32º27'38.5"N, 114º28'48.9"W [datum: WGS84]; elev. 116 m). The animal was first spotted fleeing from under a creosote bush (*Larrea tridentata*) in a dune area before eventually disappearing into a hole ca. 80 m away. We retrieved the exhausted animal from the hole and noticed its stomach was greatly distended. Opening the mouth revealed the tail of a snake protruding from

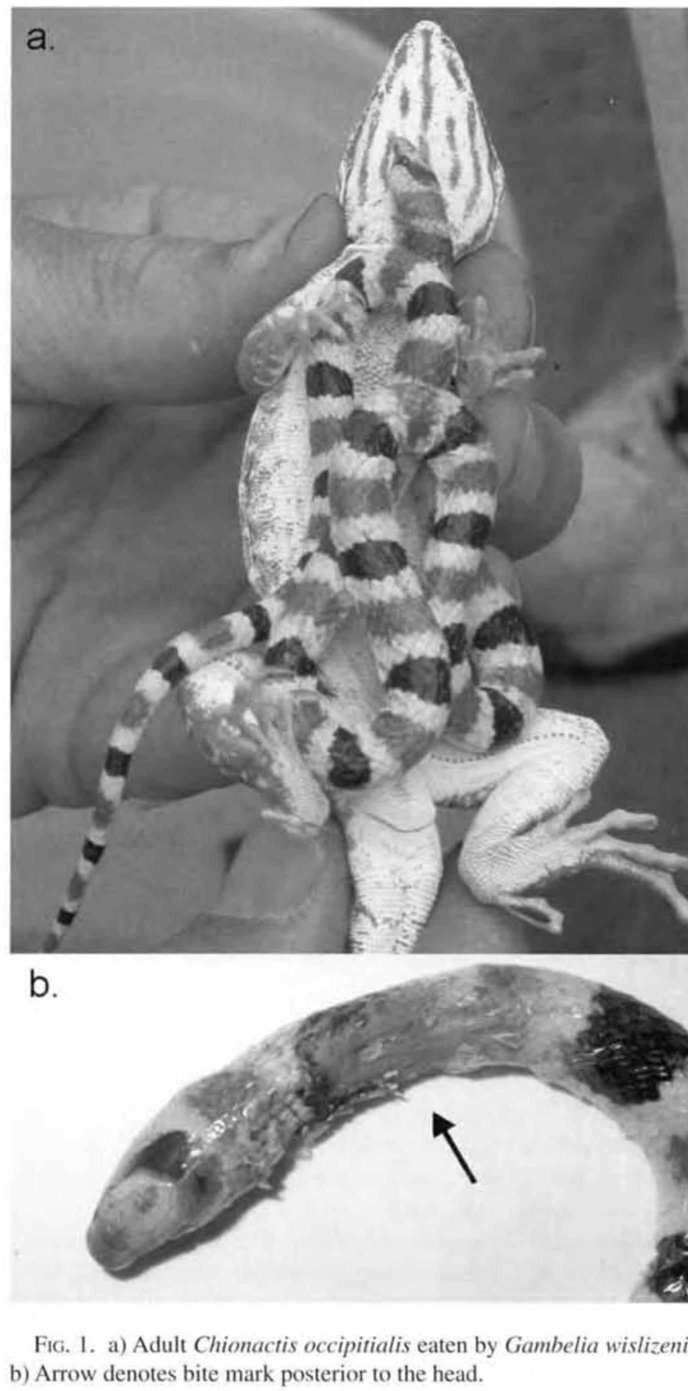

Fig. 1. a) Adult *Chionactis occipitialis* eaten by *Gambelia wislizenii.* b) Arrow denotes bite mark posterior to the head.

the esophagus; removal of the snake revealed that the *G. wislizenii* (103.5 mm SVL, 33.5 g) had eaten a *C. occipitalis* (340.3 mm total length, 7.8 g). Thus, the prey was over 3 times the length and weighed 23% of the body mass of the *G. wislizenii* (Fig. 1a). We found four bite points on the *Chionactis*, all within the first 18 cm of the head. The most substantial of these bites was 5 mm behind the head (Fig. 1b), having torn the skin away, leaving the underlying musculature exposed.

Although *Crotaphytus* is known to immobilize prey by crushing the head, the "torso compression" behavior evidenced here is consistent with that of *Gambelia* feeding on other vertebrates (Lappin 1999. Ph.D. Dissertation, Univ. California, Berkeley; Pietruszka et al. 1981. J. Herpetol. 15:249–250). The predominately fossorial and crepuscular/nocturnal activity of *C. occipitalis* (Brattstrom 1952. Herpetologica 8:61–63) would appear to make it an unlikely prey item for *G. wislizenii*. However, rather extensive diurnal activity has been reported for *C. occipitalis* in this region (Rorabaugh 2002. Sonoran Herpetol. 15:32–33), suggesting it may be more common in the diet of diurnal predators then we would predict from this initial observation.

We thank the Natural Resource Division of the Marine Corps Air Station in Yuma, Arizona for access to the BMGR range and Bryan Morrill for help in the field.

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GAMBELIA WISLIZENII (Long-nosed Leopard Lizard). **ARBOREAL BEHAVIOR**. In the North American southwest, leopard lizards (genus *Gambelia*) are characteristically ground dwelling (Stebbins 2003. A Field Guide to Western Reptiles and Amphibians, 3rd ed., Houghton-Mifflin, New York. 533 pp.; Smith 1946. Handbook of Lizards, Comstock Publishing Co., Ithaca, New York. 557 pp.). In *G. wislizenii,* climbing is not mentioned in several substantive ecological studies of this species (Parker and Pianka 1976. Herpetologica 32:95–114; Tanner and Krogh 1974. Herpetologica 30:63–72), and to our knowledge, only a few records exist of climbing in this species. Clark (1974. Trans. Kansas Acad. Sci. 77:68) observed a *G. wislizenii* perched 30 cm off the ground in a shrub, and Miller and Stebbins (1964. The Lives of Desert Animals in Joshua Tree National Monument. University of California Press, Berkeley. 452 pp.) mentioned collecting an individual on top of a "massive rock 30 feet from the ground." Crowley and Pietruszka (1983. Anim. Behav. 31:1055–1060) commented that this species often climbs into shrubs or onto rocks, but did not provide additional information. For this reason, we augment the limited data on climbing in *G. wislizenii* with an observation from the Mojave Desert of California (USA).

At 0930 h (PST) on 13 September 2003, we observed a juvenile (70 mm SVL, 7.6 g, sex undetermined) *G. wislizenii* perched on the vertical stump of a dead Joshua Tree (*Yucca brevifolia*). The site, 9 km NW of Piñon Hills, Los Angeles County (117°42'W, 34°29'N [datum: WGS84]; elev. 1070 m), is on the edge of the Mojave Desert in Joshua tree woodland and creosote scrub habitat. The lizard was perched 117 cm above the ground in full sunlight and oriented 15–20° from vertical on the 134-cm high stump. Air temperature at time of capture was estimated at 32.0°C (data from Saddleback Butte 22 km to the NW).

Arboreality in other desert lizards is sometimes attributed to thermoregulatory behavior (e.g., Adolph 1990. Ecology 71:315–327), but climbing is probably not an important part of the thermoregulatory repertoire of *G. wislizenii* because this behavior seems infrequent (but see Crowley and Pietruszka, *op. cit.*, for an alternative view). Detailed accounts of thermoregulatory behavior in *G. wislizenii* are lacking, although McCoy (1967. Amer. Midl. Nat. 77:138–146) describes diel activity consistent with the thermoregulatory pattern well known for many desert lizards, seeking shade during the hotter parts of the day and basking in the sun either on the ground or on rocks in the morning and late afternoon. *Gambelia wislizenii* may use arboreal perches to survey for and ambush Side-blotched Lizards (*Uta stansburiana*), a common prey item that is abundant at this site and sometimes is observed to climb Joshua Trees (SCA, pers. obs.).

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GERRHONOTUS PARVUS (Pygmy Alligator Lizard). **MAXIMUM SIZE**. *Gerrhonotus parvus*, an anguid endemic to Nuevo León, Mexico, is known from only three specimens 55.0–71.7 mm SVL in size (Knight and Scudday 1985. Southwest. Nat. 30: 89–94; Banda-Leal et al. 2002. Southwest. Nat. 47:614–615). The largest, an adult female (71.7 mm SVL), was maintained in captivity for five years before being described as the paratype (Knight and Scudday, *op. cit.*). Here, we report on additional individuals of *G. parvus* that increase the known maximum size.

Since the collection of the third known specimen in May 2001 (Banda-Leal et al., *op. cit.*), we have found four additional *G. parvus*. These lizards, all adult males, ranged in size from 65.8 to 76.5 mm SVL. All were found in arid transition woodland characterized by oak (*Quercus* sp.), agaves (*Agave* spp.), sotol (*Dasylirion* sp.), and extensive outcrops of limestone at elevations of 1600–1650 m. The largest of the four, found dead in a canyon bottom near San Isidro, Municipio Santiago, Nuevo León, on 11 October 2004, represents the largest known *E. parva*. It had an unbroken tail 130.0 mm long, and a mass of 8.1 g.

The largest *G. parvus* (UANL 6675) was deposited in the Universidad Autónoma de Nuevo León herpetological collection. Research and collecting were conducted under the authority of SEMARNAT scientific research permits OFICIO NÚM/SGPA/DGVS/01612 and 01454 issued to DL.

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GONOCEPHALUS ABBOTTI (Abbott's Anglehead Lizard). **ENDOPARASITES.** *Gonocephalus abbotti* is known from Malaysia and southern Thailand (Denzer and Manthey 1991. Raffles Bull. Zool. 39:309–322). We know of no reports of endoparasites from this species. The purpose of this note is to report two species of nematodes from *G. abbotti*.

One male *G. abbotti* (175 mm SVL) was collected 11 August 2004 in the Temengor Forest Reserve, Perak State, (05°24'–34'N, 101°33'–39'E [datum: AGD84]; elev. 750 m), West Malaysia. It was deposited in the La Sierra University Herpetological Collection as LSUHC 7035. Two species of nematodes were present in the body cavity and preserved in 10% formalin. The nematodes were cleared in a drop of concentrated glycerol and identified as *Orneoascaris sandoshami* (1 female, 1 male) and *Gonofilaria rudnicki* (2 females, 4 males). The nematodes were deposited in the United States National Parasite Collection, Beltsville, Maryland as: *Orneoascaris sandoshami* (USNPC 95687) and *Gonofilaria rudnicki* (USNPC 95688).

Orneoascaris sandoshami is known only from a captive *Megophrys montana* (Sprent 1985. Ann. Parasit. Hum. Comp. 60:33-55). *Gonofilaria rudnicki* has previously been found in *Gonocephalus borneensis*, *Acanthosaura armata* and *Limnonectes macrodon* from Malaysia (Mullin 1973. Proc. Helm. Soc. Wash. 40:282-285). *Gonocephalus abbotti* represents a new host record for both *O. sandoshami* and *G. rudnicki*.

The *G. abbotti* was collected under authority of permit 40/200/19SJ.1105 issued to LLG by the Environmental Planning Unit of West Malaysia.

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HELODERMA HORRIDUM HORRIDUM (Mexican Beaded Lizard). **UNUSUAL HABITAT**. *Heloderma horridum horridum* is a tropical lizard distributed along the Pacific coastal areas of México (Sonora, Sinaloa, Jalisco, Morelos, Guerrero, Oaxaca, Chiapas) and lowland Guatemala (Bogert and Martin Del Campo, 1956. Bull. Amer. Mus. Nat. Hist. 109:1–238). Here, we report an observation of *H. h. horridum* from a habitat atypical for the species at an elevation higher than all previous records.

At ca. 1800 h on 11 June 2004, OMV encountered an adult (730 mm SVL) *H. h. horridum* walking across a dirt road of 4 m wide in the Reseva Estatal Sierra de Nanchititla, Estado de México, México (18°51'31.4"N, 100°25'34.7"W, datum: NAD27; elev. 1861 m). The habitat consisted of a mixed *Quercus elliptica* and *Pinus oocarpa* forest.

This vegetation association is atypical for this venomous lizard, which is typically found in tropical deciduous forest and thorn scrub forest (Bogert and Martin Del Campo, *op. cit.*). Moreover, the record is 332 m higher than the highest elevation at which *H. h. horridum* has been previously recorded and expands their known distribution 20 km south (Aguilar-Miguel et al. 2003. Herpetol. Rev. 34:384).

A color photographic voucher (CNAR-IBH RF 024) of the *H. h. horridum* was deposited in the herpetological collection of Instituto de Biología, Universidad Nacional Autónoma de México.

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LAMPROPHOLIS DELICATA (Delicate Skink, Rainbow Skink). **INTRODUCTION.** Lord Howe Island, a 1455-ha island ca. 700 km NE of Sydney off the New South Wales coast (31°30'–31°36' S; 159°00'–159°17' E), was listed as a World Heritage Site in 1982 because of its high conservation value (Hutton 1986. Lord Howe Island. Conservation Press, Canberra, Australia. 157 pp.). It has unique biota and landforms, with a very high degree of endemism, including two endemic lizards (Hutton, *op. cit.*). Introduced taxa, which include the Ship Rat, *Rattus rattus*, a problem for the endemic lizards, have been documented on Lord Howe Island (Cogger 1971. Proc. Linn. Soc. New South Wales 96:23–38), but no documentation of introduced lizards existed. Hence, we report the extensive establishment of the eastern Australian skink, *Lampropholis delicata* on Lord Howe Island.

Over the interval 28–30 November 1998, the we undertook a lizard survey of Lord Howe Island in part to determine the validity of recent reports about the presence of *L. delicata*. We observed, captured and identified lizards wherever we saw them in all major habitats on the island. The island, ca. 11 km long and 2.8 km wide at its widest point, is roughly dumbbell-shaped, with two volcanic mountains (Lidgbird and Gower) dominating the south end, and low hills of basaltic origin in the north. Alluvial lowlands occur between these regions, and provide the area of human habitation and most of the adjacent farmland. The habitats that we visited were cultivated urban gardens and associated uncultivated urban vegetation, coastal grassland, beaches, low shrubland on the northern end of the island and closed palm and broad-leaf forest on the south end of the island. We only surveyed half way up the 777-m Mt Lidgbird, and did not visit 875-m Mt Gower. We found *L. delicata* in both urban/semi-urban (Middle Beach Road, adjacent to the Aquatic Club, in front of "Pinetrees" resort) and undisturbed areas (Catalina crash site, track up Malabar Hill) in the hills to the north of the township of Lord Howe Island. Nests of eggs were also located under clumps of soil in the cultivated urban gardens at Pinetrees resort. We did not locate *L. delicata* at the southern mountainous end of the island. On the urban and northern end of Lord Howe Island, *L. delicata* was abundant (10s to 100s per hectare).

Precisely how long *L. delicata* has been established on Lord Howe Island is unknown, but an earlier extensive survey (Cogger, *op. cit.*) did not record it. Thus, *L. delicata* probably has been present on Lord Howe Island for < 30 years. As *L. delicata* has been introduced (presumably in cargo) to both New Zealand (Gill and Whitaker 1996. New Zealand Frogs and Reptiles. Bateman Field Guides, David Bateman Ltd., Auckland, New Zealand. 112 pp.) and the Hawaiian Islands (Baker 1979. Pacific Sci. 33:207–

212), and as its distribution on Lord Howe Island is centered on human-altered areas, it probably also travelled to Lord Howe Island with cargo. *Lampropholis delicata* has the potential to impact the endemic Lord Howe Island skink, "*Cyclodina*" *lichenigerum*, a species that has greatly declined in the face of human occupation of the island (Cogger, *op. cit.*). *Lampropholis delicata* is thought to be out-competing *Lipinia noctua*, and possibly *Emoia cyanura*, in Hawaii (Baker, *op. cit.*), although these species are smaller than *C. lichenigerum*. Elements of the endemic invertebrate fauna on Lord Howe Island (still largely undocumented) might also be at risk; *L. delicata* eats a wide range of invertebrates in Hawaii. On the Hawaiian Islands, *L. delicata* occurs in both open and vegetated habitats, as well as urban areas, and also at high altitude (Baker, *op. cit.*). Hence, we predict that *L. delicata* will eventually inhabit the whole of Lord Howe Island, including Mt Gower and Mt Lidgbird, which are not as high as *L. delicata* occurs in Hawaii (1220 m) (Baker, *op. cit.*). The invasive nature of *L. delicata* means that care should be taken to prevent its spread to adjacent islands.

We collected five vouchers and tissue samples (South Australian Museum R51734-38, plus two neonates hatched from eggs, R52444-45) for future genetic analysis to identify the source of the founder population. This work was conducted under Scientific Investigation License 2434 from the NSW National Parks and Wildlife Service and University of Sydney Animal Care and Ethic Approval L04/9-98/1/2829.

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LEIOCEPHALUS CARINATUS ARMOURI (Northern Curly-tailed Lizard). **CANNIBALISM**. Florida is one of two states in the United States with the most severe invasive species problems (U.S. Congress, 1993. Harmful Non-indigenous Species in the United States. Office of Technology Assessment, OTA-F-565, Government Printing Office, Washington, D.C.). *Leiocephalus carinatus armouri*, one of many species of introduced lizard in Florida, has been rapidly expanding its range (Smith et al., *in press*, International Biodeterioration and Biodegradation; Smith and Engeman 2003. Florida Park Service Technical Report, Hobe Sound, Florida). The few dietary studies on *L. carinatus* indicate that prey is almost entirely comprised of insects (Callahan 1982. Geographical and ecological distribution of the lizard *Leiocephalus carinatus armouri* in South Florida. MA Thesis, University of South Florida, Tampa, Florida.). Meshaka et al. (2004. The Exotic Amphibians and Reptiles of Florida. Krieger Publishing Company, Malabar, Florida. 166 pp.) likewise reported 60 lizards collected from Palm Beach County consumed mostly beetles, roaches, and ants, with 11 other invertebrate taxa also represented. However, Callahan (*op. cit.*) observed Northern Curly-tailed Lizards capture two exotic *Anolis sagrei*, and Schoener et al. (2002. Ecol. Monogr. 72:383–407) showed that experimental introductions of *L. carinatus* to small tropical islands had immediate major negative effects on *A. sagrei* population density. Here we add to range of observations of saurophagy in *L. c. armouri* with an observation of cannibalism from Florida, USA.

On 6 Feb 2004, a mostly sunny day (24–25°C air temperature), CLD observed a basking adult *L. c. armouri* with a smaller lizard in its mouth in the parking lot of Tequesta Shoppes (105-191 US Hwy 1) in Tequesta (25°67.669'N, 080°05.059'W [datum: WGS84]; elev. 5 m). Upon collection of the 93 mm SVL lizard, its prey (already dead when captured) was found to be another *L. c. armouri* 55 mm SVL. Despite the observations of predation on *A. sagrei*, this is the first evidence of cannibalism in *L. carinatus*, a phenomenon that could produce ontogenetic shifts in habitat use.

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LIOLAEMUS PETROPHILUS (NCN). **PREDATION**. Birds are often reported to feed on lizards (e.g., Terres 1991. The Audubon Society Encyclopedia of North American Birds. Wing Books, New York, New York. 1109 pp.; Trejo et al. 2003. Herpetol. Rev. 34:145), but field observations of such predation are infrequent. Hence, we report an observation of a Black-bellied Shrike-tyrant (*Agriornis montana*) preying on a *Liolaemus petrophilus* from southern Argentina.

Our observation was made during a herpetological and ornithological survey of the Somuncura Plateau, Valcheta Department, Rio Negro Province (41°07'41.4"S, 66°49'21.3"W [WGS 84], elev. 800 m) using 8 x 30 binoculars from a distance of ca. 15 m. At ca. 1600 h on 4 January 2002, CHFP observed an adult male Black-bellied Shrike-tyrant attack a subadult (ca. 120 mm total length) *L. petrophilus*. The lizard had been basking for 10 min on a large boulder at the edge of a small rocky canyon when the bird was first observed perched on the top of a small shrub at least 8 m from the lizard. After 2–3 min, the bird attacked and seized the lizard with his bill across the neck and upper thorax. After the bird secured the lizard, it flew to a rock 1–2 m away, where it pecked at the lizard and beat it against the rock. After the lizard appeared immobile, the bird laid the lizard on the rock, observed it for a few seconds before giving it several more pecks, then it seized the lizard across the first third of his body and flew off.

Liolaemus petrophilus is a medium-sized (< 99 mm SVL) diurnal lizard inhabiting rocky outcrops in Patagonian steppe of the Rio Negro and Chubut Provinces, Argentina (Cei 1986. Museo Regionale di Scienze Naturali Torino, Monographie 4:1–528). Nothing is known about its predators. The Black-bellied Shrike-tyrant is an active diurnal predator that is commonly found in high-Andean steppes, pre-puna and mountain grassland in Argentina

(De la Peña. 1988. Guia de Aves Argentinas. Passeriformes IV. Literature of Latin America, Buenos Aires. 114 pp.). This is the first record of predation of *L. petrophilus* by a Black-bellied Shrike-tyrant.

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LIOLAEMUS SANJUANENSIS (NCN). **REPRODUCTION.** *Liolaemus sanjuanensis*, endemic to the Sierra de Pie de Palo in western Argentina, has an ambiguous conservation status as it is listed as a species for which "insufficient knowledge" exists (Lavilla et al. 2000. Categorización de los Anfibios y Reptiles de la República Argentina. Asoc. Herp. Argentina. 97 pp.). Acosta et al. (2004. Herpetol. Rev. 35:171) and Buff et al. (2002 Actas XVI Reunión de Comunicaciones. La Plata, Argentina. 38 pp. [www.fcnym.unlp.edu.ar/xvirch]) recorded observations on body temperature and morphology based on relatively few lizards (N = 31), providing the only published data on the biology of *L. sanjuanensis* biology. Hence, we add the first data addressing reproductive ecology of this species.

We conducted fieldwork in the Sierra de Pie de Palo, Departamento Angaco, Provincia de San Juan (31°22'S, 67°58'W [datum: WGS84]; elev. 2870–2994 m) between 1100 and 1400 h on 8–9 December of 2001. The largely Andean flora is needlegrass (*Stipa*) dominated with patches of the forbs *Fabiana, Baccharis, Adesmia,* and *Senecio* being important (Cei 1980. Hist. Natural. 1:137–140). We obtained data on 31 adult *L. sanjuanensis* captured by revisiting a randomized selection of bushes and low rocks across the study site. Each animal was measured (SVL) and dissected for gonadal/fat body examination. In females, we recorded the number of developing follicles and oviductal eggs, the length of oviductal eggs, and the condition of the oviducts. In males, we recorded the width and length of testes to enable calculation of volume based on Dunham (1983. *In* Huey et al. [eds.], Lizard Ecology, pp. 261–280. Harvard Univ. Press, Cambridge, Massachusetts). Clutch size was determined from the combined number of developing follicles and eggs in the oviducts. All measurements were obtained to the nearest 0.02 mm with Vernier calipers.

Seventeen females ranged in size from 41 to 61 mm SVL; minimum reproductive size was 43 mm, and 86% of the females had fat bodies. Female body size was correlated with clutch size ($r = 0.60$, $P < 0.05$, N = 14). Clutch size averaged 4.5 eggs (SD = 2.87, range: 6–3 eggs, N = 5). The size average of developing follicles was 6.32 mm (SD = 2.24, range: 2.5–8 mm, N = 5), whereas the average length of eggs was 12 mm (SD = 4.6, range: 8–15 mm, N = 5).

Fourteen males ranged in size from 35 to 60 mm SVL, averaging 55 mm SVL. Testicular volume was positively correlated with body size ($r = 0.60$, $P < 0.01$, N = 15), and 56% of the males had fat bodies.

Our data indicate that *L. sanjuanensis* is reproductive in December, although seasonal data are needed to establish the extent of the seasonal interval. Based on the simultaneous presence of developing follicles and oviductal eggs, more than one clutch a year is anticipated. Clutch and egg size data agree with Cei (1986. Reptiles del Centro, Centro-oeste y Sur de la Argentina. Herpetofauna de Zonas Áridas y Semiáridas. Museo Regionale di Scienze Naturali Torino. Monografie IV. 527 pp.), who provided data for one female. The mean clutch size of *L. sanjuanensis* is numerically similar to *L. darwinii* (mean: 4.9, range: 2–8, N = 40) and *L. riojanus* (mean: 4.2, range: 3–6, N = 15) (Blanco et al. 2001. Actas de Resúmenes IV Congreso Argentino de Herpetología, pp. 26–27; Blanco et al. 2003. Actas de Resúmenes XVII Reunión de Comunicaciones Herpetológica, 31 pp.); *L. koslowskyi* (mean: 4.2, range: 3–9, N = 53) (Aun et al. 1993. Cuad. Herpetol. 12:1–9); *L. saxatilis* (mean: 5.6, range: 4–7, N = 47) (Juarez 2002. Estado de Conservación de un Ensamble Herpetológico. Tesis de Licenciatura inédita. Universidad Nacional de Río Cuarto. 63 pp.); and *L. wiegmanni* (mean: 4.6, range: 4–5, N = 19), *L. multimaculatus* (mean: 4.2, range: 3–7, N = 29) and *L. gracilis* (mean: 4.7, range: 4–6, N = 19) (Vega 1999. Ecología de Saurios Arenícolas de las Dunas Costeras Bonaerenses. Tesis doctoral, inédita, Universidad Nacional de Mar del Plata. 102 pp.). Reproductive activity also takes place in December for all these species, suggesting spring–summer oviposition.

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OLIGOSOMA OTAGENSE (Otago Skink). **PREDATION.** *Oligosoma otagense* is one of the largest and rarest lizards in New Zealand (Whitaker and Loh 1995. Otago Skink and Grand Skink Recovery Plan (*Leiolopisma otagense* and *L. grande*). Threatened Species Recovery Plan No. 14, Department of Conservation, Threatened Species Unit, Wellington, New Zealand, 40 pp.) and is now afforded the highest protection status in New Zealand: 'Nationally Critical' (Hitchmough, Department of Conservation, pers. comm.). Along with habitat loss and degradation, predation is one of the greatest threats to these skinks. Predators known to feed on lizards in the Central Otago area include a number of introduced mammals such as feral cats (*Felis catus*), ferrets (*Mustela furo*), stoats (*M. erminea*), weasels (*M. nivalis*), and hedgehogs (*Erinaceus europaeus*) (Baker 1989. Aspects of Mammalian Predator Ecology Co-inhabiting Giant Skink Habitat. MSc Thesis. University of Otago. 97 pp.; Middlemiss 1995. Predation of Lizards by Feral House Cats (*Felis catus*) and Ferrets (*Mustela furo*) in the Tussock Grassland of Otago. MSc Thesis. University of Otago. 120 pp.; Whitaker and Loh, *op. cit.*). Though skink remains have been found in the stomachs of some *M. erminea* (King and Moody 1982. NZ J. Zool. 9:57–80), implicating them as a possible predator of the large *O. otagense*, no direct observations of *M. erminea* attacks on the *O. otagense* in Central Otago have been made until now.

At 1142 h on 22 January 2004, while conducting a telemetry study on *O. otagense* at Macraes Flat (45°27'12.5"S, 170°26' 53.6" E [datum: WGS84]; ca. 600 m elevation), I observed a *M. erminea*

attack on two of my telemetered skinks. The male-female pair of adults (122 mm and 102 mm SVL, respectively) was basking on a rock outcrop when the *M. erminea* bolted from the surrounding tussock ca. 10 m away and lunged for them. The skinks immediately backed into a crack, the nearest refugia on the rock where they were basking, and the *M. erminea* ran off along the streambed without attempting to extract the lizards from the crack. It took ca. 40 min. for the male to emerge and move to a deeper crack. The female waited ca. 60 min. after the attack before emerging to bask. When tracking the pair the following day, they were found to have crossed a stream (ca. 350 mm wide and ca. 150 mm deep) and moved to a rock with a deep crevice which was 21.4 m from the original site of the attack. Based on telemetry data (JMG, unpubl.data), *O. otagense* make average daily movements of 5.96 m and rarely cross water. A large movement such as this and with the two skinks in conjunction was probably induced by the *M. erminea* attack.

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PHELSUMA ORNATA (Ornate Day Gecko). **TAIL LOSS.** *Phelsuma ornata* is a small (max size ~53 mm SVL) member of a largely diurnal genus of brightly colored geckos found in the western Indian Ocean region. Endemic to Mauritius and nearby offshore islands (Vinson and Vinson 1969. Mauritius Inst. Bull. 6:203–320), *P. ornata* is a generalist with a broad diet. It eats insects, pollen, nectar, and fruits (Vinson and Vinson, *op. cit.*; Nyhagen et al. 2001. J. Trop. Ecol. 17:755–761), and adults have been seen eating juvenile *P. ornata* (N. Cole, K. Beer, pers. comm.) and juveniles of introduced house geckos (*Hemidactylus frenatus* and *Gehyra mutilata*) (Vinson and Vinson, *op. cit.*). Often, one finds *P. ornata* with the whole tail or parts of it missing, conditions usually ascribed to conspecific fights or failed predation attempts. During a sampling of the diet of *P. ornata* on Ile Aux Aigrettes, tails of other *P. ornata* were found in 4 of 91 geckos flushed (N. Cole, pers. comm.). Losing the tail generally carries a significant cost (loss of stored nutrients) for lizards, and can have severe consequences (Ballinger and Tinkle 1979. J. Herpetol. 13:374–375) for island-dwellers, where resources often are scarce or unpredictable. Hence, here I report a most unusual case of tail-loss in *P. ornata* from Round Island, a 219-ha volcanic cone rising to 300 m some 22 km N of Mauritius.

At ca. 1000 h on 25 March 2005, I observed a large (ca. 50 mm SVL) male *P. ornata* on the underside of a leaf of a small Bottle-palm (*Hyophorbe lagenicaulis*). The gecko remained still for ca. 5 minutes, upside-down, with its tail flat up against the leaf. Suddenly, the tail went limp, drooping downwards. The gecko reacted immediately to this movement, as they do whenever an insect lands or moves close to them; it twisted back along its right side, grabbed hold of its tail near the base, and ripped it off with one swift move. The tail immediately started twitching violently in the gecko's mouth (Fig. 1). The camera flash, perhaps combined with the movements of the tail, may have caused the gecko to drop the tail. The gecko then quickly disappeared into the dense palm fronds along the trunk's central axis. I picked up the tail, which continued to twitch for about a minute.

FIG. 1. Male *Phelsuma ornata* with its own tail in its mouth.

How the gecko might have handled the tail if undisturbed is unclear. This incident might simply represent a novel, but rare, response to the sudden downward movement of the tail as it became limp, which caused the gecko to view it as live prey. Alternately, self-autotomy might be a regular behavior, the context of which remains to be understood. Only further observations will allow distinguishing between these alternatives.

I thank the Mauritian Wildlife Foundation and the Mauritius National Parks and Conservation Service for permission to join the expedition, and Luke Harmon, Nik Cole, Alfredo Valido, and Marc Hayes for useful suggestions.

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PHYLLOPEZUS POLLICARIS (NCN). **REPRODUCTION.** Little is known about native Brazilian geckos (Colli et al. 2003. J. Herpetol. 37:694–706). *Phyllopezus pollicaris*, a large-bodied saxicolous gekkonid, has a broad geographic distribution in South America in open habitats (Pianka and Vitt 2003. Lizards: Windows to the Evolution of Diversity. University of California Press, Berkeley. 333 pp.). Data on this species are available only from northeastern and southeastern Brazil. Here we provided reproductive data for *P. pollicaris* from western Brazil.

Observations were made during a study conducted from May 2003 to April 2004 near the municipality of Corumbá (19°10'49"S, 57°32'17.2"W [datum: WGS 84]; elev. 117 m), Mato Grosso do Sul state. Terrestrial bromeliads and patches of dry forest on a rocky substrate characterize the area. We took substrate temperature data randomly from both bromeliads (N = 169) and surrounding rocks (N = 169) once monthly in each hour between 0600 and

1800 h. We compared temperatures between bromeliads and rocks with a standard t-test and the variance in temperatures between the two habitats with an F-test. Means presented appear ± SD.

We captured one gravid female (70.9 mm SVL) in 28 May 2003 with two eggs (mean length: 13.8 mm; mean width: 10.2 mm) and one well-developed follicle (length: 6.0 mm; width: 4.6 mm). The female was found under a terrestrial bromeliad (*Deuterochomia* sp.). We observed a juvenile on 26 February 2004 under a fallen log. We also found a nest in a terrestrial bromeliad on 13 April 2004 with 6 eggs (mean length: 14.8 ± 0.2 mm; mean width: 11.1 ± 0.3 mm; mean volume; 953 ± 53 mm^3). The nest was positioned under a dead bromeliad on a shallow and dry soil. Temperatures in bromeliads averaged lower (mean = 31.4 ± 4.73°C) and had a narrower range (18-43.4°C) than temperatures from surrounding rocks (mean = 37.2 ± 7.9°C; t-test: 18.4, df = 168, $P < 0.0001$; range = 19–58°C; F test: 2.788, $P < 0.0001$). Four of the eggs were hatched and two were intact. Intact eggs are taken to the laboratory for incubation and after fungal attack were opened to verify species identification.

Our data imply that terrestrial bromeliads might have microhabitats thermally better suited to incubation than rocks. Our observations also indicate that *P. pollicaris* in western Brazil appear to have a clutch size of two and communal nesting similar to *P. pollicaris* from northeastern (Vitt 1992. *In* Hamlett [ed.], Reproductive Biology of South American Vertebrates, pp. 135–149. Springer-Verlag, USA) and southeastern Brazil (Righi et al. 2004. Herpetol. Rev. 35:395–396).

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SCELOPORUS GRAMMICUS (Mesquite Lizard). **CANNIBALISM.** Cannibalism is well known among lizards (Luiselli et al. 1999. J. Zool. 247:127–131; Kohlsdorf et al. 2004. Herpetol. Rev. 35:398; Perez Z. 2005. Herpetol. Rev. 36:63), often as a response to space limitation and group social structure (Kohlsdorf et al., *op. cit.*). However, this behavior is unreported in *Sceloporus grammicus*, a sceloporine widespread in north-central Mexico (Sites et al. 1992. Bull. Am. Mus. Nat. Hist. [213]:1–95). Hence, we provide an observation of cannibalism in *S. grammicus* from the state of Hidalgo, Mexico.

At 1430 h on 22 April 2005 (sunny, 28°C air temperature), while studying lizard populations in an oak-pine and juniper association at La Estanzuela (20°10'N, 98°45'W [datum: WGS84]; elev. 2700 m), we observed an adult female (48 mm SVL, 2.65 g) *S. grammicus* eating a conspecific neonate (22.3 mm SVL, 0.31 g). The neonate was basking on a rock near the female when the female noticed it, and made a sudden rush grabbing the neonate by the midbody. The female then maneuvered the neonate so it could swallow it head first and consumed it over the next 3 min. We collected the adult lizard after it had eaten, and sacrificed it to examine its gut contents. Twenty-five minutes after ingestion, the neonate was intact.

Both specimens (EST-ABR-3-2005, EST-ABR-3.1-2005) are deposited in the Centro de Investigaciones Biológicas (CIB), Universidad Autónoma del Estado de Hidalgo. We acknowledge support for our research on lizard populations from SEP-PROMEP-1103.5/03/1130, Programa Institucional de Investigación (PII) of the Universidad Autónoma del Estado de Hidalgo, UAE-DIP-ICBI-AAB-020, and thank Marc P. Hayes for his comments.

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THECADACTYLUS RAPICAUDA (Turnip-tail Gecko). **DIET**. *Thecadactylus rapicauda*, a relatively large (95–126 mm SVL) nocturnal gekkonid, occurs in a variety of habitats in Central America, South America, and the West Indies (Savage 2002. Amphibians and Reptiles of Costa Rica, Univ. Chicago Press. 934 pp.). Its diet comprises a wide range of invertebrates (Beebe 1944. Zoologica 29:145–160; Duellman 1978. Misc. Publ. Mus. Nat. Hist. Univ. Kansas 65:1–352; Vitt and Zani 1997. Herpetologica 53:165–179), and, rarely, lizards (*Sphaerodactylus*, Beebe, *op. cit.*; *Anolis*, Malhotra and Thorpe 1999. Reptiles and Amphibians of the Eastern Caribbean, Macmillan Educ. Ltd., London). Here, we augment the prey range of *T. rapicauda* with a report of predation on a leptodactylid frog, *Eleutherodactylus johnstonei* from Grenada.

At 1907 h on 15 February 2005, we encountered an adult (ca. 85 mm SVL) *T. rapicauda* eating an adult (ca. 20 mm) *E. johnstonei* in an area of mixed orchard trees and native forest at Pearls, St. Andrew Parish, Grenada (12°08.879'N, 61°36.765'W [NAD27 (Caribbean)]; elev. 5 m). The lizard was 2.0 m above the ground, oriented head down on a vertical branch of a tree of undetermined species. The frog was being ingested posterior-first. *Eleutherodactylus johnstonei* is common at Pearls (Germano et al. 2003. Carib. J. Sci. 39:68–76; pers. observ.) and we observed additional individuals in the tree where the predation episode occurred. To our knowledge, this is the first record of *T. rapicauda* consuming an anuran.

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SERPENTES

AGKISTRODON PISCIVORUS LEUCOSTOMA (Western Cottonmouth). **MORPHOLOGY**. Congenital tail loss has been reported in several species of pit-viper, particularly rattlesnakes (e.g. Klauber 1972. Rattlesnakes. Their Habits, Life Histories, and Influence on Mankind. Univ. California Press, Berkeley, California.

740 pp.; Holycross 2000. Herpetol. Rev. 31:177–178; Christman et al. 2004. Herpetol. Rev. 35:62). On 9 August 2004 I collected a male *Agkistrodon piscivorus leucostoma* (570 mm SVL, 65 mm tail length; 23 subcaudal scutes) at the Old Sabine Bottom Wildlife Management Area, ca. 5 km NE of Lindale, Texas, USA. Gloyd and Conant (1990. Snakes of the *Agkistrodon* Complex. Society for the Study of Amphibians and Reptiles, Oxford, Ohio. 614 pp.) report that male *A. p. leucostoma* have 38–53 (mean = 44.3) subcaudal scutes. Tail length and the number of subcaudal scutes suggests that this snake's tail was about half of typical length. I measured 37 *A. p. leucostoma* (males = 16; females = 21) at this site from November 2002 to August 2004 and this was the only individual with a tail abnormality. There was no evidence of scarring or injury, suggesting this abnormally short tail might be a congenital defect.

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AGKISTRODON PISCIVORUS LEUCOSTOMA (Western Cottonmouth). **REPRODUCTION**. The reproductive ecology of *Agkistrodon piscivorus* is well documented. The smallest gravid female previously reported was 455 mm SVL (Burkett 1966. Univ. Kansas Publ. Mus. Nat. Hist. 17:435–491). In northeast Texas, gravid females average 579 mm SVL with the smallest being 540 mm SVL (Ford 2002. *In* Schuett et al. [eds.], Biology of the Vipers, pp. 167–177. Eagle Mountain Publ., Eagle Mountain, Utah). Litter size averages five offspring and neonates average 207 ± 8.9 mm SVL and 14.9 ± 2.49 g mass (Ford 2002, *op. cit.*). Here, we report reproductive data for a short female *A. piscivorus leucostoma* from northeast Texas.

On 15 August 2004 we collected a gravid female (490 mm SVL) from Old Sabine Bottom Wildlife Management Area, Smith County, Texas, USA. On 29 August she gave birth to four offspring, one of which did not emerge from its embryonic sac. The stillborn weighed 10.5 g and measured 19.7 SVL, and 23.6 TL. The three surviving offspring averaged 206.7 ± 12.6 mm SVL (range 195–220 mm), 246.7 ± 14.4 mm TL (236–263 mm), and 10.9 ± 1.2 g mass (9.5–11.7 g). The post parturition mass of the female was 121 g therefore the relative clutch mass was 35.7%. Although the female's mass after parturition was much less than the previously reported mean for *A. piscivorus* in northeast Texas (213 ± 19.6 g), clutch size is comparable with other females from the region. This observation agrees well with Ford et al. (2004. Southwest. Nat. 49:465–471) who found no correlation between female SVL and clutch size in this species. This small female's low post-partum mass but normal clutch and offspring size suggests she contributed a larger percentage of her energy intake to her clutch than would a larger female.

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AMPHIESMA MIYAJIMAE (Taiwanese Keelback). **REPRODUCTION**. *Amphiesma miyajimae* is a rare, oviparous natricine snake, endemic to mountainous areas below 1000 m in Taipei County, northern Taiwan (Maki. 1931. A Monograph of the Snakes of Japan. Daiichi Shobo Publish, Tokyo, Japan. 51 pp.). On 17 July 1996 we found an *A. miyajimae* (Dept. of Natural Resources, National Ilan University; NIU-NR-021004; 428 mm SVL) dead in a roadside ditch in Sze-Leng, Tao-Yuan County at 720 m elev. The specimen was gravid and contained three completely developed eggs ranging in length from 29.6 to 33.0 mm (mean = 31.0 ± 1.8 mm SD) and in width from 9.8 to 10.4 mm (10.2 ± 0.3 mm). Maki (op. cit.) reported that the eggs of this species are very long and thin (42 x 11 mm, longer than the eggs described herein), but did not report the clutch size or the maternal SVL. Based on the stage of development of the eggs, we presume that oviposition probably would have taken place in late July or early August.

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ANILIUS SCYTALE (False Coralsnake). **REPRODUCTION.** *Anilius scytale*, the only species in the Aniliidae, is restricted to northern South America. Adults range up to 1184 mm total length (TL) and females are reproductively mature at 350 mm TL (Dixon and Soini 1986. The Reptiles of the Upper Amazon Basin, Iquitos Region, Peru. Milwaukee Public Museum, Milwaukee. 154 pp.). Little information on ecology or life history of this species has been published, despite its broad distribution.

On 05 December 2003 we collected an adult female (762 mm TL, 149.28 g, young not included in her weight) dead on the road ca. 30 km N of Manaus on Highway AM-010 in Amazonas state, Brazil. She was found with 20 live young surrounding her corpse. Upon dissection, four additional young, one of them malformed, were found inside the female. The 24 neonates averaged 182.8 ± 0.72 (SD) mm TL (range = 165.8–195.1) and averaged 1.65 ± 0.32 (SD) g (range = 1.11–2.38) in weight. The combined mass of the neonates was 39.56 g.

Neonatal total lengths reported here are within the range of previously reported observations (Martins and Oliveira 1998. Herpetol. Nat. Hist. 6:78–150; Cunha and Nascimento 1981. Boletim do Museu Paraense Emílio Goeldi 109:1–20). However, clutch size reported here is considerably larger than previously published records (range 4–15; Cunha and Nascimento *op. cit.*; Dixon and Soini, *op. cit.*; Martins and Oliveira, *op. cit.*). Interestingly, this female is ca. 15% shorter than a snake (927 mm TL, 181 g) that gave birth to 15 young (Martins and Oliveira, *op. cit.*), although relative clutch mass was lower in our snake (27%) as compared to the other (29%), and the young in the clutch of 15 were also larger (206–234 mm; Martins and Oliveira, *op.cit.*). The largest reported gravid female (1184 mm TL) contained only 6 embryos (Dixon and Soini *op. cit.*). The female and her young are deposited in the collection of Amphibians and Reptiles of the Instituto Nacional de Pesquisa da Amazônia (INPA-H 11364-11388).

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BOA CONSTRICTOR CONSTRICTOR (Boa Constrictor) and ***BOTHROPS JARARACA*** (Jararaca). **DIET**. During a radiotelemetric study of Grey Four-eyed Opossum (*Philander frenata*) and Bare-tailed Woolly Opossum (*Caluromys philander*) in an Atlantic Forest fragmented landscape in southern Poço das Antas Biological Reserve (22°34'S, 42°15'W), Brazil, we observed predation by *Boa constrictor constrictor* and *Bothrops jararaca*. Additional information on these habitats is provided in Viveiros de Castro and Fernandez (2004. Biol. Conserv. 119:73–80). Two of seven radio-collared *P. frenata* were eaten by *B. c. constrictor*. On 27 November 2001 we located one of our male *P. frenata* (335 g) inside a *B. c. constrictor* (ca. 7 kg and ca. 2.5 m TL). On 19 December 2002 we located a second male *P. frenata* (515 g) inside a second, smaller *B. c. constrictor*. One of four radio-collared *C. philander* was eaten by *B. jararaca*. On 4 June 2003 we located a female *C. philander* (ca. 185 g) inside a *B. jararaca*, at a location where this opossum had already been located, probably foraging. The radiotransmitter was found two months later in the feces of the snake ca. 6 m away from the place where the pitviper had been seen last. Radio-telemetry probably did not increase the risk of being preyed upon by these snakes, because both *B. c. constrictor* and *B. jararaca* are principally ambush hunters (Hartmann et al. 2003. Phyllomedusa 2:35–41; Martins et al. 2002. *In* Schuett et al. [eds.], Biology of the Vipers, pp. 307–328. Eagle Mountain Publ., Eagle Mountain, Utah) and we postulate that radio-collars might even reduce opossum activity and probability of predation. The high frequency of predation we observed on radio-collared opossums suggests that snake predation might be an important source of mortality in these populations. Yet, to the best of our knowledge, these are the first records of *B. c. constrictor* predation on *P. frenata* and of *B. jararaca* predation on *C. philander*.

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BOTHROPS ATROX (Common Lancehead). **DIET**. *Bothrops atrox* has a broad and ontogenetically variable diet that includes centipedes, fishes, frogs, lizards, snakes, birds, and small mammals (*see* Martins and Oliveira 1998. Herpetol. Nat. Hist. 6:78–150, and citations therein). On 30 March 2003 at 0930 h we captured a juvenile *B. atrox* (281 mm SVL, 12 g after prey removal) in a pasture near Cacoal (11°26'S, 61°26'W), Rondônia, Brazil. Upon dissection, we found a *Leptodactylus fuscus* (Leptodactylidae; 55 mm SVL, 7 g) that had been ingested head-first in the snake's stomach. This is the first report of *L. fuscus* in the diet of *B. atrox*. The snake was deposited in the herpetological collection of Faculdade de Ciências Biomédicas de Cacoal (FACIMED 036).

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CONTIA TENUIS (Sharp-tailed Snake). **REPRODUCTION**. The reproductive biology of *Contia tenuis* is poorly known. Two reports suggest that eggs are laid in summer and hatch in fall (Brodie et al. 1969. Herpetologica 25:223–227; Cook 1960. Herpetologica 16:163–173). However, to the best of our knowledge, copulation has not been observed in the wild or captivity. At 1241 h on 6 March 2005, we found two *C. tenuis* copulating under a wooden board near a meadow/forest ecotone in Briones Valley (37°55'31"N, 122°10'00"W), Contra Costa County, California, USA. The day was unseasonably warm (19.4°C). When disturbed from their location near the board's edge, the pair attempted to flee, but remained connected via the male's intromitted hemipenis. The snakes were not captured or photographed, but we estimate that each was ca. 170–200 mm total length.

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CROTALUS HORRIDUS (Timber Rattlesnake). **BEHAVIOR.** Although many rattlesnake species probably drink beads of dew or raindrops from their skin, there have been few published observations of rattlesnakes altering their body posture to facilitate water collection in the wild (Ashton and Johnson 1998. Herpetol. Rev. 29:170; Bogert 1927. Nature Mag. 10:297–299; Greene 1997. Snakes: The Evolution of Mystery in Nature. Univ. of Calif. Press, Berkeley. 351 pp.; Schwenk and Greene 1987. J. Herpetol. 21:134–139). On 05 May 2001 we watched a radio-tagged male *C. horridus* drink water from the margins of its tightened coils during a heavy downpour in bottomland forest in western St. Louis County, Missouri, USA. This rattlesnake was observed in a looser coiled position several minutes earlier. The behavior we witnessed is similar to the rain collecting behavior described for the Great Basin Rattlesnake, *Crotalus oreganus lutosus* (Aird and Aird 1990. Bull. Chicago Herpetol. Soc. 25:217); however, we did not witness coiling in anticipation of the approaching storm.

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DRYMARCHON CORAIS MELANURUS (Indigo Snake). **DIET**. *Drymarchon corais* is a highly polyphagous colubrid (Greene 1997. Snakes: The Evolution of Mystery in Nature. Univ. California Press, Berkeley. 351 pp.) with a wide geographic distribution and eight currently recognized subspecies (McCranie 1980. Cat. Amer. Amph. Rept. 267.1). Of these, *Drymarchon c. melanurus* appears to occupy the broadest range of habitats, ranging from humid rainforest habitats in Yucatan, México through both mesic and xeric areas of Central American and the coasts of Colombia. Although diet probably varies considerably over this broad distribution, information relating locality and dietary information is largely lacking. On 6 December 1998, a dead female *D. c. melanurus* (MHUA 14076, 1100 mm TL) was found on a roadway in the Guajira desert in northern Colombia (11°0'46"N, 72°42'18"W, ca. 160 m elev.) with an adult *Mastigodryas pleei* (Colubridae, MHUA 14077, 900 mm TL) in its digestive tract. It was unclear from these circumstances whether ingestion of the *M. pleei* comprised an incidence of predation or scavenging. Nevertheless, this observation documents sympatry of these taxa in this region and demonstrates that *D. corais* are capable of ingesting snakes of almost the same size. Specimens were deposited in the Museum of Herpetology of the Universidad de Antioquia (Medellín, Colombia).

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ERPETON TENTACULATUM (Tentacled Snake). **REPRODUCTION.** Twinning has been reported in a variety of reptiles (Hartdegen 1999. Herpetol. Rev. 30:141). Among the squamates, crocodilians, and chelonians, twinning has been reported only in oviparous species with the exception of Hubert (1985 *In* Gans and Billett [eds.], Biology of the Reptilia Vol. 15, pp. 28–29, John Wiley & Sons, New York) who reported experimentally derived twins in *Lacerta vivipara*. Twinning is easily documented in oviparous species because the number of hatchlings outnumbers the eggs hatched. On 12 May 2003 a female *Erpeton tentaculatum* held in captivity (Oklahoma City Zoo) gave birth to eight neonates, including two stillborn twins. The twins were still connected to a single yolk sac by their individual umbilici (OMNH 41670 and 41671) and are possibly monozygotic. To the best of our knowledge, this is the first documentation of a non-induced twinning event in a live-bearing reptile.

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HETERODON PLATIRHINOS (Eastern Hog-nosed Snake). **REPRODUCTION**. On 08 February 2005 at ca. 1430 h we observed two *Heterodon platirhinos* copulating (tails intertwined) in a manner analogous to previously reported mating behavior (e.g., Plummer and Mills 1996. J. Herpetol. 30:80–82). Copulation was visibly confirmed when the female began to drag the male and the male's everted hemipenis was withdrawn from the female. The snakes were observed in a 65-year-old, frequently burned, slash pine (*Pinus elliottii* var. *elliotti*) plantation in Baker County, Georgia, USA. High temperature on this date was ca. 24°C. To our knowledge, the earliest previously reported dates of copulation for *H. platirhinos* in the wild are 19 March (Plummer and Mills, *op. cit.*) and 28 March (Guidry 1953. Herpetologica 9:49–56).

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LAMPROPELTIS TRIANGULUM AMAURA (Lousiana Milksnake). **SIZE RECORD**. On 20 July 2004 at 2040 h one of us (TAS) collected a male *Lampropeltis triangulum amaura* DOR on Osburn Road, 0.3 km south of Farm Road 1375 (30°31'29"N, 95°40'55"W, 77 m elev.), Montgomery County, Texas. This specimen (TCWC 88217) measured 901 mm TL (809 mm SVL + 92 mm tail length). The longest *Lampropeltis triangulum amaura* reported prior to this measured 787 mm TL (Boundy 1995. Bull. Chicago Herpetol. Soc. 30:109–122). We thank J. R. Dixon for verifying the subspecific identification.

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LIOPHIS LINEATUS (NCN). **REPRODUCTION.** Relatively few data are available concerning the natural history Colombian snakes, especially those that inhabit remote areas. On 11 December 1998, I encountered a female *Liophis lineatus* (MHUA 14075, 708 mm TL) on the Guajira peninsula on the Atlantic coast of Colombia that contained six eggs. I measured three of these eggs and they averaged 29.4 mm in length. The snake was found in a shallow pit near riparian forest (11°0'46"N, 72°42'18"W, ca. 160 m elev.) that also contained several *Bufo marinus*. The Guajira desert receives only ca. 900 mm of rainfall annually, with most falling from April to November, and has a pronounced dry season extending from December to March. This observation suggests that reproduction in *L. lineatus* in this area might be timed such that hatching coincides with the onset of the rainy season. The specimen is deposited in the Museum of Herpetology of the Universidad de Antioquia (Medellín, Colombia).

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MICRURUS DECORATUS (Decorated Coralsnake). **DIET.** *Micrurus decoratus* is found in high elevation remnants of endangered Atlantic Forest in the Serra do Mar and the Serra da

Mantiqueira in Brazil. Although little is known of the natural history of this secretive species, Marques (2002. Amphibia-Reptilia 23:228–232) reports 5 prey items (3 *Siphonops* sp. and 2 *Amphisbaena* sp.) from 24 specimens he examined. We examined the stomach contents of 109 museum specimens of *M. decoratus* from São Paulo, Rio de Janeiro, Minas Gerais, and Paraná, Brazil housed in the following collections: Instituto Butantan, São Paulo (IB: 88 specimens), Instituto Vital Brasil, Rio de Janeiro (IVB: 7 specimens), Museu de História Natural Capão da Imbuia, Curitiba (MHNCI: 1 specimen), Museu de Zoologia da Universidade de São Paulo (MZUSP: 7 specimens), and Museu Nacional do Rio de Janeiro (MNRJ: 6 specimens). Three prey items were identified. Two *Siphonops* sp. were in advanced stages of digestion and could not be specifically identified, although we were able to determine that one of these was consumed head-first and the other tail-first. A single *Amphisbaena dubia* (280 mm) was consumed tail-first by a 674 mm SVL *M. decoratus*. These observations offer further evidence that *M. decoratus* feeds primarily on amphisbaenids and caecilians. Carolina Castro-Mello identified the amphisbaenids.

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OXYRHOPUS RHOMBIFER SEPTENTRIONALIS (False Coral Snake). **DIET**. *Oxyrhopus rhombifer* is a terrestrial and primarily nocturnal colubrid (tribe Pseudoboini) that occurs in open habitats in South America. Four subspecies are recognized, *O. r. inaequifasciatus*, *O. r. bachmanni*, *O. r. rhombifer*, and *O. r. septentrionalis* (Peters and Orejas-Miranda 1986. Catalogue of the Neotropical Squamata. Part I – Snakes, 2nd ed. Smithsonian Inst. Press, Washington. 174 pp.). Limited data suggest that *O. r. inaequifasciatus*, *O. r. bachmanni*, and *O. r. rhombifer* primarily consume lizards and small mammals (Maschio et al. 2004. Herpetol. Rev. 35:71, and citations therein). However, there is no published information regarding the diet of *O. r. septentrionalis*.

During an investigation of the natural history of a snake community in Cerrado vegetation of Brasília, Distrito Federal, Brazil (15°35'S, 47°50'W), we identified the gut contents of 40 preserved *O. r. septentrionalis* in the Coleção Herpetológica da Universidade de Brasília (CHUNB). Prey remains were removed from both the stomach and hindgut, all snakes and intact prey were measured and weighed, and prey/predator mass ratio (MR) was calculated when possible. Twenty-two *O. r. septentrionalis* (55%) did not contain prey remains and one (2.5%) contained completely unidentifiable prey remains. Identifiable prey remains were found in 17 snakes (42.5%) and included lizards (N = 15; 88.2%) and small mammals (N = 2; 11.8%). A diverse assemblage of lizards was represented, including six tropidurids, four gymnophtalmids, three teiids, a polychrotid, and a scincid. Two nearly intact *Tropidurus itambere* (34 mm SVL, 3.5 g; 44 mm SVL, 3.5 g) and two *Tropidurus* sp. (40 mm SVL, 2.5 g; 34 mm SVL, 2.5 g) were discovered in snakes measuring 230 mm SVL (8 g, MR = 0.44), 248 mm SVL (8 g, MR = 0.44), 231 mm SVL (7 g, MR = 0.36), and 255 mm SVL (9 g, MR = 0.28), respectively. Two additional snakes contained the scales of tropidurid lizards that could not be further identified. Two *Micrablepharus atticolus* (both 33 mm SVL, 1 g) were discovered in a 169 mm SVL (4 g; MR = 0.25 each) snake. One *Cercosaura ocellata* (30 mm SVL; 1 g) and one *Colobosaura modesta* (40 mm SVL; 3 g) were eaten by snakes measuring 187 mm SVL (4 g; MR = 0.25), and 200 mm SVL (5g; MR = 0.6), respectively. Three *Ameiva ameiva* (102 mm SVL, 28 g; 106 mm SVL, 38 g; 114 mm SVL, 35 g) were found in the stomachs of snakes measuring 526 mm SVL (45 g, MR = 0.62), 566 mm SVL (53 g, MR = 0.71), and 609 mm SVL (100 g, MR = 0.35), respectively. An *Anolis meridionalis* (no data measure) and a *Mabuya nigropunctata* (80 mm SVL; 12 g) were eaten by snakes measuring 380 mm SVL (24 g) and 557 mm SVL (62 g, MR = 0.19), respectively. A young *Calomys tener* (Rodentia, Sigmodontinae, 60 mm, 5 g) and an unidentified rodent were found in stomachs of snakes measuring 335 mm SVL (14 g, MR = 0.36) and 340 mm SVL (24 g). All prey were ingested headfirst. Linear regression showed a positive correlation between prey SVL and predator SVL ($r^2 = 0.979$; $F_{1,9} = 414.4$; $P = 0.04$).

Our data indicate that *O. r. septentrionalis* feed primarily on lizards, but occasionally eat mammals as well. Further, *O. rhombifer* appears to feed on a great variety of lizards. Two families of lizards, Anguidae and Gekkonidae, which we did not find in our sample, have been reported in the diet of *O. r. rhombifer* (Maschio et al. 2004, *op. cit.*, and citations therein). Our sample indicates that prey SVL (primarily lizards) increases with *O. r. septentrionalis* SVL, as is the case in many snakes (Arnold 2001. *In* Seigel and Collins [eds.], Snakes: Ecology and Behavior, pp. 87–115, Blackburn Press, New Jersey).

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OXYRHOPUS TRIGEMINUS (False Coral Snake). **PREY**. *Oxyrhopus trigeminus*, a terrestrial colubrid snake, is widely distributed in Brazil (Peters and Donoso-Barros 1986. Catalogue of the Neotropical Squamata, Part I, Snakes. Smithsonian Institution Press, Washington, DC.). Although a few reports suggest it preys mainly on lizards and small mammals (Amaral 1978. Serpentes do Brasil. Iconografia Colorida. - Edições Melhoramentos, Editora da Universidade de São Paulo; Vitt and Vangilder 1983. Amphibia-Reptilia 4:273–296), its diet remains poorly known. Vitt and Vangilder (*op. cit.*) report that of nine snakes they examined, seven contained prey, including the rat *Bolomys lasiurus* and three lizard species: *Cnemidophorus ocellifer*, *Ameiva ameiva*, and *Tropidurus torquatus* (= *T. hispidus;* see Rodrigues 1987. Arq. Zool., São Paulo 31:105–230). On 28 November 2002 at 0700 h we found an adult male *O. trigeminus* (544 mm SVL, 56 g) in Restinga de Jurubatiba National Park, (22°16'53S, 41°39'20W), Quissamã, north of Rio de Janeiro State, Brazil. The snake was on

the ground near the base of a set of bromeliad ramets and appeared to have recently fed. We collected the snake and transported it to the laboratory. En route to the laboratory, the snake regurgitated a male *Tropidurus torquatus* (91 mm SVL, 30 g). In light of recent taxonomic changes (see above), *T. torquatus* represents a novel prey record for *O. trigeminus*. The snake (MNRJ 9850) and lizard (MNRJ 9851) are deposited in the Museu Nacional, Rio de Janeiro. Supported by grant of the Programa de Pesquisas Ecológicas de Longa Duração - PELD/CNPq/Site 05/ Jurubatiba.

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PSAMMOPHIS NAMIBIENSIS (Namib Sand Snake). **BEHAVIOR.** Diurnal, slender, and fast-moving, the Namib Sand Snake (*Psammophis namibiensis*, see Broadley 2002. Afr. J. Herpetol. 51:83–119) occurs in hot and sandy areas throughout the Namaqualand Region (Namibia) to the north of the Cape Province, South Africa (Branch 1998. Field Guide to Snakes and other Reptiles of Southern Africa. Struik, Cape Town. 376 pp.; Bauer et al. 1993. Madoqua 18:117–145). On 23 July 2004 at 1100 h near Fort Khan (55 km W of Usakos, Erongo Region, Western Central Namibia, 15°10'E, 22°20'S), in an arid savanna of *Acacia erioloba*, we watched a *P. namibiensis* (ca. 900 mm TL). During these observations, a Namaqua Sand Lizard (*Pedioplanis namaquensis*; 45–50 mm SVL) moved 120 cm away from the snake in the shade of an Acacia tree. The snake stopped, raised the head 10 cm above the ground, and visually tracked the moving lizard. The lizard climbed into the lower branches of the acacia, where it was struck and grasped at mid-body by the snake. The snake immediately began to "chew," alternating both maxillaries, to sink the rear fangs of this opistoglyphous snake more securely into the prey. After 90 seconds, the lizard ceased struggling and appeared to be dead. After another 130 seconds the snake dropped the lizard, moved to the head of the lizard (*sans* tongue flicking), and began to ingest it head-first. In 110 seconds the lizard was completely swallowed. The snake moved to the tree trunk and began to bask with only the portion of the body containing the lizard exposed to sunlight (exhibiting regional body thermoregulation; Peterson et al. 1993. *In* Seigel and Collins [eds.], Snakes, Ecology and Behavior, pp. 241–314. McGraw-Hill, New York).

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PSEUSTES SULPHUREUS (South American Puffing Snake). **DIET.** *Pseustes sulphureus* is a diurnal, arboreal, and oviparous snake that occurs in the neotropical region, from Mexico to southeastern Brazil, where it seems to be somewhat rare (Amaral 1978. Serpentes do Brasil. Melhoramentos/EDUSP, São Paulo, 247 pp.). It probably feeds primarily on birds and their eggs, but appears to have a varied diet that includes amphibians, lizards, bats and other small mammals (Amaral op.cit; Freitas 2003. Serpentes Brasileiras. Malha-de-Sapo Publicações e Consultoria Ambiental Lauro de Freitas. 206 pp.; Marques et al. 2001. Serpentes da Mata Atlântica: um Guia Ilustrado para a Serra do Mar, Editora Holos, São Paulo. 184 pp.; Rufino 1999. Herpetol. Rev. 31:103). Rivas and Kane (2003. Herpetol. Rev. 34:72) provide the only specifically identified avian prey, a *Crypturellus soui* (Little Tinamou).

At 1210 h on 17 November 2004 we found a subadult female *P. sulphureus* entering a *Stelgidopteryx ruficollis* (Southern Rough-winged Swallow) nest at the Reserva Ecológica de Guapiaçú (22°24'619"S, 42°44'253"W, 250 m elev.) in Cachoeiras de Macacu municipality ca. 150 km W from Rio de Janeiro, Brazil. The nest was located at the end of a tunnel about 5 cm in diameter and 41.5 cm long. When first sighted, only the anterior third of the snake was inside the nest. The snake remained in this position for ca. two minutes. It then entered the nest completely and about a minute later its head emerged at the entrance. We then captured the snake and forced it to regurgitate an intact *S. ruficollis* nestling (20.5 g), which it had swallowed head-first. The eaten nestling was one of a brood of three; the two remaining nestlings were found alive inside the nest after the predation event. The snake measured 92.8 cm SVL, weighed 150 g (excluding the prey), and was cataloged into the Rio de Janeiro Zoological Garden (FRZ12533). Our observation suggests that *P. sulphureus* is an active forager.

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PTYAS MUCOSUS (Oriental Rat Snake). **ECTOPARASITES.** On 18 June 2003 firefighters gave us an adult female (ca. 1600 mm TL) *Ptyas mucosus* captured at a school in Chiayi County, Taiwan (23°27'08"N, 120°27'18"E). Four ticks were imbedded between the dorsal scales; one ca. 300 mm and the other three ca. 500 mm from the snout. The ticks were removed and identified as adult female *Amblyomma cordiferum*. Immature stages of this tick species feed on rodents, and adults have been reported from the King Cobra (*Ophiophagus hannah*) and the Reticulated Python (*Python reticulatus*) (Barnard and Durden 2000. A Veterinary Guide to the Parasites of Reptiles. Vol. 2. Krieger Publishing, Florida. 107 pp.). To our knowledge, this is the first recorded case from Taiwan of *P. mucosus* being a host for this tick species.

We thank Pi-Hwa Su for preparing electron microscope images of the ticks and Gennady Kolonin for verifying tick identification.

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SEMINATRIX PYGAEA (Black Swamp Snake). **REPRODUCTION.** Previous reports of litter size in *Seminatrix pygaea* range from 2 to 15 and were determined primarily by counting the number of enlarged follicles or embryos during palpation or dissection (Gibbons and Dorcas 2004. North American Watersnakes: A Natural History. University of Oklahoma Press, Norman. 438 pp.). During July 2004, three of 15 pregnant females gave birth to record size litters (16, 19, and 22). Pregnant *S. pygaea* were collected between 27 May and 1 June 2004 from Ellenton Bay (Savannah River Site, South Carolina) using aquatic minnow traps. All snakes were housed individually in the laboratory at 27°C and offered salamander larvae (*Ambystoma talpoideum*) every 7–10 days until they gave birth. Within 24 h of parturition I measured the mass (nearest 0.01 g), SVL (nearest mm), and tail length (nearest mm) of the mother and all neonates. Total litter mass (TLM, all neonates together) was measured and used to calculate reproductive investment (relative clutch mass) by dividing the post-partum maternal mass by the total litter mass (Shine 1980. Oecologia 46:92–100). All neonatal values are presented as mean ± 1 SE. Because of their small size at birth, it was not possible to safely sex the neonates by probing; therefore I relied on relative tail length to sex the neonates (Dodd 1993. Can. J. Zool. 71:1281–1288). On 17 July a female (post-partum mass = 33.90, SVL = 363) gave birth to 22 neonates (TLM = 28.36, mass = 1.29 + 0.02; SVL = 108.9 ± 0.62; 9 Females: 13 Males). On 20 July a litter of 16 neonates (TLM = 22.41, mass = 1.40 ± 0.03; SVL = 112.8 ± 0.75; 7F: 9M) was born to a second female (post-partum mass = 29.23, SVL = 354). Lastly, on 25 July a female (post-partum mass = 33.25, SVL = 383) gave birth to 19 neonates (TLM = 18.81, mass = 0.99 ± 0.02; SVL = 101.5 ± 0.93; 13F: 6M). All three mothers expended a large reproductive effort as indicated by high relative clutch masses (0.84, 0.77, and 0.57 respectively). None of the litters contained stillbirths and all snakes were returned to their original point of capture.

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GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 36, Number 1 (March 2005). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extension reports unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA MACULATUM (Spotted Salamander). USA: TENNESSEE: HAMILTON CO.: Volunteer Army Ammunitions Plant (35°06'17"N, 85°07'49"). 17 March 2004. Thomas P. Wilson and Chris Manis. Verified by Kerry Hansknecht. University of Tennessee at Chattanooga Museum of Natural History (UTCA/GMU 4146). New County Record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94pp. [Hard copy and Internet versions, the latter of which includes links to information on Tennessee herpetology published since 1996], http://www.apsu.edu/amatlas/, accessed 12 May 2004)

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AMBYSTOMA OPACUM (Marbled Salamander). USA: GEORGIA: WHITFIELD CO: Dalton Middle School Campus (34°47'32.9"N, 84°56'33.1"W). 15 May 2005. Collected from a drift fence adjacent to wooded wetland. Chris Manis and John Patrick. Verified by John Jensen. University of Tennessee at Chattanooga Museum of Natural History. UTCA/GMU 4630. New county record (Williamson and Moulis 1994. Distribution of Amphibians and Reptiles in Georgia. Savannah Sci. Mus. Spec. No. 3, 712 pp.).

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AMBYSTOMA TIGRINUM TIGRINUM (Eastern Tiger Salamander). USA: TENNESSEE: HAMILTON COUNTY: Volunteer Army Ammunition Plant (35°06'17"N, 85°07'49"). 17 March 2004. Thomas P. Wilson. Verified by Kerry Hansknecht. University of Tennessee at Chattanooga Museum of Natural History. UTCA/GMU4169. New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No.12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

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Habitat of the Bicolor Frog, *Clinotarsus curtipes*, in the Western Ghats, South India

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Understanding species-habitat associations are imperative for wildlife management (Cross and Petersen 2001). Although several causes of global amphibian declines are suggested, habitat modification is implicated in many cases (Daniels 1991; Fisher and Shaffer 1996; Lips 1998, 1999; Richards et al. 1993). Because amphibians show site fidelity and have limited dispersal capabilities, forest fragmentation and modification could effectively disrupt their population structures (Marsh and Pearman 1997; Osawa and Katsuno 2001) and cause local extinctions of species (Blaustein et al. 1994). For example, frogs belonging to the genus *Leptodactylus* have been reported to be more abundant in larger patches of forest than in smaller patches (Marsh and Pearman 1997). In particular, amphibian populations relying on forest microhabitat features might undergo rapid decline because of disturbances.

Because of the rapid conversion of Indian forests to plantations, the status of Indian forest amphibians is of concern (Daniels 2003; Reddy et al. 2002). In south India, forest practices have modified the once contiguous forests of the Western Ghats into fragments resulting in isolation of habitats, disrupted microhabitat and altered vegetation structure. However, information on Indian amphibians is sparse (Oommen et al. 2000). Among Indian frogs, Bull Frog (*Hoplobatrachus tigerinus)* populations appear to have declined from paddy fields (pers. obs.). This might be due in part to the export of frog legs (now banned) and the application of insecticides and pesticides used in rice cultivation (Mohanthy-Hejmadi and Dutta 1981). Reports have indicated a threat by habitat fragmentation to torrent frogs of the genera *Nyctibatrachus* and *Melanobatrachus* (Gupta 1998). Surveys in modified habitats have recorded complete absence of several species of the genus *Micrixalus,* although they are present in the adjoining forest habitats (Daniels 2003; Krishna et al. 2005). The disturbed sites of Kudremukh National Park in the central Western Ghats have shown a 50% reduction in amphibian species richness when compared to undisturbed forest sites (Krishnamurthy and Hussain 2004).

We examined forest habitat associations of the Bicolor Frog, *Clinotarsus curtipes* (Ranidae, Hyloraninae) in three habitat types: native forest, coffee and cardamom plantations. This frog breeds in streams and ponds with tadpoles occupying aquatic habitats for over a year, after which frogs inhabit the litter and rock crevices in forest floors of the Western Ghats, South India (Daniel 2002). Our results provide insights to the potential effects of native forest conversion to plantation on this species.

We surveyed frogs and habitats at Bisale Forest Reserve and adjoining plantations (12°44'N; 75°43'E) in the South Indian state of Karnataka. The study area was a 366-ha forest ranging in elevation from 145 to 940 m. The area receives heavy rainfall (annual average rainfall: 4.5 m) from southwest monsoon winds for six months a year. The vegetation type is semi-evergreen (Champion and Seth 1968), dominated by *Dipterocarpus indicus, Kingiodendron pinnatum,* and *Humboldtia brunonis* (Pascal 1988). Many perennial hill streams, shallow ponds, and freshwater swamps exist and offer ideal locations for amphibians. The periphery of these protected forests are highly fragmented and experience high human disturbance from crop cultivation, power generation projects, road construction, tree harvest, and cattle grazing. The forests are fragmented in lower elevations by arecanut (*Areca catechu*), coconut (*Cocos nucifera*), and rubber (*Hevea brasiliensis*) plantations and at higher elevations by cardamom (*Elettaria cardamomum*) and coffee (*Caffea arebica*) plantations.

We sampled frogs in three adjoining habitats in the high elevations: forest, cardamom plantation, and coffee plantation. Rainfall, elevation, wind speed, and temperature were similar at all three sampling sites. Native forest habitat had not been previously disturbed. Cardamom is grown in the valleys of hilly slopes as an intercrop in the native forest without clearing the undergrowth and forest canopy. Very few cultivation operations are practiced, neither fertilizer nor insecticides are used and undergrowth removal is minimal. Coffee is sparsely shade-grown in India; cultivation involves removal of native canopy and undergrowth, with the application of fertilizers, insecticides, and pesticides to prevent stem bores. These farming practices convert natural forests into modified monoculture plantations.

We searched for frogs using transect sampling (Jaeger 1994), recording frogs within 10 x 4 m transects placed parallel to each other. Based on the habitat sizes, 10 transects were placed in forest and cardamom habitat and 5 in coffee habitat. Transects were sampled from May 2001 to October 2002. Forest habitat transects were sampled fortnightly once from May to December 2001 and monthly once from January to April 2002 resulting in a total of 200 transects in forest habitat (8000 m^2). However, due to the plantation activities, sampling in the other two habitats were not equal. In cardamom habitat we sampled 10 transects monthly once from May 2001 to June 2002 resulting in a total of 140 transects (5600 m^2), and in coffee habitat, 5 transects were sampled from May 2001 to May 2002 for a total of 65 transects (2600 m^2).

Transects were delimited by stakes and nylon chords. Two observers walked transects between 0600 to 0800 h and 1800 to 2100 h to flush frogs. Bicolor Frog sightings were recorded along with microhabitat per sighting (e.g., on litter, under a rock, under canopy, open canopy). Because Bicolor Frogs were not sighted during the post-monsoon and dry seasons, we used only data from May to October 2001 to estimate frog density in all three habitats. Hence, abundance was calculated from 120 transects in forest (10 fortnightly transects for 6 months, i.e., 10 x 2 x 6 =120), 60 transects in cardamom (10 x 1 x 6) and 30 transects (5 x 1 x 6 = 30) in coffee habitats, sampled only during the wet season. We determined abundance per transect (individuals/100 m^2) and calculated the average density among transect samples per habitat type (Sluys et al. 2001). The number of frogs sighted per transect sample was considered the encounter rate. Encounter rates of Bicolor Frogs were compared with the daily rainfall, temperature, and humidity in the forest habitat measured prior to initiating the sampling (N = 58).

Four habitat variables (canopy cover, understory cover, litter thickness, and occurrence of water bodies with muddy bottoms and 10 m in diameter) were classified per transect and measured once during the wet season. These variables were assigned scores 1–3 to represent a complete (1), intermediate (2) and low (3) status for the habitat variables following the methods of Fogarty and Vilella (2002). To determine if habitat variables affect frog encounter rate, we tested four habitat features considering the habitat features as dependent variables and frog encounter rate as a fixed factor in multivariate analysis (MANOVA, SPSS 10.0). Similarly, to determine if weather variables affect frog encounter rate we also analyzed three weather parameters (daily atmospheric temperature, relative humidity, and rainfall) as dependent variables and frog encounter rate as a fixed factor in MANOVA. Because the frog encounter rate was not normally distributed, the data were recoded into categories for multivariate analysis. All the tests were conducted at $\alpha = 0.05$.

Preliminary analysis indicated that *Clinotarsus curtipes* was detected on the ground only during the wet season (May to October) and was not sighted during the post monsoon and summer months (Fig. 1). The post monsoon and dry season sampling resulted in very few observations (N = 2) and therefore were not considered for abundance estimations. Transects in forest yielded an average frog abundance of 16.66 / 100 m^2 ($\pm$ 6.58 SE; range 0.0–40.5; N = 120 transect samples). Their abundances in cardamom (mean = 0.98 ± 0.43 / 100 m^2; range 0.0–3.75; N = 60 transect samples) and coffee (mean = 1.07 ± 0.51 / 100 m^2; range 0.0–2.0; N = 30 transect samples) habitats were very low.

Results of multivariate analysis of encounter rate and environmental variables indicated that only atmospheric relative humidity explained frog encounter rate ($F_{3,3,3} = 4508$, P = 0.007). Among four habitat variables, litter cover ($F_{3,3,3} = 5.741$, P = 0.005, N = 25) and presence of lentic water bodies (F = 8428, P = 0.001, N = 25) explained frog encounter rate (Table 1).

Bicolor Frog abundance varied with habitat studied. Their abun-

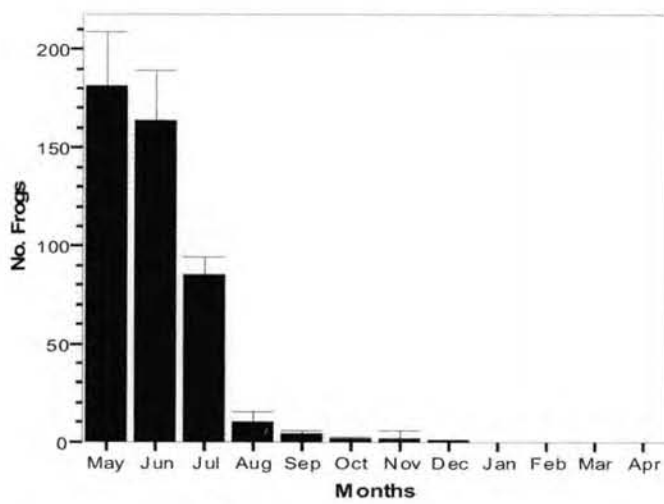

FIG. 1. Seasonal abundance (mean ± SE) of *Clinotarsus curtipes* on the forest floor at Bisale Forest Reserve, Karnataka, Western Ghats, India.

TABLE 1. Results of multivariate analyses of variance (MANOVA) to determine the effect of habitat and environmental parameters on the encounter rate of *Clinotarsus curtipes* from a high elevation site in Bisale Reserve Forest, Karnataka, India.

Dependent Variable	df	F	P
Canopy cover	3	2.130	0.127
Understory cover	3	0.162	0.921
Litter cover	3	5.741	0.005
Water source	3	8.428	0.001
Daily rainfall (24 h)	3	2.273	0.090
Air temperature (°C)	3	2.443	0.074
Relative humidity	3	4.508	0.007

dance was highest in the forest habitat. Their encounter rates were associated with the daily atmospheric relative humidity, litter-cover and presence of mud-bottom water bodies that are larger than or equal to 10 m in diameter. Because the forest habitat of Bisale Forest Reserve is characterized by these features, Bicolor Frogs may be found more abundantly here than other habitats studied. Although they were present in the coffee and cardamom plantations, they were in very low abundance when compared with the forest sites. However, more detailed natural history studies and long-term monitoring would be essential to differentiate varying abundances from a decline or from natural fluctuations (Pechmann et al. 1991). Also, due to our nonrandom site selection, the scope of inference of our study results are limited to the three specific locations surveyed; however, the dramatic differences in densities we observed are relevant to be considered to similar habitats elsewhere. Our results suggest that coffee and cardamom plantations do not provide optimal habitat for Bicolor Frogs.

Similar to Túngara Frogs (*Physalaemus pustulosus*) (Marsh 2001) in secondary tropical moist forest of Panama, abundance of *Clinotarsus curtipes* was related to the presence of a large water body and canopy-covered habitats. Density of *Eleutherodactylus coqui* in Puerto Rico forests was less dependent on plant species richness and composition than vegetation structure (Fogarty and Vilella 2002). Studies have shown that the percent relative humidity alone affects the calling male density of *E. coqui* (Fogarty and Vililla 2001). This might be the case with *C. curtipes* as well. As the cardamom estates are on the hill slopes, the torrential streams are fast-flowing with limited pools. Absence of large mud-bottom, lentic water bodies might be the reason for the low abundance of *C. curtipes* in the cardamom habitat. Similar to Indian torrential frogs, *Micrixalus* (Krishna et al. 2005), *C. curtipes* were more abundant (about 20 times) in forest habitat than the adjacent coffee habitats. Coffee plantations might lack the canopy cover required by these frogs. Reduced canopy cover can increase ambient temperature, reduce humidity, and expose the forest floor (Marsh and Pearman 1997). Synergistic interactions of all such modifications in the coffee habitat might be the reason for their low occupancy in such habitat.

In the Western Ghats, numerous fragmented forests are being converted into plantations. This is a concern for native biota, including frogs such as *C. curtipes*. Although this is not a rare species, being "lower-risk-near-threatened" (Inger and Dutta 1986; Molur and Walker 1998), the maintenance of biodiversity across the forest landscape is an emerging priority to retain forest ecosystem health. At higher elevations, fragmented native forests due to coffee and cardamom plantations are a concern, while at lower elevations, native forests are being converted to monocultures of bamboo and eucalyptus. Furthermore, urbanization (Davidson et al. 2001) and roads may act as barriers for amphibian dispersal (Marsh and Trenham 2001).

Many amphibian populations have been reported to exist as subpopulations across a large geographic area (Lips et al. 2003). Habitat fragmentation may affect metapopulation and genetic structure, in turn affecting a population's ability to respond to the environmental changes (Amphibia Web 2003). This theory has been a basis for conserving species in fragmented habitats (Marsh and Trenham 2001). The synergistic interactions among diverse human impacts on forests such as land use changes, habitat degradation, vegetation removal, litter removal, and removal of non timber forest produce has made the conservation of forests and wildlife a major challenge. The present study provides information on habitat associations of bicolor frogs in the forests of the Western Ghats These data are useful for forest managers while integrating species-specific management strategies into landscape forest management designs (Cross and Petersen 2001).

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Sounds Produced by Nesting Leatherback Sea Turtles (*Dermochelys coriacea*)

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Compared to literature on other vertebrates, there are few studies on sound production by turtles (Carr 1995). Gans and Maderson (1973) reviewed the literature on reptile sound production and turtles appear to be the least vocal of the living reptiles. However, sounds have been heard and recorded in a number of species. Squealing sounds of young *Platysternon megacephalum* are produced when they are disturbed (Campbell and Evans 1972). The Mexican *Staurotypus* has two very distinct voices (Cope 1865) and two species of *Geochelone* produce sounds in different contexts (Campbell and Evans 1972). Kinosternids, the mud turtles, are also known for sound production (Gans and Maderson 1973).

A number of reports have noted the audible growls of sea turtles, especially *Dermochelys coriacea* (Carr 1995; Lutcavage and Lutz 1997; Mrosovsky 1972). The purpose of our study was to record, characterize and quantify the sounds emitted by nesting Leatherback Sea Turtles. We looked for changes in the sounds that related to the behavioral sequence in female nesting and we tested for correlations between sound parameters (e.g., frequency) and female size. While the sounds produced by nesting leatherbacks appear to be connected with respiration, their potential role in communication, if any, is not understood.

Materials and Methods.—We recorded the sounds of nesting Leatherback Sea Turtles in June 1999 on two beaches of Culebra, a small island off the northeast coast of Puerto Rico. The beaches where the recording took place, Playas Brava and Resaca, are heavily utilized by leatherbacks during the nesting season.

To record the turtles' sounds, we used a Marantz® PMD-222 portable cassette recorder, a Sennheiser® ME66/K6 directional microphone covered with a Sennheiser® MZW 66 foam windscreen to reduce wind noise. The frequency response of the system was ± 3 decibels (dB) from 40 Hertz (Hz) to 12.5 kHz. Recordings were made on one side of the cassette only. The recording system was calibrated by recording a 400 Hz tone prior to and after recording. The calibration signal did not differ by more than 10 Hz or 1 dB re 20 microPascals (uPa) over the entire recording period.

We recorded females during various stages of nesting (egg laying, covering, and camouflaging) by holding the Sennheiser microphone ca. 30 cm from the turtle's mouth. Size (carapace length and width), tag identification numbers (metal clips and PIT microchips), and the number of eggs laid for each recorded female were also noted.

Six hours of tape were recorded from eight female leatherback turtles during various stages of nesting. Of these eight females, two (FAAV and F390) were recorded during the entire nesting process from egg laying through the camouflaging of the nest.

Three other females (F347, F372, F147) were recorded only during covering and camouflaging. The rest of the females (F303, F360, F050) were recorded only during the camouflaging stage.

For each female, we digitized eight minutes of recording during each nesting behavior using a 16-bit analog-to-digital converter at a sampling frequency of 8000 Hz. Measurements were made using CoolEdit '96 program (Syntrillium Software Corp.). All time measurements were made to the nearest 1 ms. The rates of sound production were determined for each of three sound categories (see Results) during each nesting behavior. To ensure consistency across females, the first thirty-five sounds during covering behavior and the last thirty-five during camouflaging behavior were used for analysis (duration, rates and spectral content). The peak frequency of 10 exhales for each female ($N = 8$) were averaged and regressed against female size (carapace length, cm). Because the air passages of a turtle might resemble a resonating closed pipe, we compared our measured relationship to that predicted by a closed pipe using the following formula (Rossing 1990):

$$F_1 = V / 4L$$

where F_1 = fundamental resonant frequency, V = velocity of sound, and L = length of the closed pipe. Note that if length (L) doubles, frequency would be halved.

Results.—Fig. 1 is the sonogram of a recording from one female during camouflaging. Based on audible and quantifiable differences, we distinguished three categories of sound generated by nesting females: exhale/inhale, gular pumps, and grunts. Exhale/inhale was the longest of the sounds produced, lasting on average about 800 ms. Pumps and grunts where significantly shorter at approximately 200 ms and 400 ms, respectively (Table 1). Only five females produced grunts, which were more variable in duration and recorded only during camouflaging behavior. The duration of the exhale/inhale sounds increased significantly between covering and camouflaging the nest (t-test, $t = 3.14$, $P < 0.03$), whereas the duration of gular pumps did not change (Table 1). Although the duration of the exhale/inhale combination increased from covering to camouflaging, the rate at which they were produced remained constant at 4–5 per minute. The duration of pumps did not differ between covering and camouflaging (Table 1), but the rates at which they were produced more than doubled from about 7 per minute during covering to about 17 per minute during camouflaging (Table 2).

TABLE 1. Average duration (SD) of three categories of sound emitted by nesting Leatherback Sea Turtles during two nesting behaviors, covering and camouflaging (averaged across females $N = 5$). Means of each female are based on 35 recordings of each sound during each nesting behavior.

Sound	Duration (ms)		
	Covering	Camouflaging	Overall
Exhale/Inhale[a]	702 (56)	893 (23)	812 (36)
Pumps	214 (26)	209 (7)	209 (9)
Grunts[b]			388 (100)

[a]Significant difference in duration of exhale/inhale during covering and camouflaging ($t = 3.14$, $P < 0.03$).
[b]Based on only 13 sounds from 5 females.

All of the sounds produced by nesting females were broadband, having some energy across the entire 4 kHz range of the analysis. However, there were certain peaks in the spectrum for each of the sounds emitted. Exhale/ Inhale commonly had a spectral peak near 400 Hz and second band around 1200 Hz (Fig. 1). In the exhale portion of the exhale/inhale combination, the peak frequency increases slightly throughout the duration of the sound. The grunts also contained frequencies with peaks that were higher (2000 Hz and up) than exhale/inhale. Pumps did not contain the low frequency peaks (300–500 Hz) common to exhale/ inhale or grunts.

For the two females that we were able to record during all phases of nesting, the number (and rate) of sounds produced increased from egg laying to covering and camouflaging (Fig. 2). Grunts were only produced during camouflaging. One of the females (FAAV) produced pumps only while she camouflaged her nest. The other female (F390) produced pumps during each nesting stage and the number of pumps increased from < 1 per minute while she

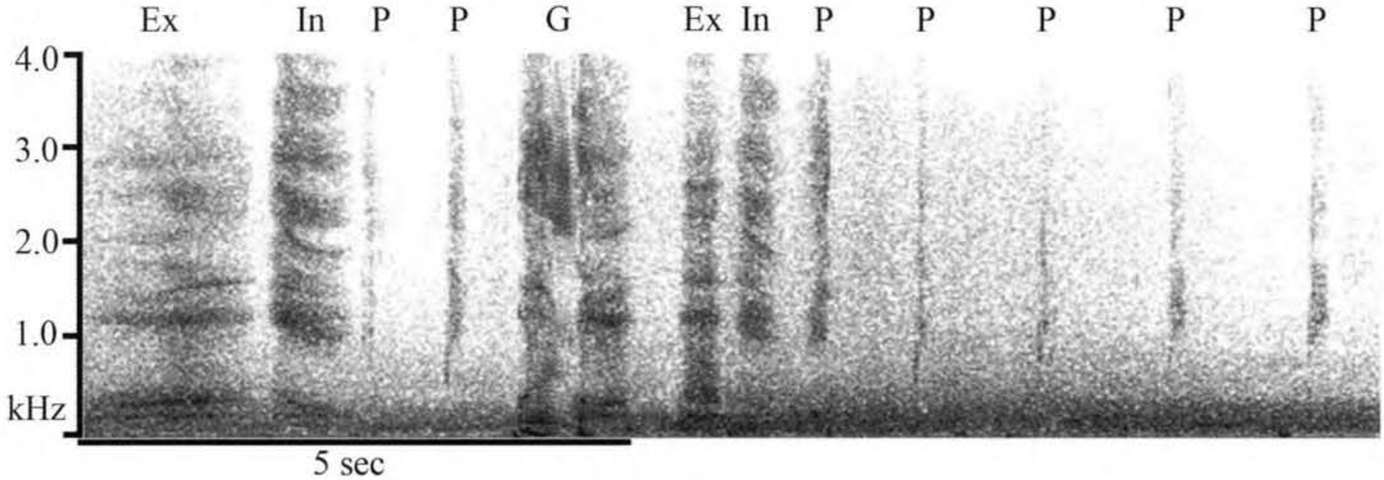

FIG. 1. Sonogram of a recording of one female Leatherback Sea Turtle while she camouflaged her nest site. The gray band extending across the bottom of the sonogram is background noise from the waves breaking on the shore. The darker columns are sounds produced by the female and above each sound its category is indicated (Ex In: exhale/inhale, G: grunt, P: gular pump).

TABLE 2. Mean rate (SD) of sound production of nesting Leatherback Sea Turtles. Averages are based on rates during 8 minutes of recording from each female (N = 5).

Sound	Rate (min^{-1})	
	Covering	Camouflaging
Exhale/Inhale	4.7 (0.7)	4.5 (1.0)
Pumps[a]	7.3 (7.3)	17.2 (6.1)
Grunts	0	0.9 (0.7)

[a]Significant difference in rate of gular pumping during covering and camouflaging ($t = 4.17$, $P < 0.02$).

laid eggs to 10 per minute and 22 per minute while she covered and camouflaged the nest, respectively. Both females increased the rate of Exhale/Inhale during each stage of nesting (Fig. 2).

The peak frequencies of the exhale/ inhale significantly decreased with female size (Fig. 3). We assumed that the air passages would scale linearly with carapace length, our measure of female size. If so, then the resonant frequency of the closed pipe (air passages) should change by a ratio of 0.841 (the ratio of carapace lengths of the largest female to the smallest 138 cm/164 cm) between the smallest and largest females in our sample. Thus, the predicted slope of the relationship is –2.55 Hz / cm (dotted line Fig. 3) and is similar to the slope of the best-fit line, –2.08 Hz/cm (solid line Fig. 3). Using a resonant frequency of 400 Hz, the formula for the closed pipe predicts a length of 21 cm for the distance between the trachea and the open mouth.

Discussion.—Sounds made by animals can be either incidental or communicative. Incidental sounds are by-products of the normal activity of the animal, such as grinding of the shell or closing of the jaws. Communication involves an acoustic signal used by one animal (the sender) to modify the behavior of another animal (the receiver, see Bradbury and Verhencamp 1998).

If the sounds produced by nesting Leatherback Sea Turtles were communicative, they should fall in the audible range for the species. Patterson (1966) used behavioral conditioning to measure audibility in *Trachemys scripta* and found they were most sensitive to frequencies between 200 and 600 Hz. More recently, Bartol et al. (1999) measured the auditory evoked potentials in Loggerhead Sea Turtles to broadcasts of broadband clicks and tone bursts. The sea turtles were most sensitive to frequencies of 250 and 500 Hz with a decreased sensitivity (10–15 dB) to 750 and 1000 Hz. Currently, no data exists on the hearing sensitivity of leatherbacks. However, peak frequencies of the sounds we recorded for leatherbacks were between 300 and 500 Hz (Fig. 3) and are consistent with the low-frequency hearing range found in other turtle species.

During sound production, the leatherback female extends her neck and tilts the head back, towards the carapace, a posture that suggests that she might be broadcasting. This position could also increase airflow into and out of the lungs. The origin of leatherback sounds is the respiratory system and involves movement of air into and out of lungs. For leatherbacks, the increased rate of exhale/inhale, pumps and grunts from egg laying to camouflaging (Fig. 2) presumably relate to increased oxygen demands. Paladino et al. (1990) showed that the metabolic rates of leatherbacks engaged in covering and camouflaging were 0.222 liters O_2/ kg h. In comparison, the metabolic rates for unrestrained leatherbacks during egg laying is only 0.015 liters O_2/ kg h (Lutcavage et al. 1990), nearly a 15-fold difference (Lutcavage and Lutz 1997).

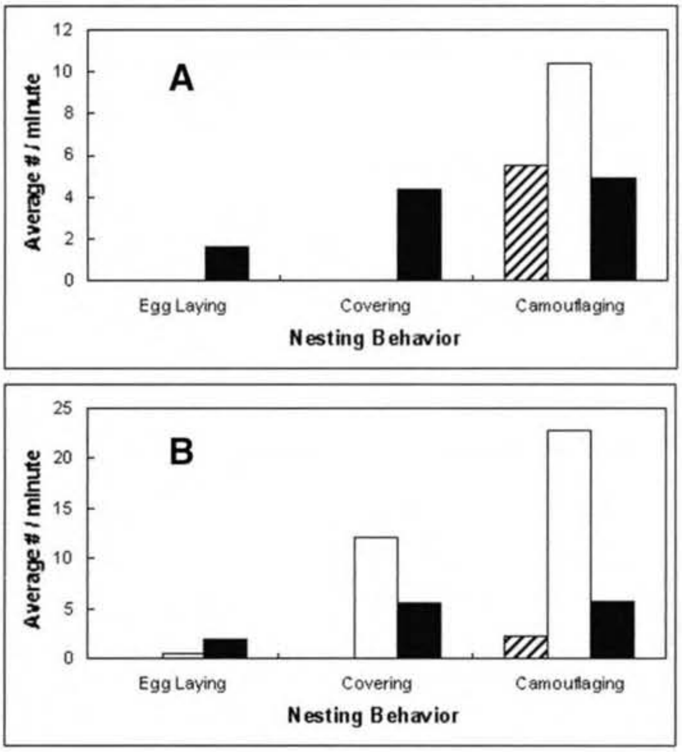

FIG. 2. Rate of grunts (hatched bars), pumps (white bars) and exhale/ inhale (black bars) recorded for two female Leatherback Sea Turtles, (A) FAAV and (B) F390, during three nesting stages. Rates are the average number of each sound type produced during N = 8, one-minute recordings. Both females increased the number of each category of sound as nesting progressed from laying eggs to camouflaging.

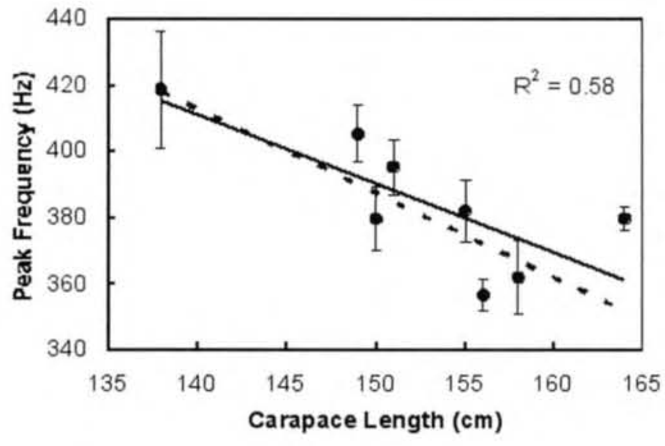

FIG. 3. Relationship between carapace length of nesting Leatherback Sea Turtles and the peak frequency of (exhale/inhale) sounds they emitted. Points are the mean peak frequency (± SE) for each female based on 10 sounds each. The solid line is the best-fit regression for the means ($y = -2.08 + 702$, $P < 0.03$) and the dotted line is the predicted relationship if the air passages of the turtles act as a resonating closed pipe.

Camouflaging a nest is vigorous activity involving active movement of all four flippers to distribute sand. Increased oxygen demand should require significantly longer exhale/inhale and/or an increase in the number of pumps from covering to camouflaging. In the Green Turtle *(Chelonia mydas)* respiratory mechanics involves compression by the body wall and extremities causing extrapulmonary pressure to be slightly positive. Expiration occurs, causing the glottis to open, air to be forcefully expelled, and extrapulmonary pressure to become negative. Filling of the lungs is accomplished by an elastic rebound of the body wall and extremities (Tenney et al. 1974).

Gular pumps may also play a role in respiration by female sea turtles. Tenney et al. (1974) describe them as small expiratory leaks in the green turtle. In reptiles, the gular organ is homologous with the larynx (Blumberg and Alberts 1997), which has muscles controlling the constriction or adduction of membranes that open or close the respiratory airway. Monitor lizards use the hypobranchial apparatus to expand the gular cavity to create positive pressure gular pumps to assist lung ventilation (Owerkowicz et al. 1999).

The sounds produced by nesting Leatherback Sea Turtles are quite loud and impressive. If these sounds are incidental by-products of respiration, selection should act to minimize the number or intensity of sounds produced during egg laying because they might attract predators. If so, we expect females to time their sound emissions with waves breaking on shore so that their sounds would be masked by the environmental noise.

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Status and Conservation of the American Crocodile (*Crocodylus acutus*) in Banco Chinchorro Biosphere Reserve, Quintana Roo, Mexico

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The American Crocodile (*Crocodylus acutus*) is one of the most widely distributed crocodilian species in Latin America, ranging from the United States to northern South America, including the Caribbean (Ross 1998). However, *C. acutus* populations have declined throughout much of its range because of past overexploitation, continued illegal hunting, and habitat destruction (Ross 1998; Thorbjarnarson 1989). As a result, the species is considered vulnerable by the International Union for the Conservation of Nature and Natural Resources (IUCN), listed on Appendix I of the Convention on Trade in Endangered Species of Wild Flora and Fauna (CITES) (Ross 1998). Furthermore, this species is listed as subjected to Special Protection in the Endangered Species list of the Norma Oficial- Mexicana (NOM-059-ECOL-2000), the Mexican law for the protected species and subspecies of flora and fauna (Diario Oficial de la Federación 2000).

In the past, trade in crocodile skins was a relatively important issue in Mexico, principally in coastal states of Campeche, Colima, Chiapas, Jalisco, Nayarit, Guerrero, Oaxaca, Quintana Roo, Sinaloa, Tabasco, Tamaulipas, Veracruz, and Yucatán (INE 1999). However, this activity declined because of the ban on hunting of wild populations as a result of the lack of management, enforcement of hunting regulations, and overexploitation. In 1970, the Federal Government of Mexico declared the total and permanent protection

of the three species of crocodilians that occur in its territory, *Crocodylus acutus*, *C. moreletii*, and *Caiman crocodilus fuscus* (INE 1999), and legal commerce of skins was suspended. Since then, various studies and distinct conservation programs have been developed in Mexico concerning the status of wild populations, reproduction, population genetics, interaction with humans, and management proposals (Velasco and De Sola 2000).

However, geographically the studies are not well distributed, and surprisingly little is known concerning the abundance and distribution of *C. acutus* along the coast of Quintana Roo. The few studies carried out in this rapidly developing state show a low number of individuals and a slow recovery throughout its former range (Cedeño-Vázquez 2002; Domínguez-Laso 2002). The status, dynamics, and behavior of the population of *C. acutus* at Banco Chinchorro Biosphere Reserve (Fig. 1) are poorly known (Carballar 2001). Such information is essential for the development of appropriate conservation strategies. The objectives of this study were 1) to obtain baseline data to evaluate the status of the *C. acutus* population in Banco Chinchorro Biosphere Reserve, and 2) to suggest conservation actions based on these findings.

Study Area.—The reserve is situated east of the Quintana Roo coast, between the fishing villages of Río Indio and Río Huach (Fig. 1). It is in the open sea 31 km from the village Mahahual, which is the nearest continental point, and separated from the coast by a 1000-m deep channel (UNEP/IUCN 1988). The reserve measures 144,360 ha, which include reef formations, reef lagoons, four cays, and adjacent oceanic waters. It is a reef coral complex and is one of the largest structures of this kind in the Caribbean (Jordán and Martin 1987) and the most important in Mexico. The reef has an irregular elliptic form of 43 km long and 18.0 km wide.

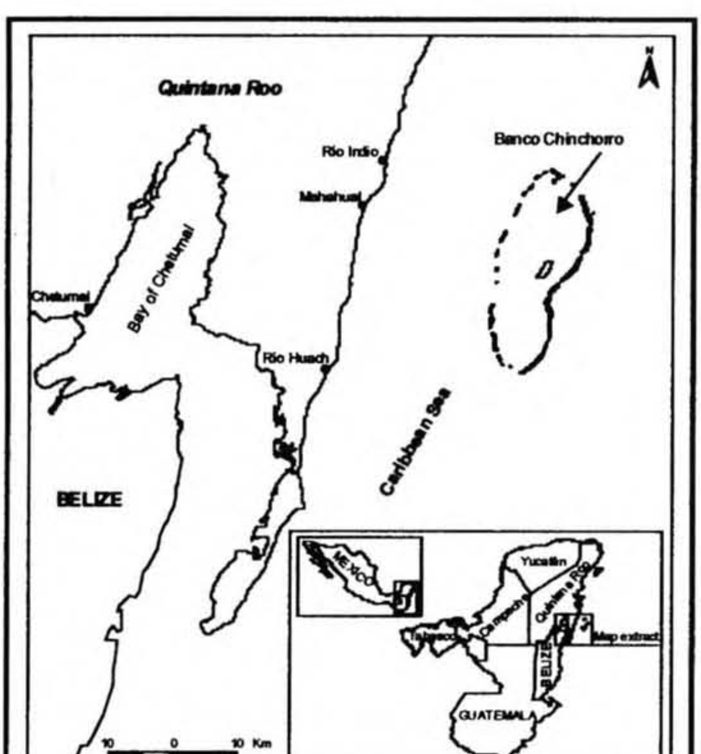

FIG 1. Location of Banco Chinchorro Biosphere Reserve.

The total perimeter of the barrier reef is 115 km (Jordán and Martin 1987). The 53,379-ha reef lagoon is variable in depth, with a decrease in the north–south direction. Four cays occur in a lagoon that covers 582 ha or 0.40% of the total reserve surface. Of this area, 435 ha are terrestrial habitats and 147 ha are interior lagoons. In the extreme north of the reserve is Cayo Norte, with two cays and a total area of 40 ha. Cayo Centro (Figs. 1, 2), localized in the center of the system, is the largest cay covering 541 ha. The fourth cay, localized in the extreme south is the 0.4-ha Cayo Lobos.

The terrestrial vegetation of Banco Chinchorro is comprised of halophytic vegetation or coastal dune vegetation (five different associations), and mangrove: *Rhizophora mangle*, *Avicennia germinans*, *Conocarpus erectus*, and *Laguncularia racemosa* (Cabrera 1998). The shoreline vegetation of the cay was dominated by red mangrove. Three small beaches were found along the shoreline, all associated with fishing camps. There are also fishing huts on pilings in open water in the southeast part.

Methods.—Potential habitat of crocodiles was identified on maps of Banco Chinchorro and by interviewing local fishermen. Three set of spotlight surveys were conducted between June and August 2003 in Cayo Centro. Daylight reconnaissance and nocturnal surveys were conducted using a 4.27-m aluminium boat powered by a 15-hp outboard engine or by paddling along the shoreline and spotting crocodile eyeshines using handheld spotlights (100 and 400 CP) and 4.5-V headlights. A team of two observers, one data recorder, and a boat driver conducted the surveys. Ten different routes were surveyed during the study (Fig. 2). Three different groups of survey routes were described during the study.

The Chandés Lagoon was divided into five routes for survey purposes (Lighthouse Lagoon, Edifice Lagoon, Lagoon A, Lagoon B, and Lagoon C), but all present the same habitat type. The main characteristic of this habitat is its heterogeneity: red and black mangroves constitute many patches in the lagoon, and *Batis maritima* forms carpets of vegetation (30 cm high) on the lagoon shoreline—where the soil is solid (on the east coast) or in 20–cm deep water places where it is usually associated with cut off branches or dead branches and muddy soil. The lagoon is relatively protected against wind and wave action.

Rabios Lagoon, Rabios 2 Lagoon, Perla Lagoon, and Small Lagoon present a habitat characterized by red or black mangrove along the shoreline. These lagoons are linked directly to the sea by openings in the mangroves and are more subject to wave action. The water is also deeper.

Spotlight counts were done on established survey routes to estimate the abundance of crocodiles at each location by recording encounter rate (crocodiles/km) (King et al. 1994). This technique has been used to determine a relative index of the population, because not all the crocodiles present are observed during a survey (Bayliss 1987; King et al. 1990). To maintain similar conditions and to ensure that it was dark enough to detect eyeshine, surveys were conducted at night and began ca. 20–30 min after sunset (Messel et al. 1981). Surveys were not conducted under rough water conditions or during rain, which substantially limit visibility and produce low counts (Woodward and Marion 1978).

For each crocodile sighted, we recorded location with a Global Positioning System (GPS), water salinity (measured with an optical refractometer on scale of 0–100 ppt), habitat type, shoreline vegetation, water depth, and air and water temperatures. Crocodiles

sighted were approached as closely as possible to estimate total length (TL), which was eventually used to determine population structure by size class. We used the following classes, which are those suggested by Platt and Thorbjarnarson (2000) for the species: hatchlings (TL < 30 cm), yearlings (TL = 30.1–60 cm), juveniles (TL = 60.1–120 cm), subadults (TL = 120.1–180 cm), and adults (TL > 180 cm). When TL could not be determined, crocodiles were classified as "eyeshine only." Use of the same observers and equipment reduced observer bias and equipment-related variation.

Encounter rates and abundance were calibrated where data from more than one survey were acquired, according to the method proposed by Messel et al. (1981). Estimations for each size class on each location or survey route were also calibrated (Messel et al. 1981). The coordinates and the time of the beginning and the ending of each survey were documented with a handheld GPS. Survey routes were calculated as shoreline distance along small bays and lagoons (King et al. 1990). Crocodile abundance index was calculated through the encounter rate as the number of crocodiles per kilometer of survey route. A chi-square analysis was used to compare size-class distributions within each site against a null model of equal distribution (Zar 1999).

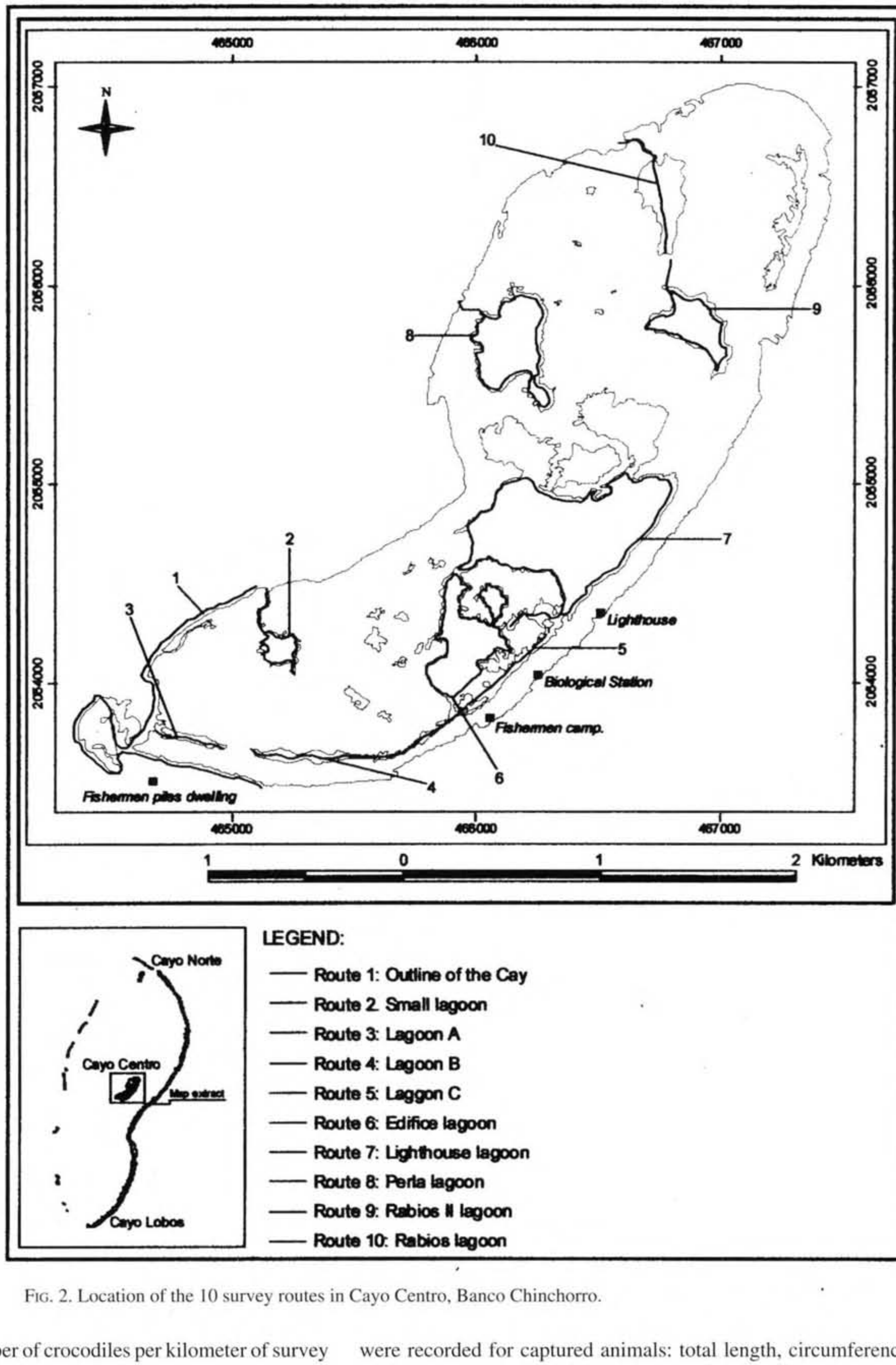

FIG. 2. Location of the 10 survey routes in Cayo Centro, Banco Chinchorro.

Efforts were made during spotlight surveys to capture animals by hand or with a self-locking wire noose. The following data were recorded for captured animals: total length, circumference of the base of the tail (TC), snout–vent length (SVL), and head length (HL), measured with a plastic ruler tape or a plastic caliper to the nearest 0.1 cm. Captured crocodiles were sexed by cloacal examination (Brazaitis 1968; Magnusson 1982). Observed sex ratios by size class and total were tested against a null hypothesis

of 1:1 sex ratio using chi-square analyses with the Bonferroni correction for multiple comparisons (Zar 1999).

Captured individuals were marked by attaching numbered tags and by removing tail scales in a coded pattern (Platt and Thorbjarnarson 1997).

Results and Discussion.—Only two species of crocodiles are present in the coastal areas of the Yucatan Peninsula: *Crocodylus acutus* and *C. moreletii*, and frequently they are sympatric along the mainland coast. Many characters can be used to distinguish the two species: color, snout formation, preorbital ridge, premaxillary suture, scutellation (Platt 1996). Contrary to the species list of the reserve (INE 2000), but in agreement with crocodile specialists, all individuals captured and observed during this study were *C. acutus*, and no *C. moreletii* were observed. In effect, *C. moreletii* is primarily a freshwater species, occurring in brackish water, whereas *C. acutus* is associated with brackish and saline habitats (Cedeño-Vázquez 2002; Platt 1996; Thorbjarnarson 1989). Our data support these findings and suggest that with a mean salinity of 52.9 ppt (minimum 30 ppt, maximum 61 ppt), *C. moreletii* is unable to live in the cay.

Furthermore, high salinity and lack of fresh water presents a problem in osmoregulation for hatchlings crocodiles (Platt and Thorbjarnarson 2000; Thorbjarnarson 1989). The principal behavioral mechanism used by crocodiles to maintain water balance is probably drinking brackish water made available ephemerally by rain (Mazzotti 1983). We hypothesize that growth and survival of hatchling crocodiles is limited by rainfall on offshore islands.

A total of 147 *C. acutus* were observed during daylight reconnaissance and spotlight surveys. Of these, 34 (23.1%) were classified "eyeshine only," 53 (36.1%) were captured, and 60 (40.8%) were approached closely enough to estimate size. The population size class structure (Fig. 3) was estimated from crocodiles captured or approached closely enough to estimate total size (N = 113).

We used the size class scheme proposed by Platt and Thorbjarnarson (2000) in neighboring Belize for comparative purposes. They observed that, in Belize, individuals over 4.0 m TL are rare, although *C. acutus* is known to attain maximum total lengths of 6.25–7.0 m elsewhere (Thorbjarnarson 1989). Their observations indicate that in Belize *C. acutus* might attain a smaller body size than reported for other populations. It is unknown whether this is because of genetic or environmental factors, or perhaps a consequence of past overharvest which removed most large adults (Platt and Thorbjarnarson 2000). Our results are consistent with these findings—only 3 (2.7%) crocodiles had a total length > 240 cm. The largest crocodile sighted was an individual encountered in the Chandés Lagoon for which we estimated a total length slightly longer that 3.0 m.

An apparent absence of large specimens indicates that the population might still be in a state of recovery from past poaching in the region (according to local informants there is not evidence of poaching still occurring) or, that crocodiles simply do not grow very large in these offshore habitats as a result of genetic and environmental factors as suggested by Platt and Thorbjarnarson (2000). Another possible explanation could be the limited nesting habitat, since only three small beaches were found along the shoreline (Mazzotti, pers. comm. 2004). Juveniles (N = 30, 26.5%) and subadults (N = 31, 27.4%) were most abundant, followed by adults (N = 23, 20.4%), yearlings (N = 15, 13.3%), and hatchlings (N = 14, 12.4%). The lower number of hatchlings and yearlings in the atoll might reflect sampling bias as they might be concealed within vegetation and escape detection during spotlight surveys (Platt and Thorbjarnarson 2000). Another explanation could be lack of fresh water that may limit the survival of young individuals. Although few potential nesting sites are available on the atoll, reproduction is occurring as indicated by our observations of hatchlings. Few potential predators of nests were observed (crabs were the only potential egg predators we observed), and as the area is a biosphere reserve, habitat is effectively preserved. However, natural disturbances caused by hurricanes are frequent.

A total of 133 *C. acutus* were observed along survey routes. We estimated an overall encounter rate of 6.8 crocodiles/km, but important differences among the three habitat types were detected. We obtained a high density (13.9 crocodiles/km) in the Chandés lagoon compared to 1.3 and 1.1 crocodiles/km, respectively, in the outline of the cay and the other lagoons. These last two values are not very different from the density of 0.94 crocodiles/km encountered by Platt and Thorbjarnarson (2000) in atolls in Belize. Furthermore, Carballar et al. (2001) found an encounter rate of 1.8 crocodiles/km in the lagoons and 0.37 crocodiles/km outside the cay. Our results, with 8.4 and 1.3 crocodiles/km in the same sites, are much higher. These differences might indicate an increase in the number of crocodiles over the past two years in the interior lagoons or, more likely be the result of differences between survey methods and perhaps choice of survey sites. It seems that Carballar et al. (2001) did not survey lagoons A, B, and C—locations where we encountered the most individuals.

Notably, the size-class distribution of crocodiles is significantly different in each habitat ($p < 0.05$; df = 2). Although all classes were represented in the Chandés lagoon, we encountered only two subadults in other interior lagoons, whereas eight adults, one yearling, one juvenile, and one subadult were found on the outside of the cay. Few individuals inhabit the outline of the cay and lagoons other than Chandés, and those we encountered were primarily subadults or adults, which are more able to tolerate wave action, deep water, and difficult accessibility to the shore. In contrast, the Chandés lagoon, with its heterogeneous habitats and relative protection from wind and wave action, is ideal for all age classes.

Among the Crocodylidae, both male and female-biased

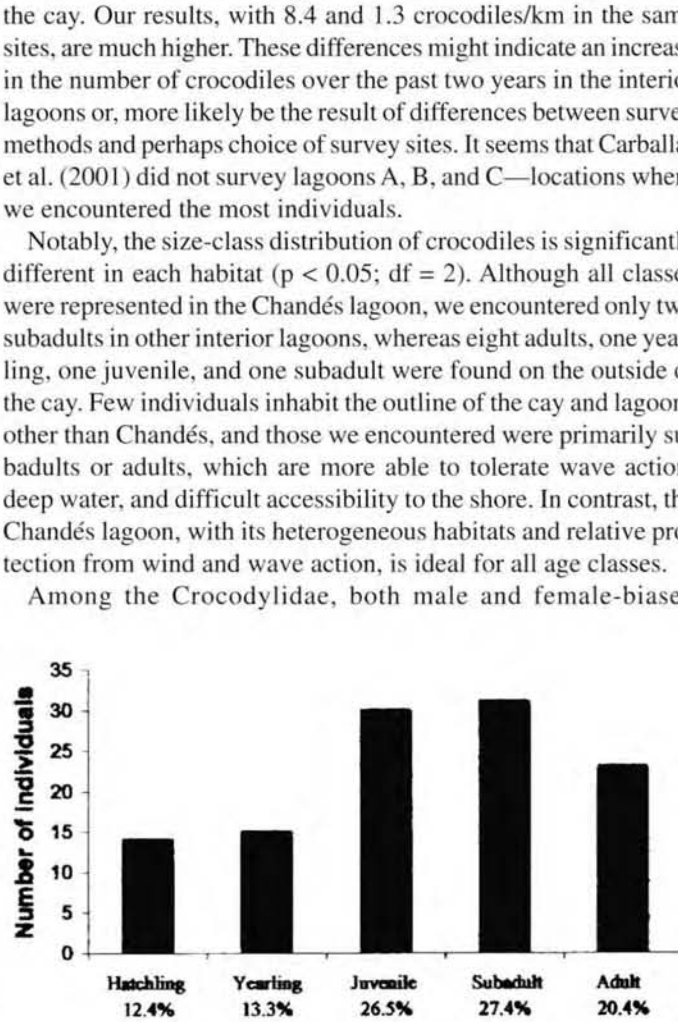

FIG. 3. Population structure by size class of *Crocodylus acutus* of Cayo Centro (Banco Chinchorro).

TABLE 1. Comparison of the sex ratio of American Crocodiles captured in Cayo Centro (B. Chinchorro).

Age class	Males	Females	Sex ratio	χ^2
Yearling	6	0	6:0	6.0 NS
Juvenile	12	2	6:1	7.1*
Subadult	8	1	8:1	14.4*
Adult	8	2	4:1	13.8*
Total	34	5	6.8:1	21.6*

NS = not significant.
* = significant at $p \leq 0.05$.

population sex ratios are known, including at the intraspecific level (Carrion et al. 2000; Thorbjarnarson 1997). Although male-biased populations have been reported (Thorbjarnarson 1988, 1989), sex ratios not significantly different from 1:1 are the most common for *C. acutus* populations (Brandt et al. 1995; Cedeño-Vázquez 2002; Cherkiss 1999; Gaby et al. 1985; Kushlan and Mazzotti 1989; Moler 1991; Platt and Thorbjarnarson 2000). The population of Banco Chinchorro is thus an exception, as it presents a strongly male-biased sex ratio in all age classes, except for yearlings (Table 1). This class presents a tendency of being male biased too, but the small number of individuals might not be sufficient to detect differences from a 1:1 model. Concerning the hatchlings, we had a sufficient number of individuals, but we were not able to sex them (Allsteadt and Lang 1995; Joanen and Mc Nease 1978).

Conclusions.—The current status of *C. acutus* in Banco Chinchorro Biosphere Reserve seems good. Most crocodile populations are resilient to overexploitation and respond well to protection (Bayliss 1987). However, various studies showed that coastal populations of *C. acutus* remain low in most locations (Cedeño-Vázquez 2002; Mazzotti 1999; Platt and Thorbjarnarson 2000). In Banco Chinchorro, the population was subjected to hunting in the past, with a report of 21 animals killed in one night by one person (M. Colli, pers. comm. to PC), so we can reasonably estimate that the population was low when the hunting ban was established. The hunting ban, which was respected in the early 1980's, and the classification of Banco Chinchorro as a biosphere reserve in 1997, allowed the crocodile population to begin recovery. Commercial fishing activities are presently not occurring near the cay, so drowning mortality in nets does not represent a threat to crocodiles as it is in Belize (Platt and Thorbjarnarson 2000). The reserve is well protected and we did not detect hunting of crocodiles, and fishermen, who are the only inhabitants of the cay, coexist with the crocodiles and take care of them. Although we observed garbage on potential nesting sites, destruction of habitat or tourism-related development is non-existent. Banco Chinchorro Biosphere Reserve offers good conditions for long term survival of the crocodile population. The fact that the site is so far off the mainland coast means living conditions for crocodiles are unusual (high salinity, apparently closed population), and we can infer that specific adaptations have been developed. Finally, although the population seems to be undergoing a recovery, management actions and a population monitoring program are necessary. The monitoring program will be important to determinate population conservation strategies and should be based on nest counts, together with spotlight and capture surveys.

Management Implications.—Although fishermen live in harmony with crocodiles, we suggest environmental education programs directed to fishermen and children in schools of coastal villages of Quintana Roo. We think that it is important that they understand that we should protect crocodiles and avoid contact. Children will be the future actors of this region, and it is necessary to inform them of the importance of environmental protection, especially of large predators which are often eliminated when they live near humans. Several studies could be targeted on the American Crocodile population of Banco Chinchorro. These studies could provide particular information on the adaptation of the species, and could serve to improve the conservation programs. We suggest studies focused on the relation of young *C. acutus* to salinity levels, and on the location of actual and potential nesting sites. These studies appear very important to us because the protection of young individuals and the preservation of nesting and nursery habitat are crucial for long-term population viability, and the most important element of any conservation plan (Platt and Thorbjarnarson, 2000). We suggest also that a more precise study is necessary to confirm and examine the causal factors of the apparently male-biased sex ratio of the population.

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Predation of Juvenile and Adult Anurans by Invertebrates: Current Knowledge and Perspectives

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Anuran amphibians are preyed on by vertebrates, invertebrates, and even carnivorous plants (Duellman and Trueb 1994). Most of these reports on predation are anecdotal (Fitch 1987; Greene 1993) and do not provide data other than a short description of the predatory event (e.g., Boistel and Pauwels 2002; Brandão and Garda 2000; Del-Grande and Moura 1997; Mitchell 1990). The scattered information on the subject makes it difficult to identify patterns. Additionally, McCormick and Polis (1982) pointed out the lack of quantitative data evaluating the impact of arthropod predators upon vertebrates. This is particularly true for predation by invertebrates upon post-metamorphic (generally adult) anurans. For example, reports on this subject usually state that few cases of invertebrate predation upon anurans are recorded (e.g., Bastos et al. 1994; Bernarde et al. 1999; Del-Grande and Moura 1997; Hinshaw and Sullivan 1990; Mitchell 1990), when, in fact, a considerable amount of information is generally available (e.g., McCormick and Polis 1982). Therefore, I review the subject in an attempt to depict our current knowledge, add unpublished data, and provide a background to which new reports may be added.

By reviewing published information on the subject I collected data on a wide range of taxa, i.e., at least 68 post-metamorphic (juvenile to adult) anuran species preyed upon by at least 57 invertebrate species, including arachnids, crabs, leeches, and various insect groups (Tables 1 and 2). Besides the species listed (Table 2), there exists indirect evidence and laboratory studies that add

TABLE 1. Invertebrate predators and number of species reported to prey upon post-metamorphic anuran amphibians.

Class	Order	Family	Common name	Abbreviation	Number Of species
Hirudinea	Arhynchobdellida	Hirudinidae	Leeches	Ah	1
Chilopoda	Scolopendromorpha	Scolopendridae	Giant centipedes	Gc	1
Arachnida	Scorpiones	Buthidae	Scorpions	Sc	1
	Uropygi	Thelyphonidae	Vinegaroons	Ut	1
	Amblypygi	Ambypigidae	Amblypigids	Am	1
	Araneae	Araneidae	Orb weavers	Aa	3
		Ctenidae	Wandering spiders	Ac	2
		Ctenizidae	Trapdoor spiders	Az	1
		Dipluridae	Tarantulas	Ad	1
		Lycosidae	Wolf spiders	Al	6
		Pisauridae	Fishing spiders	Ap	10
		Sparassidae	Crab spiders	As	1
		Theraphosidae	Tarantulas	At	6
Malacostraca	Decapoda	Coenobitidae	Crabs	Dc	1
Hexapoda	Coleoptera	Carabidae	Ground beetles	Cb	3
		Cicindelidae	Tiger beetles	Cc	1
		Dytiscidae	Diving beetles	Cd	1
	Diptera	Tabanidae	Horse flies	Di	1
	Hemiptera	Belostomatidae	Water bugs	Hb	8
		Nepidae	Water scorpions	Hn	1
	Hymenoptera	Formicidae	Ants	Hf	4
	Mantodea	Mantidae	Preying mantis	Mm	1
	Neuroptera	Corydalidae	Hellgrammites	Ch	1

other potential invertebrate predators to the list, such as spiders (*Oilos antaguensis*, *Stasina portoricensis*, and *Avicularia latea*), amblypygids (*Phrynus longipes*), and forest crabs (*Epilobocera situatifrons*) (Formanowicz et al. 1981; Stewart 1995). Laboratory studies using pipid and hyperoliid frogs report pisaurid spiders as additional potential predators upon previously unreported anuran families (Table 2).

It appears that many anuran species can be preyed upon by invertebrate predators, independent of prey body size/age (see discussion in McCormick and Polis 1982), phylogeny, or recognized presence of an elevated quantity of biologically active skin secretions (Duellman and Trueb 1994) (Table 2). However, the risk of predation by invertebrates seems to be greater in two crucial periods of the anurans life cycle: 1) during the breeding season, when most species enter the water and consequently are in contact with potential aquatic predators (e.g., Bastos et al. 1994; Haddad and Bastos 1997; Toledo 2003); and 2) when the recently-metamorphosed frogs are about to leave or actually leave the water (Fig. 1), thus facing both aquatic and terrestrial invertebrates (e.g., Clerke and Williamson 1992; Hirai and Hidaka 2002; Robertson 1989; Toledo 2003). Almost 90% of the observations that provide descriptions of the frog behavior before the predation were recorded during these two stages.

Predation events occurred both in and out of the water and about 73% of them involved water bugs (approximately 25%) and spiders (approximately 48%) as anuran predators (Fig. 2). This may reflect the high density of these animals in nature (DuBois and Gobin 2001; Formanowicz et al. 1981; McCormick and Polis 1982; and references therein). Additionally, it could indicate that spiders and water bugs may be significant predators of anuran populations (Formanowicz et al. 1981; Toledo 2003), though, few studies have determined actual predation rates on adult anurans (e.g., Haddad and Bastos 1997; Hinshaw and Sullivan 1990).

In reviewing the subject I was able to identify a few cases of incorrect or repeated data. For example, Nauman and Dettlaff (1999) reported "the first published record of a giant water bug preying on an adult frog"; however, at least three reports on giant water bugs preying on adult frogs were already available by that time (Bastos et al. 1994; Haddad and Bastos 1997; Hinshaw and Sullivan 1990). Additionally, both Toledo (2003) and Brasileiro

FIG. 1. Juvenile *Hyla albosignata* being preyed upon by a tarantula on vegetation near a stream in a forested area, Municipality of Pilar do Sul, State of São Paulo, Brazil. Photograph by André Antunes.

TABLE 2. Post-metamorphic (juvenile to adult) anurans (15 families; at least 68 species) reported as prey of invertebrates (22 families; at least 57 species) and the microhabitat where the predation occurred. Anuran specific names follow Frost (2004), and thus some genera and species are updated. Predators' abbreviations are in table 1. An asterisk (*) after the anuran names indicates the recognized presence of a high amount of biologically active skin secretions.

Anurans (Prey)	Invertebrates (Predators)	Predation microhabitat	References
Ascaphidae			
Ascaphus truei	Hellgrammite – unidentified (Mh)	Pool in the stream	Jones and Raphael, 1998
Bufonidae			
Bufo bufo *	*Formica rufa* (Hf)	Lake margin	Zuffi, 2001
Bufo crucifer *	*Lethocerus grandis* (Hb)	Temporary pond	Haddad and Bastos, 1997
Bufo houstonensis *	*Solenopsis invicta* (Hf)	Litter	Thomas and Allen, 1997
Bufo marinus *	*Iridomyrmex purpureus* (Hf)	Pond margin	Clerke and Williamson, 1992
Bufo marinus *	*Scolopendra alternans* (Gc)	Leaf litter	Carpenter and Gillingham, 1984
Bufo terrestris *	*Lethocerus* sp. (Hb)	Temporary pond	McCoy, 2003
Centrolenidae			
Centrolene prosoblepon	*Cupiennus* sp. (Ac)	Over rocks, near the water	Hayes, 1983
Hyalinobatrachium fleischmanni	*Cupiennus* sp. (Ac)	Over leaf	Hayes, 1983
Dendrobatidae			
Colostethus inguinalis	Freshwater crab – unidentified (Dc)	Not provided	Duellman and Trueb, 1994
Dendrobates auratus *	*Sericopelma rubronitens* (At)	Litter	Summers, 1999
Dendrobates pumilio *	*Paraponera clavata* (Hf)	Litter	Fritz et al., 1981
Hylidae			
Acris crepitans	*Hogna helluo* (Al)	Semi-permanent wetland	Blackburn et al., 2002
Acris gryllus	*Dolomedes* sp. (Ap)	Edges of water body	Goin, 1943
Hyla albomarginata	*Belostoma* sp. (Hb)	Temporary pond	Froehlich, 2001
Hyla albosignata	Tarantula – unidentified (At)	Vegetation over water	A. Antunes, unpubl. data
Hyla cinerea	*Dolomedes okefinokensis* (Ap)	Vegetation over water	Jeffery et al., 2004
Hyla cinerea	*Acanthepeira stellata* (Aa)	Not provided	Lockley, 1990
Hyla crepitans	*Belostoma* sp. (Hb)	Permanent pool	Mijares-Urrita et al., 1997
Hyla ebraccata	*Cupiennius coccineus* (Ac)	Swamp	Szelistowski, 1985
Hyla japonica	*Diplonychus japonicus* (Hb)	Flooded rice field	T. Hirai, unpubl. data
Hyla japonica	*Dolomedes sulfurous* (Ap)	Flooded rice field	T. Hirai, unpubl. data
Hyla japonica	*Laccotrephes japonensis* (Hn)	Flooded rice field	T. Hirai, unpubl. data
Hyla japonica	*Lethocerus deyrollei* (Hb)	Flooded rice field	Hirai and Hidaka, 2002
Hyla jimi	*Belostoma elongatum* (Hb)	Temporary pond	Toledo, 2003
Hyla minuta	*Belostoma elongatum* (Hb)	Temporary pond	Toledo, 2003
Hyla minuta	*Lethocerus delpontei* (Hb)	Permanent pond	Bastos et al., 1994
Hyla minuta	*Dolomedes* sp. (Ap)	Permanent pond	Bastos et al., 1994
Hyla minuta	*Ancylometes vulpes* (Ap)	Permanent pond	Bernarde et al., 1999
Hyla minuta	*Ancylometes gigas* (Ap)	Permanent pond	Bernarde et al., 1999
Hyla miotympanum	*Abedus* sp. (Hb)	Permanent stream	Pineda, 2003
Hyla nana	*Thaumasia* sp. (Ap)	Swamp	Pramuk and Alamillo, 2002
Hyla sanborni	*Diapontia cf. uruguayensis* (Al)	Web over pond	Del-Grande and Moura, 1997
Hyla versicolor	*Argiope aurantia* (Aa)	Web near pond	Steehouder, 1992
Hyla versicolor	*Lethocerus americanus* (Hb)	Pond	Hinshaw and Sullivan, 1990
Litoria caerulea	*Hierodula werneri* (Mm)	Not provided	Ridpath, 1977
Litoria caerulea	*Atrax formidobilis* (Ad)	Not provided	McCormick and Polis, 1982
Litoria ewingi	*Catadromus lacordairei* (Cb)	Not provided	LittleJohn and Wainer, 1978
Litoria lesueurii	*Lycosa lapidosa* (Al)	On the rocks of a creek bed	Raven, 1990
Litoria raniformis	*Archimantis latistyla* (Mm)	Not provided	Ridpath, 1977
Pseudacris crucifer	Diving beetle – unidentified (Cd)	Temporary pond	Hinshaw and Sullivan, 1990
Pseudacris feriarum	*Dolomedes triton* (Ap)	Temporary pond	Mitchell, 1990
Pseudacris ocularis	*Lycosa* sp. (Al)	Ground, near water body	Owen and Johnson, 1997
Scinax alter	*Ancylometes rufus* (Ap)	Over aquatic vegetation	Prado and Borgo, 2003
Scinax alter	*Thaumasia* sp. (Ap)	Water surface	Marra et al., 2003
Scinax cruentommus	Wolf spider – unidentified (Al)	Vegetation over ground	Aucone and Card, 2002
Scinax elaeochroa	*Cupiennius coccineus* (Ac)	Swamp	Szelistowski, 1985
Scinax fuscomarginatus	*Oxyuptychus brasiliensis* (Ah)	Vegetation over pond	Brand,,o and Garda, 2000
Scinax fuscomarginatus	Tarantula – unidentified (At)	Temporary pond	L. F. Toledo, unpubl. data
Scinax fuscomarginatus	Water bug – unidentified (Hb)	Temporary pond	L. F. Toledo, unpubl. data
Scinax ruber	Preying mantis – unidentified (Mm)	Over vegetation	J. L. Guillaumet, unpubl. data
Scinax squalirostris	*Belostoma elongatum* (Hb)	Temporary pond	Toledo, 2003

TABLE 2. Continued.

Anurans (Prey)	Invertebrates (Predators)	Predation microhabitat	References
Scinax sp. (*aff. similis*)	*Belostoma elongatum* (Hb)	Temporary pond	Toledo, 2003
Hyperoliidae			
Hyperolius marmoratus	*Thalassius fimbriatus* (Ap)	Laboratory situation	McCormick and Polis, 1982
Leptodactylidae			
Eleutherodactylus coqui	*Olios* sp. (As)	Above ground	Formanowicz Jr. et al., 1981
Eleutherodactylus coqui	*Oligoctenus ottleyi* (Al)	Not provided	Formanowicz Jr. et al., 1981
Eleutherodactylus coqui	*Phrynus palmatus* (Am)	Not provided	Formanowicz Jr. et al., 1981
Eleutherodactylus coqui	*Tityus obtusus* (Sc)	Vegetation over ground	Villanueva-Rivera et al., 2000
Eleutherodactylus zugi	*Ctenus vernalis* (Ac)	Ground inside cave	Novo et al., 1985
Eleutherodactylus sp.	*Paraponera clavata* (Hf)	Litter	Fritz et al., 1981
Eleutherodactylus spp.	*Cupiennius coccineus* (Ac)	Experimental condition	Szelistowski, 1985
Hylodes phyllodes	*Trachalea keyserlingi* (Ap)	Leaf litter next to a stream	Schiesari et al., 1995
Leptodactylus knudseni *	*Theraphosa lebondi* (At)	Not provided	Boistel and Pauwels, 2002
Leptodactylus labyrinthicus *	*Belostoma elongatum* (Hb)	Temporary pond	Toledo, 2003
Leptodactylus ocellatus	*Lethocerus annulipes* (Hb)	Not provided	Lima, 1940
Physalaemus cuvieri	*Belostoma elongatum* (Hb)	Temporary pond	Toledo, 2003, Brasileiro et al., 2003
Physalaemus fuscomaculatus *	*Belostoma elongatum* (Hb)	Temporary pond	Toledo, 2003
Physalaemus cf. fuscomaculatus *	*Lethocerus* sp. (Hb)	Temporary pond	Giaretta and Menin, 2004
Physalaemus pustulosus	*Sericopelma rubronitens* (At)	Leaf litter	Gray et al., 1999
Physalaemus spiniger	Wolf spider – unidentified (Al)	Temporary pond	L. M. Giasson, unpubl. data
Limnodynastidae			
Limnodynastes tasmaniensis	*Catadromus lacordairei* (Cb)	Not provided	LittleJohn and Wainer, 1978
Neobatrachus centralis	*Selenotypus* sp. (At)	Not provided	Raven, 1990
Neobatrachus centralis	*Selenocosmia crassipes* (At)	Not provided	McCormick and Polis, 1982
Microhylidae			
Microhyla ornata	*Lycosa carmichaeli* (Al)	Not provided	McCormick and Polis, 1982
Myobatrachidae			
Crinia pseudinsignifera	*Aganippe raphiduca* (Az)	Ground, near spider burrow	Butler and Main, 1959
Crinia signifera	*Chlaenius darlingensis* (Cb)	Margin of pond	Robertson, 1989
Uperoleia laevigata	*Chlaenius darlingensis* (Cb)	Margin of pond	Robertson, 1989
Pelobatidae			
Spea multiplicata	*Tabanus punctifer* (Di)	Mud margin of pond	Jackman et al., 1983
Spea multiplicata	*Cicindela sedecimpunctata* (Cc)	Not provided	McCormick and Polis, 1982
Pipidae			
Xenopus laevis *	*Dolomedes triton* (Ap)	Laboratory situation	Rogers, 1996
Rhacophoridae			
Rhacophorus arboreus	*Cybister japonicus* (Cd)	Flooded rice field	T. Hirai, unpubl. data
Rhacophorus schlegelii	*Laccotrephes japonensis* (Hn)	Flooded rice field	T. Hirai, unpubl. data
Rhacophorus schlegelii	*Lethocerus deyrollei* (Hb)	Flooded rice field	Hirai and Hidaka, 2002
Ranidae			
Euphlyctis cf. cyanophlyctis	*Lycosa barmanica* (Al)	Not provided	McCormick and Polis, 1982
Fejervarya limnocharis	*Lethocerus deyrollei* (Hb)	Flooded rice field	Hirai and Hidaka, 2002
Rana cascadae	*Lethocerus* sp. (Hb)	Lake	Nauman and Dettlaff, 1999
Rana clamitans	Wolf Spider – unidentified (Al)	Grass field	Neil, 1948
Rana nigromaculata	*Epomis nigricans* (Cb)	Flooded rice field	T. Hirai, unpubl. data
Rana nigromaculata	*Lethocerus deyrollei* (Hb)	Flooded rice field	Hirai and Hidaka, 2002
Rana porosa	*Lethocerus deyrollei* (Hb)	Irrigation ditch (rice field)	T. Hirai, unpubl. data
Rana rugosa	*Lethocerus deyrollei* (Hb)	Flooded rice field	T. Hirai, unpubl. data
Unidentified anurans			
Frog	*Grammostola* sp. (At)	Not provided	McCormick and Polis, 1982
Frog	*Lasidora* sp. (At)	Not provided	McCormick and Polis, 1982
Frog	*Birgus latro* (Dc)	Not provided	McCormick and Polis, 1982
Frogs and toads	*Mastigoproctus giganteus* (Ut)	Not provided	McCormick and Polis, 1982
Green Frog	*Nephila plumipes* (Aa)	Not provided	McCormick and Polis, 1982
Green Tree Frog	*Nephila plumipes* (Aa)	Not provided	McCormick and Polis, 1982
Leptodactylidae, Brown Frogs	Wolf Spider – unidentified (Al)	Not provided	McCormick and Polis, 1982
Tree Frog	*Dolomedes okefenokensis* (Ap)	Not provided	McCormick and Polis, 1982

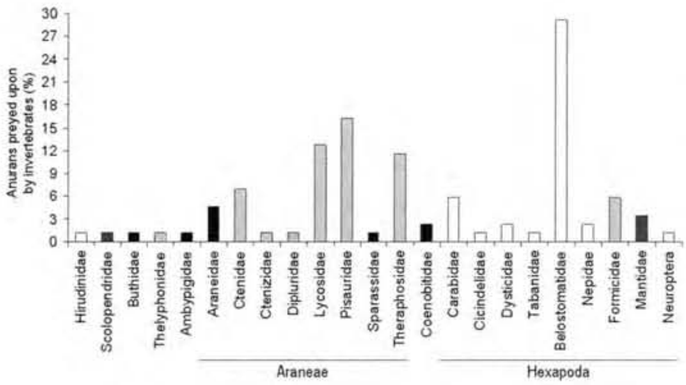

FIG. 2. Percentage of different anuran species that were preyed upon by different invertebrate families based on references listed in Table 2 (N_{total} = 89 accounts). White bars indicate predation events reported to occur in the water; dark bars indicate predation events out of the water; gray bars indicate predation events both in and out of the water; and striped bars represent lack of information on the microhabitat in which the predation occurred.

et al. (2003) provided duplicate reports of the predation of *Physalaemus cuvieri* by the same water bug species (*Belostoma elongatum*) at the same study site. Nevertheless, repeated records may be beneficial as they provide more evidence for an actual predator-prey relationship, and may help determine if any geographic variation occurs in the predator-prey relationship.

Despite the considerable number of reports much more information is likely to appear in the next few years. However, the simple descriptions of a predatory event without providing further details (e.g., microhabitat and prey activity before predation - data that should generally be available to the observers) make future discussions and predictions difficult (see Greene 1993). Therefore, even reports on simple interactions between predator and prey (particularly in the context discussed here) should provide more detailed accounts whenever possible (see complementary discussions in Greene 1986; 1993).

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Application and Evaluation of a Stomach Flushing Technique for Alligators

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Crocodilian diets can be studied by observing what an animal eats, conducting feeding trials on captive animals, performing biochemical and isotope analysis, or by obtaining samples of the ingested food from the stomachs of wild animals. Stomach contents can be obtained post-mortem from specimens killed for that purpose or collected incidentally from commercial harvests. However, many crocodilian species are threatened or endangered and there are ethical and practical constraints on killing animals for study. Therefore, non-lethal methods have been developed to obtain stomach contents from live crocodilians without causing them harm.

Non-lethal methods used to obtain the stomach contents of crocodilians fall into three categories: invasive scoops that mechanically retrieve material through the esophagus (Taylor et al. 1978), irrigation methods that introduce water and flush material from the stomach (Fitzgerald 1989; Taylor et al. 1978) and combinations of these (Webb et al. 1982). These methods vary in effectiveness at recovering all the stomach contents, ease of application in the field and degree of invasive trauma to the animal. The purpose of this study is to evaluate the hose-Heimlich technique (irrigation method) for accuracy and to check for internal damage on American Alligators (*Alligator mississippiensis*). We also report on the effectiveness of the hose-Heimlich technique used during an alligator diet study, and we investigate alternative water sources for use with this technique.

The hose-Heimlich technique described by Fitzgerald (1989) was used to obtain the stomach contents from live adult American

alligators during a diet study at three lakes in central Florida in 2001–2003 (Rice 2004). Alligators were caught from an airboat between 2200 and 0400 h and tagged, weighed, measured, lavaged, and then released back into the lake. We tested the accuracy and reliability of the hose-Heimlich technique in 2001 on 20 alligators, which were lavaged and then euthanized for collection of tissues for another study. We examined the stomach contents at necropsy to determine the proportion of contents previously recovered. In addition, we checked for any damage to the esophagus or stomach caused by the procedure.

To perform the hose-Heimlich technique, each alligator was strapped to a 245 x 31 cm plywood board and placed at an incline, resting on a wood sawhorse. The jaws were secured opened with a heavy-duty PVC pipe (200 mm length, between 60 and 150 mm diameter) of appropriate size. A soft Teflon hose (5–15 mm diameter) coated with mineral oil was inserted through the esophagus and into the stomach. We previously had established by dissection that the fourth whirl of scutes anterior to the hind legs provided an external marker of the posterior end of the stomach allowing proper placement of the hose. The Teflon hose was connected to a garden hose and, subsequently, a water source. The water source was a domestic water supply, or the lake using an electric bilge pump or a 3.5 hp Briggs and Stratton motor driven pump. All sources delivered water at the rate of approximately 50 L/min.

Each alligator was angled down with its mouth positioned over a 68 L bucket. With the hose in the alligator's stomach and the water running, the animal's abdomen was squeezed in a manner similar to the Heimlich maneuver (Heimlich 1975) resulting in the expulsion of stomach contents and water into the bucket. This lavaging process was repeated until only clear water was entering the bucket. The contents of the bucket were poured through a 0.5 mm mesh nylon strainer and collected in 10% buffered formalin in a 1 L plastic jar labeled with lake, date, and identification numbers on each jar.

The hose-Heimlich technique has been successfully used in several studies to obtain the stomach contents from live crocodilians (Barr 1994, 1997; Fitzgerald 1989). Fitzgerald (1989) tested the technique for effectiveness on Spectacled Caiman (*Caiman crocodilus*) and found that it removed 100% of the caiman's food content. However, Fitzgerald (1989) did find that some caiman retained stones in their stomach. In the 20 alligators that were lavaged and then dissected, we found only one instance where the hose-Heimlich technique was incomplete. During necropsy, we found a large piece of gar (*Lepisosteus* sp.) that had blocked the sphincter and thus prevented the exit of water and stomach contents. Therefore, we characterized an incomplete lavaging process by low water and stomach content output, and by bloating of the stomach area that made it impossible to squeeze.

The technique does sometimes cause minor irritations to the alligator's esophagus and cardiac sphincter; however, most of these irritations were minor (Fitzgerald 1989). We also found some abrasions on the alligator's esophagus and cardiac sphincter, but believe that these were minor and temporary. Animals kept in captivity for periods up to 14 months and those recaptured (two recaptures occurred 63 days after receiving the hose-Heimlich technique) appeared normal (Rice 2004).

During the study of alligator diets in three central Florida lakes (Rice 2004), the technique was applied to 162 adult alligators (182–304 cm total length [TL]) and an incomplete sample (described above) occurred four times. The prey obtained varied in size from invertebrates that weighed < 1 g to fishes weighing over 300 g. The technique also was successful in obtaining non-prey items including vegetation, wood, rocks, toys, fishing lures, and fishing line.

Fitzgerald (1989) identified the need for water under pressure as a disadvantage to the hose-Heimlich technique. However, by using a bilge pump or gas powered motor, we adapted the method for use where a domestic water source was unavailable, and both alternate water sources worked as well as a domestic water source. Barr (1997) also used a portable water pump to flush hundreds of alligator stomachs.

The hose-Heimlich technique proved to be most effective on alligators ≤ 290 cm TL. Two separate attempts to lavage alligators 304 cm TL failed because we were not strong enough to squeeze the alligator's large abdominal area. The largest alligator that was successfully lavaged was 290 cm TL. The largest caiman Fitzgerald (1989) tested the hose-Heimlich technique on was 108 cm snout–vent length (ca. 216 cm TL) and the largest alligator Barr (1997) sampled was 317 cm TL; however, most of Barr's (1997) study animals were < 152 cm TL. When examining the diet of large alligators (i.e., > 290 cm TL), it might be advisable to use an alternate technique.

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A Photographic Method for Quantifying Color Characteristics and Color Patch Dimensions in Lizards

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Knowledge of animal coloration is of central importance to understanding sexual selection, predator-prey relationships, and thermoregulation (Cloudsley-Thompson 1999; Endler 1990; Norris 1967). However, describing animal color signals is a conceptual and technical challenge. Two sets of methods have been primarily used to meet this challenge: human-based (e.g., Zucker 1988) and spectrophotometric methods (Endler 1990).

Munsell color chips are a human-based method often used to quantify animal colors (e.g., Zucker 1988). This method involves matching by eye samples of printed colors to animal colors. These colors are quantified by assigning them a hue (or dominant wavelength), saturation (or purity of color), and brightness (or total reflectance across a given bandwidth) based on a match to a color chip with those values. However, because such measures are subjective, both intra- and inter-observer repeatabilities of scores are likely to be low. Another difficulty is that low intensities of ambient light can lead to several colors of different hues, saturations, and brightnesses appearing identical to a human observer. The quality of ambient light can also be problematic: in a forest where green light is reflected from trees, a white surface will appear green (Endler 1990). Another limitation of color chips is that they offer discrete choices for continuously varying hue, saturation and brightness. Finally, any human-based method ignores the fact that two colors that appear identical to a human observer might be perceived as different by another animal due to varying retinal sensitivities. Therefore, color methods based solely on human abilities have only limited power to determine the color variation that other animals perceive.

Spectrophotometry (Endler 1990), while much more objective than human based observations, also has limitations. Unlike human-based methods, spectrophotometry can be used to analyze colors well outside the gamut of those perceptible to humans. However, as with color chips, spectrophotometers only take point measurements of reflectance spectra, and thus cannot analyze color patch sizes and color patterns. Additionally, spectrophotometry is logistically difficult and invasive, since it requires capturing an animal and restraining it under a sensor. This drawback may be particularly problematic for lizard color analysis, since some lizards change color rapidly when handled (Norris 1967).

We present a new method for quantifying animal colors and their substrates using digitized photographs. While this method may not capture all the color variation perceived by any given animal, it offers advantages over other methods in that it is objective, allows for analyses of color patterns rather than single points, and allows determination of the size of a color patch. It may also be used to quantify dorsal colors of animals and that of their backgrounds in nature without capture. This method differs from most previous photographic-based methods in that other methods have either used subjective assessments of photographs (West and Packer 2002), or have quantified unstandardized photographs (Haeger 2002). We present data from analyses of color pattern variation in Ornate Tree Lizards (*Urosaurus ornatus*). This study has two objectives: to present a method for color analysis of photographs, and to apply these methods to two specific instances of color analysis in *U. ornatus*. We further suggest photography-based techniques that are not limited by human-visible spectra as measured by typical photographs.

Study Animals.—Ornate Tree Lizards (*U. ornatus*) have been the subject of numerous accounts of how color patterns may be used in conspecific signaling. Hover (1985), as well as Thompson and Moore (1991), described how gular (= throat) color badges may influence dominance relationships. These authors categorized male tree lizards into two groups: lizards with a patch of blue or green surrounded by a ring of yellow or orange were categorized as 'orange-blue' males that assumed a dominant social status. Alternatively, 'orange' males were those that did not have a distinct central patch and were submissive in social interactions (Thompson and Moore 1991). These authors defined an orange-blue male as one that had more than 10% of his total gular patch comprised of the central blue patch, whereas an orange male was one that had less than 10%. These operational definitions apply to most animals in some populations (P. Hamilton, pers. obs.; Thompson and Moore 1991). However, some individuals do not readily fall into either the orange-blue or orange categories. This includes males that have two distinct colors that blend together, rather than forming a distinct central and peripheral color, and males with a yellow central patch with an orange periphery and those with a purplish center and an orange periphery (Fig. 1e).

Tree lizards have been the subject of study for another color-based intraspecific signal, termed dorsal darkening (Zucker 1994). Zucker (1994) found that once a male gained a dominant status, it would exhibit a dark dorsal color, while losers of dominance interactions displayed a lighter color resembling that of females. Dorsal darkness was measured by comparing a lizard's dorsal color to that of a grayscale standard. Subjectivity is a concern here. If the scorer of such colors knows the contest outcome and then scores darkness, such scores may be biased. Furthermore, in order to be blindly scored by naive observers, the lizard must be removed from its social setting, which can cause the dorsal color to change rapidly from handling stress (Norris 1967). Thus, as for gular colors, there is a need for an unbiased, quantitative measure of color for analyses of dorsal darkness that reduces or eliminates the potential effects of handling stress.

Although Ornate Tree Lizards vary extensively in color characteristics, this study is not intended to characterize all, or even most, of the color variation found. Rather, it is an attempt to apply a new technique to specifically describe throat types and dorsal darkness. Thus, we shall only present data that bears on variables

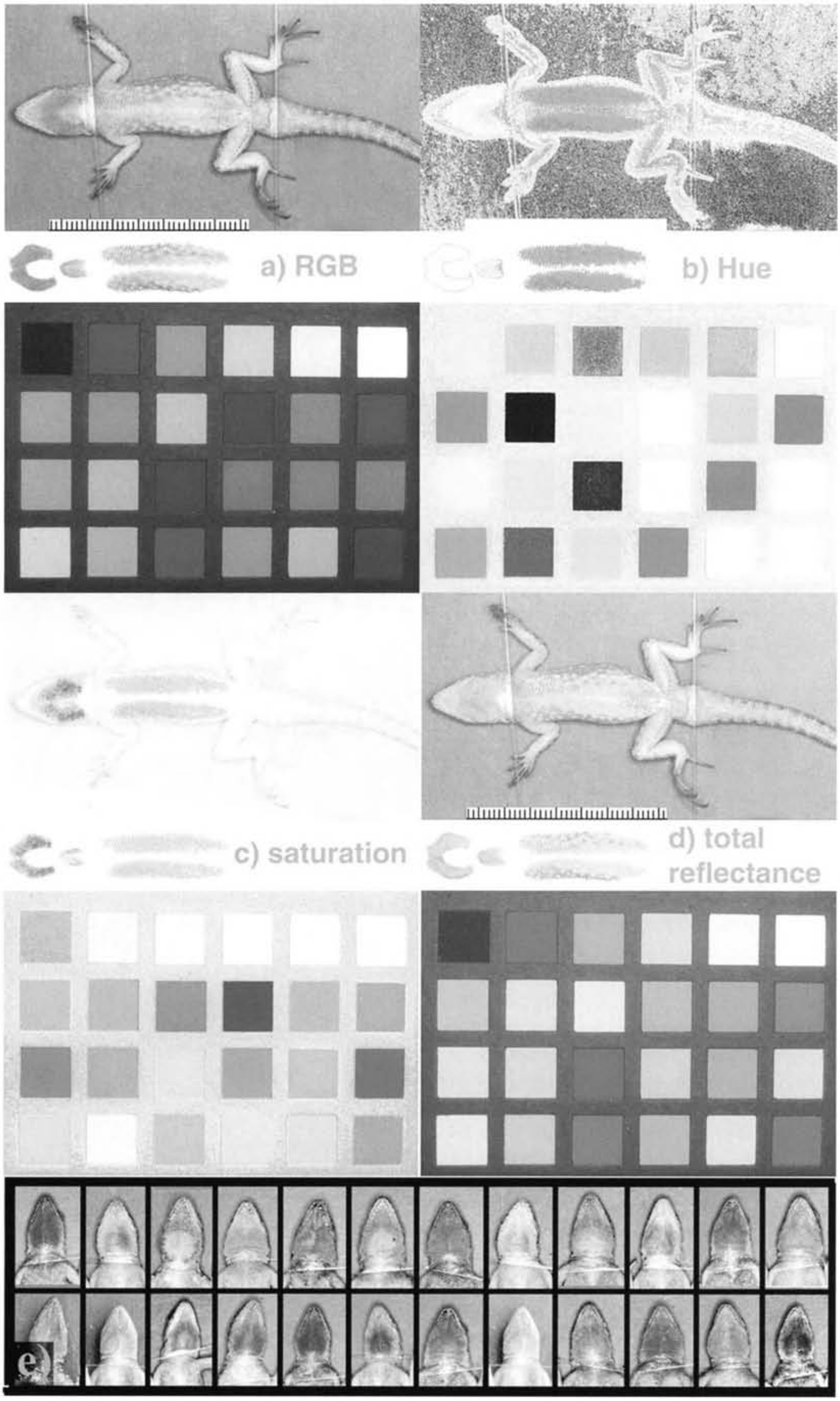

FIG. 1. A digitized image (a) is separated into three digital layers: b) Hue, c) saturation, and d) total reflectance are each represented as optical density. E) A representative sample of throat colors in Ornate Tree Lizards from Sierra Estrella, Arizona, USA.

that have previously been used to describe these traits: hue and size of gular color patches, and reflectance of the dorsum.

Methods and Materials

The lizards used in this experiment were collected from the Estrella Mountain Regional Park in Maricopa Co., south-central Arizona. Two analyses were performed. The first used photographs of tree lizard venters to quantify gular colors. The second used photographs of unrestrained male and female lizards in the field to obtain darkness of both lizard dorsums and backgrounds.

Colors in a photograph are subject to variation in ambient lighting, exposure, type of film, processing and other factors, and therefore standardization of each photograph is necessary. This is accomplished by taking additional photographs of a color standard (GretagMacbeth 1998) with lizard photographs (Figs. 1, 2).

For ventral photographs, Kodachrome ISO 64 transparency film was used with a fully manual SLR camera, so that each photograph was taken with the same exposure and aperture (f-stop 11, shutter speed 1/60). All photographs on a single roll of film were taken under identical conditions: either under photographic lamps indoors; or in the field, under shade, using a macro ring-flash with a manual setting (Vivitar 5000 Macro Flash). Each photo on a single roll of film was taken with the same subject to camera distance and the camera in a fixed position on a tripod. These procedures virtually eliminated the effects of ambient lighting, as was demonstrated by shooting exposures with the same setting without flash or lamps which resulted in nearly black photographs. A photograph of the color standard (Fig. 1) was taken at the beginning of each roll, serving as a standard for the subsequent photographs of lizards. Ventral photographs were taken of 43 male tree lizards, while they were restrained on top of an 18% neutral gray background (Fig. 1) along with a mm ruler.

For dorsal photographs, Kodachrome 200 transparency film was used with a fully manual SLR camera and a telephoto lens on a tripod. All dorsal photographs were of free-ranging tree lizards in situ (Fig. 2), that had been previously bead-marked (Fisher and Muth 1989), allowing identification of individual lizards. The lizard was then replaced by the color standard, which was also photographed (Fig. 2) using the same settings and conditions of the previously photographed lizard. This assures consistent exposure, aperture and lighting of each lizard photograph with the respective color standard photograph. We present data here on 233 male and 91 female tree lizards. To avoid psuedoreplication, individual lizards were used only once in each analysis presented here (dorsal and ventral color).

The film was developed into transparencies (slides), using the same developer (A&I, Hollywood, California, USA; K-14 Process) to assure consistency of quality. Transparency photographs of the lizards and color standard were digitized by scanning each image of the lizard and color standards with a transparency scanner (CanoScan FS2710), resulting in a 3600 x 2400 pixel RBG digital image. All automatic and color correction options on the scanner and software were turned off. Digital imaging software (Scion Image, available at: http://www.scioncorp.com; although this software has now been replaced by ImageJ: http://rsb.info.nih.gov/ij/) was used to correct for color biases in lizard photographs by calibrating with the respective known values of the color standard. We accomplished this by separating each image into three digital layers which represent hue, brightness (or % reflectance) and chroma (or saturation) each as optical density (Fig. 1). The hue and brightness layers were calibrated by using regressions between the actual hue and brightness of the color standard and the optical density of hue and brightness layers, respectively. This was done with the 'calibration' function in Scion Image. The actual hue values were those provided with the color standard. Reflectance of the gray samples in the standard were determined empirically with spectrophotometric analysis (results not presented,

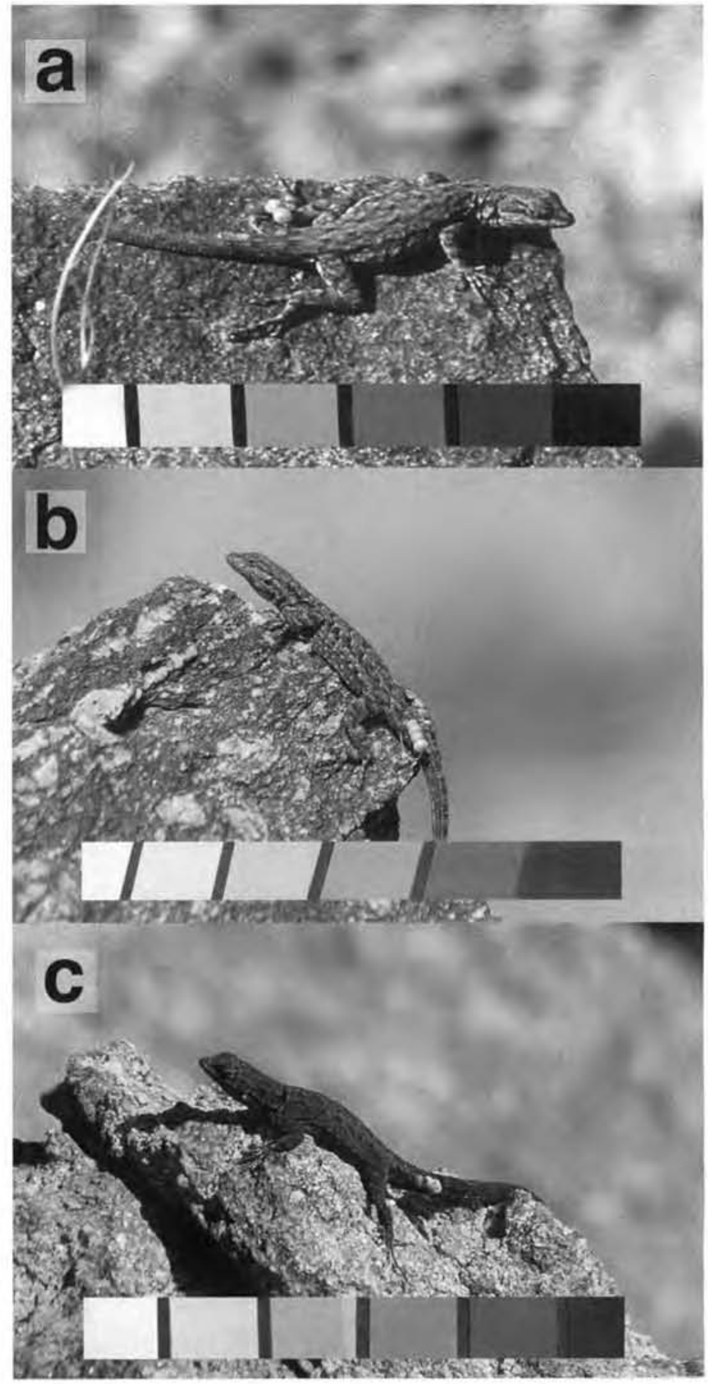

Fig. 2. Examples of three lizard photographs and their corresponding photographs of a color standard: a) female, b) light colored male, and c) dark male. Grayscales taken with each lizard photograph are included as insets in each photo.

data available upon request). Scion Image allows for the calibration regressions to be linear or nonlinear. Most of the calibrations used in this study were linear, and some were a second or third degree polynomial. The choice of model depended on the shape of the correction curve, and some corrections achieved a higher R^2 for this regression with a nonlinear correction model. The calibrations attained from photos of the color standard were then applied to lizard photographs, thus removing the potential biases of film, developing, and digitizing, from the images.

Using the 'measure' tool in Scion Image, optical density of a color patch in either the hue or brightness layer was then measured, resulting in either a hue score between 0–360 representing the 360 degrees of a color wheel, or a brightness score of 0–100%, representing total percent reflectance across the entire visible spectrum. Spatial scale was calibrated using the mm ruler in each ventral photo and the 'Set Scale' option in Scion Image. Using photos thus corrected for hue and linear measurements, we measured size and hue of both inner and outer throat patches. Using photos corrected for reflectance, we measured percent reflectance of both the lizard dorsum (excluding the head, neck, legs and tail) and a representative sample of rock background (Fig. 2).

Results

Digitally derived hues of throat patches and digitally measured reflectance of dorsal darkness were highly correlated with values of the color standard. The average regression between known hue values and hues obtained from photos for throat patches resulted in a $R^2 = 0.95$. The average regression for dorsal darkness had an R^2 of 0.98. These measures indicate a high degree of accuracy in predicting hue and darkness, respectively.

Analysis of throat patch sizes and hues of male tree lizards at Sierra Estrella revealed a great deal of continuous variation (Figs. 1, 3) with some individuals that could be categorized as monomorphic for throat hue. These individuals were at 0% difference in hue degrees between patches. Individuals were categorized as having either more or less than 10% of their throat patch made up of a central color, although there was a large amount of variance in this variable, with several individuals possessing central patches comprising 40% or more of the total patch.

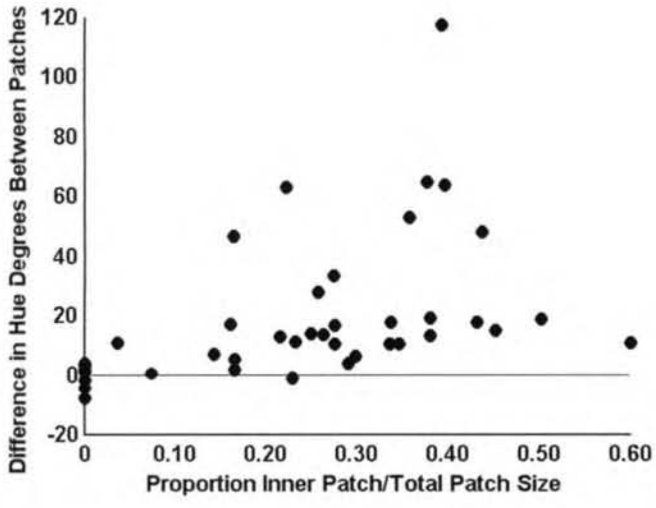

Fig. 3. Throat colors of male Ornate Tree Lizards, as described by contrast in hue and size proportion of the central and peripheral throat patches.

From the dorsal reflectance analysis, both sexes tended to have low percent reflectances, usually below 10% (Fig. 4). Furthermore, the backgrounds they rested on had similarly low reflectance, and females rested on slightly darker backgrounds than males, although not significantly so (two-tailed t-test, $p = 0.220$). Last, males tended to be darker than females (one-tailed t-test, $p = 0.002$, Fig. 4).

Discussion

Throat Color.—This study found that male tree lizards at Sierra Estrella exhibit largely continuous variation in the two throat patch variables: difference in hue between the inner and outer patch and proportion of the total patch comprised of the inner patch. Some individuals could be unambiguously assigned to a monomorphic throat class: those individuals that intercepted the y-axis in Fig. 3. However, among other individuals, considerable variation existed in both size and hue axes. Many individuals had a large inner patch (e.g., >30% of the total patch size) and possessed an inner patch that either perfectly matched, or greatly contrasted with, the outer patch in hue. This continuous variation in throat colors differs from the dichotomous morphs described in Thompson and Moore (1991). The discordance between studies might reflect differences in methodologies or geographic variation in signal design. Application of the methods described herein to several populations might address these possibilities.

Dorsal Darkness.—Males and females showed variation in dorsal reflectance, and males were darker than females. These data agree with those of Zucker (1994), who found that male tree lizards in some populations change color to signal social status. Further application of these methods will reveal if darker males may be sacrificing the degree of crypsis exhibited by females in order to convey their dominance status. Furthermore, because dark coloration might incur thermoregulatory cost, with darker animals heating faster (Norris 1967), dorsal darkness might indicate a handicap or honest signal. This is another possibility that might be explored using these techniques.

Color Methods.—The methods described herein allow simultaneous examination of patch size, shape, hue and brightness. These techniques allow quick and objective measurements to be taken of animal colors, and for dorsal colors, without the stress of handling. The high R^2 values for calibration of hue and reflectance obtained here show that the values obtained are consistent and accurate. These accuracies were consistent with different cameras, lenses, films (two types mentioned above), developers (as tested with an additional developer not used in the results herein), as well as ambient (sun, clouds, etc.) and artificial (lamps vs. flash) lighting. Data not presented here indicate that saturation of color, or 'chroma' may similarly be estimated with such methods with an R^2 of 0.80 (P. Hamilton, unpubl. data). It is important to note that the method described herein does not account for UV (ultraviolet) signals. This is not likely a limitation in the study system described here given that color patches of *U. ornatus* do not contain a strong UV signal (P. Hamilton and J. Macedonia, unpubl. data).

An obvious extension of these methods would be to use digital photography, rather than digitizing film photographs. There should be no problem applying such methods, with the one exception

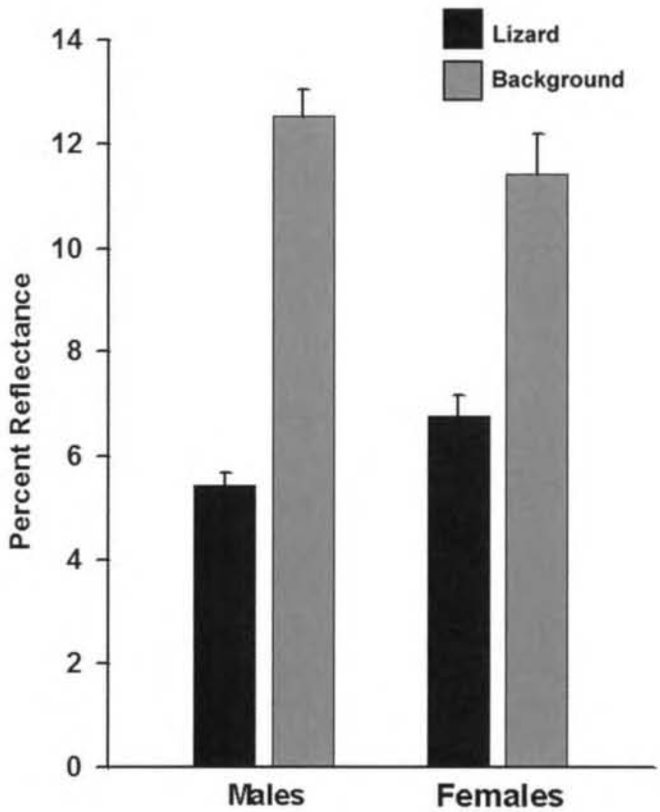

FIG. 4. Dorsal reflectance of male and female Ornate Tree Lizards, and their respective backgrounds.

that each photograph of an animal needs to be taken exactly the same as that of the standard. Many digital cameras do not offer such capabilities, and in particular, flash output can not always be standardized. Further methodological advances using similar methods may be able to measure additional spectral information, such as UV, from digital images. Another potential application of such methodology would be by applying various photographic filters, one may selectively measure reflectance of a specific wavelength (Chiao et al. 2000). Thus, a grayscale image can be produced in which the value of each pixel represents the reflectance of the UV bandwidth, the range of spectral sensitivity for a particular photoreceptor, or any other bandwidth of concern. Thus, one could obtain images that exactly correspond to an animal's perception of color (e.g., Webster and Mollon 1997). Such methodology could also be extended to produce images that match the perception of potential competitors or predators (e.g., Sumner and Mollon 2003).

In summary, analysis of animal color patterns in nature is fraught with conceptual and logistical difficulties. Researchers have generally dealt with animal color quantification in one of two ways: human-based (color chips) and technology-based (spectrophotometric) methods. A third alternative, that contains elements of each traditional method, uses standardized digital images. By the careful application of a photographic standard, one can eliminate nearly all potential biases in photographs (e.g., lighting, film, developing, digitizing). It is possible then to extract from such photos the three variables commonly used to classify colors: hue, brightness, and saturation. Additionally, dimensions of color patches may be simultaneously evaluated. We use such methods to evaluate two applications of lizard color quantification: throat polymorphism and dorsal darkness in Ornate Tree Lizards, *Urosaurus ornatus*. For throat polymorphism, we measured the size and hue of throat color patches in male *U. ornatus*. This allowed us to evaluate a new quantitative and objective method for traditional ranking of throat polymorphism types. For dorsal darkness, we evaluated dorsal reflectance of free ranging tree lizards, and described the variation found in this elusive, plastic character. These methods could easily be applied to similar systems in which classification of colors is crucial to hypothesis testing, such as *Uta stansburiana* (e.g., Sinervo and Lively 1996). Additionally, studies of the effects of color on thermoregulation (e.g., Pearson 1977) could benefit from the application of techniques that can assess total reflectance as an indicator of solar energy absorption of animals *in situ*.

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A New Trap Design to Sample Small Terrestrial Lizards

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A variety of techniques have been proposed to facilitate collecting small lizards including pitfall and wire-mesh traps (Doan 1997; Simmons 1987), sticky traps (Glor et al. 1992; Whiting 1998; Downes and Borges 1998), and baited traps (Zani and Vitt 1995). Several specialized techniques for capturing lizards have been developed as well including the use of sticky poles (Durtsche 1996), mechanical grabbers (Witz 1996), an exotic Vietnamese trapping technique (Ziegler 1999), and mesh barriers to facilitate hand capture (Paterson 1998). However, each of these methods has limitations for capturing some lizard species. Here we describe a relatively simple trapping method, a tube-trap, to capture small terrestrial lizards that use small mammal burrows or similar terrestrial crevices as retreats.

The tube-trap is constructed from a 2-L plastic bottle to form a transparent cylinder approximately 160–180 mm long and 30–35 mm in diameter. The top and bottom of the bottle are cut off to obtain a rectangle approximately 110 x 180 mm and the long edges are fastened together with glue to form a cylinder (Fig. 1). A circle end cap is glued from the outside to one end, and from the other end a transparent door is attached by two fine wires that allow the door to swing in but not out. The diameter of the door should be slightly smaller (2–3 mm) than the diameter of the cylinder. A ring 3–4 mm in width is glued to the outside of the door end to prevent the door from opening outwards. The end cap, ring, and door are made from another 2-L bottle.

We tested this trap during June–July 2002 in South Urals, Russia on the sand lizard *Lacerta agilis*, primarily in steppe and semi-forest habitats. In the field we chased lizards into refuges such as holes or crevices in the ground. Then we set the traps into these holes with the door end of the tube facing into the hole (if the crevice was too large relative to the trap, soil was used to fill in the gaps). We left the trap for 1.5 h while searching for other lizards. Within this time, lizards emerged from deep within their retreats and entered the tube-traps by pushing the door inwards as they attempted to reach the surface. The one-way opening of the door does not allow animals to escape from the trap. The tubes are easy to monitor for captures because they are transparent.

Our total sampling period was 20 d (1260 trap/h). We set nine traps for 7 h (1000–1700 h) daily and checked them every 1.5 h. All animals found in the trap were removed and later released. No mortality was observed. Thirty-nine animals were captured in the tube-traps: nine males (23.1%) and 30 females (76.9%). Therefore, the tube-trap appears to be an effective tool for capturing these small lizards in terrestrial retreats.

There are several advantages of the tube-trap design: it is simple and inexpensive to make, compact and easy to transport, it can be positioned in a variety retreats, and it does not injure animals or require that they be removed from glue. Thus, the tube-trap should be useful for surveying and monitoring populations of other terrestrial lizards.

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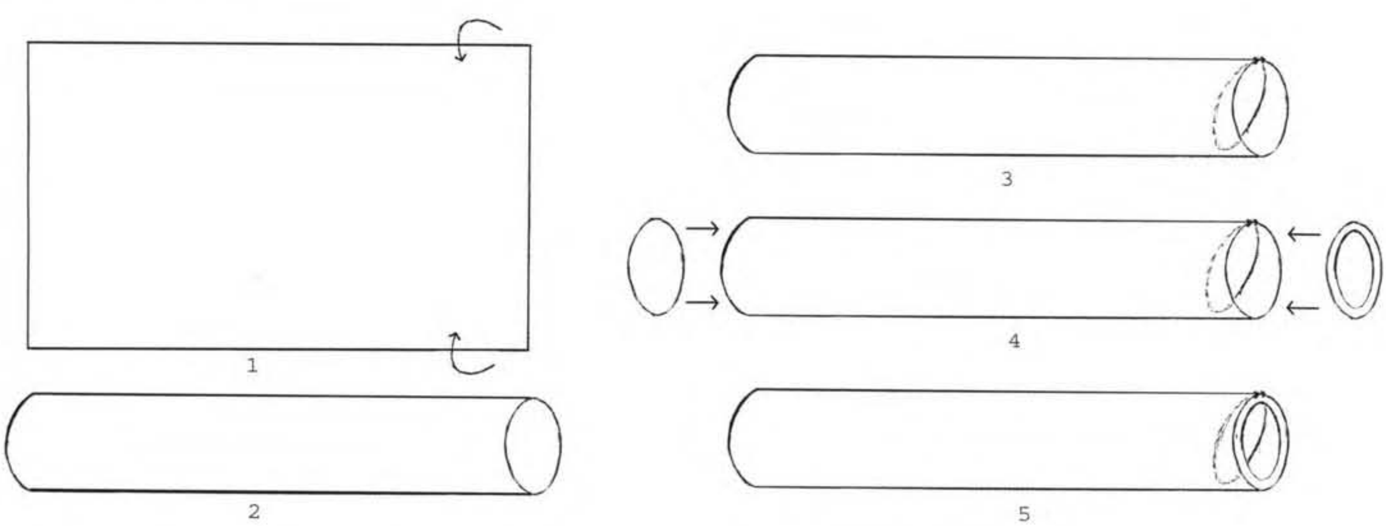

FIG. 1. Steps in the construction of the tube-trap. 1–2: cut off top and bottom of 2-L plastic bottle and form the rectangle into a tube; 3: attach circular plastic door (slightly less than diameter of tube) to one end of the tube using fine-wire as a hinge; 4: glue plastic circle onto opposite end and glue plastic ring outside the door to prevent the door from swinging out; 5: completed tube-trap.

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Marking Hatchling Turtles via Intraperitoneal Placement of PIT Tags: Implications for Long-term Studies

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Turtles provide excellent models for ecological, evolutionary, physiological, and toxicological studies of long-lived animals. In such studies, it is often necessary for individual turtles to be marked for long-term identification. Several techniques exist for permanently marking individuals, including notching or drilling of the carapace, external attachment of metal or plastic tags, and internal injection of a coded, Passive Integrated Transponder (PIT) tag. Each of these methods has advantages and disadvantages, depending on research goals and study duration. While carapace alteration has been successfully used in numerous population-level studies (e.g., Cagle 1939; Gibbons 1987), there is a finite number of mark combinations, limiting the number of animals that can be identified. Furthermore, marks may become obscured or indistinguishable from marks resulting from natural shell damage, and physical disfigurement of animals may be undesirable. External tags, which have been used most extensively in sea turtle research, may be lost or rendered unreadable after only a few years (Balazs 1985, 1999; McDonald and Dutton 1996).

An alternative to the above marking methods is the use of implanted PIT tags, inert glass-encased microchips and electromagnetic coils encoded with unique alphanumeric labels, which are activated and recorded by a handheld reader. The PIT tag system is undoubtedly a superior method for animal marking with respect to long-term retention and readability. When properly implanted, these tags rarely corrode or break, and will theoretically remain operable for the lifetime of the individual. One-hundred percent tag retention and readability over an extended period of time with an absence of detectable negative effects on marked animals have been reported for several reptile species, including caiman (Dixon and Yanosky 1993), Leatherback Seaturtles (McDonald and Dutton 1996), Red-eared Sliders (Buhlmann and Tuberville 1998; Runyan and Meylan, *in press*), Florida Cooters and Florida Red-bellied turtles (Runyan and Meylan, *in press*), and garter snakes (Keck 1994).

A drawback to the use of PIT tags is that animals marked only in this manner are not readily identifiable as study animals without the proper scanning device. This problem is easily remedied by combining PIT tagging with a visible external mark common to all tagged animals, if appropriate. While the costs of employing PIT tagging was once prohibitive for many research programs, recent reductions in cost have made the systems affordable to a greater number of investigators. Currently, PIT tag scanners may be purchased for less than US $400 and tags for approximately US $4–$6 each.

Specifically, marking of hatchling turtles in a manner that will remain unambiguous over long time periods presents a unique challenge. Techniques used for marking large juvenile or adult turtles generally are inappropriate for very small individuals. Often it is difficult to notch the carapace of a hatchling turtle so that the mark will remain discernable as the individual grows, and placing a metal or plastic tag on rapidly-growing external tissues can exacerbate the risk of tag loss and possibly impede movements by the juvenile. Whereas PIT tags have been successfully implanted into adult turtles in shoulder muscle (Balazs 1999), the inguinal region of the body cavity (Buhlmann and Tuberville 1998), and subcutaneously into a limb (Balazs 1999; Willem Roosenburg, pers. comm.; pers. obs.), the current minimum size of available PIT tags (2 mm diameter x 12 mm long) precludes intramuscular or subcutaneous insertion into hatchlings without causing severe trauma. Thus, in this study we explored an alternative technique for implanting PIT tags into hatchlings that would minimize trauma while remaining detectable for a long period of time.

We tested the efficacy of insertion of PIT tags into the peritoneal cavity of juvenile Painted Turtles (*Chrysemys picta*), as has been done successfully in hatchling caiman (Dixon and Yanosky 1993) and snakes (Keck 1994). We were interested in determining whether hatchling turtles could be tagged in such a manner without affecting survival or growth. Additionally, we monitored tag retention and readability for nearly one year following implantation.

Turtles used in this study were four weeks post-hatching (absorption of external residual yolk was complete) and were derived from five laboratory-incubated clutches. The clutches were obtained from gravid *C. picta* females caught between 22 May and 7 June 2002 in southern Maryland. Oviposition was induced using intraperitoneal injections of oxytocin at a dosage of 20 IU/kg (Ewert and Legler 1978). We randomly selected eight individuals to be tagged from a pool of 18 hatchling turtles. Hatchlings were randomized in such a manner that at least one individual from each clutch was included in each of the two treatment groups. Wet mass and carapace length (CL) of each individual were measured prior to insertion of PIT tags, at the time of tagging, and on three subsequent dates. When size variables were later analyzed it became apparent that average initial sizes of tagged individuals exceeded

TABLE 1. Summary statistics and comparisons of juvenile traits in tagged and untagged individuals. Results are presented as means ± 1 SE (when applicable). CL = carapace length.

Treatment	$N_{initial}$	Initial mass (g)	Initial CL (mm)	Survival (%)	Final mass (g)	Final CL (mm)	Instantaneous growth rate (mass: g^{-1})	Instantaneous growth rate (CL; mm^{-1})
Tagged	8	4.75 ± 0.18	24.9 ± 0.30	87.5	13.38 ± 2.49	39.0 ± 2.7	0.079 ± 0.016	0.032 ± 0.01
Untagged	10	3.81 ± 0.16	23.1 ± 0.25	80	11.88 ± 2.23	36.9 ± 2.8	0.084 ± 0.16	0.033 ± 0.01
		P = 0.001	P = 0.001		P = 0.661	P = 0.590	P = 0.829	P = 0.937

those of untagged individuals. Mean initial measurements (± 1 SE) for wet mass and CL were 4.75 ± 0.18 g and 24.9 ± 0.30 mm for tagged individuals and 3.81 ± 0.16 g and 23.1 ± 0.25 mm untagged individuals (Table 1). The differences in both initial mass and initial CL were statistically significant at the beginning of the study, yet sizes of the two groups had converged by the end of the study (Fig. 1). Both the long duration of the experiment and the nearly identical growth rates and trajectories of the two groups (Table1, Fig. 1) suggest that initial size differences did not influence the results.

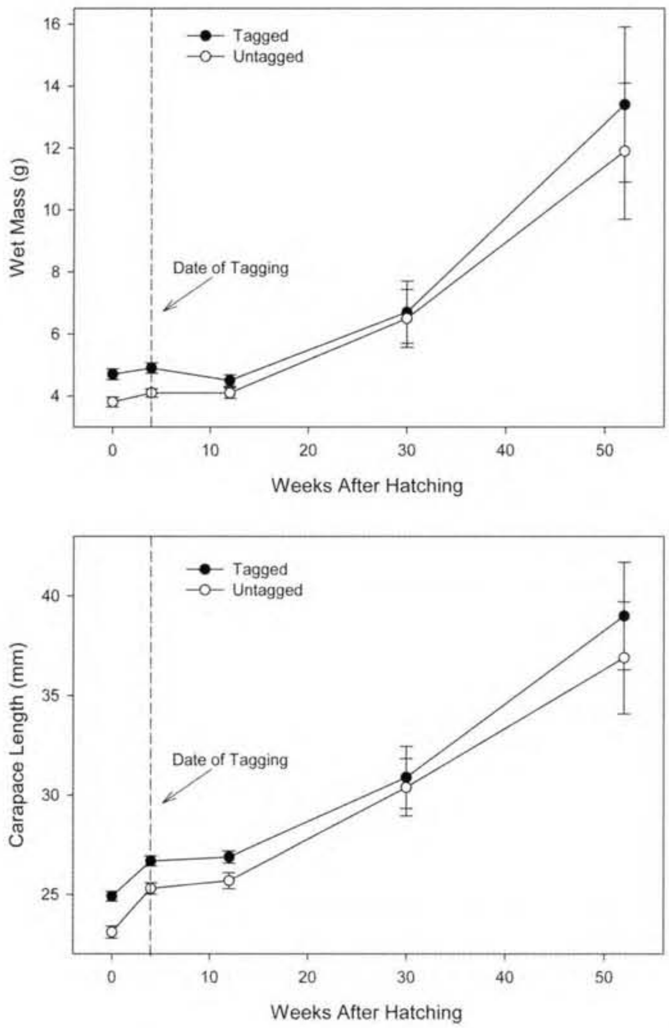

FIG. 1. Growth trajectories based upon change in mass (upper panel) and change in carapace length (lower panel) for tagged and untagged *Chrysemys picta* hatchlings monitored from August 2002 until September 2003 at the Chesapeake Biological Laboratory in Solomons, Maryland. Data presented are means ± 1 SE.

Individuals to be tagged were blotted dry and the skin of the left inguinal fossa was cleaned with a topical antiseptic (10% povidone-iodine solution). A sharp 1 mm internal diameter PIT tag insertion needle and tag (1 x 12 mm, model TX1400L, Biomark Inc., Boise, Idaho), and a blunt probe were soaked for ca. one minute in 91% isopropyl alcohol prior to loading the tag into the needle. After extending the left hind leg, the needle was placed beveled-edge upwards against the taut abdominal skin midway between the limb and the plastron. Pressure was gently applied until only the bevel of the needle pierced the skin. Thus the shaft of the needle did not enter the body cavity, minimizing wound size and potential contact with internal organs. As the needle was maintained in position, the tag was slowly pressed through the incision using the plunger of the needle until the tag was completely expelled from the needle. The result of this procedure was insertion of the PIT tag into the peritoneal cavity, with the rearmost portion (< 1 mm) of the tag protruding through the incision. The sterilized blunt probe was then used to gently push the protruding end of the tag into the cavity.

We observed no blood loss during or after the tagging procedure, probably because integumentary and peripheral vascularization is minimal in this region of the body. Immediately after insertion of the tag, the incision was cleaned with 10% povidone-iodine solution, re-dried, and treated with an antiseptic liquid bandage containing 1% 8-hydroxyquinoline (New Skin™, Medtech, Jackson, Wyoming) which served to seal the incision and protect it from infection. Tagged individuals were placed in individual 800 ml plastic containers that contained a paper towel moistened with a 5% dilution of household chlorine bleach in well water. At two-day intervals over the following ten days, individuals were retreated with New Skin and the towels were replaced.

During the first few days of the ten-day post-operative period, the tags in two individuals were partially expelled from the body cavity (< 2 mm extended outside of the body cavity). These tags were gently re-seated with a sterile probe prior to being re-treated with povidone-iodine solution and New Skin™. Note that in subsequent work with adults of other species in which tags were placed subcutaneously in a limb, we have found that the use of an adhesive (Locktite™ Super Glue, Henkel Consumer Adhesives, Avon, Ohio) similar to that currently used in human medicine (e.g., Wood et al. 1992) resulted in 100% tag retention over 3–4 week post-tagging. Thus this product might prove more effective for closing tagging sites than the compound employed in the current study. At the end of ten days, all tagged individuals were examined to ensure that the incision had visibly closed. Additionally, all individuals

received unique identifications painted onto the carapace using non-toxic acrylic paint that was reapplied as needed. None of the animals in either group was fed until after the 10-day period because hatchlings of this age were likely still resorbing internal yolk stores (despite prior absorption of the external portion of yolk).

Following the post-operative holding period, mass and CL were measured in tagged and untagged individuals, and then all turtles were released into a common holding tank containing 19 L of well water. This and all subsequent measurements of mass of tagged turtles were corrected for the mass of the tag. Turtles were fed and water was changed at two to three-day intervals for the duration of the study. Food consisted of a gelatin-based aquaculture fish food containing 50% protein (Aquatic Eco-systems, Apopka, Florida) mixed with ground whole fish and shellfish. During the study, the laboratory in which the turtles were held was maintained between 21 and 24°C and light was provided by overhead fluorescent lights (12 hours light:12 hours dark) supplemented with natural light from a southwest-facing window 2 m from the holding tank.

Individuals were measured and weighed at 1, 4, and 11 months post-tagging. Turtles were also scanned to verify tag retention using a Biomark Pocket Reader EX (Biomark Inc., Boise, Idaho) and examined for general health.

Final wet mass, CL, and growth rates were compared using two-sample *t*-tests. Instantaneous growth rates in mass and CL over the course of the study were calculated as:

$$[\ln(\text{final mass or CL}) - \ln(\text{initial mass or CL})] / 11 \text{ months}$$

(Ricker 1979)

A Type I error rate of $\alpha = 0.05$ was used for all statistical tests.

All animals retained their tags for the duration of the study and we were successful in detecting all tags with the scanner. One turtle partially expelled its tag (< 1 mm protruded through the skin) during the first month after release into the holding tank. This tag was re-seated as described above. Survival, wet mass, and CL did not differ between treatments (Table 1). Growth trajectories are shown in Figure 1. Instantaneous growth rates over the course of the study did not differ between tagged and untagged individuals (Table 1). We did not observe any detectable changes in behavior between groups that might influence survival probabilities of turtles released into the wild.

The results of this study suggest that PIT tags can be successfully injected into the peritoneal cavity of hatchling turtles without affecting growth and survival. Because *C. picta* is characterized by relatively small hatchling body sizes, it is likely that this technique could also be applied to other species characterized by small hatchling size.

The study was terminated in August 2003, when the turtles were one year post-hatching, and therefore we do not know how much longer the tags would be detectable by the scanner. As the turtle grows, it is possible that the tag will become more difficult to detect because of the addition of bone and flesh that might block communication between the tag and the scanner. However, used on full power and in optimal orientation to the body, most PIT tag scanners have a communication distance of 6–30 cm, depending upon the type of scanner used (www.biomark.com). In addition, the other investigations cited in this report suggest little migration of PIT tags from their original implantation site. For example, Buhlmann and Tuberville (1998) and Keck (1994) found that PIT tags injected into the body cavity become attached in place by coelomic membranes or other connective tissues, minimizing migration and potentially allowing identification of individuals as they achieve a considerably larger size. Because our study lasted less than one year, we do not know how long the PIT tags would remain detectable as the turtles grow beyond the size achieved here.

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Increases in Capture Rates of an Aquatic Snake (*Seminatrix pygaea*) Using Naturally Baited Minnow Traps: Evidence for Aquatic Funnel Trapping as a Measure of Foraging Activity

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The secretive nature of most snake species can hinder efforts to understand aspects of their ecology and population biology unless systematic capture techniques are employed and potential sampling biases are recognized (Parker and Plummer 1987). For herpetofauna other than snakes (e.g., amphibians, lizards, and turtles) numerous studies of collecting methods and sampling regimes have resulted in standardized methods, with well-elucidated biases (e.g., Dodd 1991; Dunham et al. 1994; Gibbons 1990; Heyer et al. 1994; Willson and Dorcas 2004; Willson et al. 2005). Several collection techniques have been used successfully for terrestrial snakes (reviewed in Fitch 1987, 1992), such as terrestrial drift fences with pitfall and funnel traps (Gibbons and Semlitsch 1981), road cruising (Dodd et al. 1989; Mendelson and Jennings 1992; Seigel and Pilgrim 2002), visual encounter surveys (Sun et al. 2001), and artificial cover objects (Fitch 1992; Grant et al. 1992). For capturing snakes in aquatic habitats most studies have relied upon visual encounter surveys, opportunistic captures, or aquatic funnel traps (Casazza et al. 2000; Gibbons and Dorcas 2004; Madsen and Shine 2000; Seigel et al. 1995a; Seigel et al. 2000), but the effectiveness and biases of these methods have seldom been examined experimentally (e.g., Willson et al. 2005).

Keck (1994) demonstrated that aquatic funnel traps can be used to successfully capture snakes in aquatic habitats and that baiting funnel traps with dead prey items (e.g., fish and amphibians) can increase capture rates. Here I chose a blocked experimental design that would allow a further, more powerful test of whether baiting traps increases capture rates of aquatic snakes. By design this experiment also examines whether aquatic snakes randomly enter funnel traps during movements or if they seek out funnel traps due to foraging behavior, thereby providing insight into some of the potential biases of aquatic trapping.

This experiment was conducted from 4–25 June 2003 at Ellenton Bay, a protected Carolina bay wetland located on the U.S. Department of Energy's Savannah River Site in South Carolina. Ellenton Bay is an ideal locality for aquatic trapping experiments because (1) it generally supports large populations of aquatic snakes, including the focal study species, *Seminatrix pygaea* (Black Swamp Snakes; Winne et al. 2005) and (2) it is dominated by shallow water (< 1 m deep) and relatively uniform distributions of emergent grasses (predominantly *Panicum* spp.), water lilies (*Nymphaea odorata*), and water shields (*Brasenia schreberi*), thus reducing variability in capture success attributable to heterogeneous habitat distributions. Traps were set in shallow water with approximately 3–5 cm of the trap above water to reduce the possibility of drowning captured snakes. Two varieties of commercially available cylindrical funnel traps, designed to capture minnows (i.e., minnow traps), were used during the study: steel (model G-40; Cuba Specialty Manufacturing Company, Fillmore, New York) and plastic (model 700; N.A.S Incorporated, Marblehead, Ohio). Steel funnel traps were 42 cm long and 19 cm in diameter, and constructed of galvanized steel mesh (mesh openings = 0.6 cm wide). Plastic funnel traps were 43 cm long and 16 cm in diameter, and had slightly smaller mesh openings (0.4 cm wide). All of the funnel traps had two funnels, one on each end of the trap (openings 2.5 cm in diameter), that extended 11 cm inwards towards the center of the trap. Throughout most of the study a total of 36 plastic and 30 steel funnel traps was used (i.e., 18 and 15 pairs, respectively); however, some pairs were not used during the first few days of the study.

Aquatic funnel traps were set in pairs (traps within a pair < 1 m apart) and within pairs each trap was randomly assigned to serve as either a "baited" or an "unbaited trap." This blocked design removed any variation in trap success that could be due to microhabitat differences. Rather than actively baiting traps with dead prey items, baited traps were allowed to naturally accumulate (i.e., self-bait) live larval amphibians (e.g., tadpoles and salamander larvae) throughout the study. In contrast, the unbaited traps were emptied of their contents daily. At Ellenton Bay aquatic funnel traps rapidly accumulate amphibian larvae; as a result, unbaited traps were not always truly unbaited. However, because all snakes were captured after the second trap night, baited traps always contained substantially more larval amphibians than unbaited traps. Traps were checked daily and all snakes were taken to the lab, where sex (presence or absence of hemipenes), snout–vent length, mass, and reproductive state (determined by palpation, Seigel et al. 1995b) were recorded. All snakes were individually marked (branding) and released at their point of capture. All predatory aquatic insects were removed daily from both baited and unbaited traps.

I captured 47 adult *S. pygaea* over 1758 trap nights. I used Chi-squared tests to test the null hypothesis that there were equal numbers of captures in baited and unbaited traps. There was an obvious bias in captures towards baited funnel traps: 79% of all snakes ($\chi^2 = 15.51$, $p < 0.001$) and 88% ($\chi^2 = 9.94$, $p = 0.002$) of all pregnant females were captured in the baited traps (Fig. 1). Capture rates (trap nights/captures) were over 3 times higher in baited traps (4.2% vs. 1.3%).

The majority of *S. pygaea* were captured in baited funnel traps despite having an equal chance of encountering the unbaited funnel traps located less than 1 m away. This result confirms Keck's (1994) finding that baiting increases capture rates of aquatic snakes and demonstrates the benefits of allowing traps to self-bait (e.g., Seigel et al. 1995; Winne et al. 2005). The strong bias in capture rates of baited funnel traps suggests that the majority of the aquatic trap captures were due to foraging behavior rather than random entry into traps. Indeed, Seigel et al. (2000) noted that another natricine snake, *Thamnophis marcianus*, often feeds on tadpoles inside aquatic funnel traps. Consequently, captures of snakes in aquatic funnel traps may be biased towards foraging individuals, a result which has important implications for inter- and intraspecific comparisons of relative abundance within snake communities.

There are at least four reasons why inter- or intraspecific differ-

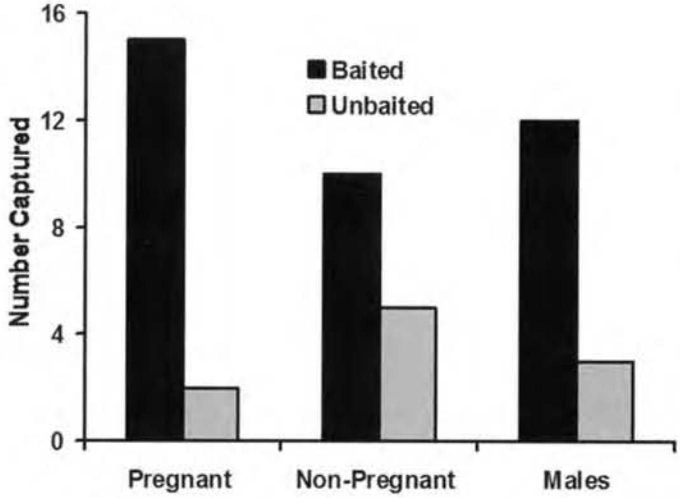

FIG. 1. Number of pregnant and non-pregnant female and male *Seminatrix pygaea* captured in baited vs. unbaited aquatic funnel traps at Ellenton Bay in June 2003. Overall, 79% of snakes ($\chi^2=15.51$, $p<0.001$) were captured in baited traps.

ences in foraging ecology could lead to biased estimates of relative species abundance or sex ratios in aquatic funnel traps. First, if species/sexes differ in foraging mode (i.e., active vs. sit-and-wait foragers) funnel trap captures may be biased towards the species/sex that is a more active forager. Second, if species/sexes differ in their diet any potential capture biases of funnel traps towards certain prey species/sizes could translate into biases towards the species/sex that forages for that particular prey species/size. Third, in studies specifically comparing capture rates over time or among sites, capture rates may differ because of differences in accumulated bait. Lastly, if species/sexes differ in seasonal patterns of active foraging funnel traps might result in biased estimates of relative abundance during some seasons.

The current study species, *S. pygaea*, may serve as one example of how intraspecific differences in foraging ecology might translate into biased estimates of relative abundance using baited minnow traps. Based on aquatic funnel captures, the Ellenton Bay population of *S. pygaea* is significantly female biased during May and June, but the sex ratio is equal during other parts of the year (Winne et al. 2005). This seasonal change in sex ratio is strongly correlated with sexual differences in foraging ecology. During May and June pregnant *S. pygaea* contain food items significantly more frequently than adult males (unpublished data), presumably because males are searching for mates instead of foraging for prey. In contrast, in other months of the year, when the sex ratio at Ellenton Bay is equal, males are frequently found with food items (unpublished data), indicating that they have resumed foraging.

No single collection method is without biases (Fitch 1992), including aquatic funnel trapping. Despite some inherent biases, aquatic funnel traps are effective at capturing large numbers of highly secretive aquatic snakes (*Farancia* spp., *S. pygaea*, and *Regina rigida*; Willson et al. 2005), which are particularly difficult to collect using other conventional methods (e.g., visual encounter surveys, terrestrial sampling; Gibbons and Semlitsch 1991). Further, aquatic funnel traps provide an excellent method for systematically tracking demographic changes in aquatic snake populations (e.g., Madsen and Shine 2000; Seigel et al. 1995a) because they allow for highly repeatable sampling regimes and greatly reduce observer biases associated with visual observation and hand collecting techniques (Casazza et al. 2000; Keck 1994). The results of this study clearly demonstrate that aquatic funnel traps are most effective when baited and highlight the importance of considering some of the potential sampling biases inherent to this technique.

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Detectability of a Large-bodied Snake (*Sistrurus c. catenatus*) by Time-constrained Searching

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Detectability of vagile species is an important consideration when surveying populations. Without an approximation of the proportion of individuals present that are detected by a given method, it is difficult to determine how well relative measures represent true population values (Boulinier et al. 1998; Burnham and Overton 1979; Hyde and Simmons 2001; Norvell et al. 2003). This difficulty can be compounded if detectability varies by time (Bonnet et al. 2002), temperature (Royle 2004), habitat (Hyde and Simmons 2001; Prior et al. 2001; Weatherhead and Charland 1985; Weatherhead and Prior 1992), or segment of the population (Martin 1993; Prior et al. 2001). For cryptic taxa such as snakes, detectability should be a particularly important factor because most individuals in a given area may not be seen. Despite its importance, detectability is generally not considered in field studies that estimate abundance of snakes (e.g., Mendelson and Jennings 1992; Seigel 1998; Stevenson et al. 2003; Sullivan 2000).

Large-bodied, sedentary snakes (e.g., rattlesnakes) tend to avoid traps and artificial shelters (Fitch 1992; Ryan et al. 2002). For these species, time-constrained searches (searching a set area in a given amount of time) may be the most efficient method of surveying the population. Rattlesnakes can be detected both visually and by hearing the rattle. Determining the detectability of snakes in time-constrained searches will provide an empirical foundation for population estimates, and a standard with which to evaluate alternative methods of detection. Using snakes equipped with radio transmitters, I tested how often, and under what conditions, individual Eastern Massasauga rattlesnakes (*Sistrurus c. catenatus*) were found by time-constrained searches when the snake was known to be present.

Methods.—I opportunistically captured Massasauga rattlesnakes for use in the study by searching suitable habitat on the Bruce Peninsula, Ontario (Weatherhead and Prior 1992). I implanted 7 adult snakes (2 non-gravid females, 5 males) with temperature-sensitive radio transmitters (Model SI-2T, Holohil Systems Inc., Ontario) in 2002 and 2003 as part of a separate study. Surgical procedures generally followed Reinert and Cundall (1982). Post-surgery, snakes were held for three days and then released at their point of capture. Snakes carrying implanted transmitters in this and other studies appeared to behave normally over extended time periods, although there is little comparative data from non-implanted snakes or experimental evaluation of the impact of implanted transmitters on behavior (Harvey, pers. obs.; Lutterschmidt and Reinert 1990).

Each detectability trial was conducted by two individuals, a tracker and a searcher. After locating a snake with a transmitter, the tracker established a 50 x 50 m square around the snake using string. The snake's position within the square was randomly determined for each trial using coordinates derived from a random number generator (Excel 2002). The searcher, naïve to the snake's location other than it was somewhere within the square, was given 20 min to find the snake. Based on preliminary trials this was considered sufficient time to search the entire area at a steady pace. Upon completion of each trial, the temperature of the snake was determined from the transmitter pulse rate, and the percent of the snake that was visible from above was recorded to the nearest 25%. If a snake was located by the searcher, the time required to find the snake and method of detection (audible, visual) were noted.

Of the 61 trials conducted in June and July 2004, no more than two trials were conducted per snake per week, with each snake used in an equal number of trials overall (8 or 9 each). Trials were conducted during the day (0930–1600 h) in fields, marshes, and forests, and in a range of weather conditions. Trials were split equally between two experienced and fourteen inexperienced searchers. Experienced searchers had observed massasauga rattlesnakes in the wild more than 500 times each, whereas inexperienced searchers had fewer than 20 observations each prior to the trials. To avoid inexperienced searchers improving at finding snakes over the course of trials, no individual conducted more than four trials. To estimate variance in detection rates I applied the bootstrap technique with 1000 replications (Efron and Tibshirani 1993).

Results.—Snakes were successfully located in 9 of 61 trials (14.8%, SD = 4.6%). Searchers usually passed near snakes during trials but the snakes did not respond by movement or rattling. Only in 3 cases was the snake completely hidden during the trial. Neither the experience of the searcher nor the habitat the snake was in affected whether a snake was found (Table 1). Snakes were found most often at intermediate temperatures (20–30°C; Table 1). No

TABLE 1. The number of Eastern Massasauga rattlesnakes found visually and by hearing the rattle during 61 searching trials on the Bruce Peninsula, Ontario. Observations are grouped according to four factors. The mean probability (p) that the detection rate was independent of each factor was determined using chi-square tests with 1000 bootstrap replicates.

	Searcher experience		Snake temperature (°C)			Habitat			Snake visibility (%)				
	Experienced	Inexperienced	<20	20–30	>30	Field	Marsh	Forest	0	25	50	75	100
# trials	31	30	12	28	21	19	23	19	13	12	10	16	10
Visual	2	4	0	5	1	2	2	2	0	0	0	4	2
Rattle	1	2	0	2	1	2	1	0	0	0	2	0	1
Total	3	6	0	7	2	4	3	2	0	0	2	4	3
p	0.31			0.11			0.40				0.07		

snakes were found visually when <75% visible and no snakes were found at all when <50% visible. All snakes found visually were stationary when detected. Snakes at intermediate temperatures were more visible than cool snakes (<20°C) or hot snakes (>30°C) ($F_{2,58} = 3.10$, $p = 0.05$). Low detection rates prevented us from testing for interactive effects between factors or determining the relationship between each factor and the time required to locate snakes in successful trials.

Discussion.—Snakes known to be present were detected by searching a 2500 m^2 area for 20 min in approximately 1 in 7 trials. Snakes were detected most often when their body temperatures were intermediate (20–30°C) and when they were more visible. Under weather conditions leading to intermediate body temperatures, when snakes were more likely to bask, detectability improved to 1 in 4 snakes.

The physiologically optimal body temperature range in snakes is an evolutionarily conservative trait and tends to be between 28 and 34°C (Lillywhite 1987). Massasauga rattlesnakes may be more likely to respond to disturbance by rattling when near physiologically optimal temperatures (Prior and Weatherhead 1994). In this study, however, most snakes were found visually. Snakes were more exposed when their body temperatures were just below their probable physiological optimum, presumably to warm themselves, which made them more visible to searchers. At body temperatures below 20°C, however, snakes were more concealed. This may signal a shift towards crypsis as the means of defense when low body temperatures reduce motor performance (Mori and Burghardt 2004). Conclusions regarding the effects of all factors on detectability should be considered tentative given the modest sample sizes and lack of testing for interactive effects.

All trials were conducted with non-gravid females and males. Gravid females of many viviparous species use habitat with less ground or canopy cover than males or non-gravid females to assist in embryonic development (Lourdais et al. 2004; Reinert 1993). The use of more exposed habitat would likely make gravid females easier to detect than males or non-gravid females (Bonnet and Naulleau 1996), but that remains to be tested for Massasauga rattlesnakes.

Knowing that Massasauga rattlesnake detectability was low, can one use a measure of detectability to estimate the actual number of snakes present in an area sampled? Using similar search methods, Weatherhead and Prior (1992) encountered Massasauga rattlesnakes in my study area at a rate of 0.18 snakes/h. Assuming they searched under the same range of weather conditions, and thus detected only 1 of every 7 snakes present, the number of snakes in the area they sampled would have been 7 times higher than encountered. Deriving abundance estimates in this manner requires two important caveats. First, estimates based on low detection rates (<30%) are more likely to be biased than estimates based on higher detection rates (MacKenzie et al. 2002). Second, search effort (thus, detectability) may be somewhat inflated in situations where snakes are known to be present relative to snake surveys when presence is unknown. A more conservative way to use detectability estimates to improve snake surveys is to incorporate the factors that affect detectability into the study design. For example, by always conducting surveys under the same weather conditions, estimates of abundance should always have the same bias. In terms of sampling efficiency, conducting surveys only under conditions where detectability is high (e.g., cool, sunny days when snakes are basking) may result in more snakes being found per unit search effort. At the very least, researchers should be aware that population estimates based on time-constrained searches may be seriously underestimated, and that the extent of the underestimate can vary with environmental conditions.

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A Comparison of Internal and External Radio Transmitters with Northern Leopard Frogs (*Rana pipiens*)

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Little information is available on post-breeding movements, habitat requirements, and mortality of northern leopard frogs (*Rana pipiens*) because they disperse into upland or other wetland habitats following reproduction and are difficult to detect (Waye 2001). Radio telemetry is used to examine these characteristics in other taxa, however, its usefulness for studying *R. pipiens* has not been established. An obstacle in deploying telemetry to study movement is finding a transmitter attachment method that does not adversely affect the animal's health and behavior and allows tracking over several months. The objective of our study was to evaluate existing external and internal radio transmitter attachment methods and adopt or develop a technique appropriate for *R. pipiens*.

Radio telemetry has been used to study movements of several ranid species, including *R. draytonii*, *R. luteiventris*, and *R. clamitans* (Bulger et al. 2003; Pilliod et al. 2002; Lamoureux et al. 2002). Researchers have used external belts or harnesses to attach transmitters to anurans (Bartelt and Peterson 2000; Bull 2000; Goldberg et al. 2002; Matthews and Pope 1999; Waye 2001; Hodgkison and Hero 2001; Watson et al. 2003; Muths 2003). A few studies successfully used surgical implantation as a method of radio tagging frogs (Goldberg et al. 2002; Lamoureux and Madison 1999; Werner 1991), as well as fish and salamanders (Beaumont et al. 2002; Colberg et al. 1997).

Surgical implantation has some advantages over harness attachment, including reducing skin lesions and rates of transmitter loss (Werner 1991). However, achieving the proper level of anesthetic without compromising survival is difficult (Goldberg et al. 2002; Green 2001). Prior to our study, surgical anesthesia had been tested in the laboratory (Goldberg et al. 2002; Lamoureux and Madison 1999), but it was unclear if it could be successfully performed in the field. In addition, the postsurgical fate and longevity of *R. pipiens* carrying implanted transmitters was unknown.

We evaluated four types of external attachments: nickel bead chains, aluminum bead chains, plastic cable ties, and sewing elastic in the field. When the belt attachments proved unsatisfactory for our purposes, we tested two types of internal attachment tech-

niques on frogs in the laboratory: subcutaneous and peritoneal implantation. Following the laboratory studies, we tested the efficacy of peritoneal implants on *R. pipiens* in the field. We tracked these individuals for several months post-surgery to assess the usefulness of the transmitters for monitoring habitat use and movement over time.

We attached radio transmitter harnesses (model BD-2GHX, 1.85 g, 165 MHz band, 20-week life, whip antenna; Holohil Systems, Ltd., Carp, Ontario, Canada) to 26 wild *R. pipiens* adults from August to October 2000. Transmitters did not exceed 5–6% of the frog's total weight, below the 10% threshold recommended by Richards et al. (1994). We tested nickel (N = 15) and aluminum bead chain (N = 8) (Rathbun and Murphey 1996), plastic cable-ties (N = 8), and sewing elastic (N = 5) to find a harness material that allowed long-term radio tracking of individual frogs without restricting movements or causing injury to the frogs. Plastic cable-ties were plastic fasteners with a self-locking end, usually used in household or light mechanical applications. The sewing elastic was purchased at a fabric store; the cut ends were joined by thread stitches. Transmitters were attached to the harness by running the harness material through a rigid plastic tube affixed to the transmitter package by the manufacturer. The harness was attached around the waist of the frog so that the transmitter rested on the lower back of the frog just above the vent (Fig. 1). After shedding belts, several of the same frogs were refitted with a new harness; a total of 36 attachments were evaluated. Frequent escapes from the nickel bead chain belts within the first few weeks made it necessary to confine frogs in 1.8 m x 1.8 m enclosures placed along the edge of the wetland. Subsequent tests of aluminum bead chain, plastic cable ties, and sewing elastic harness materials and their effects on incidence of injury, transmitter loss, and behavioral changes were tested on frogs in the enclosures. On 12 October, the remaining 4 frogs in the enclosure were released and tracked with the telemetry equipment to their overwintering burrows. We estimated how far external radios could be detected with our receivers.

Subcutaneous and peritoneal surgical implantation techniques were developed and evaluated in the laboratory during winter 2001.

FIG. 1. Northern Leopard Frog (*Rana pipiens*) with external transmitter and whip antenna attached with elastic harness. (Photo courtesy of United States Geological Survey.)

Holohil model BD-2GHX radio transmitters weighing 1.85 g with an internal loop antenna coated with epoxy resin were implanted using surgical procedures similar to those described by Goldberg et al. (2002). Other scientists with experience in anuran surgical implantation techniques were also consulted to refine the procedure (G. Birchfield, University of Missouri, Columbia, Missouri and S. Heppell, United States Environmental Protection Agency, Corvallis, Oregon, pers. comm.).

Nineteen *R. pipiens* adults weighing > 15 g, purchased from a biological supply company (Ward Biological Supply, Rochester, New York, USA), were held for several weeks prior to surgery to ensure that they were healthy and feeding. Frogs were fed live crickets daily. Immediately prior to surgery, frogs were anesthetized by placing them in a 1-gallon glass (3.79-liter) jar containing an aqueous solution of 0.02% tricaine methanesulfonate (MS-222, Finquel™, Argent Chemical Laboratories, Inc., Redmond, Washington, USA) buffered with sodium bicarbonate to pH 7 and kept at room temperature (22–23°C). The MS-222 solution was deep enough that the frogs could just hold their heads above the surface of the solution with all four feet on the bottom of the jar. A frog was deemed appropriately anesthetized for surgery when it did not right itself when placed on its back and was generally unresponsive to touch (ca. 2–5 min.; smaller frogs were anesthetized faster). All surgical instruments and transmitters were sterilized with Benz-all™ (12.9% benzalkonium chloride solution, Xttrium Laboratories, Chicago, Illinois, USA); sterile gloves were used for each surgery. Anesthetized frogs were placed on a damp sterile sponge on their right side. An incision about 15 mm in length was made with surgical scissors through the skin and underlying muscle and peritoneum (peritoneal implant only) along the left side of the frog near the center axis (Fig. 2). A radio transmitter was inserted through the incision and under the skin (subcutaneous implant) or into the peritoneal cavity, avoiding excessive pressure on the internal organs. A Polysorb 6/0 suture package with a reverse cutting needle (United States Surgical Corporation, Norwalk, Connecticut, USA) was used to close the incision. The peritoneal incision was closed with a continuous suture technique with the single-instrument tie knot at the beginning and end of the incision (Summerfelt and Smith 1990). The skin incision was closed with 4–5 simple interrupted sutures with the single-instrument tie knot. After suturing, the skin incision was treated topically with Bactine™ antiseptic spray. Frogs were closely observed until they recovered from the anesthetic and were kept in the laboratory for up to 19 weeks post-surgery to assess transmitter loss, and health and behavioral effects. Frogs were weighed and snout–vent length measured at the time of the surgery and also weighed at the end of the study or at the time of death. At the end of the study, all live frogs were euthanized by emersion in MS-222 (Green 2001) and a necropsy was performed.

In spring and summer 2001 and 2002, 90 wild *R. pipiens* adults weighing approximately 30 g or more were captured adjacent to their breeding site (i.e., pond or wetland) and received peritoneal implants of radio transmitters (Holohil BD-2GHX, 1.85 g, loop antenna). Three study sites were used in 2001 and two in 2002. The study area was located in Houston and Winona counties in Minnesota, part of the Driftless Area Ecoregion of North America. Rolling hills with steep riverine drainages and erosive soils support a less intensive agriculture than in many parts of the Mid-

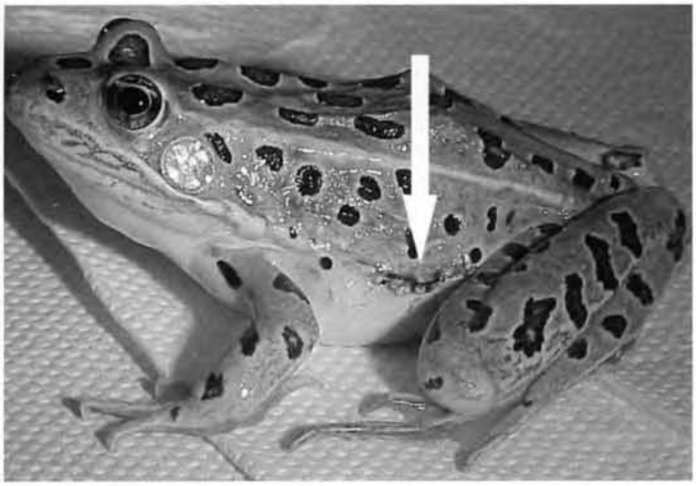

FIG. 2. Northern Leopard Frog (*Rana pipiens*) with transmitter surgically implanted showing incision location (arrow). (Photo courtesy of United States Geological Survey.)

west, with agriculture occupying 30–40% of the landscape, along with woodlands and some grasslands (McNab and Avers 1994).

We conducted our surgeries in the field near the capture site to reduce transport stress and avoid accidental transfer of diseases from the laboratory to native populations. In 2001, surgeries were conducted outside under a canvas tent and in 2002 surgeries were conducted in a vehicle. Frogs were observed closely for up to 4 h after surgery to monitor recovery from the anesthetic. Frogs were released and tracked from the ground with a hand-held Yagi antenna and receiver system (Advanced Telemetry Systems, Inc, Isanti, Minnesota, USA). Individuals were located 4–5 days per week during 2001 and daily in 2002; frogs were tracked from the time of implant until October, or until frogs died, radio contact was lost, or transmitters failed. To assess health status, some frogs with transmitters were weighed every 30 days following release during 2001. To minimize disturbance, frogs were not weighed after release in 2002. We estimated how far implanted radios could be detected with our receivers.

Of the 15 frogs fitted with nickel bead chain belts and released, 10 shed their belts within two weeks and the remaining frogs developed skin lesions and the belts were removed (Table 1). Of the frogs fitted with aluminum bead chain, sewing elastic, or plastic cable-tie belts and confined in enclosures, 18 of 21 harness attachments applied to these frogs failed within 1 to 3 weeks (transmitter was shed, Table 1). Eight of 11 frogs developed skin lesions within two weeks and 7 were released. Among the four frogs released with transmitters from the enclosure in October, one frog shed its transmitter within five days and the remaining three frogs were tracked for 14 days, when tracking ended.

Overall, external belts were tested on 26 frogs; the belts caused skin lesions in 14 frogs and transmitters were retained a median of 10 days after attachment (Table 1). Thirty transmitters were shed out of 36 attachments. None of the harness materials we evaluated performed satisfactorily. When we tightened the belts, the frogs developed skin lesions; when we loosened the belts, they shed them. We were able to detect external transmitters with whip antennas at distances ranging from 100 to 200 m in the field.

The time required to achieve a surgical level of anesthesia during our laboratory trials was short and variable (range = 1.5–3 min) despite constant environmental conditions. Most frogs began feeding within four days post-surgery and their incisions healed within two weeks of surgery.

During the first laboratory trial (surgery on 15 February 2001), three frogs received subcutaneous implants and four frogs received peritoneal implants (Table 2). During the subsequent trial (surgery on 2 March 2001), all 12 frogs received peritoneal implants. One of three frogs receiving subcutaneous implants in the first trial failed to recover from anesthesia and one frog experienced suture rupture after 19 days. The third frog retained its transmitter until the trial ended. We discontinued subcutaneous implants after the first trial because they created a lump on the frog's ventral surface that threatened to rupture the sutures. All four frogs receiving peritoneal implants in the first trial survived the surgery, 3 frogs lived from 6 to 49 days post-surgery, and the remaining frog lived to the end of the observation period (116 days, Table 2).

In the second trial with peritoneal implants, all 12 frogs survived the surgery, three frogs died within 10 days of surgery, one escaped from its cage after 95 days, and the rest survived to the end of the observation period (Table 2). After initial healing of the suture site, 8 of 12 frogs developed small skin lesions near the

TABLE 1. Fate of frogs (*Rana pipiens*) fitted with radio transmitters attached with four types of harness materials, 1 August to 26 October 2000. Includes frogs observed in the field and in enclosures adjacent to the breeding pond.

Harness type	Frogs (N)	Attachments (N)	Transmitter shed (N)	Min-max days until transmitter shed[c] (median)	Frogs with skin lesion (N)	Min-max days until skin lesion (median)	Min-max days transmitter retained[d] (median)
Nickel bead chain	15	15	10	2–10 (2.0)	5	3–19 (6.0)	2–23 (3.0)
Aluminum bead chain[a]	3[b]	8[a]	6	2–31 (7.5)	2	9–13 (11.0)	2–31 (13.0)
Sewing elastic[a]	4[b]	5[a]	5	2–41 (20.0)	2	8–9 (8.5)	2–41 (21.5)
Plastic cable-ties[a]	5	8[a]	7	2–37 (10.0)	4	7–20 (16.5)	2–42 (11.5)
Total	26[b]	36	30	2–41 (4.0)	14	3–35 (10.0)	2–42 (9.5)

[a] Observed in enclosures. Some frogs were re-fitted with another attachment after shedding the first one.
[b] One frog was switched from aluminum bead chain to sewing elastic after 13 days.
[c] Includes only frogs that ultimately shed their transmitter harness.
[d] Includes all frogs, including those that had the harness removed due to lesions and those that retained the harness until the end of the study period.

Table 2. Fate of frogs (*Rana pipiens*) undergoing laboratory surgeries, 2001. Fate codes: NRA) Non-recovery from anesthesia; PSC) Death due to postsurgical complications; ESC) Escaped; SES) Survived to end of study; and OTH) Other.

Trial number	Frog ID	Implant location	Surgical weight (g)	Final weight (g)[a]	Days survived post-surgery	Days until skin lesions	Days until lesions healed	Fate	Comments
1	1	Sub-Q	20.8	20.8	<1	-	-	NRA	
1	2	Peritoneal	15.1	-	6	4	Did not heal	PSC	Transmitter broke through sutures day 4
1	3	Sub-Q	23.3	35.2	74	19	Not recorded	OTH	Transmitter broke through sutures day 19; euthanized day 74, necropsy unremarkable
1	4	Sub-Q	19.9	39.1	116	-	-	SES	Necropsy unremarkable
1	5	Peritoneal	29.3	45.8	116	-	-	SES	Transmitter encased in tissue adjacent to gastrointestinal system
1	6	Peritoneal	23.6	-	14	-	-	PSC	Cause of death unknown
1	7	Peritoneal	24.7	30.2	49	-	-	PSC	Infection not associated with sutures
Summary	Trial 1		22.4 (4.2)[b]	34.2 (9.4)[b]	49[c]	-	-		
2	1	Peritoneal	24.5	10.0	6	-	-	PSC	Suture failed
2	2	Peritoneal	23.9	17.5	9	-	-	PSC	Emaciated, hole in incision, bleeding
2	3	Peritoneal	25.0	42.5	134	39	Did not heal	SES	Transmitter encased in connective tissue
2	4	Peritoneal	25.7	-	3	-	-	PSC	Emaciated, sutures healed
2	5	Peritoneal	25.6	40.6	134	-	-	SES	Transmitter encased in connective tissue
2	6	Peritoneal	28.1	43.5	134	68	Did not heal	SES	Transmitter encased in tissue adjacent to gastrointestinal system
2	7	Peritoneal	27.9	47.5	134	46	18	SES	Transmitter encased in tissue adjacent to gastrointestinal system
2	8	Peritoneal	25.6	51.6	134	33	39	SES	Transmitter expelled day 98
2	9	Peritoneal	28.9	47.9	134	36	Did not heal	SES	Transmitter encased in tissue, 'captured' by gastrointestinal system
2	10	Peritoneal	42.9	46.1	134	42	17	SES	Transmitter encased in connective tissue, high internal parasite load
2	11	Peritoneal	47.5	65.1	95	31	Did not heal	ESC	Transmitter expelled day 34, escaped from cage day 96
2	12	Peritoneal	31.3	53.2	103	51	22	SES	Transmitter expelled day 89, necropsy unremarkable
Summary	Trial 2		29.7 (7.6)[b]	42.3 (15.7)[b]	134[c]	40.5[c]	20[c]		

[a] Final weight does not include transmitter.
[b] Mean (SD)
[c] Median

suture site 31–68 days post-surgery; in four frogs these healed spontaneously. Nine of the 12 frogs continued to feed, behave normally, and gain weight (Table 2). Three frogs expelled their transmitters at 34, 89, and 98 days post-surgery, probably via the gastrointestinal system; we found no exit wounds elsewhere. The nine frogs that survived more than 10 days all gained weight (mean = 16.0 g ± 6.2 SD) by the end of the observation period. Overall, three transmitters broke through the skin shortly after surgery, three frogs expelled the transmitter, and necropsies revealed that four frogs had encased the transmitter in connective tissue adjacent to or inside the gastrointestinal tract (Table 2).

Among the 90 wild frogs surgically implanted with radio trans-

TABLE 3. Fate of frogs (*Rana pipiens*) undergoing field surgical implantation of radio transmitters, April–July, 2001–2002. Fate is the number of frogs experiencing that outcome: A) Failure to recover from anesthesia; PM) Killed by predator or mower; U) Frog found dead–unknown causes; T) Transmitter failure; M) Missing; R) Recovered transmitter without frog; and S) Survived to end of study.

Year	Site	Frogs (N)	Min-max weight (g) (mean, SD)	Min-max locations (N) (median)	Min-max days tracked (N) (median)	Fate						
						A	PM	U	T	M	R	S
2001	StN	20	35.9–69.2 (46.1, 10.2)	4–67 (36)	6–119 (48)	3	5	1	1	5		5
	ShA	7	41.5–78.7 (56.1, 12.9)	21–71 (44)	28–102 (58)		1		1	3		2
	Urb	17	35.1–58.2 (43.9, 6.7)	6–66 (14)	7–108 (20)	7	2		1	7		
2002	StN	20	30.0–71.8 (42.9, 11.1)	5–76 (25)	4–114 (31)	1	3	1	1	9	2	3
	HoA	26	27.6–61.1 (36.5, 3.5)	2–84 (12)	1–124 (25)	6	5	9	3	3		
Total	4	90	27.6–78.7 (43.0, 10.0)	2–84 (23.5)	1–124 (38.5)	17	16	11	7	27	2	10

mitters, 17 did not recover from the anesthesia. Eleven of the 17 mortalities were associated with elevated anesthesia solution temperatures (> 25°C). In the initial field surgeries, anesthesia solution temperatures were allowed to equilibrate with ambient (air) temperatures because this strategy had been successful in the laboratory. Two episodes of poor surgical survival associated with surgeries conducted on warm days led us to conclude that anesthetic solution temperatures might be the problem. We began to control the solution temperature to < 25°C, regardless of air temperatures, and subsequently 30 of 31 frogs survived the surgery.

Of 77 frogs that survived the surgery and were released, 27 frogs died (predators, N = 8; alfalfa mowers, N = 8; unknown causes, N = 11), 7 were recaptured live with transmitter failures, 27 were lost (fate unknown), 2 transmitters were recovered without the frog (fate of frog unknown), and 10 frogs survived long enough to enter hibernation (Table 3). Of the 11 frogs found dead due to unknown causes, 9 frogs died within 10 days and 2 frogs died within 60 days post-surgery. Eight of the deaths occurring within 10 days post-surgery occurred following a rapid decrease (from 25 to 0°C) in air temperatures. Sores near the incision, similar to those observed in the laboratory, were noted in three frogs. Frogs were tracked for up to 124 days post-surgery (median = 38.5 days). Three failed transmitters were sent back to the manufacturer for diagnosis; battery failure and component malfunction were identified as the causes.

In 2001, most frogs monitored (15 of 19) gained weight (mean = 12.8 g ± 14.7 SD). Most frogs were detected hiding in grass or near hedgerows of crop fields. We were able to detect transmitters with internal loop antennas at distances ranging from 50 to 75 m in the field and the longest single-day movement we observed for an individual frog was 313 m.

All external attachment techniques we tested proved inadequate for tracking *R. pipiens* over long time periods because frogs shed their belts quickly or developed lesions that required release. In comparison, *R. pipiens* with peritoneal implants were tracked for up to 4 months during our field study. Tracking durations reported from other studies deploying belts on anurans also have been relatively short, for example, 1–20 days for *R. pipiens* (N = 24, Waye 2001), 11–126 days for *R. luteiventris* (N = 71, Bull 2000), up to 30 days (mean = 16–21 days) for *R. sylvatica* (N = 11, Muths 2003), 5–12 days for *Eleutherodactylus augusti* (N = 5, Goldberg et al. 2002), 9–13 days for *Littoria nannotis* (N = 19, Hodgkison and Hero 2001). Twelve of 38 *Bufo boreas* shed their belts within two weeks (Bartelt and Peterson 2000). Further, nearly all studies reported skin lesions associated with the belts, although recent work by Muths (2003) using craft elastic strung with glass beads shows promise of belt retention without injury.

We found that nonrecovery from anesthesia was a major mortality factor for *R. pipiens* receiving surgical implants. Most surgical failures appeared to be associated with elevated MS-222 solution temperatures (> 25°C). Ambient temperature fluctuates more in the field than in the laboratory, so this problem did not arise during our laboratory trials. We ultimately achieved success in surgical implantation and recovery of the frogs using a mobile laboratory suitable for both the surgery and postsurgical observation of the frogs. After our surgical experiences, we found recommendations for limiting the temperature of MS-222 to ≤ 25°C when used as an anesthetic for amphibians (Green 2001).

Goldberg et al. (2002) also reported that achieving the appropriate level of anesthesia was the most difficult part of surgery, although temperature of the anesthetic solution was not mentioned. Werner (1991) implanted radio transmitters into six *Bufo americanus,* with no reported mortality using a 0.01% solution of MS-222 for 15–20 min. Lamoureux and Madison (1999) performed 23 surgeries on *Rana clamitans* with no reported mortality; they used a 0.5% solution of MS-222 to anesthetize the frogs, but did not report exposure times. Lamoureux et al. (2002) performed 27 surgeries on *R. clamitans* with one surgical death.

Laboratory testing of terrestrial salamanders has demonstrated that responses to MS-222 anesthesia vary among species and de-

pend upon both pH and concentration (Lowe 2004). Lowe also suggests using aqueous pH buffers to prepare the MS-222 rather than neutralizing the solution with sodium bicarbonate. It is likely that anurans also have species-specific responses to MS-222 (Green 2001). We conclude that reliable, safe application of MS-222 as a surgical anesthetic for amphibians is possible under controlled conditions (solution concentration, pH, temperature, and exposure time) and with some initial exploratory laboratory testing of the target species.

Presumably, the mortality of frogs that recovered from anesthesia but died from unknown causes within 10 days was related to the surgery. The majority of these deaths (8 of 10 frogs) coincided with a rapid decrease in ambient temperature within days of surgery. An early April period of warm temperatures in 2002 (highs >25°C) induced breeding behavior in adult *R. pipiens* and was followed by a temperature drop to near 0°C. Mortality may have resulted from the combined stress of recent emergence from hibernation, breeding activity, an extreme fluctuation in ambient temperature, and surgery. Avoiding this type of mortality will be difficult because of the need to implant transmitters while *R. pipiens* are concentrated at breeding ponds for brief periods in spring, a time of unpredictable weather conditions in the upper Midwest. Rudolph et al. (1998) also found that snakes implanted with radio transmitters had higher mortality when implants occurred late in the season when temperatures were colder. Frogs are at high risk of predation in the immediate post-surgical period because individuals vary in the time it takes to fully recover from anesthesia. Protecting frogs from predation during the surgical recovery period may improve immediate post-surgical survival. Field enclosures provide predator protection and concealment, but not climate-controlled conditions.

Although the surgical implants resulted in health effects, primarily mortality within 10 days of surgery, *R. pipiens* that survived past 10 days behaved normally and gained weight, both in the laboratory and in the field. Our laboratory trials indicated that frogs experienced low mortality from 10 to 134 days post-surgery, although some small skin lesions developed. In the field, frog mortality occurring after 10 days post-surgery was apparently unrelated to the surgery, as evidenced by good health (e.g., weight gain and apparently normal behavior). We observed that predation and hay mower strikes were the primary non-surgical mortality factors for *R. pipiens*. Ours may be the first direct evidence of mortality due to hay mower strikes reported from a telemetry study. This has obvious conservation implications for amphibian populations. For example, frequently-mowed hay fields located adjacent to amphibian breeding sites may reduce post-breeding survival.

Even surgical implantation does not ensure that frogs will retain the transmitters for the duration of studies. With subcutaneous implants, transmitters can break through the sutures and be lost within days of surgery. Conversely with peritoneal implants, some frogs retained transmitters a month or more before expelling them, presumably via the gastrointestinal tract. Shedding transmitters via the gastrointestinal tract also has been observed in fish (Marty and Summerfelt 1986), but to our knowledge, has not been previously described in frogs.

Another challenge to the use of internal implants with a highly mobile species like *R. pipiens* is the limited detection range that we observed for transmitters with internal loop antennas (50–75 m). Undoubtedly, this was a factor in the high rate of missing frogs (35%) we experienced. Likewise, Goldberg et al. (2002), using somewhat smaller transmitters, detected external transmitters at distances > 200 m, whereas detection was limited to 6–40 m with implanted transmitters. Although external implants have longer detection ranges, they may be of limited value in some studies because of their short retention times. If tracking frogs over several months is needed to meet study objectives, frogs may need to be tracked more frequently to reduce loss rates due to long distance movements between tracking events. In the case of *R. pipiens*, tracking events may need to occur at intervals shorter than 24 h. In summary, we believe surgical implantation holds the most future promise for tracking *R. pipiens* over relatively long periods with minimal health effects.

Our data indicate that both external belts and surgical implantations of radio transmitters can have significant health risks for frogs. For those studying movements of rare species, this presents a dilemma because high morbidity and mortality are unacceptable in small populations. We make several suggestions for limiting morbidity and mortality. First, we found that all attachment methods required significant skill and experience to be successful, a non-trivial problem for beginning researchers. We suggest that novices spend time practicing attachment techniques with someone skilled in the desired method. If possible, practice the technique on a common frog species similar in size to the target species, perhaps a species available from biological supply companies. Belt retention and skin lesion development may be species- and perhaps habitat-specific, therefore, we suggest testing the best available external belts on the target species in field enclosures. If external belts are retained long enough to achieve the research purposes without causing skin lesions, belts are the best solution. If not, proceed to surgical implantation.

Likewise, we recommend practicing the initial surgeries in the laboratory on a similar non-target species under the supervision of someone skilled in the technique. Because anesthetics and dosages are species-specific (Green 2001), anesthesia concentration, pH, exposure time, and temperature should be tested on the target species in the laboratory. Surgeries should be conducted under controlled conditions. If a vehicle is available that provides protection from adverse weather and temperature extremes, field surgeries can be done; otherwise, conduct surgeries in the laboratory. This decision will also depend upon the distance from the field site to the nearest laboratory. We recommend that frogs be protected from predation for at least 24 h post-surgery in the laboratory or in a field enclosure. Frogs should display feeding and/or escape behaviors before release. Track frogs at least daily and more frequently during wet weather to minimize loss of study subjects.

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A Successful Trap Design for Capturing Large Terrestrial Snakes

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Large scale trapping protocols for snakes can be expensive and require large investments of personnel and time. Typical methods, such as pitfall and small funnel traps, are not useful or suitable for capturing large snakes. A method was needed to survey multiple blocks of habitat for the Louisiana Pine Snake (*Pituophis ruthveni*), throughout its historic range in Louisiana and Texas, to obtain presence-absence data and to obtain specimens for radio-telemetry studies (Himes et al. 2002; Rudolph and Burgdorf 1997; Rudolph et al. 2002).

We required a method that was feasible with respect to cost of materials, time necessary to service traps, ease of installation, and efficiency in capturing snakes. The trapping method needed to capture large, mobile species, but not small, litter-dwelling species. We ultimately designed a large four-entrance funnel trap, with extensive drift fence arms to guide snakes toward the trap opening. These traps have been in use since 1993 to survey large snakes in Arkansas, Louisiana, and Texas. This trap design also was used to examine the impact of roads and vehicle-related mortality on large snakes (Rudolph et al. 1999).

Traps consisted of 121.9 x 121.9 cm (48 x 48 in.) tops and bot-

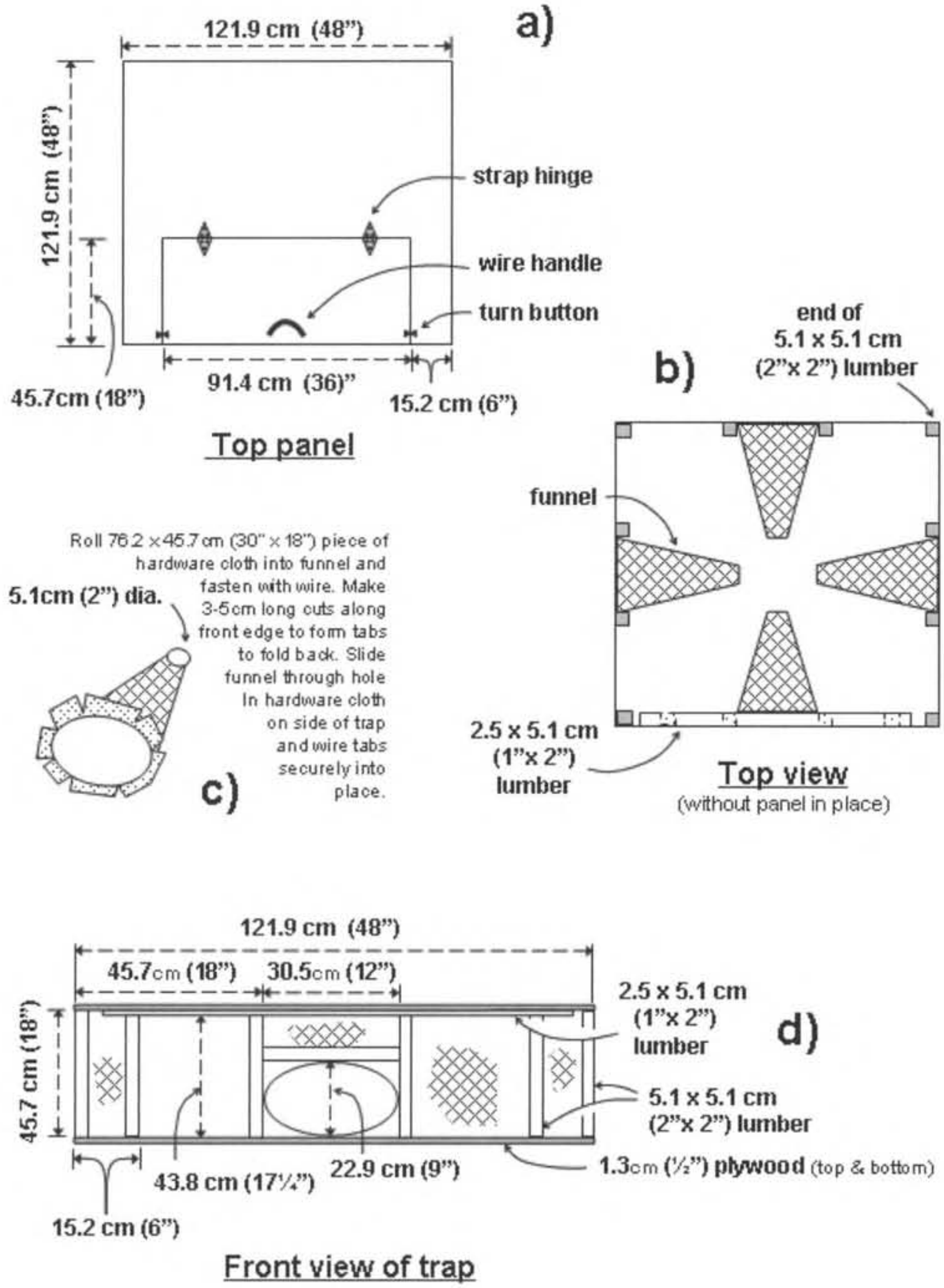

FIG. 1. Schematics of a successful trap design to capture large, mobile species of terrestrial snakes in eastern Texas a) top view of the trap b) top view of trap without top panel in place to show position of funnels c) an individual funnel and d) front view of trap. Trap dimensions and components are shown in English units of measurement to facilitate purchase from local building supply stores.

toms constructed of 1.3 cm (1/2 inch) treated plywood supported by wooden uprights 45.7 cm (18 inches) in height (Fig. 1). The sides were screened with hardware cloth (0.64 cm [1/4 inch] mesh). One or two hinged doors in the top of the trap allowed access for retrieval of snakes. Four funnel entrances of 64 cm (1/4 inch) mesh hardware cloth wired to the box at midpoint of each side allowed entrance of snakes (Fig. 1). Minimum diameter of the inner portion of the funnel was approximately 5.1 cm (2 inches).

Traps were installed by placing them on a soil surface that had been previously cleared and leveled. Excess soil was used to fill any gaps that would allow snakes access beneath the traps. Drift fences were constructed of 6.4 mm (1/4 inch) mesh hardware cloth approximately 15 m (50 feet) in length and 61 cm (2 feet) in height (Fig. 2). Longer drift fences could be used if desired. Drift fences were installed perpendicular to each side of the trap beginning at the midpoint of the funnel entrance. Fences were buried approximately 10 cm in depth and braced with wooden stakes or short pieces of iron reinforcement bar as required. Small pieces of hardware cloth were cut to fit, inserted part way into the funnel opening and wired to the drift fence to keep snakes from going around the terminus before entering the funnel (Fig. 2). Mesh size, height, and length of drift fences could easily be varied to capture snake

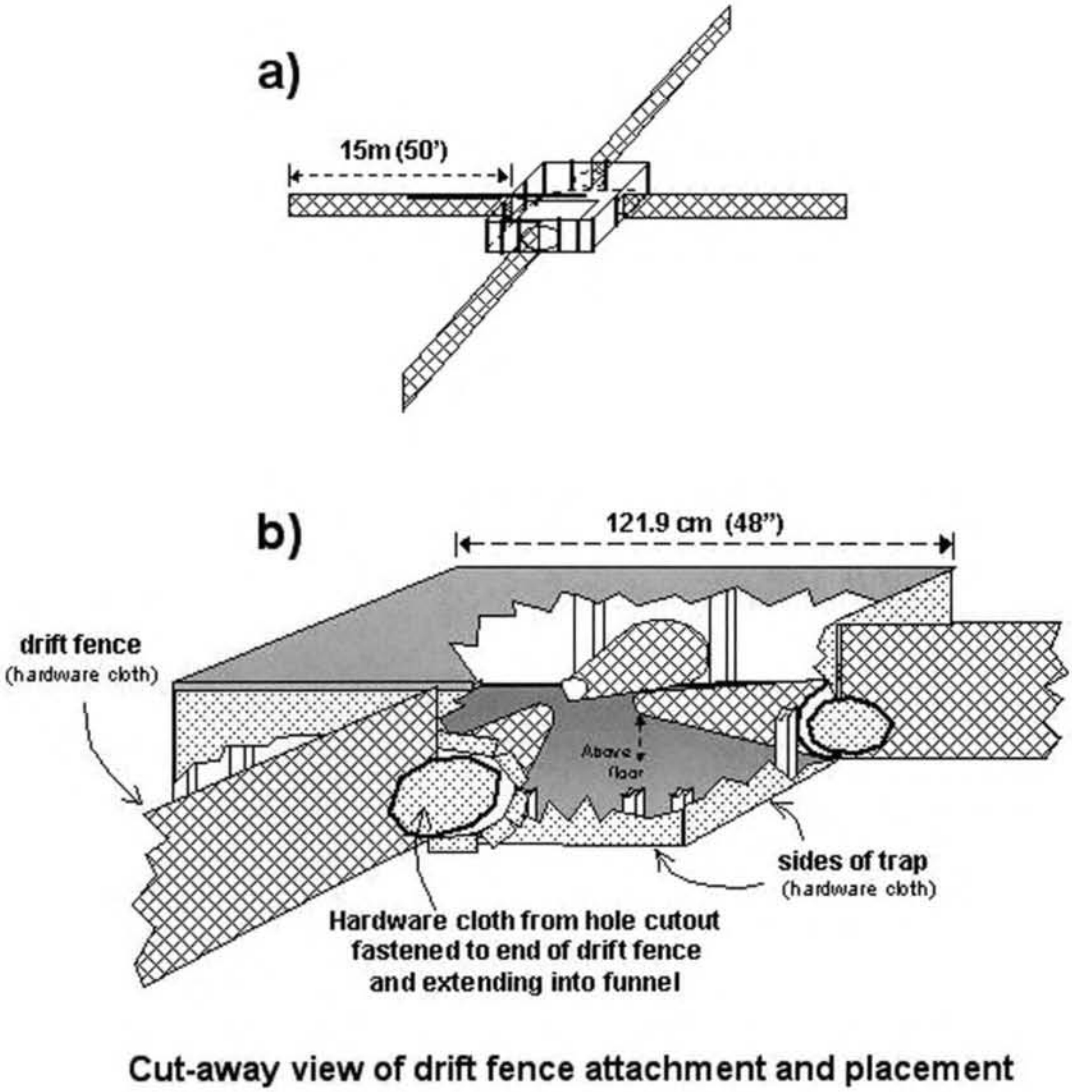

FIG. 2. More schematics of the trap design a) full view of the trap and drift fences and b) a cut-away view of drift fence attachment and placement.

species of varying body sizes. Other commonly used drift fence materials such as sediment cloth or metal flashing could also be used. Funnel traps may be placed at distal ends of each drift fence to increase capture rates. In addition, each trap was supplied with a 3.8 liter (1 gal.) chick watering source. When possible, traps were installed in situations that provided some shade to further reduce stress on captured individuals. Snake traps were constructed using treated wood, making them very durable. We have had traps in the field continuously in use for up to 6 years, in both wet and dry forest situations. These traps are in good condition and are still serviceable. See Table 1 for list of materials.

Trap success varied depending on site characteristics. However, in the upland pine habitat where most of our effort has been directed, we captured an average of 7.5 snakes (large species only) per trap per season during the early March to late October trapping period (240 trap days). Snake capture data for an array of 15 traps located in Nacogdoches Co., Texas, from 1999–2002, approximately 13,920 trap days, indicate the diversity of species captured (Table 2). These data documented a significant range extension for the Glossy Snake, *Arizona elegans* (Collins et al. 2001), and

TABLE 1. Snake trap materials.

Materials	Quantity
1.3 cm (1/2 in.) thick sheet, treated plywood	1
5.1 x 5.1 cm (2 x 2 in.) treated lumber, 2.4 m (8 ft) long	4
2.5 x 5.1 cm (1 x 2 in.) treated lumber, 1.2 m (4 ft) long	1
0.64 x 0.64 cm (1/4 x 1/4 in.) mesh, hardware cloth 61 cm (24 in.) wide	
30 m (100 ft) roll for drift fences	2
8.5 m (28 ft) piece for trap & funnels	1
7.6 cm (3 in.) strap hinge	2
turn button	2
20-gauge galvanized wire 15 m (50 ft)	1
nails (or screws), box of 100	1
heavy duty staple gun and box of staples	1

TABLE 2. Snakes captured in 15 traps located in Nacogdoches County, Texas from 1999 to 2002.

Scientific name	Common name	No. Captured
Arizona elegans	Glossy Snake	4
Coluber constrictor	Racer	10
Elaphe obsoleta	Eastern Ratsnake	44
Heterodon platirhinos	Eastern hog-nosed Snake	1
Lampropeltus calligaster	Yellow-bellied Kingsnake	11
Masticophis flagellum	Coachwhip	79
Nerodia fasciata	Southern Watersnake	1
Agkistrodon contortrix	Copperhead	49
Agkistrodon piscivorus	Cottonmouth	7
Unidentified species	Skeleton in trap	18

suggested that the Louisiana Pine Snake, *Pituophis ruthveni*, might not occur at this site.

The trapping protocol resulted in some snake mortality, primarily because of occasional infestations of imported fire ants (*Solenopsis invicta*). We used a variety of commercially available ant poisons to treat all visible mounds within approximately 10 m of the traps. This was generally sufficient to control ants within the traps. During the four-year period of trapping, 30 snakes died in our traps, an average of 7.5 snakes per year, or 13.3% of the snakes captured. We also suspected that ophiophagous snakes such as Common Kingsnakes (*Lampropeltis getula*) and Prairie Kingsnakes (*L. calligaster*) occasionally entered traps and consumed other captured snakes.

The design of our traps resulted in few small litter-dwelling species being captured. This presumably resulted from their reluctance to leave the litter surface and ascend the inclined funnel to enter the trap, and the fairly large mesh size that allowed very small individuals to pass through. Adjustments in funnel orientation and mesh size would easily allow the trap to be tailored to specific needs. The use of 3.2 mm (1/8 inch) mesh hardware cloth for the trap, funnels and drift fences would permit the capture of smaller species of snakes. However, it should be noted that the finer mesh hardware cloth tears easily compared to the 6.4 mm (1/4 inch) mesh hardware cloth and requires more support when used for drift fences.

Taxa other than snakes were frequently captured in the traps. The capture of invertebrates, amphibians, and reptiles presented few problems. However, the capture of birds and small mammals resulted in considerable mortality. Birds, in particular, had very short survival times in the traps, as they tended to injure themselves attempting to escape. Reducing the size of the funnel entrance from 8–10 cm to < 5 cm prevented larger mammals (skunks, opossum, squirrels) and most game birds (quail) from entering the traps, and had no obvious impact on capture rates for snakes. Small passerines could still get in the traps. However, more frequent checking on a daily basis would reduce mortality of trapped animals.

This trap design, especially in conjunction with the long drift fences, was quite effective at capturing large terrestrial snakes. The large size of the trap itself and the water source was intended to limit the number of trap visits to once per week. However, in our study we had a higher mortality rate of captured snakes than expected, largely because of fire ants that are common in our region. More frequent trap visits and fire ant eradication would have likely reduced the amount of mortality. We suggest that our trap design in conjunction with efforts to reduce snake mortality, such as ant control, placing traps in shade when possible, and daily trap visits, should maximize success in capturing large terrestrial snakes.

Acknowledgments.—We thank J. Keel for several design and construction improvements that improved trap utility. Research was conducted under Texas collecting permit (SPR-0490-059). Initially, in 1993 we checked traps weekly because we assumed that the large trap design and watering system would limit mortality and allow longer intervals between checks. However, our observations of mortality in traps checked weekly support the recommendation to check traps daily as suggested in the ASIH Animal Care Guidelines (see Guidelines for Use of Live Amphibians and Reptiles in Field Research, American Society of Ichthyologists and Herpetologists; http://www.asih.org/pubs/herpcoll.html.).

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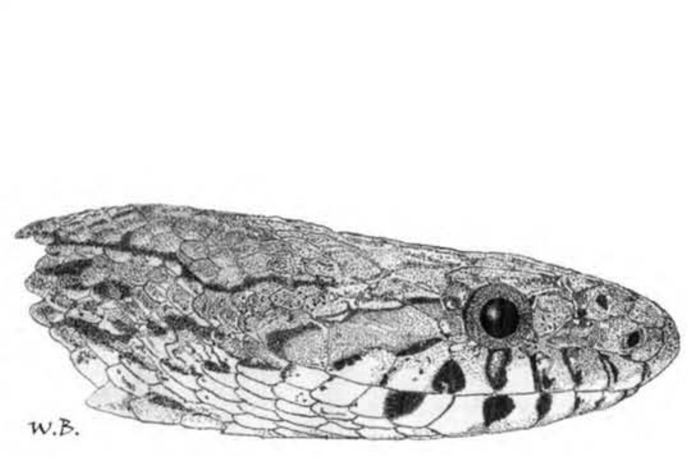

Elaphe guttata (Cornsnake), adult male. USA: Virginia: Greene County. Pen and ink illustration by Will Brown (http://www.blueridgebiological.com/).

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The Rattlebox: An Apparatus for Studying Learning in Rattlesnakes

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This article describes the rattlebox, an apparatus designed to study learning in rattlesnakes (genera *Crotalus* and *Sistrurus*). The rattlebox is relatively inexpensive, simple to construct, and can be adapted to study several learning paradigms. First, we describe the construction of an automated box that consistently induces rattling. Second, we report preliminary results of a study of habituation of the rattling response in three Western Diamondback Rattlesnakes (*Crotalus atrox*). Finally, we suggest potential uses of the apparatus for studies of classical and operant conditioning.

Learning can be defined as a "relatively permanent change in behavioral potential as a result of experience" (Abramson 1994). Countless studies have been published which assess the learning capacities of gold fish (*Carassius auratus*), pigeons (*Columbia livia*), white rats (*Rattus norvegicus*), and dogs (*Canis familiaris*) under various learning paradigms ranging from habituation to classical conditioning and operant procedures. While much has been discovered about learning processes using these traditional "laboratory species," a true phylogeny of learning will require experiments with a greater number of non-traditional species (Bitterman 1965). Further, behavior (and performance in learning tasks) can be used as characters in phylogenetic analysis (de Quieroz and Wimberger 1993), which by its very nature requires a much broader taxonomic scope. Snakes are one such group in which noticeably few learning studies have been published. There are probably several reasons for this paucity.

Burghardt (1977) noted the difficulties encountered in performing learning experiments with snakes. Among these difficulties are their relative inactivity (snakes spend a large proportion of their time sedentary), a general lack of positive reinforcement (most snakes consume large meals infrequently [although see Burghardt et al. 1973, Holtzman et al. 1999, Kleinginna 1970, and Begun et al. 1988 for exceptions]), and a limited number of dependent variables in which to measure (the tubular body form of snakes suggests a rather simple behavioral repertoire relative to other vertebrates).

Rattlesnakes are noticeably lacking from studies of learning probably because of the limitations listed above along with the relatively large body size of some species and handling difficulties associated with their venomous nature. One dissertation (Mills 1970) describes attempts to use escape and avoidance contingencies with Sidewinder (*C. cerastes*) and Mojave (*C. scutulatus*) rattlesnakes. Mills concluded that while escape response topography was subject to change, true avoidance was not trainable in his three subjects. It should be noted that in studies of avoidance and escape it is important to consider the study animal's "species-specific defensive response" (Bolles 1970). Thus, dependent variables appropriate for rattlesnakes should include occurrence of rattling, latency to rattling, and duration of rattling, along with the prototypical striking, and flight behavior that have been utilized in previous learning studies of colubrids. With the first three dependent variables in mind, we have designed an apparatus that consistently releases the rattling response and allows for easy quantification of latency and duration.

The purpose of the rattlebox is to repeatedly apply an invariable stimulus to a test subject that consistently results in the subject rattling its tail. Previous studies have used stuffed animals (LaDuc 2002), predator effigies (Shipman 2002), or a human observer (Duvall et al. 1985) to elicit defensive behavior from rattlesnakes. However, because the experimenter presents each of these, there is variation among presentations in the way they are perceived by the test subject. Additionally, whenever a human observer serves as the stimulus, they risk being envenomated by the test subject. The apparatus diagrammed in Fig. 1 reduces inter-presentation variation and the risk to the experimenter of being bitten.

The rattlebox is a simple 60 cm (L) x 64 cm (W) x 60 cm (H) box in which a moveable top is affixed to heavy-duty cabinet drawer slides that allow it to slide open horizontally. To reduce the possibility of pheromones influencing behavior, we built the prototype out of plywood covered with latex paint. We also covered the bottom of the rattlebox with newsprint that was changed following each training session. If pheromones are an issue, or the object of investigation, we suggest that the plywood be replaced with Plexiglas. Plexiglas is easier to clean and less likely to be contaminated by potentially confounding odors.

A snake is introduced into the apparatus through a 6.5 cm diameter keyhole located at the lower center of one side of the box. Snakes are coaxed into the box with a snake hook via this opening, which is closed with a swinging door. A clear acrylic barrier is located on the inside ca. 18 cm from the floor of the box to prevent snakes from escaping or being caught in the door as it returns to the closed position. The barrier has a removable portion to facilitate cleaning and handling of subjects. The inside walls (above the acrylic barrier) and the underside of the moving door are covered with open-cell foam (5 cm thickness), which absorbs some of the noise made by the motor (see below) and the movement of the drawer slides. Three compression springs (one of which is mounted to the stop contact; see below) are glued to the leading edge of the door to dampen the force upon closing.

The rattlebox is automated to open and close automatically at preset intervals using the motor of a remote-controlled toy train (Coastal Express, Scientific Toys, LTD, Chai Wan, Hong Kong), four electrical contacts and a cyclic timer (Canakit, Vancouver, BC, Canada. http://www.canakit.com). Whereas we used a toy train motor to open and close the lid, any radio-controlled motor with forward and reverse will work.

The motor is fixed in a horizontal position with the wheels in contact with a track that is attached to the moving top (Fig. 1). When the motor is engaged in the forward direction the box top is drawn open. The motor is engaged in the forward direction by two

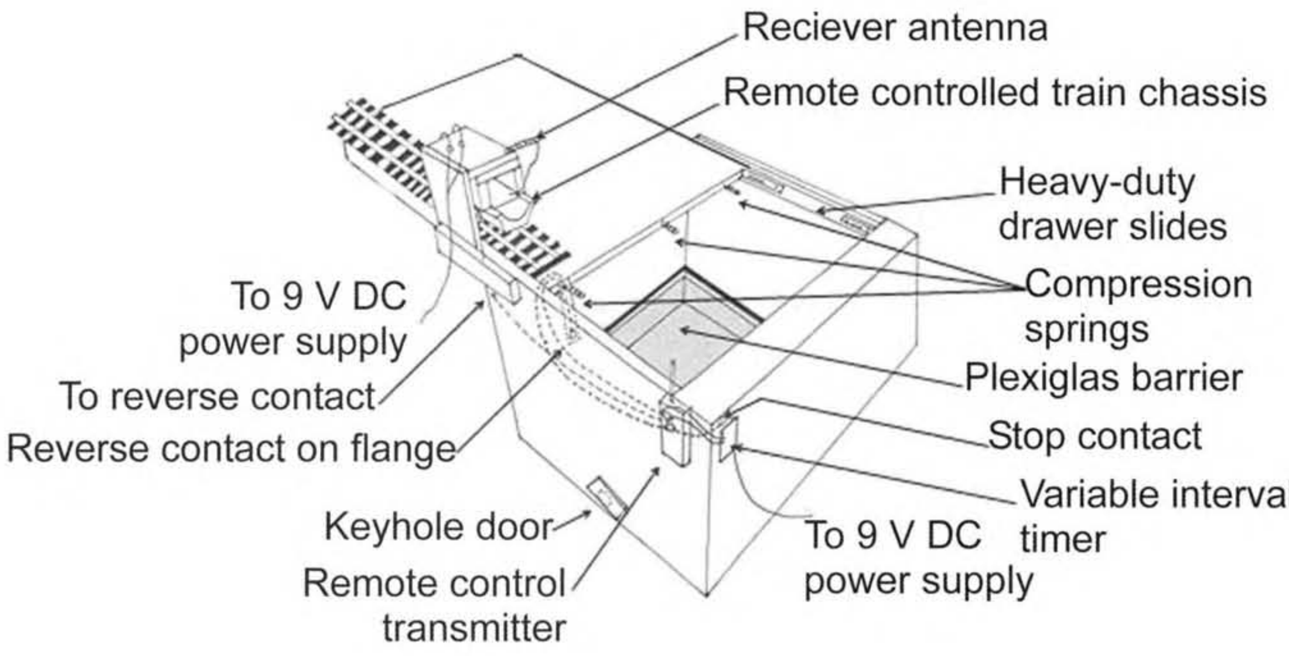

FIG. 1. Schematic representation of the rattlebox. Note the compression spring on the stop contact positioned on the top of the flange bearing the reverse contact. (—) indicates wiring for the forward direction (i.e., open). (– –) indicates wiring for the reverse direction (i.e., closed). (-·-) indicates wiring to stop the motor.

wires that connect the forward button of the remote controller to the normally open and common contacts on the interval timer. To return the top to the closed position, the motor is engaged in the reverse direction by contact made by copper contacts attached to a downward projecting flange affixed to the moving door and the stationary back wall. Contacts are soldered to wires that lead to the reverse button on the circuit board of the remote controller. The motor is stopped at the end of a trial by two additional contacts attached to the forward moving edge of the door and the inside of the front wall of the box. These contacts are soldered to wires that lead to the stop button on the circuit board of the remote controller. A parts list is available from the authors upon request.

A microphone (Earthworks model # M30, Milford, New Hampshire) placed inside the center of the box and pre-amplifier (Earthworks model #1021) outside the box are controlled via a laptop computer by an observer in an adjacent room. Just prior to the beginning of a trial, the observer starts a digital recorder (we used Audio Record Wizard http://www.nowsmart.com/arwizard) and obtains a digital recording of each trial. Between trials each recording is analyzed and the occurrence/non-occurrence of rattling (along with other relevant variables) is recorded.

The rattlebox can be used in the implementation of multiple learning procedures. Below we give a preliminary description of its utility in the study of habituation of the rattle response in Western Diamondback Rattlesnakes. We also outline its potential uses in classical and operant conditioning studies.

Three wild-caught *C. atrox* from Oklahoma were used to test the Rattlebox in a study of habituation of the rattle response. To produce habituation of the rattling response, the top of the box was opened every five minutes (i.e., intertrial interval = 5 min) automatically with the interval timer. For each trial, occurrence or non-occurrence of rattling was determined from playback of digital recordings. Habituation was achieved when a snake failed to rattle for ten consecutive trials, which is a strict criterion for behavioral studies (Ashmead and Davis 1996). Midway between the tenth consecutive no response trial and the eleventh trial, snakes were prodded with a snake hook through the keyhole for ca. 5 sec. This prod served as a dishabituating stimulus. Dishabituation is used to rule out effector fatigue and sensory adaptation as explanations for the observed response decrement to repeated stimulation (Abramson 1994). Two and a half minutes following the presentation of the prod, the lid was opened and the presence or absence of rattling was recorded. The presence of a rattling response during the re-introduction of lid opening is evidence for a learned changed in behavior.

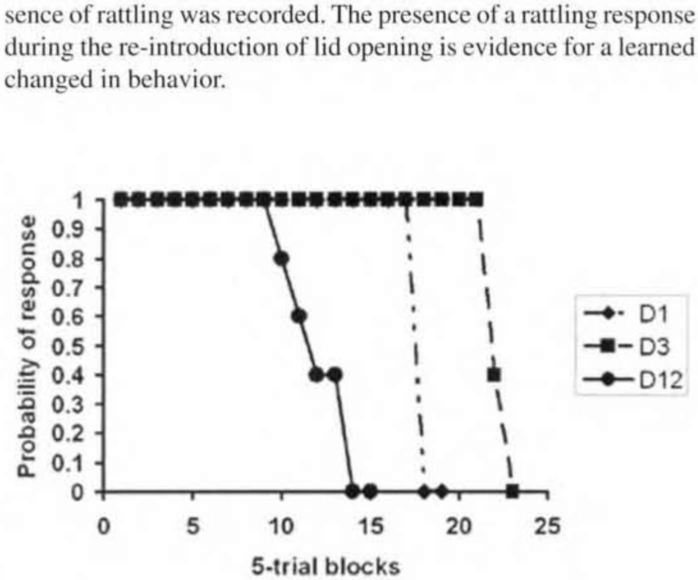

FIG. 2. Habituation of the rattle response by three *Crotalus atrox* tested in the rattlebox. Note the ordinate is in 5-trial blocks and that some symbols overlap.

The habituation curves of the rattle response for subjects D1, D3, and D12 are shown in Fig. 2. Note the high probability of response in the first 50 trials for all three individuals (mean ± SE = 0.99 ± 0.007 for all three individuals combined). Following the dishabituating stimulus, all snakes responded. It is evident that the rattlebox is useful in consistently eliciting a rattle response and in detecting individual differences in rattling behavior.

In addition to habituation, the rattlebox can also be used to study classical conditioning in rattlesnakes. Our laboratory has just begun to test classical conditioning in rattlesnakes in which the opening and closing of the box serves as an aversive unconditioned stimulus. To serve as a conditioned stimulus, we have mounted a 60 W incandescent light on the inside of the box. Temporarily turning on the light serves as a conditioned stimulus.

We have also designed an operant procedure that utilizes the rattlebox. In operant conditioning, a subject's response is reinforced by its consequences. By placing the rattlebox in a cold room and positioning a heat lamp inside wired to a voice-activated relay, each rattle response is rewarded with an increase in ambient temperature. Because rattling typically does not occur spontaneously, it can be shaped by gently prodding the snake with a snake hook through the keyhole.

The results presented here demonstrate the utility of the rattlebox in studies of learning in rattlesnakes. Specifically, Western Diamondback Rattlesnakes repeatedly exposed to an aversive yet harmless stimulus show a learned decrease in rattling. Furthermore, the box is relatively inexpensive and can be built in one day. Extension of the rattlebox to studies of classical and operant conditioning is also easily accomplished. We hope this apparatus will shed light on the perceptual world of rattlesnakes and stimulate further research in the area of learning in snakes.

Acknowledgments.—Development of the apparatus was funded by a grant from the East Texas Herpetological Society to AJP. B. Baker, B. Wilson, and H. Schlothower provided the snakes. N. Birnbaum, N. Faught, and L. Hyde assisted in data collection. An anonymous reviewer made helpful comments on an earlier version of the manuscript.

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NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 36, Number 1 (March 2005).

CAUDATA

AMBYSTOMA OPACUM (Marbled Salamander). **SPERMATOPHORE DEPOSITION.** On 4 Nov 2000, a lone male *Ambystoma opacum* was observed depositing a spermatophore at Ginger's Bay, a small Carolina Bay on the Savannah River Site in Aiken Co., South Carolina. The nearest conspecific, another male, was more than 3 m away during deposition, too great a distance to have influenced the sexually active male by female mimicry (Arnold 1976. Z. Tierpsychol. 42:247–300). Because spermatophore deposition in *A. opacum* occurs very rapidly, with certain individuals achieving as many as 4 depositions in as short as 30 seconds (pers. obs.), there was not sufficient time for another salamander to have interrupted normal courtship with this male, leaving him alone to be observed in an attempt to finish mating. A search of the immediate vicinity yielded no other spermatophores. Previous reports of courtship in *Ambystoma* have emphasized the tendency for males to deposit spermatophores repeatedly, but only in the presence of other courting individuals (e.g., Noble and Brady 1933. Zoologica 11:89-132; McWilliams 1992. Behaviour 121:1–19). These lines of evidence strongly suggest that this individual was engaging in spermatophore deposition in the absence of courtship or influence by either past or present male sexual activity. Males of congeneric species have been reported to deposit in solitude but only after being initially stimulated by mating aggregations or courtship behavior by conspecifics (Anderson 1961. Copeia 1961:132–139; Arnold 1976. *op. cit.*; McWilliams 1992. *op. cit.*). Because males presumably are limited in the number of spermatophores they can produce in a breeding season (Verrell 1986. J. Comp. Psych. 100:291–295; Verrell 1988. J. Herpetol. 22:394–400), selection should strongly favor male mating strategies that result in successful insemination of females. Thus, if isolated spermatophore

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The Society for the Study of Amphibians and Reptiles, the largest international herpetological society, is a not-for-profit organization established to advance research, conservation, and education concerning amphibians and reptiles. Founded in 1958, SSAR is widely recognized today as having the most diverse society-sponsored program of services and publications for herpetologists. Membership is open to anyone with an interest in herpetology—professionals and serious amateurs alike—who wish to join with us to advance the goals of the Society.

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All members and institutions receive the Society's primary technical publication, the *Journal of Herpetology*, and its news-journal, *Herpetological Review*; both are published four times per year. Members also receive pre-publication discounts on other Society publications, which are advertised in *Herpetological Review*.

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Future Annual Meetings

2006 — New Orleans, Louisiana, 12–17 July (with ASIH, HL)
2007 — Saint Louis, Missouri (with ASIH, HL)

About Our Cover: *Lyriocephalus scutatus*

This Lyre-headed Dragon (*Lyriocephalus scutatus*) is living in a protected stand of rainforest near Kandy in the uplands of Sri Lanka. The slow-moving agamid is one of a small core of Sri Lankan reptiles that are sometimes referred to as relict endemic taxa.

Sri Lanka (formerly Ceylon) is hailed as having greater biodiversity per unit area than any other Asian country, and most of this lies in the moist southwest and central highlands. Given its close proximity to India, it is hardly surprising that the two countries have much in common. Linked many times since the Miocene (Das 1995. Lyriocephalus 1(1–2):17–20), they share the majority of Sri Lanka's reptile genera and a good many species. Despite this, Sri Lanka is well-endowed with endemics. It seems the moist southwestern regions were subject to the longest periods of isolation, by intervening dry terrain as well as by fluctuating sea levels. More than 80 reptile species, well over half the terrestrial fauna, are endemic to Sri Lanka (de Silva 2001. The Herpetofauna of Sri Lanka. An Historical Overview, Current Status with Checklists. ARROS, Sri Lanka) and most of these are restricted to those high rainfall areas.

The relict endemics include a monophyletic cluster of three agamid genera: *Ceratophora* with five species, and *Cophotis* and *Lyriocephalus* with one species each (Pethiyagoda and Manamendra-Arachchi 1998. J. South Asian Nat. Hist. 3(1):1–50). The group, considered by some as a distinct subfamily, the Lyriocephalinae, features some of the world's most striking lizards. They are characterized by modified rostrums or rostral scales. In some species these form impressive horns, ranging from simple curved structures to large serrated appendages. All are restricted to the southwest or central uplands.

Lyriocephalus scutatus boasts an impressive bulbous hump on the snout and acute bony flanges above the eyes. This 300 mm lizard is usually green, but can change rapidly to brown. Males are largest, with deeper gular sacs and the most protrusive humps. They occur in closed, lowland to sub-montane rainforests, from about 25–1600 m elevation, but have demonstrated a limited degree of tolerance to habitat modification by utilizing well-vegetated home gardens when these abut suitable habitat (Bambaradeniya et al. 1997. Lyriocephalus 3[1]:25–28).

Within their isolated domains the endemic relict agamids have evolved to occupy narrow ecological niches. They now rely on ever diminishing rainforests, threatened by the usual culprits of habitat degradation, deforestation and encroachment by fires, with the resulting fragmentation of populations. They share an island with nearly 20 million people, or around 290 per km^2. Yet *Lyriocephalus scutatus* is one of the lucky ones because it has a reasonably broad distribution through the central uplands and southwest, and its status is currently listed as 'merely' Vulnerable. Many of its horned relatives are restricted to single threatened localities and virtually all are considered to be Endangered to Critically Endangered.

Our cover subject was photographed by Australian herpetologist **Steve Wilson** in a small stand of forest on the outskirts of Gampola. Steve's visit to Sri Lanka is part of an on-going interest in the herpetofauna of tropical islands. His most recent books, *A Complete Guide to Reptiles of Australia*, co-authored with Gerry Swan (New Holland, 2003), and *A Field Guide to Reptiles of Queensland* (New Holland, 2005), are identification guides. His next project, a reptile book for children, aims to instil a sense of wonder into the next generation. This is due for publication in 2006.

Steve used Provia 100 ASA slide film and an Olympus OM2n camera with a 24 mm wide-angle lens. Natural daylight was augmented with a small manual fill flash.

SSAR BUSINESS

Student Travel Awards Silent Auction

The SSAR Student Travel Awards Committee announces the Eleventh Annual Frameable Art Silent Auction to be held at the 2006 SSAR meeting in New Orleans, Louisiana from 12–17 July. Preferred donations include herp-related photos, line drawings, prints, paintings, plates, engravings, or anything frameable, if not already framed. If you are interested in donating an item (tax deductible for U.S. residents), please contact Thomas Eimermacher (e-mail: Thomas.Eimermacher@selu.edu).

SSAR Student Travel Awards Call for Applications

Ten awards of US $200 each are available. An applicant for a travel award must be a student and a member of SSAR, must not have previously received a travel award from SSAR, and must be the first author of a paper or poster to be presented. Application package must include: 1) letter signed by his/her major advisor or department chair that states: he/she is not completely funded for travel from another source; 2) an official copy of the poster or paper abstract to be presented; 3) a self-addressed, stamped envelope. If the research is co-authored, the applicant must also include a letter from his/her advisor stating that the work was primarily the product of the applicant. Qualified applicants are pooled and winners are drawn at random. Students from local meeting site and current members of the SSAR Travel Awards Committee are excluded from applying for a travel award. Applications must be postmarked by 15 April 2006. Award checks will be disbursed at the meeting. Send application package to Dawn S. Wilson, Southwestern Research Station, P.O. Box, 16550, Portal, Arizona 85632, USA or for further information e-mail: dwilson@amnh.org.

SSAR Sustaining Members

SSAR wishes to acknowledge the following Sustaining Members. If you are interested in supporting the Society at this levels (or as a Contributing Member), please contact Breck Bartholomew at the Membership Office (breck@herplit.com).

Ralph Axtell, Lloyd and Mathilde Barr, Bill Barthen, Richard D. Bartlett, Christopher J. Bell, Catherine R. Bevier, Richard W. Blob, Alvin R. Breisch, Sheila E. Tuttle and William S. Brown, Janalee Caldwell, Ulisses Caramaschi, Farley Connelly, Amanda Crnkovic, James Dixon, Howard Evans, John P. Feeney, Stephen Goldberg, James A. Holm, Joseph Hummer, Akihiro Koshikawa, Richard H. Legere, Teresa J. Mayfield, Walter E. Meshaka, Jr., Russell Mittermeier, Paul Moler, John C. Murphy, James Organ, Gretchen E. Padgett-Flohr, William S. Parker, Robert Prescott, Jr., Jack Sites, Jr., Glen Stewart, Laurie Vitt, David Wales, Harlan D. Walley, Hartwell Walsh, Jr.

Journal of Herpetology Changes

On 1 January 2006, the *Journal of Herpetology* will begin to accept submissions via AllenTrack, the web-based manuscript submission and tracking system of Allen Press. AllenTrack will facilitate and expedite editorial manuscript handling, and will make the behind-the-scenes production of the journal more efficient than our current system. Instructions for accessing AllenTrack and submitting manuscripts will be available on the SSAR website (http://www.ssarherps.org). Questions regarding submission of manuscripts via AllenTrack should be directed to Geoff Smith (see below).

Accompanying the implementation of AllenTrack, Geoff Smith will take over as Editor of the *Journal of Herpetology* from Brian Sullivan on 1 January 2006. Brian has served as Editor since 2000. Under Brian's editorship, the journal has seen changes in its format and a drastic reduction in the delay from acceptance to publication of manuscripts (from > 12 months to ≈ 4 months on average). SSAR extends its thanks to Brian for his valued service to the journal and the society.

Geoff has served as an Associate Editor for the *Journal of Herpetology* since 1998. He can be reached at smithg@denison.edu.

2005 Annual Meeting, Tampa, Florida

The 48th annual meeting of SSAR took place from 6-11 July, 2005 at the Marriott Waterside Hotel and Marina in Tampa, Florida. SSAR members once again met with members of the American Elasmobranch Society (AES), the American Society of Ichthyologists and Herpetologists (ASIH), and The Herpetologists' League (HL). The meeting was hosted by the University of South Florida with local organizers Henry Mushinsky, Phillip Motta, and Earl McCoy

A total of 1228 herpetologists and ichthyologists from many countries including Australia, Chile, China, Costa Rica, France, Ireland, New Zealand, and Switzerland attended the meeting. Over half of those present were students! Approximately 690 papers and 310 posters were presented. Six symposia, including one sponsored by SSAR (The Biology of Boas, Pythons, and Related Taxa organized by Bob Henderson, Bob Powell, and Gordon Schuett) were included in the meeting schedule.

A huge thanks are due to Henry Mushinsky and Phil Motta (Co-Chairs) and other members of the Local Committee (especially the graduate students) for all of their hard work. We are grateful to Sharon Brookshire, Jan Hudzicki, and their staff from the Kansas State University Division of Continuing Education for another very smoothly-run meeting

Social Programs and Resolutions

On the evening of 6 July, President Robin Andrews introduced Past-President Janalee Caldwell and Dr. Laurie Vitt (Sam Noble Oklahoma Museum of Natural History, University of Oklahoma) who jointly gave this year's SSAR President's Travelogue "*From the Amazon to the Cerrado: Reptiles and Amphibians of Brazil.*" Between the two of them, they have over 50 years of experience in the neotropics and, as anyone who saw Jan and Laurie's photographic exhibition in the Sam Noble Museum at the 2004 JMIH could have predicted, we were treated to an amazing slide show of parts of Brazil of which most of us only dream.

Henry Mushinsky and Phil Motta opened the Plenary Session on 7 July and welcomed us to Tampa. In addition to providing general information about the meeting and meeting venue, both Henry and Phil warned us of sharks, lightning, and Ybor City. Dr. Renu Khator (Provost and Vice President of Academic Affairs, University of South Florida) also welcomed us to Tampa (and warned us yet again about Ybor City), invited us to visit the University, and then spoke about many of the challenges she saw facing higher education.

These welcomes were followed by well-received presentations from Patrick Gregory (Past-President, ASIH), Roy McDiarmid (Distinguished Herpetologist, HL and President-Elect, SSAR), and Sonja Fordham (The Ocean Conservancy). As usual, the Annual Group Photograph followed the morning Plenary Session and paper sessions began after lunch. The General Reception was held that evening at the Florida Aquarium, a short walk up the road from the meeting venue.

In a repeat of last year, where tornado warnings drove the Annual Picnic indoors, weather once again, this time in the form of Hurricane Dennis, resulted in this year's picnic being an indoor event. It lacked some of the anticipated ambience of the planned venue (the Lowry Park Zoo), however a good time was had by all.

Over $5,300 was raised at the Annual SSAR/HL Live Auction held on Sunday evening. SSAR uses these funds to support Student Travel Awards. Thanks to David Green for his auctioneering skills, to Ron Javitch for his very generous bidding, and to Stan Trauth who donated a Hellbender t-shirt on behalf of the Cryptobranchid Interest Group. The t-shirt was signed by the speakers at a recent Hellbender conference and was auctioned for $100.

The Annual Banquet was held in the Marriott Hotel on 11 July with Larry Page (prior Past-President, ASHI) serving as the Master of Ceremonies. Past-Presidents of ASIH, SSAR, HL, and AES in attendance at the banquet were acknowledged. There was one Past-President over age 80 and several over age 70. In a remark that now appears prescient (and at the time provoked much laughter), Henry Mushinsky issued Bob Cashner (Chair, Local Organizing Committee for the 2006 JMIH in New Orleans) with a challenge to beat the tornados that threatened the 2004 JMIH and Hurricane Dennis that threatened the 2005 JMIH.

A number of awards were presented including *both* the Robert K. Johnson and Henry S. Fitch Awards to Dr. Margaret Stewart. The Johnson Award is to honor members of ASIH who have provided outstanding service to the society and the Fitch Award honors an individual for long-term excellence in the study of amphibian and/or reptile biology. Dr. Stewart received her Ph.D. from Cornell University and joined the Department of Biological Sciences at the State University of New York, Albany in 1956. She is widely-known for her work on population, behavior, and community ecology of amphibians especially *Eleutherodactylus coqui* in Puerto Rico. Meg is author or coauthor of over 65 scientific papers and reviews. She has supervised 16 Ph.D. or Master's students and over 40 undergraduate theses as well serving as an important mentor to many in the herpetological community.

Meg has served both SSAR and ASIH. She was President of SSAR in 1979, has served on and chaired the Nominating Com-

SSAR President Robin Andrews congratulating Dr. Meg Stewart, the 2005 recipient of the Robert K. Johnson and Henry S. Fitch Awards. (M. Preest)

mittee, chaired the Kennedy Student Award Committee, served on the editorial board of Journal of Herpetology, and has been part of the Long Range Planning Committee. For ASIH, Meg was President in 1996 and Historian for a number of years. She has also been active with the World Congress of Herpetology. These awards to Meg were greeted with loud applause from the Banquet attendees. Meg looked pleasantly stunned to receive the first award and then doubly stunned to receive the second. SSAR congratulates Meg for this well-deserved recognition.

The following SSAR resolutions, prepared by Richard Wassersug (SSAR Resolutions Chair), were read:

Resolution on Outgoing SSAR Officers, Editors, and Others:
Whereas, the following individuals have given freely of their time, energy, and expertise to SSAR, and,
Whereas, because of their hard work and dedication, SSAR programs, projects, and goals have been advanced, and,
Whereas, SSAR is dependent on the generosity and tremendous efforts of its members and is grateful for their willingness to serve,
Therefore be it resolved that the Society for the Study of Amphibians and Reptiles offers its gratitude and sincere thanks for jobs well done to the following individuals: Joe Mendelson, Board of Directors; Gabriela Parra Olea, Board of Directors; Robert Powell, Editor, *CAAR*; Steve Corn, Editor, *Herpetological Conservation*; Brad Hollingsworth, Associate Editor, *Herpetological Review*; Daryl Karns, Associate Editor, *Herpetological Review*; Brian Bowen, Associate Editor, *Herpetological Review*; Ruston Hartdegen, Herpetological Husbandry Section Editor, *Herpetological Review*; Eli Greenbaum, Current Research Section Editor, *Herpetological Review*; Linda Ford, Resolutions Committee Chair; Dennis Desmond, SSAR Webmaster; Zack Walker, SSAR Webmaster; Ruston Hartdegen, Coordinator, *Relationships with Herpetologists at Zoological Parks Committee*; James Murphy, member, *Relationships with Herpetologists at Zoological Parks Committee*.

Resolution on 5th World Congress of Herpetology:
Whereas, the organizers of the 5th World Congress of Herpetology (Stellenbosch, South Africa) put on a stellar conference in terms of both its scientific content and stimulating, pleasant atmosphere, and,
Whereas, this contribution to herpetology was appreciated by visitors from all around the world,
Therefore be it resolved that the SSAR congratulates the World Congress for such a successful meeting and looks forward to similar successful World Congresses in the future.

The following joint society resolutions were read by Adam Summers (Chair, ASIH Resolutions Committee):

Joint Resolution Thanking the Local Committee:
Whereas the Tampa meeting was a great success, and
Whereas the local color was interesting, tasty, and, in Ybor city even titillating,
Therefore be it resolved that the society heartily and sincerely thanks Phil Motta and Henry Mushinsky for their hard work as local committee chairs.

Whereas 20 years ago Henry Mushinsky, then a callow assistant professor hosted a meeting of SSAR and HL in Tampa, and
Whereas the information packet for that meeting contained a list, complete with extensive reviews, of the local topless bars,
Therefore be it resolved that the society recognizes Henry for having matured and mellowed into a politically correct, tactful, and tasteful full professor.

Whereas the society recognizes that a substantial portion ... some would say all, of the work associated with the meeting was accomplished by the many students associated with the Motta, McCoy and Mushinsky labs,
Therefore be it resolved that the society recognizes and thanks them for their efforts.

Joint Resolution Concerning Storms and Floridians:
Whereas, the timing of the Joint Meetings of Ichthyologists and Herpetologists coincides with the tropical hurricane season, and
Whereas, Hurricane Dennis caused some anxious moments for participants at this year's meeting, altering plans for yet another outdoor picnic, preventing most participants from venturing from the meeting hotel for two full days, overwhelming hotel's restaurants and bars at the hotel, and stranding those brave enough to dine elsewhere, but causing no harm to anyone, and
Whereas, Floridians have had to deal with far too many Hurricanes in the past few years, with many people losing their life and homes or were otherwise massively inconvenienced, and
Whereas, the Florida Keys and Panhandle had to endure the wrath of Hurricane Dennis,
Therefore be it resolved that participants at the Joint Meetings of Ichthyologists and Herpetologists send well wishes to Floridians affected by Hurricane Dennis and previous hurricanes, and hope that the state will be spared from future hurricanes.

Joint Resolution Thanking Student Attendees:
Whereas these meetings are greatly enhanced, and even defined by the contributions of our student members, and
Whereas student members made up 60% of our total attendance, and
Whereas students rather than professors brought the vast majority

of the captured herps to the hotel bar,
Therefore be it resolved that the society thanks the students for their presence and reminds them to attend business meeting and volunteer their service to the society.

The Banquet closed with thanks from Larry Page to the Local Committee and Conference Organizers and a warm invitation from Bob Cashner to attend to 2006 Joint Meeting in New Orleans, Louisiana (12–17 July).

Board Meeting and Business Meeting Summaries

Society President Robin Andrews called the Annual SSAR Board Meeting to order at 0805 h on 6 July 2005 in the Marriot Waterside Hotel and Marina, Tampa, Florida. In attendance were 11 members of the Board of Directors and 13 Editors, Committee Chairs, or members of the Society. Minutes of the 2004 Board of Directors Meeting (Norman, Oklahoma) were approved.

In her first 6 months in office, President Andrews, with the unanimous support of the Board, signed an agreement that made SSAR a participant in JSTOR. The Society will receive several thousand dollars in royalties annually. President Andrews appointed Clay Garrett as chair of the Relations with Herpetologists at Zoological Parks Committee and Alan Savitzky as chair of the Committee that will organize SSAR's 50^{th} Anniversary celebration in 2007 (Robert Aldridge, Breck Bartholomew, Janalee Caldwell, Jonathan Losos, Henry Mushinsky, and Kirsten Nicholson, members). She recommended that the President's Challenge Fund be used to support the activities of this Committee. She wrote letters of congratulation to the 2005 recipient of the Dean E. Metter Award (Matthew Chatfield), to the winner and runner-up of the 2005 Kennedy Student Award (Cameron Stevens and Caren Goldberg respectively), and to Janalee Caldwell, Ellen Censky, and William Matthews for hosting the 2004 JMIH in Norman. Janalee Caldwell and Laurie Vitt were invited to present the President's Travelogue at the 2005 JMIH.

Past-President Caldwell appointed Zachary Walker to replace Dennis Desmond as SSAR webmaster and worked closely with Zack and Dennis during the transition. She also appointed Anne Maglia to chair the new Web Oversight Committee (Gad Perry and Lisa Beldon, members) and Catherine Bevier to chair the Herpetological Education Committee (HEC, a joint SSAR/HL committee; Taylor Edwards, Steve Mullin, Greg Watkins-Colwell, Ruston Hartdegen, Dave Hardy members). Additional information about this committee is available on the SSAR website. SSAR has many important documents currently in the possession of past founders, officers, and members. George Pisani has agreed to serve as the society archivist and will work with Kraig Adler and President Andrews.

During the 2004 JMIH, Janalee Caldwell (along with various officers and editors of the three herpetological societies) attended a meeting with Allen Press to discuss aspects of BioOne and the future of the Society's journals.

Following the Business Meeting in Norman, President Caldwell turned over the SSAR gavel to Robin Andrews.

Treasurer, Theodora Pinou reported that the Society made a profit of \$34,377 for calendar year 2004; \$5,563 in operating income, \$2,974 in donations, and \$16,196 of realized investment income. Dora reported that the society is currently in a sound financial position and recommended implementing a plan to ensure long-term financial security. The Long-Range Planning Committee will be consulted regarding engaging the services of a professional portfolio manager to offer investment advice to the Society. Dora

Participants in the SSAR-sponsored symposium "The Biology of Boas, Pythons, and Related Taxa." Photograph by M. Preest.

and President Andrews will discuss the funding of the Henri Seibert and Kennedy Awards and contact the Planning Committee with suggestions.

The move of the Publications Library from St Louis University, Missouri to Salt Lake City, Utah was completed by late 2004 at a cost of $14,220.

The decline in membership numbers noted in recent annual reports continues this year. There was ongoing discussion of the benefits of SSAR membership in the face of increased reliance on BioOne for access to society journals. A penalty fee of $10 for late membership renewal was recently imposed. Although this penalty has not been enforced, $1,170 has been raised voluntarily. This will be used to cover the extra costs of postage.

Dora provided an accounting of various Book Initiate Funds (e.g. Bailey Endowment Fund, Gordon Fund, etc.) and Student Award Funds (e.g. Dean Metter Memorial Award, Minton Endowment Fund, etc.). The Board has not allocated funds for the International Cooperation Project Fund since it was established a number of years ago. President Andrews recommended that the HEC use this fund to update the list of research grants published on the Society website (this list was generated by Janalee Caldwell and Rafael de Sá). Dues forms will continue to include a box where members can indicate whether they wish to make a contribution to the International Cooperation Project and contributors will be acknowledged on the website.

There was discussion of a proposal to initiate a Middle School Special Award in Herpetology (provide $50 per state science fair). The Board felt that support of our graduate student members should take precedence over support of younger students. It was suggested that a certificate of acknowledgement or an SSAR publication might be suitable for Middle School students. The logistics of such an undertaking will be substantial. The HEC will consider this suggestion.

Currently, $1000/yr is budgeted to cover Society website expenses. The cost of hosting the website is expected remain at approximately $180/yr. Additional funds could be used to update the site, add images, provide sample PDF files of chapters from SSAR publications, etc.

Among her duties in the past year, Secretary Marion Preest reported that she wrote a summary of the 2004 Annual Meeting, compiled the 2005 Annual Report, and prepared agendas for the Board and Business Meetings at the 2005 Annual Meeting. She also worked closely with Kirsten Nicholson (Chair, Nominations Committee) prior to the election held in 2004. Marion communicated with the nominees and reported the results of the election in *Herpetological Review*.

Breck Bartholomew (Publication's Secretary) reported that income from sales of the Society's publications totaled $37,248. He distributed a list of recent Society publications to those in attendance at the Board meeting. Material is still being counted and organized following the move of the Publications Library to Salt Lake City. Breck advertised the recent facsimile *Les Tortues de l'Indochine* using a postcard mailing. The net income generated suggested that this may be a profitable way of advertising Society publications. Dealing with returned journals involves a considerable expense for the Publications Office. The Web Oversight Committee will investigate the possibility of including a change of address function on the website. There was discussion of the initiation of a "junior membership category" for high schools and middle schools. The school might be charged an individual rate rather than an institution rate. The HEC will consider this.

Lunch break for Julian Lee, Bobby Espinoza, Linda Ford, and Jose Rosado. (M. Preest)

Robert Powell, Editor of *Catalogue of American Amphibians and Reptiles* (*CAAR*), reported on the status of this publication effort. Bob has stepped down as editor (although he continues to help in an advisory capacity) and Andy Price has assumed the role of editor. Gregory Watkins-Colwell has become an Associate Editor and Twan Leenders was appointed as section editor for Anura. Bob noted that the 2004 contributions to *CAAR* consisted of 20 accounts (Nos. 781–800; 3 salamander, 3 frog, 1 turtle, 10 lizard, and 3 snake accounts plus an index to accounts 601-800) for a total of 76 printed pages. Color plates were included in 19 of the accounts. Andy Price reports that the 2005 subscription is tentatively scheduled for publication on June 30 (20 accounts), and he has plans for another 20 accounts for 2006. Andy indicated that he may consider other printers to see if savings can be made. The *CAAR* index on the website needs updating. Breck Bartholomew will send a copy of *CAAR* to all members along with a catalogue of SSAR publications. Bob reported that he faces a continual struggle to receive an adequate number of accounts and that the accounts he has received recently have not been geographically balanced (there is a paucity of accounts on Central and South American taxa).

Kraig Adler (Editor) reported on the publication activities of *Contributions to Herpetology*. No books were published in 2004. "*Biology of the Reptilia*, Volume 20 (Morphology)," edited by Carl Gans and Abbot Gaunt is anticipated for December 2005. Formatting will begin shortly on "*Tasks and Problems Studying the Life of Reptiles in Zoos*," by Hans-Günter Petzold and, although the final manuscript has not yet been submitted, much preliminary work has been done on the color plates of "*Field Guide to Amphibians and Reptiles of the West Indies*," by S. Blair Hedges. Future publications will include "*Herpetological Time Travel Through the Zoo and Aquarium World*," by James B. Murphy, and "*Lizards of Southern Africa*," edited by William R. Branch and Aaron Bauer.

Editor of *Facsimile Reprints in Herpetology*, Aaron Bauer, reported that two new facsimiles were published in 2005; "*Les Tortues de l'Indochine*" by René Bourret and "*The Herpetologi-*

Brian Crother and Henry Mushinsky at the SSAR/HL live auction. (M. Preest)

cal Contributions of Sir Andrew Smith" with a biography, concordance of names and annotated bibliography by William R. Branch and Aaron M. Bauer. This last publication was included in the meeting bags of delegates at the recent World Congress of Herpetology in South Africa as a commemoration of the meeting and an SSAR promotion. Planned for publication in early 2006 is "*The Herpetological Contributions of Mario Giancinto Peracca*," edited by Franco Andreone and Elena Gavetti (with an English translation of the introduction) and possible for early 2007 is "*The Herpetological Contributions of John Edward Gray.*" Other titles that are under consideration for future facsimiles include the collected works of Lönnberg and Andersson, "*Zur Entwicklungsgeschichte und Anatomie der Ceylonesischen Blindwuehle Ichthyophis glutinosus*" by Sarasin and Sarasin, and "*The Fossil Turtles of North America*" by O.P. Hay. *Herpetological Circulars* Editor, John Moriarty, reported that HC 33, "*Johann von Fischer and His Chameleons: The History of the Common Chameleon*" will be published in late 2005. It will be 96 pages with a full color cover. A grant from the Atherton Seidell Endowment Fund of the Smithsonian Institution has been requested to cover printing costs. "*A Review of Marking Techniques for Amphibians and Reptiles*" is anticipated in early 2006 and "*Synopsis of Helminths Endoparasitic in Snakes of the United States and Canada*" is planned for late 2006.

Former Editor, Steve Corn reported that Volume 2 in *Herpetological Conservation*, "*Ecology, Conservation, and Status of Reptiles in Canada*," is expected in late 2005. Robin Jung and Joe Mitchell, current Co-Editors of *Herpetological Conservation* reported that they have received 28 of the 55 proposed manuscripts for Volume 3 "*Urban Herpetology: Ecology, Conservation and Management of Amphibians and Reptiles in Urban and Suburban Environments.*" They expect reviews of all manuscripts to be completed by August 2005. Joe indicated that there has been much interest in this publication and that outside funding is being sought.

Herpetological Review Editor, Robert Hansen reported a 6% increase in the number of pages in *Herpetological Review* Volume 35 compared with Volume 34 and a 69% increase since 1999. He expects Volume 36 to be approximately the same size as Volume 35. The time lag for publication ranges from 3–15 months. Most manuscripts are submitted and handled electronically. Greater scrutiny of submitted manuscripts by editorial staff has resulted in an increase in the rejection rate. The SSAR author assistance program continues to be used. Brad Hollingsworth (Associate Editor), Daryl Karns (Associate Editor), Ruston Hartdegen (Section Editor), and Eli Greenbaum (Section Editor) have resigned. New appointments include Steve Johnson as Associate Editor, Michael Burger and Michele Johnson as Section Editors, and Barbara Banbury and Michael Jorgenson as Copy Editors.

Journal of Herpetology Editor, Brian Sullivan submitted a report indicating that the number of submissions in 2004 was similar to that in the last several years. The rejection rate in 2004 was comparable with that in recent years (50–60%). In the first 3 months of 2005, 76 manuscripts were received. Use of AllenTrack will begin in 2006 and is expected to reduce the time involved in review and publication of manuscripts. Peter Ducey and Andrew Price have joined the staff as Associate Editors. In 2006 Geoff Smith will assume the position of Editor and Brian will step down. A replacement for Bill Parker (Managing Editor) is being sought.

The Board received reports from all standing committees. Stephen Richter (Chair) reported that the Conservation Committee has updated its material on the SSAR website. They have discussed updating the state conservation links on the website, developing associations with other conservation organizations, and developing education-oriented goals, potentially in collaboration with the Herpetological Education Committee.

The screening committee for the Dean Metter Memorial Award (Joseph Beatty [Chair], Anne Maglia, and Brian Miller) received eight proposals for the third Dean E. Metter Award. An award was made to Matthew W.H. Chatfield for his proposal "Hybrid Zone Dynamics Between Two Species of Salamanders in the Genus *Plethodon*."

Erik Wild, Chair of the Grants in Herpetology Committee received fifty-seven proposals in 2005 and the committee made awards of $500 in each of seven categories (Conservation, Field Research, Laboratory Research, Herpetological Education, Travel, International, Bibliographic Research). Erik expressed satisfaction in changes implemented last year in the application process.

Marion Preest (Chair, Henri Seibert Awards Committee) reported that five awards were made at the 2004 Norman meeting. In 2005, the Systematics category, which has recently attracted few participants, was combined with the Evolution category.

The recently-formed Herpetological Education Committee (a joint SSAR/HL committee, Catherine Bevier, Chair) has taken on the task of setting up a "herp hotline" (on the SSAR and HL websites) to facilitate addressing questions regarding herps from the academic and hobbyist communities. In the future, this committee will update the "Careers and Jobs in Herpetology" webpage.

Chair of the Kennedy Student Award Committee, Bob Gatten reported that the winner of the 2005 Kennedy Student Award is Cameron Stevens for his paper:

Stevens, C. E., and C. A. Paszkowski. 2004. Using chorus-size ranks from call surveys to estimate reproductive activity of the

wood frog (*Rana sylvatica*). Journal of Herpetology 38:404-410.

This year this committee also chose Caren Goldberg as a runner up:

Goldberg, C. and C. Schwalbe. 2004. Habitat use and spatial structure of a barking frog (*Eleutherodactylus augusti*) population in southeastern Arizona. Journal of Herpetology 38:305-312.

Henry Mushinsky (SSAR Rep, Meeting Planning Committee) reported on the development of plans for upcoming JMIH meeting (anticipated sites - 2006, New Orleans; 2007, Saint Louis; 2008 Montreal; 2009 Long Beach). Financial concerns necessitated changing the venue of the 2007 meeting from Ithaca to Saint Louis. The 2008 meeting was originally proposed as a joint meeting with the World Congress of Herpetology (WCH) but the WCH will be moved to another, as yet undetermined, venue. The committee is trying to alternate meeting venues across the United States and states that it is open to meeting in other countries.

There was discussion of the following proposals from the Meeting Planning Committee:

1. Limit the total number of oral presentations to 700
2. Set new deadlines and change procedures for the approval of symposia
3. Limit the total number of symposia to eight
4. Establish a procedure for workshops
5. Establish a plan to share costs/benefits of JMIH

The Board approved proposals 1 and 2 at the meeting and the remaining proposals were approved electronically by the majority of the Board following the meeting. The first 700 abstracts received for oral presentations at meetings will be accepted and the remainder will be accepted as posters. Currently there is no plan to limit the number of posters. The Board was informed that the new limit of 700 would not apply if there is a joint meeting of JMIH and WCH. The deadline for approval of symposia proposals by the respective societies will now become 31 March of the preceding year (i.e. approximately 16 mo prior to the symposia being held). This will allow the Meeting Planning Committee to better coordinate the symposia when they meet in April. Societies will submit a ranked list of symposia to the Meeting Planning Committee. An attempt will be made to balance symposia between societies and in terms of topics, taxa, etc.

Strong support for planning a joint meeting with WCH was voiced by virtually all attendees at the Board meeting. There was discussion of whether SSAR should always participate in a World Congress regardless of where the meeting is held or whether SSAR should always participate in a World Congress when the meeting is held in the Americas. No decisions were made. In reference to the proposal above regarding a plan to share the costs and benefits of JMIH, the Treasurer requested that she be provided with a breakdown of costs of recent joint meetings.

In 2005, the Nominations Committee (Kirsten Nicholson, Chair) presented a slate of eight nominees for four Directors positions (three regular, one non-US) and two nominees for the position of President-Elect. Dora Pinou (current Treasurer) and Marion Preest (current Secretary) agreed to serve additional terms. No election will be held in 2005. A new procedure will be implemented in 2006 to allow the Elector to track voters and to ensure confidentiality of votes.

Resolutions were read at the 2003 meeting in Norman (Linda Ford, Chair, Resolutions Committee) thanking retiring members of SSAR for their service and acknowledging Rafe Brown for his presentation of the SSAR President's Travelogue and the SSAR Conservation Committee for bringing recognition to the society (see *Herp. Review* 35(4): 306-308). Richard Wassersug has replaced Linda Ford as chair of this committee.

Brian Crother (Chair, Standard English and Scientific Names Committee) reported that an update of the names list was published in *Herp. Review* 34:196-203. Although successful in standardizing usage of most names, the list has also generated some controversy. The committee had anticipated beginning work on the next volume in 2004, but this was decided to be too soon. Brian commended the members of the committee for their service.

Twenty-seven applications were received for the Student Travel Award and ten awards ($200 each) were presented by Dawn Wilson at the Business Meeting in Norman.

Anne Maglia (Chair, Web Oversight Committee) reported that Dennis Desmond resigned as webmaster and was replaced by Zachary Walker. New features of the site include the ability to pay membership dues online, html alternatives for pdf document downloads, and access to pages of herpetological FAQ's. Formatting has been standardized and, in consultation with the Secretary and appropriate committee chairs, listings of committee memberships have been updated. The web domain name "ssarherps.org" has been renewed.

Elector, Maureen Kearney reported the results of an election held in Fall 2004: President-Elect (Roy McDiarmid) and four Board members, class of 2008 (Rafe Brown, Meredith Mahoney, Jim McGuire – Regular Members; Rick Shine – non-US Member). Theodora Pinou and Marion Preest were reelected as Treasurer and Secretary respectively.

In his report, Clay Garrett (Chair) presented the mission statement, general goals, and recent activity of the Relations with Herpetologists at Zoological Parks Committee. Clay presented a paper (Herpetological Research in Zoos: A Contemporary Assessment; In press, *Herpetological Review*) at the annual AZA Taxon Advisory Group Meetings in New Orleans, LA, stressing the importance of collaboration among zoo curators and between zoo and academic colleagues. He also gave an overview of the upcoming SSAR Relations with Herpetologists at Zoological Parks Committee web page and forum. The committee will attempt to recruit international herpetologists to add to its membership. Specific goals for 2005 include development of a database of papers resulting from zoo/academic collaboration, discussion of a symposium on zoo/academic research at future JMIH, and completion of a Committee web page with an interactive component to facilitate dialogue and the exchange of ideas between the zoo and academic communities. The web forum will require a one-time fee to be covered by the Ft. Worth Zoo. Entry to the forum will be restricted and users will require a username and password.

Clay presented some statistics regarding use of the SSAR website; the site appears high on a Google search, approximately 90% of the visitors to the site are from the United States, approximately 80% of the visitors remain on the site for less than 30 seconds, and 85% remain for less than 2 minutes. There was some discussion of what could be done to increase the number of visitors and the amount of time visitors spend on the site. It was suggested that adding search terms in languages other than English

might have an effect.

Al Savitzky (SSAR Representative to the American Institute of Biological Sciences, AIBS) submitted a report detailing his activities. He attended the 2005 AIBS annual meeting in Washington, DC. An informational brochure on the organization was published this year and is available at www.aibs.org/about-aibs/resources/AIBS_brochure.pdf. The major strength of AIBS, from the perspective of our Society, is its involvement in educational issues and science policy, including especially federal research funding and conservation policy. Al noted that the AIBS Outstanding Service Award was presented to Jay Savage for his contributions to organismal biology and ecology and his work with the Organization for Tropical Studies.

AIBS sponsored a series of presentations on "Evolution and the Environment" at the Fall, 2004 meeting of the National Association of Biology Teachers. The Education Office has been heavily involved with two issues, workforce diversity and the teaching of evolution. AIBS also sponsors an education specialist through a subcontract with the National Evolutionary Synthesis Center (NESCENT), an NSF-funded inter-institutional project headquartered in Durham, NC. In addition to the educational aspects of the program, SSAR members may be interested in the varied research opportunities available through NESCENT (www.nescent.org/). AIBS also manages the website ActionBioscience.org (www.actionbioscience.org/), which was founded by a private philanthropist and later transferred to AIBS. The site contains writings on a wide range of biological topics, in both English and Spanish. A new category of membership for academic units (such as biology departments) has been announced. Efforts to establish NEON (National Ecological Observatory Network, www.neoninc.org/) continue with a $6M grant from NSF. AIBS plans to request funding from Congress to begin building the network in 2007.

Following the AIBS meeting, a session was devoted to discussion of BioOne and Open Access publishing. BioOne has shifted its business model from one of providing supplemental income to one of providing replacement income to make up for anticipated future losses of library subscriptions for print journals. BioOne continues to enjoy the support of the academic library community and subscriptions to BioOne are increasing, especially overseas, where the collection has been marketed actively. BioOne entered into an agreement with JSTOR whereby "legacy content" (back issues) of journals published by BioOne publishers will, with the permission of the publisher, be carried by JSTOR. Furthermore, BioOne will establish a "moving wall" by which the most recent several years of each publication will be carried by BioOne and the oldest BioOne volume will be transferred to JSTOR for archiving.

Open Access (OA) publishing involves immediate free access to published content, posting in an open archive, and no copyright restrictions on re-use of materials. This raises obvious concerns for both nonprofit (such as SSAR) and for-profit publishers. The concept of OA publishing received a major boost when the Director of NIH, Elias Zerhouni, proposed that all NIH-funded research be made open access. That policy was adopted by Congress this Spring. Technically, the policy only "recommends" that the research be made available through OA, but the biomedical community views it as a *de facto* requirement. Despite many flaws and strong resistance from the scientific community, the NIH argument that publicly funded work should be available free to all users is popular with the public and politicians, and there is concern that the NIH lead may be followed by other agencies. Reportedly, NSF is not interested in promoting OA, but it still could be mandated to do so. Steep increases in the costs of journal subscriptions, together with the perceived need of the public to have access to medical research results, has fueled the NIH policy on OA. Rather than subscribers or readers paying, the most common model for OA is "author-pays," with an estimated cost to authors of several thousand dollars per submission. In the NIH model, the presumption is that the funding agency will absorb these costs through their inclusion in grants, but in organismal biology and ecology an author-pays model could be catastrophic. Unfunded, modestly funded, and overseas researchers would be greatly disadvantaged by such a system. Interested members of SSAR are directed to materials from the recent AIBS meeting on OA, which are to be posted on the AIBS website (www.aibs.org) by the end of May.

Al summarized a presentation on the economics of publishing science, technology, and medicine journals (octavia.zoology.washington.edu/publishing/). In ecology, the price per page for library subscriptions to nonprofit journals averaged $0.19, versus $1.19 for for-profit publishers. More surprisingly, the oft-heard argument that the higher priced commercial journals are "better" — i.e., have higher impact factors, etc. — is in fact untrue for the general classes of nonprofit and for-profit journals. Based on ISI impact factors, five of the top six journals in ecology are published by nonprofit publishers.

Dick Durtsche (Symposium Coordinator) received a proposal from Peter Paton and David Scott for SSAR to sponsor a half-day symposium, "Amphibian and Reptile Use of Golf Courses" at the 2006 Annual Meeting in New Orleans. The proposal was sent to two reviewers, both of whom returned positive recommendations. Sponsorship is being provided by the USGA/NFWF Wildlife Links program. A motion to accept this proposal was made and approved by Board members.

The SSAR 2006 budget was approved. There being no further business, the meeting was adjourned at 1455 h.

The Annual SSAR Business Meeting was called to order by President Andrews at 1705 h on 9 July. Approximately 38 SSAR members were in attendance. President Andrews summarized business dealt with at the Board Meeting on 6 July. Winners of the 2005 Kennedy Award, Seibert Student Awards, Grants in Herpetology Awards and Student Travel Awards were announced. Al Savitzky lead a brief discussion of some issues related to BioOne and Open Access publishing. The meeting was adjourned at 1800 hrs.

—Respectfully submitted by
Marion Preest, SSAR Secretary

NEWSNOTES

Slowinski Award Announced for 2005

The Center for North American Herpetology is pleased to announce that the recipient of The Joseph B. Slowinski Award for Excellence in Snake Systematics for 2005 is Zoltan Nagy, of the Institute of Pharmacy and Molecular Biotechnology, University of Heidelberg, Germany.

On 12 September 2001, the world lost one of its premier biologists, a loss that went virtually unnoticed in the wake of the tragedy that befell the United States the previous day. Joseph Bruno Slowinski, the 39-year old curator of amphibians, turtles, reptiles, and crocodilians at the California Academy of Sciences in San Francisco, died in the jungles of Burma from the bite of a venomous snake. Joe was bitten on 11 September and, despite heroic efforts to save his life by expedition companions and colleagues, succumbed to the effects of the bite the next day. Eventually, the world took notice, and numerous media outlets across the nation and throughout the world chronicled Joe Slowinski's exemplary career, cut so tragically short.

A distinguished committee, comprised of Frank Burbrink (City University of New York, Staten Island), Brian Crother (committee chair, Southeastern Louisiana University, Hammond), and Robin Lawson (California Academy of Sciences, San Francisco), have deemed the paper entitled "Molecular Systematics of Racers, Whipsnakes and Relatives (Reptilia: Colubridae) Using Mitochondrial and Nuclear Markers" (2004. Journal of Zoological Systematics and Evolutionary Research), as the most distinguished paper on snake systematics to appear worldwide during 2004. The paper was co-authored by Robin Lawson, Ulrich Joger, and Michael Wink.

As senior author of the paper, Zoltan Nagy becomes the third recipient of The Slowinski Award, and will receive a check from The Center for North American Herpetology for US $500 along with a commemorative memento in recognition of his achievement.

Adler Completes Term as Vice Provost at Cornell University

Kraig Adler, Professor of Biology at Cornell University, ended his seven-year term as Cornell's Vice Provost for Life Sciences in June. In this newly created post, he had responsibility for the university's $650-million New Life Sciences Initiative, which involves more than 500 professorial faculty. The objective of this initiative is to integrate the life sciences with the physical, engineering, and computational sciences without compromise to Cornell's traditional strengths in organismal biology.

During Adler's tenure as vice provost, 55 new life science faculty were appointed in six colleges and $350 million in life science building projects begun. He also oversaw the Ithaca-campus portions of the Tri-Institutional Research Program, a $160-million cooperative project with Weill Cornell Medical College, Rockefeller University, and Memorial Sloan-Kettering Cancer Center in New York City.

Adler now returns full-time to this faculty position in the Department of Neurobiology and Behavior when he will teach and complete several books in progress. He joined the Cornell faculty in 1972 and has served as chair of his department on two occasions. Previously he had been on the faculty of the University of Notre Dame after completing his doctorate at The University of Michigan in 1968.

Call for Symposium Proposals for the 2007 Herpetologists' League Meeting

The Herpetologists' League sponsors thematic symposia for its annual meetings. Any League member may submit a proposal for a symposium for the upcoming meeting by sending a proposal application to the chair of the Symposium Committee. Official sponsorship by the HL allows for the scheduling and announcement of the symposium in the meeting program and registration materials. In addition, a small amount of financial support (a maximum of $ 2000) is available to support sponsored symposia. Sponsorship by the HL does not guarantee financial support and symposia may be sponsored in name only or funded at a level lower than requested by the applicants.

Interested persons should contact Rafael de Sá, Chair HL Symposium Committee (e-mail: rdesa@richmond.edu) for details. Submission deadline for 2007 proposals is 15 March 2006.

Kansas Herpetological Society Annual Meeting

The Kansas Herpetological Society held its 32nd Annual Meeting at Pittsburg State University in Pittsburg, Kansas, on November 4–6, 2005. Over 125 participants attended scientific paper sessions presented by scientists and students from across the nation. Featured speaker was Stanley Trauth, professor at the Arkansas State University. Dr. Trauth spoke about Arkansas herpetofauna.

Lynett Bontrager, graduate student at Emporia State University, received the 2005 Howard K. Gloyd/Edward H. Taylor Scholarship, honoring the memory of two great biologists with strong ties to Kansas. The 2005 Alan H. Kamb Grant for Research on Kansas Snakes was made to George R. Pisani, Kansas Biological Survey. Larry L. Miller, Northern Hills Junior High School, Topeka, was chosen as the eighth recipient of "The Suzanne L. & Joseph T. Collins Award for Excellence in Kansas Herpetology."

In 2006, the Society will meet at the Sternberg Museum of Natural History, Fort Hays State University in Hays, Kansas.

Timber Rattlesnake Symposium

A symposium on Timber Rattlesnake (*Crotalus horridus*) Biology and Conservation in the Upper Mississippi River Valley was held on 24 September 2005, at Saint Mary's University in Winona, Minnesota. Sponsors included the Minnesota Department of Natural Resources, the Wisconsin Department of Natural Resources, and the Minnesota Herpetological Society. Nearly 100 participants from at least eleven states heard twelve presentations on timber rattlesnakes in Minnesota, Wisconsin, Iowa, and Illinois. The au-

dience included researchers, students, wardens, private landowners participating in habitat management programs, government agency personnel, and snake enthusiasts. Twenty-eight page, spiral bound program books, which include extended abstracts and seven pages of color photographs, are available for US $12.95 postpaid from Zoo Book Sales, Lanesboro, Minnesota (e-mail: zoobooks@acegroup.cc).

MEETINGS

Meetings Calendar

Meeting announcement information should be sent directly to the Editor (rwh13@csufresno.edu) well in advance of the event.

25–26 March 2006—29th Annual All Florida Herpetology Conference, Gainesville, Florida, USA. Information available at: www.flmnh.ufl.edu/herpetology/herpsconference/afhc.htm.

31 March–2 April 2006—Symposium—Conservation and Herpetology: The Middle American Connection. Miami-Dade College, Miami, Florida, USA. Information available from Larry David Wilson, organizer, by e-mail: lwilson@mdc.edu.

13–15 April 2006—53rd Annual Meeting of the Southwestern Association of Naturalists (SWAN), Universidad de Colima, Colima, Mexico. Information available at: http://www.biosurvey.ou.edu/swan/ or from Dr. Stanley Fox, SWAN President-elect (e-mail: foxstan@okstate.edu).

17–19 July 2006—49th Annual Meeting, Society for the Study of Amphibians and Reptiles, together with The Herpetologists' League and the American Society of Ichthyologists and Herpetologists. New Orleans, Louisiana, USA. Information: http://www.dce.ksu/jointmeeting/.

24–27 November 2006—Herpetological Association of Africa 8th Conference. Potchefstroom campus of the North-West University, South Africa. Information available from conference organizers Louis du Preez (drklhdp@puk.ac.za) and Ché Weldon (drkcw@puk.ac.za).

CURRENT RESEARCH

The purpose of **Current Research** is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, **María del Rosario Castañeda** or **Michele Johnson**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can be found at: http://www.herplit.com/contents.

Senescence and Chemical Protection in Fishes, Reptiles, and Amphibians

Evolutionary theories of aging predict that species that experience low rates of extrinsic mortality, such as weather, predation, or disease, will have slower senescence and longer maximum life spans than their relatives with high extrinsic mortality rates. This relationship is expected because few individuals of high extrinsic mortality species will live long enough for systems that retard senescence to be selected. The authors tested this hypothesis by comparing 1193 chemically-protected (i.e., poisonous or venomous) species, which presumably are less vulnerable to mortality by predation, and their non-protected relatives in fishes, snakes, frogs, and salamanders. Data on maximum longevity, body size, and chemical defenses were collected from primary literature, zoo and laboratory records, and field guides and analyzed at both species and genus levels. Results for each phylogenetic group showed that maximum longevity was positively correlated with body size and that for a given body size, chemically-protected species have longer maximum life spans than their non-protected relatives. Somewhat surprisingly, results also suggested that smaller species are more likely to have chemical defenses than larger species. These results are consistent with evolutionary theories of senescence and support the importance of extrinsic mortality in the evolution of aging.

Blanco, M. A. and P. W. Sherman. 2005. Maximum longevities of chemically protected and non-protected fishes, reptiles, and amphibians support evolutionary hypotheses of aging. Mechanisms of Ageing and Development 126:794–803.

Correspondence to: Paul W. Sherman, Department of Neurobiology and Behavior, W307 Mudd Hall, Cornell University, Ithaca, New York 14853, USA; email: pws6@cornell.edu.

Convergence of Chemical Defense in Poison Frogs

Aposematically colored poison frogs are recognized in four anuran families and occur in Central and South America, Australia, and Madagascar. Poison frogs store defensive alkaloids in granular glands and generally are incapable of producing these compounds. Instead, it appears they sequester alkaloids from their arthropod prey, including beetles, ants, and millipedes. In this study, the authors conducted a survey of *Mantella* frogs from Madagascar (a genus that shares many traits with neotropical poison frogs), and their potential dietary arthropods at Ranomafana National Park. After collecting and preserving frog and arthropod specimens, gas chromatography-mass spectrometry (GC-MS) analyses detected 11 known poison frog alkaloids in the arthropod samples, 7 of which were also identified in the mantillid extracts. This study also reported the discovery of a number of alkaloids, including nicotine, previously unknown from mantillids These results suggested that the evolution of passive chemical defenses in unrelated Malagasy and Neotropical poison frogs is an example of two types of convergence: first, the convergent evolution of arthropods containing toxic alkaloids, and second, the independent evolution of alkaloid uptake and sequestration mechanisms

in these frogs.

Clark, V. C., C. J. Raxworthy, V. Rakotomalala, P. Sierwald, and B. L. Fisher. 2005. Convergent evolution of chemical defense in poison frogs and arthropod prey between Madagascar and the Neotropics. Proceedings of the National Academy of Science 102:11617–11622.

Correspondence to: Valerie C. Clark, Department of Chemistry and Chemical Biology, Cornell University, Ithaca, New York 14853, USA; e-mail: vcc4@cornell.edu.

Habitat Fragmentation Causes Reduced Reproductive Investment in Lizards

The results of habitat fragmentation (e.g., reduced species richness in patches) are better known than their underlying processes, particularly as there may be species-specific responses to fragmentation. If fragmentation results in fewer resources or increased predation, females may adjust resource allocation between offspring size and offspring number. In this study, gravid female lacertid lizards (*Psammodromus algirus*) were captured in forests (≥ 200ha) and forest fragments (≤ 10ha) in northern Spain and brought into the laboratory for egg-laying. Juveniles that hatched were then released in the wild and monitored for survival. Results showed that while females from the two habitats did not differ in body condition, females from the fragments laid fewer eggs than females of similar body size from the forests, but these eggs were not larger, as would be predicted by the hypothesis of resource allocation trade-offs. Among juveniles, larger eggs produced larger offspring, and larger offspring had higher survivorship. These results showed that the reduction of reproductive output in fragmented habitats can be added to the list of negative effects of fragmentation on natural populations.

Díaz, J. A., J. Pérez-Tris, J. L. Tellería, R. Carbonell, and T. Santos. 2005. Reproductive investment of a lacertid lizard in fragmented habitat. Conservation Biology 19:1578–1585.

Correspondence to: José A. Díaz, Departamento de Zoología y Antropología Física, Facultad de Biología, Universidad Complutense, E-28040 Madrid, Spain; e-mail: jadiaz@bio.ucm.es.

Landscape Effects on Spotted Frog Population Structure

While many models of speciation invoke landscape features such as rivers or mountains as the cause of genetic divergence, little is known regarding the effects of such features on genetic variation. Landscape features may particularly affect amphibians and other groups with poor dispersal abilities. To determine whether ridges and elevation gradients act as barriers to gene flow in Columbia spotted frogs (*Rana luteiventris*), and whether a pond represents a 'randomly mating population' (or deme), the authors examined genetic variation at six microsatellite loci in 790 adult frogs from 28 sites in western Montana and Idaho. Results showed that 1) mountain ridges generally restricted gene flow, suggesting that mountains may facilitate allopatric speciation in amphibians, and 2) there was limited gene flow between high and low elevation ponds, although dispersal may not be restricted between these elevations. The molecular data also demonstrated that, except for geographically isolated ponds, breeding populations often encompass more than one pond. The authors concluded from these results that the overall population structure of the spotted frog is a "valley-mountain" structure in which low elevation populations have large historical effective sizes and high gene flow, high elevation populations have opposite characteristics, and gene flow between high and low elevations is limited but not absent. The authors also discussed potential conservation implications of these findings.

Funk, W. C., M. S. Blouin, P. S. Corn, B. A. Maxell, D. S. Pilliod, S. Amish, and F. W. Allendorf. 2005. Population structure of Columbia spotted frogs (*Rana luteiventris*) is strongly affected by the landscape. Molecular Ecology 14:483–496.

Correspondence to: W. Chris Funk, Integrative Biology, University of Texas, 1 University Station C0930, Austin, Texas 78712, USA; e-mail: wcfunk@mail.utexas.edu.

Increase in Species Discoveries: Not a Case of Taxonomic Inflation in Amphibians

While amphibian species are declining worldwide, researchers continue to discover new species; in the last 11 years, the number of recognized amphibian species increased over 25 percent. Some attribute this increase in species numbers to taxonomic inflation, where known subspecies are raised to species status or formerly synonymous species are subdivided. The authors, however, argued that for amphibians, this increment is due to the increase in the use of bioacoustic and molecular genetic techniques, as well as an intensified effort to explore poorly studied tropical areas. Using endemic Malagasy frogs of the family Mantellidae as a representative example, the authors showed that the genetic divergence (the Kimura two-parameter distance) between recently described species and their closest previously known relatives is no greater than for species described in earlier periods. Additionally, using herpetological catalogs and museum records, they determined that most of the species described since 1992 were not the result of subdividing other species, showing that the new species are discrete evolutionary units. This finding might have significant conservation implications, as far more species might be at risk of decline or extinction than are currently recognized.

Köhler, J., D. R. Vieites, R. M. Bonett, F. H. García, F. Glaw, D. Steinke, and M. Vences. 2005. New amphibians and global conservation: a boost in species discoveries in a highly endangered vertebrate group. Bioscience 55:693–696.

Correspondence to: Miguel Vences, Zoological Museum of Amsterdam and the Institute of Biodiversity and Ecosystem Dynamics, University of Amsterdam, 1092 Amsterdam, The Netherlands; e-mail: vences@science.uva.nl.

Molecular Phylogeny of Turtles

Morphological characters have long been used to resolve phylogenetic relationships among turtles, and their more recent combination with molecular data has increased statistical support of the phylogeny; however, several key nodes in this group remain

unresolved. The authors used existing mtDNA, as well as new nuDNA sequence data from the RAG-1 gene, to determine whether polytomies in the tree are an accurate representation of turtle evolution or if the additional data can clarify the relationships among the major cryptodiran groups. Using 24 species representing all major families of turtles, the authors performed maximum parsimony, maximum likelihood, and Bayesian analyses on almost the entire (~3kb) RAG-1 gene. These analyses supported most results of previous phylogenetic analyses, in some cases with higher statistical support. The RAG-1 gene also suggestd that two groups often considered sister taxa, Platysternidae and Chelydridae, are not closely related, although their precise placement on the tree remains unclear. However, the different analyses differ on the positions of the earliest branches of the turtle phylogeny. Maximum parsimony suggested three basal branches (Carettochelyidae, Trionychidae, and all other extant species), while maximum likelihood and Bayesian analyses grouped Carettochelyidae and Trionychidae as sister to all other hidden-necked turtles (Cryptodirans). The authors further discussed the utility and limitations of molecular and morphological data.

Krenz, J. G., G. J. P. Naylor, H. B. Shaffer, and F. J. Janzen. 2005. Molecular phylogenetics and evolution of turtles. Molecular Phylogenetics and Evolution 37:178–191.

Correspondence to: Fredric J. Janzen, Department of Ecology, Evolution, and Organismal Biology, Iowa State University, Ames, Iowa 50011-1020, USA; e-mail: fjanzen@iastate.edu.

Bite Performance Best Predicts Reproductive Potential in Collared Lizards

The evolution of weapons in sexually dimorphic species is often attributed to male combat, and individual variation in these weapons is expected to play an important role in determining fitness. While laboratory experiments have shown correlations among head size, bite force, and social dominance in lizards, bite force has not yet been shown to predict fitness in natural populations. The authors studied *Crotaphytus collaris*, the collared lizard, to test the hypothesis that weapon (i.e., bite) performance was related to reproductive fitness. Collared lizard males establish territories that encompass several female territories and defend them from intruding males, with agonistic interactions between males often escalating to violent biting. The authors captured lizards to measure morphology (body size and head dimensions) and bite force and subsequently determined territory boundaries of these males. To measure potential fitness, they counted female territories overlapping with each male's territory, observed courtship encounters, and calculated potential output of the males by summing the potential reproductive output of all the overlapped females. Results showed that bite force was significantly correlated with territory size, number of female territories overlapped, estimated number of females inseminated, and potential reproductive output. Also, in several multiple regression models, bite force was the only significant predictor of fitness (i.e., morphological measures were not significant predictors). These results indicated that studies in which measures of morphology are considered to be a proxy for fitness potential should have a known underlying morphology-performance relationship.

Lappin, A. K., and J. F. Husak. 2005. Weapon performance, not size, determines mating success and potential reproductive output in the collared lizard (*Crotaphytus collaris*). American Naturalist 166:426–436.

Correspondance to: A. Kristopher Lappin, Department of Biological Sciences, Northern Arizona University, Flagstaff, Arizona 86011, USA; email: kristopher.lappin@nau.edu.

Robotic Lizard Experiments Show Display Content is Context-Dependent

Animal displays often contain variable, and sometimes redundant, signals. These displays may evolve under sexual selection (via female choice) or from opposing selective pressures from multiple contexts (e.g., territory defense and courtship). In this study, the authors used playback experiments with a robotic lizard model to partition the complex headbob displays and body postures of the lizard *Sceloporus graciosus* into meaningful units and to determine if these units have different functions for different receivers. After determining that *S. graciosus* responded both to the robot and a live lizard with similar behaviors, they exposed lizards to combinations of natural or artificial, and single or double displays. Results showed that male lizards responded to specific body postures of the signaling robot, while female lizards responded to the number of headbob displays. These results suggested that the evolution of displays in *S. graciosus* is the result of different selective pressures in different social contexts. Interestingly, the playback experiments also showed that lizards can both respond to and imitate novel display behaviors.

Martins, E. P., T. J. Ord, and S. W. Davenport. 2005. Combining motions into complex displays: playbacks with a robotic lizard. Behavioral Ecology and Sociobiology 58:351–360.

Correspondance to: Emília P. Martins, Department of Biology and the Center for the Integrative Study of Animal Behavior, Indiana University, 1001 East 3rd St., Bloomington, Indiana 47405-3700, USA; email: emartins@indiana.edu.

Convergence and Divergence in Predator-Induced Plasticity in Newt Larvae

When multiple species are exposed to similar environments, evolutionary theory predicts that convergent phenotypes will result. Therefore, when an environment is defined by its predator composition, prey species may evolve similar anti-predator traits. The authors performed a comparative analysis of six sympatric species of newts representing both major clades of the genus *Triturus* to determine whether inducible morphological and behavioral responses to predation were convergent. Two sets of experiments were performed; in the first, larvae of each newt species were exposed to dragonfly larvae to induce phenotypic plasticity. Results showed that morphological plasticity varied among all species, while behavioral plasticity differed between the two clades but not within them. The second experiment tested whether predation risk was dependent on body size; results suggested that similar predators may affect the two differently-sized clades in different

ways. The authors offered several suggestions for why these species that occupy extremely similar environments would evolve divergent phenotypes. The species may have important unrecognized unique features, such as differences in microhabitat use. Alternatively, they may represent distinct adaptive peaks in the same environment, or they may be constrained by historical differences in habitat use.

SCHMIDT, B. R., AND J. VAN BUSKIRK. 2005. A comparative analysis of predator-induced plasticity in larval *Triturus* newts. Journal of Evolutionary Biology 18:415–425.

Correspondence to: Benedikt R. Schmidt, Zoologisches Institut, Universität Zürich, Winterthurerstrasse 190, 8057 Zürich, Switzerland; e-mail: bschmidt@zool.unizh.ch.

The Mid-Domain Effect Model Applied to Green Turtle Nest Distribution

The mid-domain effect (MDE) model states that within a shared geographical domain, the greatest species richness will occur at its center after ranges of several species are randomly placed in the domain. While this model has been applied to multiple interspecific systems, the authors performed the first analysis of the MDE in an intraspecific context. In particular, they assessed the spatial and temporal nest distributions of a population of green turtles (*Chelonia mydas*) in Costa Rica that was surveyed continuously between 1972 and 2000. Results indicated that both spatial and temporal nest distributions have remained stable during this time period. Spatial nest distribution along the 18-mile beach showed a strong central tendency and closely fit predictions made using MDE model simulations. The temporal distribution, however, showed a stronger central tendency within the nesting period than the MDE model predicted. The authors discussed environmental factors that may cause observed deviations from the model.

TIWARI, M., K. A. BJORNDAL, A. B. BOLTEN, AND B. M. BOLKER. 2005. Intraspecific application of the mid-domain effect model: spatial and temporal nest distributions of green turtles, *Cheldonia mydas*, at Tortuguero, Costa Rica. Ecology Letters 8:918–924.

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ZOO VIEW

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Grace Olive Wiley: Zoo Curator with Safety Issues

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"WHEN FIRST TAKEN CAPTIVE MOST WILD CREATURES ARE QUITE TERRIFIED AND PANICKY—THIS WAS TRUE OF THE RATTLESNAKE THAT BIT ME AND YET ON MY RETURN FROM THE HOSPITAL THIS SAME NERVOUS FELLOW WAS TAMED WITHOUT ANY TROUBLE—IT WAS DONE IN TWO WEEKS, WITH ONLY ONE HAND!"

—GRACE OLIVE WILEY IN 1930

Grace Olive Wiley (1883–1948), a librarian at the Minneapolis Public Library, wrote a letter to John J. McCutcheon, president of the Brookfield Zoo's Zoological Society on 29 January 1927, applying for the curatorial job of reptiles. In a later letter to director Edward Bean on 29 May 1933, she offered to donate her enormous private collection (115 species and 330 individuals) and a number of cages to the Zoo if the position were offered to her. During that time, it was highly unusual for women to hold curatorial positions in zoos but apparently her résumé and offer were convincing for she was hired that year (Fig. 1).

Wiley held the curatorial position for two years and her time at the Zoo was filled with controversy. She believed that venomous reptiles could be tamed and handled with bare hands, a practice that did not endear her to her superiors (Fig. 2). Although she was told to stop handling them, she refused to do so. Later in fact, Wiley wrote an article in *Natural History Magazine* in 1937, outlining her techniques for taming king cobras, Egyptian cobras,

FIG. 1. Undated picture (likely in 1933) of reptile house at Chicago Zoological Park (Brookfield Zoo) from *Minneapolis Sunday Tribune* article announcing opening and installation of Grace Olive Wiley as curator. This building still functions as an amphibian and reptile exhibit. Credit: provided by George Rabb, Chicago Zoological Society.

FIG. 2. Although there is no information attached to this photograph of Grace Olive Wiley and her friend, it appears to have been taken in the service area of the reptile building at Brookfield Zoo. Episodes such as this led to her dismissal as reptile curator in 1935.

puff adders, Australian black snakes, Australian tiger snakes, green mambas, sea snakes, coral snakes, fer-de-lance, moccasins, copperheads, thirteen species of rattlesnakes, and Gaboon vipers, which could not only be handled without any danger but enjoyed being stroked. In the article, Wiley offered this observation: "Somehow they know very, very soon that I am friendly and like them. They appear to listen intently when I stand quietly at their open door and talk to them in a low, soothing voice. In some unknown manner my idea of sympathy is conveyed to them." After a series of 19 snake escapes, some of which included three Egyptian cobras, one bandy-bandy, and several venomous sand snakes, her boss Acting Director Robert Bean lost patience and fired her in September 1935. One reason was monetary: because of her, the upcoming liability insurance payment for the Zoo was increased to the point it exceeded her annual salary.

Wiley complained to a *Time* magazine reporter on 30 September: "I hate to say it and I know some persons who don't like snakes are very nice persons but Mr. Bean was frightened and frightened persons will exaggerate. I do not feel I was guilty of carelessness. I just forgot, simply forgot, to close the door to the cobra's cage after I cleaned it. I couldn't do everything at once. All the other snakes that got away were harmless except Bandy-Bandy and I'm sure he went down the drain pipe. "The cobra,' she added, 'just found the coziest place it could in the whole reptile house. If most persons were half as nice as snakes, this world would be a better place." When a keeper put his hand into a bag of dried leaves which he planned to use for cage decorations, he found "Bandy-Bandy."

The news media followed these incidents and her career with interest. A few newspaper headlines: "Woman's Kindness Wins Deadly Snakes at Brookfield Zoo;" "19 Snakes Got Away, Grace Wiley Fired as Snakes Escape;" "Bandy-Bandy Found Alive;" "Mrs. Grace Wiley Packs Her Reptile Friends;" "Snakes Depart. Long Beach Herpetologist Taking Collection to Hollywood."

After leaving the Zoo, she had started a private roadside reptile exhibit called "Grace Wiley—Reptiles" in Cypress, California where she allowed venomous snakes, including king cobras, tiger snakes, gaboon vipers, kraits, copperheads, and rattlesnakes, to be handled by children and crawl through crowds of visitors for a small fee. Although undated with provenance unknown, the photographs in this article (Figs. 3–4) were probably taken in Long Beach, California. They were found in the collection of Wesley Dickinson, her close friend who died from a king cobra bite.

Wiley died from an Indian cobra bite. She had only one vial of anti-snakebite serum on hand because it was expensive and she needed so many types for her collection. Unfortunately, this single

FIG. 3. A delighted Grace Olive Wiley with Gila monster and rattlesnake.

FIG. 4. In this undated photo, Wiley's mother is shown with a king cobra.

glass vial of Haffkine serum was not used as it was accidentally broken shortly after the bite. She was rushed to Long Beach Hospital in an ambulance but died ninety minutes after being bitten.

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LETTERS TO THE EDITOR

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Lizard Foraging Modes: Global Need for Data, Methods for Data Collection and Call for Data

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A large majority of lizard species hunt for prey using one of two foraging modes, ambush foraging and active foraging, described informally by Evans (1961) and defined and explored theoretically by Pianka (1966) and Huey and Pianka (1981). Ambush foragers adopt posts affording unobstructed views, remain immobile while waiting for prey, and then attack prey that usually are detected visually. Active foragers search for prey by moving through the habitat and locate prey using both visual cues and chemical cues sampled by tongue-flicking (Evans 1961).

Study of foraging activity has led to important advances in our understanding of the evolution of lizard taxonomic and ecological diversity (Cooper 1997; Schwenk 1993; Vitt et al. 2003). Most species can be categorized as ambush or active foragers, but certain species do not fit the two-mode paradigm well (Butler in press; Perry 1999, in press). My goals here are to indicate lizard groups for which data are needed, present information needed to collect data, and encourage herpetologists to contribute to our collective data base on lizard foraging activity.

Data available and data needed.—The major variables in studies of lizard foraging are number of movements per minute (MPM) and percent time spent moving (PTM). PTM is a better index than MPM, but that both variables are important components of foraging activity (Cooper et al. 2001; Butler, *in press*). MPM or PTM data are available for over 150 species, but for many species data are minimal or only include one variable. If only those species for which there are data on ≥ 10 individuals for a total observation time of ≥ 100 minutes are considered, data are available for 82 species.

Data are needed for several taxonomic groups (Table 1). In Iguania, data on both variables are unavailable for any single species in Tropiduridae and Hoplocercidae and few data are available for Chamaeleonidae or for some major subtaxa in Agamidae, especially Australian groups. Data for surprisingly few phrynosomatid species are available given their diversity and wide distribution. Direct observations of horned lizards (*Phrynosoma*) are desirable because indirect observations suggest that they may forage more actively than other phrynosomatids (Shaffer and Whitford 1981). In Scleroglossa, data are lacking for anguids, gerrhosaurids, gymnophthalmids, xantusiids, xenosaurids, and varanids. Among gekkotans, we need data for several terrestrial species, especially arenicolous ones, and pygopodids. Additional data for lacertids and skinks are highly desirable due to greater variability of foraging activity than in other families. The only datum for any anguimorphan is a PTM value for *Heloderma*

suspectum (Jones 1983). Special efforts to collect data on anguids and varanids are warranted due to their importance in understanding the evolution of foraging.

Data collection.—Foraging data are simple and inexpensive to collect. Perhaps the greatest difficulty is determining motivation (Anderson 1993, *in press*). Conducting observations at inappropriate times may yield inaccurate estimates of foraging movements. Estimates based on data collected when lizards are basking or at rest digesting would lead to misleadingly low estimates of movement. Inclusion of data on movements for purposes other than foraging (territorial patrolling, courtship, aggressive behavior, and shuttling between sun and shade to thermoregulate) would inflate estimates of foraging movement. Movements unrelated to foraging should be excluded and observations should be restricted to times and conditions that favor foraging, e.g., warm and at least partially sunny weather for heliotherms. Data should not be collected during thermoregulatory basking or when lizards have stopped foraging for the day. Further discussion of data collection can be found in Anderson (1993) and Perry (*in press*).

Upon sighting a lizard, the researcher stops moving and prepares to record data. Observing from a blind would be helpful for wary species, and observing from behind trees, rocks, or other objects can be helpful with many species. If a lizard appears to be disturbed, no data should be collected. Staying still is crucial to reducing disturbance. By remaining immobile for at least two minutes or a shorter period if the lizard resumes normal activity, the researcher can maximize the likelihood of observing normal behavior. Active foragers start moving again if they have stopped, and often walk directly toward observers. Ambush foragers often make displays, postural adjustments, or head movements showing that normal behavior is occurring.

The greater the distance between researcher and lizard during observations the better for many species, but many active foragers continue normal foraging activity when followed from a distance of about 5 m. Varanids are difficult to observe because they flee upon detecting a human being at much greater distances. Some anguids and horned lizards remain motionless for extended periods after detecting an observer. Telescopes or blinds may be needed.

Data can be recorded on microcassette tapes and transcribed onto data sheets from which foraging variables can be derived. Species, date, and time are recorded, plus whether the lizard is moving or motionless. During continuous (focal) observation the researcher records all activities, using a stopwatch to indicate the time to the nearest second since the start of the focal observation when each change from moving to immobility occurs. Attacks on prey and their success or failure should be recorded, as well as whether prey were discovered through active search or ambush. Times spent on irrelevant activities such as social behavior should be recorded, but excluded. If an individual's irrelevant activities are extensive, its data should be excluded. It may be useful to record whether the lizard is in open sun, filtered sun (partially shaded), or in shade during intervals of motionlessness and movement because stops in the shade for thermoregulation are important at high temperatures. Distance moved during each movement bout should be estimated. Estimating distances requires some practice and is imprecise, but estimates should be adequate to distinguish among taxa. Brief postural adjustments of head and body or changes in body orientation involving minimal forward movement are not considered foraging movements. Lizards often pause very briefly while moving, but stops of less than one second are ignored and considered to be momentary pauses during continuous activity.

Table 1. Numbers of species for which data meeting criteria for minimal samples and observation times are available in major lizard taxa.

Taxa	MPM	PTM	Both
Iguania			
Agamidae	3	3	3
Chamaeleonidae	1	1	1
Corytophanidae	1	1	1
Crotaphytidae	2	2	2
Hoplocercidae	0	0	0
Iguanidae	2	2	2
Opluridae	1	1	1
Phrynosomatidae	9	11	9
Polychrotidae	24	16	16
Tropiduridae	1	1	0
Scleroglossa			
Gekkota			
Eublepharidae	2	2	2
Gekkonidae	13	13	13
Autarchoglossa			
Scincomorpha			
Lacertoidea			
Xantusiidae	0	0	0
Lacertidae	9	10	9
Teiidae	9	12	8
Gymnophthalmidae	0	0	0
Scincoidea			
Scincidae	9	10	9
Cordylidae	6	6	6
Gerrhosauridae	0	0	0
Anguimorpha			
Anguidae	0	0	0
Xenosauridae	0	0	0
Helodermatidae	0	1	0
Varanidae	0	0	0

Active foragers often move slowly during area-concentrated search, and may stop locomotion while poking under leaves or around stems of plants, often tongue-flicking. Because such activities reflect active search, they should be recorded as part of time spent moving (or more accurately, searching). This possible source of differences in estimates of MPM and PTM among investigators has not been discussed previously.

Most researchers have attempted to view each lizard continuously for 10–30 minutes. Perry (*in press*) found that observation intervals of less than five minutes were unreliable. When a lizard moves out of sight behind an object, it is necessary for the investigator to move (slowly and as little as possible) to a new vantage point. If the lizard is lost before the full observation period has

been completed, truncated observations can be useful. Ideally, all observations would be for the full planned interval, but if data are difficult to obtain, the criterion for duration can be shortened. At the end of the focal observation, the investigator should record shaded air temperature at 1 m and optionally substrate temperature where the lizard was sighted.

With a little practice the data are very easy to collect. From the record of number of intervals and duration of movement and total time for each focal observation, it is simple to calculate MPM and PTM. It may help to transcribe the data onto a data sheet that shows durations of movement and immobility continuously throughout the observation interval. A sample data sheet can be obtained from the author. The total number of movements divided by total minutes of observation gives MPM and total time spent moving divided by total time of observation give PTM. Time spent subduing prey and eating is excluded because the focus is on search, not consumption. Average duration per movement can be calculated from the relationship AD = 0.6PTM/MPM, which follows from the definitions PTM = 100(N x AD)/T and MPM = 60N/T, where T = total time observed in s, N = number of movements per s, and AD = average duration per movement bout in s. Average speeds during the entire interval and while moving can be calculated and later adjusted for differences in body length between species or individuals.

For the entire data set, means and standard errors of MPM, PTM, and average speeds can be calculated. If attack data were recorded, the proportion of total attacks by all individuals on prey discovered while moving (PAM) can be calculated. This variable is available for only a few species (e.g., Cooper and Whiting 1999; Cooper et al. 2001), but has great potential for indicating the relative importance of ambush and active foraging within and among species.

How many data should be collected? Perry (*in press*) found that the sample size needed for reliable estimates varies considerably among taxa, with N > 15 being adequate except for gekkonid lizards, for which sample sizes of 50 may be needed in some cases. Because data on effect of sample size exist for only three species, more information is needed. I have adopted a goal of obtaining data for at least 10 specimens and a duration of at least 100 minutes for each species and, when possible, collecting more data. However, smaller data sets can be useful because data collected by different investigators can be pooled, which is important for rare and inaccessible species.

Call for data.—Interested readers can contribute to the size and taxonomic and ecological diversity represented in our data base by collecting data on additional species, especially from the groups highlighted above as in need of study. Latin American, African, Australian, and Asian herpetologists are in exceptionally good locations to contribute data for unstudied major taxa. In addition to being added to the growing data base, new data could be the basis for natural history notes on single species or for articles on several species. I encourage individuals to contact me about needs for data from their localities and about possible collaborations.

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ARTICLES

Herpetological Review, 2005, 36(4), 369–371.

On Names for Neotropical Rattlesnakes (Reptilia: Serpentes: Viperidae: *Crotalus*)

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The primary functions of zoological nomenclature are to provide stability and universality for zoological names to insure maximum communication of information. This is especially important

when dealing with deadly venomous organisms where accurate identification and consistent use of scientific names are fundamental to medical interventions. A recent scientific study of the rattlesnakes, genus *Crotalus*, that proposes new applications of long-established names and/or resurrection of previously unused ones (Campbell and Lamar 2004) might be thought to undermine this important process, but instead represent advances in knowledge.

Since Klauber's classic works (Klauber 1952, 1956), the species-group names of Neotropical rattlesnakes have enjoyed stability and universality of application. However, recent research indicates that several recognized taxa comprise a complex of distinct species requiring several name changes. This proposal aims to support specific names that maintain prevailing usage as much as possible, while recognizing advances in knowledge by the designation of neotypes.

Linnaeus (1758) described three species of rattlesnakes, *Crotalus horridus*, *C. dryinas*, and *C. durissus*. The type specimens of all three have been lost. Much confusion surrounded the application of these and several post-Linnean names for rattlesnakes during the 19th and early 20th centuries (see Vanzolini and Calleffo 2002, for a recent review). By the 1920s, *C. horridus* generally was used for a North American rattlesnake and *C. terrificus*, based on *Caudisona terrifica* Laurenti, 1768 (no known type specimen), was applied to a Neotropical one (e.g., Werner 1922). From 1926 onward Amaral utilized the name *Crotalus terrificus*, for the then single recognized Neotropical species, and in 1929 he placed *durissus* as a subspecies of *C. terrificus* even though *durissus* had priority.

Klauber (1941) conducted a detailed analysis of Linnaeus' brief rattlesnake descriptions, primary references (all pre-Linnean original descriptions), and secondary references (also pre-Linnean). He concluded that all three Linnean names were likely based on the Neotropical rattlesnake called *C. durissus* by Klauber and by most subsequent workers (see McDiarmid et al. 1999). However, in order to maintain stability he followed the then current usage of *C. horridus* for the North American timber rattlesnake, the type species of the genus *Crotalus*. Klauber also pointed out that *Caudisona terrifica* Laurenti, 1768, while usually treated as a new scientific name, appears to have been based on Linnaeus' description of *C. horridus* with some additions. Despite these conclusions, Klauber applied the name *Crotalus durissus durissus* to Mexico–Central American populations and *C. d. terrificus* to the South American subspecies. Unfortunately, Klauber did not take that opportunity or subsequent ones (Klauber 1952, 1956) to designate neotypes for the names in question.

Since Klauber's 1941 paper, usage has followed his arrangement, but by 1989 (Campbell and Lamar 1989), 12 additional subspecies of *C. durissus* were recognized. In the course of resurrecting or describing 10 of these, Hoge (1966) designated a neotype for *Caudisona terrifica* from "Julio de Castilho, Município Taquari" (actually Julio [sic] de Castilhos, Município Julio [sic] de Castilhos according to Vanzolini and Calleffo 2002), State of Rio Grande do Sul, Brazil. This action was not fortunate as it is extremely unlikely that any snakes forming the basis of Linnaeus' or Laurenti's descriptions of rattlesnakes came from southern Brazil (Vanzolini and Calleffo 2002).

Most recently Campbell and Lamar (2004) concluded that several populations within a polytypic *Crotalus durissus* merited separate species status. As the lost holotype of *C. durissus* was from the Claudius Grill Collection, also called the Surinam Collection, they proposed that the name properly belongs to the South American species. Klauber (1941) was aware that the type came from the Surinam Collection and concluded that the type of *C. durissus* most probably came from South America. It thus seems a reasonable inference that it came from Suriname. The restriction of the type locality by Campbell and Lamar (2004) to Paramaribo, Suriname, does not, however, of itself unequivocally establish the usage of the name *Crotalus durissus durissus* for a Suriname population. These authors did clarify the nomenclatural complexities as first revisers (Art. 24, International Code of Zoological Nomenclature 1999) by explicitly selecting *Crotalus durissus* Linnaeus, 1758 over *C. dryinas* Linnaeus, 1758 because of the universal prevailing usage of *C. durissus*.

Campbell and Lamar (2004) also recognized as distinct species two taxa considered as subspecies of *C. durissus* by all workers subsequent to Klauber (1952, 1956). The first is *Crotalus totonacus* Gloyd and Kaufield, 1940, from northeastern Mexico. The second includes Klauber's (1952, 1956) *C. d. durissus*, *C. d. culminatus* Klauber, 1952, and *C. d. tzabcan* Klauber, 1952. Because the name *C. durissus* was applied by Campbell and Lamar (2004) to the South American rattlesnake they exhumed the name *Crotalus simus* Latreille, 1801, a name not used as valid for over 150 years, for the other Mexico–Central American populations. The name *C. simus* is based on the very same specimen, formerly in the Museum d'Histoire Naturelle (Paris), that was the model (Daudin 1803:321) for the illustration in Seba (1735, pl. 45, fig. 2) as referred to by Latreille in the original description. Klauber (1941) earlier had pointed out that Seba's plate clearly is of the Mesoamerican species. Unfortunately, the holotype of *C. simus* could have come from any one of the four recognized taxa of rattlesnakes from Mexico–Central America so correct application of the name is in doubt.

In order to clarify the situation and establish names for the involved species of Neotropical rattlesnakes we take the following actions:

1. Designate Nationaal Naturhistorisch Museum, Leiden (RMNH) 12857, an adult male, from near 2.5 km east of Tibiti, Saramacca District, Suriname (ca. 5°33'N, 55°54'W), as the neotype of *Crotalus durissus* Linnaeus, 1758, as defined and diagnosed in Campbell and Lamar (2004:539–547). The original type specimen has long been lost (Klauber 1952) but was probably South American in origin and most likely came from Suriname.

2. Designate University of Texas, Arlington (UTA-R 52032), an adult male from vicinity of El Arenal, San Vicente, Departamento de Zacapa, Guatemala, 360 m elevation (14.880176°N, 89.861817°W) as the neotype of *Crotalus simus* Latreille, 1801 as defined and diagnosed in Campbell and Lamar (2004:583–586). A search by Thireau (1991:4) of the collections in the Museum National d'Histoire Naturelle, Paris failed to locate the holotype, which was labeled as being from "Ceylon" and it is presumed lost. However, the specimen must have come from Mesoamerica based on the distinctive neck pattern of paravertebral dark stripes in combination with the dorsal color pattern of mostly non-overlapping, light-centered diamonds that are characteristic of *C. simus*. There are, of course, no known rattlesnakes from Asia.

With these actions we insure that the name *Crotalus durissus* will continue to be used for the majority of populations referred to by that name since 1941 and that *Crotalus simus* will be associated unambiguously with a Mexico-Central American species of Neotropical rattlesnake.

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Body Temperatures of Free-Ranging Softshell Turtles (*Apalone spinifera*) in a Small Stream

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The thermal ecology of freshwater turtles is based largely on studies of a relatively few species in which, typically, body temperatures are highly variable, average approximately 24–28°C, and commonly track water temperatures. Basking is a common, but not universal (e.g., *Chelydra*, Brown et al. 1990; *Pseudemydura*, King et al. 1998) behavior associated with elevating body temperature. However, even for the many species that do in fact bask, whether heat gained from basking uncouples body temperatures from water temperatures long enough to be biologically significant in thermoregulation has long been debated and likely varies with species and locality (e.g., Auth 1975; Boyer 1965; Crawford et al. 1983; Di Tranni and Zuffi 1997; Manning and Grigg 1997; Moll and Legler 1971; Schwarzkopf and Brooks 1985; Spotila et al. 1990).

Compared to the various semi-aquatic turtles for which thermal biology has been studied (mostly emydids), it would seem that certain features of the highly aquatic trionychid turtles might impact their thermal ecology. For example, highly aquatic turtles, such as trionychids, (1) have a lower critical thermal maximum (CTM) than semi-aquatic species, such as emydids (Hutchison et al. 1966, 1979); (2) the flat shell of softshells enhances the rate of radiant heat exchange (Boyer 1965); (3) the cutaneous surface area of softshells is the highest known among turtle species (Stone and Iverson 1999); and (4) softshells have the highest rate of evaporative water loss of any known reptile, 3–4 times that of the emydid *Trachemys* (Robertson and Smith 1982). High evaporative water loss causes trionychids, unlike emydids, to cool faster than they heat in air (Smith et al. 1981) and can depress surface and core body temperatures, at least in the laboratory (Khosatzky 1981; Robertson and Smith 1982).

Although the physiology related to various thermal characteristics of trionychid turtles has been studied in the laboratory (Boyer 1965; Hutchison et al. 1966, 1979; Khosatzky 1981; Nebeker and Bury 2001; Robertson and Smith 1982; Smith et al. 1981), field thermal data are extremely sparse. The only available thermal data for free-living trionychid turtles include a few ambient water temperatures measured opportunistically for *A. mutica* and *A. spinifera* (Graham and Graham 1991; Plummer 1977; Williams and Christiansen 1981) and body and ambient water temperatures of hibernating *A. spinifera* measured with temperature-sensitive radiotransmitters (Plummer and Burnley 1997). Body tempera-

tures have not been reported for any free-living trionychid species during their active season. The purpose of this paper is to provide basic field information on softshell thermal ecology by describing body temperatures of free-living *A. spinifera* in a small stream.

Materials and Methods

We have studied a population of *Apalone spinifera* by mark-recapture in Gin Creek, a first-order tributary (average width = 4–5 m, depth = ~35 cm) of the Little Red River in White County, Arkansas since 1994 (unpubl. data). A detailed description of the study area is given by Plummer et al. (1997). Softshells were captured by hand or in funnel traps. Of the approximate 300 marked turtles (50 adults) in the population, only adult females were used in the present study because, compared to males, their larger body size facilitated implantation of transmitters and data loggers. Similar body sizes of the selected females (200–240 mm plastron lengths) reduced possible size-related differences in heating and cooling rates. For each softshell, plastron length (PL) and body weight were measured, a unique mark was provided, and a transmitter (Model SM-1, AVM Instrument Co., Livermore, California) was attached to the posterior part of the carapace prior to its release at its site of capture. Beyond these common methods, data were collected differently in 1995 and 2000.

In addition to the attached transmitter, in 1995 a second temperature-sensitive transmitter (Model CHP-2P, Telonics, Inc., Mesa, Arizona) was surgically implanted in each of four adult females. Implanted transmitters (6 x 12 x 30 mm, 6–7 g) were inserted into the body cavity through a small incision made in the body wall anterior to the hind legs near the bridge. The incision was closed with nylon sutures. Combined mass of the attached and implanted transmitters was <1% of turtle mass.

In 1995, each softshell was located each day during their activity season (15 Mar–29 Oct). At each location, the pulse rate of the temperature-sensitive transmitter, water temperature, and air temperature were recorded. We also attempted to determine the turtle's behavior (active, inactive, buried, basking). Transmitter pulse rates were later converted to temperatures from calibration curves constructed previously for each transmitter. At the end of the study period, turtles were recaptured and taken to the lab where implanted transmitters were removed and the incision closed. Turtles were then released at the site of their last capture.

In 2000, a TidBit® temperature data logger (Onset Computer Corp., Pocasset, Massachusetts) was surgically implanted in the body cavities of two adult females using the surgical procedures outlined above. The combined mass of TidBits (17 x 21 mm, 21 g) and attached transmitters was <3% of turtle mass. TidBits were programmed to record temperatures at 5 min. intervals. After implantation, turtles were released into the field. From 11 May to 17 August 2000, we infrequently and irregularly located turtles and attempted to determine their behavior (active, inactive, buried, basking). At the end of the study period, turtles were recaptured and taken to the lab where implanted data loggers were removed for downloading and the incision was closed. Turtles were then released into the field at the site of their last capture.

Basking events were indirectly identified in 2000 by comparing body temperature traces with concurrent water temperatures. Sharp increases (at least 4°C within 60 min.) in sequential body temperatures relative to water temperatures were assumed to represent aerial basking events (Fig. 1). This technique was highly conservative as basking events not resulting in sharp increases in body temperatures could not be identified. For example, brief basking events and basking events occurring in the shade, late in the season when water temperatures were warm, or early in the morning on overcast days may not have been detected on the temperature traces.

To obtain concurrent minimum environmental temperatures available to softshells in 2000, a TidBit data logger was suspended in a pool at a shaded 25 cm depth about 30 m upstream of a low water dam. The pool maintained an approximate constant water level during the course of data collection. To obtain concurrent maximum environmental temperatures available to aerially basking softshells, we constructed a metal softshell model painted medium flat gray and containing a TidBit data logger. At nonlethal temperatures (<35°C) produced in the laboratory with radiant heat, equilibrium temperatures of a tethered softshell and the model were similar. In the field, the model was placed near a known softshell basking site on the stream bank that was exposed to full sunlight throughout the day.

Statistical analyses were conducted with SYSTAT (SYSTAT, 2002). For data that were normally distributed and had homogeneous variances, paired-samples t-tests with Bonferroni probabilities were used to compare body temperatures between buried/basking and early/late season for individual turtles. A nonparametric Wilcoxon test was used to compare body temperatures between active/inactive individual turtles because the data did not meet parametric assumptions. Coefficients of determination (r^2) were used to describe the relative amount of variation in body temperature that was explained by water and air temperatures. Unless otherwise stated, means are accompanied by one standard error.

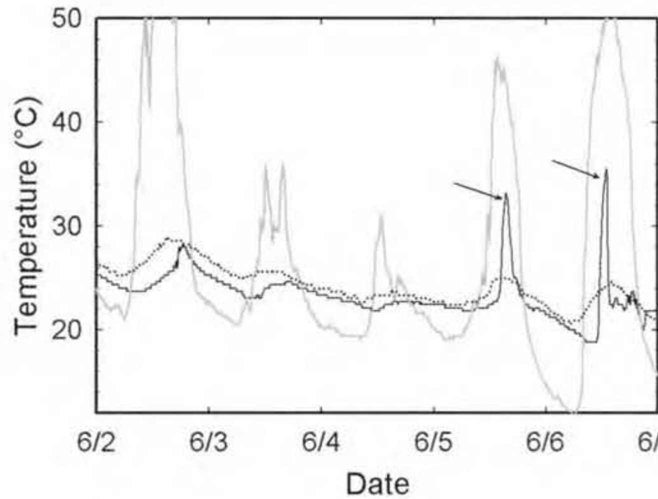

FIG. 1. Water temperatures (dotted line), model temperatures (gray line), and body temperatures (solid line) of an *Apalone spinifera* on representative days in 2000. Model temperatures were relatively high on 2, 5, and 6 June, but basking occurred only on 5 and 6 June. Arrows indicate spikes in body temperature that were assumed to result from aerial basking on 5 and 6 June. On 3 and 4 June, model temperatures were relatively low; apparently no basking occurred as body temperatures tracked water temperatures with little variance throughout the day.

TABLE 1. Times monitored and body temperatures (°C) of active (moving), inactive (nonmoving), buried in stream substrate, and aerially basking *Apalone spinifera* in 1995. Shown are mean, standard error, and sample size (in parentheses).

	Turtle Number			
Category	4	16	63	80
time	15 Mar–27 Sep	15 Mar–24 Oct	21 Jul–24 Oct	21 Jun–24 Oct
active	25.5 ± 0.42 (76)	25.5 ± 0.42 (95)	27.0 ± 0.65 (39)	27.6 ± 0.6 (39)
inactive	24.0 ± 0.60 (95)	23.0 ± 0.65 (85)	24.3 ± 0.66 (51)	25.7 ± 0.56 (60)
buried	19.9 ± 1.26 (3)	29.3 ± 1.25 (11)	28.5 (1)	28.4 ± 0.98 (15)
basking	25.4 ± 1.78 (9)	28.9 ± 0.82 (12)	(0)	26.3 ± 1.59 (4)

RESULTS

For 1995, a total of 677 body temperatures were measured on four *A. spinifera* throughout their activity season. Categories of body temperatures that could be associated with concurrent turtle behavior were generally similar among the four turtles (Table 1). Body temperatures, pooled from all four turtles, averaged 25.2 ± 0.20°C (range 12.8–34.0°C). Pooled body temperatures of active turtles averaged 26.1 ± 0.25°C (15.2–33.2°C, N = 249) and those of inactive turtles averaged 24.1 ± 0.32°C (21.8–33.4°C, N = 291). Variation in water temperature explained more variation in body temperature among the four turtles (73–89%; mean 81%) than did air temperature (60–63%; mean 62%). Water temperature explained more variation in body temperatures of inactive turtles (78–97%; mean 89%) than active turtles (62–87%; mean 74%). Body temperatures were statistically higher when turtles were active than when inactive for three of the four turtles (Table 1; Wilcoxon, no. 4, Z = -6.05, P < 0.001; no. 16, Z = -5.14, P < 0.001; no. 63, Z = -2.21, P < 0.05; no. 80, Z = 1.02, P > 0.30). For inactive turtles, body temperatures when buried (27.9 ± 0.82°C, 18.0–34.0°C, N = 30) did not differ from basking turtles (27.2 ± 0.84°C, 17.0– 32.9°C, N = 25; Table 1; no. 4, t = -6.50, P > 0.30; no. 16, t = 0.65, P > 0.60; no. 80, t = 1.03, P > 0.50). This lack of significance could have resulted from the small sample size or because softshells often buried in very warm water. On several occasions in 1995, we captured softshells buried in substrates that exceeded 33°C.

For 2000, a total of 40,287 body temperature measurements were recorded. Overall body temperature averaged 25.0 ± 0.05°C (17.9 –37.9°C) and the distributions of body temperatures were similar between turtles (Fig. 2A). Water temperature explained 65–67% of the variation in body temperature in two turtles. At night (2200–0600 h), water temperature explained 78–84% of the variation in body temperatures compared to 60–63% in the day (0600–2200 h). Body temperatures in late season averaged 2–4°C higher than in early season (t = 115.31, P < 0.001; Table 2; Fig. 2B). Higher seasonal body temperatures were associated with an average 3.5°C higher water temperature and 4.5°C higher model temperature in July and August in 2000.

Opportunities for aerial basking to raise body temperature were rarely constrained by low environmental temperatures as maxi-

TABLE 2. Body temperatures (°C) of two *Apalone spinifera* in 2000. Shown are mean, standard error, and minimum-maximum (in parentheses).

Turtle No.	Entire Season (May–August)	Early Season (May–June)	Late Season (July–August)
15	25.7 ± 0.02	24.2 ± 0.02	27.6 ± 0.02
	(17.9–37.9)	(17.9–35.5)	(21.9–37.9)
189	25.1 ± 0.02	24.5 ± 0.02	28.5 ± 0.04
	(18.8–35.9)	(18.8–35.9)	(25.0–32.8)

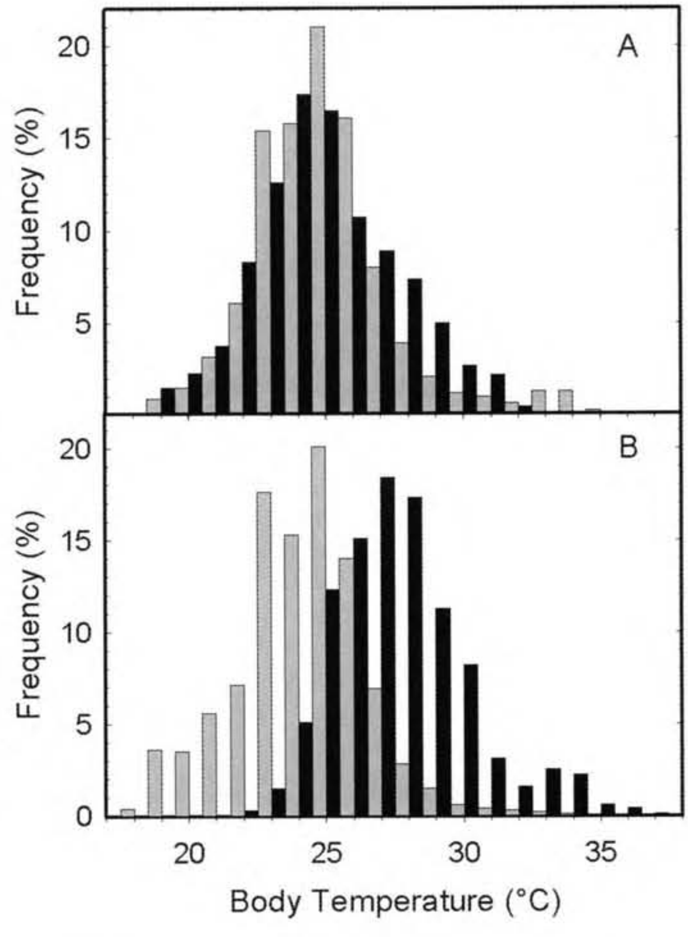

FIG. 2. A. Histogram of body temperatures for two *Apalone spinifera* during the same time period in 2000 (20 May – 6 July; N = 13,680 each turtle). During this period, mean body temperature for turtle no. 15 (dark bars) was 25.1 ± 0.023°C and that for no. 189 (gray bars) was 25.0 ± 0.023°C. B. Histogram of body temperatures for *Apalone spinifera* no. 15 in early season (May–June; gray bars) and late season (July–August; dark bars) in 2000. Mean early season body temperature was 24.2 ± 0.02°C (N = 14,678) and that for late season was 27.6 ± 0.02°C (N = 11,631).

TABLE 3. Statistics of basking in two *Apalone spinifera* as determined from a comparison of body temperature and water temperature tracings in 2000. Shown are turtle number, number of days monitored, number and percent of days that included a basking event, total number of basking events, average number of basking events per day, average number of basking events per day for days that included a basking event, and length in minutes of basking events (mean, SD, min.–max.).

Turtle No.	No. Days	No. Basking Days (%)	No. Basking Events	No. Events/ Day	No. Events/ Basking Day	Length of Basking Event (min)
189	49	25 (51.0)	42	0.86	1.7	104 ± 95 (10–415)
15	96	45 (46.8)	80	0.83	1.8	122 ± 91 (16–560)

mum model temperature exceeded 35°C on 90 of 94 days during the study period. Results from our highly conservative method of identifying aerial basking suggested that each turtle basked about 1.5–2 times per day on at least half of the days it was monitored (Table 3). Basking events averaged 1.5–2 h in length and were highly variable (CVs ~75–90%). We visually observed a total of seven aerial basking events in the field, six of which were later independently identified from the downloaded body temperature data.

Discussion

The few temperature data available for softshells include preferred ambient temperatures for *T. sinensis* in the laboratory (20–25°C; Khosatzky 1981), ambient water temperatures for free-living *A. mutica* early and late in the activity season (13.5–25.5°C; Plummer 1977), preferences of juvenile *A. mutica* in a laboratory thermal gradient (~27°C; Nebeker and Bury 2001), body temperatures of basking *A. ferox* in the laboratory (26.5–35.2°C, mean = 32.7°C; Boyer 1965), and for *A. spinifera*, ambient water temperatures of buried turtles (Graham and Graham 1991) and a telemetered free-living individual (~30°C; Williams and Christiansen 1981), and the preferred (32.7°C), voluntary maximum (35.7°C), and CTM (41°C) determined from individuals in the laboratory (Hutchison et al. 1966). Our estimates of average field body temperatures for *A. spinifera* are toward the low end of the range of body temperatures reported for trionychids in the literature, and were remarkably similar using different methods in two different years (25.2°C in 1995 and 25.0°C in 2000). Highly aquatic turtles, such as softshells, often have lower CTMs than semi-aquatic or terrestrial turtles (Hutchison et al. 1966) and a lower CTM often indicates lower optimum body temperatures during activity for some reptiles (Huey 1982). Nebeker and Bury (2001) found a lower thermal preference for hatchlings of the highly aquatic *A. mutica* compared to the semi-aquatic emydid *Pseudemys nelsoni*.

Softshells appear to function as thermoconformers much of the time, with body temperature tracking water temperature. The higher r^2 values for body and water temperatures for nighttime periods and for inactive turtles reflect basic softshell natural history, i.e., diurnal turtles that spend large amounts of time burrowed in the substrate under water (Ernst et al. 1994). The difference also suggests that daytime-active softshells thermoregulate to some degree. Comparison of early-season and late-season data from both 1995 (Table 1) and 2000 (Table 2; Fig. 2) further emphasizes the large effect that water temperature has on body temperature. Periods of elevated body temperatures resulting from aerial basking occur commonly, but generally are of brief duration and do not result in a "plateau" of regulated body temperature over an extended period as often occurs in terrestrial reptiles and in some semi-aquatic turtles that shuttle between land and water (e.g., *Emydoidea*, Sajwaj and Lang 2000). Our observations suggest that, despite fundamental differences in behavior (highly aquatic), body shape (flattened), and physiology (high cutaneous surface area and evaporative water loss), field body temperatures of trionychids are similar to that of other freshwater turtles in levels of preference and variation and that softshells appear to most often function as thermoconformers as do many other freshwater turtle species.

The assumption that body temperature spikes indicated aerial basking events was supported by the fact that six of seven basking events directly observed in the field were independently identified on the temperature traces. Aerial basking is a common occurrence for *A. spinifera* in Gin Creek (~50% of days; ~2/d/turtle) and can result in elevated body temperatures. These results compare favorably with Auth's (1975) direct observations of basking in *Pseudemys scripta* (44% of days; 2–3/d/turtle, up to 5/d in favorable weather) especially given that our highly conservative indirect method likely failed to detect every basking event. In addition to aerial basking, we observed *A. spinifera* practicing partial aerial basking (i.e., body partially submerged; N = 5 observations), as did Graham and Graham (1997) and Plummer and Burnley (1997).

Basking may have several functions in turtles (summarized in Boyer 1965; Moll and Legler 1971). For some species, thermoregulatory heat gain is primary (e.g., Crawford et al. 1983; Spotila et al. 1990) whereas other turtles commonly bask without raising body temperature (e.g., Manning and Grigg 1997). Aerial basking coupled with terrestrial behavior may be important in the daily and seasonal thermal strategy of semi-aquatic turtles such as *Emydoidea* (Sajwaj and Lang 2000) and *Clemmys* (Litzgus and Brooks 2000), but *Apalone* species are highly aquatic and typically leave water only briefly to nest and bask (Ernst et al. 1994; MVP pers. obs. 1975, 2003). We do not deny the importance of basking in *Apalone* spp. as it apparently is a widespread, commonly occurring behavior the specifics of which differ among sympatric *Apalone* species (Lindeman 2001) and possibly between the sexes (Plummer 1977). Nevertheless, considering the behavior of softshells and a morphology/physiology that promotes rapid environmental heat exchange, we doubt whether body temperatures of basking *Apalone* are uncoupled from water temperatures long enough to be of thermoregulatory significance in their over-

all thermal strategy (Congdon 1989).

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Sources of Larval Identities for Amphibians from Borneo

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At present, 160 species of amphibians (composed exclusively of Anura and Gymnophiona) are known from Borneo (Das 2005; Das and Haas 2005; Inger and Stuebing 2005). The last summary of knowledge on their larval forms, compiled by Inger (1985), revealed that 45–60% of the fauna then described (63 larval forms), had known larval stages. An additional 14 larval forms could not be assigned to the parent species at the time. Some progress has been made in the two decades that has now elapsed, through the

discovery and allocation of additional tadpoles to their parent species within Borneo and extralimitally.

This review provides an annotated list of Bornean species of amphibians, along with details of larval forms in the literature, and was prepared as a precursor to a project, supported by a grant from Volkswagen Stiftung, to match amphibian larvae to their parent species from Borneo, using DNA sequence data.

The quality of description of Bornean amphibian larvae as found existing in the literature varies significantly, as noted by Inger (1985), and is also true for other faunas (see for instance, Leong [2002], for a similar account of the status of the tadpoles of the Malay Peninsula). In this treatment, we scored larval descriptions from 0–7, where 0 = unknown; 1 = abbreviated description; no figure; 2 = abbreviated description; with figure; 3 = extended description; no figure; 4 = extended description; with figure; 5 = scanning electronic micrography (SEM); 6 = no description, non-SEM image; and 7 = measurements; no description or images. Additionally, X = those with direct development (*Philautus* spp.).

The respective references cited are in chronological order. Mention is made if descriptions are based on extralimital samples, and indicated with 'B', if drawn from Borneo. Where not specified, these are from unspecified localities.

In total, 89 species of amphibians known from Borneo now have known tadpoles. This represents 55.6% of the known Bornean amphibian fauna. Additionally, the larvae of several species (including *Bufo quadriporcatus*, *Kaloula baleata*, *K. pulchra*, *Microhyla berdmorei*, *Fejervarya cancrivora*, *Rana erythraea*, *Rhacophorus cyanopunctatus*, *R. reinwardtii*, and *Theloderma horridum*) have been described exclusively from extralimital areas (including China, India, Sri Lanka, Thailand, the Malay Peninsula, Java and the Philippines Archipelago). Given the systematic uncertainties with several lineages, it is unclear at least in some cases (e.g., *Kaloula baleata* and *Fejervarya cancrivora*) whether the allocation would be relevant to Bornean populations of the respective species.

Groups with unknown larval stages include the sole Bornean representative of the Bombinatoridae (comprising *Barbourula kalimantanensis*, a poorly-known endemic of Kalimantan, Indonesia); 13 species of Bufonidae; 13 species of Microhylidae; 10 species of Megophryidae; 13 species of Ranidae; 20 species of Rhacophoridae; and five species of Ichthyophiidae. Ecological correlates are also evident. For instance, a large number of species from relatively inaccessible peat swamp habitats have unknown larval forms (including *Pseudobufo subasper*, *Limnonectes kenepaiensis*, *L. paramacrodon*, *Rana baramica*, and *R. laterimaculata*). Six of eight endotrophic tadpoles of the bufonid genus *Pelophryne* too remain unknown, in addition to all but one *Philautus*, a rhacophorid genus with 17 Bornean species, containing species showing direct development.

When larval descriptions are available, these may be in an abbreviated form, or no vouchers are listed, making identities uncertain. Examples include descriptions of larval *Leptobrachium montanum* and of *Rana signata*: both these names are now known to contain more than a single species (see Brown and Guttman 2002; Malkmus et al. 2002). In other cases, larval descriptions are so general that species identification below generic level is hardly possible.

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TABLE 1. Checklist of amphibians of Borneo, annotated with status information on larval descriptions and their sources. Status of descriptions: 0 = unknown; 1 = abbreviated description; no figure; 2 = abbreviated description; with figure; 3 = extended description; no figure; 4 = extended description; with figure; 5 = scanning electronic micrography (SEM); 6 = no description, non-SEM image; 7 = measurements; no description or images; and X = direct development.

	Status of description
Bombinatoridae	
Barbourula kalimantanensis	0
Bufonidae	
Ansonia albomaculata	3 (Inger, 1985: B)
Ansonia anotis	1 (Inger et al., 2001: B)
Ansonia fuliginea	0
Ansonia guibei	2 (Malkmus et al., 2002: B); 4, 5 (Malkmus and Kosuch, 2000: B)
Ansonia hanitschi	1 (Malkmus et al., 2002: B)
Ansonia latidisca	0
Ansonia leptopus	4 (Inger, 1992a: B)
Ansonia longidigita	1 (Malkmus et al., 2002: B), 2 (Manthey and Grossmann, 1997: B), 4, 5 (Inger, 1985: B)
Ansonia minuta	1 (Inger, 1966: B); 3 (Inger, 1985: B)
Ansonia platysoma	0
Ansonia spinulifer	2 (Malkmus et al., 2002: B)
Ansonia torrentis	0
Bufo asper	1 (Bourret, 1942a: Indo-China; Manthey and Grossmann, 1997; Smith, 1930); 2 (Iskandar, 1998: Java and Bali, Indonesia; van Kampen, 1910; Nieden, 1923; Bourret, 1942b); 3 (Inger, 1985: B); 4 (Berry, 1972: Peninsular Malaysia)
Bufo divergens	1 (Inger, 1966: B; Malkmus et al., 2002: B)
Bufo juxtasper	1 (Manthey and Grossmann, 1997); 2 (Malkmus et al., 2002); 4, 5 (Inger, 1985: B)
Bufo melanostictus	1 (Boulenger, 1912; Bourret, 1942a: Indo-China; Inger, 1966); 2 (Pope, 1931: Hainan, China; Bourret, 1942b: Indo-China; Kirtisinghe, 1957: Sri Lanka; Manthey and Grossmann, 1997); 3 (Leong and Chou, 1999: Singapore); 4 (Chou and Lin, 1997: Taiwan, Republic of China); 6 (Iskandar, 1998: Java and Bali, Indonesia; Fei and Ye, 2001: China; Yang, 1998: Taiwan, Republic of China; Nutaphand, 2001: Thailand).
Bufo quadriporcatus	4 (Leong and Chou, 1999: Singapore)
Leptophryne borbonica	1 (Iskandar, 1998: Java and Bali, Indonesia); 2 (Berry, 1972; Malkmus et al., 2002; Manthey and Grossmann, 1997); 3 (Inger, 1985: B); 4 (Berry, 1972: Peninsular Malaysia)
Pedostibes everetti	0
Pedostibes hosii	2 (Manthey and Grossmann, 1997: B); 4 (Inger, 1966: B); 4, 5 (Inger, 1985: B)
Pedostibes maculatus	0
Pedostibes rugosus	0
Pelophryne api	0
Pelophryne brevipes	4 (Alcala and Brown, 1982: Mindanao, Philippines)
Pelophryne exigua	0
Pelophryne guentheri	0
Pelophryne macrotis	0
Pelophryne misera	2 (Malkmus et al., 2002: B); 6 (Malkmus, 2002: B)
Pelophryne rhopophilus	0
Pelophryne signata	2 (Manthey and Grossmann, 1997: B, as *Pelophryne brevipes;* description a composite of *P. brevipes* and *P. signata*); 3 (Inger, 1985: B, as *Pelophryne brevipes*)
Pseudobufo subasper	0
Microhylidae	
Calluella brooksi	0
Calluella flava	0
Calluella smithi	0
Chaperina fusca	1 (Parker, 1934; Bourret, 1942b; Inger, 1956: B, developmental notes; Inger, 1966: B);); 2 (Manthey and Grossmann, 1997; Malkmus et al., 2002); 4, 5 (Inger, 1985: B)
Gastrophrynoides borneensis	0
Kalophrynus baluensis	0
Kalophrynus eok	0
Kalophrynus heterochirus	0
Kalophynus intermedius	0
Kalophrynus nubicola	0

TABLE 1. Continued.

	Status of description
Kalophrynus pleurostigma	1 (Parker, 1934; Bourret, 1942b; Inger, 1956: developmental notes; Inger, 1966: B; Malkmus et al., 2002: B); 2 (Lim and Ng, 1991: Singapore; Manthey and Grossmann, 1997; Leong and Chou, 1999: Singapore); 3 (Inger, 1985: B); 4 (Berry, 1972: Peninsular Malaysia); 6 (Lim and Lim, 1992: Singapore; Iskandar, 1998: Java and Bali, Indonesia)
Kalophrynus punctatus	0
Kalophrynus subterrestris	0
Kaloula baleata	1 (van Kampen, 1910: Java, Indonesia); 6 (Iskandar, 1998: Java and Bali, Indonesia)
Kaloula pulchra	1 (Smith, 1930; Parker, 1934: Thailand; Inger, 1966: Thailand); 2 (Smith, 1916: Thailand; Annandale, 1917: Singapore; Bourret, 1942b: Thailand; Manthey and Grossmann, 1997; Leong and Chou, 1999: Singapore; Malkmus et al., 2002); 6 (Nutaphand, 2001: Thailand; Chan-Ard, 2003: Thailand)
Metaphrynella sundana	0
Microhyla berdmorei	1 (Parker, 1934: Annam, Vietnam; Inger, 1966: Annam, Vietnam); 2 (Smith, 1924: Indo-China; Bourret, 1942b); 4 (Leong, 2004: Peninsular Malaysia)
Microhyla borneensis	1 (Parker, 1934; Inger, 1966: B; Malkmus et al., 2002); 2 (Leong and Chou, 1999: Singapore); 4, 5 (Inger, 1985: B)
Microhyla maculifera	0
Microhyla perparva	3 (Inger, 1985: B); 4 (Inger and Frogner, 1979: B)
Microhyla petrigena	1 (Malkmus et al., 2002: B); 4 (Inger and Frogner, 1979: B); 4, 5 (Inger, 1985: B)
Megophryidae	
Leptobrachella baluensis	0
Leptobrachella brevicrus	0
Leptobrachella mjobergi	3 (Inger, 1985: B); 4 (Dring, 1983b: B); 4, 5 (Inger, 1983: B)
Leptobrachella parva	0
Leptobrachella palmata	0
Leptobrachella serasanae	0
Leptobrachium abbotti	2 (Malkmus et al., 2002: B); 4, 5 (Inger, 1985: B, a composite of *Leptobrachium abbotti* and *L. montanum*)
Leptobrachium gunungense	2 (Malkmus et al., 2002: B)
Leptobrachium hendricksoni	1 (Inger, 1983: B; 1985: B); 2 (Manthey and Grossmann, 1997)
Leptobrachium montanum	2 (Manthey and Grossmann, 1997: B; Malkmus et al., 2002: B); 3 (Inger, 1983: B: probably a composite of *Leptobrachium montanum* and *L. abbotti*); 4, 5 (Inger, 1983: B, probably a composite of *L. montanum, L. abbotti,* and possibly also *L. gunungense;* Inger, 1985: B, a composite of *Leptobrachium abbotti* and *L. montanum*); 6 (Malkmus, 1999)
Leptobrachium nigrops	1 (Inger, 1966: B, allocation to parent species tentative); 2 (Matsui, 1979: B, questionably assigned to *Leptobrachium nigrops;* Manthey and Grossmann, 1997; Leong and Chou, 1999: Singapore); 3 (Inger, 1985: B); 4 (Berry, 1972: Peninsular Malaysia); 4, 5 (Inger, 1983: B)
Leptolalax arayai	2 (Malkmus et al., 2002: B); 6 (Malkmus, 1999)
Leptolalax dringi	0
Leptolalax gracilis	2 (Matsui, 1979: B); 3 (Inger, 1985: B); 4, 5 (Inger, 1983: B). Grandison's (1982) description of larvae from Peninsular Malaysia is incertae sedis, as this species is not known from Peninsular Malaysia)
Leptolalax hamidi	0
Leptolalax maurus	0
Leptolalax pictus	0
Megophrys baluensis	2 (Matsui, 1979: B; Malkmus et al., 2002: B)
Megophrys edwardinae	0
Megophrus kobayashii	2 (Malkmus et al., 2002: B); 6 (Malkmus, 1999)
Megophrys nasuta	1 (Inger, 1966: B); 2 (Manthey and Grossmann, 1997; Leong and Chou, 1999: Singapore; Malkmus et al., 2002: B); 4, 5 (Inger, 1985: B)
Ranidae	
Fejervarya cancrivora	1 (Schijfsma, 1932: Java, Indonesia; Bourret, 1942a: Indo-China; Alcala, 1962: Philippines; Inger, 1966: B); 2 (Bourret, 1942b); 4 (Alcala, 1962: Negros, Philippines; Leong and Chou, 1999: Singapore)
Fejervarya limnocharis	1 (van Kampen, 1910: Java, Indonesia; Smith, 1916: Thailand; Schijfsma, 1932: Java, Indonesia; Bourret, 1942a: Indo-China; Inger, 1966; Malkmus et al., 2002); 2 (Annandale, 1917: India; Pope, 1931: Hainan, China; Bourret, 1942b; Liu, 1950: China; Kirtisinghe, 1957: Sri Lanka; Manthey and Grossmann, 1997: Peninsular Malaysia; Leong and Chou, 1999: Singapore; Ziegler, 2002: Vietnam); 4 (Chou and Lin, 1997; Taiwan, Republic of China); 6 (Yang, 1998: Taiwan, Republic of China; Chan-Ard, 2003: Thailand)

TABLE 1. Continued.

	Status of description
Hoplobatrachus sinensis	2 (Bourret, 1942a: Indo-China); 4 (Chou and Lin, 1997: Taiwan, Republic of China); 6 (Yang, 1998: Taiwan, Republic of China; Chan-Ard, 2003: Thailand)
Huia cavitympanum	1 (Yang, 1991: B; Malkmus et al., 2002: B); 2 (Inger, 1966: B; Matsui, 1979: B); 3 (Inger, 1985: B); 6 (Boulenger, 1893: B)
Ingerana baluensis	0
Limnonectes asperata	0
Limnonectes finchi	1 (Malkmus et al., 2002: B); 3 (Inger, 1985: B)
Limnonectes ibanorum	2 (Inger, 1966: B); 4, 5 (Inger, 1985: B)
Limnonectes ingeri	4, 5 (Inger, 1985: B)
Limnonectes kenepaiensis	0
Limnonectes kuhlii	1 (Schijfsma, 1932: Java, Indonesia; Dring, 1979: Peninsular Malaysia; Bourret, 1942a; Indo-China; Matsui, 1979; Leong and Chou, 1999: Singapore); 2 (Smith, 1917; Pope, 1931: Hainan, China; Bourret, 1942b; Inger, 1966: B; Manthey and Grossmann, 1997: B; Malkmus et al., 2002: B); 4, 5 (Inger, 1985: B); 6 (Yang, 1998: Taiwan, Republic of China)
Limnonectes laticeps	1 (Inger, 1985: B, association with parent species weak); 4 (Leong, 2004: Peninsular Malaysia)
Limnonectes leporinus	1 (Malkmus et al., 2002: B); 2 (Inger, 1966: B, as *Rana blythi*); 4, 5 (Inger, 1985: B, as *Rana blythi*)
Limnonectes malesianus	1 (Inger, 1985: B); 2 (Manthey and Grossmann, 1997); 4 (Leong and Chou, 1999: Singapore)
Limnonectes palavanensis	1 (Inger, 1956: B, as *Rana microdisca palavanensis;* Inger, 1985: B; Malkmus et al., 2002: B)
Limnnectes paramacrodon	0
Limnonectes rhacodus	0
Meristogenys amoropalamus	1 (Malkmus et al., 2002: B); 3 (Yang, 1991: B)
Meristogenys jerboa	0 (illustrations of *Staurois jerboa* in van Kampen, 1910, reproduced by Bourret, 1942b, based on specimens that are incertae sedis)
Meristogenys kinabaluensis	2 (Malkmus et al., 2002: B); 3 (Inger, 1985: B; Yang, 1991: B)
Meristogenys macrophthalmus	0
Meristogenys orphocnemis	1 (Malkmus et al., 2002: B); 3 (Yang, 1991: B)
Meristgenys phaeomerus	3 (Yang, 1991: B); 4, 5 (Inger, 1985: B)
Meristogenys poecilus	3 (Inger, 1985: B; Yang, 1991: B)
Meristogenys whiteheadi	1 (Malkmus et al., 2002: B); 3 (Yang, 1991: B); 6 (Boulenger, 1893: B)
Occidozyga baluensis	1 (Malkmus et al., 2002: B); 3 (Inger, 1985: B)
Occidozyga laevis	1 (Malkmus et al., 2002); 2 (Alcala, 1962: Negros, Philippines; Smith, 1916: Thailand; Bourret, 1942b: Thailand); 3 (Inger, 1985: B); 4 (Alcala, 1962: Negros, Philippines; Leong and Chou, 1999: Singapore)
Rana baramica	0
Rana erythraea	1 (van Kampen, 1910: Java, Indonesia; Smith, 1930; Bourret, 1942a: Indo-China; Bourret, 1942b; Inger, 1966: B; Malkmus et al., 2002); 2 (Leong and Chou, 1999: Singapore); 6 (Lim and Lim, 1992: Singapore); 7 (Manthey and Grossmann, 1997)
Rana glandulosa	0 (The description of the larval stages in Berry [1972] from Peninsular Malaysia, which has been reproduced by Inger [1985] and Manthey and Grossmann [1997] refers to *Rana banjarana* Leong and Lim [2003])
Rana hosii	1 (Bourret, 1942b; Inger, 1966: B); 2 (Manthey and Grossmann, 1997: Peninsular Malaysia; Malkmus et al., 2002)
Rana laterimaculata	0 (description in preparation by T.-M. Leong, pers. comm.)
Rana luctuosa	1 (Boulenger, 1912; Bourret, 1942a: Indo-China; Dring, 1979: Peninsular Malaysia; Inger, 1985: B; Malkmus et al., 2002); 2 (Bourret, 1942b: Thailand and Peninsular Malaysia; Inger, 1966; Manthey and Grossmann, 1997: Thailand and Peninsular Malaysia)
Rana nicobariensis	1 (van Kampen, 1923:226: Java, Indonesia; allocation to parent species tentative; Smith, 1930; Bourret, 1942a: Indo-China; Bourret, 1942b; Inger, 1956; Iskandar, 1998: Java and Bali, Indonesia; Malkmus et al., 2002); 2 (Schijfsma, 1932: Java, Indonesia)
Rana picturata	0 (may be confused with *Rana signata* in the literature)
Rana raniceps	1 (Boulenger, 1912: as *Rana labialis*; Bourret, 1942a: Indo-China: as *Rana chalconota;* Malkmus et al., 2002); 2 (Flower, 1896: Singapore: as *Rana chalconota*; Bourret, 1942b: Singapore: as *Rana chalconota*; Inger, 1966: B: as *Rana chalconota*; Manthey and Grossmann, 1997: Peninsular Malaysia: as *Rana chalconota;* Leong and Chou, 1999: Singapore); 4, 5 (Inger, 1985: as *Rana chalconota*)
Rana signata	2 (Inger, 1966: B; Manthey and Grossmann, 1997: B: figures may be a composite of *Rana signata* and *R. picturata*); 4, 5 (Inger, 1985: B, comments as for preceding entry)
Staurois guttatus	1 (Malkmus et al., 2002: B); 4 (Inger and Wassersug, 1990: B: species not identified, and referred to "centronelid–like anuran larva;" identified by Inger and Tan (1990) as *Staurois natator.* Inger's (1966) description of the larvae from Mindanao is based on the tadpoles of a non-conspecific species)

TABLE 1. Continued.

	Status of description
Staurois latopalmatus	0 (description purported to be of this species in Boulenger, 1893 is incertae sedis; that in Inger, 1966, possibly a larva of *Rhacophorus* sp., R. F. Inger, pers. comm.)
Staurois parvus	0 (possibly confused with *Staurois guttatus*)
Staurois tuberilinguis	1 (Malkmus et al., 2002: B); 4, 5 (Malkmus et al., 1999: B); 6 (Malkmus, 1999)
Rhacophoridae	
Nyctixalus pictus	1 (Inger, 1966: B); 2 (Manthey and Grossmann, 1997; Malkmus et al., 2002); 3 (Inger, 1985: B); 4 (Leong and Chou, 1999: Singapore)
Philautus acutus	X
Philautus amoeanus	X
Philautus aurantium	X
Philautus bunitus	X
Philautus disgregus	X
Philautus erythropthalmus	X
Philautus gunungensis	X
Philautus hosii	1 (Inger, 1966: B)
Philautus ingeri	X
Philautus kerangae	X
Philautus longicrus	X
Philautus mjobergi	X
Philautus petersi	X
Philautus refugii	X
Philautus saueri	6 (Malkmus et al., 2002: B)
Philautus tectus	X
Philautus umbra	X
Polypedates chlorophthalmus	X
Polypedates colletti	1 (Inger, 1966: B); 3 (Inger, 1985: B)
Polypedates leucomystax	1 (van Kampen, 1907: Sumatra, Indonesia; Boulenger, 1912; Villadolid and Rosario, 1920: Luzon, Philippines; Bourret, 1942a: Indo-China; Alcala and Brown, 1956: Philippines; Inger, 1956: B: as *Rhacophorus leucomystax linki*); 2 (Flower, 1899: Peninsular Malaysia and Singapore; Pope, 1931: Hainan, China; Bourret, 1942b; Liu, 1950: China; Matsui, 1979; Manthey and Grossmann, 1997: Pulau Bintan, off Sumatra, Indonesia; Iskandar, 1998: Java and Bali, Indonesia Malkmus et al., 2002: Pulau Bintan, Indonesia); 4 (Ahl, 1931; Ting, 1970: Singapore; Alcala, 1962: Negros, Philippines; Leong and Chou, 1999: Singapore; Ziegler, 2002: Vietnam); 6 (Nutaphand, 2001: Thailand)
Polypedates macrotis	1 (Malkmus et al., 2002: B); 2 (Inger, 1966: B); 4, 5 (Inger, 1985: B)
Polypedates otilophus	1 (Inger, 1956: B; Malkmus et al., 2002: B); 2 (Boulenger, 1893: B; Inger, 1966: B; Manthey and Grossmann, 1997: B); 4, 5 (Inger, 1985: B)
Rhacophorus angulirostris	2 (Malkmus et al., 2002: B); 3 (Inger, 1985: B: as *Rhacophorus* sp. KB; Inger and Tan, 1990: B); 7 (Manthey and Grossmann, 1997: B)
Rhacophorus appendiculatus	1 (Inger, 1966: B; Malkmus et al., 2002: B); 3 (Alcala and Brown, 1962: Negros, Philippines: questionably allocated to this species; Inger, 1985: B); 4 (Leong, 2004: Peninsular Malaysia)
Rhacophorus baluensis	1 (Malkmus et al., 2002: B); 3 (Inger and Tan, 1990: B)
Rhacophorus cyanopunctatus	4 (Leong, 2004: Peninsular Malaysia)
Rhacophorus dulitensis	1 (Inger, 1966: B; Malkmus et al., 2002: B); 3 (Inger, 1985: B)
Rhacophorus everetti	0
Rhacophorus fasciatus	0
Rhacophorus gadingensis	0
Rhacophorus gauni	3 (Inger, 1992b: B; Inger, 1985: B: as *Rhacophorus bimaculatus;* identity of Inger's *R. gauni* on pp. 82–83 remains unknown)
Rhacophorus harrissoni	2 (Malkmus et al., 2002: B); 4, 5 (Inger, 1985: B)
Rhacophorus kajau	1 (Inger, 1985: B: identity of this species uncertain); 2 (Dring, 1983a: B)
Rhacophorus nigropalmatus	1 (Inger, 1966: B; Malkmus et al., 2002: B); 3 (Inger, 1985: B); 4 (Berry, 1972: Peninsular Malaysia)
Rhacophorus pardalis	1 (Inger, 1966: B; Manthey and Grossmann, 1997: B; Malkmus et al., 2002: B); 3 (Inger and Tan, 1990: earlier, Inger, 1985 referred the material to *Rhacophorus bimaculatus*); 4 (Inger, 1956: B; Alcala, 1962: Negros, Philippines; uncertain whether conspecific with Bornean population); 4, 5 (Inger, 1985: B)
Rhacophorus reinwardtii	1 (Manthey and Grossmann, 1997; Iskandar, 1998: Java and Bali, Indonesia); 2 (Boulenger, 1882:89-90: probably refers to species of *Amolops, Huia,* or *Meristogenys*); 6 (Siedlecki, 1909: Java, Indonesia)

TABLE 1. Continued.

	Status of description
Rhacophorus rufipes	0
Theloderma horridum	1 (Bourret, 1942a: Indo-China); 2 (Boulenger, 1903: Peninsular Malaysia; Manthey and Grossmann, 1997)
Ichthyophiidae	
Caudacaecilia asplenia	0
Caudacaecilia nigroflava	0
Ichthyophis atricollaris	0
Ichthyophis biangularis	0
Ichthyophis dulitensis	0
Ichthyophis monochrous	1 (Inger, 1966: B; Malkmus et al., 2002)

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Diet of Midland Painted Turtles (*Chrysemys picta marginata*) in a Northern Lake Michigan Bay

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In Painted Turtles (*Chrysemys picta*), variation in the degree of carnivory, water temperature, or growing season length are usually invoked as explanations for variation in life-history traits, such as individual growth rate and body size, within and between populations (Iverson and Smith 1993; Frazer et al. 1993; St. Clair et al. 1994). Painted Turtles are opportunistic predators and omnivorous as adults (Ernst et al. 1994). In creek, marsh, small pond, or lake habitats, painted turtles may ingest large quantities of plants and aquatic insect larvae and other aquatic arthropods (MacCulloch and Secoy 1983; Lindeman 1996; Rowe and Parsons 2000). In contrast, populations residing in relatively large riverine habitats may consume mainly invertebrates (Gibbons 1967; MacCulloch and Secoy 1983). A high protein, carnivorous diet may be responsible for relatively rapid growth rates and larger adult body size in some populations (Gibbons 1967; MacCulloch and Secoy 1983) and may be, in part, responsible for a positive correlation between latitude and body size (MacCulloch and Secoy 1983). Therefore, studies of dietary habits at both local and broad geographic scales may lend insights into geographic variation in life-history traits of Painted Turtles.

Midland Painted Turtles (*Chrysemys picta marginata*) of the Beaver Island Archipelago, in northern Lake Michigan, reside in inland lakes and wetlands, and in shallow Lake Michigan bays. We studied the dietary habits of Painted Turtles at Garden Island Harbor during two periods in 2001: 5–26 June (the early sampling period) and 3–12 August (late sampling period). Garden Island Harbor (GIH) is a shallow Lake Michigan bay in Charlevoix County, Michigan (45°47.90'N, 85°30.39'W) that is ca. 2 km N of Beaver Island. Garden Island is an uninhabited island in northeastern Lake Michigan and our study area is associated with an extensive lakeside marsh system located on the southwest portion of the island. Garden Island Harbor is about 1,300 x 700 m and, with its fringe wetlands, has a total surface area of about 100 ha. Maximum depth of GIH is about 5 m.

We found turtles in two aquatic habitats in the harbor: 1) relatively deep (1–2 m) and cool water (mean ± SD, range, water temperature at 2 m depth = 18.0 ± 3.10°C, 9.9–25.7°C, N = 1632 hourly samples recorded between 6 June and 12 August 2001 using Optic Stowaway data loggers, Onset Computer Corporation) where turtles were observed actively foraging, and 2) in relatively shallow (10–50 cm) and warm water (mean hourly water temperature at 50 cm depth = 21.6 ± 3.33°C, 13.4–30.1°C) while they were nestled, motionless, at the bases of bulrushes. We collected turtles by hand (75%) while wading or snorkeling or in fykenets (25%) placed at depths of 1.5–2 m. Of those turtles captured by hand, about 60% were collected in open water and the other 40% were collected among the bulrushes in the shallows. Upon capture, we determined the gender of the turtle, uniquely marked marginal scutes, measured mass to the nearest 10 g using a spring scale, and measured maximum straight-line carapace length (CL) to the nearest 1 mm using calipers.

Data on diet were obtained via stomach flushing. We restrained animals in a device modified from Fields et al. (2000) and anesthetized individuals using a dosage of 25 mg ketamine / kg body mass (Fields et al. 2000). After opening the turtle's mouth, we forced it to bite down on a rubber stopper and inserted a pediatric feeding tube (3 mm diameter) into the stomach. The tube was connected to a weed spray can that was modified to deliver water. Stomach contents were collected in a wire mesh strainer and subsequently preserved in 10% formalin. We later sorted each sample into taxonomic groups, dried each taxon individually in aluminum foil to a constant mass at 80°C, and then measured dry mass to the nearest 0.001 g. We attempted to count individual prey items from each stomach although partial digestion of items made this

impossible for some samples.

We calculated the frequency of occurrence of taxa (frequency of stomachs that contained a particular taxon) in the early and late sampling periods separately, and in males and females separately. Chi-square contingency analyses were used to make comparisons in frequencies of prey items between early and late sampling periods while accounting for differences in sample sizes between periods. Only one male was captured during the early period making comparisons of males and females possible only within the late period. We used the most frequently consumed prey items in statistical analyses such that the expected Chi-square values for a category were not less than five (i.e. caddisfly larvae, crayfish, snails, and plants) in order to maintain statistical validity of a Chi-square Goodness of Fit test (Zar 1996). Total mass percent was the total dry mass of a prey item type expressed as a proportion of the total dry mass of the sample. Because prey item densities are likely to exhibit temporal variation due to variation in life cycles of aquatic insects, we assessed temporal variation in diet that would affect an overall view of diet (Lindeman 1996). Since painted turtles are sexually dimorphic in size (females are larger than males), potential gender differences in diet were also evaluated because females may eat larger prey items than males (Cagle 1952; Shealy 1976). To assess potential differences in the mass of food consumed by male and female turtles, which could bias our results, we conducted an ANCOVA with CL as a covariate.

We obtained food items from 57 of 64 (89.1%) individuals that were stomach-flushed. During the June sampling period, 25 female turtles and one male turtle were collected. During August, food samples were obtained from 16 female and 15 male turtles. For individuals from which we obtained food samples, CL averaged 151.3 ± 12.91 mm and body wet mass averaged 433.9 ± 113.91 g.

Of the stomachs that contained food, plant matter was found in 25 of 57 (43.9%) stomachs while animal matter was found in 55 of 57 (96.5%) stomachs (Table 1). Of the stomachs that contained plant matter, fragments of Wild Celery (*Vallisneria americana*) were found in 38.5% with small fragments of unidentified plant fragments comprising the remaining fraction. The most frequently ingested animal items were crayfish (Decapoda), snails (Pulmonata), and caddisfly (Trichoptera) larvae. Counts per stomach of dragonfly (Anisoptera) and damselfly (Zygoptera) larvae were as high as 40. Counts per stomach of snail (Pulmonata) ranged from 40–100. Johnny Darters (*Etheostoma nigrum*) and Spot-tail Shiners (*Notropis hudsonius*) were the main vertebrate items. Neither seasonal (early vs. late period) or gender effects were significant ($P > 0.05$ in both Chi-square contingency analyses).

On a dry mass basis, animal matter comprised 97.2% of the total dry mass while plant matter represented only 2.8% (Table 1). Crayfish were the dominant prey items followed by snails, fish, and dragonfly larvae. There was no significant difference in the amount of dry mass consumed by males or females ($P > 0.05$ in an ANCOVA with gender as a main effect and CL included as a covariate).

Midland Painted Turtles at GIH were nearly carnivorous consuming mainly crayfish, snails, and caddisfly larvae. While other investigators have observed an animal matter bias in the diets of painted turtles (Hart 1982; MacCulloch and Secoy 1983; Lindeman 1996), such extreme proportions of dietary animal matter, such as that observed in our study, has not been reported previously. In other populations where turtles consumed mainly animal prey, arthropods (crayfish, insect larvae, or scuds) were common dietary items (MacCulloch and Secoy 1983, Lindeman 1996). Other studies have reported almost herbivorous diets (Gibbons 1967) or nearly equal volumes of plant and animal material (Lagler 1943; Ernst and McDonald 1989; Rowe and Parsons 2000). Differences in diet among Painted Turtle populations are likely to be in part because of differences in prey availability. For instance, Painted Turtles that were sampled throughout the summer months over a two-year period at Miller's Marsh on neighboring Beaver Island (Rowe and Parsons 2000) were found to consume large quantities of Yellow Lily (*Nuphar variegatum*) fruit, which does not occur at GIH. Conversely, Spot-tail Shiners and Wild Celery, which were fairly common in the diets of Painted Turtles at GIH, do not occur at Miller's Marsh.

TABLE 1. Dietary composition of 57 Painted Turtle (*Chrysemys picta*) stomachs from Garden Island Harbor, Michigan.

Item	Frequency of occurrence (% of stomachs that contained an item)	Total mass %
Crustacea		
Decapoda (A)	39 (68.5)	42.840
Amphipoda (A)	4 (7.0)	0.120
Insecta		
Coleoptera		
Gyrinidae (A)	2 (3.5)	0.029
Hydrophilidae (A)	7 (12.3)	0.154
UID beetle (L)	1 (1.8)	0.004
UID beetle (A)	2 (3.5)	0.008
Diptera (L)	3 (5.3)	0.880
Ephemeroptera (A)	2 (3.5)	0.058
Ephemeroptera (L)	4 (7.0)	0.382)
Hemiptera (A)	1 (1.8)	0.025
Odonata		
Anisoptera (L)	2 (3.5)	5.170
Zygoptera (A)	2 (3.5)	0.012
Plecoptera (L)	3 (5.3)	0.129
Tricoptera (A)	1 (1.8)	0.025
Tricoptera (L)	16 (28.1)	3.767
UID insect	2 (3.5)	0.075
Annelida		
Hirundinea	1 (1.8)	0.050
Molluska		
Pulmonata	28 (49.1)	31.165
Vertebrata		
Osteichthyes	12 (21.0)	9.390
UID animal	8 (14.0)	2.884
Plant	25 (43.9)	2.839

* A = adult, L = larva, UID = unidentified

Acknowledgments.—Thanks are extended to J.C. Gillingham and Central Michigan Biological Station for laboratory space and logistic support. The efforts of D. Breen, P. Rowe, and C. Zurenko made data collection possible. Turtles were collected under a permit issued to J. C. Gillingham (Michigan Department of Natural Resources Cultural and Scientific Collectors Permit # CA341) and turtles were handled according to IACUC standards (approval number 02-07) issued by Central Michigan University.

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Habitat of the Bicolor Frog, *Clinotarsus curtipes*, in the Western Ghats, South India

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Understanding species-habitat associations are imperative for wildlife management (Cross and Petersen 2001). Although several causes of global amphibian declines are suggested, habitat modification is implicated in many cases (Daniels 1991; Fisher and Shaffer 1996; Lips 1998, 1999; Richards et al. 1993). Because amphibians show site fidelity and have limited dispersal capabilities, forest fragmentation and modification could effectively disrupt their population structures (Marsh and Pearman 1997; Osawa and Katsuno 2001) and cause local extinctions of species (Blaustein et al. 1994). For example, frogs belonging to the genus *Leptodactylus* have been reported to be more abundant in larger patches of forest than in smaller patches (Marsh and Pearman 1997). In particular, amphibian populations relying on forest microhabitat features might undergo rapid decline because of disturbances.

Because of the rapid conversion of Indian forests to plantations, the status of Indian forest amphibians is of concern (Daniels 2003; Reddy et al. 2002). In south India, forest practices have modified the once contiguous forests of the Western Ghats into fragments resulting in isolation of habitats, disrupted microhabitat and altered vegetation structure. However, information on Indian amphibians is sparse (Oommen et al. 2000). Among Indian frogs, Bull Frog (*Hoplobatrachus tigerinus*) populations appear to have declined from paddy fields (pers. obs.). This might be due in part to the export of frog legs (now banned) and the application of insecticides and pesticides used in rice cultivation (Mohanthy-Hejmadi and Dutta 1981). Reports have indicated a threat by habitat fragmentation to torrent frogs of the genera *Nyctibatrachus* and *Melanobatrachus* (Gupta 1998). Surveys in modified habitats have recorded complete absence of several species of the genus *Micrixalus*, although they are present in the adjoining forest habitats (Daniels 2003; Krishna et al. 2005). The disturbed sites of Kudremukh National Park in the central Western Ghats have shown a 50% reduction in amphibian species richness when compared to undisturbed forest sites (Krishnamurthy and Hussain 2004).

We examined forest habitat associations of the Bicolor Frog, *Clinotarsus curtipes* (Ranidae, Hyloraninae) in three habitat types: native forest, coffee and cardamom plantations. This frog breeds in streams and ponds with tadpoles occupying aquatic habitats for over a year, after which frogs inhabit the litter and rock crevices in forest floors of the Western Ghats, South India (Daniel 2002). Our results provide insights to the potential effects of native forest conversion to plantation on this species.

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All members of the SSAR are entitled to vote by mail ballot for Society officers, which allows overseas members to participate in determining the Society's activities; also, many international members attend the annual meetings and serve on editorial boards and committees.

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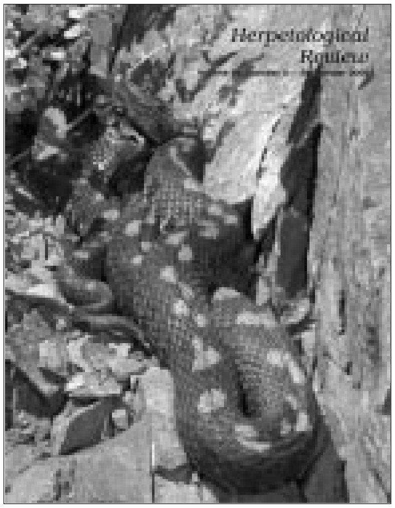
Future Annual Meetings

2006 — Site pending, 12–17 July (with ASIH, HL)
2007 — Saint Louis, Missouri (with ASIH, HL)

About Our Cover: *Vipera raddei*

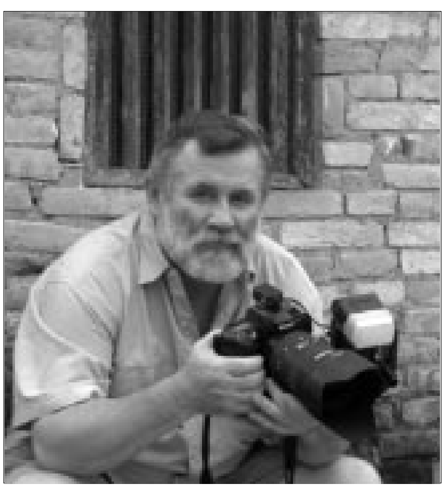


The *Vipera xanthina* complex comprises eight species according to recent treatments (Nilson et al. 1999; Kaupia. Darmstädter Beiträge zur Naturgeschichte, Heft 8, 1999:99–102; Ananjeva et al. 2004. Colored Atlas of Reptiles of the North Eurasia: Taxonomic Diversity, Distribution, Conservation Status. St. Petersburg, 2004: 230 pp.) allocated to the subgenus *Montivipera*: *xanthina, bornmuelleri, bulgardaghica, albizona, wagneri, raddei, albicornuta,* and *latifii*. The Armenian Viper, *Vipera (Montivipera) raddei raddei* Boettger, 1890 is distributed in the southern regions of Armenia and Nakhichevan (Azerbaijan) as well as in adjacent regions of Turkey and Iran. *V. r. kurdistanica* Nilson & Andrén, 1986, is known from northeastern Iran to Lake Urmia.

The cover image depicts *V. raddei*, a rare, narrowly endemic and declining species included in the Red Lists of Armenia (1987) and the former USSR (1984) (see Jeff Ettling's article in this issue [p. 231] of *Herpetological Review* describing current conservation-oriented field research on this species). It occurs at elevations of 1000 to 2700 m in xerophytic montane associations, in particular oak forests and open juniper woodlands, favoring rocky slopes with sparse brush cover. The distribution pattern in the southern spur ranges of the Lesser Caucasus reflects the mosaic of suitable habitats in this region.

The cover photo was taken by **Nikolai L. Orlov**, who found and photographed the basking snake in situ in the morning among rock outcrops, 2300 m elevation, in the Megri District of southern Armenia. This population, first discovered in 2004, is associated with a rocky subalpine meadow. The snakes here appear to differ from those elsewhere by their darker coloration. Orlov used a tripod-mounted Fujifilm FinePix S2 Pro digital camera, with a Nikkor 60mm f2.8 macro lens, capturing the image using available light.

Orlov, who has authored more than 160 publications, is a senior research scientist in the Department of Herpetology, Zoological Institute, Russian Academy of Sciences (Saint Petersburg, Russia; http://www.zin.ru/labs/herplab/index.html). His interests focus on the herpetofauna of Palearctic and Oriental Asia: biodiversity, biogeography, ecology, taxonomy, phylogeny, conservation, and captive breeding.



SSAR BUSINESS

Seibert Award Winners for 2005 Announced

The 14th annual Seibert Awards were presented at the 48th Annual Meeting of the SSAR in Tampa, Florida, 5–12 July 2005. These awards are named in honor of Henri C. Seibert, an early and tireless supporter of SSAR (having served as an officer for over 20 years). In recognition of outstanding student presentations at the annual meeting, a single award was given in each of the following categories: Physiology/Morphology (5 eligible presentations), Evolution/Systematics (5 eligible presentations), Ecology (16 eligible presentations), and Conservation (9 eligible presentations). All four awardees will receive a check for US $200 and a book from Chuck Crumly at the University of California Press.

The Winners—Physiology/Morphology: **Diana Andres**, Rod Mackie, Steve Secor, and Bobby Espinoza, Cal State University, Northridge; University of Illinois, Urbana-Champaign; University of Alabama, Tuscaloosa, "The grass *is* greener: Costs of diet switching may inhibit insect eating by herbivorous reptiles." Ecology: **Deborah Hutchinson**, Frank Schroeder, Alan Savitzky, Akira Mori, Jerrold Meinwald, and Gordon Burghardt, Old Dominion University; Cornell University; Kyoto University; University of Tennesee, "Chemical evidence for sequestration of defensive toxins in the Asian snake *Rhabdophis tigrinus* (Colubridae: Natricinae)." Conservation: **Kristen Bell** and Maureen Donnelly, Florida International University, "Influence of forest fragmentation on community structure of frogs and lizards in lowland Costa Rica." Evolution/Systematics: **Daniel Moen**, Stony Brook University, "Cope's Rule in cryptodiran turtles: Do extant species reflect a trend of phyletic size increase?"

Honorable Mention—Physiology/Morphology: **Sean Graham**, Matthew Grober, and Gordon Schuett, Georgia State University, "Seasonal timing of the mating period in cottonmouths (*Agkistrodon piscivorus*): Evidence from sex steroids, urogenital tract histology, and male sexual behavior." Ecology: **Michael Benard**, University of California, Davis, "Survival trade-offs between two predator-induced phenotypes in Pacific treefrogs (*Pseudacris regilla*)." Conservation: **Brian Todd**, Betsie Rothermal, and Whit Gibbons, Savannah River Ecology Lab, "Forest clearing reduces growth and survival of recently metamorphosed southern toads (*Bufo terrestris*)." Evolution/Systematics: **Tom Devitt**, University of California, Berkeley, "Phylogeography of a ring species: The *Ensatina eschscholtzii* complex revisited."

The judges were Chuck Crumly (University of California Press), Bobby Espinoza (California State University, Northridge), David Hardy, Sr. (Tucson, AZ), Kirsten Nicholson (Washington University), Charles Peterson (The College of New Jersey), Marion Preest (The Claremont Colleges), and Stephen Richter (Eastern Kentucky University).

Grants-in-Herpetology: Annual Report (2005)

An award in the amount of US $500 was made to each of the

following individuals:

Conservation.—**Jodi Rowley**, James Cook University. Project title: "Uncovering the secret lives of frogs. Why some frogs are declining from a fatal disease and others are doing just fine."

Field Research.—**Dean A. Croshaw**, University of New Orleans/Savannah River Ecology Laboratory. Project title: "Polyandry in *Ambystoma talpoideum* and its consequences for individuals and populations."

Laboratory Research.—**Sean Graham**, Georgia State University. Project title: "Endocrine regulation of the mating season in cottonmouths (*Agkistrodon piscivorus*): Evidence from sex steroids, urogenital tract histology, and male sexual behavior."

Herpetological Education.—**David Wojnowski**, Kent State University. Project title: "Project SAVE (Saving Africa's Vital Ecosystems)."

Travel.—**Juan M. Guayasamin**, University of Kansas. Project title: "Phylogenetic relationships of Glass Frogs (Anura: Centrolenidae)."

International.—**Jennifer Germano**, University of Otago, New Zealand. Project title: "How do homing capabilities affect the success of translocations of *Leiopelma pakeka*?"

Bibliograhic Research.—**Keith A. Metzger**, State University of New York-Stony Brook. Project Title: "A comprehensive literature survey of lepidosaur diets."

2005 Grants-in-Herpetology Committee.—Chair: Erik R. Wild. Reviewers: Jeffrey Parmelee, Tiffany M. Doan, Craig E. Nelson, Kirsten Nicholson.

SSAR congratulates the 2005 GIH recipients and thanks the committee members for their efforts.

Grants-in-Herpetology 2006 Proposals

Proposals are now being accepted for the 2006 SSAR Grants-in-Herpetology Program. This program is intended to provide financial support for deserving individuals or organizations involved in herpetological research, education, or conservation. Application deadline is 31 December 2005. Grant application details are available at:

<http://www.ssarherps.org/pages/GIH.html>

NEWSNOTES

Florida Turtle Conservation Trust Launches New Website (www.ftct.org)

The Florida Turtle Conservation Trust (FTCT) was formed in 1999 by a group of Florida biologists and conservationists concerned with the conservation outlook for Florida turtles. Our purpose is to promote the conservation of all Florida turtle species and the preservation of intact, free-ranging populations and their associated ecosystems throughout the state of Florida. The FTCT is committed to and supports education, conservation, research, and management efforts with the above goals in mind.

Florida is home to over 8% of the world's known turtle species and is a significant area for both turtle diversity and habitat. Twenty-five of the 54 turtle species found in the United States also occur in Florida. They are represented in upland communities, such as scrub and sandhill, in rivers, lakes, swamps, and even coastal habitats, such as salt marsh, mangrove communities and marine systems. Certainly, habitat diversity and species richness makes Florida a chelonian hotspot.

The FTCT focuses its efforts on the conservation of non-marine species. This work is accomplished independently or in partnership with agencies and other non-governmental organizations. To date, the FTCT has:

- organized and co-sponsored a symposium on the status and conservation of Florida turtles;

- co-sponsored a national workshop on the ecology, status and conservation of diamondback terrapins;

- initiated the development of both a national and Florida Diamondback Terrapin Working Group;

- partnered with the Gopher Tortoise Council on a project that distributed an educational book to nearly 3,000 elementary school libraries throughout the range of the gopher tortoise;

- partnered with the Gopher Tortoise Council on a project that distributed an educational slide/PowerPoint presentation and supplemental resource notebook to educators throughout the range of the gopher tortoise;

- co-developed and funded the Pinellas County School District's Florida turtle track pack;

- organized Florida turtle educational exhibits at nature festivals and environmental events;

- and assisted the Florida Fish and Wildlife Conservation Commission with the development of a diamondback terrapin educational poster and exhibit.

Members of the FTCT include biologists, land managers, agency representatives, environmental consultants, educators, conservationists, and concerned citizens. In addition to supporting conservation work, members receive discounts on meeting registration fees and opportunities to attend organized field trips. For more information please visit www.ftct.org.

MEETINGS

Meetings Calendar

Meeting announcement information should be sent directly to the Editor (rwh13@csufresno.edu) well in advance of the event.

7–9 October 2005—Gopher Tortoise Council Annual Meeting, Palatka, Florida, USA. Information: www.gophertortoisecouncil.org.

21–23 October 2005—Snakebites in the New Millennium Symposium, University of Nebraska Medical Center, Omaha, Nebraska, USA. Information: http://app1.unmc.edu/cce/snakebites/

5–6 November 2005—Kansas Herpetological Society Annual Meeting, Pittsburg State University, Pittsburg, Kansas, USA. Information: http://www.ku.edu/~khs/AnnualMeetingInfo.html.

31 March–2 April 2006—Symposium—Conservation and Herpetology: The Middle American Connection. Miami-Dade College, Miami, Florida, USA. Information available from Larry David Wilson, organizer, by e-mail: lwilson@mdc.edu. See additional information on p. 352 of this issue.

CURRENT RESEARCH

The purpose of **Current Research** is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, **María del Rosario Castañeda** or **Michele Johnson**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can be found at: http://www.herplit.com/contents.

Comparative Analysis Of Morphological Characters Associated With Arboreality And Orthinophagy In Snakes

Several morphological characters are correlated with diet and habitat use. In snakes, gape size and relative head length are correlated with maximum prey size, while arboreal habits are associated with tail length, body size and heart position. The insular endemic pitvipers *Bothrops insularis* (SE Brazil) and *Gloydius shedaoensis* (NE China) are under similar selective pressures not shared by their mainland closest relatives. On islands, adults of both species have an almost exclusively avian diet (while mainland species feed on mammals), and show an increase in arboreality relative to mainland relatives. The authors compared morphological characters associated with dietary habits and arboreality between mainland and insular *Bothrops* and *Gloydius* species and assessed phylogenetic relationships between *B. insularis* and mainland species. Results show that both *B. insularis* and *G. shedaoensis* have significantly longer heads and smaller litter sizes than mainland relatives. However, body size, tail and fang length, and heart position only differ between *B. insularis* and mainland relatives. The authors suggest caution, in the absence of multiple studies on single species, when interpreting character changes related with shifts in selective pressures.

Wüster, W., M. R. Duarte, and M. D. G. Salomão. 2005. Morphological correlates of incipient arboreality and ornithophagy in island pitvipers, and the phylogenetic position of *Bothrops insularis*. Journal of the Zoological Society of London 266:1–10.

Correspondence to: Wolfgang Wüster, School of Biological Sciences, University of Wales, Bangor LL57 2UW, Wales, United Kingdom; e-mail: w.wuster@bangor.ac.uk.

Comparison of Flying Performance in *Draco* Lizards

Previous studies on flying lizards of the genus *Draco* found an isometric relationship between wing area and body mass, even though there is significant intraspecific variation in body size. Based on this isometric pattern and on aerodynamic theory, the authors hypothesized that smaller species would perform better at gliding than larger species. Within the genus, larger body size has evolved independently several times, with larger species occurring in lineages found in sympatry with other *Draco* species. Additionally, none of the single-species communities is composed of a large-bodied species. The authors' objective was to establish a possible association between body size and locomotor performance evolution. To test for gliding performance, trials were conducted using separate takeoff and landing poles of known height and distance from each other. Maximum velocity (adjusted for wind velocity and direction), total height lost during the glide, and total glide angle were estimated based on trial videos. Data was collected for 11 species covering the range of body sizes in the genus and independent contrasts were calculated to correct for phylogenetic autocorrelation. Results agree with the predictions: smaller species have higher velocity, lose less altitude and have smaller angles during glides. Furthermore, results support gliding performance in *Draco* lizards can be estimated from morphological data alone. The authors discuss the ecological implications of larger size and its apparent fitness cost overcome only in the presence of other flying lizards.

McGuire, J. A., and R. Dudley. 2005. The cost of living large: comparative gliding performance in flying lizards (Agamidae: *Draco*). The American Naturalist 166:93–106.

Correspondence to: Jimmy A. McGuire, Museum of Vertebrate Zoology, University of California, Berkeley, California 94720, USA; e-mail: mcguirej@socrates.berkeley.edu.

Sea-Level Rise Impact On Turtle Nesting Habitat

One of the inevitable consequences of global warming is an increase in sea-level. To estimate the impact on turtle nesting habitat, the authors measured individual beach profiles and developed elevation models using geographic information systems. Fieldwork was done in Bonaire, Netherlands Antilles, where four species of turtles nest: *Eretmochelys imbricata, Caretta caretta, Chelonia mydas*, and *Dermochelys coriacea*. Data on potential turtle nesting sites collected from 1993 to 2000 was used to estimate relative nesting use of different beaches. Three different sea-level rise scenarios were considered: 0.2, 0.5 and 0.9 m, which represent the full range of potential sea-level rise estimated by the Intergovernmental Panel on Climate Change (2001). Associations between physical characteristics (length, width, slope, elevation, aspect, and land use behind the beach), nesting activity and flooding vulnerability were estimated. Potential nesting area was estimated based on the preferred elevation range for *E. imbricata* and *C. caretta.* Results show that nesting activity was correlated with beach slope, with steeper beaches more frequently used. Based on

the models, 14% of the total beach would be lost to inundation with a 0.2 m sea-level increase; 31% and 50% would be lost with 0.5 and 0.9 m rises, respectively. No relationship was found between nesting activity and vulnerability, or between nesting activity and land use behind the beach. With a 0.2 m sea-level rise, preferred nesting areas for *E. imbricata* and *C. caretta* would decrease 11%; the decrease would be 41% and 21% with a 0.5 and 0.9 m sea-level rise respectively. Even though it is difficult to anticipate the effect of sea-level rise on turtle nesting habitat and to predict female response to the rise, estimations that allow identification of vulnerable areas are necessary for future coastal management decisions.

FISH, M. R., I. M. CÔTÉ, J. A. GILL, A. P. JONES, S. RENSHOFF, AND A. R. WATKINSON. 2005. Predicting the impact of sea-level rise on Caribbean sea turtle nesting habitat. Conservation Biology 19:482–491.

Correspondence to: Isabelle M. Côté, School of Biological Sciences, University of East Anglia, Norwich NR4 7TJ, United Kindom; e-mail: i.cote@uea.ac.uk.

Effects of Early Evolutionary History in Present-Day Ecology

Two main theories on the origin of ecological traits have been proposed: 1) the 'deep history hypothesis,' which states that differences in ecological traits among species arose early in the evolutionary history of clades and that present day assemblages are based on those preexisting differences, and 2) the 'competition hypothesis,' which argues that niche differentiation occurred in relatively recent ecological time, resulting from shifts in prey availability, competition, or dietary preferences. The authors combined phylogenetic and ecological data to reconstruct the evolution of dietary shifts in squamates and test two predictions consistent with the 'deep history hypothesis': 1) the presence of a strong relationship between diet and phylogeny and 2) the ability to identify nodes in which dietary shifts have occurred. One hundred and eighty-four species, of 12 families, were included in the analysis. Two phylogenetic hypotheses were considered, a composite tree reflecting the traditional view and a recently proposed alternative (Townsend et al. 2004). Canonical correspondence analysis was used to measure the association between dietary composition and phylogeny, and to identify points of diet divergence in squamates. Results show a strong relationship between diet and evolutionary history, and significant dietary shifts in Iguania/Scleroglossa, Agamidae/Iguanidae, Scincidae, Varanidae, Gymnophthalmidae, and Teiidae. Results also suggest deep history has played an important role in lizard diet specification and could account for the actual niche partitioning in communities of non-closely related species. However, authors also point out that although present-day differences have 'ancient roots', current interspecific interactions still have a strong influence on present assemblages. Traits associated with dietary and other ecological shifts in squamates are also discussed.

VITT, L. J., AND E. R. PIANKA. 2005. Deep history impacts present-day ecology and biodiversity. Proceeding of the National Academy of Science 102:7877–7881.

Correspondence to: Laurie J. Vitt, Sam Noble Oklahoma Museum of Natural History and Zoology Department, University of Oklahoma, Norman, Oklahoma 73072, USA; e-mail: vitt@ou.edu.

Colonization Patterns of Beta *Anolis* (*Norops*) Lizards

The lizard genus *Anolis* is distributed from southeastern North America, to tropical South America, including Central America and the West Indies. The traditional view suggests that West Indian species represent over-water dispersal from a mainland ancestor with subsequent inter-island colonizations. The focus of this study is the highly diverse mainland clade *Norops* (or Beta section), which recent analyses have suggested is derived from a West Indian ancestor. Highly successful island-to-mainland colonizations are particularly rare. The authors included mitochondrial ND2 (189 spp., *Norops* and non-*Norops*), and nuclear ITS-1 (51 spp., *Norops*) sequences. Phylogenetic analysis included parsimony and Bayesian methods. The ancestral state reconstruction (mainland or West Indian) was performed on the mitochondrial-only tree, using a Bayesian tree-sampling technique (Pagel and Lutzoni 2002). Additionally, Wilcoxon signed-ranks and Shimodaira-Hasegawa tests were performed to test alternative relationships within the *Norops* clade. A West Indian *Norops* ancestor was reconstructed in all trees, as well as a mainland ancestor in the node that leads to all mainland species. The combined analysis (ND2 and ITS-1) of *Norops* reconstructs three geographically circumscribed clades: Cuba, Jamaica, and Mainland. The Jamaica and Mainland clades are recovered as sister taxa, to the exclusion of the Cuban clade, supporting the hypothesis of mainland *Norops* being nested within a West Indian group. Alternative reconstructions were rejected by the Shimondaira-Hasegawa test but not by the Wilcoxon signed-ranks test. The authors discuss alternative scenarios, and particular characteristics of West Indian *Anolis* communities that might have promoted this successful island-to-mainland colonization.

NICHOLSON, K. E., R. E. GLOR, J. J. KOLBE, A. LARSON, S. B. HEDGES, AND J. B. LOSOS. 2005. Mainland colonization by island lizards. Journal of Biogeography 32:929–938.

Correspondence to: Kirsten E. Nicholson, Department of Biology, Campus Box 1137, Washington University, St Louis, Missouri 63130-4899, USA; e-mail: knicholson@biology2.wustl.edu.

Effects of Inactivity in Skeletal Motor Nerve Terminals in *Cyclorana alboguttata*

The authors studied the effects of prolonged inactivity associated with aestivation on neuromuscular transmission in the burrowing frog *Cyclorana alboguttata*. This species lives in semi-arid environments and is active for short periods of time after heavy precipitation. Between active periods, frogs burrow underground and experience a metabolic depression. To measure the effects of inactivity, the authors compared the structure and function of neuromuscular junctions on the iliofibularis muscle between active individuals and individuals that had been aestivating for 6 months. Structure variables included number, shape and length of primary, secondary and tertiary neuron branches. Function measurements included end-plate potentials (EPPs), miniature end-plate potentials (MEPPs), and resting membrane potential (RMP). EPPs and MEPPs were used to calculate quantal content (number of acetyl-

choline vesicles released per synapse by the nerve), quantal size (response of the muscle to the spontaneous release of a single synaptic vesicle), mean probability of transmitter release and number of active release sites. No significant differences were found between active and aestivator individuals in terminal structure, RMP or MEPPs. However, in the aestivating group the mean amplitude of induced EPPs significantly decreased and the proportion of nerve stimulations that failed to induce an EPP significantly increased. Quantal content was significantly higher in active frogs; in aestivating frogs there was a significant reduction in the probability of transmitter release and in the number of active release sites. Comparisons with previous studies on anurans and mammals are presented. In addition, characteristics of *C. alboguttata* physiology of aestivation and potential mechanisms of nerve preservation are discussed.

HUDSON, N. J., N. A. LAVIDIS, P. T. CHOY, AND C. E. FRANKLIN. 2005. Effect of prolonged inactivity on skeletal motor nerve terminals during aestivation in the burrowing frog, *Cyclorana alboguttata*. Journal of Comparative Physiology A 191:373–379.

Correspondence to: Craig E. Franklin, School of Life Sciences, The University of Queensland, QLD, Brisbane, 4072, Australia; e-mail: c.franklin@uq.edu.au.

Foraging Mode of *Bradypodion pumilum* and the Foraging Mode Dichotomy

Two foraging strategies, sit-and-wait and active, have been well accepted in lizard ecology. Other life history characteristics (e.g., type of prey, home range size, clutch size, daily energy expenditure) are associated with foraging mode, making the distinction a useful organizing concept. Due to the taxonomic bias and small taxon sampling, recent studies have questioned the validity of this partition. The author studied time budget and foraging mode in the chameleon *Bradypodion pumilum*, which represents a highly derived taxon difficult to classify, since it possesses traits that belong to each of the foraging modes. Association between levels of activity and sex, age, time of day and ambient temperature were assessed and lag-sequential analysis was applied to test for nonrandom association between foraging behavior and behaviors preceding it. In addition, the author presents an interspecific analysis of foraging mode using discriminant function analysis (DFA) on number of movements per minute (MPM) and percent time moving (%TM) data from the literature. The resulting discriminant function classified *B. pumilum* as an active forager. DFA results support the traditional cutoff values for classification of foraging modes (sit-and-wait foragers %TM < 15 and MPM < 1.0). Finally, the author comments on the intraspecific variability in foraging behavior, the value of the sit-and-wait and active forager dichotomy, and the utility of DFA to support this distinction.

BUTLER, M. A. 2005. Foraging mode of the chameleon, *Bradypodion pumilum*: a challenge to the sit-and-wait versus active forager paradigm? Biological Journal of the Linnean Society 84:797–808.

Correspondence to: Marguerite A. Butler, University of Tennessee, Department of Ecology and Evolutionary Biology, 569 Dabney Hall, Knoxville, Tennessee 37996, USA; e-mail: mabutler@utk.edu.

Evaluating the Impact of Trade on Wild Populations

The increasing trade of amphibians and reptiles has raised questions of whether this trade is affecting wild populations' survival and if it is contributing to the global amphibian and reptile decline problem. The authors review data on US shipments of amphibians and reptiles from 1998 to 2002 from the United States Fish and Wildlife Service (USFWS) Law Enforcement Management Information System (LEMIS). The authors found that the vast majority of the imported and exported species are for commercial use, including food, pets and traditional medicine, and that more than a million individuals, body parts, and products are shipped across the US borders every year. Most of the shipments are declared as wild caught with a significant amount of the records registered at or above the genus level, that is, with no species-specific information. Additionally, several species might be considered particularly vulnerable when trade volume is compared with biological characteristics and geographic distribution. Species with wide ranges, high densities and high reproductive productivity may be able to tolerate intensive collecting. Although the data do not confirm active unsustainable collection, it does provide information on the large volume of animals taken from the wild, the deficiencies of the LEMIS system, and the necessity for stricter regulations to prevent overcollecting.

SCHLAEPFER, M. A., C. HOOVER, AND C. K. DODD, JR. 2005. Challenges in evaluating the impact of the trade in amphibians and reptiles on wild populations. BioScience 55:256–264.

Correspondence to: Martin A. Schlaepfer, Department of Integrative Biology, Patterson Hall, 1 University Station C0930, University of Texas, Austin, Texas 78712, USA; e-mail: mas50@mail.utexas.edu.

Origins and Phylogenetic Relationships of Lissamphibia

Relationships among living amphibians (Lissamphibia) have been difficult to resolve, in part due to the large gap in time and morphology between fossils and extant forms. As a reflection of this ambiguity, there is still controversy about lissamphibian origins and whether the group is monophyletic. To address these questions, the authors sequenced 8 mitochondrial genomes of living amphibians and combined them with previously published genomes of amphibians (6 spp.) and other vertebrates (6 spp.). Phylogenetic reconstructions were performed using parsimony, maximum likelihood, neighbor-joining and Bayesian analyses. Alternative phylogenetic hypotheses within Lissamphibia were tested using approximately unbiased (AU) and Shimodaira-Hasegawa (SH) tests. Bayesian molecular dating that allows for an estimation independent of a molecular clock was used to calculate divergence times for major groups. Results from all phylogenetic approaches support the monophyly of Lissamphibia and Batrachia (Anura and Caudata). Alternative reconstructions rendering Lissamphibia paraphyletic and Anura and Gymnophiona as sister taxa were rejected by AU and SH tests. However, the Caudata sister to Gymnophiona hypothesis was not rejected. Additionally,

the authors tested the compatibility of their molecular time estimates with fossil time estimates on three alternative hypotheses: Lissamphibia is monophyletic with 1) Temnospondyli as sister group, or 2) Lepospondyli as sister group, and 3) Lissamphibia is not monophyletic, with Gymnophiona related to Microsaura (Lepospondyli), and Batrachia related to Temnospondily. Results support the hypothesis of lissamphibian monophyly with Temnospondyli as sister group. Finally, the potential geographic origins of each group are discussed, considering current distributions, plate tectonics, clade ages, and fossil record.

ZHANG, P., H. ZHOU, Y. Q. CHEN, Y. F. LIU, AND L. H. QU. 2005. Mitogenomic perspectives on the origin and phylogeny of living amphibians. Systematic Biology 54:391–400.

Correspondence to: Liang-Hu Qu, Key Laboratory of Gene Engineering of the Ministry of Education, Biotechnology Research Center, Zhongshan University, Guangzhou 510275, China; e-mail: lsbrc04@zsu.edu.cn.

ZOO VIEW

"Vipers should cover the world like Sherwin-Williams paint."—Joe Laszlo explaining why his viper collection at the San Antonio Zoo was so large.

During the 1980s, one of the finest collections of living true vipers ever assembled was at the San Antonio Zoological Gardens where Jozsef (Joe) Laszlo was curator. Through Joe's efforts, the Zoo became recognized as a place where a number of viperid taxa rarely seen could be appreciated. His contribution to our understanding of the captive management of European vipers was critical. Laszlo was certainly a pioneer in focusing on husbandry issues, and the International Herpetological Symposium (IHS) issues an annual award in his name to a person who significantly contributes to captive management. When he died unexpectedly in 1987, his loss cast an unbelievable gloom in the zoo community; he was truly beloved. Joe was my first herpetological friend to die and I still miss him. See Murphy (1988. Herpetol. Rev. 19:5–6) and Card and Murphy (2000. SSAR Herpetol. Circ. No. 27:1–44) for details of his life and contributions to herpetology.

Joe's office was in the center section of the reptile building. Piles of reprints, correspondence, and handwritten notes littered his desk. To breed vipers, Laszlo was convinced that the interface between temperature and light was important for success. The off-exhibit area being small, he was unable to build a spacious hibernaculum to cool his temperate zone vipers so he installed a soft drink cooler instead to house the animals. Banks of fluorescent lights were suspended everywhere with an array of different bulbs which he was testing. Racks of shoe boxes and terrariums held a bewildering assortment of vipers. Joe was sure to call whenever he acquired any new viper, especially from Europe, and I still remember his excitement and enthusiasm when his first Armenian vipers (*Montivipera raddei*) came to the Zoo.

FIG. 1. Example of human allometric scaling and poor grooming. Joe Laszlo (left) and James Murphy in 1982. Photo courtesy of Bert Langerwerf, modified by David T. Roberts.

Today, Joe would be proud of the advances in our understanding of viperid biology and particularly impressed with the multifaceted program described in the following article by curator Jeff Ettling at the St. Louis Zoo. However, Laszlo would be saddened to discover that the wild population of this beautiful snake in Armenia have declined nearly 90% in approximately twenty years.

New Books and Papers

For captive managers, two new books have surfaced which are useful for ensuring proper sex ratios for the charges in the collection. The first is edited by Nicole Valenzuela and Valentine A. Lance and the title is *Temperature-Dependent Sex Determination in Vertebrates* (2004. Smithsonian Books, Washington DC; ISBN:1-58834-203-4). Lance was a reproductive physiologist at the Center for the Reproduction of Endangered Species (CRES) at the San Diego Zoo for many years. The book is organized into four sections: Prevalence of Temperature-Dependent Sex Determination of Vertebrates; Thermal Effects, Ecology, and Interactions; Evolutionary Considerations; and Conclusions: Missing Links and Future Directions. The second book is *Reptilian Incubation: Environment, Evolution and Behaviour*, edited by D. C. Deeming (2004. Nottingham University Press, Nottingham UK; ISBN:1-897676-11-5).

The Wildlife Conservation Society, headquartered at the Bronx Zoo, has published a book relevant to the Asian chelonian crisis. The authors are Win Maung and Win Ko Ko and the book is *Turtles and Tortoises of Myanmar* (2002. Wildlife Conservation Society, Yangon).

In 1829, Edward Turner Bennett wrote a fascinating book called *The Tower Menagerie: Comprising the Natural History of the Animals Contained in that Establishment, with Anecdotes of Their Characters and History. Illustrated by Portraits of Each, Taken from Life, by William Harvey, and Engraved on Wood by Branston and Wright.* The London Tower Menagerie (1245–1832) was not an ideal facility for reptiles but at various times over a span of nearly 600 years, the anaconda (called *Python Tigris* Var. by Bennett, likely Ceylonese pythons, *Python molurus pimbura*), over 100 rattlesnakes (called *Crotalus horridus*), and the alligator (called *Crocodilus lucius*) lived in the Tower. The Indian boa (called *Python Tigris*) laid a clutch of eggs which did not hatch. An interesting new book about the long history of the Royal Collection of Wild and

FIG. 2. Illustration of American Alligator (*Alligator mississippiensis*) living in Royal Menagery, Tower of London from Robert Huish's "The Wonders of the Animal Kingdom Exhibiting Delineations of the Most Distinguished Wild Animals in the Various Menageries of the Country" in 1830. Alligators and crocodiles are described as follows: "Living, as it were, in the confines of both land and water, these enormous animals extend their dominion equally over the inhabitants of both elements. Here they enjoy an absolute rule, and dread none of the common dangers which assault other less powerful animals." Bennett's specimen was said to be young, measuring not more than three feet in length, did not grow for two years, and was fed raw beef weekly which may be why the head seems abnormally small. Credit: Courtesy of Smithsonian Institution Libraries, Washington, DC.

Ferocious Beasts kept at the Tower Menagerie has been written by Daniel Hahn — *The Tower Menagerie* (2004. Jeremy P. Tarcher/Penguin, New York; ISBN:1-58542-335-1).

Workers with herps may not have considered the opportunity to see play in their animals. Gordon Burghardt has just published a comprehensive book called *The Genesis of Animal Play. Testing the Limits* (2005. MIT Press, Cambridge, Massachusetts; ISBN:0-262-02543-4). There are many references to play behavior in lower vertebrates, including an intriguing observation on possible play in amphibians by Kevin Zippel. Full disclosure: the African cichlid (*Tropheus duboisi*) playing with a submersible thermometer on the dust jacket lived in my home aquarium for many years. Many days I would hear this strange tapping noise and finally realized that the fish was hitting the side of the tank with the thermometer. I was reluctant to mention it to Gordon at first for fear of being labeled a lunatic hearing strange noises.

Jack Frazier has been a Smithsonian Research Associate based at the National Zoo's Conservation and Research Center in Front Royal, Virginia for many years. Jack is a major player in sea turtle conservation. It was gratifying to see that his commitment to their protection has been recognized in a terrific new book by James R. Spotila (*Sea Turtles. A Complete Guide to Their Biology, Behavior, and Conservation*. 2004. The Johns Hopkins University Press, Baltimore and London; ISBN: 0-8018-8007-8, p. 84). In 1997, Jack published a paper which is relevant to zoo biologists ("Sustainable development: modern elixir or sack dress?" Environ. Conserv. 24:182–193). The five central arguments of this paper are: (1) the expression has tremendous popularity and the term "sustainable" has appeared in countless contexts for decades; (2) although it is undefined, the term "sustainable development" is often used in so-called scientific discourse; (3) from the context in which it is used it routinely refers to continual growth (like cancer); (4) a major danger in its persistent use is that people who should be considering the concept carefully, consent its use in order to have social recognition and access to grants, etc.; (5) an attempt to attain continual growth cannot be consistent with biological conservation, whether considered as biological diversity or as ecological services.

Hans-Werner Herrmann, former herpetological curator at the Cologne Zoo and researcher with CRES, has published two papers in 2004: "A new frog species of the genus *Cardioglossa* from the Tchabal Mbabo Mtns, Cameroon (Anura: Arthroleptidae)" [Herpetozoa 17:119–125]; "Anuran habitat selection and temporal partitioning in a montane and submontane rainforest in Southwestern Cameroon—first results" [Salamandra 40:239–260].

In my last column (see p. 102), I noted the availability on CD of several Powerpoint presentations concerning herpetology. In order to simplify the acquisition of these programs, the permissions officer at Smithsonian Intitution Libraries has agreed that recipients can keep them permanently rather than having to return them as I communicated earlier.

—James B. Murphy, Section Editor

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Saint Louis Zoo Wildcare Institute: Center for Conservation of Near East Mountain Vipers

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Over the past decade, the Saint Louis Zoo has focused its efforts on the captive management and reproduction of mountain vipers, *Montivipera*, of the Near East. With a vested history in this snake complex, the Zoo found value in focusing its conservation efforts on a group largely ignored by other zoological institutions. The Zoo's studies of captive vipers have already provided useful information on reproduction and behavior (Ettling 1996; Ettling and Marfisi 2002).

In May 2004 the Saint Louis Zoo officially announced its new Conservation Division, the Wildcare Institute. Under the umbrella of the Institute are 12 Conservation Centers that focus on endangered species and their habitats. The goal of the Institute is to work through partnerships to help animals, ecosystems and people simultaneously. The key to the success of the Wildcare Institute will be collaboration with universities, government agencies, conservation organizations, field researchers and other zoos. The Center for Conservation of Near East Mountain Vipers will focus on helping implement conservation management and public education to ensure the future of mountain vipers in the wild.

The *Montivipera xanthina* complex is comprised of eight species with a distribution that includes southeastern Europe, Asia Minor, Armenia, and western Asia. Our limited knowledge of their natural history is due in part to restricted and isolated rocky habitats (Nilson and Andrén 1986). Over the past 20 years the combination of habitat alteration, over-collection, and unnaturally high

FIG. 1. Surgical implantation of transmitter. Individuals in photo are as follows: Alexander Malkhasyan (left), Jeff Ettling (center), Aram Agasyan (right rear), and Andy Snider (right front).

FIG. 2. Jeff Ettling demonstrating the use of radiotelemetry equipment.

mortality resulting from human persecution has drastically reduced many mountain viper populations (Nilson and Andrén 2000). In fact, five of the eight species are now listed by the IUCN as vulnerable, endangered, or critical. Unless proper equipment, public education, and human resources necessary for conducting basic conservation activities are allocated, this complex of snakes faces an uncertain future.

In June 2004 the first long-term project of the Center for Conservation of Near East Mountain Vipers was initiated. The species targeted for the inaugural study was the Armenian viper, *Montivipera raddei*. The population numbers of *M. raddei* have dropped a staggering 88% over the past 20 years, primarily because of habitat alteration and over-collection. As a result it is listed as a species of concern in Armenia's National Red Data Book. For effective conservation of *M. raddei*, as well as other species, it will be necessary to establish a network of nature reserves. With little data available on home range size and demography, it is difficult to make sound management decisions at the current time.

The project is a collaborative effort that involves individuals from five institutions: Jeff Ettling (Saint Louis Zoo), Andy Snider (Detroit Zoological Institute), Dr. Nikolai Orlov, Dr. Natalia Ananjeva, and Roman Khalikov (Russian Academy of Sciences), Dr. Aram Agasyan and Alexander Malkhasyan (Armenia Ministry of Nature Protection), and Konstantin Shiryaev (Tula Exotarium, Russia).

The study is utilizing radio-telemetry and mark/recapture to determine the home range size, seasonal activity patterns, habitat preferences, and demography of *M. raddei*. Our selected study site is in Khosrov Nature Reserve, considered one of the most important protected areas in Armenia because of its unique plant and animal communities. Over 50% of all Armenian plants and 171 animal species (60 endemic species) are represented in the Reserve. To date, six vipers have been implanted with radio transmitters. An additional four snakes were planned to be implanted with transmitters in May 2005. The movement patterns and habitat preferences of these snakes will be monitored for a period of five years. In addition to the specimens with transmitters, all *M. raddei* that are captured within the study site are sexed, weighed, measured, and permanently marked for future identification with subcutaneous implanted passive transponders.

Although the radio-telemetry study will provide the fundamental information necessary for development of conservation management guidelines for *M. raddei*, it must also be accompanied by a strong educational component. With assistance from the Zoo's education staff, a poster and brochure currently are being developed. The field team will use these materials in outreach programs in rural communities and with pastoral farmers who often encounter the snakes. Future plans include a workshop for teachers in Armenia that will provide them with curricula on ecosystems, conservation, and the plight of the Armenian viper. It will also be important to provide training for future educators. A family in St. Louis, Missouri, interested in assisting our project, has offered to sponsor an Armenian exchange student who will be pursuing a career in environmental education. A search is currently underway and a student should be in place in 2006.

Through the combination of ecological fieldwork, development of management guidelines, and an intensive outreach education program, our goal is to establish a secure future for *M. raddei* in Armenia. In addition to continuing our work in Armenia, the Center for Conservation of Near East Mountain Vipers plans to pursue other collaborative projects involving the other seven species of mountain vipers.

Questions regarding the Armenian Viper Project or Center for Conservation of Near East Mountain Vipers should be directed to Jeff Ettling (e-mail: ettling@stlzoo.org). Further information about the Wildcare Institute and/or its Conservation Centers is available from the Saint Louis Zoo's website (www.stlzoo.org).

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LETTERS TO THE EDITOR

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Aspidoscelis Versus *Cnemidophorus* as a Genus of Whiptail Lizards in North America

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A recent announcement of Publications Received [Anonymous, 2004. Herpetol. Rev. 35:205] mentioned that Axtell (2003) "... retains usage of *Cnemidophorus sensu lato*, treating *Aspidoscelis* as a subgenus (by extension, *Ameiva* and *Kentropyx* are also regarded as subgenera)..." This raised the questions of what evidence Axtell used and what generic name(s) he intended to use for the subgenera *Ameiva* and *Kentropyx*. We obtained a copy of Axtell (2003) from the author and here we review this matter further.

Axtell (2003:1) reviews aspects of the biology of "*Cnemidophorus* (*Aspidoscelis*) *exsanguis* Lowe" in Texas, with emphasis on distribution. He presents no new evidence bearing on the question of which generic name is appropriate for this taxon, or other species of North American whiptail lizards, nor does he present evidence contradictory to the conclusions of Reeder et al. (2002). Instead, he rebuffs these conclusions with the following two sentences: "In this account I have treated *Aspidoscelis* as a subgenus of *Cnemidophorus*, rather than changing that name with its over 200 year nomenclatural history. With this action, I realize that both *Ameiva* and *Kentropyx* would also be reduced to subgeneric rank, but with the molecular data indicating paraphyly among these two groups (Reeder et al. 2002), this may [be] the best option until more is known" (Axtell 2003:9). This is not only a rejection of certain well-supported conclusions of Reeder et al. (2002) in the absence of new data, but it is also a misunderstanding of their comments. In addition, Axtell does not explicitly indicate what generic name he would apply to the subgenera *Ameiva* and *Kentropyx* that he mentions. His writing implicitly suggests that these taxa would represent additional subgenera of *Cnemidophorus*. While this alternate strategy is generally consistent with the phylogeny, such a taxonomic decision would violate Article 23 (principle of priority) of the International Code of Zoological Nomenclature (1999). We write to clarify the situation and restate our conclusion that *Aspidoscelis* is the most appropriate generic name for the North American whiptail lizards.

Reeder et al. (2002) presented an extensive phylogenetic analysis of 39 taxa of teiine macroteiid lizards (representing "*Ameiva*," "*Cnemidophorus*," *Dicrodon*, *Kentropyx*, and *Teius*), using several teiid and non-teiid outgroups. Phylogenetic trees were generated on the basis of combined mitochondrial DNA sequence data, allozyme data, and morphology, then compared *a posteriori* with karyotypic data for consistency. While various parts of the phylogenies generated had differing levels of support indicating that more research is needed to resolve the relationships among teiines, one aspect of the analyses was clear: the genera *Ameiva* and *Cnemidophorus sensu lato* are paraphyletic.

The South American species in the *Cnemidophorus lemniscatus sensu stricto* species group, containing the type species of the genus, were strongly supported as a clade, with this group being more closely related to *Kentropyx* and most species of *Ameiva* than to the whiptail lizards of North America (Reeder et al. 2002). However, all of the North American species analyzed in the *deppii*, *tigris*, and *sexlineatus* species groups of *Cnemidophorus sensu lato* (and by extension the *cozumela* and *tesselata* species groups) comprised a strongly supported monophyletic group that appears to be distantly related to most of the Neotropical taxa (Reeder et al. 2002).

This left Reeder et al. (2002) with various options to consider with respect to taxonomic changes: (1) suggest no changes in taxonomy, and therefore not even recognize the strongly supported North American clade as a distinct lineage; (2) recognize as a genus the strongly supported clade, but, for stability, make no other changes until the phylogenetic history of the other groups is clarified by future research; or (3) address the widespread paraphyly by combining all species of *Ameiva*, *Cnemidophorus*, and *Kentropyx* into one genus, perhaps applying subgenera in an attempt to preserve some taxonomic stability within this complex and large clade, but in which case, the oldest name would be the generic name *Ameiva* Meyer 1795. Given the strong support for the clade of North American taxa and the remaining levels of uncertainty requiring more research, we chose the second alternative as being a conservative way to apply nomenclature. Placing all species of *Kentropyx* and *Cnemidophorus* into the genus *Ameiva* would be a provisional resolution at best and would obscure the phylogenetic history already retrieved, as would suggesting no taxonomic changes.

Reeder et al. (2002) did not enjoy changing long established names; we prefer nomenclatural stability but require that it be consistent with phylogeny. We made one change of a generic name, thereby adopting the most conservative approach that is consistent with the evidence and based on a philosophy of phylogenetic systematics. This is the same reasoning used in recognizing that snakes and lizards are members of Squamata, although many decades ago this required shifting Serpentes out of Vermes. Change often is the cost of advancing knowledge. The use of *Aspidoscelis* Fitzinger 1843 as the genus for the North American whiptails was not a matter of personal choice. Following Article 23 of the International Code of Zoological Nomenclature (1999), Reeder et al. (2002) used the oldest name available within the synonymy of *Cnemidophorus*.

We note that Axtell (2003) has apparently adopted a nomenclatural approach akin to our option 3 above. Though not explicit, it appears that Axtell (2003) is advocating recognition of several subgenera within an expanded genus *Cnemidophorus*. He explicitly places *Aspidoscelis* as a subgenus of the genus *Cnemidophorus* and implies that *Ameiva* and *Kentropyx* would also be subgenera of *Cnemidophorus*. Axtell does not mention the South American taxa of the *Cnemidophorus lemniscatus* species group (*sensu lato*),

but his recognition of *Aspidoscelis* as a subgenus implies that he would treat the taxa of the *C. lemniscatus* species group as members of a subgenus *Cnemidophorus*. If this is what Axtell is recommending, we note that this would be in violation of Article 23 of the International Code of Zoological Nomenclature (1999), as *Ameiva* would have priority over *Cnemidophorus* as the generic name.

If we have inaccurately assumed Axtell's (2003) intended new subgeneric classification mentioned above, then there are only two other options he might be advocating. The first would be for *Ameiva* and *Kentropyx* to be subgenera within either an expanded genus *Ameiva* (oldest available name) or an expanded genus *Kentropyx*. In both cases, phylogenetic principles would be violated as the species of the subgenus *Kentropyx* (whether considered to be in the genus *Ameiva* or *Kentropyx*) are more closely related to members of the genus *Cnemidophorus* (members of the *C. lemniscatus* species group *sensu stricto* of South America) than to species of *Ameiva*. Alternatively, Axtell (2003) could be recommending the recognition of *Ameiva* and *Kentropyx* as separate genera, each with a single nominate subgenus. If so, not only would this complicate the nomenclatural situation with the erection of redundant taxa (i.e., subgeneric content being equivalent to generic content), but also it would do nothing to correct the paraphyletic nature of *Cnemidophorus sensu lato*.

In Reeder et al. (2002) nomenclatural stability was best served by avoiding additional generic changes (beyond resurrecting *Aspidoscelis*) until future evidence is brought to bear on other parts of the phylogeny, by not lumping all of the taxa into *Ameiva* while awaiting that evidence, and by not erecting formal subgeneric taxa that would be temporary. Stability is not served if the results of Reeder et al. (2002) are rejected or modified without bringing new data or analyses to bear on these issues. New data, however, have been collected recently. With much more mtDNA sequence data (i.e., 2609 bp vs. 876 in Reeder et al. [2002]) and several additional Neotropical teiine taxa (including the type species of *Cnemidophorus*, *C. murinus*), new analyses and results provide additional strong support for the recognition of the North American clade of *Aspidoscelis* (Reeder, Bell, and Cole, unpubl. data). In conclusion, we encourage use of the genus *Aspidoscelis* for North American whiptail lizards as specified by Reeder et al. (2002) and, until further evidence or analyses are brought to bear on this issue, we reject Axtell's (2003) unjustified allocation of *Aspidoscelis* as a subgenus of *Cnemidophorus* sensu lato.

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ARTICLES

Herpetological Review, 2005, 36(3), 234–236.

Egg Attendance by Female Frogs in Two Species of *Eleutherodactylus* from Costa Rica

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Eleutherodactylus crassidigitus and *E. fitzingeri* are common inhabitants of the forest floor of humid lowland and premontane forests from Costa Rica through Colombia, occurring from sea level to 1500 m in elevation (Savage 2002). Although relatively common, little information is available on the reproductive biology of these species. Both species, as well as most members of the genus, lay encapsulated eggs out of water and undergo direct development within the egg bypassing the larval stage and hatching out as miniature adults (Savage 1975). The secretive nature of these and many other species of *Eleutherodactylus* makes collection of detailed ecological observations haphazard and fortuitous at best.

In the only report of egg attendance in *E. crassidigitus*, Taylor (1952) reported finding an adult and 26 eggs under a rock. There are two reports of egg attendance in *E. fitzingeri*. Dunn (1931) found 44 eggs attended by an adult frog, which he identified as a male, but based on size alone, 51 mm snout to vent (SVL), Lynch and Myers (1983) suggested it was a female. Mendoza Quijano et al. (2002) reported a female *E. fitzingeri* attending 85 eggs in a small cavity on the ground. These three observations suggest that *E. crassidigitus* and *E. fitzingeri* may provide parental care to their eggs (Townsend 1996). Egg attendance occurs in at least 48 of the more than 525 species of *Eleutherodactylus* and of these, 24 species exhibit female attendance of eggs (Crump 1996, Townsend 1996). Herein I describe female clutch attendance for *E. crassidigitus* and *E. fitzingeri* with notes on egg deposition sites, clutch size and hatchlings.

I made observations along the south central Pacific coast of Costa Rica at the following localities: Hacienda Baru National Wildlife Refuge, Dominical, Puntarenas (09˚16'00"N, 83˚52'20"W, 10 m

Table 1. Summary of attending female snout–vent length (SVL) and eggs per clutch of *Eleutherodactylus crassidigitus*. Means reported as $\bar{x} \pm$ 1 SD.

Date	Female SVL (mm)	Eggs Per Clutch
14 May 2000	39	36
3 June 2000	39	25
28 May 2001	41	42
13 June 2001	43	47
3 July 2001	45	45
	$\bar{x}$ = 41.4 ± 2.6	$\bar{x}$ = 39.0 ± 8.8

elev.); Finca Los Arboles, Tres Piedras, Puntarenas (09˚19'30"N, 83˚52'0"W, 95 m elev.); and Quebrada Grande, Palmar Norte (08º57'95"N, 83º26'60"W, 90 m elev.). This area is tropical moist forest and receives 2500–4000 mm of rainfall annually, and experiences a dry season from late December through April (Campbell 1999).

During a 26-month period from 19 December 1999 through 15 May 2002, I encountered 11 female *E. fitzingeri* attending clutches and five *E. crassidigitus* attending clutches during quadrat and transect sampling. I measured SVL with a 15 cm plastic ruler and egg diameter with dial vernier calipers. I found all 16 clutches under leaf litter. After I removed and counted eggs I replaced them and attending female within 5 cm of the eggs and replaced the leaf litter on top pf both. In two additional cases I obtained egg counts by dissection of gravid *E. fitzingeri*. The eggs of both species were non-pigmented, spherical with yellowish yolk, and were clustered in a grape bunch although not connected by a jelly or foam matrix.

I found 5 female *E. crassidigitus* attending clutches in the months of May (N = 2), June (N = 2), and July (N = 1). In all cases the attending frog was sitting on top of the clutch and were covered by leaf litter. One adult female and a clutch were collected and deposited in the collection of the University of Costa Rica (UCR 14759).

Oviposition sites were associated with shady microhabitats within the forest floor. I found three clutches near the buttresses of large trees: two clutches were found in vertical crevices inside the buttresses of *Brosimum utile*, and one clutch was under deep leaf litter near the root mass of a *Ceiba pentendra*. I discovered a fourth clutch in the crack of a large boulder and a fifth in the deep leaf litter of *Scheelea rostrata* fronds. I found 11 female *E. fitzingeri* attending clutches in the months of January, February, April, June, and September (Table 2). I collected one attendant female and two gravid females and deposited them at UCR (UCR 14714, 16031, 16033).

I recorded seven clutches in primary forest and four clutches along streambeds. All were under leaf litter in deep shade, and nine clutches abutted roots, logs, buttress or boulders. All nests were circular inside a depression in the soil with the eggs flush with the surface of the ground. A small, raised, ridge of soil and debris surrounded the edge of each nest. It appeared that females created or modified these basins by clearing them out of all debris. When a female was brooding, her body completely covered the entire clutch. These females became rigid and flattened when disturbed and remained in this position when handled.

From 9 to 18 February 2002 I marked and monitored one attending female twice daily, once in the morning and once at night, for 10 days. During the day the attending female was always sitting on the eggs. The female attended the clutch everyday, and 8 out of 10 nights, until she disappeared. The eggs were not ready to hatch, and I estimated them to be at approximately stage 9 of development based on tail movements (Townsend and Stewart 1985).

Females attended eggs until they hatched. On three occasions I found females attending nests in the process of hatching. Hatchlings were found hopping on and under the leaf litter. The nests contained the remnant egg capsules. From 1 to 4 June 2001 I monitored a nest of new hatchlings dispersing from the nest. A female frog remained next to the clutch for three days until all hatchlings had dispersed. I observed a similar behavior on two other occasions. Hatchlings of *E. fitzingeri* had a visible yellow yolk sac and a mean SVL of 7.2 ± 0.74 mm (N = 36).

The average clutch size of *E. fitzingeri* was 62.1 ± 18.7 eggs with a range of 24 to 81 (N = 8, Table 2). A positive correlation exists between clutch size and female SVL ($r^2 = 0.54$, df = 7, N = 8) as has been reported in other *Eleutherodactylus* species (Wake 1978). I dissected two gravid females and counted 84 and 92 eggs, respectively. I excluded these from the analysis because it is unknown whether this species deposits multiple clutches. Egg diameter ranged from 2.80 mm to 5.71 mm for 99 eggs measured of four clutches (Table 2).

TABLE 2. Summary of clutch characteristics of *Eleutherodactylus fitzingeri*. Means reported as $\bar{x}$ ± 1 STD; all measurements are in millimeters.

Date	Female SVL	# Eggs per clutch	# Eggs Measured	Mean Egg Diameter	Nest Dimensions (L x W x H)	# Hatchlings Measured	Mean Hatchling Size	Locality
3 Apr 2000	55	71						Dominical
17 Apr 2000	41	24						Dominical
15 Jun 2000	43	45	9	4.97 ± 0.19	58 x 62 x 18			Dominical
22 Jun 2000	44	69						Dominical
22 Apr 2001	46	62			64 x 70 x 24			Tres Piedras
22 Apr 2001	45	71	72	5.42 ± 0.23	60 x 72 x 23			Tres Piedras
1 Jun 2001						16	7.1 ± 0.65	Tres Piedras
5 Sep 2001	51	74	74	3.10 ± 0.15	63 x 72 x 25			Tres Piedras
15 Sep 2001	57	81	9	3.27 ± 0.18				Palmar Norte
17 Jan 2002						11	7.0 ± 0.74	Tres Piedras
3 Feb 2002						9	7.0 ± 0.88	Tres Piedras
9 Feb 2002	57	84						Tres Piedras
9 Feb 2002	55	92						Tres Piedras
	$\bar{x}$ = 49.4 ± 6.2	$\bar{x}$ = 67.3 ± 19.8						

Eggs attendance is the most common form of anuran parental care (Wells 1981) and can serve many functions including: protection against predators and pathogens, aeration of aquatic eggs, hydration of terrestrial eggs, prevention of developmental abnormalities, and to assists hatchlings as they emerge from the nest (Crump 1994). In the case of terrestrial breeding species the principle function of parental care includes hydration of eggs and protection from invertebrate predators (Townsend 1996), which may be the case in *E. crassidigitus* and *E. fitzingeri*. This paper confirms the anecdotal observations of Dunn (1931), Mendoza Quijano et al. (2002), and Taylor (1952), that females of these two species provide parental care to their clutches by egg attendance. 100% of the clutches I found had an attending female present indicating that clutch attendance is obligatory and not facultative.

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Non-rattling Defensive Tail Display in the Dusky Pygmy Rattlesnake, *Sistrurus miliarius barbouri*: A Previously Undescribed Behavior

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Defensive tail displays are often exhibited by snakes with bright and/or blunt tails in response to a stressor or a tactile stimulus and depending on the species, these displays can vary in speed, duration, frequency and proportion of tail length used (Greene 1973). Tail displays also make the tail visually obvious to a potential predator and may provide survival value to a snake by intimidating the predator, diverting the predator's attack away from the head and toward the tail, or distracting the predator and thus allowing the snake to strike or escape (Greene 1973). While rattling in rattlesnakes is a well-known defensive tail display used in potentially dangerous situations, non-rattling defensive tail displays might also function either as warning, distraction, or disorientation mechanism as they do in non-rattlesnakes (Greene 1973, 1988, 1992, 1997; Klauber 1972). As part of a larger repertoire of defensive behaviors, non-rattling tail displays might be particularly useful for rattlesnakes with inaudible or barely audible rattle chains or for those rattlesnakes possessing an insufficient number of rattle segments to produce a rattling sound. Here, we document a non-rattling defensive tail display for the first time in the Dusky Pygmy Rattlesnake, *Sistrurus miliarius barbouri*.

Sistrurus miliarius barbouri is a small rattlesnake species, seldom exceeding 55 cm, that has a bright yellow tail as a juvenile and a disproportionately small rattle compared to other rattlesnake species. Rowe et al. (2002) reported high rates of rattle loss in this species, with approximately one-half of all snakes examined possessing fewer than two interlocking segments. Because at least two interlocking segments are needed to produce a rattling sound, approximately one-half of all Pygmy Rattlesnakes are incapable of producing a rattling sound (Rowe et al. 2002). In field observations associated with another study, we noticed that in addition to rattling, this snake undulates its tail when captured. The entire tail is swayed back and forth in large arcs, while the distal half of the tail is wiggled in smaller sinusoidal movements. Both motions occur at a faster speed than those observed when this species caudal lures, and are often interrupted by brief periods of rattling that last approximately one second. Based on these observations and the bright and often rattleless tail of *S. m. barbouri*, we hypothesized that these undulatory (not vibratory) tail movements are a defensive tail display that is part of the typical defensive repertoire in *S. miliarius*. Based on this hypothesis and Greene's (1973) observations, we made two predictions about what we might ex-

pect to see in more detailed field observations of this species. First, if this tail display is a defensive behavior, then it should be used in response to tactile stimuli from a potential predator, as in other species observed by Greene (1973). Second, if tail movements function as a mechanism that compensates for missing rattle segments, then we predicted that *S. miliarius* with fewer than two rattle segments (and thus inaudible rattles) would display tail movements more often than do snakes with longer rattle chains.

TABLE 1. Comparison-wise summary of median time (minutes ± 1 standard deviation) and mean time (minutes ± 1 standard error) spent by *Sistrurus miliarius barbouri* displaying tail movements. Observations were made for up to two minutes following capture.

Comparison	N	Median ± 1 SD	Mean ± 1 SE
Snakes with < 2 rattle segments	11	0.5 ± 1.01	0.95 ± 0.30
Snakes with > 2 rattle segments	28	0.23 ± 0.92	0.81 ± 0.17
Adults	23	1.5 ± 0.96	1.10 ± 0.2
Juveniles	16	0.00 ± 0.80	0.47 ± 0.20
Females	22	0.71 ± 0.96	0.95 ± 0.21
Males	17	0.00 ± 0.92	0.72 ± 0.22

Materials and Methods.—To test our hypothesis, we made observations on snakes from Rock Springs Run State Reserve in Lake County, Florida (USA), between June and November of both 2001 and 2002. We located adult (≥ 2 yrs) and juvenile (1–2 yrs) snakes by visual survey and noted if the snake rattled or undulated its tail upon approach and for up to two minutes following capture by gloved hands. We also recorded the duration of tail undulations. We determined age using measures of snout–vent length, tail length, and mass reported for this species by Bishop et al. (1996). We used a two-tailed Fisher's exact test and a Mann-Whitney *U* test to analyze frequency and duration data, respectively.

Results and Discussion.—We never observed a non-rattling tail display before capture in our study population. Non-rattling tail movements were exhibited only after capture and moreover, they were used in equal frequency to rattling (χ^2 = 0.21, df = 1, P = 0.65, N = 39). The frequency and duration of tail movements were not significantly correlated with number of rattle segments (χ^2 = 0.003, df = 1, P = 0.96; U = 19.6, P = 0.74), age (χ^2 = 2.92, df = 1, P = 0.09; U = 16.1, P = 0.08) or sex (χ^2 = 0.56, df = 1, P = 0.45; U = 15.5, P = 0.47). Median and mean durations of tail display are reported in Table 1.

Crypsis is often the first line of defense for rattlesnakes, with other behaviors exhibited as graded responses to escalating threat (Duvall et al. 1985). Non-rattling defensive tail display occurred in equal frequency to and concomitantly with rattling in this species. This indicates that tail display is part of a larger defensive repertoire typical of this species and because this behavior was only exhibited after tactile stimulation, is probably only used at higher levels of threat and defensive escalation. Greene (1973) suggested that tail displays may provide survival value to the snake by distracting the predator and allowing the snake to strike. In this study, pygmy rattlesnakes often struck while displaying and this observation further supports the hypothesis that this behavior is defensive in nature.

We predicted that *S. miliarius* with fewer than two rattle segments would display tail movements more often than do snakes with longer rattle chains. However, our data did not support this prediction and suggests that tail display might not be used to compensate for inaudible rattles in this species. However, even when adjusted for their small body size, the rattling of *S. miliarius* with two or more rattle segments is much quieter and higher pitched than in other pitvipers (Cook et al. 1994). If the rattle is an ineffective warning device, regardless of chain length, then all Pygmy Rattlesnakes might be expected to exhibit non-rattling tail displays, as was observed in this study. Alternatively, this defensive tail display might reflect an ancestral trait that also occurs in other vipers, or it simply might be a behavioral atavism. Comprehensive and detailed tests covering a range of controlled stimuli and several lineages of snakes are needed to resolve these possibilities. Klauber (1972) suggested that adults often exhibit defensive behaviors more frequently than juveniles and although not statistically significant in this study, there was a trend for adults to exhibit defensive tail displays more often and for longer durations than juveniles. Although the origin and exact role of this tail display remain unclear, its use by *S. m. barbouri* in a defensive context is supported by our observations.

Defensive tail displays were observed in both adult and juvenile snakes but only juveniles exhibit a bright yellow tail color. This suggests that the bright tail color of juvenile *S. m. barbouri* may not contribute to the effectiveness of tail movements as a distraction or disorientation mechanism. Alternatively, this bright color probably enhances the optical attractiveness of the tail when used as a caudal lure (Neill 1960). Caudal luring differs from this defensive tail display in that luring is exhibited exclusively in the presence of prey, is slower in speed of undulations, uses less length of the tail and is affected by age and sex (Rabatsky 2002; Rabatsky and Waterman 2005).

Eryx johnii and *Tropidophis pardalis* are the only two other species thought to use the tail both as a defensive tail display and caudal lure (Greene 1973). Based on our observations of *S. miliarius* in the wild, this snake may be a third species that uses the tail for both behaviors. Although the specific benefits of this defensive tail display are still unclear, having a behavioral repertoire that includes multiple defense mechanisms might enable *S. miliarius* to respond more effectively to a wider variety of potentially dangerous situations, especially considering that the rattle of this species is incapable of sound production or just barely audible in most individuals.

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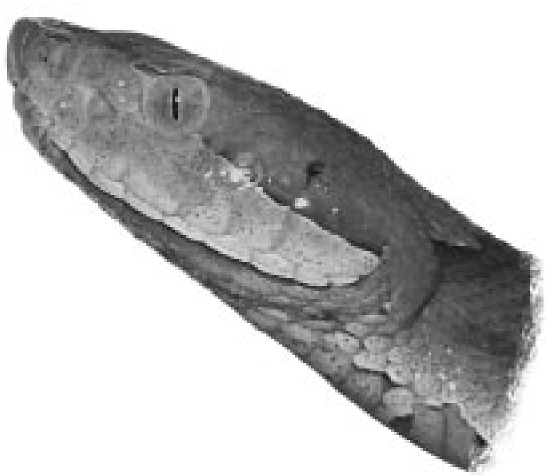

Agkistrodon contortrix (Copperhead). USA: Virginia: Greene County. Photographic illustration by Will Brown (www.blueridgebiological.com).

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Diet Composition and Microhabitat of *Eleutherodactylus johnstonei* in an Introduced Population at Bucaramanga City, Colombia

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Eleutherodactylus johnstonei Barbour 1914 is an endemic species of many islands of the Lesser Antilles (Frost 1985). It is widely distributed in the Eastern Caribbean (Kaiser and Hardy 1994) and in northern South America (Frost 1985; Kaiser et al. 2002; Ovaska 1991) where it is associated with urban areas. It has been introduced by natural phenomena and by human activity (Kaiser et al. 2002). In Colombia it has been reported in the cities of Barranquilla (Acosta - Galvis 2000; Ruiz-C. et al. 1996), Cali (F. Castro in Kaiser et al. 2002), and Bucaramanga (Ortega et al. 2002).

Diet and microhabitat use of *E. johnstonei* have been studied only in a population of Barbados (Ovaska 1991), where the species is probably indigenous (Marsh 1983). For this population the most abundant prey found was Formicidae, followed by collembolans, dipterans, and homopterans, among others. The individuals of this population use bromeliads, trunks, leaf litter, and small rocks as diurnal refuges, and during the night they are active across the arboreal stratum. In recently colonized areas, these ecological data have not been recorded although such information could contribute to an understanding of why this species is a successful invader. Here, we report on diet composition and microhabitat use in an introduced population of *Eleutherodactylus johnstonei* and compare these data with those from native populations.

Materials and Methods.—The studied population is located in the house gardens of Bucaramanga (Santander, Colombia; 07˚07' 28.7"N and 73˚06'41.6"W, 1040 m altitude). The area has a nearly constant bimodal regime of rains and a mean temperature of 24˚C during the year. The vegetation in the gardens is characterized by a variety of ornamental plants. Individual frogs were collected in gardens in leaf litter and on bushes between 2000 and 2200 h. Additional searches were made in forests bordering the study site, to determine presence adjacent to gardens and whether there has been displacement of native frogs by the introduction of *E. johnstonei*. Initially, we collected 30 frogs and made an analysis of minimum sample size using a saturation curve of consumed prey. We monthly collect 17–20 individuals (May of 2001 through

April of 2002) following the suggestions of this previous analysis. We collected frogs larger than 15 mm snout–vent length (SVL) to facilitate handling in the laboratory. Following the suggestions of Heyer et al. (1994), we recorded SVL, mouth width (MW), substrate type (soil, leaf litter, leaves, trunks, rocks, and grass) and perch height. Individuals were euthanized and fixed in 10% formalin to interrupt the digestive processes and prey decomposition. Specimens were deposited in the Herpetological Collection of the Museo de Historia Natural, Universidad Industrial de Santander (UIS-A).

Leaf litter arthropods were collected with an insect net and Berlesse funnel at the study location. They were preserved in 70% ethanol and were used as reference samples for comparisons and determination of the stomach contents of the collected frogs. Digestive tracts of each individual were removed and their contents preserved in 70% ethanol. Taxonomic determinations of prey were made using the keys of Borror et al. (1989). Fragments that showed identification problems were compared with preserved samples of arthropods. Number and percentage of prey per stomach was recorded. An index of relative importance was calculated to evaluate the contribution of each category to this population's diet (following Pinkas et al. 1971). We tested correlations between frog SVL and MW and the size and volume (using the ovoid spheroid formula, Caldwell and Vitt 1999) of the ingested prey to see if prey size depends on frog corporal size or mouth size. Chi-square tests were used to investigate whether significant statistical differences existed in the use of the microhabitat and perch height.

Results and Discussion.—We dissected 212 stomachs (140 males and 72 females), revealing 1448 prey items identified to order, and grouped into 22 categories excepting members of Formicidae. Diet was composed of insects and other arthropods such as spiders and isopods (Crustacea), and other prey as gastropods and oligochaetes (Table 1). Although there was some plant material in the diet, these were not included because only two of the 212 dissected stomachs contained these items.

Traditionally it has been thought that anurans have a generalist diet, which reflects the richness and size of the resource (Duellman and Trueb 1986). Our results suggest that *E. johnstonei* is a carnivorous generalist species as determined by the presence of a variety of prey items such as homopterans, orthopterans, thysanopterans, dermapterans, gastropods, formicids, collembolans, and isopods. A generalist diet is likely one of the characteristics (but not the only one) that makes this frog an excellent colonizer.

TABLE 1. Diet composition of males and females of an introduced population of *Eleutherodactylus johnstonei*. Numerical importance (number of prey item in relation to total number of items found in the species), frequency (percentage of prey item number in relation to total number of items found in the species), prey volume (total volume of prey category in all individuals examined), and percentage of relative importance [IRI = % FO (%V + %N), FO, percentage of stomachs containing an specific item, V volumetric importance, and N, numerical importance].

	Numerical Importance		Frequency		Prey volume		% IRI	
Prey	Males	Females	Males	Females	Males	Females	Males	Females
Formicidae	435	260	96	64	248.31	169.13	5780.6	4309.1
Diptera	120	135	58	45	82.73	108.48	1026.9	1657.
Collembola	84	35	24	14	5.34	6.34	200.3	106
Homoptera	16	18	14	14	76.87	41.15	84.7	103
Hymenoptera	13	10	9	9	82.9	12.34	68.3	28.1
Heteroptera	2	7	1	7	2.61	93.54	0.4	69.4
Orthoptera	1	2	1	2	0	3.19	0.1	1.4
Dermaptera	6	3	6	2	16.17	5	10.9	2.1
Nymphs	8	4	5	3	11.57	11.2	8.2	5.4
Caterpillar	22	17	8	7	62.75	462.43	55.2	318.6
Gastropoda-1	10	9	9	6	48.91	83.44	42.3	56.3
Scolopendra	2	2	2	2	1.6	0	0.6	0.8
Larvas	8	7	7	6	15.7	26.35	13.7	22.8
Coleoptera	13	20	10	14	122.97	69.6	106.8	144.5
Gastropoda-2	0	1	0	1	0	48.7	0	4.6
Acari	20	11	14	9	1.75	1.05	28.3	20.6
Blattaria	9	3	5	3	115.48	38.26	48.6	1.2
Isopoda	23	15	11	10	85.69	59.37	96.3	84
Thysanoptera	13	0	2	0	4.34	0	3.1	0
Pseudoscorpion	2	0	2	0	1.46	0	2.6	0
Oligochaete	2	0	2	0	14.03	0	2.5	0
Araneae	11	10	11	9	6.26	6.54	25.2	23.3
TOTAL	820	569	129	88	1007.4	1246.12	7605.6	6958.7

The 22 taxonomic prey categories contribute to the individual's development according to the index of relative importance (IRI). The most important category was Formicidae (54.24%) followed by dipterans (47.16%) and collembolans (19.33%), whereas the categories with a low IRI possibly reflect opportunistic ingestions related to the abundance of these resources in the study place. In other *E. johnstonei* populations, ants were the most important prey (51.4% in Barbados; Ovaska 1991), and in Jamaica, Stewart (1979) reported two introduced species (*E. johnstonei* and *E. planirostris*) and two native species (*E. gossei* and *E. cundalli*) whose main food source was Formicidae. Also, in *E. coqui*, Lavigne and Drewry (1971) found that ants were the most consumed prey, and Duellman (1978) found that for 9 of 15 species of *Eleutherodactylus*, ants were the most consumed prey. The high percentage of ants in the diet might suggest a high availability of this resource in the sampling places not measured by any of these investigators (nor us), or that these species specialize upon ants.

However, other species of *Eleutherodactylus* are not consumers of ants. Arroyo (2002) reported collembolans and coleopterans as the most important prey for an *Eleutherodactylus* assemblage in a cloud forest of the Cordillera Oriental of the Colombian Andes. Gutierrez (2003) reported, for another assemblage of cloud forest *Eleutherodactylus*, that the most common prey items were isopods and coleopterans, in an area south of the location studied by Arroyo (2002). Ants were items that frogs consumed only occasionally in both studies; in fact, ants are typically rare at higher elevations including cloud forests. Thus, prey availability might explain the differences in diet among *Eleutherodactylus* species. Duellman and Trueb (1986) suggest external factors (seasonal abundance of the food and competitors' presence or absence) and intrinsic factors (ecological and morphological tolerances) relating to body size with the election and type of prey consumed, and with use of microhabitats for foraging.

Prey composition of each sex was not significantly different ($Z_{(139,71)}$ = -0.776212; P = 0.4376). There was also no significant differences among sexes in the numeric importance ($U_{(1,21)}$ = 209.500; P = 0.445), frequency in the stomachs ($U_{(1,21)}$ = 221; P = 0.622), volume of the ingested prey ($U_{(1,21)}$ = 236; P = 0.88) and the relative importance index ($U_{(1,21)}$ = 226.5; P = 0.91, Table 1).

The adult population of *E. johnstonei* showed a positive relationship between SVL and MW and the size and volume of the consumed prey. There was a significant correlation between SVL and prey size (r = 0.1983; P = 0.0036; N = 212) and prey volume (r = 0.148; P = 0.0308; N = 212). Similarly, there was a significant correlation between MW and prey size (r = 0.1689; P = 0.0135; N = 212) and MW and prey volume (r = 0.1974; P = 0.0038; N = 212) indicating that larger frogs and bigger mouths ingest larger prey. These relationships were also reported in a native population of *E. johnstonei* in Barbados (Ovaska 1991), in *E. coqui* (Woolbright and Stewart 1987), in six sympatric species of anurans the central Amazonian (Lima 1998), and in a subtropical community of anurans (Basso 1990) showing that changes in size and prey types with the sizes of frogs are expected by morphological reasons and for changes in the spectrum of types of prey that can be ingested (Lima and Magnusson 2000). The positive relationship between MW and the size and volume of the prey constitutes an important element supporting the ideas Toft (1980, 1981) that the width of the mouth limits the size of the prey captured by certain species.

Eleutherodactylus johnstonei used vegetation associated with the herbaceous substrate (families Araceae, Bromeliaceae, Conmelinaceae, and Poaceae) as places for calling and perching. Trees taller than 2 m (families Combretaceae and Rutaceae) provided protection against solar radiation/drying and maintained soil moisture. The analysis of substrate use allowed us to establish significant differences for this resource (soil, leaf litter, leaves, trunks, rocks, and grass) intersexually ($\chi^2_{(0,05;5)}$ = 13.11; P > 0.01) and intrasexually (males, $\chi^2_{(0,05;5)}$ = 48.3; P < 0.001 and females $\chi^2_{(0,05;5)}$ = 32.86; P < 0.001, Fig. 1).

Perch height used is also different between the sexes ($\chi^2_{(0,05;6)}$ = 16.79; P < 0.01); males perch higher than females to call, and females prefer lower perches. Among males there were no significant differences in perch height ($\chi^2_{(0,05;6)}$ = 9.3; P > 0.10), contrary to from females who showed significantly different perch heights ($\chi^2_{(0,05;5)}$ = 32.74; P < 0.001) (Fig. 2).

Most of the males were collected calling on the bush substrate whereas females were collected close to the calling sites at lower perch heights. These intersexual differences are presumed to be related with reproductive behaviors: males use higher perches to call before amplexus, but when oviposition occurs they descend to the ground because males care for the eggs, changing their use of the vertical position. Females are more associated with the soil and leaf litter, presumably in relationship with their reproductive behavior and maybe to avoid capture by predators or disturbance. Similar results were obtained in *E. fitzingeri* (Höbel 1999) and in anurans of Anchicayá where the males are arboreal and the females are associated with the soil and leaf litter (Vargas and Castro 1999). Thus, the substrate and perch height used for by frogs may be more closely related to reproduction than with food availability, although these two activities are not completely separated.

At Bucaramanga, *E. johnstonei* is limited exclusively to the vegetation of the gardens. In the forest patches near to the gardens, we did not find *E. johnstonei* nor did we hear their song. In this

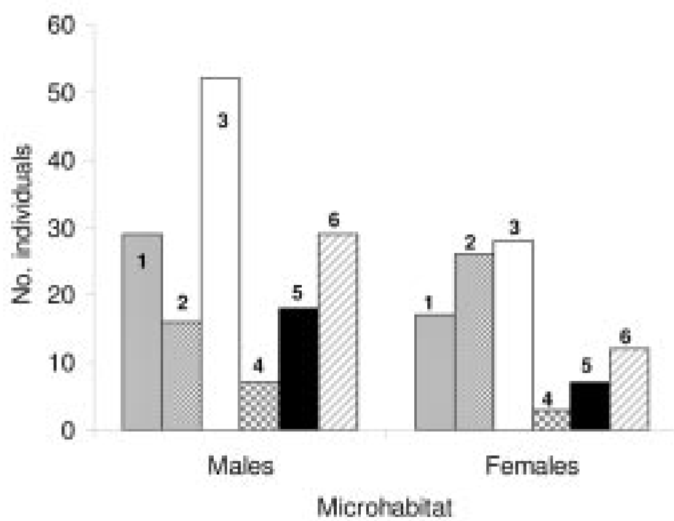

FIG. 1. Substrate used by *Eleutherodactylus johnstonei* (inter and intrasexes). 1) soil, 2) leaf litter, 3) leaves, 4) trunks, 5) rocks, 6) grass. Analysis of substrate use showed that there were significant differences for this resource intersexually and intrasexually.

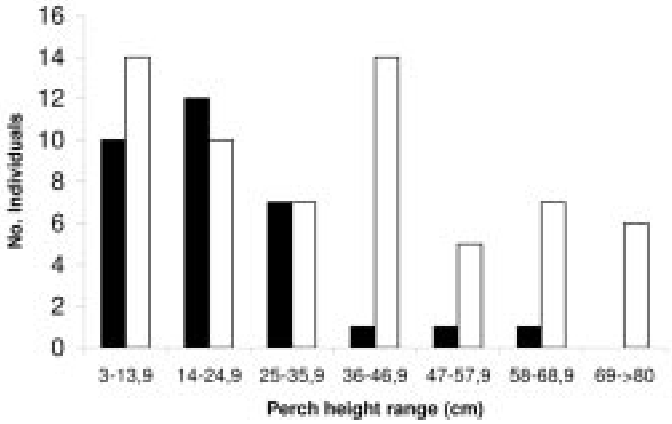

FIG. 2. Perch height used by both sexes of *Eleutherodactylus johnstonei*. Males, white blocks; females, black blocks. Intersexual differences in perch height ranges are presumed to be associated with reproductive behaviors: most males were found calling on leaves of bushes whereas egg-guarding males and females were found at lower perches in different substrates.

zone, we found native species (*E. raniformis* and *E. taeniatus*), which are absent from the gardens of the city. The adjacent vegetation of the neighborhood where the population of *E. johnstonei* is found corresponds to a highly disturbed tropical dry forest on the Andean slopes to the east of the city. Possibly this forest does not have the humidity and microhabitat features required for the survival of the species, similar to those permanently irrigated gardens, which can provide an ideal habitat for reproduction and other physiological aspects. Because native species are absent in the residential areas, *E. johnstonei* enjoys great success in these empty niches. Thus, at present, we have not been able to observe displacement of native species by the arrival of *E. johnstonei*. Although *E. johnstonei* is a generalist species in diet and microhabitat use allowing it to easily colonize new territories, these characteristics do not explain why this species is associated almost exclusively with houses gardens and not other neighboring disturbed areas at this locality.

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On the Acoustic Communication System of *Eleutherodactylus fitzingeri* (Anura: Leptodactylidae)

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Frogs of the genus *Eleutherodactylus* are the main component of many neotropical herpetofaunas (Scott 1976). However, very little is known about their natural history, and even less information is available on the form and function of their vocalizations. For most species only short call descriptions are published, and for others it is unknown whether they vocalize at all. Yet, the few members of the genus *Eleutherodactylus* whose vocal behavior has been studied in detail show a great diversity of vocalizations: specialized calls for courtship and mating have been reported (Ovaska and Caldbeck 1997), as well as calls for the defense of retreat sites (Stewart and Rand 1991) and even calls produced by females in response to male calls (Schlaepfer and Figeroa-Sandi 1998).

I studied the vocal behavior of *Eleutherodactylus fitzingeri*, a common inhabitant of the tropical lowland forests of Costa Rica (Savage 2002). Although the distribution of *E. fitzingeri* extends from Nicaragua to central Colombia (Lynch and Myers 1983), to date all available information on the vocalizations of this species comes from frogs recorded in Panama (Fouquette 1960; Ibáñez et al. 1999; Lynch and Myers 1983). I provide data on geographic variation of the advertisement calls within Costa Rica and suggest that a vocalization formerly named the "sporadic call" (Ibáñez et al. 1999) is in fact a highly variable aggressive signal.

Material and Methods.—My main study site was at La Selva Field Station, Heredia Province, in the Caribbean lowlands of Costa Rica. I also recorded some frogs from the Pacific lowlands at Marenco Lodge, Puntarenas Province. I used a Sony WM-D6C tape recorder and a Sony ECM 969 microphone to record the calls of males (at ambient temperature of 25–28˚C). I either recorded completely undisturbed calling males or I vocally imitated their advertisement call and recorded their vocal response. Whenever possible, I measured the size of the frogs I had recorded (snout–vent length to the nearest 0.1 mm with calipers and weighted them to the nearest mg with a Pesola scale). I digitized the recordings at a sampling rate of 22kHz and analyzed them using the program CoolEdit96 (Syntrillium Co.) on a portable computer. To test whether call variation between populations was statistically significant I calculated Mann-Whitney's U-tests.

Results.—I recorded two types of calls: an advertisement call that was produced by solitary calling males, and a distinctly different call which was given during antagonistic interactions between males or in response to vocal call imitations.

The advertisement calls (Fig. 1) recorded from Costa Rican frogs were highly variable, and consecutive calls were given in irregular intervals of several minutes. There was significant geographic variation in several call parameters. Calls from the Pacific population (N = 6) contained between 7–11 notes and had a mean ± SD duration of 1228 ± 301 ms (range: 830–1610 ms). Calls in the Caribbean population (N = 16) however contained 12–24 notes and had a mean duration of 2884 ± 597 ms (range: 1700–3900 ms). Both call duration and number of notes per call were significantly different between populations ($P < 0.001$ in both cases). Since the duration of the individual call notes was similar in both sites (mean = 10 ± 2 ms; $P = 0.88$), the difference in call duration results from Caribbean males having more notes per call and having a longer internote interval between consecutive notes (mean = 165 ± 13 ms compared to 138 ± 17 ms; $P < 0.001$). The dominant frequency of the calls of Caribbean frogs was 1931 ± 221 Hz, that of Pacific frogs was 1788 ± 27 Hz. This difference was not statistically significant ($P = 0.27$). Males from the Pacific slope were significantly larger (33 ± 1 mm) and heavier (2.6 ± 0.3 g) than males from the Caribbean site (28 ± 1mm, 1.7 ± 0.3 g; $P < 0.005$ in both cases).

To loud natural or imitated *E. fitzingeri* advertisement calls males responded with a vocalization that sounded like a series of creaking chirps (Fig. 2). Because I did not make recordings of these vocalizations at Marenco, all data given below refer to Caribbean frogs (N = 16). These response calls were produced within 6.3 ± 3.6 seconds after the offset of the rival/imitated call. On average 5.3 ± 3.0 of these calls were produced sequentially (max: 12 calls), with periods of 3.9 ± 3.8 sec of silence between consecutive calls. The mean duration of a complete sequence of response calls thus lasted 17 ± 10 sec. Individual calls contained between 1–4 notes, each of which could last from 3 to 110 ms. The duration of the individual calls was therefore highly variable (31–375 ms). Their build-up, however, followed a common scheme of increasing duration and complexity (Fig. 2). The first call was generally the shortest and consisted of one prolonged note. The following calls often increased in duration and number of notes, and generally here too an increase of note duration from start to end of the call could be observed. The dominant frequency of these calls was

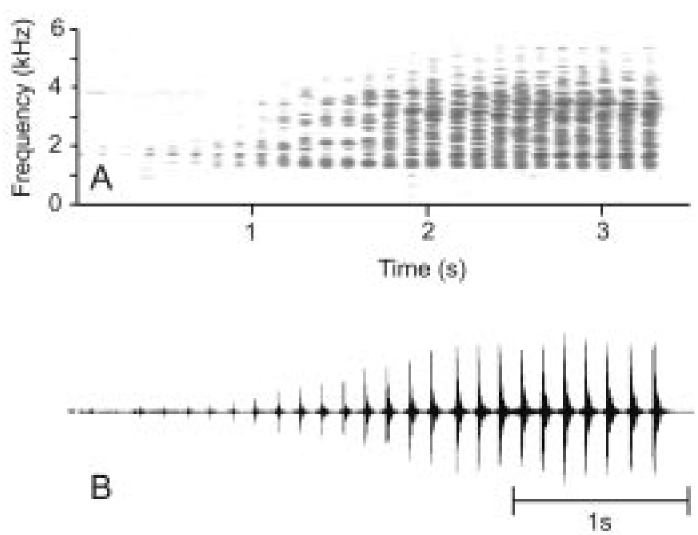

FIG. 1: An advertisement call of *Eleutherodactylus fitzingeri* recorded in Costa Rica. The upper panel (A) shows a sonagram, the lower panel (B) the waveform of the call.

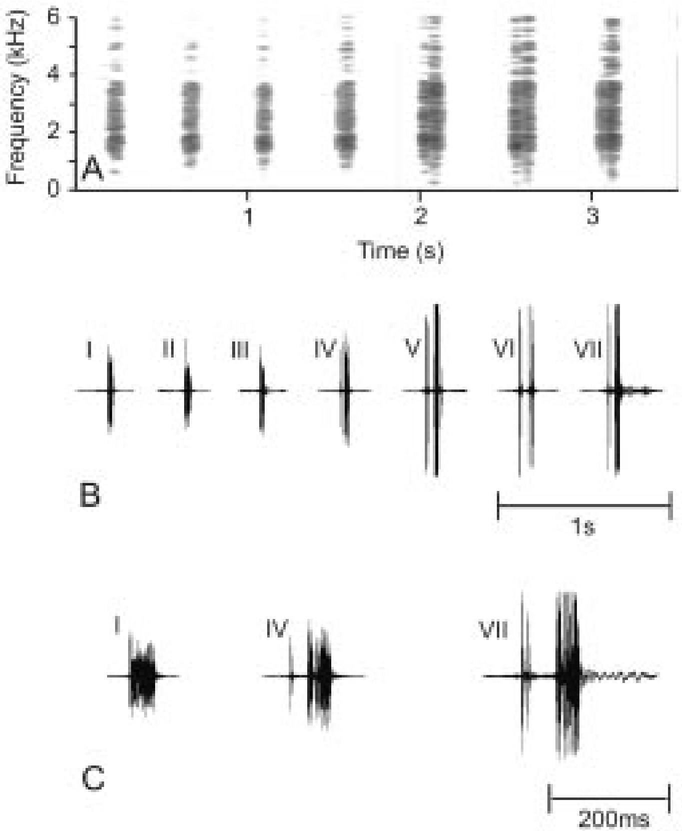

FIG. 2. Aggressive call response of *Eleutherodactylus fitzingeri* consisting of seven consecutive calls. The whole series was 29 sec long, but silent periods between successive calls were deleted in order to show the calls at the same time scale as the advertisement call from Fig. 1. Shown is a sonagram (A) and a waveform (B) of all seven calls. In (C) the waveform of the first, forth, and last call of the series are shown at expanded time scale. Note how the duration and complexity of the calls increases.

2079 ± 363 Hz. Some males showed positive phonotaxis, turning to face the source of the imitation call before responding, and certain males even moved towards the source of the call, repeatedly emitting this vocalization. Although these calls could be elicited from the majority of males by means of loud call imitations, they were very infrequently heard in nature.

Discussion.—The short advertisement calls are the most frequently heard vocalizations of *E. fitzingeri*, but because of the often large time lapses between consecutive calls, the frogs are very difficult to locate (Fouquette 1960; Lynch and Myers 1983). This may be interpreted as an avoidance mechanism against audio-orientated predators (Tuttle and Ryan 1981), and ties in with the overall life-history pattern of cryptic coloration (Lynch and Myers 1983) and secretive perch choice (Höbel 1999).

Body size might affect spectral call parameters like dominant frequency, and temperature may affect temporal call parameters like note duration, etc. (Gerhardt and Huber 2002). This should ideally be taken into account when comparing populations and describing geographic variation in call parameters. Unfortunately, my data set was not complete enough to run correlation analyses that would have eliminated these confounding factors. However, the most striking distinction between the advertisement calls of the two populations was the difference in the duration of the call, which was mainly caused by the different number of notes produced per call. Addition of call notes is to my knowledge not affected by temperature. Also, temperature should affect temporal call parameters in similar ways, e.g., lower temperatures should slow down note duration as well as the duration of the inter-note interval. In my analysis however, I found significant differences between populations in one call parameter (inter-note interval), but not the other (note duration).

Although there is geographic variation in the advertisement calls of *E. fitzingeri*, this variation does not follow a clinal pattern. Calls of Panamanian *E. fitzingeri* comprise 2–18 notes per call (Fouquette 1960; Ibáñez et al. 1999; Lynch and Myers 1983), and are thus intermediate to those of the two sites I investigated in Costa Rica. Also, the general structure of the calls is very similar between different Costa Rican and Panamanian populations (Fouquette 1960; Ibáñez et al. 1999; Lynch and Myers 1983). What is the function of this vocalization? As in most frogs, the advertisement call probably serves a dual purpose of mate attraction and territorial function (Wells 1977). Although direct evidence in form of observations of females performing phonotaxis towards a calling male or a speaker broadcasting an advertisement call is still missing, a role in pair formation is nevertheless suggested by the observation that it is the most frequently given vocalization and that it is more often given in the rainy season, e.g., during the period when reproduction takes place (Höbel 1999; Ibáñez et al. 1999). A territorial function, probably regulating inter-male spacing is suggested by males showing phonotaxis while emitting a special aggressive call (see below) when they perceive very loud advertisement calls.

Calls similar to the response calls reported here have been described for Panamanian *E. fitzingeri*. Ibáñez et al. (1999) reported hearing single one-note calls of this type, and termed this vocalization the "sporadic call." However, they did not comment on its function. Lynch and Myers (1983) elicited a similar vocalization (series of four chirps) by playing back an advertisement call that they had just recorded from the same male, which led them to suggest that this vocalization might constitute a response to conspecific male intruders. The circumstances under which this call type is given, i.e., when hearing a loud advertisement call of a rival male, together with the observation of males moving towards the source of a rival call while giving this vocalization supports the idea that it may be an aggressive call.

As a rule, the structure of a species' aggressive call differs markedly from the structure of its advertisement call (Schwartz 2001). In *E. fitzingeri* the number of notes in the aggressive call is greatly reduced compared to the advertisement call, but the duration of the aggressive call notes is increased compared to advertisement call notes. This change in call structure is different from the one found in *Eleutherodactylus* species from the West Indies, where the combination and addition of the two basic notes of the advertisement call form calls used in aggressive signaling. *Eleutherodactylus coqui* converts its advertisement call into an aggressive signal by adding advertisement call like notes to the end of it (Stewart and Rand 1991), and the aggressive signal of *E. antillensis* is comprised of a rapid series of notes that resemble the second note of their advertisement call (Ovaska and Caldbeck 1997). Based on these observations there does not seem to be a general pattern in which aggressive calls differ from advertise-

ment calls in *Eleutherodactylus*, but comparative data on aggressive calls in this frog genus is too scarce to draw any conclusions yet.

Eleutherodactylus coqui has highly variable aggressive calls, and a graded increase in aggressive call duration is related to retreat site defense (Stewart and Rand 1991). In *E. fitzingeri* the variability in duration and structure of the aggressive call suggests that males may be able to respond in a graded fashion to increasing levels of intrusion/competition as well. However, playback experiments with advertisement calls varying in intensity and thus implying varying distance to rival males are needed to elucidate whether *E. fitzingeri* does in fact have a graded aggressive communication system.

For *E. fitzingeri* from Panama a third vocalization has been described. Ibáñez et al. (1999) mention that females occasionally gave repeated screams when seized, suggesting a distress vocalization. I never heard a distress call while catching frogs in Costa Rica (both males and females), but I also did not make an effort to elicit or record distress calls.

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Seasonal Timing of Follicular Development of the Mud Snake, *Farancia abacura* (Colubridae)

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There is limited information on the seasonality of reproduction of mud snakes, *Farancia abacura*. Observations of reproductive behavior in this species are difficult both in captivity and the wild due to its secretive habits. There are several reports of oviposition and subsequent hatching (Goldstein 1941; Meade 1935b, 1937, 1940a,b, 1945; Reynolds and Solberg 1942), but little is known about seasonally dependent follicle size.

Although complete records of breeding and reproductive habits are limited, Meade (1946) discussed the natural history of *F. abacura*, including reproductive behavior, oviposition, and maternal care. He maintained a live collection of *F. abacura* and produced the first record of breeding habits in *F. abacura* (Meade 1946). Mating and oviposition occurred in July and September, respectively, with the eggs incubating for seven weeks prior to hatching. Hatching of seven clutches occurred between September and October, with incubation periods ranging from seven to nine weeks (Meade 1946). More recently, Robinette and Trauth (1992) investigated both female and male reproductive cycles from mud snakes collected throughout Arkansas. The greatest mean follicle diameter was observed in May and June, synchronal with testicular recrudescence in males.

We examined 129 female *F. abacura* from throughout their range to investigate the seasonal timing of follicular development and discuss the possible relationship between seasonal emergence and the seasonal timing of reproduction.

Materials and Methods

Data Collection from Museum Specimens.—Data were collected on oviductal follicle size, snout–vent length (SVL), head width (HW), head length (HL), and total length (TL) of *F. abacura* from adult female museum specimens (Appendix I). Ovarian follicles and oviductal tissue samples were removed through a ventral incision and stored in 70% ethanol for later measurement. Follicles were measured with a Fowler dial caliper and classified based on length according to Betz's (1963) system [Class I = 0.1–5.0 mm; Class II = 5.1–10.0 mm; Class III = 10.1–20.0 mm; and Class IV = 20.1–46.0 mm]. This system allowed for each follicle to be grouped into one of four distinct size classes and is commonly used in studies investigating follicle size and development (e.g., Goldberg 2002; Holycross and Goldberg 2001; Kofron 1979b, 1983; Rosen and Goldberg 2002).

Descriptive Analyses.—We present descriptive data on season-

ally dependent follicle length from 76 of 129 females examined. The number of female specimens collected each month was compared to the number of males and juveniles collected per month, demonstrating the possible influence of follicular development on the differences in seasonal emergence and activity between these demographic groups. Follicle size also was compared among months and regressed against female body size to determine if body size correlates with follicle size.

Results

We examined 129 females for data on morphology and follicle length. Only 76 specimens provided reproductive data that could be used in our analyses, due to damaged follicles (e.g., road killed specimens) or previous dissection. Specimens were sampled primarily from Louisiana and Texas, with some adults from Florida, Mississippi, Oklahoma, South Carolina, and Tennessee (Table 1).

Most museum specimens sampled were collected between March and June, with the greatest number of females collected in April (Fig. 1). All museum specimens collected from September to December were from Louisiana and Texas populations. Museum records indicate that females tended to be captured more often than males and juveniles throughout the year.

Mean follicle lengths for *F. abacura* were compared within their respective months of capture (Fig. 2). Class II follicles were prevalent throughout the year. However, mean follicle length is greatest in June and July, as more Class III follicles were found for these months. Of the 76 females examined, only one follicle (35.3 mm) in one female (SVL = 92.3 cm, TCWC 45620) form Brazos Co., Texas was observed in the developmental stage of Class IV. However, this female's mean follicle length was still within the Class III developmental stage.

Snout–vent length (SVL) in adult female *F. abacura* ranged from 53.4–191.0 cm (mean ± SE = 93.14 ± 2.556, N = 110); 47.0–122.0 cm in adult males (mean ± SE = 71.60 ± 1.769, N = 62) and 14.5–45.0 cm in juveniles (mean ± SE = 27.50 ± 1.346, N = 50). We found no relationship between female body size (SVL) and mean follicle length in *F. abacura*, as SVL explained only 2% (r^2 = 0.0203) of variation in mean follicle size (F = 1.51; df = 1, 74; P = 0.223). However, regression analyses for SVL versus Class I, II, and III follicles lengths indicated a significant relationship between SVL and Class I follicle lengths (F = 5.39; df = 1, 15; P = 0.035; r^2 = 0.264). No significant relationship was found between SVL and Class II or III mean follicle lengths (Fig. 3).

Table 1. The number of female, male, and juvenile *Farancia abacura* specimens examined with an indication of their respective collection localities by state. Snakes with a SVL < 45.0 cm were consider to be juveniles. Of the 51 juveniles, 18 of these individuals were also identified as females and examined for reproductive condition. Thus a total of 129 adult and sub-adult females were examined.

	Number of Specimens			
Locality	Females	Males	Juveniles	Total
FL	2	1	0	3
LA	59	37	31	127
MS	2	0	3	5
OK	1	1	2	4
SC	1	1	0	2
TN	1	0	0	1
TX	43	21	15	79
Unknown	2	1	0	3
Total	111	62	51	224

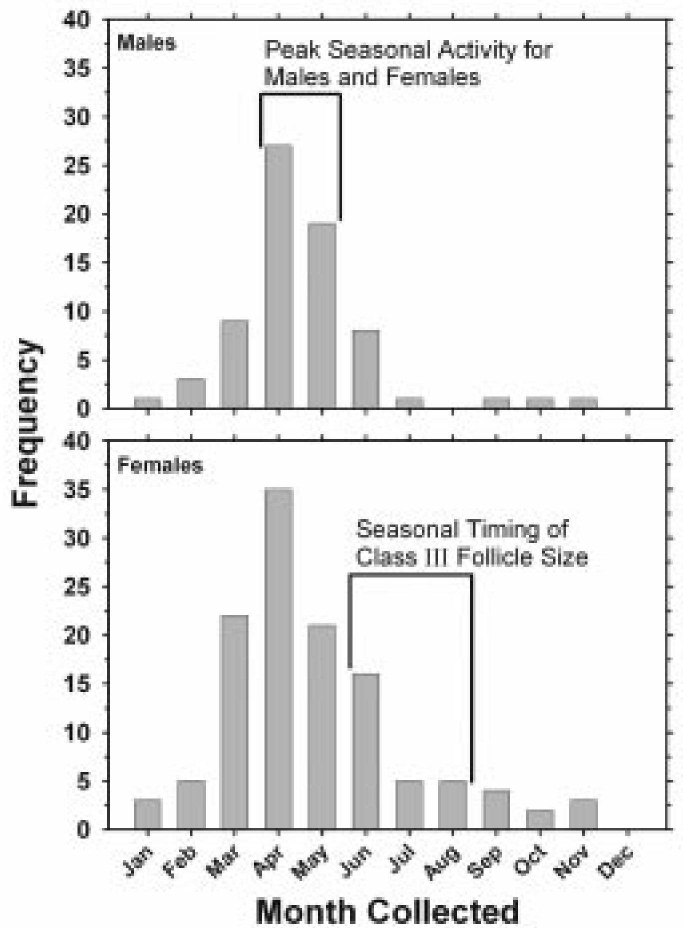

Fig. 1. Seasonal activity patterns determined from the capture records of museum specimens. Most museum specimens examined were collected between March and June, with the greatest number of males and females collected in April. These data may represent less secretive habits of the species during the months associated with seasonal reproduction. Class III follicle sizes were observed from June to August, after the period of peak seasonal activity.

Discussion

Several studies report the timing of oviposition and subsequent hatching in *F. abacura* (Goldstein 1941; Meade 1935b, 1937, 1940a, 1945; Reynolds and Solberg 1942), but little is known about seasonally dependent follicle sizes. Most museum specimens examined in this study were collected between March and June with the greatest number for females being found in April. This tendency for higher captures in April could be due to an increase in activity associated with reproductive behavior. This observation is supported by Robinette and Trauth (1992) who examined 22 male and 22 female *F. abacura reinwardtii* from Arkansas and found that reproductive cycles peaked in May and June. Although we might expect that specimen capture in spring is directly due to seasonal activity, we cannot exclude the possibility of sampling

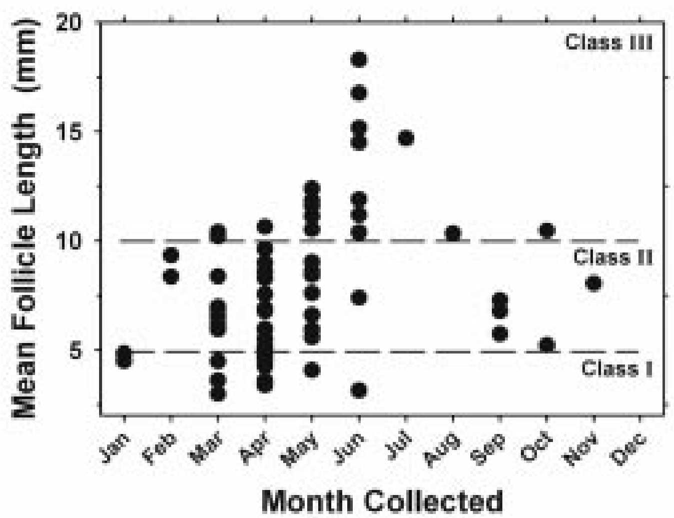

FIG. 2. Monthly distribution of mean follicle length of *Farancia abacura* (N = 76). The greatest proportion (>75%) of individuals demonstrating a Class III mean follicle size was observed in June, July, and August. Class IV was observed only in July.

bias due to greater frequency of collecting trips in spring. However, the observations of road-killed specimens may not show such a collection bias. Of the snakes examined in this study, all 14 road-killed specimens were collected during spring and early summer, thus supporting observations of seasonal activity in *F. abacura* (see also Means and Christman 1998). Lutterschmidt (unpubl. data) conducted a 12-month survey of snake activity in southeastern Louisiana, during which 33 *F. abacura* sampled were found only from April through August, with more than 85% of these captures occurring in April, May, and June. These observations of seasonal activity are similar to observations of juvenile emergence of *F. abacura* in South Carolina where 67 of 98 individuals were captured in April and May (Semlitsch 1988). Although activity is greatest in spring and summer, indicating seasonal emergence and activity, *F. abacura* has been collected throughout the year. However, Meade (1935a; 1946) indicated that they most likely hibernate between November and mid-February. Many of these differences in activity may result from observing different populations over the geographical range of *F. abacura*.

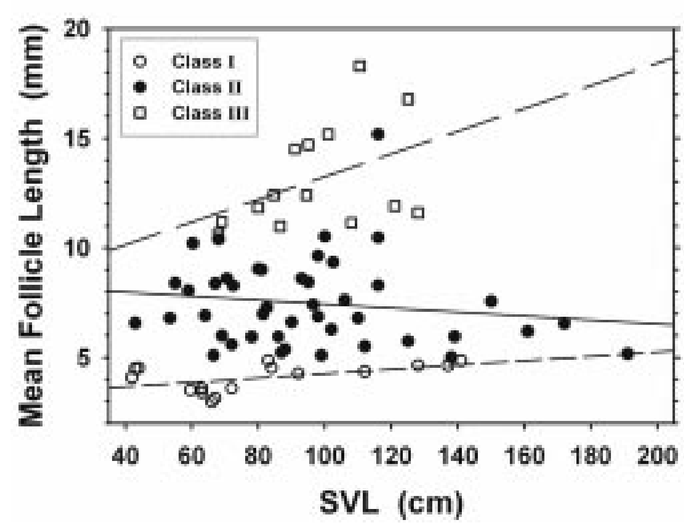

FIG. 3. Relationship between SVL and mean follicle lengths (MFL) of *Farancia abacura*. Regression results and equations: SVL vs. all MFL (F = 1.51; df = 1, 73; P = 0.223; r^2 = 0.0203; MFL = 0.016*SVL + 6.26); SVL vs. Class I MFL (F = 5.39; df = 1, 15; P = 0.035; r^2 = 0.264; MFL = 0.010*SVL + 3.27); SVL vs. Class II MFL (F = 3.20; df = 1, 42; P = 0.081; r^2 = 0.071; MFL = _0.014*SVL + 8.54); SVL vs. Class III MFL (F = 2.58; df = 1, 12; P = 0.134; r^2 = 0.177; MFL = 0.052*SVL + 8.07).

Class II follicles are prevalent throughout the year (March, April, May, August, September, October, and November). However, in June and July follicles increase in length to Class III. After reaching Class III, follicles develop rapidly to Class IV, which are ≥ 2 cm in length and occur just prior to ovulation (Kofron 1979b). Only one specimen (collected in July) of the 129 examined had an ovum in Class IV (Fig. 2). This suggests that when the ova of female mud snakes are in later developmental stages (i.e., III and IV), female snakes may become secretive and less subject to capture. Once *F. abacura* find a mate, they return to their secretive habits. This correlates with Meade's (1937, 1946) observations of July breeding habits. A road-killed gravid female from Florida (collected in August 1997, SVL = 119.0 cm) had three large ova and approximately nine additional vascularized areas in the right oviduct, indicating she had recently oviposited part of her clutch (Means and Christman 1998).

Many studies of snake reproduction have addressed the relationship between female body size and the relationship between clutch mass and clutch size (e.g., Brodie and Ducey 1989; Ford and Seigel 1989; Tinkle 1957; Kofron 1979a, 1983; Santos and Llorente 2001; Voris and Jayne 1979; White et al. 1982), finding reproductive plasticity in female life-history traits. For example, when exposed to periods of low foraging success prior to vitellogenesis, clutch mass and clutch size may decrease (e.g., Seigel and Ford 2001). However, female body size seems to have little effect on mean follicle length. Within a species, mean follicle length is simply a function of development, thus follicle size is a function of time and not female body size. We found no relationship between female body size and mean follicle length during reproduction (Fig. 3). However, upon separating out each developmental size class (i.e., Class I, II, and III), we found a significant relationship between SVL and Class I follicle size. Kofron (1979b) examined reproductive age and ovarian morphology of seven aquatic snake species in south-central Louisiana, not including *F. abacura*. He measured follicles and classified them according to the system that we used here and showed that follicles of all seven species were in Classes I and II at the end of the first reproductive year. Class III follicles were present at the end of the second reproductive year, and then rapidly enlarged to Class IV during the spring of the third reproductive year just prior to ovulation. Although we did not demonstrate a SVL-dependent mean follicle size among females, individual females most likely produce larger follicles with increasing age and body size (Betz 1963; Kofron 1979b). This might explain why we observed a significant relationship between SVL and only Class I follicles. Most of our observation for Class I follicles (56%) were from females less than 80 cm SVL.

We hope the information gathered from museum specimens and presented here aids future investigators studying the seasonal timing of reproduction in *Farancia*.

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Appendix I

Specimens of *Farancia abacura* examined. Standard museum symbolic codes for institutional resource collections follow Leviton et al. (1985).

USA:

Florida: Dade Co.: TNHC 50103, Lake Co.: OMNH 18993, Putnam Co.: OMNH 34414

Louisiana: Avoyelles Co.: LSUMZ 2724, LSUMZ 75894, LSUMZ 75914, Beauregard Co.: LSUMZ 22552, Bossier Co.: LSUMZ 24247, Caddo Co.: LSUMZ 4838, Cameron Co.: TCWC 17417, East Baton Rouge Co.: LSUMZ 2723, LSUMZ 5959, LSUMZ 11895, LSUMZ 20331, LSUMZ 20332, LSUMZ 24248, LSUMZ 24249, LSUMZ 31246, LSUMZ 38093, LSUMZ 38959, LSUMZ 39191, LSUMZ 44913, LSUMZ 65908, LSUMZ 83190, LSUMZ 83386, LSUMZ 83390, LSUMZ 84521, East Feliciana Co.: LSUMZ 2725, LSUMZ 6109, LSUMZ 9121, LSUMZ 18296, LSUMZ 34306, Evangeline Co.: LSUMZ 29097, LSUMZ 58466, LSUMZ 58467, LSUMZ 74846, LSUMZ 75895, Franklin Co.: LSUMZ 43537, Grant Co.: LSUMZ 74849, Iberbville Co.: LSUMZ 18770, LSUMZ 46868, LSUMZ 75888, LSUMZ 75889, Jefferson Co.: LSUMZ 9163, LSUMZ 9164, LSUMZ 18282, LSUMZ 58389, LSUMZ 58454, LSUMZ 58455, Jefferson Davis Co.: LSUMZ 59063, Lafayette Co.: LSUMZ 74848, LSUMZ 75909, Lafouche Co.: LSUMZ 19178, Livingston Co.: LSUMZ 12884, LSUMZ 13008, LSUMZ 55927, LSUMZ 79283, LSUMZ 80501, LSUMZ 80503, Natchitoches Co.: LSUMZ 75896, LSUMZ 83451, LSUMZ 83485, LSUMZ 83504, LSUMZ 84597, LSUMZ 84674, Orleans Co.: LSUMZ 9162, LSUMZ 14154, Plaquemines Co.: LSUMZ 75900, Pointe Coupee Co.: LSUMZ 4149, LSUMZ 18295, Rapides Co.: LSUMZ 74853, LSUMZ 75869, LSUMZ 75893, Richland Co.: LSUMZ 42524, St. Landry Co.: LSUMZ 20330, LSUMZ 74850, LSUMZ 75862, LSUMZ 75868, TCWC 38241, St. John the Baptist Co.: LSUMZ 39805, LSUMZ 58438, LSUMZ 59624, LSUMZ 80948, St. Martin Co.: LSUMZ 74843, LSUMZ 74844, LSUMZ 74845, LSUMZ 74847, LSUMZ 74851, LSUMZ 75866, LSUMZ 75891, LSUMZ 75892, LSUMZ 75897, LSUMZ 75898, LSUMZ 75907, LSUMZ 75913, LSUMZ 75915, LSUMZ 75916, LSUMZ 75917, LSUMZ 75910, LSUMZ 75911, LSUMZ 75912, LSUMZ 79053, St. Mary Co.: LSUMZ 75890, LSUMZ 75899, St. Tammany Co.: LSUMZ 24098, LSUMZ 24099, LSUMZ 28816, LSUMZ 58518, LSUMZ 80255, LSUMZ 80898, LSUMZ 81207, Tangipahoa Co.: LSUMZ 17674, LSUMZ 23175, LSUMZ 47458, LSUMZ 57956, LSUMZ 57959, LSUMZ 57960, LSUMZ 80507, LSUMZ 80508, LSUMZ 80509, LSUMZ 80510, LSUMZ 80511, Terreborne Co.: TCWC 74150, Terreborne Co.: TCWC 71458, Vernon Co.: LSUMZ 20174, Washington Co.: LSUMZ 21026, West Carroll Co.: LSUMZ 20333

Mississippi: Attala Co.: LSUMZ 75989, Hancock Co.: LSUMZ 41368, LSUMZ 19176, Jackson Co.: LSUMZ 57957, Sharkey Co.: LSUMZ 47883

Oklahoma: McCurtain Co.: OMNH 30111, OMNH 38351, OMNH 24380, OMNH 30706

South Carolina: Charleston Co.: LSUMZ 36919, Jasper Co.: LSUMZ 74432
Tennessee: Lake Co.: LSUMZ 74856
Texas: Anderson Co.: TCWC 64992, TCWC 81207, Angelina Co.: SFA 654, Aransas Co.: TCWC 81205, Austin Co.: TCWC 4583, TCWC 6453, Burleson Co.: TCWC 18279, Brazoria Co.: TCWC 53155, Brazos Co.: TCWC 5164, TCWC 13838, TCWC 45620, Chambers Co.: TCWC 60707, Colorado Co.: TCWC 64322, Dewitt Co.: TCWC 82477, Fort Bend Co.: TCWC 81641, Galveston Co.: TCWC 27368, Grimes Co.: TCWC 64991, TNHC 36319, Hardin Co.: TNHC 4534, TNHC 19800, TNHC 21940, TNHC 28728, Harris Co.: TCWC 183, TCWC 8711, TCWC 18278, Harrison Co.: TCWC 79273, Houston Co.: TCWC 67299, Jackson Co.: TCWC 29467, Jasper Co.: SFA 2896, TCWC 48425, TCWC 78732, Jefferson Co.: TCWC 8710, TCWC 16178, Leon Co.: TCWC 2614, TCWC 5158, TCWC 5159, TCWC 5160, TCWC 5161, TCWC 5162, TCWC 5163, TCWC 5177, TCWC 8709, TCWC 8712, Liberty Co.: TNHC 21846, Madison Co.: TCWC 17389, TCWC 49322, Morris Co.: TCWC 78731, Montgomery Co.: TCWC 57916, TCWC 68233, TCWC 68237, TCWC 81209, TCWC 82476, Nacodoches Co.: SFA, SFA 1216, SFA 1233, SFA 2033, SFA 2291, SFA 2309, Newton Co.: TCWC 48426, Orange Co.: TCWC 33646, TNHC 21963, Refugio Co.: TNHC 20583, TNHC 32202, San Jacinto Co.: LSUMZ 34289, Tyler Co.: TCWC 78730, TCWC 81204, Victoria Co.: TCWC 70080, Walker Co.: TCWC 67234, TCWC 82818, Wharton Co.: TCWC 4757, TCWC 81206
Unknown Locality: SFA, SFA, TCWC 31956

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Aquatic Chytrid Pathogen Detected in Terrestrial Plethodontid Salamander

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A conservative estimate by Stuart et al. (2004) identified declines in 43% of all amphibian species worldwide. Three major causes were recognized as underlying these rapid global declines: overexploitation, habitat reduction, and enigmatic agents (Stuart et al. 2004). Enigmatic agents (mainly pathogens) may be responsible for driving nearly a quarter of the world's amphibian species towards rapid extinction (Stuart et al. 2004). The main relationship currently recognized between a pathogen and amphibian declines has been with the chytrid fungus *Batrachochytrium dendrobatidis* (Chytridiomycota) (Carey et al. 2003). This emerging fungal pathogen causes the disease chytridiomycosis and is responsible for amphibian declines, die-offs, and possible extinctions (Berger et al. 1998; Bosch et al. 2001; Carey et al. 2003; Daszak et al. 1999; Green et al. 2002;, Muths et al. 2003). *Batrachochytrium dendrobatidis* has been considered an aquatic pathogen because it requires water to transmit zoospores (Longcore et al. 1999) and cannot survive desiccation (Johnson et al. 2003). In wild populations of amphibians, chytridiomycosis has only been associated with aquatic habitats and surface water. We report here the first case of chytridiomycosis in a wild-caught, strictly terrestrial salamander. Our discovery expands the known ecological occurrence of this deadly pathogen into the terrestrial community, and indicates that many more amphibians, not just those associated with aquatic habitats, are potentially vulnerable to the disease.

We observed a *B. dendrobatidis* infection through histological examination in wild-caught terrestrial Jemez Mountains Salamander (*Plethodon neomexicanus*, Plethodontidae), a species endemic to the relatively dry slopes of the Jemez Mountains, New Mexico, USA. A single gravid adult female (specimen 18810; U.S. Geological Survey, National Wildlife Health Center, Madison, Wisconsin; mass: 2.57 g; SVL: 63.3 mm) was collected in a meadow with a few aspen trees (*Populus tremuloides*) (2950 m elev.). The infected salamander had typical foci of infection around the vent containing multiple zoosporangia of *B. dendrobatidis* and black flakes of unshed skin around the vent (Fig. 1A), characteristic of abnormal ecdysis (Berger et al. 1998). Cytological and histological examinations of the abnormal molt and epidermis revealed thalli and zoosporangia of *B. dendrobatidis* (Fig. 1B, 1C). In addition, a PCR-based assay, which amplifies the internal transcribed spacer regions of the rDNA cassette specific to *B. dendrobatidis* (Annis et al. 2004), confirmed the presence of DNA of *B. dendrobatidis* in skin of the ventrum and tail.

This first report of chytridiomycosis in a wild-caught, strictly terrestrial species suggests that *B. dendrobatidis* survives in terrestrial habitats. The persistence and transmission mechanisms of the pathogen in terrestrial communities remain largely unknown. It is possible that the fungus was transmitted to this salamander either by direct or indirect contact with sympatric infected aquatic amphibians. Other sympatric amphibians include Tiger Salamanders (*Ambystoma tigrinum*) and Boreal Chorus Frogs (*Pseudacris maculata*).

Although Stuart et al. (2004) concluded that enigmatic agents are primarily affecting Neotropical montane stream-associated species, it is generally accepted that surface water-associated amphibian species on all continents are at serious risk from *B. dendrobatidis.* Despite suspected declines in some terrestrial salamanders (Parra-Olea et al. 1999), and a report of chytridiomycosis in a captive terrestrial salamander (Pasmans et al. 2004), this pathogen has not been a major concern in strictly terrestrial frogs, salamanders, or caecilians because of their dissociation from surface water. The discovery of chytridiomycosis in a wild-caught terrestrial salamander significantly expands the potential host-range of *B. dendrobatidis*, suggesting that many more amphibians are at risk than previously thought.

Terrestrial communities might play a heretofore unrecognized, but important role, in the distribution, persistence, or dispersal of this epizootic pathogen. Whereas effective methods of control of *B. dendrobatidis* in sites of natural amphibian populations are unknown, attention should be directed towards limiting the spread

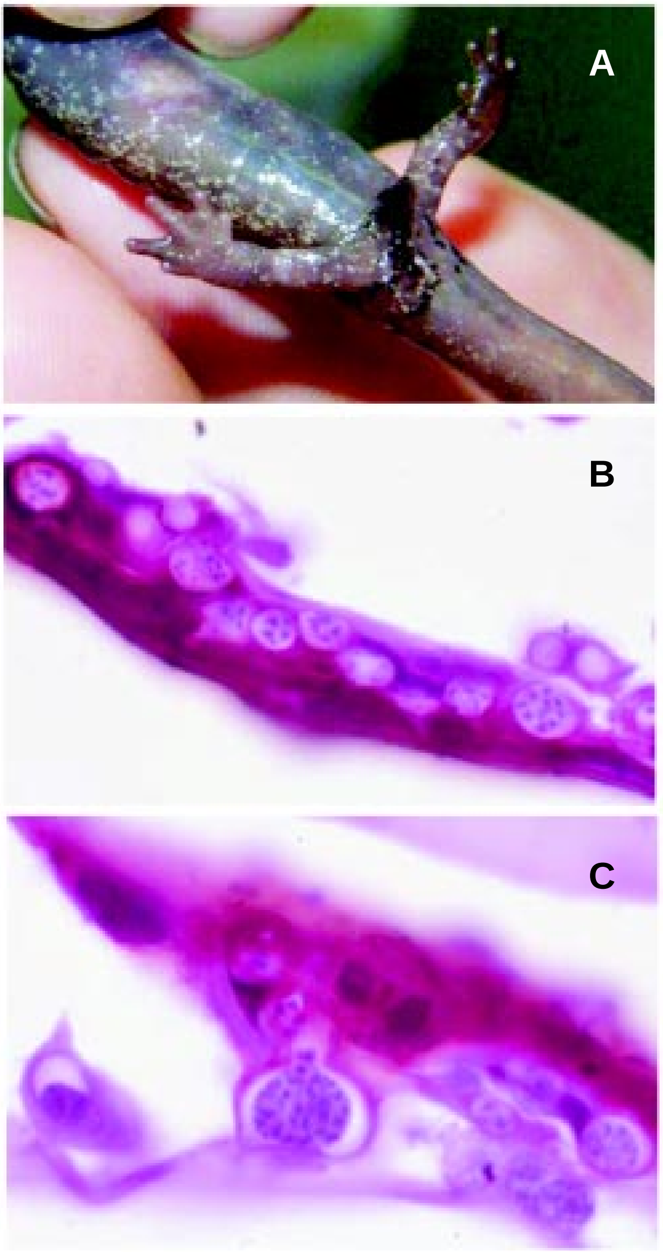

FIG. 1. Infection of *Batrachochytrium dendrobatidis* in terrestrial Jemez Mountains Salamander (*Plethodon neomexicanus*). A) Infected female with abnormal (black) spots around vent as it appeared after 11 days at 4˚C. The black foci were limited to ventral skin and consisted of abnormally retained flakes of molt (dys-ecdysis). B) Histological section (hematoxylin and eosin [H&E] stain, 1000x) of abnormal molt showing numerous spherical zoosporangia of *B. dendrobatidis*. C) the larger flask-shaped chytrid thallus at bottom center is filled with zoospores and shows a characteristic discharge pore at the 12 o'clock position (H&E stain, 1000x).

of the agent by strict biosecurity measures in the field to prevent anthropogenic transmission and dispersal. Continued and expanded efforts to monitor the status of amphibian populations worldwide, to understand the biology of this pathogen, and to investigate the complex interactions of this host-pathogen system are urgently needed to reduce global losses of amphibian species.

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Description of the Tadpole of *Pseudopaludicola boliviana* (Anura: Leptodactylidae)

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The genus *Pseudopaludicola* consists of frogs of small size (< 20 mm SVL [snout–vent length]) and they are distributed in the oriental region of South America, from the north of Colombia to the Province of Buenos Aires in Argentina. Frost (2004) recognized 12 species of *Pseudopaludicola*: *Pseudopaludicola boliviana*, *P. canga*, *P. ceratophryes*, *P falcipes*, *P. llanera*, *P. mirandae*, *P. mineira*, *P. mystacalis*, *P. pusilla*, *P. riopiedadensis*, *P. saltica*, and *P. ternetzi*. Lynch (1989) and Lobo (1994, 1995, 1996) studied the systematics of the genus exhaustively. In Argentina, the species of the genus *Pseudopaludicola* are *P. falcipes* (Hensel 1867); *P. mirandae* (Mercadal de Barrio y Barrio 1994); *P. mystacalis* (Cope 1867) and *P. boliviana* Parker 1927 (Lavilla and Cei 2001). The first citation of *P. boliviana* for Argentina was for the Province of Chaco (Lobo 1989, 1990).

Pseudopaludicola boliviana belongs to the *Pseudopaludicola pusilla* group, in which the included species (*P. boliviana, P. canga, P. ceratophyes, P. llanera, and P. pusilla*) have toes with T-shaped terminal phalanges. The distribution of these species in South America is widespread. *Pseudopaludicola boliviana* is distributed in disjunct regions of eastern Colombia, northern Brazil (Roraima), and southern Venezuela through Guyana to Surinam and French Guiana, eastern Bolivia, Paraguay, southwestern Brazil, and northern Argentina; *P. canga* is known only from the type locality, Serra dos Carajás, municipality of Marabá, state of Pará, Brazil; *P. ceratophyes* is known only from Leticia, Colombia; *P. llanera* in northeastern Colombia and adjacent Venezuela in the drainage of the Río Orinoco, and *P. pusilla* is distributed in the lower and middle Magdalena River valley and the Caribbean lowlands of northern Colombia and adjacent Venezuela.

In Argentina, *P. boliviana* is distributed in the provinces of Formosa, Chaco and northern Santa Fé (Lobo 1992). Recently, Duré et al. (2004) also cited this species for the Province of Corrientes, the first record east of the Paraná River. Until the present**,** tadpoles of species belonging to the *Pseudopaludicola pusilla* group have not been described. In this paper, we describe *P. boliviana* tadpoles from Corrientes, Argentina.

Materials and Methods.—The tadpole description of *P. boliviana* is based on specimens collected in a rice field located 30 km NE of the city of Corrientes (27˚30'S; 58˚45'W), Province of Corrientes, Argentina. Specimens (N = 16) were collected by us on 4 December 2003. A subset of those individuals (N = 10) was raised in the laboratory through metamorphosis to confirm the species identification. The remaining tadpoles (N = 6) were preserved in 10% formalin.

Descriptive terminology follows that of Altig and McDiarmid

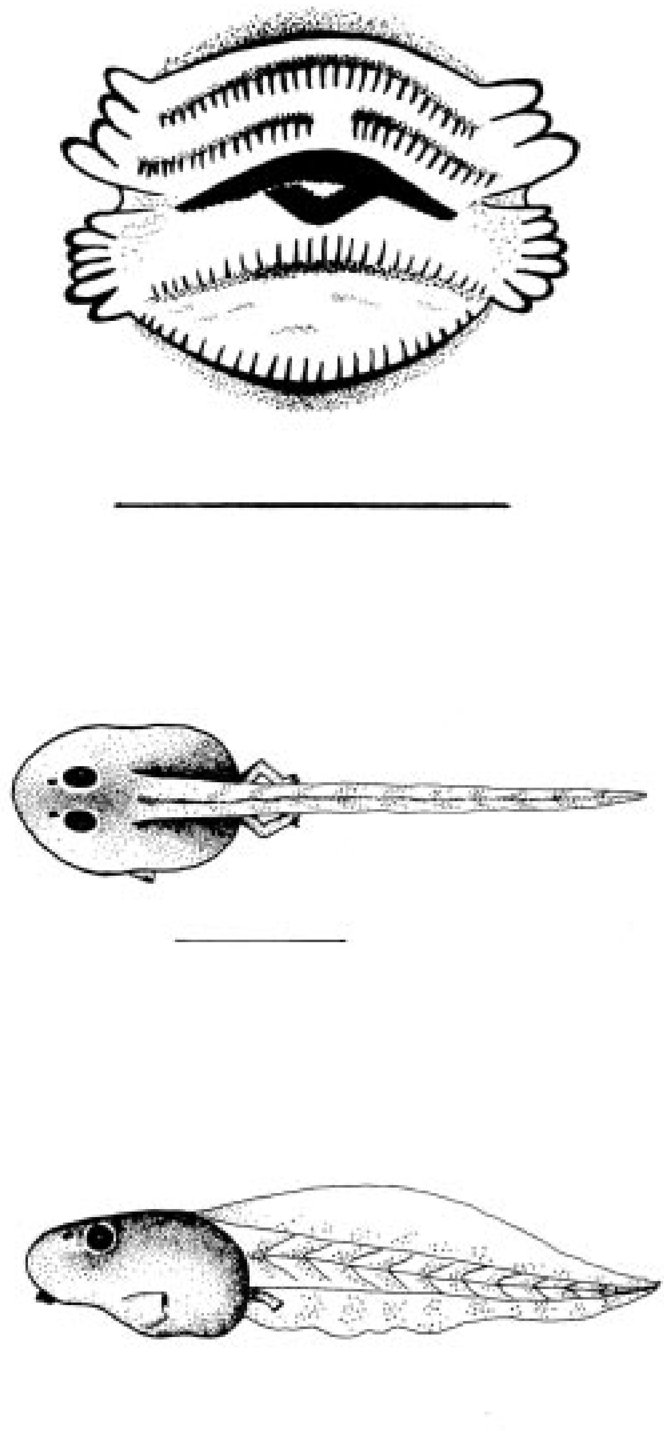

FIG. 1. Oral disc, dorsal and lateral views of *Pseudopaludicola boliviana* tadpole, CECOAL 005, from Corrientes, Argentina. Gosner stage 36. Scale line: 1 mm, 5 mm, and 5 mm (top to bottom).

(1999) and Kehr and Williams (1990). The morphometric variables considered are those suggested by Kehr et al. (2004). Measurements were taken with dial caliper and recorded to the nearest 0.1 mm; these variables are abbreviated as follows: TL (total length), BL (body length), TaL (tail length), BW (body maximum width), BWE (body width at eyes), BWN (body width at nostrils), BH (body

maximum height), FH (fin height), TMH (tail muscle height), RSD (rostro–spiracular distance), SPD (spiracular–posterior distance), FN (fronto–nasal distance), NO (narial–ocular distance), N (nostril diameter), E (eye diameter), EN (extranarial distance), IN (internarial distance), EO (extraorbital distance), IO (interorbital distance), ODW (oral disc width), RG (rostral gap), MG (mental gap). Tadpoles were staged using Gosner's table of normal development (Gosner 1960). Drawings were made with the aid of a camera lucida attached to a Wild M3C stereomicroscope.

Results and Discussion.— The specimen illustrated (CECOAL 005) (Fig. 1) is at Gosner stage 36 and has the following measurements in mm: TL = 18.8, BL = 7.0, TaL = 11.8, BW = 4.8, BWE = 4.3, BWN = 3.4, BH = 3.8, FH = 4.2, TMH = 1.7, RSD = 4.5, SPD = 2.8, FN = 1.0, NO = 0.4, N = 0.1, E = 1.0, EN = 1.0, IN = 0.8, EO = 2.4, IO = 0.9, ODW = 1.3, RG = 0.9, MG = 0.9. Table 1 summarizes the measurements of tadpoles in different stages collected at the same time with the tadpole described here.

TABLE 1. Measurements (in millimeters) of *Pseudopaludicola boliviana* tadpoles from Corrientes, Argentina. The individuals (N = 5) were collected together with the tadpoles described in the text. Tadpoles were staged according to Gosner (1960).

	Stage				
Morphometric variables	30	31	41	41	41
TL (total length)	9.6	10.4	19.3	18.4	19.6
BL (body length)	3.8	4.2	7.0	6.8	7.1
TaL (tail length)	5.8	6.2	12.3	11.6	12.5
BW (body maximum width)	2.7	2.7	5.2	4.7	4.8
BWE (body width at eyes)	2.3	2.5	4.3	4.1	4.2
BWN (body width at nostrils)	1.8	2.0	3.2	2.9	3.2
BH (body maximum height)	2.1	2.3	4.0	3.6	3.5
FH (fin height)	1.6	1.6	3.4	3.7	3.9
TMH (tail muscle height)	0.6	0.8	1.8	1.6	1.3
RSD (rostro-spiracular distance)	2.2	2.9	4.3	4.4	4.6
SPD (spiracular-posterior distance)	1.3	1.2	2.5	2.4	2.5
FN (fronto-nasal distance)	0.5	0.7	1.0	0.9	1.0
NO (narial-ocular distance)	0.2	0.2	0.2	0.4	0.3
N (nostril diameter)	0.1	0.2	0.3	0.2	0.2
E (eye diameter)	0.6	0.6	1.2	1.1	1.2
EN (extranarial distance)	0.6	0.6	1.5	1.2	1.2
IN (internarial distance)	0.5	0.4	0.8	0.8	0.9
EO (extraorbital distance)	1.5	1.4	2.9	2.7	3.0
IO (interorbital distance)	0.5	0.5	1.0	0.9	1.0
ODW (oral disc width)	0.6	0.7	1.3	1.2	1.1
RG (rostral gap)	0.5	0.6	1.0	0.9	1.0
MG (mental gap)	0.3	0.6	0.7	0.6	0.6

Tadpoles of *P. boliviana* have an ovoid body, wider than high (BW/BH = 1.3). Snout rounded in lateral and dorsal views; nostrils dorsal, located nearer eyes than snout; eyes dorsolateral. Spiracle single, sinistral, and ventrolateral, visible in dorsal view; vent tube 1.8 mm long, positioned and opening medially; tail 63% of total length; the maximum tail fin height is greater than that of the body; dorsal fin extending slightly onto body, and is higher than ventral fin; tail tip pointed-rounded.

Oral disc positioned anteroventral to ventral; single row of 3–4 large marginal papillae on each side of the rostral gap and six large marginal papillae on each side of the mental gap, with a small gap separating the two groups of marginal papillae on each side; mental gap 0–0.6 times lower than rostral gap; labial tooth row formula 2(2)/2 (Fig. 1); labial teeth, with two to four cusps; length of tooth rows: Al = 0.9 mm, A2 = 1.0 mm, gap of A2 = 0.2 mm; P1 = 1.1 mm, P2 = 0.9 mm; upper jaw sheath approximately 0.7 mm long; upper jaw sheath and lower jaw sheath serrated; upper jaw sheath broadly arch-shaped, lower jaw sheath V-shaped.

In life, dorsally, the body is brown with scattered dark spots; small dark spots start at the caudal musculature; two dark spots on each eyelid; iris with scattered golden spots; laterally, body pale brown, and base of spiracle pigmented; the caudal musculature with small bands darker among each muscular package; the dorsal fin clearer than ventral fin; ventral fin with scattered golden spots and melanic bands; ventrally, intestinal coils not visible, intestinal area with golden color; throat with scattered golden spots. In preservative, body light olive or gray with small dark and reticulate spots; throat semitransparent and intestinal coils barely visible through skin; tail fins transparent with small, black patches of melanin mainly on the ventral fin.

This is the first tadpole described for a species of the *Pseudopaludicola pusilla* group. In Corrientes, in the same area where *P. boliviana* is very common, there were also developing tadpoles of *P. falcipes*. Lamentably, information is scarce about the morphology of *P. falcipes* tadpoles and only the oral disc features are well detailed (Barrio 1945, 1953; Cei 1980). The differences between the tadpoles of these two syntopic species are: (1) *P. falcipes* without mental gap (*P. boliviana* present) and, (2) *P. falcipes* with labial tooth row formula 2(2)/3 (*P. boliviana* 2(2)/2). Lavilla and Cei (2001) cited two additional species occurring in the Province of Corrientes: *Pseudopaludicola mystacalis* (Cope 1867) and *P. mirandae* Mercadal de Barrio and Barrio (1994). The tadpoles of these species are unknown.

Until now, considering the tadpole described here, there are only three species of the genus *Pseudopaludicola* with the tadpoles described: *P. boliviana* (described here), *P. falcipes* (Barrio 1945, 1953) and *P. ternetzi* (Lobo 1991). In reality, the tadpole described by Lobo (1991) was considered a posteriori as *P. ternetzi* (Lobo 1994) because this author described this tadpole as *P. mystacalis*. It is probable that *P. ternetzi* is not present in Argentina as its known range is otherwise restricted to Goias, Brazil; nevertheless we will compare the morphological features between *P. boliviana* and *P. ternetzi* tadpoles: (1) both tadpoles share the same labial tooth row formula 2(2)/2; (2) *P. ternetzi* lacks a mental gap (*P. boliviana* present) and, (3) total length and body lengths are similar in the two tadpoles (stages 36–37) (*P. ternetzi*: 20.8

mm and 7.3 mm respectively; *P. boliviana*: see Table 1).

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Glueboards for Estimating Lizard Abundance

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Trapping animals without the use of bait reflects the density of the captured species and the level of that species' activity on the surface sampled. Trap capture with bait additionally reflects the attraction of the bait, environmental conditions affecting bait sensory cue detection, and the motivation level of the animal, among other variables. When the variable of interest is population density, the other factors (activity level, habitat, motivation, etc.) are nuisance variables that increase variance, but do not necessarily bias the relationship between the chosen index (typically captures/trap h) and the phenomenon of interest (population density). The strength of each such relationship is a crucial methodological attribute. Unfortunately, the precision of the statistical correlation between trap capture success and population density is rarely known. We are not aware of any study that has quantified the precision of population estimation using trap capture of reptiles. The development of total removal sampling (Rodda et al. 2001a) has made possible the estimation of this relationship for small herpetofaunal assemblages. Using total removal sampling, we sampled the herpetofauna of islands of the Pacific Ocean, Indian Ocean, and the West Indies in small (10 × 10 m) plots. By preventing immigration/emigration while removing all aboveground vegetation, we were able to completely enumerate (census) the absolute density of each species in the plots. We estimated relative population densities for small lizards on the basis of glueboard capture rates obtained concurrently from traps set in a ring surrounding each total removal plot. Given the close geographic correspondence between the sample areas, we expected a tight correlation between glueboard capture rates and absolute population densities.

The precision of a bivariate relationship is traditionally characterized by r^2, the squared correlation coefficient. We report this value, but in addition report a new metric of population estimation precision: percentile range of the population densities corresponding to the 95% confidence limits of a midrange relative population density estimate. One weakness of r^2 as a metric of precision is that it is a ratio that reflects changes in both the numerator and denominator. Without changing the precision of a relationship, r^2 can be increased by extending the range of values being correlated. A more intuitive weakness of r^2 in this case is that it is measured in units that do not relate directly to the feature being estimated. That is, it does not express uncertainty about popula-

tion density estimate in terms of population density.

For a specific system, confidence limits can be expressed in terms of absolute density (e.g., 8–14/ha). Unfortunately, such ranges cannot be used to compare the precision of estimates among different species or habitats. Typical measures of dispersion, such as standard errors, assume normality. Densities are unlikely to be normally distributed—ours were not. Percentile ranks, because they make no assumptions about the shape of the underlying distribution, are more general.

Consider an ideal linear relationship between a relative and absolute population abundance measure. In a hypothetical example, trap capture yield varies 0–100 captures/trap h. At midrange, about 50 captures/trap h, the true density of our hypothetical taxon is about 10/ha, which is the 50th percentile of known abundance (which in this example ranges 0–25/ha). Furthermore, the 95% upper and lower confidence limits (CL) of our estimate are 8/ha and 14/ha, which are the 40th and 60th percentiles of known abundance respectively. Thus a midrange relative population estimate provides us with the knowledge that 95% of the time the true density of a population producing 50 captures/trap h will fall within the 40th–60th percentile range, and the single best estimator is at the 50th percentile, or 10/ha. A less precise relationship might have indicated only that the true value was in the range of 25th–75th percentiles, and a worthlessly imprecise measure would cover the full range of possibilities: 0–100th percentile. The central question of our study was: what percentile range of true densities is associated with the 95% confidence limits on a relative population measure at midrange?

The answer to this question is, unfortunately, context specific. We consider three possible sources of variance—species, habitat, and island—within the context of our specific sample size. A different sample size would produce different degrees of precision, but our sample sizes are typical and can therefore be used to illustrate the types of challenges facing an effective relative population measure.

Relative population estimators, indices, or counts are assumed to be proportional to true density. That is, if a later count were three times that of an earlier count, we could assume that the true density has increased threefold. If that condition is met for all possible changes, the regression of true density on sample density will form a straight line that passes through the origin, the slope reflecting the detectability of the species. The slope represents average detection multiplier (= $\hat{N}/\bar{n}$); alternately, the inverse of slope represents average detection fraction or $\hat{p}$ (= $\bar{n}/\hat{N}$), where $\hat{N}$ is the best estimator of absolute abundance and $\bar{n}$ is the average index value (in our case, glueboard capture rate). If the detection fraction ($\hat{p}$) is constant over the range of densities considered, the points will lie along a line radiating from the origin. A y-intercept deviating significantly from zero indicates inconstancy in the detection fraction, and therefore a relative population estimator that will not be proportional. In our experience, the detection fraction tends to be reduced at low population densities, leading to a positive y-intercept. Inconstancy in the detection fraction will produce bias in population estimates, but the bias can be eliminated if the form and magnitude of the detection fraction inconstancy is quantified. We begin this process by quantifying the direction and magnitude of y-intercept deviations from zero.

The estimation of absolute population density is implicit rather than explicit in many population studies. Often, temporal or spatial differences in relative abundance are of greater interest than is population density per se. A temporal change is often expressed as a ratio of follow-up count or index divided by the baseline index or count. Suppose that a later trap capture rate is twice that of an earlier one: we would like to infer that the target species has doubled in density. The confidence limits on this inference can be approximated by regressing known ratios of absolute population densities on the corresponding ratios of relative population estimates. For example, we might find that the absolute population density changed from 1400/ha to 1700/ha, a ratio of 1.21. This is not exactly the expected ratio of 2.0, but some error is expected. In the absence of error, all corresponding ratios would be equal and therefore would lie on the line Y = X. If the points lie along a different slope, we can infer that the underlying conceptual model (i.e., constant detectability) is in error. Note that any comparison between two estimates involves at least two opportunities for inferential or estimation errors. Confidence limits on a comparison of estimates will therefore always be wider than the confidence limits on a single inference. In this paper we regress the ratios of all pairs of absolute abundances on the corresponding relative population measures to inspect the form of the relationship and quantify the precision of such inferences for each species.

Our data were collected during 1995–2000 with 38 total removal plots; 22 on the island of Guam, six on Rota, four on Saipan (Mariana Islands, western Pacific), two on Ile aux Aigrettes (Mauritius outlier, Indian Ocean), and four on Guana (north of Tortola, British Virgin Islands, West Indies). Total removal yields were partially reported in Rodda et al. (2001b), Rodda and Campbell (2002), and Rodda et al. (2005). Four of the 38 total removal plots were 5 × 5 m (0.0025 ha) and 33 others were 10 × 10 m (0.01 ha). The four small plots were obtained from the same area at the same time and, for the purposes of this study, were pooled to represent a single 10 × 10-m plot. The number of individuals captured per species per total removal plot ranged 0–676; nonzero captures per species averaged 21.5/plot (median = 6; sum of total removal captures = 4612). However, many of the lower species counts were omitted from consideration because of small sample size (see below).

We grouped all data into four habitat types: *Leucaena* forest, grassland, *Pandanus* forest, and broadleaf forest (Mueller-Dombois and Fosberg 1998). *Leucaena* forest is notable for the small size and translucency of leaves. *Leucaena* forests are relatively well lit, even in the shadows. *Pandanus* has very large, thick tangled leaves, which inhibit light penetration and create dark mesic forests. The broadleaf forest category included all other forestlands, which exhibited more average light and moisture conditions (unpubl. data).

Glueboard procedures followed Rodda et al. (1993). Glueboards were placed in a circular array of twelve traps on the ground in a ring concentric with the total removal plot at a distance of 5–10 m from the plot perimeter. Ground traps were spaced about 7 m apart. When used, 12 arboreal traps were stapled to a trunk or large limb at approximately breast height, one on the tree nearest each terrestrial trap. Traps were monitored for 24 h beginning at around 0830, but we found that relatively few captures were obtained from ground traps after the first 3 h of trapping. Therefore the capture results from ground traps reported here reflect three morning hours;

Table 1. Results of our analysis comparing absolute population estimates obtained from total removal plots to glueboard capture rates. The slope of best no-intercept regression indicates the detection rate multiplier ($1/\hat{p}$) achieved by glueboard sampling (lower values represent more complete sampling). The y-intercept indicates the constancy in detection over the ranges of densities sampled (higher y-intercept signifies reduced constancy).

Species	Relationship between absolute and relative abundance	Slope of best no-intercept regression	y-intercept (individuals/ha)
Anolis cristatellus	$r^2 = 0.88$, NS	15,840 (SE = 2900)	250 (NS)
Carlia fusca	$r^2 = 0.65$, $P < 0.0001$	4560 (SE = 680)	1511 ($P = 0.072$)
Emoia caeruleocauda	$r^2 = 0.55$, $P < 0.0001$	13,800 (SE = 2570)	1780 ($P = 0.028$)
Gehyra mutilata	$r^2 = 0.27$, $P = 0.016$	212,400 (SE = 78,600)	1330 ($P = 0.043$)
Hemidactylus frenatus	$r^2 = 0.83$, $P < 0.0001$	72,700 (SE = 8520)	350 (NS)
Lepidodactylus lugubris	$r^2 = 0.04$, NS	100,800 (SE = 24,800)	2930 ($P < 0.0001$)
Sphaerodactylus macrolepis	$r^2 = 0.82$, $P = 0.02$	368,300 (SE = 83,400)	10,400 (NS)

arboreal trap results reflect 24 h. Arboreal traps were omitted from three grassland plots and 17 other removal plots. The median placement of glueboards occurred within 19 days (range 1–78 d) of the total removal sample, generally afterwards. Total glueboard sample size for the three well-documented terrestrial species (see below) was 1025 captures in 1982 trap h. Glueboards were far less effective in trees, producing only 88 captures among four reasonably well-documented species in 19,252 trap h. Arboreal lizards were occasionally captured on ground traps; for example, the arboreal *Anolis cristatellus* was captured 9 times in 141.5 ground trap h.

Twenty-four species of lizards, snakes, and frogs were obtained by total removal, but only seven lizard species had sufficient glueboard captures to merit comparison between the techniques. Several of the omitted species warrant mention here: *Anolis carolinensis* was captured 35 times in total removal plots on Saipan, Rota, and Guam, but was caught only once on glueboards. This species thus appears refractory to glueboard capture, perhaps as a consequence of its excellent vision and deliberate movements as a sit-and-wait predator. Data from this species were analyzed through the ANOVA mentioned below, but not otherwise considered. *Bufo marinus* was taken on 45 occasions in total removal plots, but only once on glueboards. Our impression is that this species can routinely disable the glue in glueboards, perhaps by urination. The nocturnal arboreal gecko *Gehyra oceanica* was taken only once on glueboards, despite a sample of 90 individuals in total removal plots. This species ordinarily uses the surfaces on which we place arboreal glueboards and it is firmly grasped by glueboards; its scarcity among captures is therefore perplexing and may be related to its relatively deliberate locomotion. There was no evidence, such as skin remnants on traps, that this species freed itself from the glueboards. Glueboard capture data from *Lepidodactylus lugubris* were included in the following analysis despite our failure to capture it on glueboards in the vast majority of sites (detected by glueboards in only 4 of 31 sites where its presence was confirmed by 625 captures in total removal plots). This species is easily snared by glueboards, but it routinely travels over leaves and other very small diameter perches (Rodda et al. 2005), where placement of glueboards is difficult or impossible. Thus, the following analyses are based on the subset of species that are relatively easy to sample with glueboards.

We performed ANOVAs to identify the factors that influence glueboard capture rate. To be consistent with the proposed use as a metric of relative abundance, we forced the model intercept to pass through the origin (i.e., when the species was absent, capture rate was zero). Because we used a different time period for arboreal than terrestrial glueboards, we performed separate analyses for arboreal and terrestrial species. Furthermore, because we wanted to consider the role of island, we eliminated from ANOVAs all species that we recorded on only one island (i.e., *Sphaerodactylus macrolepis* and *Anolis cristatellus*).

We also regressed the absolute population density on the relative capture rates for each habitat sampled to inspect the form of the relationship and to identify 95% confidence limits for samples of the seven species with sufficient data (*A. cristatellus*, *Carlia fusca*, *Emoia caeruleocauda*, *Gehyra mutilata*, *Hemidactylus frenatus*, *Lepidodactylus lugubris*, and *S. macrolepis*). We had sufficient data for the two terrestrial skinks (*C. fusca* and *E. caeruleocauda*) to further consider the variability of capture rates within a single habitat type, *Leucaena* forest, on two and three islands, respectively. For all seven lizard species we also regressed logs of all pairwise permutations of ratios between non-zero absolute abundances on the corresponding log ratios of non-zero glueboard capture rates to inspect the form of the relationship and identify 95% confidence limits for samples. If each ratio between densities was exactly reflected in the corresponding ratio between trap capture rates, the ratios would lie on the line Y = X. Because the ratios were collected from pairs of plots, the number of ratios differs from the sample size of plots. For example, there are six pairs possible from four nonzero plots.

The ANOVA for terrestrial species indicated that density was associated with glueboard capture rate ($F_{1,35} = 7.99$, $P = 0.0077$), which also exhibited significant interactions with species ($F_{1,35} = 24.38$, $P < 0.0001$), species and habitat ($F_{1,35} = 3.34$, $P = 0.014$), and species and island ($F_{1,35} = 4.81$, $P = 0.0066$). Thus to obtain the most precise estimate of population density from glueboard captures, it would be necessary to calibrate the relationship separately for each habitat*island*species condition.

Five arboreal species were analyzed with ANOVA (*A. carolinensis*, *G. mutilata*, *G. oceanica*, *H. frenatus*, and *L. lugubris*). These did not collectively exhibit a significant relationship between total removal density and glueboard capture rate, although they did exhibit significant effects for habitat ($F_{1,35} = 7.32$, $P_{2,45} = 0.0018$), species ($F_{1,35} = 18.72$, $P_{4,45} < 0.0001$), and habitat*species ($F_{1,35} = 3.12$, $P_{7,45} = 0.009$).

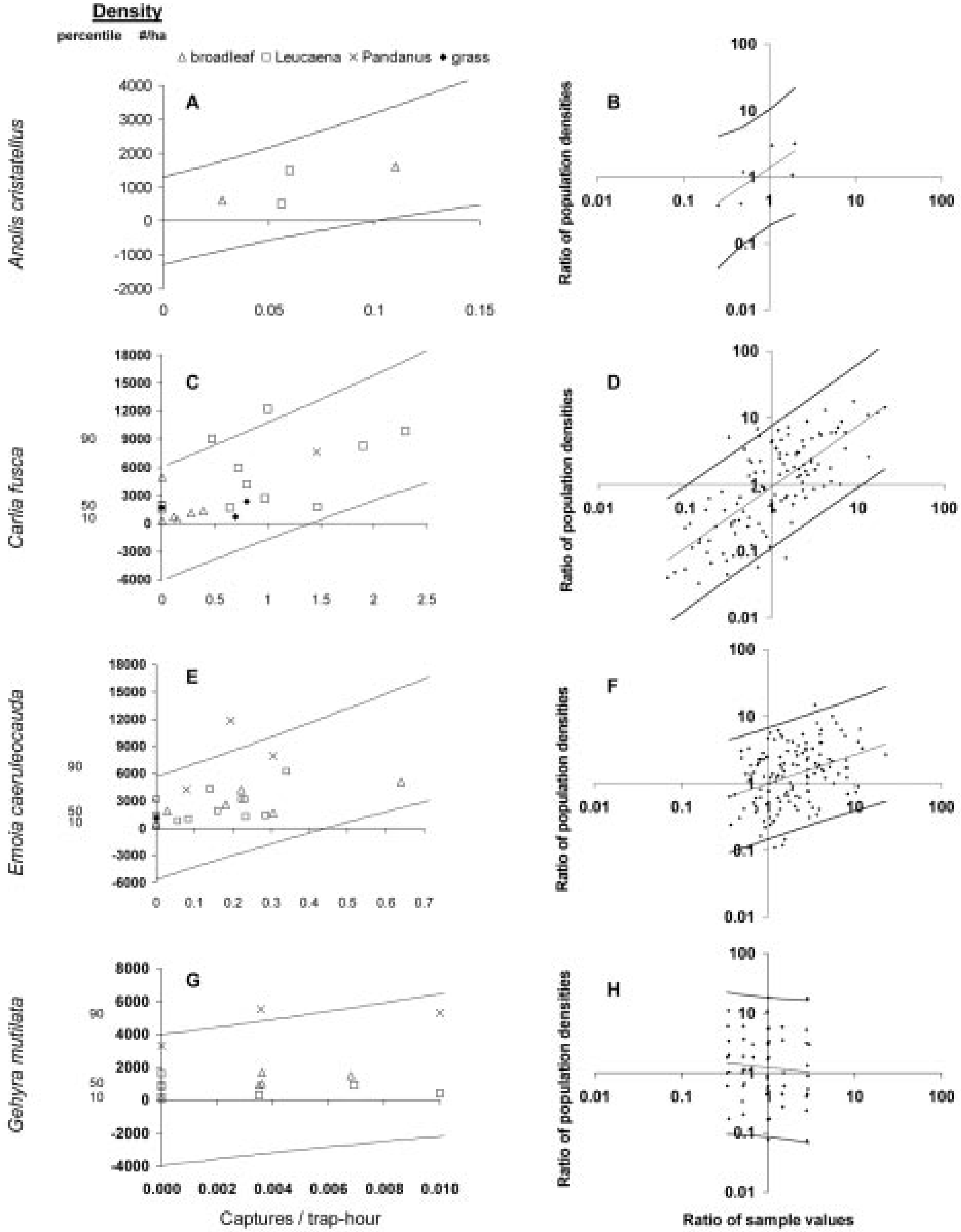

FIG. 1. Glueboard capture rates based on 12 traps for three morning hours for diurnal lizards (A–F), and 12 traps for 24 h for the nocturnal species (G–H). Left-hand graphs relate absolute densities to glueboard capture rates. Right-hand graphs relate pairwise ratios in absolute densities to pairwise ratios in glueboard capture rates. Because each possible pairing of points in the left-hand graphs yields a point in the right-hand graphs, the sample sizes are unequal, although based on the same information. The right-hand graphs are comparable among species, and are scaled identically to facilitate comparison. Outer lines in all panels represent 95% confidence limits for samples. (A) The relationship between absolute density (determined by 10 x 10-m total removal plots) and glueboard capture rate for *Anolis cristatellus* in two habitat types. (B) The relationship between pairwise ratios of *A. cristatellus* total removal population densities and the corresponding ratios of glueboard capture rates. (C–H) Other species as indicated by row headings.

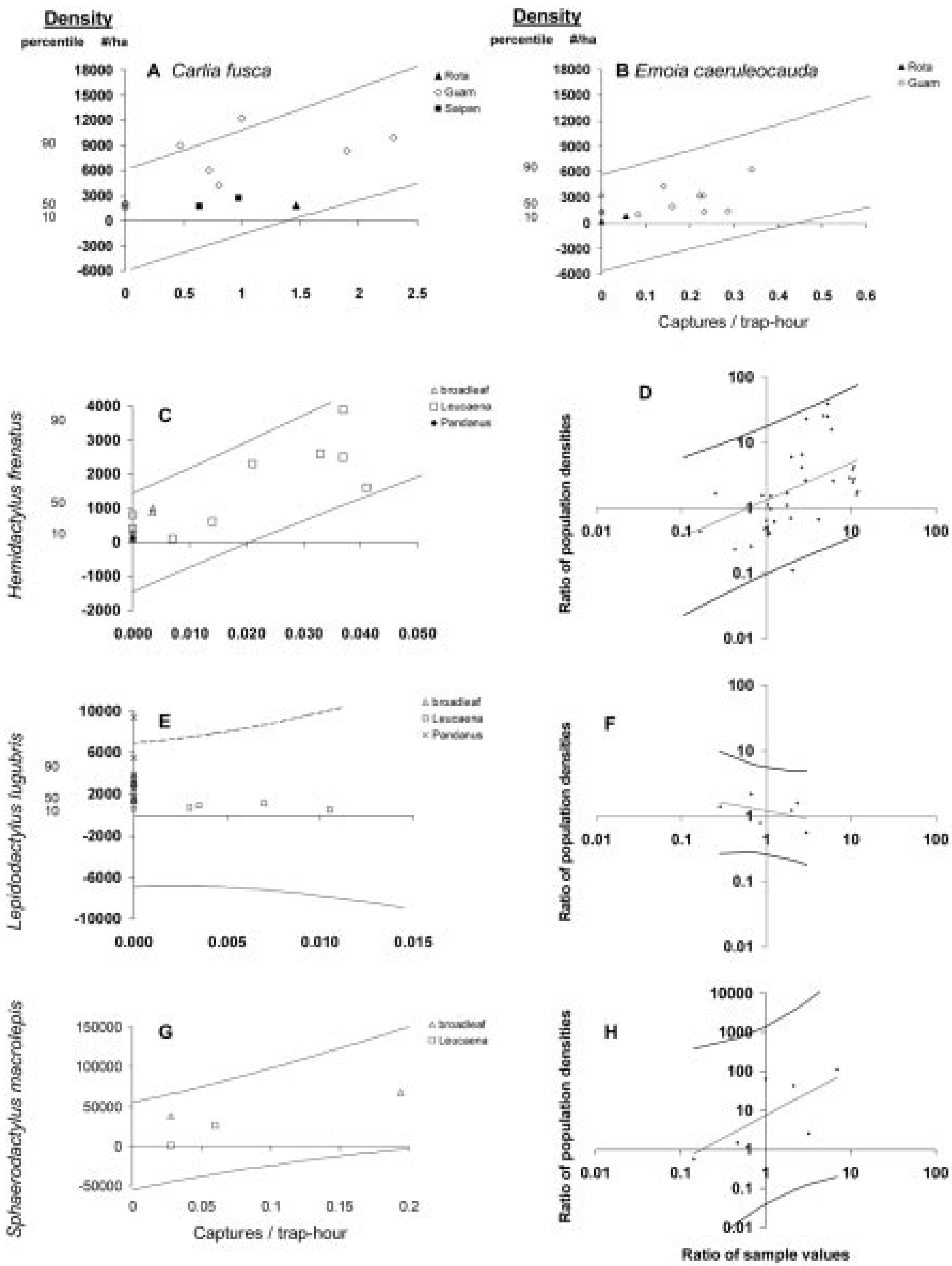

FIG. 2. (A) Relationship between absolute density and glueboard capture rates for *Carlia fusca* in a single habitat type (*Leucaena* forest) on three islands. See Fig. 1 left-hand column for graphical conventions. (B) Same relationship as A for *Emoia caeruleocauda* on two islands. The remainder of Fig. 2 follows the graphical conventions of Fig. 1. Note different scaling on ordinate for H.

The relationship between absolute and relative measures was significant for all but two species (*A. cristatellus* and *L. lugubris*), suggesting a reasonable correlation between methods (Table 1; Figs. 1, 2). However, of the five that were significant, three taxa (*C. fusca*, *E. caeruleocauda*, and *G. mutilata*) were relatively imprecise (r^2 < 0.7). Although an r^2 of 0.7 is satisfactory for many ecological studies, it does not produce adequate precision for correlated population densities estimates. This is most clearly seen from the percentile ranks associated with 95% confidence limits for mid-range capture rates (Table 2). Two of the seven taxa studied (*Anolis* and *Sphaerodactylus*) had confidence limits at mid-range that spanned the entire known range of densities for the species (0–100th percentiles). Four of the remaining five species covered 0–90th percentile or more. At mid-range glueboard capture rates, the best species as ranked by percentile range, *H. frenatus*, covered 0–84th percentiles of abundance, allowing only the inference that the highest population densities could be excluded on the basis of an intermediate glueboard capture rate. Thus, substantially larger sample sizes would be needed to make inferences about the density of these species from glueboard sampling.

TABLE 2. Confidence limits at midrange on the computed relationship between absolute population density and glueboard capture rates. The 95% CL are in units of absolute population density and the ranks give the corresponding percentiles from the observed range of densities for that species.

Species	Midrange capture rate (captures/trap h)	95% CL (individuals/ha)	Percentile range
Anolis cristatellus	0.06	0–2360	0–100
Carlia fusca	1.0	0–10,800	0–97
Emoia caeruleocauda	0.2	0–8500	0–97
Gehyra mutilata	0.005	0–4100	0–90
Hemidactylus frenatus	0.02	0–2940	0–84
Lepidodactylus lugubris	0.005	0–8070	0–97
Sphaerodactylus macrolepis	0.07	0–88,300	0–100

The y-intercepts of the absolute/relative correlations (Table 1) reflect the appropriateness of using glueboard capture rates to quantify the relative densities of populations within a single species, a comparison that assumes index values reflect a constant proportion of the sampled populations. The y-intercepts deviated significantly from the origin for four of seven taxa (*Emoia, Gehyra, Hemidactylus,* and *Lepidodactylus*), implying inconstancy in capture probability over the observed range of population densities. While not significant (based on N = 2), the large y-intercept for *Sphaerodactylus* (10,400 individuals/ha at zero glueboard captures) suggests that capture probability may be variable for this species as well (Table 1).

If index values such as glueboard capture rates are used to compare populations of a single species among different habitats, the y-intercepts associated with those different habitats must be close to zero and the absolute/relative regression slopes must be the same. Both ANOVAs (above) generally falsified this assumption. Too few data were obtained to test this hypothesis rigorously for individual species. However, inspection of Figs. 1 and 2 suggests that the main sources of the significant species*habitat effects may be *Carlia* in *Leucaena* habitat (Fig. 1C), and *Emoia* (Fig 1E), *Gehyra* (Fig. 1G), and *Lepidodactylus* (Fig. 2E) in *Pandanus* habitat. Each of these anomalies was associated with relatively reduced detectability (high absolute densities for low glueboard capture rates). The role of "island" in detectability was inspected with reference to *Carlia* (Fig. 2A) and *Emoia* (Fig. 2B). Although there was no apparent difference between islands for *Emoia* trapping in *Leucaena* forests, detectability of *Carlia* in *Leucaena* habitat appears to be appreciably higher on Guam than on other islands. On the basis of the small number of comparisons conducted, inter-island relative population estimates may be appropriate for *Emoia* but not *Carlia*.

The ratio plots (Figs. 1B, D, F, and H; Fig. 2D, F, and H) address the use of glueboard capture rates for detecting single population changes over time. Only three of the seven comparisons exhibited r^2 values > 0.25 (*Anolis, Carlia,* and *Sphaerodactylus*) but none was > 0.6 (Table 3). Six of the seven species had confidence limits that spanned about two orders of magnitude in abundance, but the limits for *Sphaerodactylus* were exceptionally wide (ca. six orders of magnitude). To be of any value for predicting population density trajectories from the observed change in glueboard capture rates, a ratio plot must have a slope of about 1.0, and a y-intercept passing through the origin (ratio = 1.0). *Anolis* and *Carlia* pass this standard and have relatively narrow confidence limits (spanning ca. two orders of magnitude). However, with such confidence limits one must observe a tenfold change in glueboard capture rates to be 95% certain of rejecting the null hypothesis of no population change.

Constancy of detectability between species is required for in-

TABLE 3. Characteristics of the relationships between absolute population density ratios and relative population density ratios. In these ratio diagrams, an axis value of 1 corresponds to population density equality or, for repeated samples, no temporal change.

Species	Relationship between absolute and relative ratios	Slope (significance test of slope = 1)	y-intercept (significance test of y-intercept = 1)
Anolis cristatellus	r^2 = 0.60, *P* = 0.07	0.87 (NS)	1.37 (NS)
Carlia fusca	r^2 = 0.53, *P* < 0.0001	0.92 (NS)	0.90 (NS)
Emoia caeruleocauda	r^2 = 0.13, *P* < 0.0001	0.99 (NS)	0.43 (*P* < 0.0001)
Gehyra mutilata	r^2 = 0.007, NS	Negative	—
Hemidactylus frenatus	r^2 = 0.25, *P* = 0.002	0.57 (*P* = 0.011)	1.3 (NS)
Lepidodactylus lugubris	r^2 = 0.18, NS	Negative	—
Sphaerodactylus macrolepis	r^2 = 0.52, NS	1.16 (NS)	7.4 (*P* = 0.049)

terspecific comparisons of glueboard capture rates. There was an 80-fold range in the glueboard detectability among well-sampled species (Table 1 slopes; Fig. 3). *Carlia* was the easiest to detect, followed by *Emoia* and *Anolis*. *Sphaerodactylus* and *Lepidodactylus* were nearly undetectable by glueboard sampling. No two of the tested species had detection multipliers that were sufficiently similar to support direct interspecific comparisons.

The general features of this comparison between glueboard capture rates and absolute population densities mirror those obtained from a similar analysis of the relationship between visual encounter rates and absolute population densities (Rodda et al. 2005). In both, high and moderately high r^2 values were associated with negligible precision in some population estimates. With both visual and glueboard detections we found that detectability sometimes differed appreciably among habitats. Furthermore, with both types of detections, species differed substantially in their detectability and in their suitability for single-species monitoring by means of relative population estimates. One hopeful note is that the rank order of detectability for tested species was the same for both methods. Whether detected by glueboards or visual searching, the five species with the most data were ranked (from most detectable to least) in the order *Carlia*, *Emoia*, *Hemidactylus*, *Lepidodactylus*, and *Gehyra*. In both cases *Carlia* was judged reasonably suitable for relative population estimation and *Lepidodactylus* was judged unsuitable. This correspondence of results suggests that some species will be easily sampled through a variety of methods, but it leaves no obvious avenue for estimating the abundance of problematic species such as *L. lugubris*. In contrast to the consistency between methods in relative detectability, visual quantification of *G. mutilata* was found to be especially favorable, whereas this species was found to be unsuitable for population estimation using glueboards. Thus given a choice between visual searching and trapping for population estimation of *G. mutilata*, visual searching is a clear preference.

A result such as that above may provide decisive guidance on selection of a monitoring program for a tested species, but it leaves open the question of whether one can extrapolate from these results to species or systems that have not undergone the costly validation tests performed here. The detectability differences summarized in Fig. 3 reinforce the generalization that no single unadjusted sampling method can be used interspecifically.

Even if small lizards differ in detectability among species, habitats, islands, and densities, it may be possible to use relative population estimators (index values) if the detection biases are predictable. Do basic niche dimensions clarify the range of detection possibilities? The first four species illustrated in Fig. 3 are arboreal, the latter three are terrestrial. The first species (*A. cristatellus*) and the last three (*Carlia*, *Emoia*, and *Sphaerodactylus*) are diurnal, the others nocturnal. Neither of these ecological distinctions appears to offer strong guidance on detectability (Fig. 3) or suitability for glueboard monitoring (Figs. 1, 2). Perhaps studies of additional species will clarify general patterns. In that regard, we find it notable that the two species of *Anolis* we tested differed so dramatically in detectability, despite the species being closely related, of similar dietary habits and size, and occupying similar positions in their habitats (both are primarily trunk dwellers where they were tested: *A. carolinensis* occupies canopy positions in its native range, but is typically found much lower on the small trees sampled in

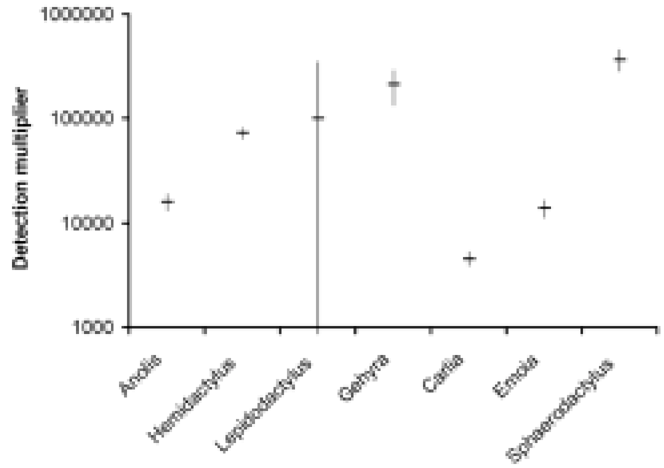

FIG. 3. Detection multipliers ((1/ $\hat{p}$) +/- SE) for the seven best-studied species.

the Mariana Islands; unpubl. data). *Anolis cristatellus* was the most detectable arboreal species that we sampled, and *A. carolinensis* was collected by glueboards so infrequently that we were unable to quantify its detectability. It seems likely that the relatively deliberate locomotion of *A. carolinensis* reduces its vulnerability to glueboard capture, but it is disheartening to recognize that general principles of detectability are unlikely to be discernible from knowledge of phylogeny, size, diet, and ecomorphology. Future generalizations about detectability may require data, such as the speed and mode of locomotion that are not routinely collected by researchers interested in estimating population size.

Analyses of detectability, proportionality, and precision are helpful in designing monitoring programs. With additional validation studies it may be possible to suggest some general guidelines for predicting the validity of specific sampling techniques. For example, our data hint that arboreal species may be less well suited than terrestrial species for glueboard estimates. Likewise, slow-moving species may be less suitable than species that run quickly. Simple arboreal habitats may be more suitable than dense, complex ones (e.g., *Pandanus* forest). Furthermore, arboreal species that are most often found on twigs and leaves appear less well suited than species that habitually use trunks. These patterns may prove to be illusory when additional sampling strategies are studied and validated, but they illustrate the types of generalities that should become available after further study. More work along these lines is needed to establish the precision of population estimates for specified samples of these species in the habitats under consideration. For the vast majority of herpetofaunal species, validation studies are needed for all circumstances under which relative population estimates might be used.

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The Predictive Power of Visual Searching

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Validation of relative population estimates has rarely been attempted for reptiles (Rodda, *in press*). Validity is expensive and time consuming to test. However, the scarcity of validation examples is due, in part, to the absence of a discrete threshold for success. Across density extremes (zero to superabundance), it is difficult to imagine how a relative measure would fail to be at least loosely correlated with density. Precision, however, depends on the strength of the correlation.

In many situations, bias is more problematic than imprecision. A relative population estimator will give a biased result if the detected fraction of the population varies systematically among the conditions of interest. Species to be compared must have the same detectability; habitats to be compared must allow equal detectability of the target species, etc. The simplest situation, a single species in a single habitat type at a single time, will yield an unbiased comparison of density only if the detection fraction is constant across the range of densities sampled. This factor is rarely considered, but can be troublesome. For example, searchers detect a lower fraction of horned lizards when the animals or signs of their presence are scarcer (Henke 1998). At low densities, a higher proportion of the animals are overlooked.

These factors suggest that a relative population measure cannot be considered "validated" in an absolute sense; an estimator will be more or less accurate depending on context. In this paper we consider visual encounter surveys (Crump and Scott 1994) as a relative population estimator for brown treesnakes (*Boiga irregularis*), skinks (*Carlia fusca* and *Emoia caeruleocauda*), and geckos (*Gehyra mutilata*, *Hemidactylus frenatus*, and *Lepidodactylus lugubris*) in forest on Guam, Mariana Islands. For each species we quantified the precision of the relative estimator from the correlation between visual searching and a validated absolute density estimator. To assess the contexts in which use of a relative estimator would be appropriate, we tabulated the constancy of the detection fraction among and within species and present evidence on the constancy of the detection fraction between habitats.

Attributes of a good estimator.—A good relative population measure will not only be correlated with true density, it will also be proportional. That is, if the population doubles, the relative measure should also increase two fold. If the regression of true population density on visual encounter rate has a positive y-intercept, the detection fraction is not constant, and a minimum density of animals must be present, on average, before the species becomes visually detectable (Fig. 1). This condition indicates a reduction in detection fraction at low densities. Conversely, a negative y-intercept indicates a reduction in detection fraction at high densities.

Another approach to assessing proportionality is to inspect the correspondence between pairwise ratios of absolute population estimates against the ratios obtained from a prospective index of abundance such as visual sighting rate. Unbiased and precise estimators will produce an exact correspondence (i.e., all points will lie on the line Y = X).

A relative population estimator that is "valid" in the sense of being correlated with absolute density may nonetheless be of no use if the confidence limits associated with the correlation span all or most possible population densities. For example, consider a species that occasionally achieves absolute population densities as high as 2500/ha. If a moderate visual encounter rate (e.g., 2 sightings/h) corresponds to an estimated absolute population density of 900/ha, but that estimator is bracketed by confidence limits of 0–2400/ha, the relative estimator is not useful.

To provide a common metric for confidence limits of species of varying abundances, we introduce the use of confidence limits expressed as percentile ranks of density. Percentile ranks are good for characterizing non-normal distributions or comparing distributions of unknown shape. Single-species abundances are rarely normally distributed—ours were not. Use of percentile ranks makes it possible to compare the utility of visual encounter rates among species of differing density.

Validation studies compare the performance of a proposed

method (the test method) against a proven reference method. For the lizard species considered, we compared the visual encounter rates (test method) to total removal samples (Rodda et al. 2001) obtained concurrently from an adjacent area (reference method). For the snake species considered, we compared the visual encounter rates to mark-recapture population estimates obtained concurrently from the same 1-ha plots. The validity of mark-recapture was established for this system by comparing mark-recapture population estimates to two total trap-outs of all snakes from 1-ha areas surrounded by snake-proof fencing (Campbell 1996). Comparing a test method to a reference method on a slightly different geographic area entails some sampling error, which should be manifest in reduced precision of the estimation. In the case of the snake sampling (identical areas), there is some loss of precision associated with estimating rather than measuring the absolute population density with the reference method. Nonetheless, these comparisons are among the first to rigorously measure the bias and precision of a relative sampling technique.

Sites.—Time-constrained visual encounter surveys (Crump and Scott 1994) and total removal sampling (Rodda et al. 2001) were conducted in three regions of Guam, Mariana Islands, 1993–97. Compared to a "region," a "site" was a small (~ 1 ha) area within which visual surveys were conducted and one or more very small (~ 0.01 ha) total removal "plots" were laid out. Because visual surveys required more space than total removal plots, the geographic correspondence between these two methods was only partial, although an effort was made to establish sample plots and visual survey routes in habitat that was representative of the entire site (see below).

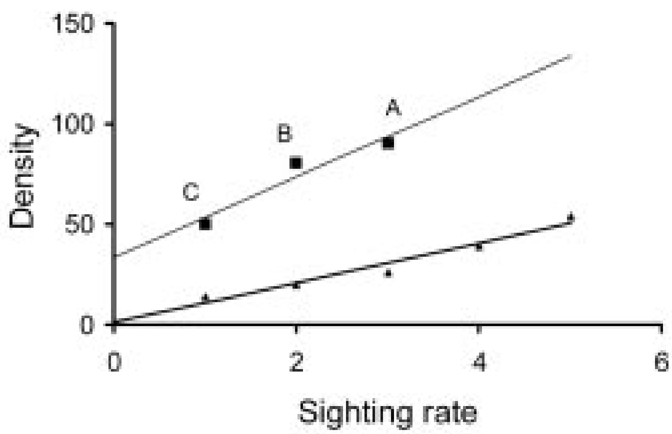

FIG. 1. Two hypothetical data sets expressing the relationship between relative and absolute population estimates. The detection fraction associated with each point is the point's X value/Y value (or sighting rate/true density). Point A's detection fraction, 3/90 = 0.033, is higher than the detection fraction at B, (2/40 = 0.025), which is in turn higher than the detection fraction at C (1/50 = 0.020). In a case such as this, in which detection fraction is reduced at progressively lower absolute population densities, the y-intercept of the associated regression line will be positive. In contrast, if the detection fraction is essentially constant vis-à-vis density (e.g., triangle points), the regression will pass through the origin (y-intercept = 0). The inverse of detection fraction (detection multiplier = Y value/X value) for a given point is equal to the slope of an imaginary line drawn from the point through the origin. Data sets composed of points with a constant detection fraction will therefore all lie along the same radial line and that line will pass through the origin.

Mark-recapture population estimation for snakes was performed quarterly at four sites in one of these regions (N 13.63, E 144.86) from 1993–94 (Campbell 1996). This habitat was scrubby secondary growth forest, consisting primarily of *Leucaena leucocephala*, an introduced legume tree having short stature (canopy heights 5–6.5 m) and tiny leaflets (3–4 x 5–8 mm). The three other sites were located in two regions of native forest, which supported a diverse array of trees, many of which had large leaves (e.g., *Pandanus* leaves up to 150 x 2000 mm; the dissected leaves of coconut palms may exceed 13 m in length). Visibility was reduced to a greater extent by the dense foliage in the large-leaved forest. Measured canopy heights were 9–15 m in the northern native-forest plots (N 13.65, E 144.86), and 5 m in the southern native-forest plots (N 13.35, E 144.67). For the purposes of our habitat analysis, sites were grouped into small-leaved forest and large-leaved forest.

Species.—Three small (1.0–2.2 g) arboreal nocturnal species of gecko were sighted with sufficient frequency for analysis: *Gehyra mutilata*, *Hemidactylus frenatus*, and *Lepidodactylus lugubris*. Two small (1.6–3.1 g) diurnal terrestrial skinks were sighted often enough for limited analysis: *Carlia* cf. *fusca* and *Emoia caeruleocauda*. The single snake studied, *Boiga irregularis*, is nocturnal and arboreal (Rodda et al. 1999b). It reached highest densities in the small-leaved habitat (Rodda et al. 1999c).

Reference population estimation.—Lizard abundance was estimated from total-removal plots (Rodda et al. 2001). This method involved erection of a lizard-proof fence during times when the species were inactive, and removal of all vegetation down to mineral soil while inspecting each item of vegetation for the presence of lizards (none of the sampled species permanently evaded capture by hiding below the surface). Thus the lizards were censused rather than surveyed in the sample plots. Of the seven sites under consideration, one was sampled by four 5 × 5 m plots, five were sampled with one 10 × 10 m plot, and one was sampled by two 10 × 10 m plots. The total number of lizards (of the five focal species) sampled per site averaged 147 (range 53–244).

Mark-recapture was used to obtain 29 estimates of absolute population densities of snakes (four sites sampled quarterly for two years). Sites were sampled daily for 15–32 d. Snakes were captured by hand and in standard brown treesnake traps (Rodda et al. 1999a), marked with PIT tags and released. Abundance estimates were obtained using the program MARK (White and Burnham 1999) under a size-stratified open model, using the relationship $N = \bar{n}/\hat{p}$, where $\bar{n}$ is the size-stratified mean number of daily captures, and $\hat{p}$ is the model's best estimator for that size class' average capture probability per day. Capture probability did not exhibit heterogeneity over time or by sex. As these plots were surrounded on all sides by 3–4 m swaths of mowed grass, and perimeter traps did not generally exhibit elevated capture probabilities, the nominal trap area (1 ha) was used for the estimation of density from abundance.

Test population estimation based on visual encounter surveys.—Experienced (> 100 h of previous surveys for these species in these habitats) reptile searchers conducted all visual encounter surveys. Observers walked forest transects at a slow speed (ca. 0.5 km/h), recording all reptiles seen on one side of a road or trail during surveys lasting 1–4 h. Nighttime surveys were conducted under

the illumination of a headlamp (various manufacturers). Each comparison between an absolute population density and a visual encounter survey mean represents 2.5 km of transect (snakes) or 5.6–76.5 person hours of lizard searching (mean 31.1 h). The transect lines used for the small-leaved habitats were serpentine paths at 25 m intervals through the 1 ha sites from which mark-recapture estimates were obtained (total removal plots were placed near the middle of the 1 ha plots, in representative vegetation). Vegetation was judged to be representative on the basis of plant species composition, canopy height, and canopy closure. The large-leaved habitats did not have suitable paths through the middle of the study sites; instead, primitive road edges passing to within 100 m of the total removal plots were surveyed for a distance of about 1 km. The roads passed through similar habitat, although the preference of *Carlia fusca* for disturbed habitat no doubt biased upwards the abundance of that species in the vicinity of the large-leaved habitat transects.

Analyses.—We asked six questions: (1) Are relative and absolute measures of abundance correlated?; (2) Are detection fractions relatively constant at different densities within a species?; (3) Is the detection fraction constant among species of small lizards?; (4) Is the detection fraction constant between habitats?; (5) What range of population densities correspond to the confidence limits at moderate visual sighting rates (i.e., how precise are the observed correlations)?; and (6) What confidence limits best describe the relationship between ratios of absolute densities and ratios of sighting rates?

In assessing the strength of the correlations between absolute and relative measures, we used a no-intercept model. We report a sample-size adjusted r^2, with the associated probability that the slope equals zero. To be conservative, all reported probability values are two-tailed, even for one-sided contrasts. We computed the regression of absolute population density on relative population estimator, because this is the direction of inference normally used for estimates of population abundances.

We did not have direct measurements of the detection fraction; therefore we could not directly test whether the detection fraction was different at higher or lower population densities. Instead, we tabulated the y-intercept values for unconstrained regressions of absolute population density on relative population estimators. A positive y-intercept would reflect a reduced detection fraction at lower population densities and a negative y-intercept would indicate the converse. The associated probability indicates the likelihood that the true value is zero for a given sample size. In addition, we express the y-intercept value in percentile scores of population density based on a mean of 28 (range 21–32) 10 × 10 m removal plots having non-zero densities. For example, the 90th percentile abundances of the study species, in ascending order, were *H. frenatus* (3500/ha), *L. lugubris* (4400/ha), *G. mutilata* (5300/ha), *E. caeruleocauda* (6300/ha), and *C. fusca* (9000/ha).

To address the question of whether the detection fraction was constant among species, we used the slope estimate (and SE) from the no-intercept regressions. The slope of the regressions is the inverse of detection fraction; therefore a high slope reflects a low detection fraction. It is perhaps easiest to think of the slope values as "detection multipliers." They are "multipliers" in the sense that one can estimate an absolute population density by multiplying the relative measure of abundance by the detection multiplier. For example, if the relative measure of abundance is 5 sightings/h and the applicable detection multiplier is 10, the estimated absolute density would be 5 × 10 = 50 individuals/ha. Thus detection multipliers are a convenient way to convert relative to absolute measures of abundance. Detection fraction captures the same information, but in less tangible quantities, usually small fractions.

In the case of the small-leaved habitats, our visual surveys were conducted entirely within the 1 ha sites, on trails having 1 km of trail edges (each survey was conducted on one side of a 0.5 km trail). Because the visual sighting rate was based on searches of exactly 1 ha, the same unit for which the absolute density is estimated, the detection multiplier in this case also expresses the number of individuals that were present for each individual seen. The number of overlooked individuals is the number present minus the number seen. A detection multiplier of 12 indicates that 11 unseen individuals existed in the area for each one sighted (detection fraction = 0.083). In the large-leaved habitats, the layout of 1 km visual search transects did not correspond to a 1 ha study plot, but the slope parameter reflects the same conceptual multiplier (each additional sighting corresponds to a density increase expressed by the slope value).

Sample sizes for quantifying detectability by habitat were sufficient for only *Hemidactylus* and *Lepidodactylus*. Because those species abundances were on different scales, reflecting different values in different habitats, we studentized (SAS Institute 1990) the residuals from each regression and compared the values of the *z*-scores between large and small-leaved habitats using a *t*-test after testing for equality of variances ($F = 3.84$; $P = 0.2$). To characterize the magnitude of the abstract scores in understandable units, we also report the mean detection multiplier for each species-by-habitat combination.

To characterize the precision of a relationship, we report the range of abundance percentiles corresponding to a midrange visual encounter rate. Confidence limits corresponding to negative population densities were truncated to zero.

The regression of $\log_{10}$ absolute abundance ratios on $\log_{10}$ sighting rate ratios produced confidence limits, slopes, and intercepts. Ratios were obtained for every pairwise permutation of nonzero values within a species. A proportional relative estimator will produce a slope of 1; therefore the slope was tested against the null hypothesis that it was equal to 1. The intercept has a less decisive interpretation, but proportionality requires that the Y = X line pass through the origin; we tested the null hypothesis that the y-intercept was equal to 0. The computed y-intercept appears in the figure at an axis value of 1, as log values were back transformed for easier visualization.

We were concerned that the very small sample sizes obtained for the two skink species would result in potentially misleading correlation coefficients and confidence limits. To assess the magnitude of the small sample bias, we randomly extracted 10 subsamples of various small sizes (N = 2, 3, 4, 5, 10, 20, and 50) from a 100-point random distribution having the slope, range, intercept, and r^2 values characteristic of our empirical data sets. Using ten simulations of each sample size we computed the mean and variance of range of confidence limits (at mid slope), adjusted r^2, and slope.

Were absolute densities correlated with sighting rates?—A positive relationship was evident for all species except brown

treesnakes (Fig. 2), for which the relationship was insignificant ($r^2 = 0.005$, NS). Although the regression is strongly influenced by two outliers (Fig. 2), the relationship is comparably weak with those outliers removed. The correlation between absolute and relative estimators was equivalent between observers (Fig. 2).

Four of the five lizard species exhibited a tight correlation ($r^2 > 0.9$), and three of these five were statistically significant (Table 1). However, the sample sizes (N = 2) for *Carlia* and *Emoia* were small. Based on our simulations of equivalent (N = 2) samples, the bias associated with r^2 in such small samples is trivial (our simulations produced an average r^2 0–2% less than the full data set).

Was the detection fraction constant at different densities within a species?—All six species exhibited a positive value for the y-intercept, although the difference was slight and statistically significant only for *Lepidodactylus*. Our simulations of small sample sizes indicated a small (5–7.5%) bias towards steeper slope at sample sizes of N = 2. This implies that large-sample y-intercepts for the skinks would be larger than that observed. The significant discrepancy for *Lepidodactylus* was the greatest observed (60th percentile). On average, about 2065 individuals of this species would be present in a hectare before the first *Lepidodactylus* was seen.

The regression of absolute population density ratios on sighting rate ratios (Fig. 3) had a slope of 0.40, significantly less than the desired slope of 1 ($P < 0.0001$). The intercept (0.62) also deviated significantly from zero ($P = 0.0037$). These results indicate that the detection fraction was lower at lower densities.

Was detection fraction constant among species?—The average detection multiplier for each species ranged from the relatively detectable *C. fusca* (mean detection multiplier = 12.88 (SE = 2.80); detection fraction = 0.0776) to the rarely seen *G. mutilata* (mean detection multiplier = 6105 (SE = 412.9); detection fraction = 0.00016). In descending order of detectability the three other species were *E. caeruleocauda* = 91.8 (SE = 14.1), *H. frenatus* = 143 (SE = 17.7), and *L. lugubris* = 848 (SE = 271.7). The wide gaps between detection multipliers (relative to SEs) reinforce the inference that detection is grossly different among species.

Was detection fraction constant between habitats?—Tests comparing large-leaved and small-leaved habitats for *Hemidactylus* and *Lepidodactylus* indicated that both geckos were seen significantly less often in the large-leaved habitat ($t = 2.55$, $df = 11$, $P = 0.027$). For *Hemidactylus*, the mean detection multiplier in small-leaved habitats was 163 (SD = 54), about an order of magnitude less than that for large-leaved habitats, 1511 (SD = 703). *Lepidodactylus* was seen less often than *Hemidactylus* (higher detection multipliers on average), but exhibited a similar tenfold difference between habitats. In small-leaved habitats its detection multiplier averaged 984 (SD = 618), whereas that in large-leaved habitats averaged 9914 (SD = 5372).

How wide were the density confidence limits?—At moderate sighting rates *Lepidodactylus* and *Emoia* had density confidence limits that covered the full range of known densities (0–100th percentile) for the species. *Hemidactylus* and *Carlia* exhibited confidence limits that covered most of the known densities (0–90th percentile and 0–60th percentile, respectively). *Gehyra mutilata* was exceptional: a moderately successful visual survey (0.25 sightings/h) corresponded to a reasonably precise characterization of the

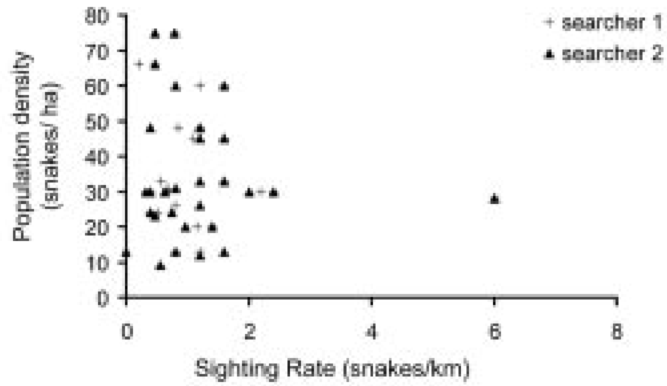

FIG. 2. The relationship between population density of *Boiga irregularis* in 1-ha *Leucaena leucocephala* forest, Guam, 1993–94 and snake sighting rates of two searchers searching each plot five times (total 2.5 km of searching per datum).

absolute density (50–70th percentile). The confidence limits for skinks are undoubtedly inflated by the small number of samples evaluated. Our simulations of two-sample regressions indicates that confidence limits for such small samples are 4.8–5.7 fold those based on 100 points; thus the width of the confidence limits for *Carlia* and *Emoia* need to be revisited when larger samples of comparisons become available. The other species have sample sizes that yield confidence limits only marginally larger than asymptotic values.

What confidence limits best describe the relationship between ratios of absolute densities and ratios of sighting rates?—The confidence limits associated with ratios were large, in keeping with the double inference being made (that both baseline and follow-up measurements were accurate reflections of true population density). For example, if the second measurement had been tenfold that of the baseline value, the naïve expectation would be that the population had increased tenfold. Instead the confidence limits range 0.33–7.5, indicating that the population could have shrunk by as much as threefold (ratio: 0.33) or increased by as much as 7.5-fold, although the most likely change was of a modest increase of about 60% (1.6-fold). The failure of the confidence limits to include the naïve expectation highlights the observed deviation from constant detection at different population densities. The wide confidence limits highlight the weakness of the double inference associated with ratios. Note that the absolute density ratio of 1 (no population change) is within the confidence limits for all of the sighting rate ratios considered (0.1–100 fold).

The overall analysis suffers from small sample sizes and incomplete geographic correspondence between test and reference plots. Thus it is encouraging that five of six species exhibited reasonably tight ($r^2 > 0.5$) positive correlations and four of five lizards exhibited very tight ($r^2 > 0.9$) correlations between absolute and relative population estimators. The presumption underlying single species relative abundance measures appears generally valid. The apparent exception is brown treesnakes, for which no correlation was evident. Our prior experience (e.g., Rodda et al. 1999c) using larger samples of visual sightings of brown treesnakes suggests that the fundamental premise is correct for brown treesnakes, but the effort contributing to each individual datum in the present study was inadequate (Rodda and Fritts 1992). Although each da-

TABLE 1. Correspondence of absolute population estimates obtained from mark-recapture (*Boiga*) or total removal plots (all lizards) to visual encounter surveys. An ideal visual survey would exhibit $r^2 = 1$, 95% confidence limits (CL) at midrange that were very narrow and near 50%, and a y-intercept near zero in both absolute density and percentile of abundance.

Species	Relationship between absolute and relative abundance	N	95% CLs at Midrange Sight Rate (percentiles)	Y-intercept	
				Individuals/ha	Percentile
Boiga irregularis	$r^2 = 0.005$, NS	58	Not applicable	36 (NS)	28
Carlia fusca	$r^2 = 0.91$, NS	2	0–60	216 (NS)	7
Emoia caeruleocauda	$r^2 = 0.95$, $P = 0.097$	2	0–100	137 (NS)	12
Lepidodactylus lugubris	$r^2 = 0.56$, $P = 0.021$	7	0–100	2065 ($P = 0.01$)	60
Hemidactylus frenatus	$r^2 = 0.90$, $P < 0.0002$	7	0–90	487 (NS)	45
Gehyra mutilata	$r^2 = 0.97$, $P < 0.0002$	4	50–70	114 (NS)	14

tum summarized five passes by each observer (2.5 km of visual searches), and although the snake is exceptionally abundant in the study habitat, 2.5 km of visual searches appears to be insufficient to accurately characterize density. The higher density of lizards, combined with the more extensive surveying effort for them ($\bar{x}$ = 31.1 h) apparently sufficed to produce strong positive correlations between relative and absolute population measures, although confidence limits were excessively wide in four of five cases. Additional validation work is needed to establish the sample size needed for an adequate level of precision.

Based on all six species exhibiting positive y-intercepts, and the low slope and nonzero intercept exhibited by the regression of ratios, we conclude that reduced detection fraction at low population densities may be a widespread problem with visual encounter surveys. Further investigation of this problem seems warranted, especially in light of the large magnitude of the intercept in some species (e.g., *Lepidodactylus*), and the high level of statistical uncertainty. On the basis of the information presented in this paper, we would not be comfortable with the assumption of proportionality for either *Hemidactylus* or *Lepidodactylus*. Further study into

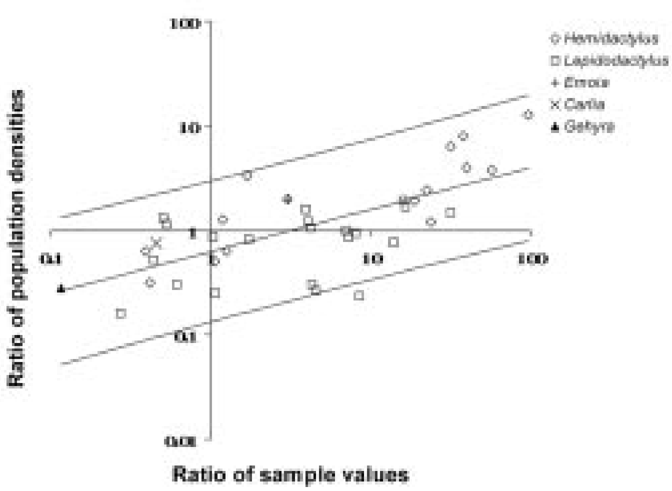

FIG. 3. The relationship between ratios of population densities and ratios of visual sighting rates for five species of lizard. All pairwise comparisons for non-zero values within a species are given, with the associated regression line and 95% confidence limits.

the magnitude and shape of the low-density decline in detection probabilities for those species may allow a correction factor to be incorporated for unbiased estimates.

The gross differences in detection multipliers or detection fractions among the species we studied indicate that relative population measures should not be used interspecifically to characterize abundances. Even species with similar sizes and habits (e.g., *Hemidactylus* and *Gehyra*) exhibited substantial differences in detectability within a single habitat type. We conclude that interspecific population density comparisons should not be based on visual survey data in the absence of validation studies that quantify the detection probabilities in the system of interest.

The difference in detectability of small geckos between habitats was about tenfold. The generality of this value is of great interest. Are habitats usually more or less similar in visibility of reptiles? Some rules of thumb would be useful for planning inventory and monitoring efforts.

We were discouraged by the wide confidence limits associated with the visual surveys we conducted. Based on the information presented, we would select visual surveys as an adequate sampling tool only for *G. mutilata*. Unfortunately, it is difficult to assess whether the reported confidence limits would be appreciably smaller if based on exhaustive visual surveys having a perfect geographic correspondence between test and reference methods. Further comparisons would be of interest, not only for the species we reviewed, but for other visually sampled species as well. It is perhaps notable that the species with the lowest detection rate, *G. mutilata*, was also the species with the most precise correlation between visual sightings and absolute density. The effective sample size was small, even for inferences limited to this species. Also, the bulk of the data for this species came from a single habitat type. Further study is needed to determine whether highly precise correlations are characteristic of certain species or habitats.

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gested improvements to the manuscript.

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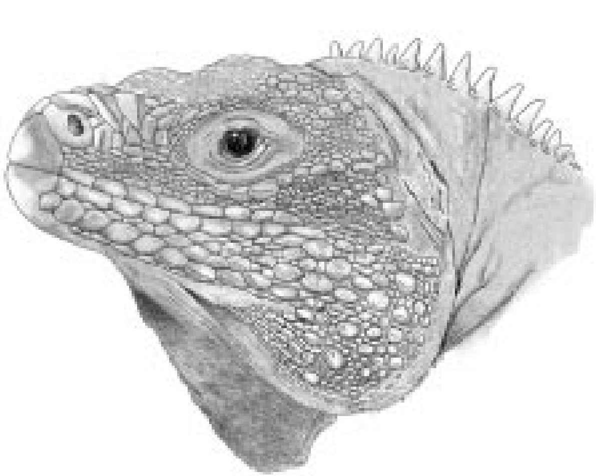

Cyclura lewisi (Grand Cayman Blue Iguana). Adult male, born 1993, held in captivity at the Shedd Aquarium in Chicago. Illustration by John Bendon (Lizardwizard@btinternet.com).

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An Effective New Radio Transmitter Attachment Technique for Lizards

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Radio telemetry is a valuable method for acquiring important ecological information such as home range, habitat preference, and dispersal distance for many types of wildlife (White and Garrott 1990). One of the limitations with using telemetry is the difficulty of developing a reliable and safe transmitter attachment technique to facilitate consistent research. Multiple transmitter attachment methods are available for a variety of lizards, with additional approaches being introduced as telemetry becomes increasingly popular and techniques are refined through trial and error (see Richmond 1998; Ussher 1999).

Using radio telemetry on saxicolous lizards living among jagged, xeric limestone conditions presents serious challenges for wildlife researchers. West Indian iguanas (genus *Cyclura*) are particularly difficult because they inhabit areas of sharp limestone and squeeze into small retreat openings, often causing the loss of externally affixed transmitters. Attaching external transmitters to hatchling or subadult iguanas also is problematic because of their small size and potential for rapid growth. Numerous radio transmitter attachment methods have been attempted, with variable results, on adults of this genus (reviewed in Goodman 2005), but none have been successful for hatchlings or juveniles.

We devised a technique for attaching radio transmitters to recently hatched Andros Iguanas (*Cyclura cychlura cychlura*) during a study of natal dispersal, survival, and habitat preferences. Data on these parameters are crucial for developing a science-based management program for this endangered lizard, especially since little ecological information is available for hatchlings of this species or its congeners.

We conducted our study from 12 August to 9 October 2003, and 3 August to 14 September 2004 on Andros Island, Bahamas, primarily in pine woodland, scrub, and mangrove habitats. Forty-one hatchlings in 2003 and 36 hatchlings in 2004 were collected for radio tracking directly from nests or from incubated eggs. Hatchlings ranged from 31 to 57 g in body mass (mean = 44; S.D. = 5.56), 84–106 mm in snout–vent length (mean = 97; S.D. = 0.41), and 122–171 mm in vent–tail length (mean = 153; S.D. = 0.97). To radio track lizards we used BD-2 (17 × 8.5 × 5.5 mm) and PD-2 (23 × 12 × 5.5 mm) model transmitters (Holohil Systems Ltd., Ontario, Canada). The average battery lifespan for the

BD-2 and PD-2 transmitters was 12 and 16 weeks, respectively. The BD-2 (1.9 g) and PD-2 (2.7 g) transmitters after encapsulation represented between 4.1 and 9.0% (mean = 6.0%; S.D. = 0.7) of hatchling body mass.

To test the efficacy of the attachment technique on another lizard species, we attached transmitters during the 2004 field season to three adult Curlytail Lizards (*Leiocephalus carinatus coryi*) inhabiting the same study sites and tracked them between 16 and 30 days. The lizards ranged from 39–45 g in body mass (mean = 42.7), 91–98 mm in SVL (mean = 95), and 127–151 mm in vent–tail length (mean = 139). The transmitters were between 4.9 and 6.0% (mean = 5.7%) of adult body mass.

The transmitters and batteries were encapsulated in an inert waterproof epoxy with tubes attached laterally through the anterior and posterior ventral edges. The antenna was a 20 cm long flexible stainless steel wire covered with a black nylon coating and shrink tubing to reinforce the base. Using a hand-held 3-element Yagi directional antenna and a Wildlife Materials, Inc. (Carbondale, Illinois, USA) TRX-48S receiver, we obtained a signal range of 500 m over open, flat terrain that was reduced to 200 m in closed forest conditions.

To attach a transmitter, two 15 cm pieces of 20 lb test monofilament line were cut (length may vary depending on personal preference and size of animal) and one piece inserted through the anterior and the other through the posterior tube of the transmitter. The transmitter was placed on the dorsal side of the pelvic girdle, the anterior monofilament line was wrapped around the lizard's body (anterior to the hind limbs) and tied with two square knots in the lateral inguinal region using needle-nose pliers. A dab of ethylcyanoacrylate glue gel was then applied to the knot to prevent it from slipping. The posterior monofilament line was then wrapped loosely around the tail, tied, and glued as above. All extra line was trimmed (Fig. 1). The antenna protruded farther than the tail tip, but appeared to have no effect on the animals. Although antennas can be trimmed, this will limit the maximum signal detection distance.

An assumption of radio tracking investigations is that animal movements are not affected by researcher techniques (White and Garrott 1990). Although not quantified, our method appears to have no significant effect on iguana behavior or movement. All hatchling iguanas ran, jumped, swam, and climbed trees without apparent difficulty. Lizards were found in pine trees 10 m above the ground, in underground (and at times underwater) limestone retreats, and within mangrove islands which required overwater movement. The Curlytail Lizards also appeared unaffected by the transmitters. The inert waterproof epoxy was gray in color and was relatively cryptic in our study environment. The epoxy can be painted to either facilitate detection by the researcher or to offer additional camouflage for the lizard.

Although no transmitters detached from the animals during the study, this technique does have limitations. Abrasions developed after two weeks in the inguinal region of five (12%) iguana hatchlings in 2003. When this occurred, we recaptured the lizard and reattached the transmitter on the ventral surface directly posterior to the cloaca using the method described above. Repositioning the transmitter removed pressure from the ventral inguinal region where the abrasions were occurring. Abrasions healed after one week and the new ventral transmitter placement appeared to have no effect on the movements, activity, or defecation ability of the hatchlings.

During the 2003 study, we noted that the posterior (tail) monofilament line often snagged on jagged limestone surfaces or tree bark as the lizards moved, thereby increasing cutting pressure on the

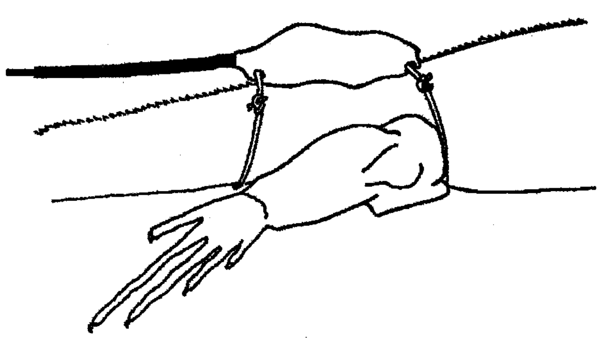

FIG. 1. Lateral view of PD-2 transmitter attachment method with both the anterior and posterior monofilaments lines tied.

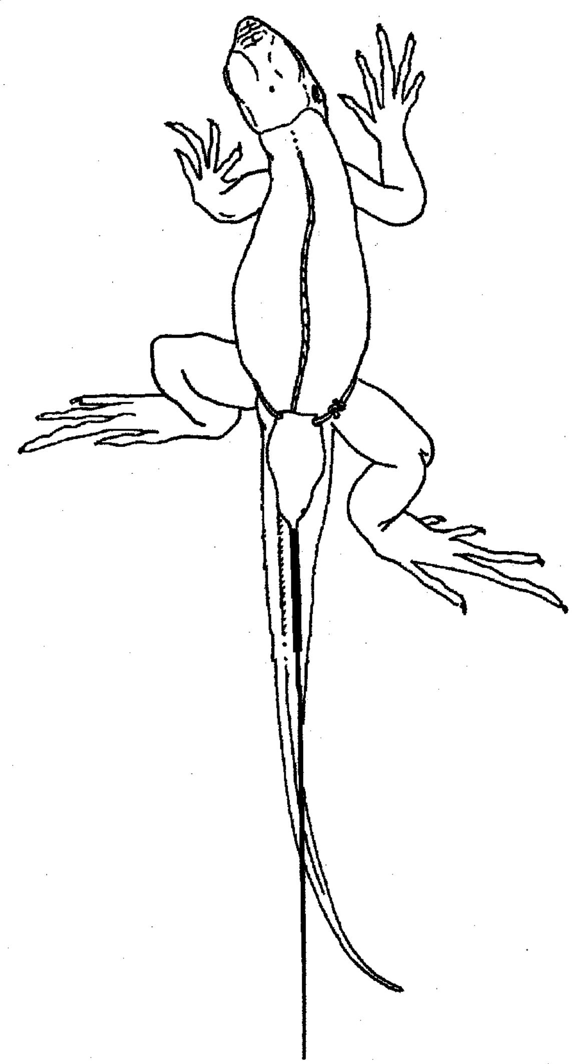

FIG. 2. Dorsal view of PD-2 transmitter attachment method with only the anterior monofilament line tied.

inguinal region. Therefore, we attached the last ten transmitters in 2003 and all the transmitters in 2004 without using the posterior monofilament line and secured the anterior (inguinal region) line more loosely (Fig. 2). This method also was effective, and in our opinion, was the better of the two options, as it allowed the transmitter to move slightly as the lizard moved, thereby reducing pressure on the inguinal region. The transmitter rotated on the body at times and occasionally flipped back and forth as the animals moved backwards then forwards in enclosed spaces. However, no abrasions were found during the remaining four weeks of the project in 2003 or throughout most of 2004. All surviving hatchlings in 2003 (N = 2) and 2004 (N = 8), as well as the three *Leiocephalus* in 2004, were recaptured at the end of this study and transmitters were removed. All recaptured iguanas had maintained, or gained body mass, were free of abrasions, and appeared healthy. One curlytail lizard, which was not recaptured until 30 days after initial attachment, exhibited slight cutting abrasions in the inguinal region.

No lizards died during this study directly as a result of the attachment method. Because very little material is required for this convenient and easy procedure, lizards can be harnessed in the field within minutes using only minimal equipment. However, we encourage using this technique only if lizards can be reliably recaptured. The monofilament line may not present a significant problem for adult lizards of equivalent size, but long-term survival of growing hatchlings will be affected if the line is not removed. Additionally, 83% and 61% of radio-tagged hatchlings were visually confirmed to be eaten by snakes in 2003 and 2004, respectively. Although we feel time of release after hatching may have influenced the higher than expected predation rates in 2003, we cannot exclude the possibility that the transmitter attachment played a role. The potential benefits of using this technique warrants further study with results being disseminated in the literature. A future modification could include inserting the monofilament line through low-diameter Tygon® tubing so that the potential for long-term cutting into the inguinal region of adult lizards is further reduced. In conclusion, use of this method allowed us to elucidate many previously unknown aspects of the behavior and ecology of *Cyclura* hatchlings (Knapp and Owens 2004), and should be applicable to other lizards of similar size.

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A New Technique for Capturing Pacific Pond Turtles (*Actinemys marmorata*) and a Comparison with Traditional Trapping Methods

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Various techniques have been used to capture freshwater turtles in the field, including hand collecting, dipnetting, snorkeling, fyke nets, baited hoop nets, collapsible traps, basking traps, and funnel traps (Iverson 1979; Kennett 1992; Kuchling 2003; Legler 1960; Vogt 1980). Pacific Pond Turtles (*Actinemys marmorata*) occur in slow-moving or stagnant aquatic habitats from British Columbia south to northwestern Baja California. The most common techniques used to capture *A. marmorata* have been snorkeling, basking traps, and funnel traps (Bury 1972; Germano and Bury 2001; Reese 1998).

I used capture-recapture methods for estimating population size, structure, and population density of the western pond turtle at Sunol Regional Wilderness, Alameda Co., California, USA. Sites were small to medium-sized (< 400 m^2) artificial stockponds, with a silt and clay substrate, and devoid of emergent vegetation. To optimize my capture and recapture rate, I tested four capture methods: funnel traps, basking traps, hand collecting, and a new technique, baited wires.

Funnel traps measured 0.8 m in length and 0.5 m in width and height. Each trap was made using 2 cm mesh of non-stretch, metallic netting painted dark green. The mouth of the trap was an elliptical funnel decreasing in diameter towards the bait. The mouth of the trap was large enough to allow adult turtles to enter (carapace width of the largest individuals is about 130 mm). Funnel traps were baited with fresh beef attached on a string to the center of the trap.

Basking traps had a rectangular shape and measured 0.8 m in length and 0.6 m in width and depth. A net was held afloat at its perimeter with a PVC pipe of 0.1 m in diameter. Two wood ramps allowed turtles to climb over the PVC pipe and to bask on a platform (0.8 m in length and 0.20 m in width) in the center of the trap.

Hand collecting consisted of walking slowly along the shoreline of the pond. When turtles were observed near the shoreline from a distance of 0.3 m, I used a dipnet to capture individuals before they escaped to deep water.

The baited wires consisted of bait attached to a heavy non-corrosive metallic wire, 0.1–0.2 m long, firmly anchored to a rock or other heavy object along the shoreline of the pond. Yellow vinyl marking flags were attached to the baited wires to locate

TABLE 1. Capture efficiency of three traditional capture techniques for Pacific Pond Turtles, *Actinemys marmorata*, compared to a new technique, baited wires. Data were collected during May 2002, at the Sunol Regional Wilderness, Alameda County, California.

Capture technique	Bait	Number of Traps	Trap days*	Number of Captures	Captures/trap day
Hand	None	None	4	4	1.0
Baited Wires	Beef	4	16	340	21.3
Basking Traps	None	3	12	20	1.7
Funnel Traps	Beef	3	12	5	0.4

*A trap-day consists of one trap set for 3 h between 1000 h and 1600 h.

them from a distance. A bait of fresh stew beef worked very well, even after multiple turtle bites. Sardines or other small fish disintegrated too rapidly in the water and therefore did not work as well. The bait was placed in shallow water usually < 0.25 m from the shoreline. Baited wires were placed around the pond at intervals of 2–5 m and checked every 10 minutes from a distance. When turtles were observed feeding on the bait, they were approached slowly and captured by hand or with a small dipnet. An average of 10 turtles could be caught without changing the bait. My assistant, who had never caught turtles before, tested the baited wires during a three-hour session. Her capture rate was about the same as mine.

The four capture techniques were tested during four days in May and June 2002, with at least seven days between each testing day. These tests were conducted at the beginning of the study in order to find the most effective capture method for my study sites. During each testing day, I exclusively used three basking traps for the first three hours (in about 1.5 h my capture rates dropped to zero). By using only basking traps, I intended to limit basking behavior disturbance that could be associated with the simultaneous use of other trapping techniques. After three hours, I used baited funnel traps and baited wires in addition to basking traps. During this period, I also captured turtles by hand when they were encountered. Three baited funnel traps, three basking traps, and four baited wires were set at haphazard intervals along the banks of a 300 m^2 stockpond known to have a large density of pond turtles. There was no emergent vegetation and the shoreline sloped gradually. The study periods were between 1000 and 1600 h under sunny skies and little wind (< 7 m/sec). Air temperatures were 22–28˚C, and water temperatures at a depth of 0.1 m were 22–27˚C.

The baited wire technique captured more than 20 times the number of turtles captured by the next best technique (Table 1). Using the baited wires, I captured 1–3 turtles every 15 min. This technique created less disturbance than the other methods when turtles were removed.

Turtles caught by hand were mostly hatchlings and small juveniles, which do not feed on beef baits (Bury 1986). All of the hatchlings were captured by hand, either in the water in algae or on land when moving from their nest to the water.

Funnel traps captured few individuals (0.4 per trap day), perhaps because the pond was small and removing turtles and replacing the bait in traps created too much disturbance. Also, turtles appeared to have trouble finding the entrance to the traps.

Basking traps captured turtles during the first part of each daily trapping session (1.7 per trap day), but, in most cases, capture rates dropped to zero during the later half of the trapping session. It appeared that the disturbance caused by removing turtles from the basking traps caused other turtles to avoid the basking traps.

In the proper habitat, baited wires are very efficient, cheap in cost (< US $0.50/wire), and require minimal equipment. Their placement takes very little time. Furthermore, the technique precludes injury to sympatric, threatened or endangered amphibians and reptiles (e.g., California Red-legged Frogs [*Rana draytonii*], California Tiger Salamanders [*Ambystoma californiense*], or Giant Garter Snakes [*Thamnophis gigas*]).

Baited wires work well in ponds with open banks and a low gradient. If the shoreline is too steep, it might be difficult to catch turtles, even with a dipnet. I have never tested the baited wire technique in a stream, but it could also work where the banks are open and the water is shallow.

Acknowledgments.—I thank the East Bay Regional Park District for allowing me to conduct my study at the Sunol Regional Wilderness. I am very grateful to Renée Sittman for her wonderful field assistance. I also thank John Garcia (Garcia and Associates) for providing logistical help. Norman Scott and an anonymous reviewer provided valuable comments on an earlier draft of the manuscript. This study was conducted under the California Department of Fish and Game Scientific Collecting Permit no. 801111-05.

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Use of Native Dominant Wood as a New Coverboard Type for Monitoring Eastern Red-backed Salamanders

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The Eastern Red-backed Salamander (RBS, *Plethodon cinereus*), probably the most abundant salamander in many forests of eastern North America (Burton and Likens 1975; Conant and Collins 1991; Jaeger 1980), has been widely used as an indicator of forest disturbance in recent years (deMaynadier and Hunter 1998; Harpole and Haas 1999; Moore et al. 2002). Because RBS are ectotherms and lungless, they may be affected by forest canopy loss because of changes in temperature and humidity that result (deMaynadier and Hunter 1998; Harpole and Haas 1999). Furthermore, Welsh and Droege (2001) have proposed the use of plethodontid salamanders (family Plethodontidae) for monitoring biodiversity and ecosystem integrity in North American forests.

The use of artificial coverboards is one of the most popular techniques for monitoring plethodontid salamander populations (Table 1; Fellers and Drost 1994). Coverboards simulate decaying logs or woody debris, under which salamanders can be found (Heatwole 1962; Marsh and Goicochea 2003; Moore et al. 2000). Coverboards are often preferred to other sampling methods, such as pitfall traps and drift fences, night transects, and unit-effort searches of natural cover objects, because they represent a non-disruptive technique, impose little risk of mortality to both salamanders and non-target species, and minimize observer bias and errors (DeGraaf and Yamasaki 1992; Enright et al. 1998; Fellers and Drost 1994; Harpole and Haas 1999). Moreover, coverboards are a time- and cost-effective method for obtaining an index of salamander population size (Enright et al. 1998).

To test the effectiveness of wood from a native dominant tree species to monitor RBS, slices of sugar maple (*Acer saccharum* Marsh.) logs were used as coverboard material in a northern hardwood forest of Québec (Lake Clair Watershed: LCW, Canada). Small boards were used (36 to 42 cm in diameter) because it was easier to transport and install them throughout the watershed. Although several types of wood were used for coverboards in other studies (Table 1), none, to my knowledge, has used wood from a native dominant tree species to monitor salamanders.

The LCW (226 ha, 46°57'N, 71°40'W, elevation: 270 to 390 m) is located approximately 50 km northwest of Québec City, Québec, Canada. The overall vegetation is dominated by deciduous species (83%) with small patches of conifers (17%). The deciduous species consist mainly of sugar maple in association with yellow birch (*Betula alleghaniensis* Britton) and American beech (*Fagus grandifolia* Ehrh.). The coniferous component includes balsam fir (*Abies balsamea* (L.) Mill.), red spruce (*Picea rubens* Sarg.), and white birch (*Betula papyrifera* Marsh.). The soil is a sandy loam of the Ste-Agathe series (Raymond et al. 1976) and is classified as an Orthic Ferro-Humic Podzol according to *The Canadian System of Soil Classification* (Canada Soil Survey Committee 1992). The humus is of mor type, and the main surface deposit is a very acidic and stony till (stone content of 25%, 1–3 m depth) on an underlying granite and syenite bedrock. Average slope is approximately 10%. Mean annual temperature is 3.4°C, and annual precipitation is 1300 mm.

In August 2001, a sugar maple tree with a diameter of 42 cm at breast height was felled. A chainsaw was used to make 104 circular sections of 4 cm thickness from the tree trunk. Boards had a diameter and surface area varying from 36 to 42 cm, and 0.09 to 0.14 m^2, respectively. Thirteen transects were established around the lake, perpendicular to the slope. Sugar maple coverboards were placed in early September 2001 along these transects at distances varying between 0 and 200 m (0, 5, 10, 20, 40, 60, 100, 150, 200 m) from the shore of the lake edge. Boards were allowed to weather for approximately nine months (September to May) prior to sampling. Coverboards were sampled during daylight hours, five times in 2002 and four times in 2003 at approximately six-week intervals from the end of May through mid-October. All boards were checked on a single rainless day (sunny or cloudy). Salamander species were recorded and snout–vent length (SVL) was measured in the field to the nearest 0.1 mm with dial calipers. Salamanders were weighed to the nearest 0.1 g with a 10 g Pesola® spring scale. No attempt was made to sex salamanders. Salamanders were handled in a transparent plastic bag sprayed with lake water. After measurements were taken, salamanders were immediately released at the edge of the coverboard.

Correlation analysis was used to evaluate the relationship between coverboard surface areas and three characteristics of RBS (weight, snout–vent length and number found under each board). Outlier analysis and normality of the data were assessed with residuals. Statistical procedures were performed using SAS v. 8.01 (SAS Institute Inc. 2000).

During the two sampling years, 285 RBS, 23 *Eurycea bislineata* (Two-lined Salamander) and one *Notophthalmus viridescens* (Eastern Newt) were found, for a total of 309 salamanders. Coverboards with solitary salamanders totalled 219, 36 coverboards had 2 salamanders, 3 had 3 and 2 had 4. Eight of the captures were with two-lined salamanders. Such simultaneous captures were also observed in other studies for RBS (Bonin and Bachand 1997; DeGraaf and Yamasaki 1992; Monti et al. 2000), and suggest that RBS are not excluding conspecifics (Monti et al. 2000). These coverboards were used by RBS for reproduction, since egg clusters were occasionally found (~3 egg clusters per year for 104 coverboards).

The encounter rate per boards was 28% and 27% for all salamanders and RBS, respectively. These rates are the highest reported for coverboards in the literature (Table 1). These results confirm the effectiveness of coverboards (Bonin and Bachand 1997; Davis 1997; DeGraaf and Yamasaki 1992; Stewart and Bellis 1970), particularly those used in the present study, for surveying plethondid salamander species. These encounter rates are higher than expected due to the low pH of the upper soil at LCW (pH = 2.8 to 3.6: Houle et al. 1997; Moore, unpubl. data). Previous studies have demonstrated the influence of soil pH on the occurrence of RBS (Wyman 1988; Wyman and Hawksley-Lescault 1987). Red-backed salamanders prefer neutral or basic environments over acidic areas (Mushinsky and Brodie 1975; Vernberg 1955; Wyman

TABLE 1. Studies having used coverboards for monitoring plethodontid salamanders in North America.

Author	Study area and forest type	Coverboard material	Coverboard dimension L x W x H (cm)	Most abundant salamander or salamander studied	Mean encounter rate of most abundant salamander found under coverboard (%)[1]
Bonin and Bachand 1997	Québec, Canada Northern Hardwood	Chipboard	30 x 30 x 1	*Plethodon cinereus* *Eurycea bislineata*	11
DeGraaf and Yamasaki 1992	New Hampshire Northern Hardwood	Pine[2]	100 x 20 x 2	*Plethodon cinereus*	10
DeGraaf and Yamasaki 2002	New Hampshire Northern Hardwood	Hemlock[2] (air-dried)	200 x 25 x 2.5	*Plethodon cinereus*	16.9
Davis 1997	Vancouver, Canada Westcoast Conifer	Cedar[2] (untreated, rough-cut)	Modified coverboard	*Plethodon vehiculum*	n.a.
Grant et al. 1992	South Carolina Diverse forest types	Plywood chipboard	133 x 66 x 2	*Plethodon glutinosus* *Eurycea quadridigitata*	7[3]
Harpole and Haas 1999	Virginia Hardwood	*Liriodendron tulipifera* (rough-cut)	60 x 30 x 5	*Plethodon cinereus*	16.8
Mathis 1990	Virginia Mixed Deciduous	Pine[2]	23 x 24 x 2 11 x 11 x 2	*Plethodon cinereus*	n.a.
Monti et al. 2000	Maine Red oak-white pine	Cedar[2]	25 x 10 x 2	*Plethodon cinereus*	2.4
Ryan et al. 2002	South Carolina Diverse forest types	Plywood chipboard	120 x 60 x 1.3	None specified	n.a.
Stewart and Bellis 1970	Pennsylvania Diverse forest types	Pine[2]	23 x 19 x 2	*Desmognathus f. fuscus*	4.2
Sugar et al. 2001	Ontario, Canada Diverse forest types	Spruce, pine, fir[2]	Modified coverboard	*Plethodon cinereus*	n.a.
Taub 1961	New Jersey Hardwood	Pine[2]	30 x 25 x 3	*Plethodon cinereus*	n.a.
This study	Québec, Canada Northern Hardwood	Sugar maple	Diverse (tree slices)	*Plethodon cinereus*	27

Notes:
n.a. = not available
[1] Estimate made from study's data. Data came from mature stands.
[2] Scientific name and/or origin not specified.
[3] Diverse habitats.

and Jancola 1992). Wyman and Hawksley-Lescault (1987) observed that very few individuals of this species were found on forest soils with pH < 3.7. More studies will be needed at the LCW to explain this phenomenon. One explanation for the high encounter rate of RBS under coverboards could be that if woody debris is limited, adding refugia may attract salamanders to an area regardless of other habitat variables (Monti et al. 2000). However, sugar maple decline has occurred for more than a decade at LCW (Duchesne et al. 2003), resulting in a relatively large amount of woody debris on the forest floor. Another explanation could be the younger age of coverboards in the present study (1 to 2 years) when compared to other woody debris. However, a comparison of sampling results from 2002 (137 RBS in five inventories) and 2003 (148 RBS in four inventories) does not support this hypothesis at this time, although longer monitoring will be needed to understand the effect of coverboard maturation and to exclude inter year variation. Other studies also found that the difference between the number of salamanders found under old and new coverboards was not significant (Grant et al. 1992; Monti et al. 2000). One of the most probable explanations for the high encounter rate of RBS

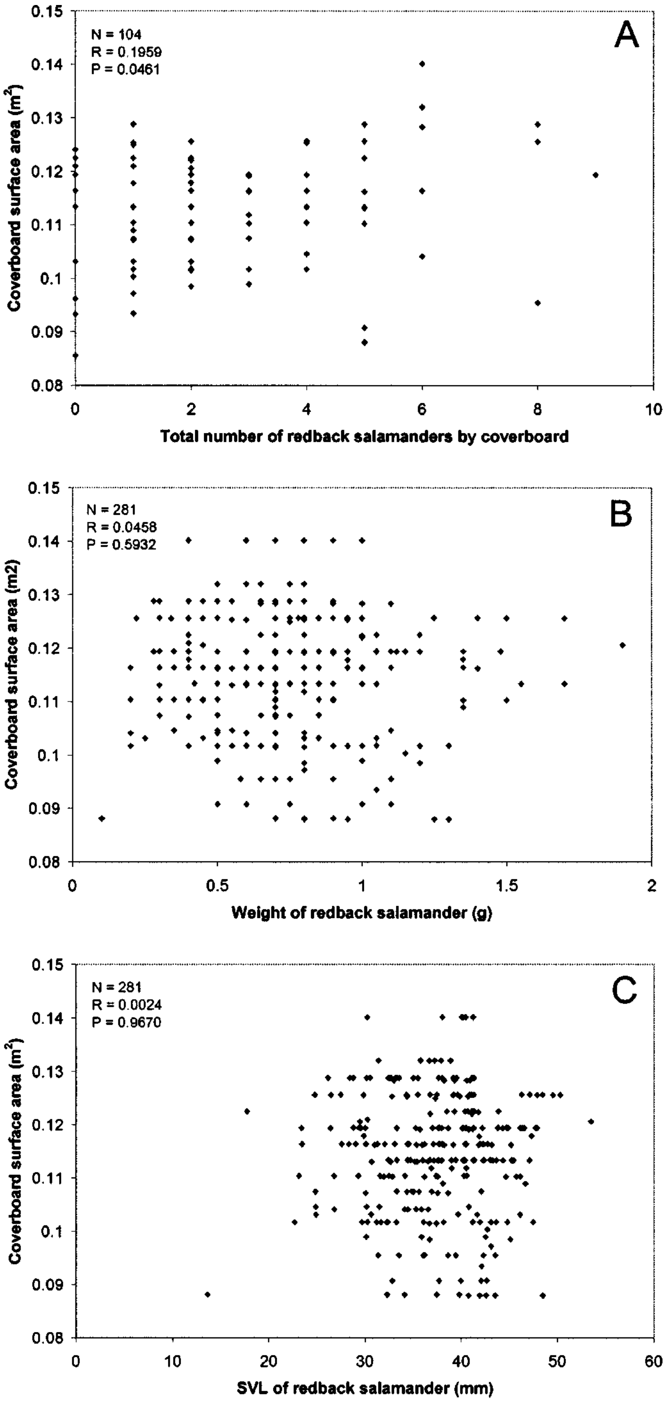

FIG. 1. Regression analysis between coverboard surface area and RBS A) number, B) weight, and C) SVL.

could be the weather prevailing before and at the time of sampling. Coverboard inventories were done, most of the time, during rainless periods (no precipitation the day of the sampling and at least one or two days before), probably forcing salamanders to retreat under coverboards to escape dry conditions. Jaeger (1980) found that the percentage of RBS under logs increased with decreasing rainfall, while simultaneously the percentage of RBS in the leaf litter decreased. This emphasizes the need to monitor RBS during rainless periods so as to maximize coverboard efficiency and, consequently, capture rate.

The relationship between the surface area of coverboards and the number of RBS found under them was significant ($P = 0.0461$; Fig. 1A). However, the weak R value (0.1959) and the relative narrow range of coverboard surface area for each number of salamanders suggests that this parameter was independent of the dimension range of coverboards used at LCW (855 to 1400 cm^2). No relationship was found between the surface area of coverboards and the weight ($R = 0.0458$; $P = 0.5932$) and SVL ($R = 0.0024$; $P = 0.9670$) of RBS during the two-year sampling period (Fig. 1B,C). Similar results were found in Virginia by Faragher and Jaeger (1997) for the size of RBS in spite of a greater range of coverboard sizes (10 to 5000 cm^2) studied. Other studies found, however, that size or weight of RBS was correlated with cover item size (Mathis 1990; Moore et al. 2000) but in these cases, cover size effect was attributed to seasonal influence.

Although no studies have been published that have documented a preference among the salamanders for one type of coverboard over another, it is possible that the wood composition of coverboards (e.g., wood species, chipboard or plywood vs rough-cut) may influence their use by salamanders due to, for example, their wood chemistry and leachate, decomposition rate and moisture retention (Droede et al. 2003). Given the close relationship of salamanders with soil features (Frisbie and Wyman 1991, 1992; Grover 1998; Heatwole 1962; Wyman 1988; Wyman and Hawksley-Lescault 1987), such factors may harm or repel salamanders. The present study was not designed to detect differences among coverboard types. However, the coverboards used at LCW could mitigate this possible phenomenon, given that they were made with *in situ* wood (dominant tree species). Also, in a recent study dealing with potential bias associated with the use of wood coverboard arrays, Marsh and Goicochea (2003) observed that samples from under artificial coverboards contained higher proportions of adult RBS and lower proportions of juveniles and hatchlings than did natural objects. There was, however, no difference in sex ratios or in SVL within stage classes. In this context, more studies will be needed to determine if this new coverboard type accurately indexes the RBS population at LCW.

This study indicates that the use of wood from a native dominant tree species to make coverboards is an efficient tool for surveying and monitoring plethodontid salamanders. Preparation can be done *in situ*, reducing transport and cost. The results suggest that, under a relatively narrow range (0.09 to 0.14 m^2), variability in coverboard surface area has no effect on salamander encounter rate, weight and snout-vent length. More studies will be needed at LCW to explain the high encounter rate of RBS in this acidic habitat.

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Hyla versicolor (Gray Treefrog) metamorph, first day on land. USA: Virginia: Greene County. Photographic illustration by Will Brown (www.blueridgebiological.com).

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A Comparison of Approaches to Counting Spotted Salamander (*Ambystoma maculatum*) Egg Masses in Vernal Ponds

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In 2003, a long-term program to monitor pond breeding amphibians at Cape Cod National Seashore, Barnstable County, Massachusetts (Paton et al. 2003) was initiated. One aspect of this program involves the use of egg mass counts for monitoring long-term population trends of the vernal pond breeding wood frog (*Rana sylvatica*) and spotted salamander (*Ambystoma maculatum*). Crouch and Paton (2000) found that counts of egg masses in ponds were the most cost-effective means of monitoring wood frog populations. Egg mass counts may also be used to estimate abundance and monitor populations of spotted salamanders (Brodman 1995, 2002; Egan and Paton 2004; Jung 2002; Petranka et al. 2003).

While there is a general agreement that egg mass counts are an effective and accurate way to estimate abundance and monitor populations of spotted salamanders (See Shoop 1974 for a contrary opinion), researchers have employed a number of approaches. Brodman (1995, 2002) used random transects across a pond to estimate egg mass density. Others have attempted to count all the egg masses present, based on either a single count of egg masses (e.g., Rowe and Dunson 1993) or multiple counts. One method of multiple counts involves marking egg masses or groups of egg masses to generate a cumulative total (Egan and Paton 2004), hereafter called the locus method (Paton et al. 2003). A second approach to multiple counts is to count (but not mark) all egg masses in the pond on a series of sample dates spanning the breeding season, and use the maximum count as the measure of abundance (Albers and Prouty 1987; Petranka et al. 2003; Petranka et al. 2004). A third, more recently employed multiple count method is the dependent double observer approach. This applies the double observer method of Cook and Jacobson (1979) to estimate the number of egg masses present on a series of counts based on their probability of detection. It then uses the maximum estimate as the measure of abundance (Grant et al. 2005). As with the other multiple count methods, this technique allows better estimates of the maximum number of spotted salamander females breeding at a site than a single count. Including additional observers allows less biased estimates of this variable (Nichols et al. 2000).

In 2003, we compared the maximum count and locus methods for counting egg masses of spotted salamanders in breeding ponds. The maximum count method involves carefully and systematically counting all the egg masses found in a breeding pond on a series of dates during the breeding season. The largest of these counts is then used as the measure of egg mass abundance for that pond that year. The locus method (Paton et al. 2003) is based on the fact that egg masses of wood frog and spotted salamander are often clustered together in a group or locus. The locus method involves counting the number of egg masses in a group (locus), and identifying and marking each locus with flagging. Single, isolated egg masses are also treated as a locus and marked. Each locus and the number of egg masses it contains is recorded. On a subsequent visit, each locus is recounted and the number of egg masses present recorded. Differences in the number of egg masses recorded in a locus from one count to the next may be due to predation, displacement (dislodging an egg mass from vegetation), the laying of additional egg masses, overcounting, or undercounting egg masses that were present during a survey. New (unmarked) loci encountered are also marked, counted, and recorded during subsequent surveys. These new loci may also represent egg masses deposited after the previous visit, or egg masses that were present during the last survey but overlooked. After repeat visits, the maximum count for each individual locus is selected and all loci in a pond summed, providing a total count of the eggs masses deposited in that pond.

Methods.—In spring 2003 we conducted two rounds of spotted salamander egg mass counts at 18 ponds in Cape Cod National Seashore. The first count was conducted between 14 April 2003 and 21 April 2003, and the second, between 28 April 2003 and 5 May 2003. This is generally the period of greatest egg mass abundance. Since data collected on a given day as part of the locus method can also be treated as a count in the maximum count method, we used these data to compare the results obtained by these two different methods. For each pond, the highest of the two daily counts was the maximum count, whereas the locus count was obtained by taking the highest of the two counts of each locus and summing for all the loci in a pond.

Results.—The maximum daily count method underestimated the locus method, on average by 2.7% (range 0–12%; Table 1). Maximum count values were significantly less than those obtained by the locus method (paired t-test $t = -3.46$; $df = 17$; $P = 0.003$), but were highly correlated with them ($R = 0.9996$; $P < 0.000000$; $N = 18$). The mean field time for data collection using the maximum count method was 29 minutes/pond and for the locus method it was 80 minutes/pond. Thus, relative to the locus method, the maximum count method systematically underestimated the number of egg masses present, on average by 2.7%, required 36% the field time, and provided highly correlated results.

Discussion.—Implementation of the locus method was problematic. Determining what constituted a “locus” was often difficult. While many egg masses form discrete loci, many egg masses are also laid singly or in small groups. Egg masses may be spread over a large area rather than concentrated in a small one. When single egg masses were near a larger group of masses, we had to decide whether to consider it a separate locus or group it with a larger neighboring locus. Moreover, since egg mass deposition takes place over the course of a few weeks, seemingly distinct loci early in the season become less so as the space in between them fills in with additional egg masses. To deal with this problem, we had to delineate boundaries between what initially were distinct loci with flagging, labeled to indicate which locus it defined. Using this method, we could be sure we were counting the same locus as in the prior sample and could determine whether egg masses were added or lost. However, defining, labeling, delineating, and recording each locus was a very time consuming process. In addition, the locus method took more time to enter and tabulate

TABLE 1. Comparison of maximum count versus locus method values for spotted salamander egg masses in 2003.

Pond	2003 Max Count	2003 Locus	Difference	% Deviation
E02	50	51	1	2%
E03	38	41	3	7%
E04	633	639	6	1%
E05a	315	321	6	2%
E05main	767	790	23	3%
E06	575	601	26	4%
E07	269	273	4	1%
E08	250	263	13	5%
E11	254	261	7	3%
E11east	24	25	1	4%
E21	261	264	3	1%
T01	544	549	5	1%
T15	22	25	3	12%
W01	489	521	32	6%
W06	27	29	2	7%
W07	338	338	0	0%
W15	64	66	2	3%
W18	44	46	2	4%
Total	4964	5103	139	2.7%

data.

The advantage of the locus method is that, by tracking the number of egg masses in a locus over sampling visits, egg masses once counted but then lost to predation or displaced during counting are still counted, as are newly deposited egg masses. This provides a more complete count of the total number of egg masses deposited. In contrast, maximum counts do not allow for tracking the disappearance of older or the appearance of newer egg masses, and may underestimate the total number of egg masses laid. While we found this to be true, egg mass counts based on the maximum count method provided nearly identical data as the locus method, but in a more time efficient and economical fashion. Increasing effort 276% to detect, on average, 2.7% more egg masses, is not worth the additional effort.

Of these two methods, we would recommend use of the maximum count method, provided that at least three counts are conducted during the appropriate time period. On Cape Cod, we conduct three counts, with the first occurring the last week of March–first week of April, the second in mid-April, and the third in the last week of April–first week of May. This ensures that regardless of whether it is an "early" or "late" spring, counts will occur during the time of peak egg mass presence. Elsewhere, sampling would need to be adjusted for local phenology.

While our results indicate that the maximum count method provides data comparable to the locus method for less effort, neither method addresses the issue of egg mass detectability raised by (Grant et al. 2005). Shoop (1974) felt that egg mass counts underestimated the numbers of spawning females due to the inablity to detect egg masses in deep (> 2 m), turbid water. Egan and Paton (2004) also noted that deeper (>1.5 m) sections of ponds are hard to survey.

The dependent double observer method of egg mass counts (Grant et al. 2005) attempts to account for differences in the detectability of egg masses due to such factors as observers, sites, vegetation, pond size and depth. In its implementation, the primary observer counts egg masses in groups out loud, and the secondary observer records the primary observer's counts and silently records any egg masses the primary observer missed (Jung 2002). Halfway around the pond, the observers switch roles. In our experience with this method in vernal ponds at Cape Cod National Seashore, it is not always feasible in practice. A fundamental assumption of this method is that the sighting ability of an observer does not change as they shift from the role of primary to secondary observer (Southwell 1996). But, suspension of silt, differences in the visibility of egg masses to the observers due to differences in glare and view angle, and the fact that the primary observer often must handle egg masses below the water's surface to count them frequently makes it impossible for the secondary observer to follow along in the count with the primary observer. Thus the secondary observer is often less able to detect egg masses than the primary, resulting in a systematic undercount by the secondary observer and a violation of the above assumption.

While we concur with Grant et al. (2005) on the desirability of modeling detectability to obtain unbiased estimates of the number of spotted salamander egg masses in a pond, our experiences suggest that it may not always be feasible. A more optimal method to assess detectability of egg masses has not yet been developed. In situations where conditions lead to violation of the assumptions of the dependent double observer method, the only reasonable recourse to estimating egg mass abundance, particularly when more than a few ponds are being monitored, seems to be single observer counts, such as the maximum count method described above. We acknowledge that the maximum count method is less than perfect, but believe it provides a meaningful index of spotted salamander breeding effort (e.g., see Petranka et al. 2004) and represents the best currently available compromise among the competing factors of accuracy and precision, ease and economy of implementation in a long term monitoring program, and minimizing monitoring impacts to pond vegetation and wildlife.

Acknowledgments.—Matthew Schult and James Lyon assisted in the field work. E. Grant, R.Jung, J. Nichols, and P. Paton provided valuable discussion and/or comments on an earlier draft of this note. This work was conducted as part of the Cape Cod National Seashore Prototype Monitoring Program.

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A Novel Arboreal Pipe-Trap Designed to Capture the Gray Treefrog (*Hyla versicolor*)

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Drift fences with pitfall traps are a common and effective method of censusing amphibian populations (Dole 1971; Gibbons and Bennett 1974; Gibbons and Semlitsch 1982; Shoop 1965). However, drift fence arrays are ineffective for capturing hylid frogs because of their ability to climb vertical surfaces (Dodd 1991; Gibbons and Bennett 1974). The difficulty of capturing treefrogs using drift fences has led to the development of alternative sampling techniques for hylid frogs including open-ended polyvinyl chloride (PVC) pipes, elevated inverted tin cans, and modified drift fences (Boughton et al. 2000; Goin and Goin 1957; Moulton et al. 1996; Murphy 1993). Currently, the most widely used of these methods consists of constructing artificial refugia from PVC pipe. Several studies have found that varying pipe-trap designs and configurations lead to differences in species composition and size classes of captured individuals (Bartareau 2004; Boughton et al. 2000; Moulton et al. 1996), suggesting that no single pipe-trap design is appropriate for all species in all locations. Here I report on the design and effectiveness of a novel pipe-trap designed to simulate natural arboreal retreats and capture the gray treefrog (*Hyla versicolor*).

The pipe-traps used in this study consisted of 60 cm long sections of 3.8 cm inside diameter black acrylonitrile butadiene styrene (ABS) pipe (Fig. 1). A 10 cm upper and 15 cm lower section of 5.0 cm inside diameter black ABS pipe were attached to trees with bungee cord and wire (Fig. 2). The smaller diameter pipe slid freely up and down during monitoring (Fig. 3), and the flexibility of the bungee cord allowed the 5.0 cm diameter sections of pipe to twist during monitoring, while remaining at the correct position on the tree. Utility wire was used to increase tension of the bungee cord on the upper and lower sections of the trap (Fig. 2) and to provide a pivot point during monitoring (Fig. 3B). Traps were sealed at the bottom with 5.0 cm diameter black ABS caps to allow for rainwater to fill the lower sheath of the 5.0 cm diameter pipe (Fig. 1). Water levels remained constant within the pipe-trap because the inside pipe sat loosely within the bottom capped portion, and excess rainwater flowed out. Frogs were able to enter and leave the pipe-trap freely at the upper opening (Fig. 1).

The pipe-trap design outlined here is similar to some PVC pipe designs evaluated by Boughton et al. (2000). However, I modified their designs in three ways. First, black ABS pipe was used rather than white PVC pipe to provide more realistic (i.e., dark) refugia sites (Lohoefener and Wolfe 1984). Other possible advantages of the dark material may include warmer internal temperatures and greater camouflage from potential predators. ABS pipe is typically used for residential plumbing applications and is similar to the polyvinyl chloride (PVC) piping used in previous studies of artificial arboreal refuge use by treefrogs. Second, I eliminated

the need to nail pipe-traps directly onto trees, which avoids damage to trees and can be an important consideration in old growth forests, or on public lands that discourage the permanent disturbance of habitat. Lastly, this pipe-trap design maintains a constant

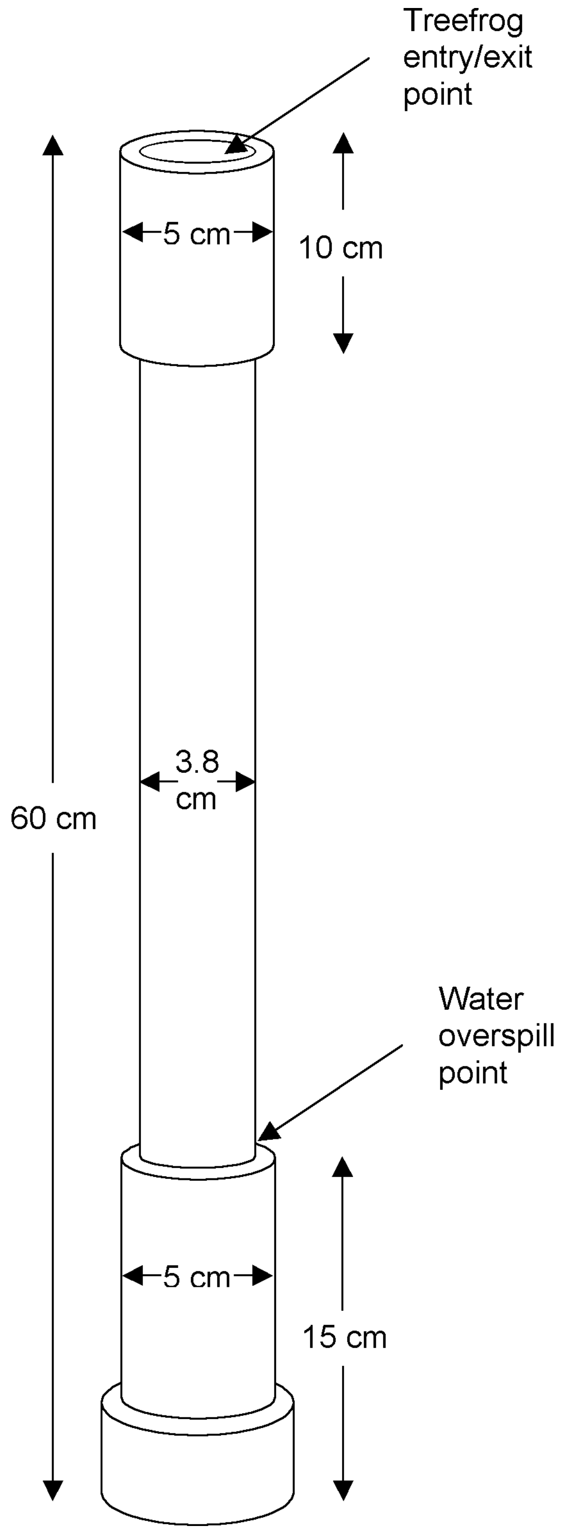

FIG. 1. Pipe-trap design. The smaller diameter inside pipe slides freely through the larger diameter top sheath and rests inside the capped bottom portion of large diameter pipe. The gap between the small and large diameter pipe maintains water level at a constant depth.

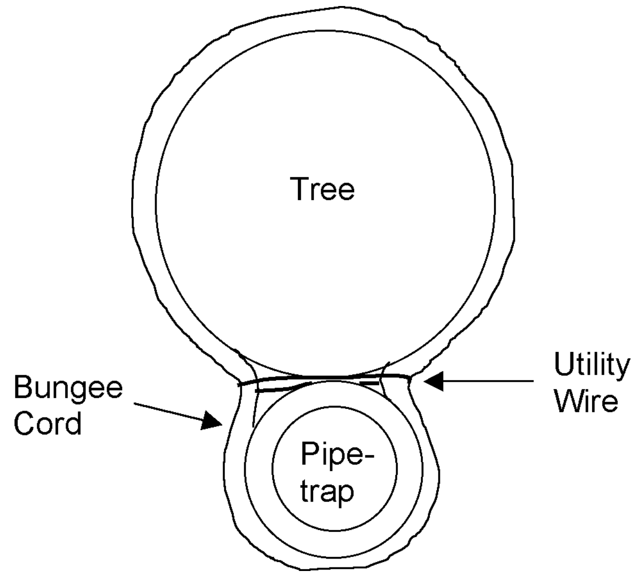

FIG. 2. Top view of a pipe-trap attached to a tree. Not shown is a second bungee cord and utility wire attachment on the bottom segment of the 5 cm diameter pipe.

water depth within the pipe-trap. If frogs are attracted to pipe-traps because of the water they contain, it is important to standardize water level among traps.

The pipe-trap refugia described in this report were constructed for an ongoing study of gray treefrog dispersal distances and terrestrial habitat requirements. To date, pipe-traps have been monitored during two fall emigrations as frogs move towards overwintering sites, two spring immigrations as frogs move towards breeding sites, and two summer breeding seasons (Table 1). Here I present data regarding the effectiveness of these traps for capturing gray treefrogs in a midwestern U.S. deciduous forest.

During the fall of 2002 and the spring of 2003, I placed 28 pipe traps at two adjacent gray treefrog breeding sites located within the Thomas Baskett Wildlife Research Area near Ashland, Boone County, Missouri. The pipe-traps were placed with the upper opening 3 m above ground on large diameter deciduous trees (mean DBH 21.8 cm) and arranged at fixed distances from breeding ponds along four transects. Each transect extended from the breeding sites 200 m into secondary growth (~100 yr) oak/hickory (*Quercus* spp./*Carya* spp.) forest with sugar maple (*Acer saccharum*) understory. During the summer of 2003, the existing transects received an additional pipe-trap at each distance and three paired transects were added to a third gray treefrog breeding site, for a total of 98 pipe-traps in seven paired transects extending 200 m from three breeding ponds into the adjacent forest. An additional pipe-trap was placed 200 m from each of the two breeding sites for a grand total of 100 pipe-traps. During monitoring, pipe-traps were checked during daylight hours for the presence of treefrogs. Frogs were extracted from the pipes by forcing a sponge through one end until the frog could be reached at the opposite end (Boughton et al. 2000; Fig. 3C). Individuals were sexed, given unique toe-clip identifications and snout–vent length (SVL) was measured with a plastic ruler. After processing, frogs were returned to the pipes and placed back on the tree.

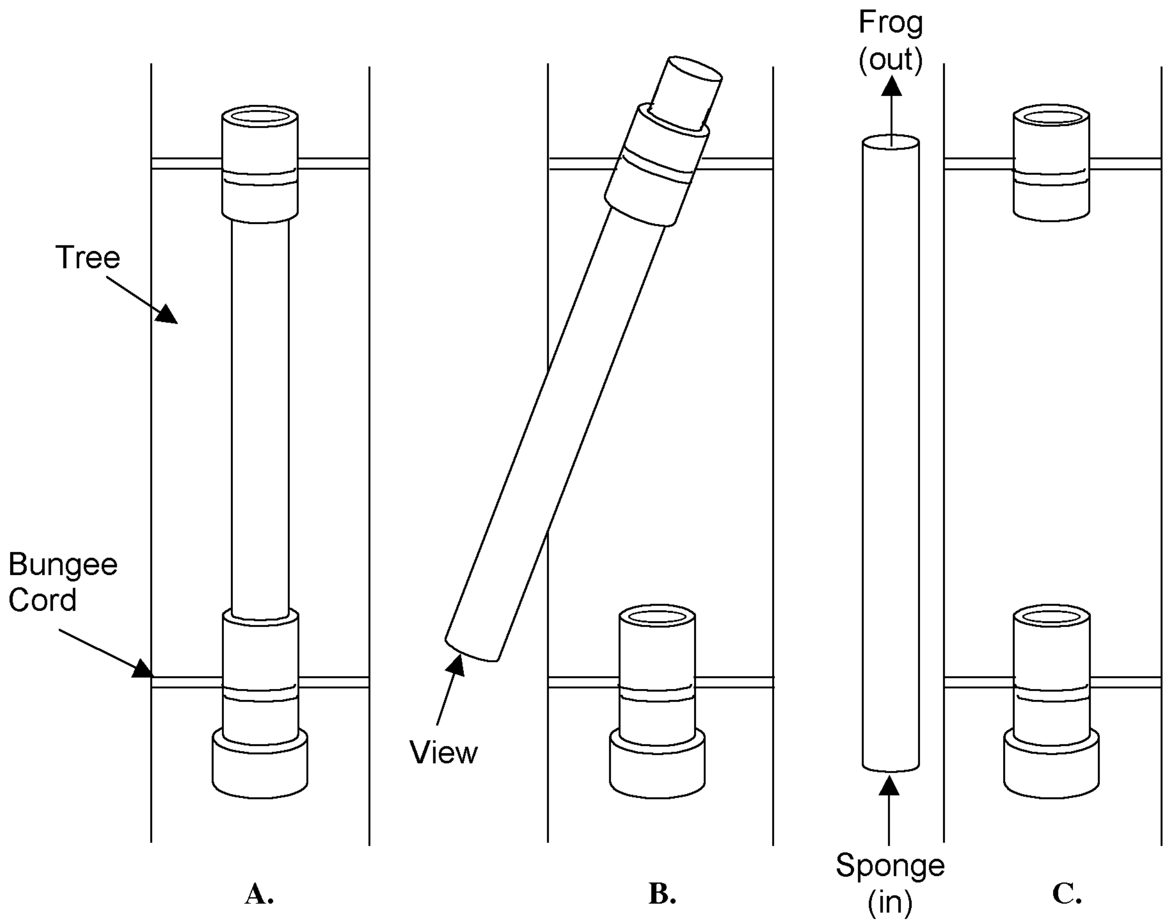

FIG. 3. Overview of pipe-trap monitoring procedure. A. Normal pipe-trap position. B. Inside pipe is slid upwards and top sheath twists on bungee cord so the observer can detect frogs from below. C. If a frog is present, the inside pipe is removed and the frog is extracted.

In total, pipe-traps captured 111 Gray Treefrogs (60 males, 36 females, and 15 juveniles) a total of 565 times (Table 1). The size range was 17–56 mm SVL, which encompasses the entire range of adult gray treefrog lengths (Conant and Collins 1998). The SVL data indicate that these pipes are capable of capturing all size classes of *Hyla versicolor*; however, without size frequency distribution data for the population, it remains unclear if these data display a bias in capture rates generated by the internal pipe diameter (see Bartareau 2004; Martin et al. 2003).

Other vertebrate species captured in the traps include one adult Spring Peeper (*Pseudacris crucifer*), one adult Five-lined Skink (*Eumeces fasciatus*), eight mice (*Peromyscus sp.*), and seven flying squirrels (*Glaucomys volans*). I observed no amphibian mortality within the pipes, however 12 of the 15 mammals encountered were dead. Prior studies using pipe-trap refugia for monitoring amphibians have not reported mammalian mortality. Use of this pipe-trap design might not be appropriate in areas in which incidental small mammal mortality is of concern, unless the open end of the pipe-trap can be modified to reduce the frequency of mammalian intruders without affecting treefrog access.

Previous studies using PVC pipe refugia have been conducted primarily in the southeastern U.S. to monitor other species of hylids (e.g., *H. avivoca, H. cinerea, H. femoralis, H. gratiosa*). These artificial refugia studies have been successful in capturing treefrogs

TABLE 1. Summary of monitoring sessions and captures.

Season	# of pipe-traps	Monitoring period	# of days monitored	# of recaptures	# of males	# of females	# of juveniles
Fall 2002	28	30 Sept. to 15 Oct.	4	7	3	1	1
Spring 2003	28	17 Apr. to 05 May	10	20	4	1	1
Summer 2003	100	17 June to 08 July	11	20	3	10	2
Fall 2003	100	11 July to 22 Oct.	42	290	31	16	21
Spring 2004	100	09 April to 14 May	18	83	18	13	14
Summer 2004	100	18 May to 11 July	28	145	29	17	8

in pipe-traps inserted upright into the ground, placed open-ended or capped at varying heights on trees, and in "T" configurations (see Bartareau 2004; Boughton et al. 2000; Moulton et al. 1996). However, in more northerly locations (Michigan; J. Ball, pers. comm.; New York, Tregger 2004) similar pipe-trap designs have not succeeded in capturing large numbers of treefrogs. The large number of captures reported in this study indicate that this new pipe-trap design may be more appropriate than previous designs for sampling populations of hylid frogs in areas outside of the southeastern U.S. Additional data regarding the factors that drive the use of artificial refugia would be beneficial to the development of pipe-traps designed to optimize captures of particular species in specific locations. For example, the height at which a pipe-trap is placed, the internal diameter and the depth of water retained within the pipe-trap could easily be adjusted to fit the specific requirements of the hylid species under investigation. While the use of pipe-trap refugia to generate estimates of treefrog density or abundance may be complicated by biases of pipe diameter and design configuration, artificial pipe-trap refugia may be especially useful for delineation of terrestrial core habitat used by hylid frogs during both the breeding and non-breeding seasons when traditional methods of capturing amphibians are inadequate.

Acknowledgments.—I thank D. Johnson and G. Johnson for helpful discussions regarding trap design, and T. Rittenhouse, R. Semlitsch, and D. Shephard for insightful comments on the manuscript. Thanks also to R. Mahan and J. Haynes for assistance with fieldwork, and to J. Millspaugh for access to field sites.

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A New Method of Temporarily Marking Lizards

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Labeling individual animals with unique and distinct markers is necessary in many ecological studies, including population density assessments, estimates of home range or territory areas, and behavioral observations. Researchers have developed many techniques for identifying individuals, but few allow convenient field identification of individuals from a distance. The ability to distinguish among individuals without repeatedly disturbing them is especially important in studies of behavioral ecology where the goal is to determine natural patterns of behavior. The most appropriate marking techniques for these studies are therefore quickly and easily implemented, clearly distinguishable from a distance, and not harmful to the marked individual (Murray and Fuller 2000; Nietfeld et al. 1994). I have developed a new method for temporarily marking small lizards that meets these criteria.

Individually marking reptiles presents a special challenge for field workers in that reptiles frequently shed their skin and with it any external markers. The bead-tagging method of Fisher and Muth (1989) avoids this problem by sewing unique combinations of beads into the most proximal region of a lizard's tail muscle. This is a permanent marker that works well for lizards that have a snout-vent length (SVL) of greater than 40–45 mm, but one that is difficult and often impossible to use for smaller lizards and for those with very slender tails. Other common methods of marking lizards have shortcomings as well. Many researchers use toe-clipping to distinguish among individuals (Ferner 1979). However, there are several problems with using this method in short-term behavioral studies. First, it may take a substantial amount of time for a toe-clipped lizard to recover from the injury caused by the clipping, which may further inhibit normal behavioral and movement patterns. Second, lizards sometimes naturally lose toe joints (Hudson 1996; Middelburg and Strijbosch 1988), which can make identifications difficult. Finally, toe clips cannot easily be seen without handling the animal. Other researchers have used non-toxic paint on the dorsum or colored acrylic polymers inserted under the skin, but these are also difficult to administer and distinguish on small lizards. For studies that can be completed in less than the average interval between natural sheddings of the species, I recommend the use of queen bee marking kits for smaller lizards. These kits, available from The Bee Works of Orillia, Canada (www.beeworks.com) for US $17.50 each, contain cardboard dots in five colors (white, blue, yellow, green, and orange) numbered 1–99 in each color. Each kit also includes phial glue and an applicator for adhering the dots to the animal.

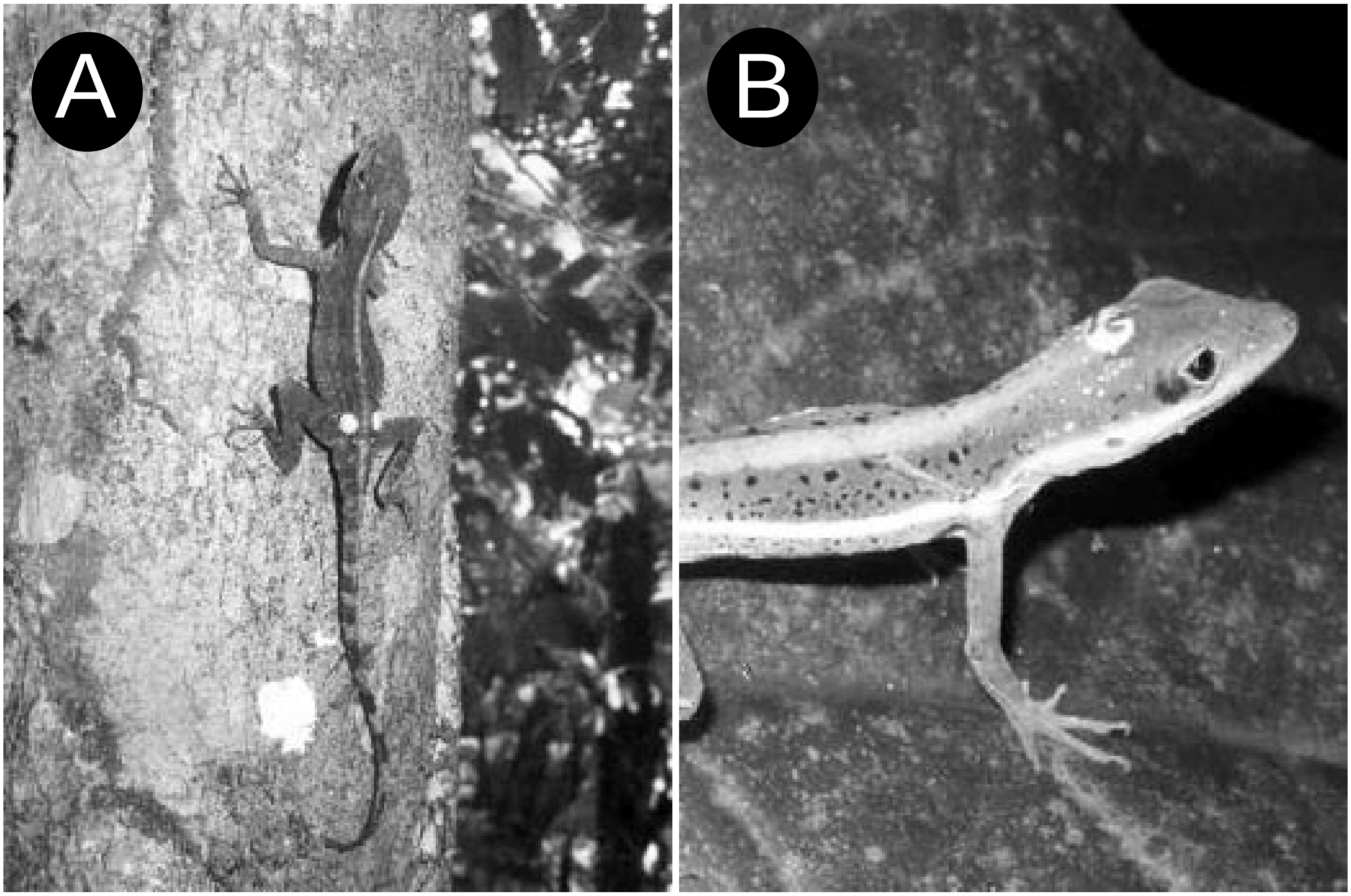

FIG. 1. A) Female *Anolis gundlachi* with two bee tags attached to its lower dorsum. B) Female *Anolis krugi* with bee tag (numbered 21) attached to its head.

We have used bee tags for marking four species of diurnal lizards: *Anolis cristatellus*, *A. gundlachi*, *A. krugi*, and *Sceloporus undulatus*. These four species have different habitat requirements and different scale types, and bee tags have proven to work well for each. *Anolis gundlachi* and *A. krugi* occur in the montane rainforests of Puerto Rico (Rand 1964; Schoener and Schoener 1971), *A. cristatellus* occurs in lowland dry forests and disturbed areas in Puerto Rico (Rand 1964; Schoener and Schoener 1971), and *S. undulatus* is found in North American woodland areas and glades (Stebbins 1954). During our behavioral studies of these species, we found that bee tags were dependable markers for approximately three weeks in the natural habitats of these species. We marked males and large females with the bead-tagging method described above (Fisher and Muth 1989), and smaller females and juveniles with bee tags. Bee tags are remarkably easy to attach; after catching a lizard we handled it for approximately two minutes to measure its SVL, take a small tissue sample from its tail, attach a bee tag combination, and allow the glue to dry. In contrast, almost twice that time was needed to attach a bead tag. Another primary advantage of the bee tag technique is its flexibility; the dots can be glued on almost any part of the dorsal surface of the lizard (Fig. 1). In our studies, we glued 2-3 bee tags on the head, the upper dorsum, or the lower dorsum of the lizards using the colors, numbers, and location of the tags to identify individuals. While the colors and position of the tags are often visible with the naked eye, close-focus binoculars were needed to read the numbers on the tags. When a tag was occasionally missing from a lizard, we were almost always able to identify the individual by the remaining tags on that individual, or by a process of elimination in which other lizards of known identification were ruled out.

Marking lizards with bee tags provided short-term results comparable to those of the bead tagging technique (Fisher and Muth 1989). Of the 166 lizards of the four species we have marked using the bee tag method, we were able to conduct behavioral observations on 141, or 85%, in a three-week period. Likewise, of the 75 lizards marked with permanent bead tags for the same studies, we were able to observe 66, or 88%. It therefore appears that these two methods have similar "success" rates. There are many reasons we may fail to repeatedly observe a lizard other than loss of its tags, including death by predation or disease. It is also logical to assume that some lizards may be captured in a rare foray from their normal home range into the study area. However, we did observe one lizard (a female *A. krugi*) shed its entire skin and eat its dots immediately after being marked with bee tags, and the dots of one female *A. cristatellus* were found in its feces. These occurrences appear to be rare in the field, but when *Anolis* lizards were placed in the animal care facility at Washington University almost every individual shed and ate its bee tags.

In many circumstances, marking small lizards with queen bee marking kits is preferable to other marking techniques, as it is

inexpensive, relatively non-intrusive, and an easily visible way to identify particular individuals. The technique is also useful for larger lizards when temporary highly visible markers are preferred to permanent ones, particularly in studies in which the researcher wishes to avoid disturbing the focal individuals as much as possible.

Acknowledgments.—Many thanks to J. Chase for the original suggestion of bee tags for use in my behavioral studies, and to R. Kirby and S. Wang for their enthusiastic assistance in the field. J. Kolbe, J. Losos, K. McIntyre, and N. Calder provided helpful comments on an earlier draft of this manuscript. This work was supported by a grant from the National Science Foundation (DEB 9982736).

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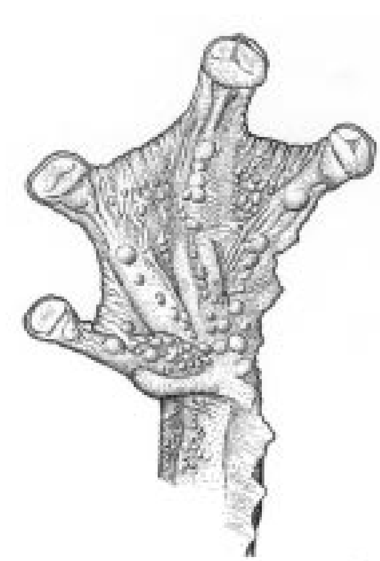

Hyla valancifer (USNM 319780) (Fringe-limbed Treefrog). Belize: Toledo: Gloria Camp. Palmar view of the hand. Illustration by Julian C. Lee.

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A Refined Method for Culturing Reptilian Cells with Comments on Aggregations of Reptilian Melanomacrophages

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Many herpetologists are using cell culture to answer questions ranging from cell and tissue function to studies of the aging process. This paper reports a culture technique improved from that of Rund et al. (1998), especially a method of concentrating cells such as melanomacrophages (MMs). We became interested in these cells with the discovery that they formed aggregations in spleen, liver, and other organs in mud turtles, *Kinosternon flavescens*, and that these aggregations increase in number and size with turtle age (Christiansen et al. 1996). Aggregations of MMs have been reported in fishes (Aguis 1985), amphibians (Sichel et al. 1997), and some reptiles (Duncker 1968) among others. The basics of our methods were similar to those of Clark and Karzon (1967), Clark et al. (1970), and Koment and Haines (1982). Ulsh et al. (2000) used autologous turtle serum instead of fetal bovine serum to facilitate culture of reptilian lymphocytes.

In our studies of the advantages these cells provide turtles in low temperature environments (Johnson et al. 1999), we observed that our cultures became overrun with fibroblast-like cells. Our need to obtain nearly pure cultures of MMs for this study as well as our need for nearly pure fibroblast-like cell cultures for our current studies of aging and the aging process in reptiles, necessitated development of the purification techniques we report here. In addition, our MM cultures have provided evidence for a potential reason for the hepatic aggregations.

Culture Technique.—Liver and spleen from Western Painted Turtles (*Chrysemys picta bellii*) were used for preparation of MMs and these tissues along with skin and lung provided cells for fibroblast cultures. The turtles were collected and sacrificed under scientific collecting permit SC255 0101 and others issued to JLC by procedures approved by the Drake University Animal Care Committee as reported in Rund et al. (1998). Approximately 10 mm cubes of tissue were placed in RPMI-1640 (Sigma-Aldrich, Inc., St Louis, Missouri) containing penicillin, streptomycin, and neomycin (100 IU/ml: 100 mg/ml; 200 mg/ml, respectively, all from Sigma-Aldrich, Inc.). Tissues were rinsed three times in 40 ml RPMI-1640 with antibiotics to remove clotted blood and debris. Washed tissues were transferred to petri dishes and crossed scalpels were used to divide them into 2–3 mm cubes. The cubes of friable organs were pushed through a 1.0 mm stainless steel screen with a spoonula but skin was shredded further with crossed scalpels. The tissue fragments, cell aggregates, and individual cells

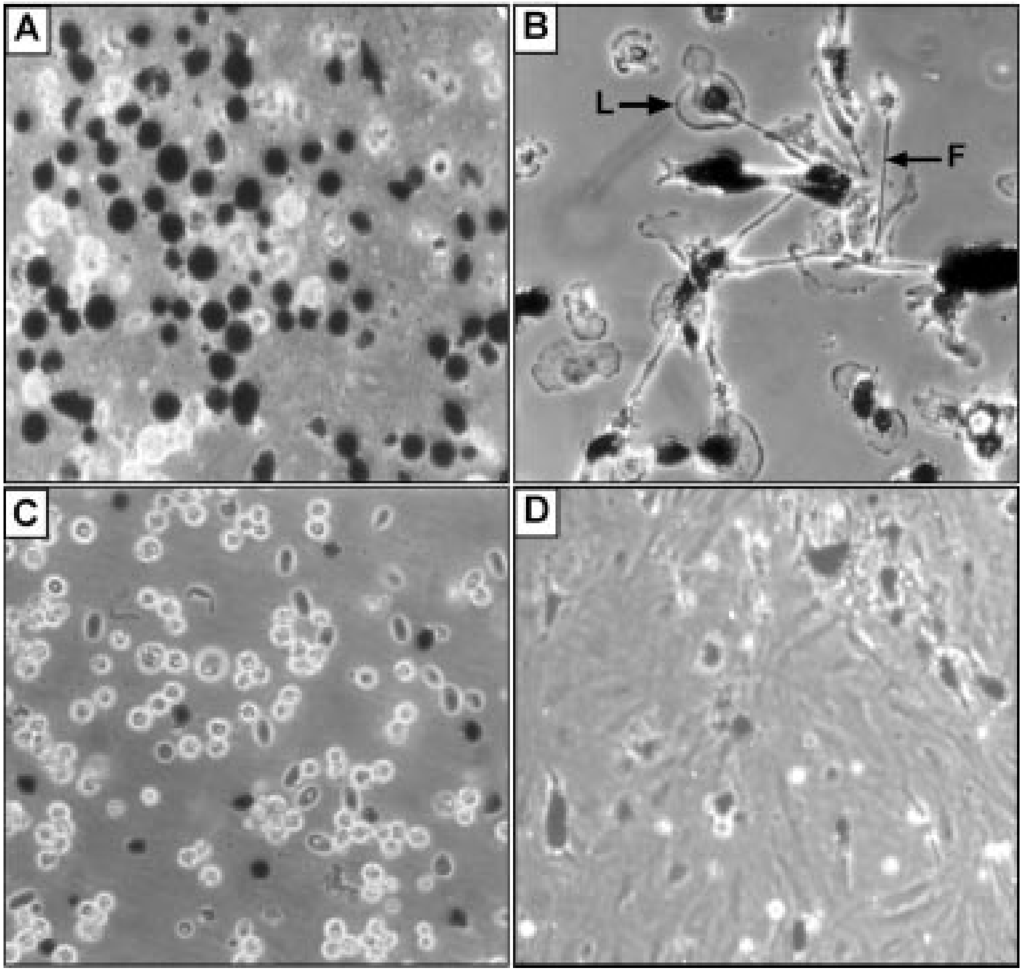

FIG. 1. Purification of reptilian cells for culture by selective trypsinization and differential settling. Initial plates (A and C) have app. 30,000 cells per plate. A = Selectively trypsonized and settled cells one hour post plating showing nearly pure culture of melanomacrophages (cells with black pigment). B = Same culture 25 days post plating. L indicates feeding lamellapodia; F indicates one of many forms of filapodia forming a network. C = Cells prepared by standard technique (Rund et.al. 1998) one hour post plating showing few melanomacrophages and abundant other cells. D = Same plate 15 days post plating showing culture overrun with fibroblast-like cells. We have used selective trypsinization to prepare nearly pure fibroblast cultures as well as melanomacrophage cultures. Blood cells do not attach and are eliminated when the cultures are fed.

were collected in complete medium (CM), RPMI-1640 with 7.5% fetal bovine serum (Gibco Inc. Grand Island, New York) and penicillin, streptomycin, and neomycin at half the concentrations used above. The cells and aggregates were allowed to settle for 8 min through a 40 ml column of CM in a sterile centrifuge tube. The pellet was collected, trunulated (repeatedly pulled in and out of a 10 ml pipette) in fresh CM to resuspend and separate the cells, and the cells were resettled as before. This procedure removed much of the cellular debris. The pellet was then resuspended in CM and transferred to ten 75cm^2 T flasks as described in Rund et al. (1998). Individual viable cells and aggregates of either MMs or fibroblasts or both attached to the substratum and spread within 3–5 days post-plating during incubation at 29˚C in a humidified incubator operating at 5% CO_2. CM was decanted and replaced with fresh CM after one week. Additional cultures were started from the decantates that contained viable cells and aggregates that had not yet fully attached. These cells and aggregates were centrifuged, resuspended in CM, and then vigorously trunulated to further separate cells before depositing cells in T flasks. MMs and other cells including many fat droplet-bearing cells were obtained by this procedure and their viability was demonstrated by their ability to attach to the flask substratum and spread.

Approximately 28 days after establishment of these primary cultures containing mixtures of cells, MMs were collected by selective trypsinization. Unattached cells such as RBCs and fragments of tissue were removed by gentle shaking and decantation. A warm 1:5 dilution of 0.25% trypsin-EDTA (Sigma-Aldrich, Inc.) in sterile PBS (10 mM phosphate buffer, pH 7.2, 137 mM NaCl) was added to the flasks and incubated for 5–7 minutes. Most fibroblasts, fat droplet-bearing cells, and hepatocytes rounded up and detached from the substrate with gentile shaking. These could be cultured in other flasks if desired. A few fibroblasts always remained but this procedure could be repeated when relatively pure MM cultures were desired. The MMs rounded and detached after approximately 15 minutes or with the addition of fresh trypsin-EDTA. The enriched MM fraction was collected by centrifugation for three minutes at 1000 x g and cultured at plating densities of 0.5–3.0 x 10^3 cells/cm^2 in T flasks. The enriched MM fraction consisted mostly of MMs with some debris and a few hepatocytes (Fig. 1A). Cells were maintained at 29˚C in CM with media replacement at weekly intervals. Cultures were selectively trypsinized if overgrowth by fibroblasts occurred. Overgrowth of MMs did not occur because these apparently end-stage, differentiated cells rarely, if ever, divided in culture. Selective trypsinization and settling as described herein, typically resulted in cultures that were greater than 90% MMs based upon microscopic determinations of melanin in attached and spreading cells (Fig. 1B). These cultures could be maintained free of fibroblast overgrowth for many weeks depending on the burden of fibroblasts in the selectively trypsinized cell fraction.

Fibroblast and other cells in preparations that were not selectively trypsinized (Fig. 1C) would grow into colonies and further multiplied to form confluent cultures of mostly fibroblasts in 10–20 days depending upon plating densities, species, age of the culture (number of times the culture had been passaged), and age of the animal from which the culture was obtained (Fig. 1D).

MM Aggregations.—Melanomacrophages tended to adhere to each other. The MM centers in the liver and spleen were resistant to trypsinization and disaggregation and clumps of MMs were lost during culturing as they did not bind sufficiently well to the plastic substratum to resist decantation during media replacements. Upon selective trypsinization, MMs tended to reaggregate to form collections of 2–6 cells that appear as the larger spherical clusters in Fig 1A. These would often settle to form clusters of MMs (Fig. 1B). MMs that had aggregated or individual MMs that otherwise found themselves in relatively close proximity to each other in culture, used a variety of cellular processes to form networks. These processes are continuing to develop at 25 days post plating (Fig. 1B). This *in vitro* evidence suggests that MMs may aggregate in sinusoids or elsewhere with the effect of forming a similar network of processes potentially to trap foreign particles or organisms moving through the vessel. Johnson et al. (1999) demonstrated that MMs in culture phagocytized red blood cells and bacteria, and that they attached to parasites.

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The Use of PIT Tags in Capture-Recapture Studies of Frogs: A Field Evaluation

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Marking animals so that they can be individually identified is an essential component of many animal studies. However, the same animals must be observed on two or more occasions for patterns of growth, development, movement and other parameters to be determined (e.g., Donnelly et al. 1994; Schemintz 1980; Skalski and Robson 1992). Capture-recapture of individuals may also be required for estimation of population size and patterns of population dynamics (e.g., Begon 1979; Caughley 1984; Seber 1982; Southwood 1978).

To be useful in these contexts the marks applied to animals should be able to uniquely identify the individual, should be permanent (at least over an animal's lifetime) and accurately discernable, and should not affect survival, reproduction or behavior (e.g., Seber 1982). Additionally, if marked animals are less likely to be captured than unmarked animals then estimates of population size based on capture-recapture analysis will be biased away from the true population size (e.g., Seber 1982). Any process of marking animals must also be logistically and economically viable (e.g., IUCN/CBSG on Permanent Animal Identification 1991).

For the use of marks to be justified, any associated pain or suffering experienced by the animals should be minimized (e.g., Anonymous 1992). Aside from being reasonably humane, such an approach is now a legal requirement in many areas for research activities that involve non-human animals.

In the case of frogs, no reliable and completely pain-free technique for marking individuals has been found. Identifying individuals on the basis of unique color patterns is sometimes possible, but only when the total number of individuals is reasonably small (e.g., Berrill et al. 1992; Bertram and Berrill 1997; Doody 1995). It is difficult or impossible to permanently attach anything external to the body of a frog (e.g., Elmberg 1989; Woodbury 1956), and therefore the most commonly used technique for marking frogs has been toe-clipping (e.g., Donnelly et al. 1994). In this technique, one or more toes are removed and a unique pattern of toe removal is assigned to each individual (e.g., Donnelly et al. 1994). It is hard to imagine that this would not be painful for the animals involved. Branding, where a mark is induced in the skin of a frog through the application of intense but localized heat or cold (e.g., Clark 1971; Ehmann 2000), seems also likely to be painful for the individuals involved.

Since 1983 it has been possible to mark individual animals with small passive integrated transponders that are generally referred to as PIT tags or microchips (e.g., Barnard 1989; Camper and Dixon 1988; Fagerstone and Johns 1987; Prentice and Park 1983). The transponder is an integrated unit consisting of an electromagnetic coil, tuning capacitor and microchip, all sealed in a cylindrical glass enclosure that is typically 1.8–2.2 mm in diameter and 10–

12 mm long (e.g., Elbin and Burger 1994; Fasola et al. 1993; Keck 1994; Ott and Scott 1999). The transponder is passive in that it contains no power supply and does not emit any signal until stimulated (e.g., Germano and Williams 1993; Jehle and Hoedl 1998; Schooley et al. 1993). The chip is inserted internally into the animal and is programmed with a unique alphanumeric code that can be read by a scanner (e.g., Christy 1996; Jehle and Hoedl 1998; Schooley et al. 1993).

This methodology has many advantages of alternative methods for marking animals. As there are high rates of scanner accuracy (Gibbons and Andrews 2004), PIT-tagged individuals can consistently be identified with little or no error. PIT tags are reliable and relatively easy to use, durable and afford an immense number of possible different codes, estimated at about 34 billion (Elbin and Burger 1994). Insertion of a tag into an animal requires no more than five minutes (Christy 1996) and often much less time (G. Pyke, pers. obs.). Tag life is considered to be 15–20 years (Germano and Williams 1993), 50–100 years (Pope and Matthews 2001), indefinite (Christy 1996; Fasola et al. 1993; Keck 1994) or 'permanent' over the lifetime of an animal (Ott and Scott 1999).

Due to these advantages and the small size of PIT tags, they have been increasingly used to individually mark all classes of vertebrate animals (Elbin 1991). They have been used with fish (e.g., Adam and Schwevers 1994; McCutcheon et al. 1994; Peterson et al. 1994), mammals (e.g., Ball et al. 1991; Schooley et al. 1993; Thomas et al. 1987), reptiles (e.g., Germano and Williams 1993; Parmenter 1993; Jemison et al. 1995), amphibians (e.g., Brown 1997; Donnelly et al. 1994; Zulich et al. 1992), and birds (e.g., Ballard et al. 2001; Elbin and Burger 1994). They have also been used with relatively large invertebrates, such as crabs (e.g., Pengilly and Watson 1994).

The consequences of the PIT tagging process for the animals involved have been considered in a number of studies. For example, relative merits of using PIT tags in relation to alternative methods for individually marking animals have been assessed (e.g., Brown 1997; Jehle and Hoedl 1998; Jemison et al. 1995; Ott and Scott 1999; Perret and Joly 2002), as have effects of PIT tagging on individual survival, growth, movement and health (e.g., Christy 1996; Fasola et al. 1993; Keck 1994; Ombredane et al. 1998). In general, PIT tagging has minimal adverse impacts on tagged animals (Gibbons and Andrews 2004).

Our own use of PIT tags to mark frogs provides an additional opportunity to consider some of the consequences of employing this technique. As part of an ongoing research program that focuses on the Green and Golden Bell Frog (*Litoria aurea*) and the Striped Marsh Frog (*Limnodynastes peronii*) my colleagues and I have been using PIT tags to mark frogs at several sites in New South Wales, Australia since March 1998 (Pyke and Miehs 2003; Pyke and White, unpubl.). We have PIT tagged over 3000 individual frogs and had multiple recaptures of many of these. We have, therefore, made a number of observations that are relevant in the context of evaluating the outcomes of the technique.

Field Studies

General Methodology.—Field studies have been carried out by teams of people that have varied in composition. These teams have been coordinated by the author, who has been present on all occasions.

We have used PIT tags supplied by Trovan in individually-packaged needles inside hermetically sealed packages. Inside each needle is a metal rod that can push the tag from the open end of the needle. We have implanted these tags subcutaneously by pinching the skin along the side of the body a short distance behind the front limb, inserting the needle through the pinched skin parallel to the body axis toward the base of the hind limb, and then pushing the tag through and out of the needle with the aid of a plunger mechanism inside a syringe that is attached to the needle. We have not anaesthetized frogs before this procedure. To seal the wound area we have used Vetbond, an n-butyl cyanoacrylate adhesive that quickly polymerizes from liquid to solid state when applied to the skin. We have adopted a minimum snout-vent length of 40 mm for PIT tagging. The alphanumeric codes for the PIT tags supplied to us have not been sequential and have varied greatly from one to the next.

We have been able to evaluate PIT tags of two different ages since manufacture. We have used PIT tags within two years of their receipt and well before the stated expiry date, which has been about seven years after we received them. These tags would have been less than two years old when used by us. We also have some PIT tags with an expiry date of 1996, but have not used them. These tags were considerably older when we examined them, probably about 15 years since manufacture (see below).

Effects of PIT Tagging on Frogs.—During field studies in Australia over a period of 6 years we have implanted PIT tags under the skin of almost 3000 frogs of nine species. One species, the Green and Golden Bell Frog (*Litoria aurea*) has accounted for most (89.2%, N = 2950) of the frogs we have micro-chipped, followed by the Striped Marsh Frog (*Limnodynastes peronii*; 8.9%) and small numbers of the other species.

The behavior of frogs while we have microchipped them suggests that any pain involved must be minimal, except when an animal is injured during the process. Although capable of emitting a distress call, the frogs that we have PIT tagged have rarely (i.e., <1% of the time) made such calls while we have handled and tagged them (pers. obs.). They have also rarely flinched or otherwise struggled during the microchipping. On the other hand, on three occasions when frogs have clearly been injured during tagging (see below) they have made loud and obvious distress calls. I assume here that distress calls and struggling movements of hand-held animals are possible signs of pain they experience, and that the absence of such behaviors suggests a lack of pain.

On only three occasions has any noticeable injury occurred to a frog during the tagging process. In each of these cases the implanting needle must have penetrated the body wall, because part of the lungs exuded from the body and out into the air almost as soon as the needle was withdrawn, and the frog emitted loud distress calls starting when the needle began to penetrate the body wall. In one case the injured frog was taken from the wild into captivity, given sutures, antibiotics and food, and subsequently released back into the wild. In another case, the lungs naturally and reasonably quickly retracted back into the frog's body and remained there after application of tissue glue to the wound, and this frog was then released where it had been captured. In the third case the frog was euthanized. Neither of the injured frogs that were released alive has subsequently been recaptured, but overall recapture rates at the associated sites have been close to zero (Pyke,

unpubl.).

No longer-term effects of our tagging on the health of individual frogs have been apparent. Whenever frogs have been recaptured about 24 h after initial tag insertion, a thin layer of Vetbond around the wound site has often been observed but the wound itself has never been visible and there have been no signs of swelling, infection or other damage to the area (N = 420). Frogs that have been recaptured about 6 weeks or longer after initial tag insertion have never shown any signs of the wound or other damage to the area (N = 1099). Our field schedule has been such that recaptures after intervals of between 2 days and 6 weeks have not been possible.

The proportion of tagged frogs among those found dead has not been significantly different from the proportion among those captured alive, suggesting that mortality is no different between tagged and untagged frogs. At Broughton Island over the period from 1999 to 2003 four dead frogs (3 *L. aurea*; 1 *L. peronii*) have been found, of which three (i.e., 75%) were tagged. Over this period, which omits the first year of the study when recapture rates were rapidly increasing, and during which recapture rates were relatively stable, the overall recapture rate across the two species was almost identical at 74.5% (N = 5379). Similarly, at North Avoca over the same period, 33.3% (N = 9) of *L. aurea* frogs found dead had been tagged compared with 48.1% (N = 497) of this species captured alive (P = 0.5; Fisher Exact Test).

If tagged frogs are less likely to mate than untagged frogs then the proportion of tagged frogs among those found in amplexus should be lower than the proportion among unmated frogs, and a significant trend in this direction was found. On Broughton Island, during spring and summer when almost all amplexing *L. aurea* are found, 60.9% of the males (N = 46) and 37.0% of the females (N = 46) were tagged while among unmated frogs, 80.0% of males and 62.4% of females were tagged (males: P = 0.003; females: P = 0.001; Fisher Exact Test). Amplexing pairs of this species have not been recorded at other sites.

However, the frogs in amplexus were significantly younger than those that were unmated. For those *L. aurea* that had been previously captured and tagged, the average number of captures per individual was significantly higher for unmated frogs than for frogs in amplexus (i.e., unmated: mean = 5.45, N = 4229; amplexing frogs: mean = 3.76, N = 54; F-ratio = 9.11 r^2 = 0.002, P = 0.003, ANOVA). For all captured *L. aurea*, including both new captures and recaptures, the average number of captures per individual was about 92% higher for unmated frogs than for frogs in amplexus (i.e., unmated: mean = 4.32, N = 5661; amplexing frogs: mean = 2.24, N = 120; F-ratio = 31.7, r^2 = 0.005, P<0.001, ANOVA). Assuming the probability of capture for a frog of this species is independent of age once the frogs have reached maturity, the average age of the unmated frogs must have been about 92% higher than that of the amplexing frogs.

Taking this age difference into account, there were no significant differences in recapture rates of amplexing and unmated frogs. If the probability of an individual of age "X" being tagged is "P_X" and the probability of an animal being captured is assumed constant throughout its life, then the probability of an individual of age "A times X" being tagged, where A is any constant, is $1-(1-P_X)^A$. Hence the recapture rates of 0.609 and 0.370 for amplexing males and females respectively are equivalent to 0.835 and 0.588 among frogs that are 92% older (e.g., $1-(1-0.609)^{1.92}=0.835$). These proportions are not significantly different from those observed for unmated males and females (P's = 0.8 and 0.5, respectively; Fisher Exact Test). Allowing for the likelihood that capture probability does not remain constant would not alter this conclusion.

During our study some PIT-tagged frogs of *L. aurea* have lived for many years, some individuals have been captured many times, and recapture rates have reached high levels. Based on recaptures, about 7% of tagged individuals have lived at least 3 years since first capture and several frogs have been alive for the 5-year duration of the study. About 8% have been captured at least 10 times and about 1% have been captured over 20 times. Recapture rates have peaked during winter each year at about 90% for males and 75% for females (Pyke, unpubl.).

Permanence of Tag Code and Accuracy of Recording Codes.—No tag failures have been detected during the present study. For most tagged individuals the tag can be seen as an elongated bump under the skin and there has not yet been a case where a tag was visible but undetected by the scanner. In a relatively small number of cases the scanner has detected a tag that was not noticed during visual inspection of the frog. Tag failures have, however, been apparent in tags that were about 15 years old. Out of a total of 75 tags that all have an expiration date of 1996 printed on the sealed container and were supplied together, 5 (i.e., 7%) could not be read by a scanner in 2004, while the remainder could be read correctly.

There has probably been negligible error with regard to the alphanumeric codes associated with the PIT tags when they have been implanted into frogs. In our case the PIT tags come supplied with stick-on labels bearing the code and we have used these labels to record the code without scanning and hence without any scanning error. We occasionally scanned the PIT tags at the time of implantation and always found agreement between the code detected by the scanner and the code on the label. We have also been able to compare the codes associated with the tags we have used with a master list for tags supplied to us, and so far found no discrepancy.

On the other hand, we have detected incorrect codes in our data when codes that are recorded for a recaptured frog only appear once in our records and have never been recorded in association with an initial capture of any animal. About 1.8% of recorded codes for frogs on Broughton Island have shown such errors (N = 5020). Such errors might also be detected if recorded microchip codes do not correspond to the entries in the master list of all codes that have been used.

We have found that these errors can generally be attributed to human error associated with recording microchip codes, with usually just one character being omitted or incorrectly recorded. Most cases of mistaken character identity can be attributed to visual or auditory similarity between the correct and incorrect characters when written or spoken respectively (e.g., visual: B vs. 8; auditory; D vs. B). Some mistakes have no obvious explanation.

We have taken steps to minimize recording errors. Typically one person scans and calls out the code to a second person that does the recording. Lighting may be poor and there may be significant background noise. To minimize recording error the person doing the scanning uses a headlamp to illuminate the scanner. To minimize auditory misinterpretation, words rather than letters are called out (e.g., 'alpha' instead of 'a'). Errors could be further

reduced if the recording person called out the recorded code to the scanning person who checked this against the code on the scanner, but this would add to the time required.

Through the diversity, as supplied, of alphanumeric codes for PIT tags and the above steps to minimize human error, we have been able to achieve a marking system that is essentially error-free. There is much noticeable variation among the alphanumeric codes for PIT tags, both within batches of supplied tags (we get them in batches of 40) and between these batches. It is this diversity of codes that permits us to detect and correct any errors that do occur, despite our attempts to minimize them. Such errors might also be eliminated where it is possible to transmit detected codes directly from scanner to computer and match these codes with other recorded information about individual frogs.

Discussion

Our field observations provide further evidence that marking frogs with PIT tags has little immediate impact, does not significantly affect long-term survival or reproductive behavior, and can be used with almost no error (see Gibbons and Andrews 2004). The behavior of frogs while we have microchipped them suggests that any pain involved must be minimal, they have rarely suffered noticeable injury during the tagging process, and no longer-term effects of our tagging on the health of individual frogs have been apparent. There have been no apparent differences between tagged and untagged frogs in terms of survival or ability to mate. Some tagged frogs have lived for many years, some individuals have been captured many times, and recapture rates have reached high levels. The diversity of alphanumeric codes for PIT tags and our steps to minimize human error have essentially eliminated errors. Hence there are many benefits associated with the use of PIT tags to mark amphibians and other animals.

Our observations, however, are more consistent with claims that tag life is 15–20 years (Germano and Williams 1993) than with reported tag longevities of 50–100 years or indefinite (Christy 1996; Fasola et al. 1993; Keck 1994; Pope and Matthews 2001). Assuming that our older tags were initially obtained in about 1989, then 7% have stopped working after about 15 years. Of course, it is also possible that longevity has increased through improved technology. Authors (e.g., Keck 1994) seldom comment regarding tag failure and so presumably this has rarely occurred. However, there has not yet been a comprehensive evaluation of tag longevity.

Acting as impediments to more widespread use of PIT tags for marking frogs are their size and cost. With a minimum snout–vent length threshold of 40 mm, given the smallest size tags currently available, there are many frogs that cannot be marked in this manner. As financial resources will always be limiting, the high cost of PIT tags relative to other methods of marking frogs also restricts their use (e.g., Elbin and Burger 1994; Germano and Williams 1993; Gibbons and Andrews 2004; Ireland et al. 2003; Ott and Scott 1999). However, given the considerable benefits associated with their use for marking animals, they are likely to be increasingly used in this manner, especially with decreases in either their size or cost.

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Coelomic Response and Signal Range of Implant Transmitters in *Bufo cognatus*

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Radio telemetry is a useful technique in ecological studies to determine habitat use, survival, and dispersal of organisms (Faccio 2003; Lamoureux et al. 2002; Millspaugh and Marzluff 2001). For amphibians, radio transmitters are attached externally using a belt harness or implanted into the coelomic cavity (Muths 2003; Werner 1991). External attachment of transmitters may affect amphibian dispersal or other life cycle events (e.g., breeding, feeding; Richards et al. 1994). Also, external transmitters are not feasible for amphibians that estivate underground, because they could interfere with digging and concealment. Alternatively, implanting transmitters requires invasive surgery that might affect body condition and survival (Madison and Farrand 1998), or damage vital organs within the coelomic cavity. Also, information on aboveground signal range of transmitters after implantation has not been published. Our goal was to describe the general effects of implant transmitters on coelomic response of a common amphibian (*Bufo cognatus*) in the Great Plains (Gray et al. 2004), and measure aboveground signal distance over four months, which was the expected battery life of the transmitters.

Materials and Methods.—We collected 14 Great Plains Toads

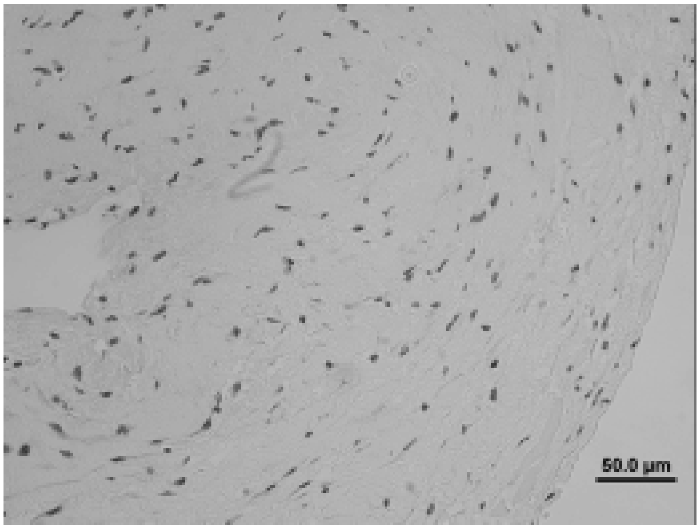

FIG. 1. Four months post-surgery microscopic view of the connective tissue encapsulating transmitters implanted in the coelomic cavity of 9 *Bufo cognatus*.

(*Bufo cognatus*) along roads at night during intense rain on 12 May 2001 northwest of Lubbock, Texas (33˚39'–33˚51'N, 101˚49'–102˚10'W) in the Southern High Plains. We placed all toads in separate 38-liter aquariums and fed them native crickets and beetles *ad libitum* for the duration of the study. Each aquarium contained 10 cm of soil substrate and a 500 cm^3 plastic water reservoir that was flush with the substrate surface to allow natural burrowing and water absorption by the toads.

We used SM1-H transmitters manufactured by AVM Instrument Company. These transmitters were single-staged (150 MHz) and powered by a CR2040 lithium manganese dioxide cell with an internal-loop antenna that encircled the battery. Signal strength and pulse rate of our transmitters at the beginning of the study were between -21 and -25 dBm and 58 and 68 BPM, respectively. The expected battery life given the power output (0.065 mA) was 4 months. The transmitter, battery, and antenna were encapsulated in RTV plastic and coated with clear dental acrylic. The final mass and volume of the transmitter package were 6.63 g (5–10% of individual toad body mass, 60–118 g) and 2.45 cm^3, respectively.

We implanted transmitters into 10 of the 14 toads on 2 June 2001. The four remaining toads did not receive transmitters and were maintained in captivity simultaneously. These toads were used as controls so we could compare histological responses to the transmitters at the end of the study. Our surgical procedures were similar to Madison (1997) and Seebacher and Alford (1999). We soaked transmitters and surgical instruments ≥ 30 minutes in chlorhexadine then rinsed them with sterile water. Toads were anesthetized by placing them into a solution of distilled water and tricaine methanesulfonate (1000 mg/L, Faccio 2003); sedation occurred within 10–32 minutes (mean = 18.5, SD = 6.8). After anesthetization, we made a 20-mm skin incision in the left caudoventrolateral quadrant of the abdomen with a sterile #20 scalpel. Next, we punctured through the abdominal wall and into the coelomic cavity with closed pointed surgical scissors. After puncturing the wall, the scissors were opened to separate the muscular fibers creating an opening into the coelomic cavity. The opening was maintained with thumb forceps then the transmitter was placed into the cavity. The incision was closed in two layers with 3-0 absorbable suture material. First, we sutured the abdominal wall with 3 stitches 5 mm apart in a simple interrupted pattern. Next, we closed the skin in a similar fashion. The incision was dried using sterile 4 × 4 gauze sponges. Finally, we applied surgical glue along the entire length of the incision to provide a temporary sealant. The entire surgical procedure lasted 8–10 minutes. Toads were then placed in distilled water containing antibacterial tetracaine powder (1% solution) for recovery (mean = 40.6, SD = 11.7 minutes). After anesthetic recovery, we returned toads to aquariums.

We measured aboveground signal distance (m) and body mass (g – transmitter package mass) twice per month from 2 June to 2 October 2001. We used a fully charged R2100 Advanced Telemetry Systems receiver and a 3-element AF Antronics Yagi antenna (model #F152-3FB) tuned specifically for 150–152 MHz to measure signal distance. Aboveground distance was determined by placing each toad in a plastic bucket and traversing a linear transect until the signal was not received. We considered these measure-

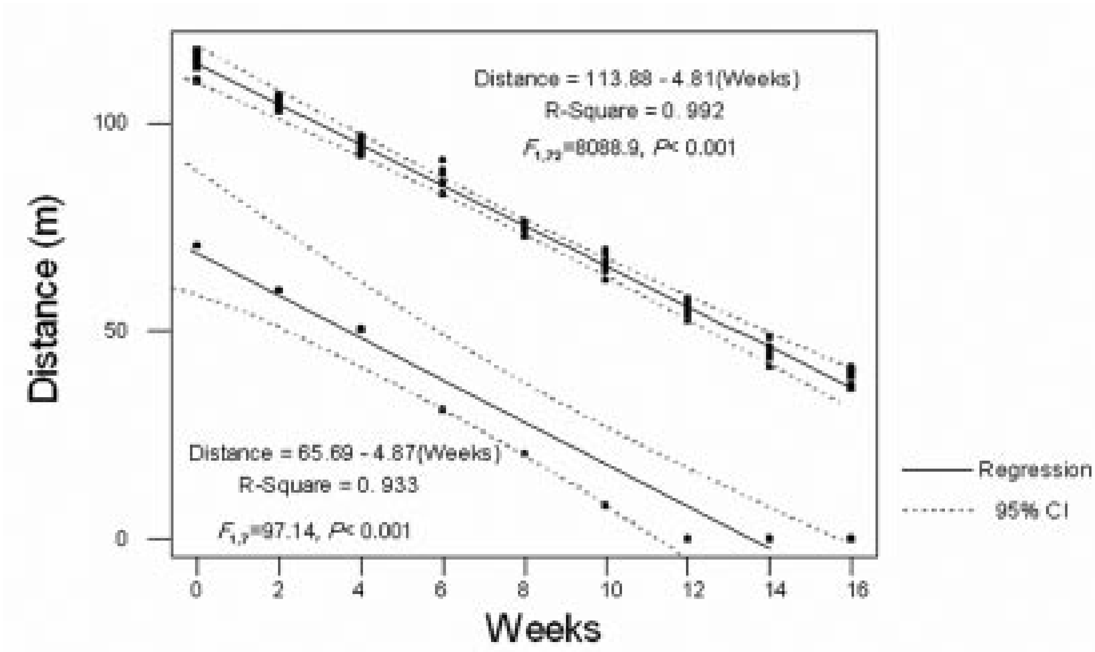

FIG. 2. Aboveground signal distance in two-week increments (2 June [week = 0] – 2 October 2001 [week = 16]) of SM1-H internal-loop antenna transmitters implanted into 10 Great Plains Toads (*Bufo cognatus*). The bottom regression is for a prototype transmitter that lost battery strength prior to the study.

ments maximum signal distances under ideal conditions because toads were aboveground and no obstructions existed between them and the receiver. Individual toad survival also was recorded.

At completion of the study, we sent all live toads (controls and ones with transmitters) to the University of Georgia Tifton Veterinary Diagnostic and Investigational Laboratory where they were euthanized and necropsied. Macroscopic inspections included surgical site condition, coelomic response to transmitters, and general organ condition. Tissue sections of all organs (including skin) were collected, processed, and examined microscopically.

Aboveground signal distance and toad body mass were regressed against post-surgery duration in two-week increments from the initiation until the end of the study (0, 2, 4, …, 16 weeks) to compare signal range and body mass through time. We performed two separate regressions for signal distance because maximum distance of one transmitter was markedly less throughout the study compared to the other nine transmitters. This transmitter was sent as a prototype six months prior to the study and used twice; all other transmitters had batteries at full strength at the beginning of the study. Also, one toad died during the study on 5 July 2001 thus its signal distance was not measured afterward nor used in the regression after week 4. Proportion of toads surviving until the end of the study was tested against a constant proportion ($p_0 = 0.5$) using a one-sample binomial test to determine if the overall survival rate differed ($\alpha = 0.05$) from the mortality rate (Milton and Arnold 1995:322). Necropsy results are presented as summary statistics.

Results.—Pathological examinations were performed on 9 of the 10 toads with transmitters and the 4 control toads. The deceased toad could not be analyzed because of advanced autolysis. Surgical sites of all toads were healed with minimal scarring. Granulation tissue existed at the surgical site of all toads and few mixed inflammatory cells (heterophils, macrophages, and lymphocytes) were present in one toad (11.1%). All transmitters were in the right caudoventrolateral coelome except one, which was in the left caudoventrolateral coelome. Each transmitter was encapsulated in a smooth, transparent connective tissue <1 mm thick (Fig. 1); few inflammatory cells and occasional vascularization were noted in the capsule of one transmitter. Six of 9 transmitters (67%) were adhered to the coelomic wall only or to the coelomic wall and 1–2 nearby organs by a strand of fibrous tissue (hereafter adhesion) that was ≤ 1 mm diameter × 1–4 mm in length. Organs of attachment included the liver, ovary, and mesentery. Histological analyses and comparison with control toads revealed no damage to the organs of attachment or other organs (i.e., lungs, spleen, kidneys, large and small intestines) in the coelomic cavity.

Aboveground signal distance decreased predictably through the study (Fig. 2). Mean aboveground signal distance at the initiation and completion of the study for the 9 transmitters was 114.2 m (SD = 2.7) and 39.4 m (SD = 1.9), respectively. The maximum distance of the prototype transmitter at the initiation of the study was 70.4 m with no signal by week 12. Toad body mass did not change ($F_{1,7} = 0.03$–5.10, $P = 0.06$–0.86) throughout the study. The proportion of toads surviving was 0.90, which differed ($P = 0.011$) from $p_0 = 0.5$. Mortality of the one toad was due to post-surgery complications; one suture pulled through the skin causing secondary infection.

Discussion.—Our results suggest that intracoelomic placement of radio transmitters does not negatively affect survival, body mass, and coelomic condition of amphibians. Post-surgery survival was 90% and body mass of all individuals was stable for the duration of the study. Previous studies also have suggested that survival and body mass are unaffected by implant transmitters (Madison 1997; Madison and Farrand 1998; Werner 1991).

Intracoelomic placement of transmitters was within the left caudoventrolateral quadrant, but at postmortem examination, 8 of 9 transmitters were found in the right caudoventrolateral quadrant. Although the exact mechanism for transmitter displacement is unknown, it may have been a consequence of stomach expansion. The stomach is located within the left middle coelome (Duellman and Trueb 1994). During feeding and subsequent stomach expansion, the stomach may have extended into the left caudal region, displacing the transmitter to the right. Once displaced, the transmitter may not have returned to the left caudal position after gastric emptying.

Coelomic response to the transmitters was similar for all toads. A thin transparent connective tissue capsule formed around all transmitters, which is a typical histological response to implants (Butler et al. 1997; Eltze et al. 2003; Kellar et al. 2002; Laitung et al. 1987; Shannon et al. 1997; Walboomers et al. 1998; Walboomers and Jansen 2000; Zhao et al. 2000). One capsule had minimal vascularization and inflammatory cell infiltrates, which was consistent with local irritation. Most toads developed one or more fibrous adhesions that resulted in anchoring the transmitters within the coelome. Adhesions are common surgical complications in all species, and they result from local trauma as well as constant irritation (Alimoglu et al. 2003; Goodwin and Grizzle 1991; Herzog et al. 1970; Montz et al. 1991). In general, adhesions are not considered beneficial structures; however in our toads, the adhesions may have aided in preventing mechanical trauma to nearby organs or preventing cranial migration during normal body movements by anchoring the transmitters locally.

Coelomic and body mass response to implants likely would be similar for other large anurans (e.g., > 60 g in body mass). Mortality of one toad occurred secondary to dehiscence of the surgical site, which has been documented previously (Werner 1991). Thus, we recommend external sutures encompass > 2 mm of skin on each side of the incision. This may be especially important for species that are fossorial such as *Bufo cognatus*.

Average aboveground signal distance at the beginning of the study was 114 m and decreased linearly over the 4 months to 40 m. This initial signal distance was 23% of the manufacturer's claim of 500 m. Only 1 of 10 transmitters lost signal in < 4 months (the expected battery life); this transmitter was the prototype and may have been operating at a reduced power capacity at the initiation of the study.

Considering that average aboveground signal distance of our implant transmitters was approximately 100 m, researchers may need to monitor amphibians frequently (1–2 times/day) in the field so they are not lost. Also, implant transmitters might not be reasonable for amphibian species that disperse long distances over short duration. New multi-staged transmitters (e.g., G3-1V) may have greater signal range than the SM1-H transmitters used in our study (B. Corbett-Kermeen, AVM Instrument Company, pers. comm.). Signal distance also might be reduced by environmental variables that we did not measure, such as aboveground vegeta-

tion and substrate (if amphibians become fossorial, Madison 1997). Thus, our distance estimates likely represent best-case scenarios of signal range for SM1-H implant transmitters.

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Observations on Problems with Using Funnel Traps to Sample Semi-Aquatic Snakes

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Funnel traps have been shown to be an effective method for sampling snakes in many different aquatic habitats (Fitch 1999; Greene et al. 1999; Karns et al. 2000; Keck 1994). However, any technique can have biases which need to be considered when choosing an appropriate sampling method. In this note I report problems encountered using funnel traps to sample snakes. These problems include: 1) predation upon trapped Banded Watersnakes (*Nerodia fasciata fasciata*) by Eastern Cottonmouths (*Agkistrodon piscivorus piscivorus*); 2) potentially biased sex ratios of *N. fasciata* and *A. piscivorus*; and 3) predation upon trapped snakes by red imported fire ants (*Solenopsis invicta*).

I used both commercially available minnow traps of dimensions 42 cm long by 22 cm in diameter (Cuba Specialty Manufacturing Co., Filmore, New York; funnel openings enlarged to 3 cm with a rake handle), and funnel traps made from hardware cloth that were 41 x 22 cm with 5-cm funnel openings (Fitch 1987) to sample *N. fasciata* and *A. piscivorus.* The study site was the Pee Dee Research and Education Center (PDREC), a 972-ha experimental farm owned by Clemson University, located in the upper coastal plain of Darlington County, South Carolina, USA. Traps were

placed in shallow water (water depth < trap diameter) along logs, in emergent vegetation, and along short drift fences. The drift fences consisted of 5-m lengths of aluminum flashing oriented perpendicular to the shoreline with two traps placed at each end. Because of low capture rates (0.007 captures/trap day [TD] in 1998 to 0.011 captures/TD in 2002), traps were checked at 48-h intervals and not on weekends. Beginning in 1998 I sampled 11 ponds, a swamp, a lake, and several drainage ditches. Sampling occurred from July–October 1998 (960 TD), May–October 1999 (4108 TD), May–July 2000 (994 TD), April–June 2001 and 2002 (810, 994 TD, respectively), and May–June 2003 (757 TD). Means are followed by ± 1 SD. An $\alpha \leq 0.05$ is considered significant in all statistical tests.

Ten female *N. fasciata* ranging from 362 to 738 mm snout–vent length (SVL, mean = 600.8 ± 102.7) were found dead in traps with live Cottonmouths, including three (19% of captures) in 1998, two (7% of captures) in both 1999 and 2000, two (18% of captures) in 2002, and one (12.5% of captures) in 2003. The largest dead specimen was found in a minnow trap with a live male conspecific (390 mm SVL) and a live *A. piscivorus*. Of six adult *A. piscivorus* trapped with dead watersnakes, four were male and all ranged from 521 to 810 mm SVL (mean = 706 ± 115.7). Necropsies of 10 dead *N. fasciata* revealed paired puncture wounds surrounded by necrotic tissue on the dorsum of eight. I was unable to find bite marks on two specimens that were in an advanced state of decomposition. Bite marks (paired puncture wounds) were located 85–502 mm (mean = 223.75 ± 156.59) posterior to the snout. One 680 mm SVL specimen was bitten twice (two pairs of puncture wounds) located 502 and 585 mm posterior to the snout. *Nerodia fasciata* has been reported in the diet of Cottonmouths (Palmer and Braswell 1995), but only two of the watersnakes (362, 595 mm SVL) appeared to have been ingested and regurgitated as evidenced by saliva on the body of the dead *Nerodia*. Upon checking the trap, the larger of these was being ingested headfirst with only the posterior 10 cm protruding from the mouth of the *A. piscivorus* (617 mm SVL male) but was regurgitated when the trap was picked up. It is unclear why not more of the *N. fasciata* were ingested, although it is possible that cottonmouths either regurgitated the *Nerodia* after becoming agitated in the traps or did not have enough space to maneuver the *Nerodia* into proper swallowing position. However, it is also possible that the *Nerodia* were bitten as a stress response.

Sex ratios are an important part of population structure. Females dominated the samples of Banded Watersnakes and Eastern Cottonmouths. The 67 *N. fasciata* sampled from this population exhibited a 1.68:1 female-biased sex ratio, which was significantly different from 1:1 ($\chi^2 = 4.83$, df = 1, P = 0.028). The primary sex ratio of 66 neonate *N. fasciata* from three litters in this population was 1.2:1, which was not significantly different from 1:1 ($\chi^2 = 4.684$, df = 2, P = 0.096; unpubl. data). I believe this female bias to be a sampling artifact because of the primary sex ratio and because observations based upon radiotelemetry suggest that male *N. fasciata* in this population frequent deeper water more often than females (pers. obs., 2002) and therefore might be less likely to encounter funnel traps restricted to the littoral zone of aquatic habitats. Secondary sex ratios for a Texas population of *N. fasciata* sampled with funnel traps also showed a female bias (Keck 1994). I found a similar trend in 63 *A. piscivorus* from the Pee Dee population, as my sample yielded a 1.52:1 sex ratio that was not significantly different from 1:1 ($\chi^2 = 3.11$, df = 1, P = 0.078). Three other populations of *A. piscivorus* had balanced or male-biased sex ratios (Blem 1981; Ford 2002; Zaidan 2001).

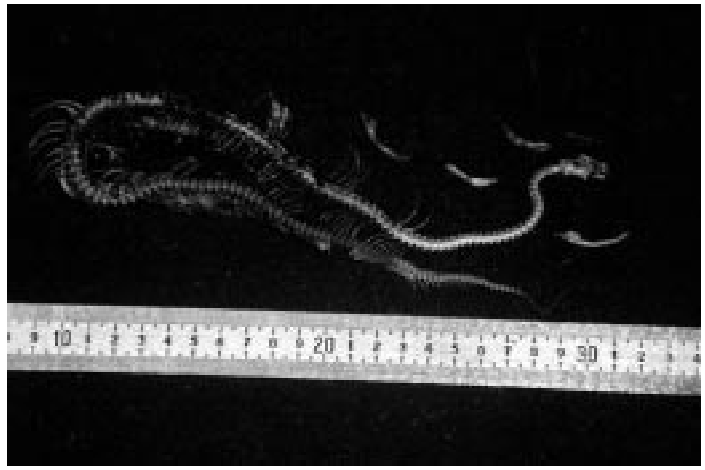

FIG. 1. Remains of a female Eastern Cottonmouth (*Agkistrodon piscivorus piscivorus*) attacked by red imported fire ants (*Solenopsis invicta*) while caught in a funnel trap at the Pee Dee Research and Education Center in Darlington, Co. South Carolina found on 9 June 1999.

Red imported fire ants (*Solenopsis invicta*) are problematic for many species of North American wildlife (Mount 1981). On 9 June 1999, a female *A. piscivorus* ca. 495 mm in length (skull and remaining vertebral column length) was found in a trap that was swarming with fire ants. The snake was reduced to a skeleton with only a small amount of viscera and the medial portions of some of the ventral scales remaining (Fig. 1). As no other cause of death was evident, it is likely that the snake was killed and devoured by fire ants. The trap had been placed perpendicular to the bank over a hole in very shallow water on 7 June 1999. If the trap had been placed in deeper water the ants probably would not have been able to attack the snake. Although fire ant predation on reptile eggs and hatchlings has been well documented for crocodilians, lizards, and turtles (Allen et al. 1994; Epperson and Heise 2003; Landers et al. 1980; Martin 1989; Moloney and Vanderwoude 2002; Mount 1981), I could find no evidence of fire ant predation on snakes in the literature. However, Tuberville et al. (2000) implicated fire ant predation in the decline of the Southern Hog-nosed Snake (*Heterodon simus*).

In conclusion, funnel traps can be an effective way to sample semi-aquatic snakes but frequent monitoring of traps, trap placement away from fire ant mounds, and possible bias in sex ratios should be considered when employing this technique.

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Evaluation of a New Method for Measuring Salamanders

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Collection of morphometric data is essential to many field studies of amphibian populations. One of the most common measurements obtained from salamanders is snout-to-vent length (SVL), a parameter useful in studies of sexual dimorphism (Bovero et al. 2003), demography (Semlitsch 1985), and systematics (Carlin 1997). Measuring salamander lengths in the field is challenging because of their small size, slimy texture, and propensity to maintain a nonlinear body position. Time expenditure is another concern, especially when researchers process large numbers of salamanders. Different measurement techniques vary in accuracy and precision, limiting the reliability of the data so that comparisons cannot be easily performed. Here, we compare a new method of obtaining salamander SVL measurements to other commonly used methods.

To restrict salamander movement and maintain a linear body orientation, we constructed a device (the "Salamander Stick") using two equally sized polyvinyl chloride (PVC) pipes (40-cm long, with 2.5 cm outer diameter). We wrapped duct tape around both ends of one PVC piece such that a gap of 2 mm separated the two pieces when positioned parallel to each other. We then wrapped duct tape around both ends of the device, which secured the 2 mm gap. After assembly, we could pass a 23-cm wide plastic sandwich bag through the gap while prohibiting the passage of objects larger than 2 mm thick (Fig. 1a).

To obtain salamander SVL measurements, we placed a salamander into a plastic sandwich bag and fed the bag opening through the gap between the two PVC pipes. We pulled the bag through the gap until the salamander (at the bottom of the bag) reached the gap. We then manipulated the salamander through the walls of the bag to straighten it along the cranio-caudal axis and ensure that its ventral surface could be viewed. Once this was accomplished, SVL measurements were obtained with dial calipers (Fig. 1b).

We compared the precision and accuracy of the Salamander Stick to two other methods. In Method 1 (hereafter, "Freehand"; adopted from Phillips et al. 2002), a salamander was set on a table, straightened, and the SVL was measured with a plastic ruler. In Method 2 (hereafter, "Tube"; adopted from Mathis 1991), a salamander was placed into a clear plastic tube (inner diameter = 1.7 cm) and the SVL was measured by placing a ruler against the outside of the tube.

In March 2004, we captured 20 adult smallmouth salamanders (*Ambystoma texanum*) from a breeding pond in Coles County, Illinois, USA. During measurements, we housed all salamanders individually in 2 L plastic tubs in the laboratory. Salamanders were randomly selected and measured (SVL ± 1.0 mm) once with a

randomly chosen method. We repeated this process until each salamander was measured 4 times for each method. A plastic ruler was used to measure salamanders from the tip of the snout to the posterior margin of the vent. To reduce bias, one of us (LJW) measured all subjects. We determined the amount of time (± 0.1 sec.) required for each measurement to evaluate the efficiency of the three methods. We completed all measurements over a five-day period and released salamanders at their capture site.

We determined measurement precision using the coefficient of variation (CV; Zar 1999). Salamanders have a tendency to contort their bodies when manipulated (Wise and Buchanan 1992), often reducing their body lengths. Because of this tendency, we assumed that the method providing the smallest mean SVL would be the least accurate representation of the "true" SVL. In contrast, the most accurate method should provide the greatest mean SVL. The precision and accuracy of each method were analyzed using one-way analyses of variance (ANOVA). All data conformed to assumptions of parametric statistics and analyses were conducted using SPSS 12.0 (SPSS, Inc. 2003).

There was a difference in the mean SVL ($F_{2,59} = 5.79$, $P = 0.005$) and CV ($F_{2,59} = 5.75$, $P = 0.005$) among the three measurement methods (Table 1). Bonferroni post-hoc tests indicated that measuring salamander SVL with the Salamander Stick was more accurate and precise than the Freehand and Tube methods. The Freehand and Tube methods did not differ in precision or accuracy. While our results obtained from the Tube and Freehand methods do not differ, neither method was more accurate or precise than the Salamander Stick. This is likely because the Tube and Freehand methods do not restrict salamander movement and straighten its vertebral column as well as the Salamander Stick. As another testament to its efficiency, we found that the Salamander Stick allowed measurements to be obtained with the least time expended (Table 1). Other techniques to obtain salamander measurements may not be as efficient as the Salamander Stick. For instance, using a plastic sandwich bag alone (without the stick) is another method used to immobilize salamanders and obtain morphometric measurements ("Baggie" method; Bury and Corn 1991). Although we did not compare the Baggie method and the Salamander Stick, we suspect that the PVC pipes decrease the time spent measuring individuals and the likelihood that a subject will contort its body as the measurement is taken.

FIG. 1. The Salamander Stick, a device for obtaining precise and accurate measurements of salamander snout–vent length. A) The device shown with a plastic bag passing through the gap between the two polyvinyl chloride (PVC) pieces. B) The lateral view of an adult Smallmouth Salamander (*Ambystoma texanum*) immobilized in the device.

TABLE 1. Accuracy (mean SVL ± 1 SE) and precision (CV ± 1 SE) for 20 Smallmouth Salamanders (*Ambystoma texanum*) measured by the three methods in March 2004. Measurement time (sec, mean ± 1 SE) is the amount elapsed between initially manipulating the salamander and the moment at which the measurement was obtained.

Method	Mean SVL (mm)	CV%	Time (s)
Freehand	76.7 ± 1.3	4.2 ± 0.4	56.5 ± 4.0
Tube	77.9 ± 1.5	4.4 ± 0.4	37.0 ± 1.3
Salamander Stick	82.7 ± 1.2	2.7 ± 0.3	34.7 ± 1.2

The Salamander Stick is an accurate, precise, and time-efficient method for obtaining standardized salamander measurements. The device is simple in design, durable, and easily transported and used in the field. It can be used to measure salamander SVL as well as total length, and the width of the device is easily modified to accommodate salamanders of different sizes including large larvae (> 3 mm girth) or neotenic species. It is inexpensive, costing less than US $6.00 to manufacture. The plastic sandwich bags used in measurements can be replaced after wear and can be easily cleaned. We have used this device in the field to measure breeding adult *A. texanum* in the spring of 2004 (N = 986), without any injury to the study organisms. Similarly, we witnessed no ill effects of repeated use of this device on the salamanders measured in this study.

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HERPETOLOGICAL HUSBANDRY

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Husbandry and Captive Reproduction in *Carlia ailanpalai* (Scincidae)

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The skink *Carlia ailanpalai* is introduced (Zug 2004) on the southernmost islands of the Mariana archipelago (Guam, Rota, Tinian, and Saipan) and reaches dense populations on Guam (mean population estimate of 9150 *Carlia*/ha for certain areas; Campbell 1996). It is likely that the species was introduced in the late 1950s to early 1960s (McCoid 1993, 1999). On Guam, the species is medium-sized and exhibits a negligible sexual dimorphism in size (males reach at least 63 mm and females 62 mm SVL) and in coloration (both sexes have a uniform light brown dorsum with cream venter grading to a slight peach on the ventral aspect of the tail). It has been suggested that C. *ailanpalai* might negatively impact native scincids (McCoid 1995, 1997). The biology of *C. ailanpalai* has not yet been reported.

We are unaware of information on long-term captive maintenance of small Australasian scincids. Available information on captive maintenance of small scincids comes from short-term studies on behavior (Done and Heatwole 1977; Perrill 1980; Torr and Shine 1994; Whittier 1993; Whittier and Martin 1992; Zwickel and Allison 1986).

As part of a larger study on the colonization biology and interactions of two western Pacific skink species (*C. ailanpalai* and *Emoia caeruleocauda*), we established a colony of these species in Kingsville, Texas. We maintained this colony for approximately 20 months until we voluntarily ceased observations. On 30 June 1995 we received 14 adult *C. ailanpalai* (6 male: 8 female; 45–55 mm SVL) and 10 subadult to adult *E. caeruleocauda* (5 male: 5 female; 35–45 mm SVL) from Guam, Mariana Islands. Observations on captive maintenance of *E. caeruleocauda* are presented elsewhere (McCoid et al. 1997). Size at maturity was determined by the presence of secondary yolking follicles revealed by dissection of preserved material (McCoid 1997). Sexes can be easily distinguished as adult males have a markedly swollen tail base. Initially, all *C. ailanpalai* were housed in a single 75 L (20 gal) aquarium. This aquarium had a sand substrate with three flat rocks for basking and cover. A shallow water dish was placed in the tank along with a small potted ivy plant (*Pothos* sp.). The aquarium was kept in a curtained, secluded room and supplied with fluorescent lighting set in an aquarium reflector. The room was air-conditioned and daily air temperatures in the aquarium ranged between 20 and 32.2˚C while daily humidity ranged between 60 and 90%. Crickets were fed twice weekly and we maintained the *C. ailanpalai* under these conditions for approximately nine months. There was no mortality during this period.

Beginning in Apri1 1996, for the next seven months of this study, we divided the 14 lizards into four 75 L (20 gal) screen-covered aquaria. Two females were placed in each tank and two males in two of the tanks. The remaining two tanks each received a single male. A 50:50 mixture of potting soil and sand was provided as a substrate and a potted ivy plant was placed in each tank. Several small flat rocks were placed in each tank as cover and basking sites. A small shallow tray in each tank was kept filled with distilled water and tanks were hand-misted twice daily. Approximately once a week, about 0.5 L of distilled water was poured into the substrate. A 300 ml dirt-filled rectangular Tupperware, container with a hole cut in the top was supplied as an egg-laying chamber. We replaced the 48-inch fluorescent lamp with a full-spectrum Vita-Lite fluorescent lamp (Duro-Test Corp.) set in a reflector and installed an additional 50 W basking-lite heat lamp (Duro-Test Corp.). The heat lamp was suspended within the aquarium ca. 20 cm above the substrate and over a basking rock. Heat lamps and fluorescent lamps were turned on at 0700 h. At 1000 h, heat lamps were turned off. At approximately 1800 h heat lamps were turned on again and left on until 1900 h when all illumination was discontinued for the evening. Daily temperatures ranged between 20 and 32.2˚C with the basking spot under the heat lamp reaching 55˚C.

Throughout the study period, the photo regime was kept at 12L: 12D to approximate conditions on Guam (which vary seasonally between 13L: 11D and 12L: 12D). Lizards were fed *ad libitum* with crickets every other day. Two feeding regimens were attempted. Initially, for the first week, crickets were dusted with Tetra® Reptical calcium/vitamin powder but all lizards refused ‘white’ crickets. In order to provide the lizards with a vitamin supplement, for the remainder of the study, we then fed the crickets powdered (prepared with a coffee grinder) T-Rex® Calcium Plus cricket food, essentially ‘gut-loading’ crickets with nutrients

and calcium. Crickets also were fed dry oatmeal and given water *ad libitum*. The 14 *C. ailanpalai* would consume ca. 1000 two- to three-week-old 'gut-loaded' crickets in 10 days.

In November 1996, we combined the remaining 13 (we sustained a single fatality due to an accidental rock crush) adult *C. ailanpalai* into three 75 L (20 gal) screen-covered aquaria. All other conditions mentioned previously remained the same. Captive husbandry was terminated in March 1997 and no fatalities occurred during this period.

Reproduction can be a measure of the success of captive husbandry. During the initial phase of husbandry when all 14 adults were housed in a single aquarium, only three clutches (over a nine-month span) were discovered (*C. ailanpalai* lays an invariant clutch of two, McCoid 1997). On1y one of these clutches had not desiccated and, after incubation, yielded two viable offspring. In strong contrast, the later husbandry housing configurations and feeding with nutrient-enhanced crickets yielded many more clutches. The four-aquarium configuration (eight females) produced 76 clutches over a seven-month period and the three-aquarium configuration (seven females) yielded 16 clutches over a four-month period. The total number of clutches produced over the 20-month husbandry period was 95. For individual females, intervals between clutches were computed using the four-aquarium (eight females) configuration that produced 76 clutches. Mean interval time between clutches for all eight females was 17.71 days with a range of 10–38 days.

Females seemed to repeatedly choose the same oviposition site. We recovered eggs by searching specific areas in the aquaria when gravid females were expected to oviposit. Eggs were transferred to small screw-top jars containing a dampened paper towel folded to fit the bottom of the jar. The jar lid was lightly fastened and the jar was placed in a darkened room (daily temperature range 21–32°C). Incubation periods (34–35 days) were identical to those reported by McCoid (1994) for wild-collected eggs. With the exception of the initial two desiccated clutches, all clutches were fertile and hatched. A single clutch from the three-aquarium configuration had viable, but malformed offspring.

The eight P generation females produced a total of 186 viable hatchlings during the 20-month study. Just prior to the termination of this study, we hatched the first F2 generation. We noted no decline in fecundity of the P generation through time and our results suggest that the Fl generation was healthy and fertile. Since the original lizards received from Guam were adults and all survived 20 months (with the exception one individual), we can assume that the species can live a minimum of two to three years in captivity. This adult longevity, coupled with ease of maintenance, high fecundity, and hatchling survivorship, suggests that this species might be a candidate for large-scale breeding efforts for those requiring large numbers of lizards.

This information also suggests reasons for success as colonizers in the southern Mariana Islands.

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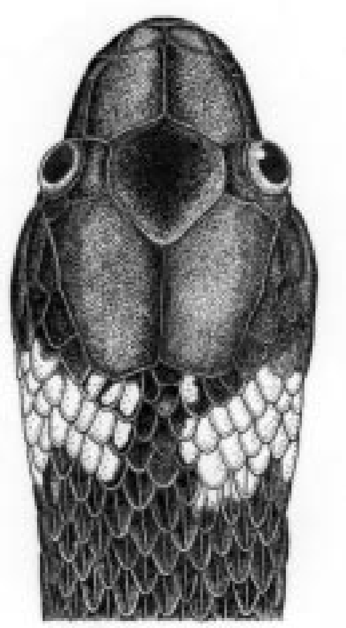

Ninia diademata (EAL 3637) (Ring-necked Coffee Snake). México: Chiapas: 3 km SW Palenque. Illustration by Julian C. Lee.

NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 36, Number 1 (March 2005).

CAUDATA

AMBYSTOMA MACULATUM (Spotted Salamander). **REPRODUCTION**. Baseline phonological and reproductive success information on amphibian species is important in determining the decline, stability, or increase in population. Herein we document the reproductive life history of the spotted salamander from seven breeding ponds and vernal pools (3 permanent beaver ponds fed by small streams, 3 vernal pool complexes, and 1 ephemeral stream) during the 1999 breeding season. All of these breeding pools are found with the confines of Powhatan Lakes Wildlife Management Area, in Powhatan County, Virginia, USA. The first adult discovered in or near one of the seven breeding areas was on 16 February. This animal was dead, possibly frozen the night before. There was no sign of predation or scavenging. Spermatophores were first observed in breeding pools on 21 February. Egg masses were discovered three days later. Egg masses discovered in breeding pools were counted, flagged, and tracked for hatching success over the course of the breeding season. Each breeding pool was checked at least three times per week. Egg deposition lasted over a period of 50 days (24 Feb–14 April). Number of eggs per mass ranged from 8 to 177 (mean ± SD = 71.9 ± 35.4, N = 158). The depth (cm) egg masses were deposited ranged from 0 – 23 (4 ± 3.8, N = 99). The mass (g) of the wet swollen weight of the egg masses ranged from 10 to 380 (111 ± 68, N = 140). The percent of eggs hatching ranged from 0 to 100 (89 ± 23.6, N = 93). Fungal hyphae were seen covering dead embryos under microscopic examination, even in intact egg masses. It is not known if this was the cause of mortality or just normal decomposition. All but one egg mass were of the clear jelly type, N = 140. Masses were found attached to various substrates at the following rates: blades of grass (43 masses), submerged sticks (37), hardwood leaves (*Acer rubrum, Fagus grandifolia, Liquidambar styraciflua, Quercus alba, Q. falcata, Q. palustris, Q. rubra*, and *Salix* sp.) (34), unattached (34), underwater plant stems (not grass) (5), *Juncus* sp. (4), metal flagging pole (1), *Carex* sp. (1), N = 159. Twenty-one percent of the egg masses were unattached to substrate. This strategy may help in the survival of this species in ponds and ephemeral breeding areas that dry up early. The last adult spotted salamanders found at breeding pools was on 28 April.

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AMBYSTOMA MACULATUM (Spotted Salamander). **PREDATION.** The known predators of *A. maculatum* include aquatic invertebrates and several vertebrates (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, DC.). Petranka (1998. *op. cit.*) listed only one bird as a predator of *A. maculatum*, the least sandpiper (*Calidris pusilla*), which was observed feeding on the larvae of *A. maculatum* (Stangel 1988. Herpetol. Rev. 14:112). Here I report an adult female Common Grackle (*Quiscalus quiscala*) preying on a partially exposed *A. maculatum* egg mass in a vernal pool on 15 May 2004 at 1320 h. The vernal pool, dominated by a button bush (*Cephalanthus occidentalis*) scrub association, was located at ca. 20 m elev in Willowdale State Forest, Town of Ipswich, Essex County, Massachusetts USA (42.68379°N, 070.90342°W). The egg mass had been deposited earlier in the season (likely late March) on a fully submerged button bush branch.

Peer and Bollinger (1997. The Birds of North America, No. 271. Acad. Nat. Sci. Philadelphia, Pennsylvania and American Ornithologists' Union, Washington, DC), state that the Common Grackle is an opportunistic forager. Among the small vertebrates taken, Peer and Bollinger (1997, *op. cit.*) listed salamanders, having cited Hamilton (1951. Auk 68:213–217), who determined over a two-year period that salamanders were an important dietary component of common grackles in central New York, especially in the food brought to their nestlings. The grackle that I observed feeding on salamander eggs was one of several observed foraging amongst the button bush and cattail (*Typha latifolia*) growing in the pond. The grackle was observed for a only a short time before my presence likely disturbed it while it was feeding on the eggs, plucking and consuming several from the exposed part of the egg mass above waterline. The grackle appeared to be undeterred by the gelatinous outer coating of the Spotted Salamander's egg mass, which has been shown to protect against predation and desiccation (Nyman 1987. Herpetol. Rev. 18:15). Common Grackles were observed nesting in the area and it is possible that the grackle I observed feeding on the Spotted Salamander eggs was out gathering food for one or more of its nestlings. No other grackles or other birds were directly observed feeding on other similarly exposed egg masses in the area. To my knowledge this is the first observation of a bird feeding on the eggs of *A. maculatum*, and it might also represent the first record of a bird feeding on the eggs of any salamander.

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AMBYSTOMA MACULATUM (Spotted Salamander). **PREDATION.** Since 1999, annual surveys have been conducted at 46–70 vernal pools in New London County, Connecticut USA. These surveys are conducted to quantify *Ambystoma maculatum* and Wood Frog (*Rana sylvatica*) egg masses as well as to document the presence of fairy shrimp and Marbled Salamander (*A. opacum*) larvae. From 1999 to 2003, no Snapping Turtles (*Chelydra serpentina serpentina*) were observed during these surveys. While conducting surveys in 2004, however, I observed 7 snapping turtles in 5 different vernal pools over four days. I witnessed both direct

and indirect signs of Snapping Turtles feeding on salamander eggs.

While conducting egg mass surveys on 18 April 2004, I observed a large (ca. 400 mm carapace length) Snapping Turtle submerged in the water of a pool. The turtle had Spotted Salamander eggs hanging out of its mouth and small fragments were floating in the vicinity of the turtle's head. The snapping turtle did not move when I approached. No other intact egg masses were observed in the vicinity of the turtle. On 19 April, I observed a Snapping Turtle (ca. 300 mm carapace length) floating near a large conglomeration of egg masses in another vernal pool. As the turtle approached me, small fragments of Spotted Salamander eggs were observed floating in the vicinity of the turtle. On 19 April and 21 April, I observed two additional Snapping Turtles (ca. 420 mm and 100 mm carapace lengths) in two vernal pools. No predation on eggs was observed. On 20 April, I observed three Snapping Turtles in a small vernal pool. The estimated carapace lengths of these turtles were 100, 330, and 420 mm. Although no turtles were observed eating eggs, fragments of Spotted Salamander egg masses were observed floating throughout the pool.

Although Snapping Turtles are not usually associated with vernal pools, it has been reported that adults prefer permanent bodies of water whereas younger individuals (150–250 mm carapace length) may be found in vernal pools (Klemens 1993. Amphibians and Reptiles of Connecticut and Adjacent Regions. State Geological and Natural History Survey of Connecticut. Bull. No. 112). Aquatic plants and fish were the major food items in the stomachs of 470 snapping turtles collected in Connecticut (Alexander 1943. J. Wildl. Manag. 7:278–282). I found no previous reports of Snapping Turtles eating Spotted Salamander egg masses.

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AMPHIUMA MEANS (Two-toed Amphiuma). **PREDATION.** Known avian predators of *Amphiuma means* include various large wading birds (Dye 1982. Florida Field Nat. 10:76; Kilham 1984. Colonial Waterbirds 7:143–145). At 2350 h on 11 June 2004, I observed an adult Barred Owl (*Strix varia*) subduing a prey item in a shallow roadside ditch (floodplain of Drowning Creek, 3.5 km N of Hoffman, Richmond County, North Carolina, USA). The owl's legs were immersed in several cm of water and its wings were spread for balance as it struggled with the unidentified prey. I exited my vehicle and shone a flashlight on the owl, which presently hopped from the water onto the ditch bank, striking with its bill at an object held in its talons. I was able to approach to within a few meters and identify the prey as a small *A. means* (ca. TL 30–40 cm). After several seconds, the owl flew into a nearby tree with the amphiuma and apparently finished killing it there before carrying it out of my view into thick woods. Barred Owls are opportunistic predators, known to take a wide range of terrestrial and aquatic prey, including various amphibians (Bent 1938. Life Histories of North American Birds of Prey, Part II. Dover Publishing, Inc., New York, NY. 482 pp.). To my knowledge, this represents the first record of predation on *A. means* by an owl.

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DICAMPTODON ATERRIMUS (Idaho Giant Salamander). **REPRODUCTION.** The natural history of *Dicamptodon aterrimus*, whose distribution is limited to the Northern Rocky Mountains of Idaho, is poorly known (Nussbaum et al. 1983. Amphibians and Reptiles of the Pacific Northwest. Univ. Idaho Press, Moscow.). On 20 June 2004, we visited Mountain Gulch, a tributary of the North Fork of the Palouse River in Latah County, Idaho (47°01'N, 116°31'W). At ca. 1330 h, we located a clutch of ca. 20–30 white eggs attached to the lower surface of a large, flat rock submerged in about 15 cm of relatively slow-moving water. No obvious signs of embryonic development were apparent, suggesting that the eggs had been laid recently. A *D. aterrimus* (109 mm SVL) was associated with the clutch, and we assumed her to be a brooding female. The presence of distinct gills indicates that this individual was paedomorphic. We know of no other direct observations that indicate breeding by paedomorphs in *D. aterrimus*.

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PLETHODON ALBAGULA (Western Slimy Salamander). **VOCALIZATION**. Several species of salamanders are known to vocalize (Brodie 1977. Copeia 1977:523–535; Brodie 1978. Copeia 1978:127–129; Davis and Brattstrom 1975. Herpetologica 31:409–412; Duellman and Trueb 1994. Biology of Amphibians. John Hopkins Univ. Press. Baltimore, Maryland. 670 pp; Mansutei 1941. Copeia 1941:266–267; Marshall 1997. Herpetol. Rev. 28:145; Neill 1952. Copeia 1952:195–196; Smith and Barichivich 2001. Herpetol. Rev. 32:246–247; Wyman and Thrall 1978. Herpetologica 28:210–212). The few sounds noted have been correlated with defense and anti-predatory behavior (Davis and Brattstrom 1975, *op.cit.*). *Plethodon albagula* has not been documented to vocalize. The following describes vocalization in five *P. albagula* adult females.

An abandoned mineshaft in Garland County, Arkansas USA, was visited between 27 June and 1 Aug 2004 and 122 adult *P. albagula* were captured. All animals were taken along the walls inside the mineshaft; air temperature was 16°C. On 27 June 2004, 122 adults (114 females and eight males) were photographed and placed in a plastic bag to be sexed and measured. On 17 and 18 July 2004, 79 animals (77 females and two males) were photographed and placed in a plastic bag to be sexed, measured, weighed, and injected with subcutaneous fluorescent Visual Implant Elastomer (VIE) markings (Northwest Marine Technology Inc., Shaw Island, Washington). None was injected more than two times, and 8 had been previously injected (all females); therefore, these salamanders underwent an abbreviated handling process.

Vocalizations were observed on 27 June and 17–18 July 2004. On 27 June between 1200 and 1900 h, vocalizations were wit-

nessed in an undocumented number of animals as a series of chirping noises. The chirping noises were audible enough to be heard 5–7 m away and greatly resembled the sound of a cricket. The vocalizations were also observed and documented on 17 July between 1100 and 1600 h by three adult females. The sounds were identical to the previous noises on 27 June. Of the three females heard vocalizing, one female (62 mm SVL) was gravid and had undergone the entire handling process including the injection of two VIE marks. Another female (55 mm SVL) was not gravid and also underwent the entire handling process, and one non-gravid female (59 mm SVL) was injected on 26 Oct 2001, but still underwent the handling process. This female was also captured on 1 Aug 2004 and did not vocalize. On 18 July 2004 between 0900 and 1200 h two more females were noted producing the noise. Both females had undergone the entire handling procedure. One female (64 mm SVL) was gravid and the other (69 mm SVL) was not gravid. In all cases, the salamander's mouth was closed; however, their gular region was pulsating. It is unclear whether the pulsating of the throat was related to the vocalization. All sounds were repetitive and stopped after a few seconds. In all but one case, in which the animal produced the sound while in a plastic bag, the vocalizations were observed after the animals were released and did not appear to be associated with any defense posture or behavior.

The function of the chirping noise is unknown. The noises were only observed in females; however, only a small number of males were handled (N = 10). This behavior apparently was not an anti-predatory response. The simple handling of the salamanders may have elicited the sound production. The injection of fluorescent VIE was probably not the stimulus for the noise, as one individual was not injected prior to the vocalization. This population of salamanders has been handled on a number of occasions in the past, but no other observations of vocalization have been recorded.

The chirping noises might be used as a warning, as the vocal salamanders were in close proximity. Two were within 3 m of each other, and two were within 9 m; in every instance, each produced the noise after they were handled. Furthermore, a non-gravid female (captured and injected on 26 Oct 2001), vocalized on 17 July 2004, but did not vocalize 1 Aug 2004 after being handled once again. Brodie's (1978, *op. cit.*) suggestion that vocalization was a means of warning predators of noxious skin secretions might have support in this instance. Every *P. albagula* handled secreted a sticky discharge. Further studies on vocalization as a means of warning in Plethodontidae are warranted.

We thank the United States Forest Service for funding and Brian Caldwell for field assistance.

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PLETHODON CINEREUS (Eastern Red-backed Salamander). **EARLY NESTING.** Breeding in *Plethodon cinereus* is either annual (southern populations) or biennial (northern populations) (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Inst. Press, Washington, DC. 587 pp.). Females typically oviposit an egg cluster in late spring or early summer, although rare late summer oviposition may occur, and the females remain with the eggs during their developmental period (Bishop 1941. New York St. Mus. Bull. 324:1–363, Petranka 1998, *op. cit*.). In Virginia, Eastern Red-backed Salamanders typically nest in June (Martof et al. 1980. Amphibians and Reptiles of the Carolinas and Virginia. Univ. North Carolina Press, Chapel Hill. 264 pp.), but Ernst et al. (1997. Bull. Maryland Herpetol. Soc. 33:1–62) reported oviposition in northern Virginia from late May to June (25 May–10 June, unpubl. data).

On 7 April 2004 at 1420 h, we found a female, lead-backed morph *P. cinereus* coiled over an egg cluster under a large wooden tie at the edge of an open mesic woodland at the Mason Neck National Wildlife Refuge, Fairfax, Virginia. Six eggs were exposed, but the female was reclining on several additional eggs. The egg cluster was directly on the soil under the tie.

This is the earliest recorded date for oviposition in *Plethodon cinereus*.

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PLETHODON CINEREUS (Eastern Red-backed Salamander). **PREDATION.** The Creek Chub, *Semotilus atromaculatus* (Cyprinidae), is a common inhabitant of forested streams and is broadly sympatric with the Eastern Red-backed Salamander, *Plethodon cinereus*.

On 11 July 2003 in Boston Run (Summit County, Ohio, USA), we captured an adult *S. atromaculatus* that had ingested an adult *P. cinereus.* The creek chub had a standard length of 166 mm, a total length of 170 mm, and a wet mass of 54.7 g. The *P. cinereus* was partially digested and in generally poor condition, thus we measured its length from the snout to base of the hind limb, following Szuba et al. (2002. Herpetol. Rev. 33:187–189). Snout to base of hind limb length was 35.9 mm. Dissection of the *P. cinereus* revealed the following stomach contents: one mite (Acari: Oribatida), fly wings (Diptera: Ceratopogonidae and Sciaridae), and segments of at least 13 ants (Hymenoptera: Formicidae).

Throughout the Boston Run watershed, we have found numerous *P. cinereus* under woody cover and in the leaf litter of small ravines that only carry water during periods of heavy rain. The *P. cinereus* discussed within this note was likely washed into the stream during severe storms that resulted in flash floods throughout the region. This hypothesis is supported by the terrestrial nature of the stomach contents of the salamander.

To the best of our knowledge, this is the first published report of *S. atromaculatus* consuming an adult terrestrial salamander as well as the first report of *P. cinereus* being preyed upon by a fish.

This research was conducted at the Woodlake Environmental Field Station within the Cuyahoga Valley National Park. The Cuyahoga Valley National Park provided the necessary permits to conduct this research, and we are grateful for their continued support. Funding for this work was provided through the National Science Foundation Research Experiences for Undergraduates program.

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TARICHA TOROSA TOROSA (Coast Range Newt). **OVERWINTERING LARVAE.** We present observations of overwintering behavior in *Taricha torosa torosa* larvae at two independent sites. We define overwintering larvae as newts that spend the entire winter season in the larval form. The winter season (December, January, and February) represents the average three coldest months for the southern California coastal region (Felton 1965. California's Many Climates. Pacific Books. 169 pp.).

From Dec 2001 through July 2002, daytime and/or nocturnal visual encounter surveys were conducted in pools in Adobe Creek (Santa Rosa Plateau Ecological Reserve, Murrieta, Riverside County, California USA) at least once per month for a phenology study of *T. t. torosa*. Larval *T. t. torosa* were captured with a dipnet, measured, and on occasion voucher specimens were collected. (Preserved specimens are currently in the collection of US Geological Survey, Biological Resource Discipline, San Diego Field Station [RNF]).

On 25 April 2001, breeding adults and over 50 egg masses were observed in a pool in Adobe Creek. In addition to the breeding activity, three *T. t. torosa* larvae (37–40 mm TL) approaching the size for metamorphosis (50–60 mm TL) (Bishop 1943. A Handbook of Salamanders. Comstock Publishing. 555 pp.) were also captured and examined. Most notable is the considerable size of the three premetamorphic larvae in comparison to the average size of recently hatched *T. t. torosa* larvae at 11–12 mm (Bishop 1943, *op. cit*.). We recognized the three large larva present at the commencement of the 2001 breeding season as larvae from the previous year that spent the winter season in the larval form, hence overwintered.

On 01 May 2002, a single larva collected measured 53 mm TL and was found in a pool containing breeding adults and egg masses (voucher number: RNF 2552). However, during the previous year egg masses were only observed on Adobe Creek in April and May. Consequently, cohorts of the April/May 2001 embryos should have transformed sometime between early Aug and mid Dec 2001(based on the natural history of *T. t. torosa*) if growth and development had not been delayed during the fall and winter months (see Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press. 587 pp.). We recognize the large larva (53 mm TL) present at the commencement of the 2002 breeding season as a larva that overwintered.

While conducting a review of the published literature we came across only one previous report of overwintering *T. t. torosa* larvae (Storer 1925. Univ. California Publ. Zool. 27:1–342).

Our recent observations of overwintering *T. t. torosa* larvae reported herein and Storer's (1925, *op. cit.*) historical record represents observations from two locations separated by a distance of ca. 90 km. Despite the documentation of two consecutive years of overwintering *T. t. torosa* larvae on Adobe Creek, we suspect this phenomenon does not occur often because of the paucity of previous reports or published records (Jennings and Hayes 1994. Amphibian and Reptile Species of Special Concern in California. Final Rept. to California Dept. Fish and Game. 225 pp.; Petranka 1998, *op. cit.*; Storer 1925, *op. cit.*).

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ANURA

AMOLOPS CREMNOBATUS (Rough-backed Torrent Frog). **ENDOPARASITES.** *Amolops cremnobatus* was described from specimens collected in Khammouan Province, Laos (Inger and Kottelat 1998. Raffles Bull. Zool. 46:29–34) and was reported in Vietnam by Bain and Truong (2001. Herpetol. Rev. 32:269). To our knowledge there are no reports of endoparasites from this species. The purpose of this note is to report the nematode *Falcaustra trilokiae* from *A. cremnobatus.*

Three *A. cremnobatus* (SVL 33 mm ± 3 mm SD, range: 29–35 mm) were collected 21 April 1999 from Ha Tinh Province, Huong Son District (18°20'N, 105°14'E), Vietnam and deposited in the herpetology collection of the Natural History Museum of Los Angeles County, Los Angeles, California as LACM 146884–146886. The esophagus, stomach, small intestine, large intestine, lungs and urinary bladder were opened and examined separately for helminths under a dissecting microscope. The body was also searched. Each frog was found to harbor individuals of Nematoda in the small or large intestines. The nematodes were cleared in a drop of concentrated glycerol, identified as *Falcaustra trilokiae*, and deposited in the United States National Parasite Collection, Beltsville, Maryland as USNPC 94898. Prevalence of infection (number infected frogs/number frogs examined) × 100 and mean intensity of infection (mean number of infected individuals) ± 1 SD and range were: 100%, 4.3 ± 3.2, 2–8.

Falcaustra trilokiae was originally described from specimens taken from *Euphlyctis cyanophlyctis* (Ranidae) collected in Andhra Pradesh State, India (Singh 1958. J. Helminthol. 32:132–138). *Amolops cremnobatus* represents the second host for *Falcaustra trilokiae.* Vietnam is a new locality record.

We thank Robert F. Inger (Field Museum of Natural History, Chicago, Illinois) for identification of *A. cremnobatus* and Amanda Woolsey (Whittier College) for assistance with dissections.

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ATELOGNATHUS PATAGONICUS (NCN). **PREDATION**. Various species prey on larval and post-metamorphic anurans, such as spiders, aquatic insects, fishes, birds, and mammals (Duellman and Trueb 1994. Biology of Amphibians. The Johns Hopkins Univ. Press, Baltimore. 670 pp. and references therein). *Atelognathus patagonicus* is a leptodactylid occurring in Laguna Blanca National Park and the surrounding area of Neuquén Province, Argentina. This frog is highly adapted for aquatic life with enlarged interdigital membranes and lateral and ventral skin folds (Cei and Roig 1968. Physis 27:265–284; Duellman and Trueb 1994, *op. cit.*). The species is listed as endangered in Argentina (Lavilla et al. 2000. Categorización de los Anfibios y Reptiles de la República Argentina. Asociación Herpetológica Argentina. 97 pp.). The habitat of *A. patagonicus* is semi-permanent to permanent ponds and lakes. Numerous species of aquatic and semi-aquatic birds also live at these sites.

We report field observations of predation on *A. patagonicus* by four species of birds. During a survey along the northwest shore of Laguna Verde—a permanent pond of 0.17 km^2 (39°0'S, 70°23'W; 1282 m elev.) in Laguna Blanca Park—we observed predation by the Silvery Grebe (*Podiceps occipitalis*) and the White-tufted Grebe (*P. rolland*) on tadpoles and post-metamorphic *A. patagonicus*. Between 1120 and 1220 h on 28 Dec 2003, we observed 22 captures by the birds. Seven Silvery Grebes captured 6 tadpoles and 15 post-metamorphic frogs. One White-tufted Grebe captured one post-metamorphic *A. patagonicus*. We watched individual birds and could track the number of prey consumed by each one. During these observations, one bird caught three *A. patagonicus*. A grebe would dive underwater, for as long as two minutes, and then emerge with a prey item in its beak. Birds held the tadpoles by their tails and the frogs by one of their legs. Then the bird would slap the prey against the water surface before swallowing it head first. We observed similar acts of predation by these two species on 29 and 30 Dec 2003, between 900 and 1700 h. At Laguna el Hoyo—another permanent pond in the national park—two other birds, the Brown-hooded Gull (*Larus maculipennis*) and the Andean Ruddy Duck (*Oxyura ferruginea*), were observed preying on *A. patagonicus* on 15 Jan 2002. In these two lagunas the most common predators are birds, and they can capture at least three frogs per hour. Hence, it is important to fully understand the interaction between bird predation and *A. patagonicus* populations.

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BUFO AMERICANUS (American Toad) and ***RANA CATESBEIANA*** (Bullfrog). **MICROHABITAT**. Use of burrows by amphibians has been documented for several species. During a field study, adult *B. americanus* (21 April 2001) and juvenile *R. catesbeiana* (9 March 2002) were observed using crayfish burrows at a breeding pond in Union City, Madison County, Kentucky. Use of burrows occurred as the pond was receding during dry conditions, suggesting burrows may have been used as refugia to avoid desiccation.

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BUFO AMERICANUS CHARLESMITHI (Dwarf American Toad). **MAXIMUM SIZE**. Conant and Collins (1998. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Third Ed., Expanded. Houghton Mifflin, Boston. 616 pp.) report the record size for *Bufo americanus charlesmithi* as 6.4 cm. Herein, we report on a new maximum body size for this subspecies from Arkansas.

On the night of 17 April 2004, we collected an adult female *B. a. charlesmithi* crossing St. Hwy 88, ca. 0.2 km W Queen Wilhelmina State Park, on the top of Rich Mountain (Polk County; 34°41.240'N, 94°23.143'W; elev. 768 m). The specimen measured 10.2 cm SVL at the time of preservation on 20 April 2004 and 9.5 cm SVL upon a more recent measurement on 14 June 2004.

The specimen was deposited in the Arkansas State University Museum of Zoology herpetological collection (ASUMZ 28453) and collected under the authority of an Arkansas Game & Fish Commission scientific collection permit.

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BUFO MARINUS (Cane Toad). **PREDATION**. *Bufo marinus* is a widespread anuran native to central and tropical South America that has been introduced into several other countries for pest control (Easteal 1981. Biol. J. Linn. Soc. 16:93–113). In these countries, the uncontrolled expansion of *B. marinus* is causing a negative impact upon native species (Catling et al. 1999. Wildl. Res. 26:161–185). Although it has been documented that eggs and tadpoles are toxic to a wide range of aquatic predators including invertebrates, fish, and other anurans (Crossland and Azevedo-Ramos 1999. Herpetologica 55:192–199; Punzo and Lindstrom 2001. J. Herpetol. 35:693–697), there is little information about natural predators of larval stages of this species (Hutchings 1979. N. Queensland Nat. 45:4–5; Crossland 1998. Herpetologica 54:364–369). Snakes of the genus *Liophis* inhabit mesic habitats and their diet consists largely of anurans and their larvae. At least one species, *L. epinephelus*, feeds on *B. marinus*, and *L. melanotus* has been reported as a predator of *Bufo granulosus* (Michaud and Dixon 1989. Herpetol. Rev. 20:39–41). On 18 Feb 2004 near Chichiriviche, Vargas State, Venezuela (10º32'N, 67º14'W, 135 m elev.), we observed an adult male *L. melanotus* on the shore of the Río Chichiriviche, 3 km SW of Chichiriviche, in a shallow margin of the river that was also occupied by a few hundred *B. marinus*

tadpoles. When captured, the snake regurgitated 8 large *B. marinus* tadpoles that appeared to have been recently swallowed. Voucher specimens are deposited in the Museo de La Estación Biológica de Rancho Grande (EBRG), Ministerio del Ambiente y de los Recursos Naturales, Venezuela as EBRG 4460 (*L. melanotus*) and EBRG 4939 (*B. marinus* tadpoles).

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BUFO OCELLATUS (NCN). **DEATH FEIGNING**. Death feigning or thanatosis (Edmunds 1974. Defense in Animals. Longman, New York, 357 pp.), is a common behavior among frogs (Sazima 1974. J. Herpetol. 8:376–377; Duellman and Trueb 1986. Biology of Amphibians. McGraw-Hill, New York; Azevedo-Ramos 1995. Rev. Bras. Biol. 55: 45–47). On 7 Aug 2003, in Unaí Municipality (46°7'W; 16°9'S) when handling an adult male *Bufo ocellatus* (42.8 mm SVL), I observed death feigning behavior in this species. The specimen adopted a motionless posture, keeping his limbs close to the body and eyes closed. After 45 sec. in this position, the frog started moving, attempting to escape. However, when restrained it reinflated the lungs and released bladder liquid. Both behaviors are similar to those described for *B. paracnemis* (Zamprogno et al. 1998. Herpetol. Rev. 29:96–97) and probably are widespread among other species of this genus. The function of death feigning might be related to increasing the chances of being lost by a predator and/or to minimization injuries when seized by a predator (Sazima, *op. cit*.). A voucher specimen (AAG-UFU 2484) is housed in the Museu of Biodiversidade do Cerrado, Universidade Federal de Uberlândia, Minas Gerais, Brazil.

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BUFO PROBOSCIDEUS (NCN). **PREDATION**. *Bufo proboscideus* occurs in the Amazon River region from Ecuador to Manaus, Brazil (Frost 2002. Amphibian Species of the World: An Online Reference V2.21, April 2003). This species is diurnal, but is often seen at night when it rests off the ground on small seedlings and shrubs (Zimmerman and Bogart 1988. J. Herpetol. 22:97–108). Here, I report predation of *B. proboscideus* by the colubrid snake *Xenoxybelis argenteus*.

On 11 April 2003 (1930 h), at Reserva Florestal Adolpho Ducke (02°55'S, 59°59'W), Manaus, Amazonas, Brazil, I found a juvenile *X. argenteus* (ca. 800 mm TL) ingesting a juvenile *B. proboscideus* (35 mm SUL). At the moment of observation, only the hind limbs of *B. proboscideus* protruded from the snake. The snake was on a shrub 1.0 m above the ground and when disturbed, regurgitated the dead frog and escaped into the vegetation.

Xenoxybelis argenteus is considered to be a strictly diurnal species that sleeps on low vegetation at night (Martins and Oliveira 1998. Herpetol. Nat. Hist. 6[2]:78–150). Their diet consists of small lizards and frogs, which are captured while the snake forages on low vegetation (Martins and Oliveira, *op. cit.*). The present observation shows that *X. argenteus* may forage opportunistically at night when frogs, such as *B. proboscideus,* sleep on vegetation.

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BUFO SPECIOSUS (Texas Toad). **MAXIMUM SIZE**. The record size reported for *Bufo speciosus* is 92 mm SVL (Conant and Collins 1998. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Third Ed., Expanded. Houghton Mifflin, Boston. 523 pp.). Herein, we report on a new maximum size for this species.

On 7 July 2004, a female *Bufo speciosus* was collected as we road cruised in Brewster County, Texas, USA. The toad was collected at ca. 2330 h on St. Hwy 118, 32.6 km N Terlingua. The highway was damp following a brief rain shower, air temperature was 27.8ºC. In the field the specimen measured 98 mm SVL, mass was 127 g. The specimen was deposited in the Arkansas State University Museum of Zoology herpetology collection (ASUMZ 28696). The specimen was re-measured following preservation and was 97 mm SVL. Collection of the specimen was under the authority of the Texas Parks and Wildlife Department permit (SPR-0704-398) issued to SET.

Submitted by **J. PHILLIP STEWART, WAYLON HILER, CHARLES MCDOWELL, ROBERT NEAL, BEN A. WHEELER,** and **STANLEY E. TRAUTH,** Department of Biological Sciences, Arkansas State University, State University, Arkansas 72467, USA (e-mail: strauth@astate.edu).

ELEUTHERODACTYLUS PLANIROSTRIS (Greenhouse Frog). **COLD TOLERANCE.** On 3 March 2004, a healthy adult *Eleutherodactylus planirostris* was found inside a sealed 3 cu. ft bag of cypress mulch at the Detroit Zoo, Oakland County, Michigan. According to a representative of the manufacturer this bag originated at a packing plant in Trenton, Gilchrist County, Florida 1–2 weeks prior to its arrival in Michigan on 11 July 2003. The bag was kept outside until it and several others were relocated to the zoo on 29 Jan 2004. All the bags appeared to be frozen solid at that time. The bags remained outside at the zoo until 29 Feb 2004 when the bag containing the frog was brought inside to thaw. The ability of some ectotherms to endure freezing climates results from freeze avoidance (selecting a microclimate that does not freeze), freeze resistance (supercooling), or freeze tolerance (accumula-

tion of intracellular antifreeze and nucleation of extracellular freezing) (Pinder et al. 1992. *In* Feder and Burggren [eds.], Environmental Physiology of the Amphibians, pp. 250–274. University of Chicago Press). Freeze avoidance cannot be ruled out in this case: it is possible that the bag of mulch (12 cm thick) provided a thermally protected microclimate, particularly if the bag had been ensconced within a pile of bags. Freeze resistance is not an option for amphibians due to their low supercooling capacity and water-permeable skin (Pinder et al., *op. cit.*). Freeze tolerance has been documented in certain extreme temperate amphibians, including some ranid and hylid frogs and a hynobiid salamander (Pinder et al., *op. cit.*); it has not been documented in leptodactylids. As we did not observe the frog until after the mulch had thawed, we are unable to state for certain if what we observed was freeze avoidance or freeze tolerance. However, the frog likely experienced freezing temperatures during some of its time in Michigan. During the 32 days the bag was kept outside at the zoo, maximal outdoor daily temperatures in the Metro Detroit region were below freezing on 15 days; average daily temperatures were below freezing on 23 days. *Eleutherodactylus planirostris* is native to the West Indies and has been introduced into Florida, Hawaii, Jamaica, Louisiana, Mexico (Frost 2002. Amphibian Species of the World online), and Georgia (Winn et al. 1999. Herpetol. Rev. 30:49). This species was first detected on the mainland US in southern Florida in 1875 (Cope 1875. Bull. U.S. Nat. Mus. 1:i–xi, 1–104.) and since has been spreading northward (Ashton and Ashton 1988. Handbook of Reptiles and Amphibians of Florida pt. 3, The Amphibians. Windward Publ. Inc., Miami. 191 pp.). Although it is typically thought that the northward range expansion of tropical species introduced into the southern US will be limited by cold or freezing temperatures, our observation of cold tolerance in *E. planirostris* suggests that macro-environmental temperature *per se* might not be a limiting factor for this species. Moreover, that this individual survived for ca. 8 months sealed in a bag of mulch speaks to the extreme tolerance of the species and its potential for inadvertent anthropogenic dispersal. The presence of extreme cold tolerance, or possibly freeze tolerance, in a tropical species is intriguing, especially in light of the freeze intolerance of several temperate species more closely related to freeze-tolerant species (Pinder et al., *op. cit.*), and raises questions about the origin(s) and phylogenetic distribution of the underlying physiological mechanisms.

Submitted by **KEVIN C. ZIPPEL**, National Amphibian Conservation Center, and **ANDREW T. SNIDER, LESLIE GAINES,** and **DAVID BLANCHARD**, Holden Museum of Living Reptiles, Detroit Zoo, Royal Oak, Michigan 48068, USA.

GASTROPHRYNE OLIVACEA (Great Plains Narrow-mouthed Toad). **PREDATION**. At Yécora, Sonora, Mexico (28°22'4.0"N, 108°55'32.6"W), 1545 m, a large chorus of *Gastrophryne olivacea* was found the night of 25 July 2004, in temporary pools as much as 25 cm deep that had formed earlier that day. The chorus was an attraction for at least 3 *Thamnophis c. cyrtopsis* that were observed foraging in and around the pools. Each was watched for a time as it appeared to be directed toward one specific calling toad, none of which made any attempt to avoid the approaching snake. The head and neck of each snake were held well above the water, as though guided by vision toward the prey, although it is not likely that the snakes were attracted to the site by vision. Most pools in the area contained breeding choruses of *Hyla wrightorum* as well as *Gastrophryne*, but all snakes observed were in pools containing only the latter genus. It is possible they selectively sought the smallest anurans of the congress, which were the male *Gastrophryne*. Apparently *T. cyrtopsis* is one of the main predators of *Gastrophryne* in this area.

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GASTROPHRYNE OLIVACEA (Great Plains Narrow-mouthed Toad). **REPRODUCTION**. At Yécora, Sonora, Mexico (28°22'4.0"N, 108°55'32.6"W), 1545 m, during the day on 25 July 2004 (0730–1830 h), as a light rain fell, weak, scattered calls of easily disturbed *Gastrophryne olivacea* were heard in extensive grasslands where the toads were impossible to detect, hidden in the grass and not fully emerged from their burrows. A little later an exceptionally severe, protracted rainstorm rapidly filled low areas all around town, where water accumulated in many small pools as much as 25 cm deep where none existed before. During that process emerging individual *Gastrophryne* appeared in huge numbers on almost all of the pools, where they called loudly in a low buzz lasting as long as 6 sec (as opposed to 3 sec recorded for eastern populations). Females were seen approaching the much smaller males, but they seemed to be selective, turning away at times from one male to another. Amplexus was adhesive. Eggs were laid the same night by captive specimens. Most pools were shared with *Hyla wrightorum*; only two were occupied exclusively by *Gastrophryne*.

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HYLA ACREANA (NCN). **LARVAL BEHAVIOR**. Carnivory in larval anurans is well documented, with the families Hylidae, Leptodactylidae, Myobatrachidae, Pelobatidae, Pipidae, Dendrobatidae, and Ranidae containing species known to have predaceous larvae (McDiarmid and Altig 1999. Tadpoles: The Biology of Anuran Larvae. University of Chicago Press, Chicago

and London. 444 pp.). The role of carnivorous species in tadpole assemblages, however, is poorly known.

During October 2002, I observed *Hyla acreana* tadpoles in the floodplain of the Madre de Dios River in southeastern Peru. *Hyla acreana* adults were most commonly found calling from secondary growth habitat bordering small pools and large puddles. These pools were common breeding habitat for upwards of thirty anuran species (McKeon and Baggallay, in prep.), though dominated by *Phrynohyas venulosus*, *Hamptophryne boliviana*, *Scinax rubra*, and *Hyla leucophyllata*. Tadpoles were captured and reared through metamorphosis for positive identification. Throughout the month, behavioral notes were taken on tadpoles *in situ*, using a mask and snorkel while lying on a balsa raft.

Four instances of depredation by tadpoles of *H. acreana* were recorded. Three prey individuals were larval *Hamptophryne boliviana*, the fourth was a tadpole of an unidentified *Scinax*. Tadpoles of *H. acreana* tended to hover near horizontal structures of submerged vegetation. Upon encountering another tadpole *H. acreana* would dart forward and seize the proximal portion of the prey in its mouthparts. Prey tadpoles were slowly consumed by tearing through the body wall.

Captive specimens of larval *H. acreana* (Gosner stages 28–36) were offered prey types belonging to the following species: *Hyla leucophyllata, Hamptophryne boliviana*, *Phyllomedusa camba*, *Phyllomedusa palliata*, *Scinax rubra*, *Allobates femoralis*, and *Phyrnohyas venulosus.* All were smaller than, or equal in length to the *H. acreana*. All prey species were avidly consumed except for *P. venuslosus*, the most common tadpole found in the pond assemblage.

I thank the Yine Project, Madre de Dios Explorations, and Pantiacolla Tours for their continuing support of herpetological research in the area.

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HYLA ALVARENGAI (NCN). **PREDATION**. Amphibians are common prey for a variety of predators (Castanho 1996. Herpetol. Rev. 27:141; Haddad and Bastos 1997. Amphibia-Reptilia. 18:295–298) *Hyla alvarengai* is endemic to the Serra do Espinhaço in the Brazilian states of Minas Gerais and Bahia (Frost 2004. Amphibian Species of the World: an Online Reference. Version 3.0. 22 Aug 2004. Electronic Database accessible at http://research.amnh.org/herpetology/amphibia/index.html). It is a saxicolous hylid, with a relatively large body size (Duellman 1993. Amphibians of the world: additions and corrections. Univ. Kansas Mus. Nat. Hist. Spec. Publ. 21:1–372) and little is known about its biology (see Sazima and Bokermann 1977. Rev. Bras. Biol. 37:413–417; Vrcibradic and Van Sluys 2000. Herpetol. Rev. 31:40–41; Carneiro et al. 2003. Anais de trabalhos completos. V Congresso de Ecologia do Brasil. pp. 563–564).

On 18 Sept 2003 at Serra do Cipó (19º20'S; 43º40'W), Minas Gerais, Brazil, ca. 1200 h, we observed an individual *H. alvarengai* being eaten by a Yellow-headed Caracara at the edge of the MG-010 road. We initially saw the hawk perched on a wall at the roadside while eating an individual *H. alvarengai*. The hawk flew away as we approached, leaving behind only the left tibia (25.9 mm) of a young *H. alvarengai*. The young of *H. alvarengai* preferentially use stones as diurnal resting sites at Serra do Cipó (Carneiro 2003, *op. cit*.), a kind of substrate in which individuals of this species are cryptic (Sazima and Bokermann 1977, *op. cit*.). Nonetheless, the use of an uncovered microhabitat to rest might make young of this species potential prey for visually-oriented predators.

We are grateful to Tadeu J. Guerra for logistical support. This work was completed while CABG received a graduate fellowship from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

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HYLA ARILDAE (Teresópolis Treefrog). **DEATH FEIGNING.** Death feigning behavior has been recorded in some neotropical hylid frogs (Azevedo-Ramos 1995. Rev. Brasil. Biol. 55:45–47; Napoli 2000. Herpetol. Rev. 32:36–37; Vrcibradic and Van Sluys 2000. Herpetol. Rev. 31:40–41). *Hyla arildae* is known to occur in forest fragments of the Serra do Mar and Serra da Mantiqueira in southeastern Brazil (Heyer et al. 1990. Arq. Zool., São Paulo, 31:255–256). During March 2004 at 1200 h, at the Parque Municipal das Mangabeiras (19º55'S; 43º56'W; 850 m elev.), Belo Horizonte, Minas Gerais State, we found an adult *Hyla arildae* (47 mm SVL) resting about 1 m above ground on a leaf of a shrub. When we touched the shrub, the treefrog jumped to the ground about 50 cm from its original position. One of us (PCFC) captured the frog by hand, and just after opening the hand we discovered the treefrog was feigning death. Immediately after being captured, the treefrog thrust its forelimbs upwards and remained motionless with eyelids half closed and its hindlimbs sheltered close to the body. We then turned the treefrog belly up, it remained in the same position for about 10 seconds. After that, we put the treefrog on the ground to take photos. It remained motionless for about five seconds then jumped into its surroundings. This is the first record of death feigning in *Hyla arildae*. We thank D. Vrcibradic and M. Van Sluys for suggested revisions to the text and FAPERJ for a grant to PCFC and CNPq for research grants to CFDR.

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HYLA CHRYSOSCELIS (Gray Treefrog). **DEPRIVATION TOLERANCE.** On 23 July 2004, a healthy adult *Hyla chrysoscelis* was found inside a sealed 2-cubic-foot bag of red cedar bedding chips by Joann Listwak of North Branch, Lapeer County, Michigan, USA. The treefrog was donated to the Detroit Zoo (accession 11322). According to a representative of the manufacturer the logs for this batch of chips came from Kentucky and/or Alabama and

were shipped to a processing plant in Lebanon, Marion County, Kentucky. Because of the destructive nature of processing (chipping, kiln drying), the frog must have gotten in the bag late in the processing and more likely came from the region of the processing plant than the log source. Because *H. versicolor* is known from just a few counties around Ft. Knox in Kentucky and *H. chrysoscelis* occurs statewide (MacGregor et al. 2004. Frogs and Toads of Kentucky. Available online at www.bioweb.wku.edu/froglogger), I assume this animal is the latter species. The bag was purchased at the Tractor Supply Company store in Lapeer, Michigan between 7–16 July. According to the manufacturer, it takes about 1 month for the bag to go from the manufacturer to the distributor; summertime shipments to the distributor are monthly and all stock is sold within the month, so the bag was likely sealed at the processing plant 30–60 days prior to sale. With an additional 1–2 weeks at the home of the purchaser, this animal was apparently isolated for 5–10 weeks. Unlike in a similar event involving an *Eleutherodactylus planirostris* sealed in a bag of moist mulch for 8 months (Zippel et al. 2005. Herpetol. Rev. 36:299–300), cedar chips are kiln-dried and bagged shortly thereafter so the presence of food and water is unlikely.

Unintentional anthropogenic dispersal of amphibians and other wildlife has become increasingly common as various means of transportation become faster and wider reaching (e.g., Kaiser 1997. Biodiv. Conserv. 6:1391–1407). We regularly receive phone calls at the zoo to identify animals that emerge from plant and produce shipments. This example, in addition to one previously documented (Zippel et al., *op. cit.*), demonstrates how ectotherms are in some ways more likely to be inadvertently dispersed by human activities. Although ectotherms are affected by deprivation (e.g., Audo et al. 1995. Oecologia 103:518–522; Dunlap 1995. J. Herpetol. 29:345–351), their small size and low metabolic needs relative to endotherms (Pough 1980. Amer. Nat. 115:92–112) make them more likely to survive transportation under extreme conditions of deprivation.

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HYLA PULCHELLA CORDOBAE (Cordoba Treefrog). **PARASITISM**. Parasitism by copepods on anuran tadpoles is rarely documented. However, such parasitism has been reported on field caught (Baldauf 1961. J. Parasitol. 47[2]:195) and laboratory-reared (Martins and Souza 1996. Rev. Bras. Biol. 12[3]:619–625) *Rana catesbeiana*, and on field caught *R. chalconota* (Tzi Ming 2001. Froglog 46[3]:3).

During February 2002, one of us (LA) collected 46 *Hyla pulchella cordobae* tadpoles (Gosner stages 26–35), from a lotic environment (Arroyo Tanti, Tanti City, Córdoba province, Argentina). Tadpoles were preserved and transferred to the laboratory where we found 9 of them with a total of 12 parasitic copepods (Lernaeidae, *Lernaea* sp.). We observed a maximum of 4 copepods on any one tadpole, whereas the maximum number previously reported varied from 6 (Baldauf, *op. cit.*) to 15 (Tzi Ming, *op. cit.*). All copepods observed by us were anchored at the junction of the body and tail. The damage by parasitic copepods seems to be variable. Tzi Ming (*op. cit.*) observed a 5.5% incidence of external limb abnormalities, although no abnormalities were reported by Baldauf (*op. cit.*), Martins and Souza (*op. cit.*) or us. Tzi Ming (*op. cit.*) found the copepod *L. cyprinacea* on *R. chalconota* tadpoles and fishes of the genus *Poecilia*. Similarly, we observed copepods (*Lernaea* sp.) on *Hyla pulchella cordobae* tadpoles and the fish *Astyanax* sp. and *Jenynsia* sp., which were collected sympatrically.

This information suggests that natural infestations of copepods on anuran tadpoles might occur at both lentic (Tzi Ming, *op. cit.*) and lotic environments. The material examined was deposited at the Invertebrates Collection of the Museo de La Plata (MLP COPEPOD 24). This is Scientific Contribution No. 763.

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HYLA VERSICOLOR (Gray Treefrog). **RECORD SIZE**. Conant and Collins (1998. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. 3rd Ed. Expanded. Houghton Mifflin, Boston, Massachusetts. 616 pp.) reported maximum size for *Hyla versicolor* as 60 mm SVL. Herein I report a female *H. versicolor* 62.4 mm as determined by standard anuran SVL measurement techniques (Conant and Collins 1998, *op. cit.*) using a vernier caliper. This specimen was collected at the Thomas Baskett Wildlife Research Area 6.7 km E of Ashland, Boone County, Missouri, USA on 15 June 2004. Length and species identification (based on collection location) was confirmed by Richard Daniel. The specimen is deposited in the University of Missouri, Columbia Herpetological Collection (UMC 7709).

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LEPTODACTYLUS LABYRINTHICUS (South American Pepper Frog). **PREDATION**. *Leptodactylus labyrinthicus* lays its eggs in foam nests in basins at margins of water bodies and has aquatic tadpoles (Cei 1980. Monit. Zool. Ital. [NS] Monogr. 2: XII. 609 pp; Silva et al. *in press*. J. Nat. Hist.). The morphology of these tadpoles has been described (Heyer 1979. Smithson. Contr. Zool. 301:1–43; Cei 1980, *op.cit.*), although ecological data are scarce. Here we report field observations of predation upon tadpoles. We observed predatory events in a cement pool (3 m; 10 cm deep), in a garden at the Cerrado Reservation of Parque Estadual de Caldas Novas (17°43'S, 48°40'W), in the municipality of Caldas Novas, Goiás State, Brazil. Observations were made during the day and night in September 2003. During the day (0700–1800 h) we observed the Leaf-scrapper (*Turdus amaurochalinos*) disturbing the dead leaves on the bottom of the pool with its beak and capturing tadpoles. The bird had a nest with two nestlings about 20 m from the pool, and used the captured tadpoles to feed them. The tadpoles were swallowed or carried in the beak. At ca. 1830 h we also observed the snake *Liophis poecilogyrus* (voucher photo: AAG-

UFU 3227) preying on these tadpoles. This snake was captured (ca. 10 min after being found) and it regurgitated 11 tadpoles (38.5 ± 2.4 mm TL), five were still alive.

Predation has been considered the main cause of tadpole mortality (McDiarmid and Altig 1999. Tadpoles: The Biology of Anuran Larvae. University of Chicago Press, 444 pp.). The Leaf-scrapper is an especially efficient diurnal predator because they can dislodge tadpoles from their retreats by removing leaves from the bottom of the pool.

We thank Celine de Melo for identification of the bird and A. A. Giaretta for critically reading the manuscript and identifying the snake.

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LEPTODACTYLUS LABYRINTHICUS (South American Pepper Frog). **NECROPHAGY**. On 26 Sept 2003 at a Cerrado reservation in Caldas Novas Municipality (17°43'S, 48°40'W), Goiás State, Brazil, we observed tadpoles of *L. labyrinthicus* gathered around the carcass of a bird (*Turdus* sp.) in a cement pool (ca. 10 cm deep). Observations occurred from 0700–2000 h. We found about 30 tadpoles entering amidst the feathers and biting the carcass. Tadpoles of *L. labyrinthicus* have been reported to feed on tadpoles and frog eggs (Cardoso and Sazima 1977. Ciência e Cultura 29:1130–1132; Silva et al. *in press*. J. Nat. Hist.), but necrophagy was previously unknown. Eggs and carrion may represent a valuable protein source for these tadpoles, and compared to other frogs, animal matter may allow a faster development (McDiarmid and Altig 1999. Tadpoles: The Biology of Anuran Larvae. University of Chicago Press, 444 pp.).

We thank A. A. Giaretta for critically reading this manuscript.

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LEPTODACTYLUS OCELLATUS (Rã-Manteiga). **CANNIBALISM.** In some animals (Machado and Oliveira 1998. J. Zool. London 246:359–367), including frogs (Townsend et al. 1984. Anim. Behav. 32:421–431), cannibalism is a major factor of mortality of immature individuals. On 6 Aug 2003 in Unaí municipality, Minas Gerais state, Brazil, we collected an adult *Leptodactylus ocellatus* (62.4 mm SVL) and found a cospecific juvenile (30 mm SVL) in its stomach. *Leptodactylus ocellatus* has a broad diet, often feeding on other frogs (Gallardo 1964. Physis – Tomo XXIV N 68:373–384), including conspecifics (present note).

Specimens examined (AAG-UFU 2482, 2494) are housed in Museu de Biodiversidade do Cerrado, in the Universidade Federal de Uberlândia, Minas Gerais state, Brazil. We thank Ariovaldo A. Giaretta for critically reading the manuscript and the owners of the Fazenda Sagres S. A. for logistic support.

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MICROHYLA HEYMONSI (Dark-sided Chorus Frog). **ENDOPARASITES.** *Microhyla heymonsi* is known from south-east Asia (Ziegler 2002. Die Amphibien und Reptilien eines Tieflandfeuchtwald-Schutzgebietes in Vietnam. Natur end Tier - Verlag GmbH, Munster, Germany, 242 pp.). To our knowledge there are no reports of endoparasites from this species. The purpose of this note is to report the nematode *Cosmocercoides multipapillata* from *M. heymonsi*.

Two *M. heymonsi* (SVL 21 mm ± 1 SD, range: 20–22 mm) were collected 21 April 1999 from Ha Tinh Province, Huong Son District, (18°20'N, 105°14'E), Vietnam and deposited in the herpetology collection of the Natural History Museum of Los Angeles County, Los Angeles, California as LACM 14682, 14683. The esophagus, stomach, small intestine, large intestine, lungs, and urinary bladder were opened and examined separately for helminths using a dissecting microscope. The body cavity was also searched. One frog (LACM 14683) was found to harbor 5 (2 males, 3 females) nematodes in the large intestine. The nematodes were cleared in a drop of concentrated glycerol, identified as *Cosmocercoides multipapillata* and deposited in the United States National Parasite Collection, Beltsville, Maryland as USNPC 94915. Prevalence of infection (number infected frogs/number frogs examined) × 100 was 50%.

Cosmocercoides multipapillata was described from *Bufo melanostictus* from India (Khera 1958. Ind. J. Helminthol. 10:6–12). It has also been reported in *Bufo gargarizans* from China (Wang 1980. Acta Zootax. Sinica 6:365–372). *Microhyla heymonsi* represents the third host for *Cosmocercoides multipapillata*. Vietnam is a new locality record.

We thank Amanda Woolsey (Whittier College) for assistance with dissections.

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PLEURODEMA BUFONINUM (NCN). **DIET**. *Pleurodema bufoninum* is a leptodactylid frog adapted to living under challenging climatic conditions of the Patagonian steppe, at the southern tip of South America (Cei 1980. Amphibians of Argentina. Monit. zool. ital. [N.S.], Monogr. 2:1–609). The species is widely distributed in the Argentine Patagonia, but in Chile it is restricted to the few steppe areas that exist west of the Andes. Little is known about its biology, with the only reference to its diet from nine specimens collected in Chile, between Pino Hachado and Icalma. Both

areas are on the frontier with Argentina (38º40'–38°50'S; 71ºW; 1200–1800 m elev.) (Pincheira-Donoso 2002. Gayana 66[1]:77–80). Nothing is known about the species' feeding ecology in the Argentine Patagonia. This note describes for the first time the diet of *P. bufoninum* collected east of the Andes.

On 9 March 2004 (late summer), during hot weather conditions (29°C), at 1530 h, we found *P. bufoninum* juveniles active, sheltering in the shade of a bridge on the shore of the Pichileufú River (Paso Flores, Río Negro Province, Argentina, 40°36'S, 70°39'W; 575 m elev), 3–5 m away from the water. The general surroundings are typical of the Patagonian steppe (semi-desert with xerophytic, stunted bushes less than 0.6 m tall alternating with grasses). On this occasion, the frogs were found at the highest, driest sites of the alluvial terrain, where there are only cobbles and boulders. Immediately after being captured, the frogs were killed and fixed in 10% formalin for later analysis. We examined 5 newly metamorphosed specimens (Gosner stages 45 and 46); measuring between 19.9 and 23.5 mm TL (mean 22.1 ± 1.57 mm). We identified stomach contents to family or order level. We recorded the number of items of each prey taxon and calculated its frequency of occurrence. We estimated the rate of feeding activity as the percentage of stomachs containing food with respect to the total number of stomachs examined (Sala and Ballesteros 1997. Mar. Ecol. Prog. Ser. 152:273–283). The percentage of stomachs containing food was 100%. We found 2–10 prey items per stomach. All prey were arthropods, and there was no plant material in the stomachs. Numerically, the diet was made up of hymenopterans (48%), coleopterans (44%), and Araneae (8%). In particular, ants (Formicidae) were the most abundant prey item (40%), followed by Hydrophilidae larvae (24%) and adult Carabidae and Curculionidae (20%). Non-Formicidae hymenopterans and Araneae were consumed in equal proportions (8%). The most frequently occurring items were Formicidae (100%), Hydrophilidae larvae (60%), and Araneae (40%).

Comparison of our results with Pincheira-Donoso (2002, *op. cit.*) shows that in both cases ants were the most abundant item in the diet of *P. bufoninum.* Coleopterans were more numerous and more frequent in our study, and they add two new families to known prey items (Curculionidae and Hydrophilidae). Hemiptera, Diptera, Homoptera, Acari, and Gastropoda, and seeds and plant remains were not present in our sample. Thus, based on our results, *P. bufoninum* feeds on a smaller number of prey taxa.

Our results complement the only previous data available on the diet of this species, and provide information on the trophic behavior of newly metamorphosed juveniles, at a lower altitude east of the Andes. Our results support the idea that the species is opportunistic, adapts to local conditions, and includes terrestrial walking and flying arthropods and aquatic coleopteran larvae in its diet.

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POLYPEDATES LEUCOMYSTAX (Java Whipping Frog). **ENDOPARASITES.** *Polypedates leucomystax* is known from India, southeast Asia, and Japan (Ziegler 2002. Die Amphibian und Reptilien eines Tieflandfeuchtwald-Schutzgebietes in Vietnam. Natur end Tier - Verlag GmbH, Munster, Germany, 342 pp.). To our knowledge, there are no reports of helminths from *P. leucomystax* collected in Vietnam. The purpose of this note is to report the nematode *Cosmocercoides mutltipapillata* and the acanthocephalan *Acanthocephalus bufonis* in *P. leucomystax.*

Two *P. leucomystax* (SVL 57 mm ± 4 SD, range = 54–59 mm) were collected 17 April 1999 from Ha Tinh Province, Huong Son District, (18°20'N, 105°14'E), Vietnam and deposited in the herpetology collection of the Natural History Museum of Los Angeles County, Los Angeles, California as 146820 and 146821. The esophagus, stomach, small intestine, large intestine, lungs, and urinary bladder were opened and examined separately for helminths using a dissecting microscope. The body cavity was also searched. Helminths were cleared in a drop of concentrated glycerol. One frog (LACM 146820) was found to harbor 6 (5 males, 1 female) *Cosmocercoides multipapillata* and 3 (2 males, 1 female) *Acanthocephalus bufonis,* both in the small intestines. Helminths were deposited in the United States National Parasite Collection (USNPC) as *Cosmocercoides multipapillata* (94916) and *Acanthocephalus bufonis* (94917). Prevalence of infection (number infected frogs/number frogs examined) ×100 was 50% for each helminth.

Cosmocercoides multipapillata was originally described from *Bufo melanostictus* from India (Khera 1958. Ind. J. Helminthol. 10:6–12). It has also been reported in *Bufo gargarizans* from China (Wang 1980. Acta Zootax. Sinica 6:365–372). *Acanthocephalus bufonis* has an Oriental distribution where it is known from bufonids, ranids, and the lacertid lizard *Takydromus sexlineatus* (Kennedy 1982. Can. J. Zool. 60:356–360). It also occurs in *Bufo marinus* in Hawaii (Barton and Pichelin 1999. Parasite 6:269–272). *Cosmocercoides multipapillata* represents a new helminth species record for *P. leucomystax*. Vietnam is a new locality record for *C. multipapillata* and *A. bufonis*.

We thank Amanda Woolsey (Whittier College) for assistance with dissections.

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PSEUDACRIS CADAVERINA (California Treefrog). **PREDATION.** During an electro-shocking survey on 12 August 2004 (1145 h), a juvenile Largemouth Bass (*Micropterus salmoides*; 120 mm TL) was collected from a small pool (ca. 10 m × 1.5 m, 40 cm) from San Mateo Creek, San Diego County, California, USA (T8S, R6W, Sec 24). Upon capture it was noticed that the rear legs of an adult *P. cadaverina* were protruding from the mouth of the *M. salmoides*. The frog had been partially digested when discovered and an examination of the legs of the *P. cadaverina* showed no abnormalities or decay leading us to conclude that the frog had been consumed live.

To our knowledge, this is the first documentation of predation of *P. cadaverina* by *M. salmoides*. Previously documented nonnative fish predators on *P. cadaverinia* include Rainbow Trout,

Oncorhynchus mykiss (hatchery raised-stock variety) and Green Sunfish, *Lepomis cyanellus* (Ervin 2005. *In* M. Lannoo [ed.], Amphibian Declines: The Conservation Status of United States Species, pp. 467–470. Univ. California Press, Berkeley and Los Angeles).

At the site of collection *M. salmoides* is an introduced invasive predatory fish. *Micropterus salmoides* has been widely introduced in North America (Courtenay and Stauffer 1984. Distribution, Biology, and Management of Exotic Fishes. John Hopkins University, Baltimore, Maryland) and has been implicated as a contributing factor in the declines of native amphibian populations (Hayes and Jennings 1986. J. Herpetol. 20:490–509; Fisher and Shaffer 1996. Cons. Biol. 10[5]:1387–1397).

The *M. salmoides* with the partially digested *P. cadaverina* remains, protruding from its mouth, were preserved in formalin and deposited, along with two digital prints of the specimen, in the Herpetological Collection at the California Academy of Sciences as vouchers (CAS 228883).

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PSEUDACRIS CRUCIFER (Spring Peeper). **PREDATION**. Because *Pseudacris crucifer* larvae are palatable (Kats et al. 1998. Ecology 69:1865–1870), they are typically excluded from wetlands containing predatory fishes (Hecnar and M'Closkey 1997. Biol. Cons. 79:123–131). Whether the allotopic distribution of *P. crucifer* and predatory fishes is the result of predation by fishes on *P. crucifer* eggs, larvae, or adults, or is the result of avoidance behavior by adult *P. crucifer* is unknown.

On 3 Feb 2004, I removed a Redfin Pickerel (*Esox americanus*; 13 cm TL) from a minnow trap set in a 0.2-ha isolated wetland on Moody Air Force Base, Lanier County, Georgia USA. A distended gut indicated that the fish had recently eaten. Upon dissection, I removed an adult male *P. crucifer* from the fish. Additional adult *P. crucifer* were captured in minnow traps and in funnel traps set at a drift fence adjacent to the wetland. The capture of amplexed pairs and spent females indicated breeding by *P. crucifer* despite the presence of a suite of predatory fishes (*Centrarchus macropterus*, *Elassoma evergladei*, and *Gambusia holbrooki*, in addition to *Esox*). Dipnetting and minnow trapping in March did not yield any *P. crucifer* larvae, suggesting complete reproductive failure.

The exclusion of certain species of amphibians from wetlands inhabited by predatory fishes has been explained as the result of predation (Knapp et al. 2001. Ecol. Monogr. 71:401–421) or adult avoidance (Hopey and Petranka 1994. Copeia 1994:1023–1025; Binckley and Resetarits 2003. Oikos 102:623–629). My observation of *P. crucifer* breeding with, and being preyed upon by, *E. americanus* suggests *P. crucifer* is excluded from wetlands inhabited by predatory fishes by predation and not by adult avoidance behavior.

Surveys at Moody AFB are supported by the United States Air Force through a contract administered by the Center for Reptile and Amphibian Conservation and Management, Fort Wayne, Indiana, and are authorized by Georgia scientific collection permit 29-WMB-04-147.

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RANA CATESBEIANA (American Bullfrog). **CHYTRIDIOMYCOSIS**. Infection by the chytrid fungus *Batrachochytrium dendrobatidis* has been associated with mass mortality of anuran amphibians in Europe, Latin America, Australia, and North America (Berger et al. 1998. Proc. Nat. Acad. Sci. USA 95:9031–9036; Bosch et al. 2001. Biol. Cons. 97:331–337; Green et al. 2002. Ann. New York Acad. Sci. 969:323–339). As of May 2004, chytridiomycosis has been confirmed in at least 69 species of anurans worldwide (Berger et al. 1999. *In* Campbell [ed.], Declines and Disappearances of Australian Frogs, pp. 23–33. Environment Australia, Canberra; Green et al., *op. cit.*; Speare and Berger. Global distribution of chytridiomycosis in amphibians. http://www.jcu.edu.au/school/phtm/PHTM/frogs/chyglob.htm, 19 March 2004).

Chytridiomycosis has recently been found in native larval and post-metamorphic American Bullfrogs (*Rana catesbeiana*) in southeastern North America (Green et al., *op. cit.*), and in introduced larval bullfrogs in Uruguay, South America (Mazzoni et al. 2003. Emerging Infectious Diseases 9:995–998) and California, USA (G. Fellers and D. Green, unpubl. data). Here, we report chytridiomycosis in an adult bullfrog in western Oregon, USA. To our knowledge, this is the first reported case of chytridiomycosis in a free-living amphibian west of the Cascade Range in the Pacific Northwest.

On 08 Feb 2004, we captured an adult male bullfrog (99 mm SVL, 62 g), near Fern Ridge Reservoir in the southern Willamette Valley (UTM 0472617E, 4878466N; 117 m elev.). The bullfrog had atypical diffuse reddening of the ventral skin. The bullfrog was held alone in a laboratory aquarium for 8 days and was offered live crickets. The bullfrog became increasingly lethargic and was found dead on the ninth day of captivity. It was promptly frozen and mailed to the USGS National Wildlife Health Center for examination. Histological examinations of the ventral skin and toewebs showed mild to moderate numbers of chytrid thalli within keratinized epithelial cells only. Autolysis and freeze artifacts caused sloughing of much epidermis, hence the distribution and intensity of the host response may have been greater than what was detected histologically.

Our observation confirms the presence of *B. dendrobatidis* in the Willamette Valley, Oregon. Several factors suggest that bullfrogs could pose a threat to native amphibians by serving as disease reservoirs or vectors for *B. dendrobatidis* (see Daszak et al. 2003. Diversity and Distributions 9:141–150). Bullfrogs are introduced into at least four continents and are widespread in the lowlands of western North America (Bury and Whelan 1984. USDI Res. Publ. 155. Washington, DC. 23 pp.). Bullfrog farming operations are expanding in Latin America, and trade in bullfrogs is global (Mazzoni et al., *op. cit.*). Most bullfrog larvae overwinter in the Pacific Northwest (Bury and Whelan, *op. cit*.; Nussbaum et al. 1983. Amphibians and Reptiles of the Pacific Northwest. Univ. Idaho Press, Moscow. 332 pp.). Multiple species of overwintering ranid larvae (including *R. catesbeiana*) are known to develop oral

chytridiomycosis (Fellers et al. 2001. Copeia 2001:945–953; Mazzoni et al., *op. cit.*). A protracted larval stage may increase exposure to *B. dendrobatidis* and increase the likelihood of infection compared to single-season larvae (Fellers et al., *op. cit.;* Bosch et al., *op. cit*.). Mortalities among anuran larvae with oral chytridiomycosis have not been reported (Fellers et al., *op. cit.*). However, long-lived larval bullfrogs may serve as year-round reservoirs of *B. dendrobatidis,* and following completion of metamorphosis, may become vectors of the infection without demonstrating clinical signs or exceptional mortality rates (Daszak et al., *op. cit.*; Mazzoni et al., *op. cit.*). Moreover, laboratory experiments using fungal isolates suggest that transmission of *B. dendrobatidis* can occur between congeneric anurans, as well as between urodeles and anurans (Davidson et al. 2003. Copeia 2003:601–607; Nichols et al. 2001. J. Wildl. Dis. 37:1–11). Disease transmission is of particular concern in the Pacific Northwest, where bullfrogs occur sympatrically with native ranid species of concern (e.g., *Rana pretiosa, R. aurora, R. boylii*). We encourage further study of *Batrachochytrium* infection in Bullfrogs in western North America, and reiterate the need for researchers to wash and disinfect field gear between field sites.

The specimen is deposited in the National Wildlife Health Center Archives, #18972. This work was supported by the U.S. Department of Interior, Amphibian Research and Monitoring Initiative. We thank R. B. Bury and R. L. Hoffman for review and the U.S. Army Corps of Engineers for access to the study site. This animal was collected under a Scientific Collecting permit from the Oregon Department of Fish and Wildlife.

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RANA CATESBEIANA (American Bullfrog). **DIET**. Predation on vertebrates by adult American Bullfrogs is well documented (Bury and Whelan 1984. US Fish and Wildlife Serv. Publ. 155. USDI, Washington, DC). A recent literature review of prey items listed eight species of snakes taken as prey (Casper and Hendricks 2005. *In* Lannoo [ed.], Amphibian Declines: The Conservation Status of United States Species, pp. 540–546. Univ. California Press, Berkeley), including one species of rattlesnake, *Crotalus atrox* (Clarkson and DeVos 1986 J. Herpetol. 20:42–49) Herein I report another rattlesnake species (*C. oreganus*) previously undocumented as American Bullfrog prey.

On the evening of 17 May 2004, I collected a male (160 mm SVL, 384 g) and female (160 SVL, 503 g) *R. catesbeiana*, in amplexus, in End-of-the-Line Pond in Santa Clara County, California, USA (37º23'15.042"N, 121º44'51.413"W). The frogs were humanely killed and placed on ice overnight. They were subsequently dissected for stomach content analysis. The stomach of the gravid female contained a nearly intact *C. oreganus* (SVL not available; remaining carcass was 260 mm in length and weighed 12.5 g). This is the second documented case of *R. catesbeiana* eating rattlesnakes with no apparent ill effects.

I thank Mark R. Jennings for advice on processing specimens. Specimens were obtained under California fishing license number 044275-20. The frog and its stomach contents have been accessioned into the permanent collection at the Museum of Vertebrate Zoology, University of California, Berkeley (Accession No. MVZ 13907).

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RANA CHIRICAHUENSIS (Chiricahua Leopard Frog). **REPRODUCTION**. Northern populations of *Rana chiricahuensis* occur along the southern edge of the Colorado Plateau in central and eastern Arizona and western New Mexico in the USA, while southern populations are found in southeastern Arizona, southwestern New Mexico, and in northern Sonora, the Sierra Madre Occidental of Chihuahua, and northern Durango in Mexico (Platz and Mecham 1979. Copeia 1979:383–390). This species is federally listed as threatened in the USA (U.S. Fish and Wildlife Service 2002. Fed. Regist. 67:40790–40811, 13 June 2002), thus additional life history information is important to aid recovery efforts. Winter breeding of northern populations of *R. chiricahuensis* at high elevation sites in Arizona has not been reported previously. Populations of *R. chiricahuensis* inhabiting sites above 1800 m elev. in Arizona and New Mexico were thought to have a short breeding season that spanned June through August (Frost and Platz 1983. Evolution 37:66–78). Data from New Mexico, including observations of egg masses in December and March and young tadpoles in December, January, February, and March, indicate that winter breeding above 1800 m is possible in areas fed by warm springs of 21–28°C (Jennings 1988. Ecological Studies of the Chiricahua Leopard Frog, *Rana chiricahuensis*, in New Mexico. New Mexico Dept. Game and Fish, Santa Fe, New Mexico, 14 pp.; Scott and Jennings 1985. Occas. Pap. Mus. Southwest. Biol. 3:1–21). On 21 Feb 2002 at 1225 h, we discovered two eggs masses in a 0.2 ha spring-fed pond at 2546 m elev. in the Three Forks area of Apache-Sitgreaves National Forest, Apache County, Arizona, USA. Snow still covered the surrounding hillsides and made many forest roads impassible. Thin ice was present along the grassy edges of the pond. The egg masses were 55 cm apart and located on the NE side of the pond. A spring vent, identifiable by a line of gravel and light upwelling of water, ran lengthwise between the two egg masses. The temperature of the water at each egg mass and at the spring vent was 18°C. Water temperature 6 m away from the eggs was 14°C. Air temperature was 15°C. The first egg mass was 8 × 6 × 4 cm and was located 24 cm from the shore in water 5.5 cm deep with the top of the egg mass 1 cm below the water's surface. The second egg mass was 10 × 5 × 4 cm and was 18 cm from the shore in water 6.5 cm deep with the top of the mass at the water's surface. Algae surrounded both egg masses. The embryos of the first and second masses were at Gosner stage 15 and 12. The next day at 1015 h embryos in the first egg mass had reached Gosner stages 16–17 and in the second mass stages 12–14.

On 25 February, we collected a small portion of each egg mass for our captive rearing and release program, which also allowed us to confirm the identity of the resulting metamorphs. The first egg mass had mostly hatched in captivity by 28 February and the

second by 2 March.

We continued to survey for eggs masses that season prior to our normal June start date. In the same area of the pool we found 5 egg masses 2–6 April and 2 masses on 15 May 2002.

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RANA PRETIOSA (Oregon Spotted Frog). **PREDATION**. North American river otters (*Lontra canadensis*) consume varying numbers of amphibians, but a high metabolic rate (Iversen 1972. J. Comp. Physiol. 81:341–344; Brown and Lasiewski 1972. Ecology 53:939–943) coupled with most dietary studies being biased toward gut contents and scats (versus direct observations) has often prevented identifying amphibian prey to species (e.g., Field 1970. Michigan Academician 3:49–58; Greer 1955. Amer. Midl. Nat. 54:299–313; Knudsen and Hale 1968. J. Wildl. Mgmt. 32:89–93; Wilson 1954. J. Wildl. Mgmt. 18:199–207). Even among studies in which prey identification was generally thorough, few amphibians were identified to genus or species (e.g., Lagler and Ostenson 1942. J. Wildl. Mgmt. 6:244–254; Ryder 1955. J. Wildl. Mgmt. 19:497–498; Toweill 1974. J. Wildl. Mgmt. 38:107–111). Scarcity of such data led us to report direct observations of *L. canadensis* predation on the Oregon Spotted Frog (*Rana pretiosa*), from south-central Washington, USA.

We made these observations at Conboy Lake National Wildlife Refuge (CLNWR), Klickitat County (45º55–59'N, 121º15–23'W; elev. 550 m) during the course of a study of *R. pretiosa* (1997–2004). The 1970-ha Conboy Lake wetland complex, 70% of which comprises CLNWR, is a seasonally fluctuating marsh fed by three largely channelized creeks and a series of springs. A mosaic of native sedges (*Carex*) and grasses (especially *Glyceria*), as well as introduced reed canarygrass (*Phalaris arundinacea*) dominate this marsh.

At 1306 h on 28 Feb 2000, CBH and MPH detected a group of five otters in Outlet Creek (the channel which drains the Conboy Lake wetland complex). Weather was sunny with a 7ºC air temperature and a 4ºC water temperature in the creek. When first observed, the otters were ca. 150 m east of the Glenwood-BZ Highway bridge. In the area of observation, Outlet Creek was diked, steep-banked, 6 m wide and 3 m deep. Concealing themselves behind the east bridge barrier, CBH and MPH watched through binoculars as the otters slowly swam toward them. The group would periodically stop and dive in what seemed to be a search of the submerged channel bank and bottom. As the otters approached within 10 m, one surfaced with a large (> 80 mm SVL) Oregon spotted frog in its mouth. Based on its large size and the broad extent (i.e., across the chest) of the orange wash, the frog was probably a female (MPH, unpubl. data). After briefly biting the frog's head, the otter swallowed it whole and dove, and the otter group continued its approach. When ca. 5 m from the bridge, one otter saw CBH and MPH, and immediately gave a series of whistles and grunts. Following the vocalizations, the entire otter group reversed direction and rapidly swam away.

At 1205 h on 5 Sept 2000, CJR observed two *R. pretiosa* (ca. 50 and 65 mm SVL) sitting ca. 20 cm from each other in a large pondweed (*Potamogeton natans*) mat that covered much of the water surface of Bird Creek. At this site (200 m E of Glenwood-BZ Highway), Bird Creek was ca. 1.3 m deep with banks grown to reed canarygrass and scrubby willow (*Salix* sp.), and had a 7.7ºC mid-channel (unvegetated) water temperature. At 1220 h, three adult river otters were observed to surface simultaneously < 3 m from the frogs. The otters submerged and surfaced several times over the next minute until one of them surfaced under the larger of the two spotted frogs, capturing it with a quick movement as the frog attempted to escape. The other frog dove beneath the mat. The otter that made the capture shook its head briefly, the anterior portion of the frog (all but the hind legs) protruding from the its mouth, then dove. The other two otters then noticed CJR, hissed, and also dove. All three resurfaced seconds later 20 m further downstream, the captured frog was no longer visible.

Rana pretiosa is only the fourth ranid frog species that has been unequivocally identified as North American river otter prey; the others are the American Bullfrog (*Rana catesbeiana*: Loranger 1981. Proc. Worldwide Furbearer Conf. 1[1]:599–605; Wilson, *op. cit*.), Green Frog (*Rana clamitans*; Ryder, *op. cit*.), and Northern Leopard Frog (*Rana pipiens*; Ryder, *op. cit*.). Oregon Spotted Frogs are highly aquatic (i.e., nearly all breeding, non-breeding active-season, and overwintering activities occur in aquatic habitat; Watson et al. 2003. J. Herpetol. 37:292–300; JDE, MPH, unpubl. data), so significant opportunities exist for the highly aquatic *L. canadensis* (Melquist and Hornocker 1983. Wildl. Monogr. 83:1–60) to prey on *R. pretiosa*. Moreover, drought or late summer conditions may increase vulnerability to otter predation at CLNWR as aquatic habitats largely recede to the channelized creeks and their diversion ditches. Some Oregon Spotted Frogs also overwinter in these structure-limited channels (JDE, MPH, unpubl. data), locations that may make them vulnerable to the river otter's aquatic-edge foraging mode (Melquist and Hornocker, *op. cit*.).

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RANA PRETIOSA (Oregon Spotted Frog). **AGGREGATION AND HABITAT USE**. Adult ranid frogs in western North America

generally disperse after spring breeding, and reports of aggregations after breeding season are limited (see Pope and Matthews 2001. Copeia 2001:787–793; Pilliod et al. 2002. Can. J. Zool. 80:1849–1862; Bulger et al. 2003. Biol. Cons. 110:85–95). As our literature search yielded no direct observations of aggregations of Oregon Spotted Frogs (*Rana pretiosa*), we report an early fall aggregation of adult *R. pretiosa* at Penn Lake (UTM 586800 E, 4866800 N; elev. 1445 m) in the Cascade Mountains, Oregon, USA.

At 1500 h on 20 Sept 2002 (air temp. ca. 20°C), we observed an adult *R. pretiosa* in shallow water dive beneath the edge of a large, flat boulder (2m × 1m × 0.4m). We lifted the boulder to find 9 adult male *R. pretiosa* (mean SVL 67.8 mm; range 59–74 mm) between underlying cobbles in water 5–20 cm deep. The boulder was located in a ca. 25 m-wide bay that receives the 2 main inflows in Penn Lake. The boulder was located ca. 5 m from the larger of these two inflows; heavy discharges during late-spring snowmelt keep the substrate around this main inflow clear of sediment and vegetation. The cobble/boulder substrate at this inflow represents < 2% (< 900 m^2) of the surface area of Penn Lake, and contrasts strongly with the organic sediments and heavy emergent vegetation in littoral zones around the rest of the 8.9-hectare lake. This is our first observation of aggregated *R. pretiosa* in >100 person-hours over 7 years of summer surveys at Penn Lake. During surveys at this and other *R. pretiosa* sites in the central Oregon Cascades, we typically find *R. pretiosa* adults occurring singly in or near warm, vegetated, shallows with flocculent substrate, which is used by frogs as escape cover (Licht 1986. Amer. Midl. Nat. 115:239–247).

The late-September timing of this observation, the atypical habitat, and the proximity of this aggregation to features sought by other ranids as overwintering sites (rock crevices, inflow streams, and associated springs) suggest that these Oregon Spotted Frogs were moving toward or were already in an overwintering location. Little is known of the overwintering habits of *R. pretiosa* (Watson et al. 2003. J. Herpetol. 37:292–300).

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SCINAX NASICUS (Lesser Snouted Treefrog). **PREDATION**. Birds are important predators on amphibians (Duellmann and Trueb 1994. Biology of Amphibians. Johns Hopkins, Baltimore. 670 pp.). *Scinax nasicus* is a small hylid that occurs in Paraguay, northern Argentina (south to Buenos Aires province), Uruguay, eastern Bolivia, and southern Brazil along the drainages of the Paraná and Paraguai Rivers (Frost 2002. Amphibian Species of the World: An online reference V2.21). On 27 Sep 2003 at ca. 0850 h I found an adult *Scinax nasicus* being preyed upon by a Great Kiskadee (*Pitangus sulphuratus*) along a fence in the Brazilian Pantanal, Nhumirim Ranch (18º59'S, 56º40'W), Mato Grosso do Sul State. The bird held the frog in its beak, and struck the frog on the fence until it was dead. The bird then swallowed the frog and flew away. *Scinax nasicus* sometimes vocalizes during the day, which might expose it to diurnal predators.

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SCINAX RUBER (Red Snouted Treefrog). **ARBOREALITY AND PARACHUTING**. Aerial descent in anurans occurs as both gliding and parachuting. Gliding is aerial descent at an angle <45° to the horizontal whereas parachuting is descent at >45° to the horizontal. Parachuting is known in several anurans including *Rhacophorus*, *Agalychnis*, and *Eleutherodactylus coqui* (Emerson and Koehl 1990. Evolution 44:1931–1946; Roberts 1994. J. Herpetol. 28:193–199; Stewart 1985. J. Herpetol. 19:391–401, and references therein), and it is suspected that many arboreal frogs may be capable of parachuting (Stewart 1985, *op. cit.*). Here we report on arboreal activity and parachuting in *Scinax ruber* from Gamboa, Panama.

Males of *S. ruber* call from the ground or low vegetation, and individuals and amplectant pairs can be found in shrubs and small trees. Arboreal activity at greater heights has not been reported although it is suspected (Ibañez et al. 1999. The Amphibians of Barro Colorado Nature Monument, Soberania National Park and Adjacent Areas. Editorial Mizrachi and Pujol, Panama. 192 pp.). Between 8–11 Aug 2004, we observed at least 20 *S. ruber*, including males and females, on the Gamboa Rainforest Resort Canopy Tower at heights up to 25 m, which is the top of the canopy. When approached or subsequent to a gentle touch, individuals jumped from the tower and descended to the ground, nearby vegetation, or to lower portions of the tower. Aerial descent was controlled and at angles >45°, which classifies it as parachuting.

On 8 Aug 2004 between 2200–2300 h, we observed eight *S. ruber* on the canopy tower. We returned the following night between 2325–0030 h (24.8°C at 25 m height) and observed 20 *S. ruber* of which 16 were captured and sexed. Aerial descents of these 16 individuals were observed, and we recorded the height at which each frog was found and the landing height to determine the vertical descent distance and also recorded the landing substrate (Table 1). Seven males, seven females, and two individuals of unknown sex were found. The average height at which individuals were found was 21.26 ± SE 1.01 m and the average vertical distance descended was 15.03 ± 1.63 m. Six of the females were gravid with eggs visible through the skin.

On 10 Aug between 2045–2115 h, ten *S. ruber* were observed on the canopy tower and another individual was observed in the top of a young palm 13.59 m from the ground. On 11 Aug between 1945–2030 h, 6 individuals were observed on the tower. These were weighed; two gravid females weighed 3.75 and 4.8 g while the four males weighed 2.5, 2.75, 3.35, and 4.15 g. Previous individuals observed appeared to be of similar sizes, and all ap-

peared to be adults. Only one non-gravid female was found on the tower throughout the four observations. Although males with vocal sacs were observed in the tower, we did not detect any calling activity. Among all descents observed between 8–11 Aug (N = 44), the maximum horizontal distance covered was ca. 7 m, but most descents resulted in less than 4 m of horizontal travel. Two individuals that originally descending with their heads away from the tower rotated 180° to land lower on the tower. One of these traveled ca. 1 m out from the tower before rotating and returning to the tower. Another frog turned ca. 130° and landed on a palm. Other individuals either turned smaller amounts or did not turn before landing on the ground, tower, or nearby vegetation.

While parachuting, individuals held their arms and legs lateral to the body, bent, and partially extended. Fingers and toes were spread. This is a common posture in frogs capable of aerial descent (Emerson and Koehl, *op. cit.*). Gliding frogs typically have enlarged hands and feet with extensive webbing between digits and accessory skin flaps on the limbs (Emerson and Koehl, *op. cit.*). *Scinax ruber* lack these characters and only have moderately webbed feet with reduced webbing between the first and second toes and only basal webbing on the hands (Ibañez et al. *op. cit.*). Unlike in the parachuting frogs examined by Emerson and Koehl (*op. cit.*), however, *S. ruber* is capable of turning during descent. These observations confirm the suspicions of arboreal activity in *S. ruber* and demonstrate their capabilities for aerial descent via parachuting.

We thank Stan Rand for his support, Jim McGuire for comments on parachuting behavior, Karin Akre and Andrés Vargas for field assistance, and the Gamboa Rainforest Resort for access to the tower. These observations were possible due to the support of a NSF grant (No. 0078150) for studies of *Physalaemus pustulosus* in the same area.

TABLE 1. Sex, height observed, descent distance, and landing substrate of 16 *Scinax ruber*. Asterisks denote gravid females. Individual 5 turned ca. 90° around a corner of the tower, landing among several tree branches before we could accurately observe the landing height.

	Sex	Height found (m)	Descent distance (m)	Landing substrate
1	M	24.90	24.9	ground
2	M	24.90	21.4	vegetation
3	F*	24.90	24.9	ground
4	U	24.90	9.15	vegetation
5	U	24.90	N/A	vegetation
6	F*	24.0	11.23	vegetation
7	F*	23.4	11.47	vegetation
8	M	22.43	12.03	vegetation
9	M	21.9	9.29	vegetation
10	F*	21.4	21.4	ground
11	F*	20.04	19.5	vegetation
12	M	20.04	11.3	vegetation
13	M	17.25	16.75	vegetation
14	M	16.25	16.25	ground
15	F	15.0	3.52	tower
16	F*	12.37	12.37	ground

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SPEA HAMMONDII (Western Spadefoot). **REPRODUCTION**. *Spea hammondii* is restricted to semi-arid regions characterized by great variation in the amount, timing, and duration of rainfall, between and among years. Breeding activity of *S. hammondii* is closely associated with rainfall events and the availability of ephemeral pools (Jennings and Hayes 1994. Amphibian and Reptile Species of Special Concern in California. California Dept. Fish Game. Final Report Contract No. 8023. 94 pp.). Breeding has been reported to take place from January through May (Storer 1925. Univ. California Publ. Zool. 27:153–163; Brown 1976. Contrib. Sci. Los Angeles Co. Mus. Nat. Hist. 286:11; Stebbins 2003. Western Reptiles and Amphibians, 3rd. ed. Houghton Mifflin Co., Boston).

On 26 and 28 Dec 1996, SVC and ELE, observed *S. hammondii* larvae (ca. 4–10 mm TL) in an unshaded ephemeral pool that had formed in a road rut (3 m × 1 m, 15 cm deep) on a mesa dominated by a sage scrub/mixed grassland vegetation community at Mission Trails Regional Park, San Diego County, California, USA (32°50'86"N, 117°04'13"W, 248 m elev.).

On 30 Dec 1996, ELE observed *S. hammondii* larvae (ca. 13–15 mm TL) in an unshaded ephemeral pool that had formed in a road rut (5 m × 1 m, 20 cm deep) on a mesa dominated by chamise chaparral, University City, San Diego County (32°52'07"N, 117°11'43"W, 114 m elev.).

On 10 Nov 2002, ELE observed *S. hammondii* egg masses (N = 43) in an unshaded ephemeral pool that formed in a road rut (11 m × 2.5 m, 25 cm deep) surrounded by grassland at Mesa Del Arroz Preserve, Alpine, San Diego County (32°49'260"N, 116°45'076"W, 600 m elev.). An egg mass consisting of 22 egg capsules (Gosner stages 1–3) was collected and deposited in the herpetological collection of the California Academy of Science (CAS 226121).

On 9 Nov 2002, ELE observed *S. hammondii* egg masses (N = 26) in an unshaded vernal pool (3 m × 1 m, 15 cm deep) on the same mesa (as mentioned above) at Mission Trails Regional Park, San Diego County (32°50'159"N, 117°04'269"W, 255 m elev.). An egg mass consisting of 10 egg capsules (Gosner stages 8–9) was collected (CAS 226120). On 21 Nov. 2002, CDS and ELE salvaged 63 larvae from the same pool because the pool was in the final stages of drying (0.3 m diameter, 3 cm deep) as a result of evaporation and lack of additional precipitation (14–16 mm TL, Gosner stage 25) (CAS 226122–123). The pool had dried by 22 Nov. prior to any larvae successfully metamorphosing, resulting in 100% mortality. The pool refilled in late Nov due to rainshowers and on 8 Dec *S. hammondii* larvae (ca. 5–8 mm TL) were observed. During subsequent visits the pool was again drying prior to the metamorphosis of the larvae. On 24 Jan 2003, CDS and ELE found no surface water and clusters of dead *S. hammondii* larvae (~1800) in the wet mud of the pool basin. Approximately 200 of these slightly desiccated larvae were collected (19–33 mm TL, Gosner stages 25–30).

In the same vernal pool described above, CDS and ELE observed *S. hammondii* egg masses (N = 33) on 22 and 24 Oct 2004.

On 24 Oct the embryos within the majority of egg clusters were motile indicating that they were in the final stages of development prior to emergence from their egg capsules. Using back calculation, the spawn was determined to be six days old, based on the stage of development and the rate of development, with the approximate daytime high for the last six days at ca. 24°C. It was determined that breeding occurred on 17–18 Oct, in response to the first measurable rainfall received in this region in 181 days (April–Oct 2004). This extended period of time without rain, tied the previous record set in 2003 for a rainless period for San Diego County since record keeping began in 1850 (National Weather Service).

We have documented *S. hammondii* breeding in Dec in 1996, Nov and Dec in 2002, and Oct in 2004. In an extended literature search, we determined that these observations reported herein appear to be the earliest breeding records reported for *S. hammondii*. Additional records for *S. hammondii* larvae (ca. 10–12 mm) occurring in January include observations made in vernal pools in Carmel Mountain Preserve in 2003 and 2004 (32°43'17"N, 116°56'56" W, 95 m elev.) and in a road rut in the San Diego National Wildlife Refuge in 2003 (32°43'17"N, 116°56'56"W, 95 m elev.), San Diego County, by Carlton Rochester and Pete Famolaro.

We thank Norm Scott and Kathie Meyer for providing comments and Jens Vindum of California Academy of Sciences for providing museum numbers. Thanks to Naomi Ervin and Tim Cass for their field assistance. *Spea hammondii* egg masses and larvae were collected under California Department of Fish and Game Permit 5399. Larvae were collected from Mission Trails Regional Park under the authority of Paul Kilburg, Senior Park Ranger.

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TESTUDINES

CHELYDRA SERPENTINA SERPENTINA (Common Snapping Turtle). **FLATULENCE**. On 19 June 2004 at ca. 1100 h, a female *Chelydra serpentina* (263 mm carapace length, 205 mm plastron length, 4082 g) was captured from an oxbow of Muddy Creek (0.30 ha mean surface area) at the Blue Grass Army Depot, Madison County, Kentucky (N37°42'15.5", W84°12'50.4"). As measurements were being taken of the animal, it released an audible gaseous discharge from its cloaca, accompanied by an unpleasant odor. No fluid was released during the discharge, but the sound it made was comparable to that of the characteristic hiss often given by this species when threatened. The odor was different from the typical musky odor released by this species, but was of equal severity. This behavior was accompanied by commonly-observed defensive behaviors in *C. serpentina*: snapping, gaping, hissing, and clawing (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Inst. Press, Washington, D.C.). The turtle was marked and released, and was not recaptured during subsequent trapping.

Flatulence in this case may have resulted from one of several factors. It may have been a displacement behavior, much like penis extrusion, which is often observed when male *C. serpentina* are handled (de Solla et al. 2001. Chelon. Cons. Biol. 4:187–189, pers. obs.). It may have been an intentional alternative to releasing musk, indicating a defensive behavior. Or the turtle may have had excess gas production due to something that it ingested. Such gas may have been released because of muscle contractions associated with the stress of handling, or because of a change in the pressure of internal organs on the intestines due to the position in which the turtle was held, or the gas release may have been coincidental with the time of capture. This apparently represents the first published account of flatulence in *C. serpentina*.

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CHRYSEMYS PICTA PICTA (Eastern Painted Turtle). **PREDATION.** On 22 January 2005, KED et al. found desiccated remains of a juvenile *Chrysemys picta picta* inside a Wood Duck nest box (Yates Millpond, ca. 6.8 km N of McCullers [35º43'07"N, 78º41'11"W], Wake County, North Carolina, USA) that was occupied by an adult Eastern Screech-owl (*Otus asio*). The turtle measured 51 mm in carapace length and 47 mm in carapace width. Scratches were present on the plastron and the left hind foot was missing, strongly suggesting predation by the owl. The head and remaining limbs were essentially intact.

Several raptor species have been reported as occasional predators of *C. picta* and other turtles (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Institution Press. Washington, DC. 578 pp.). Browne (2002. Herpetol. Rev. 33:132) reported an attack on a juvenile *C. p. picta* by a northern harrier. Reports of owls taking turtles as prey are relatively few (Johnsgard 1988. North American Owls. Smithsonian Institution Press. Washington, DC. 295 pp.). To our knowledge, this represents the first report of predation on *C. picta* by a screech-owl.

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GLYPTEMYS (= CLEMMYS) MUHLENBERGII (Bog Turtle). **FECUNDITY.** On 12 June 2003, while surveying two populations of Bog Turtles, *Glyptemys (Clemmys) muhlenbergii*, with New York State Department of Environmental Conservation personnel, 21 turtles were located. Of these, 18 (85.7%) were of the 7–13 yr old cohort, which is much higher than what would have been expected. This age group cohort coincides with the rabies epidemic which reached this area of Dutchess County, New York in 1990 (www.dec.state.ny.us/website). On 6 May 2004, these two populations were again surveyed and two additional populations close by were also surveyed. Of the 20 located turtles, 12 were

new turtles (not recaptures); of these, 11 (91.7%) were of the 7–13 yr old cohort.

It is inviting to speculate that the higher than expected cohort density of *G. muhlenbergii* might reflect reduced predation of turtles and eggs by mammalian predators such as Raccoon (*Procyon lotor*), Striped Skunk (*Mephitis mephitis*), foxes (*Vulpes fulva* and *Urocyon cinereoargenteus*), and Coyote (*Canis latrans*), as the number of these predators has been reduced because of a reduction of numbers in their populations from the rabies virus. Hypothetically this would increase turtle recruitment and yield skewed population dynamics similar to our findings.

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GLYPTEMYS INSCULPTA (North American Wood Turtle). **TERRESTRIAL MOVEMENT.** Although long distance travel along waterways by *Glyptemys insculpta* has been reported (Quinn and Tate 1991. J. Herpetol. 25:220–222), published accounts indicate that terrestrial movement is conservative and within 150–300 m of the watercourse (Harding and Bloomer 1979. Bull. New York Herpetol. Soc. 15[1]:9–26; Arvisais et al. 2002. Can. J. Zool. 80:402–408; Tuttle and Carroll 2003. Chelonian Cons. Biol. 4:656–663). In 2000–2002, we radio-tracked *G. insculpta* in three Delaware River tributaries in Delaware Water Gap National Recreation Area. The longest axes of movements were observed to be 200–600 m and similar to those previously reported within the study region (Kaufmann 1995. Copeia 1995:22–27). In the populations studied, terrestrial movements were typically within the bounds of the aforementioned studies except for those of pre-nesting females which we observed to move randomly > 600 m an evening, while searching for nesting sites in agricultural fields.

The long-range terrestrial movement of one of our females is especially notable. This turtle (CL = 177 mm; 810 g; missing LF foot) was first captured and shell notched on 2 May 2000 in a stream (122 m elev.) ca. 400 m from its confluence with the Delaware River. Subsequently, this turtle was recaptured five times near the original capture site and then was radio-tagged in April 2002 and followed weekly. On 4 June 2002, the turtle was relocated 373 m from its previous streamside capture point in an upland meadow. Despite an exhaustive search, the signal was not heard again. On 8 June 2004, the female was recaptured at the edge of a marsh (213 m elev.) in the headwaters of a different stream system on private property 3.9 km SSE of the original capture site. Second growth woodlands, old fields, a highway, and pocket marshlands are found between the previous capture points and the 2004 recapture point. The female was palpated and determined to be gravid and assumed to be searching for a nesting site. This is a possible example of gene flow promotion between different populations (Kiester et al. 1982. Evolution 36:617–619).

We appreciate the assistance of radio-trackers Melissa Stepek and Stanley Boder. We too thank Tony Gonzalas for examining the turtle and the long-dead transmitter affixed to its shell, deciphering the information on its face, and contacting the investigators. The study was completed under National Park Service/Wildlife Conservation Society Cooperative Agreement with special assistance provided by Jeffrey Shreiner.

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GLYPTEMYS INSCULPTA (North American Wood Turtle). **NEST INVADING PLANTS.** The failure of *Malaclemys terrapin* nests as a consequence of beachgrass (*Ammophilia breviligulae*) root encapsulation of eggs is well known (Lazell and Auger 1981. Copeia 1981:723–724; Stegmann et al. 1988. Can. J. Bot. 66: 714–718). Although plant species were not identified, root encapsulation was also reported to cause partial failure of *Emydoidea blandingii* nests (Congdon et al. 2000. Chel. Cons. Biol. 3[4]:569–579). And, sea oats (*Uniola paniculata*) has been implicated in the loss of 5.3% of the eggs of a Loggerhead Seaturtle (*Caretta caretta*) population (Caldwell 1959. *In* Caldwell and Carr. Bull. Florida State Mus., Biol. Sci. 4:319–348). In this last instance, the eggs were described as desiccated, with eroded shells, and invaded by roots in some cases. In 2001–2002, we studied the nesting habits of female *Glyptemys insculpta* in cornfields along the Delaware River in Warren County, New Jersey. Thirty-one nests were located and monitored. Of these, plants invaded two nests. In the first case, the roots of smooth crabgrass (*Digitaria ischaemum*) completely filled the nest chamber and enveloped all 7 eggs in the clutch. The roots of carpetweed (*Mollugo verticillata*) encapsulated 3 of 4 eggs in a second nest. One hatchling *G. insculpta* successfully emerged from the second nest. In both cases the encapsulated eggs were completely desiccated, badly eroded, and invaded by rootlets. It was not possible to determine if the eggs in these clutches were fertile, but 4% of the 228 eggs in the 31 nests were affected by root encapsulation. This observation represents another example of turtle nest invasion by plants. This mortality factor may be more significant than the current literature suggests.

We thank Daniel Atha of the New York Botanical Gardens for assistance in identifying the plant species. The study was completed under National Park Service/Wildlife Conservation Society Cooperative Agreement with special assistance provided by Jeffrey Shreiner and Larry Hilaire.

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GLYPTEMYS INSCULPTA (North American Wood Turtle). **ATYPICAL SCUTES AND ANOPHTHALMIA.** Atypical scute formation in chelonians is a commonly reported anomaly. Of 2,220 turtle specimens examined in the Chicago Field Museum, 43% had anomalous scute arrangements (Zangerl and Johnson 1957. Fieldiana: Geology 10:341–362). The majority of these arrangements had either more or fewer scutes than the standard number.

In a series of 243 *Malaclemys terrapin* specimens examined (Coker 1910. J. Morphol. 21:1–75), 24% had more or fewer scutes than normal. Aside from scute irregularities, abnormalities of the head, including anophthalmia (eyelessness), are the most numerous terata evident among advanced turtle embryos incubated under laboratory conditions (Ewert 1979. *In* Harless and Morlock [eds.], Turtles: Perspectives and Research, pp. 333–413. John Wiley and Sons, New York). Anophthalmia however does not seem to be a common phenomenon among wild turtles (Mausolf and Wunder 1974. Copeia 1974:548–550). Presumably this condition would negatively affect hatchling survival in the wild, whereas scute irregularities are not considered lethal. In 2001–2002, we studied nesting success of *Glyptemys insculpta* in cornfields along the Delaware River in Warren County, New Jersey. Ninety-two hatchlings from 20 nests, as well as 12 hatchlings found in the agricultural fields during the study, were examined for developmental abnormalities.

Irregularities in carapacial scute formation and arrangement were observed in seven individuals (6.7% of specimens). Of these, three exhibited a reduction in marginal scutes (11 right or left instead of 12) and one exhibited a supernumerary (13 right) marginal scute. Of the others, the fourth left costal scute extended between the fourth and fifth vertebrals in one individual, another exhibited "dovetail syndrome" (Ewert 1979, *op. cit.*) with eight vertebrals, and the last individual emerged with the fourth neural bone exposed. Additionally, an anophthalmic hatchling, of normal size and shell conformation, was found. Facial and maxillary bones were reduced and pinched. Eye-slits were not present, and the globes and bony elements that normally support them were missing. This individual displayed no visual ability. Although not previously reported in wild specimens, anophthalmia has been reported in *G. insculpta* that were hatched from eggs incubated under laboratory conditions (Ewert 1979, *op. cit.*).

It appears that the external abnormalities we observed are comparable to those reported elsewhere for turtle hatchlings associated with natural nests (Walde 1998. Unpubl. Ph.D. dissertation, McGill University, Quebec; Standing et al. 2000. Chelonian Cons. Biol. 3:661–664). Abnormalities in hatchling composition are most often attributed to thermal and hydric stressors present during incubation (Gutzke et al. 1987. Herpetologica 43:393–404). However, the hatchlings noted here emerged from nests located in agricultural fields that have been farmed for hundreds of years and exposed to various pesticides and fertilizers over the past century; thus a hypothetical relationship between external anomalies and chemical exposure would be a worthy topic for future research.

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KINOSTERNON SONORIENSE (Sonoran Mud Turtle). **DIET.** Hulse (1974. J. Herpetol. 8:195–199) concluded from an examination of stomach contents that *Kinosternon sonoriense* was an opportunistic carnivore that fed mainly on invertebrates, though plants, fish, and ranid frogs were occasionally eaten. Ligon and Stone (2003. Herpetol. Rev. 34:241–242) reported two observations of *K. sonoriense* feeding on adult *Bufo punctatus*. Here, we add a reptile and a bird to the list of dietary items consumed by *K. sonoriense*. Both observations were made in small pools in the Peloncillo Mountains, Hidalgo Co., New Mexico (USA), in the same canyon as the observations reported by Ligon and Stone (*op. cit*.).

On 7 August 2004, at ca. 1000 h, we observed an adult female *K. sonoriense* (101.7 mm midline carapace length [MCL], 151 g) capture and kill a Black-necked Gartersnake (*Thamnophis cyrtopsis*, 348 mm SVL, 23.3 g). The observation began when we noticed splashing in a pool (ca. 12 m^2 area, ca. 10 cm deep) beside the trail. When first observed, the turtle's jaws held the snake by the neck, ca. 10 cm behind the snake's head. During the first 10 sec of the encounter, the snake attempted to bite the turtle on the carapace at least twice. Within two minutes, the snake was dead and the turtle was eating the snake. At this point the turtle appeared to notice us and released the snake, moving away from us toward the edge of the pool. We then captured and measured the turtle and collected the snake. The skin had been stripped off the dead snake from the point where the turtle had grasped the snake forward to the head, and there was a large piece of neck muscle missing. We released the turtle and deposited the snake in the University of Central Oklahoma Collection of Vertebrates (UCO 1001).

On 10 August 2004, at ca. 1800 h, we encountered an adult male *K. sonoriense* (114.5 mm MCL, 169 g) in a small pool (ca. 1 m^2 area, ca. 15 cm deep) with a dead Mockingbird (*Mimus polyglottos*). The intact, feathered head and wings of the bird were floating on the water surface. Below the water surface was the bird's skeleton, which had been picked nearly clean of soft tissue. The turtle had bird flesh on its face and foreclaws. After we identified the turtle, we photographed the bird and observed the turtle feeding on scraps of the bird that had settled to the bottom of the pool. We do not know how the bird died and are uncertain as to whether our observation involved predation or scavenging.

Mud turtles are common in shallow pools in our study area (Stone 2001. Southwest. Nat. 46:41–53). The obvious benefits of inhabiting these pools include hydration and opportunities to eat invertebrates, which are common in pools. Our observations, coupled with those of Ligon and Stone (*op. cit.*), suggest that pools might provide opportunities for mud turtles to eat relatively large vertebrates, and that vertebrates might be more important to the diet of *K. sonoriense* than previously thought.

We thank J. Hellack and W. Radke for identifying the bird from photographs. We thank the College of Graduate Studies & Research at the University of Central Oklahoma for financial support. This study was conducted under permits issued by the New Mexico Department of Game and Fish (Permit #2905) and the U.S. Forest Service (Authorization ID: SUP0080).

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MACROCHELYS TEMMINCKII (Alligator Snapping Turtle). **DIET**. Feces from a male *M. temminckii* (52 cm carapace length

[CL]; 55.9 kg) captured by L. Allen and M. Lepori in the Trinity River off Collins Avenue (#157), 3.0 miles N of I-30, in Arlington, Tarrant Co., Texas (USA) on 28 September 1993, were collected over the week after capture, and the vertebrate components were sorted and identified. This sample included skeletal and scute elements from one juvenile Red-eared Slider (*Trachemys scripta*) (estimated carapace length = 145 mm), shell elements of a juvenile Spiny Softshell (*Apalone spinifera*) (estimated CL = 15 cm), and three unrelated items made of black rubber. A few additional bony elements of these turtle species may have represented additional individuals.

Although turtles (including *T. scripta*) have previously been reported in the diet of *M. temminckii* (Sloan et al. 1996. Chelon. Conserv. Biol. 2[1]:96–99, and references therein), this report represents the first record for a softshell turtle and documents the ingestion of inanimate objects. Furthermore, the presence of three different items made of rubber suggests that they were obtained by active foraging. This supports the hypothesis (e.g., Spindel et al. 1987. J. Morphol. 194:287–301) that large Alligator Snapping Turtles will seek food by active foraging in addition to lingual luring.

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PALEA STEINDACHNERI (Wattle-necked Softshell). **SIZE.** The published record straight line carapace length (SCL) for the Asian softshell turtle, *Palea steindachneri*, is 42.6 cm (Ernst and Barbour 1989. Turtles of the World. Smithsonian Institution Press, Washington, D.C., 313 pp.).

Two very large softshell turtles were found alive in an alley near the establishments of dealers in turtle and snake meat inside the city of Hong Kong, and brought to the junior author for identification. Each had the clusters of wattles at the base of the neck unique to *P. steindachneri* (Ernst and Barbour 1989, *op. cit.*). Both turtles weighed 25.4 kg when first received (one alive, one dead). The larger of the two exceeds the reported record length of the species with a SCL of 44.5 cm. Other measurements of this individual are: greatest carapace width, 40.8 cm; shell depth at the level of the forelimbs, 13.0 cm; total length (tip of snout to tip of tail), 86.0 cm; plastron length, 30.5 cm; plastron width at the bridge, 38.0 cm; bridge length, 7.0 cm; dorsal length of the stretched head and neck, 28.0 cm; greatest head width, 13.5 cm; mandibular length, 11.0 cm; neck length from occiput to anterior rim of carapace, 11.0 cm; total tail length, 7.6 cm; and basal tail width, 6.5 cm. Although not sexed, the size of the turtle probably indicates that it is a female. The specimens are in the collection of the junior author.

Palea steindachneri ranges naturally in China from Guandong and Guangxi provinces westward to Yunnan and Guizhou provinces, and also on Hong Kong and Hainan islands (Zhao and Adler 1993. Herpetology of China. SSAR Contributions to Herpetology 10). On Hong Kong Island, it occurs at the Byewash Reservoir of the Kowloon Reservoirs Group (Karsen et al. 1986. Hong Kong Amphibians and Reptiles. Urban Council Publications, Hong Kong, 136 pp.), but these two turtles were probably brought to the city from the mainland of China to be sold in the markets, and then escaped. It is unfortunate that the origin of the two *P. steindachneri* is unknown.

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PSEUDEMYS GORZUGI (Rio Grande River Cooter). **RETICULATE MELANISM.** Increasing melanistic pigmentation with aging is well known in deirocheline turtles, particularly male *Trachemys scripta* and some *Pseudemys* (Ernst et al. 1994. Turtles of the United States and Canada, Smithsonian Inst.). However, reticulate melanism (RM), a netlike or vermiculate pattern of black markings that replaces the normal carapacial markings, has only been described in two subspecies of *Chrysemys* (Ernst et al., *op. cit*.; Smith et al. 1969. J. Herpetol. 3:173–176; Ultsch 1999. Herpetol. Rev. 30:225). Here, we report the occurrence of this pattern in *P. gorzugi*.

Though termed as a type of melanism, RM is not similar to the melanism reported in *Trachemys* (Tucker et al. 1995. J. Herpetol. 29:291–296). In *Trachemys*, melanism results in an almost completely black coloring of the carapace and significant darkening of the plastron. We completed extensive surveys of the turtle fauna in the Pecos and Devils River drainages of Texas from 2001–2005. During that study we documented RM in *P. gorzugi*, similar to the pattern reported in *Chrysemys*, with retention of the red carapacial coloration but with the pattern significantly broken by the invasion of black vermiculations. The marginal scutes of the plastron exhibit the same color change pattern but the central plastral scutes do not darken.

The pattern changes seen in *P. gorzugi* appear to be correlated with the age and sex of the specimen. Thus far, we have observed this pattern only in large adult males. In fact, this size-correlated color pattern change has only been observed in the largest 15% of the adult males encountered (N = 124, mean carapace length = 20.0 cm, SD = 5.0). Based on these values, males with carapace lengths at least one standard deviation greater than the mean, in this case, those males with carapace lengths ≥ 25.0 cm, display evidence of these changes in phenotype.

Reticulate melanism has not, to our knowledge, been reported in any other species of *Pseudemys*. In the hundreds of individuals of *P. texana* collected from Spring Lake (TSU Dept. of Biology survey data) and the San Marcos River (Caldwell and Hays counties, Texas; MRJF survey data), none of the specimens show evidence of this color pattern change. Thus, RM observed in large adult male *P. gorzugi* could indeed be a unique trait that further supports the monophyly of the species.

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STERNOTHERUS ODORATUS (Common Musk Turtle). **CLUTCH SIZE**. Typical clutch sizes in *Sternotherus odoratus* range from 1 to 9 eggs (Ernst et al. Turtles of the United States and Canada. Smithsonian Inst. Press, Washington and London. 578 pp.) and in the Jersey and Calhoun county populations in Illinois the clutch size averages 5.8 eggs (Tucker 1999. Bull. Maryland Herpetol. Soc. 35(3):61–75). On 11 May 2003, a gravid female *S. odoratus* (130 mm carapace length, 85 mm carapace width, 57 mm carapace height, 98 mm plastron length, and a gravid mass of 370 g) was collected crossing IL Rt 100 near Grafton, Illinois in Jersey County. Oviposition was induced via intramuscular oxytocin injection (Ewert and Legler 1978. Herpetologica 34:314–318). This female produced 13 eggs, exceeding all previous reports for this species from any population. The eggs averaged 4.06 g in mass, 26.1mm in length, and 15.9 mm in width. These eggs were incubated in vermiculite at ambient environmental temperatures and hatched between 24–26 August 2003. *Sternotherus odoratus* is suspected of communal nesting with more than one turtle laying their eggs in the same place (Ernst et al. 1994, *op. cit.*) Intermingling of separate clutches from more than one individual is possible and might obscure field observations of clutch size. The laboratory induction of oviposition eliminates this bias.

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STERNOTHERUS ODORATUS (Common Musk Turtle) **SIZE and REPRODUCTION**. The seminal work of Tinkle (1961. Ecology 42:68–76) on clinal variation in turtle reproduction addressed *S. odoratus*, and subsequent study showed that local variation could distort putative geographic patterns (e.g., Gibbons. 1970. Can. J. Zool. 48:881–885). Local variation in the reproduction of *S. odoratus* occurred in Indiana (Clark 2000. Unpubl. Ph.D. Thesis, Indiana University, Bloomington). This note documents maximum sizes of three natural history parameters for *S. odoratus* from three geographically separated fish farms. These farms consisted of many adjacent shallow (~0.5–1 m deep) ponds that were drained and refilled asynchronously. Most data came through oxytocin-induced oviposition or dissection.

The largest turtle (CM 154456; measurements in mm: 150 Mx CL, 125 Mx PL, 103 CW, 66 SH; 626 g live mass, nongravid female) came from a goldfish farm (Indiana, Morgan Co., Grassyfork Hatchery, 39.47°N, 86.36°W, 27 May 1993, collected by J. M. Capler and M. A. Ewert). The mid-dorsum of the carapace was slightly depressed relative to its immediately lateral curvature. The head had bold, bright stripes typical of young adult *S. odoratus*. The carapace length of this individual exceeded the published record of 137 mm (Conant and Collins 1991. A Field Guide to Reptiles and Amphibians: Eastern and Central North America [3rd ed.], Houghton-Mifflin, Boston).

Table 1 lists 11 clutches (from Indiana, *op. cit.*; another goldfish farm, Alabama, Marshall Co., Big Spring Farm, 34.22°N, 86.41°W; a natural lake, Wisconsin, Washington Co., 43.41°N, 88.22°W) that exceed the long standing record (nine eggs, Risley 1933. Pap. Michigan Acad. Arts, Sci. Lett. 17:685–711). The largest clutch (12 eggs), although partially destroyed during oviposition, was represented by 12 large (5–6 mm diam) ovarian corpora lutea. The same ovaries included nine small (2.5–3 mm diam) corpora lutea from a previous clutch and 11 enlarged (13–14 mm dia), preovulatory follicles. The RCMs of these turtles (Table 1) were much larger than in other kinosternids (Iverson et al. 1991. J. Herpetol. 25:64–72). Ten additional turtles from the two goldfish farms yielded nine-egg clutches (7 from Indiana, 3 from Alabama).

The largest egg (7.63 g, 33.7 × 18.7 mm), from Indiana (*op. cit.*, 28 May 1994), from a female (116 mm CL, 279 g FSM), was normally elongate (l/w =1.8, Clark et al. 2002. Funct. Ecol. 15:70–77), but did not develop. This egg was accompanied with four other eggs of normal size (4.5–4.6 g). The largest egg that has hatched (6.85 g, 30.3 × 19.0 mm) was part of a clutch of eight large eggs (5.5–6.9 g) from a female (128 mm CL, 315 g FSM) from Arkansas (Garland Co., Lake Hamilton State Fish Hatchery, 34.41°N, 93.06°W, 20 May 1989).

Which practices, if any, on fish farms enable female *S. odoratus* to become large and evidently uniquely prolific remain unevaluated. Nonetheless, these data suggest that geographical studies of reproductive data on turtles need cognizance of habitat type.

I thank J. Capler, P. Clark, and C. Etchberger for assistance with collecting these turtles, and the Carnegie Museum of Natural History (C. J. McCoy) for access to turtles in his possession.

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TABLE 1. Large clutch size and related attributes of Sternotherus odoratus. [CS = clutch size, FSM = female spent mass (g), Mx CL = maximum straight line carapace length (mm), Mx PL = maximum straight line plastron length (mm), RCM = relative clutch mass (clutch mass/FSM), (mm), corp. lut. = corpora lutea].

Locality	Obs. date	CS	Count	FSM	Mx CL	Mx PL	RCM
Alabama	20 May 1980	11	corp. lut.	297	129	97	0.137
Alabama	20 May 1980	10	eggs	270	124	94	0.140
Indiana	4 Jun 1988	12	corp. lut.	297	121	101	_
Indiana	24 Jun 1988	11	eggs	238	_	_	0.172
Indiana	7 Jun 1993	11	eggs	240	107	88	0.200
Indiana	6 Jul 1993	11	eggs	301	99	96	0.171
Indiana	4 Jun 1988	10	eggs	277	118	99	0.163
Indiana	21 Jun 1988	10	eggs	232	112	97	0.189
Indiana	15 Jun 1991	10	eggs	279	124	98	0.164
Indiana	13 Jun 1993	10	eggs	266	113	96	0.168
Wisconsin	16 Jun 1979	10	eggs	262	120	96	0.165

TERRAPENE CAROLINA CAROLINA (Eastern Box Turtle). **PREDATION.** Eastern Box Turtles are omnivores that take a wide range of plant and animal matter (Dodd 2001. North American Box Turtles. A Natural History. Univ. Oklahoma Press). Every summer, from 1990 to 2004, I used a series of 17 mist nets to capture breeding songbirds. Box turtles are common in my study site, which is within the Jug Bay Wetlands Sanctuary (38°46'N; 76°42'W), on the east shore of the Patuxent River in Anne Arundel County, Maryland. Mist nets are 12 m long × 2 m high and are stretched between tall poles in forest, stream floodplain, and along the edge of a tidal wetland. The lowest tier of the net is normally about 30 cm above the ground, but when a bird is captured in this part of the net its weight causes the net to sag. As a result, a songbird can become entangled on the ground. On three occasions I have observed an Eastern Box Turtle eating a songbird that had been captured in a mist net.

On 29 June 1991, a turtle devoured an adult female Acadian Flycatcher (*Empidonax virescens*; USFWS band No. 1830-75071). On 25 June 1996, I observed a turtle eating a Red-eyed Vireo (*Vireo olivaceus*; unbanded). The vireo was dead, partially eaten, and the turtle had blood and feathers on its face. On 1 July 2003, I observed a turtle eating an Ovenbird (*Serius aurocapillus*; unbanded). The left wing was missing all tertial and secondary flight feathers and most primary feathers. The wings and body were bloody and bird could not fly. The turtle's mouth was filled with feathers. At my approach the Ovenbird escaped but probably did not survive the attack.

In each incident, the songbird had been initially captured in the lowest part of the mist net and was unable to escape when the turtle attacked it. Box Turtles probably capture and eat small healthy vertebrate animals only under unusual circumstances. Legler (1960. Univ. Kansas Publ. Mus. Nat. Hist. 11:527–669) reports a *Terrapene* eating a bobwhite quail chick and Anton (1990. Bull. Chicago Herpetol. Soc. 25:143–144) reported one eating a house sparrow. Alsop and Wallace (1978. J. Tennessee Acad. Sci. 53:134) report box turtles eating songbirds that had been killed at a tall radio tower during migration. There are also reports of box turtles eating small mammals that had been captured in traps (Legler 1960, *op. cit.;* Metcalf and Metcalf 1970. Trans. Kansas Acad. Sci. 73:96–117). While predation on healthy adult songbirds is certainly rare, the nestlings of ground-nesting species could be vulnerable to opportunistic predation by these turtles.

Songbirds were captured for study under permit #09517-L issued by the U.S. Fish and Wildlife Service.

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TESTUDO GRAECA (Spur-thighed Tortoise). **SIZE**. The maximum straight carapace lengths (SCL) of *Testudo graeca* previously reported for Morocco come from Admine, in the Souss Valley (30°13'N, 9°31'W; 70 elev.). In this region, females reach 226.2 mm and males 184.4 mm (Carretero et al., *in press*. Anim. Biol.). Although Souss Valley specimens have been assigned to the subspecies *T. g. soussensis*, recent studies on mtDNA (Harris et al. 2003. Rev. Esp. Herpetol. 17:5–9) and morphometrics (Carretero et al., *in press*) do not support a distinction from the nominal subspecies found elsewhere in Morocco. During a herpetological survey in several Moroccan localities, six extremely large specimens were found in Tagourast (Boulemane Province, 32°51'N, 3°52'W; 1130 m elev.) on 14 October 2003. Two females (236.4 mm and 248.6 mm) and one male (200.3 mm) exceeded the highest SCL values reported for Souss Valley specimens (Bayley and Highfield 1996. Chel. Cons. Biol. 2:36–42; Carretero et al., *in press*); another male measured 184.1 mm. To our knowledge the largest female represents the maximum size record of this species in nature for Morocco. Despite the low sample size, this population seems to be composed of adult individuals of large size (means: 181.8 mm males, 218.8 mm females, N = 3 in both cases). All tortoises were photographed and released after measuring. It is noteworthy that Admine and Tigueust are 750 km apart, occupy different climatic zones (littoral in Admine and continental with high thermal amplitude in Tagourast) at different altitudes and harbor different habitats (patchy open forest with irrigated cultures and dry steppe, respectively). Furthermore, the Tagourast population is the southeastern limit of the *T. graeca* range in Morocco (Bons and Geniez 1996. Amphibians and Reptiles of Morocco. AHE. Barcelona).

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LACERTILIA

ANOLIS SMARAGDINUS (Bahamian Green Anole). **DISPERSAL**. Several factors seem to influence lizard dispersal (Massot and Clobert 2000. J. Evol. Biol. 13:707–719), yet it remains the focus of relatively limited study. Notably, little attention has addressed how the patch size of unsuitable habitat might impede dispersal. Hence, we provide an observation of *Anolis smaragdinus* from the Bahamas showing how a patch of unsuitable habitat might have influenced dispersal.

In October 1993, as part of an experimental study of interspecific interactions (Losos and Spiller 1999. Ecology 80:252–258), five adult *A. smaragdinus* (2 males, 3 females) were introduced onto a tiny (801 m^2) islet lacking lizards that was located SW of Georgetown, Great Exuma, Bahamas (23º25'N, 75º50'W). This islet is connected to another slightly larger one (943 m^2) by an isthmus of bare rock that is land positive for only about one half of the tidal cycle; this latter islet also originally lacked lizards but none were introduced to it. The minimum distance between vegetation on the two islets is 17.7 m. However, the edge of both islets is vegetated with *Rhachicallis americana* (Rubiaceae), a small plant (mean height = 0.29 m; range = 0.05–0.58 m, N = 45) that *A. smaragdinus* rarely uses (JBL and DAS, unpubl. data). Moreover, *A. smaragdinus*, which is rarely seen on the ground, typically occupies shrubby vegetation > 1 m in height (Schoener 1968. Ecology 49:704–726). The minimum distance separating habitat typically occupied by *A. smaragdinus* (i.e., bushes > 1 m in height) on the two islets is 49.8 m. When we returned a year later (October 1994), we found one adult male and two smaller

individuals (sex undetermined) in a brief (ca. 15 min) survey of the larger islet (as well as an estimated 10 individuals on the smaller island to which they had been introduced).

This observation indicates that typically arboreal anoles may disperse some distance on the ground to colonize vegetation patches lacking canopy contact, a rarely reported phenomenon (Hicks and Trivers 1983. *In* Rhodin and Miyata [eds.], Advances in Herpetology and Evolutionary Biology: Essays in Honor of Ernest E. Williams, pp. 570–595. Museum of Comparative Zoology, Cambridge, Massachusetts). We consider the alternate possibility, that *A. smaragdinus* independently colonized the larger islet over water from another source island or was brought there by humans, to be highly unlikely. These islets are in a remote area ca. 5 km from Great Exuma. Natural colonization is unlikely because we have never observed this species on a tiny remote islet of this sort except for populations that we introduced in over two decades of studying the distribution of anoles on hundreds of islands in the Bahamas. Moreover, Hurricane Lili exterminated the populations on both islets in 1996. Since then we have visited these islets about four times a year and never found this species. In addition, these diminutive islets hold little interest for locals or tourists; we never saw evidence that humans other than ourselves visited them.

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ASPIDOSCELIS TIGRIS AETHIOPS (Sonora-Sinaloa Desert Whiptail). **HABITAT, BODY SIZE, and REPRODUCTION.** We present data on a population of *Aspidoscelis tigris aethiops* (= *Cnemidophorus tigris aethiops*; Reeder et al. 2002. Am. Mus. Novitat. 3365:1–61) sampled by JLE in 2004 at Estación Ortíz, Valle de Guaymas, municipality of Guaymas, Sonora, México (28°17'23.9"N, 110°43'0.8"W, elev. 103 m). Estación Ortíz, the most southerly continental locality and lowest elevation (see Vitt and Breitenbach 1993. *In* Wright and Vitt [eds.], Biology of Whiptail Lizards (Genus *Cnemidophorus*), pp. 211–243. Oklahoma Mus. Nat. Hist., Norman, Oklahoma) at which habitat, body size, and reproductive characteristics for *A. tigris* (*sensu* Walker 1983. Southwest. Nat. 28:1–8) have been assessed, is situated ca. 40 km from the Gulf of California in a relatively flat Sonoran Desert basin surrounded by rocky hills. Most of the habitat utilized by *A. t. aethiops* (*sensu* Taylor and Walker 1991. Copeia 1991:800–809) in Valle de Guaymas is dominated by plant associations of mesquite (*Prosopis* sp.), large cholla and prickly pear cacti (*Opuntia* sp.), and scattered creosote bush (*Larrea* sp.). Some of these associations are impenetrable to humans; however, patches of open substrate among the plants are utilized by whiptail lizards and other reptiles. Most individuals of *A. t. aethiops* analyzed in this study were collected near the town, where they were easily stalked in severely altered habitats characterized by open areas, sandy soil, and degraded vegetation. This subspecies was also abundant, but difficult to collect, away from the town on gravelly soil in dense vegetation at the base of the hills. No other species of *Aspidoscelis* was observed at Estación Ortíz.

Analyses of reproduction and body size in *A. t. aethiops* are based on dissections and measurements performed by JMW on 176 preserved specimens of this subspecies catalogued in the herpetological collection of Unidad de Biología, Tecnología y Prototipos (UBIPRO 12847–12859, 12865–12869 [22 July 2004]; 13155–13197, 13214–13328 [12–14 August 2004]). Data are presented by sex as ratios, ranges of variation, and/or means (to one decimal place) ± 1SE.

Numbers of males and females, respectively (in parens), by size (as 10 mm increments in SVL) in the pooled UBIPRO sample are 35–39 (1:2), 40–49 (1:3), 50–59 (4:14), 60–69 (34:37), 70–79 (44:20), and 80–87 (13:3). Chi-Square tests revealed that the 22 July 2004 sample was significantly male-biased (16:2; $\chi^2 = 4.7$, $P = 0.03$); however, no significant gender bias existed in the 1214 August 2004 sample (81:77, $\chi^2 = 0.01$, $P = 0.91$). Collections of *A. tigris* are well known to often have unequal sex ratios that reflect behavioral differences correlated with the reproductive cycle (Pianka 1970. Ecology 51:703–720; Burkholder and Walker 1973. Herpetologica 29:76–83). Dearth of females in our July sample may reflect most females carrying oviductal eggs during which time their more retiring behavior made them less visible to humans (see Pianka 1970, *op. cit.*). Conversely, nearly equal sex ratio in the August collection may reflect most females (N = 34) carrying yolked ovarian follicles 3.0–8.0 mm in diameter, during which time they continue to actively forage to support clutch development (see Pianka 1970, *op. cit.*); at that time few females (N = 7) had oviductal eggs (mean dimensions 8.3 × 15.1 mm). In the pooled sample of *A. t. aethiops*, the 43 gravid females have a SVL range of 60–81 mm. Sexual dimorphism in the Estación Ortíz population of this subspecies is indicated by the significantly different SVL means ($P < 0.05$) for all adult females (68.5 ± 0.73, range 60–81, N = 60) compared to all adult males (71.7 ± 0.71, range 60–87, N = 91) in the pooled sample and the 13:3 ratio of males to females in the 80–87 mm SVL range. Numbers of undamaged gravid females (as 10 mm increments in SVL) are 60–69 (27), 70–79 (13), and 80–81 (3). Clutch size range in 43 females is 1–4, mean 2.2 ± 0.09. The number of eggs per clutch in *A. t. aethiops* is positively correlated with SVL ($r = 0.66$, $P < 0.01$). In the SVL range of 60–73 mm, clutch size is 1 (N = 1), 2 (N = 33), and 3 (N = 1), and in the SVL range of 72–81 mm it is 2 (N = 1), 3 (N = 5), and 4 (N = 2).

The geographic distribution of no other species of whiptail lizard in North American deserts approximates the vast latitudinal range of *Aspisoscelis tigris*. Its range extends from Oregon and Idaho in the USA to Sinaloa State, México (Wright 1994. *In* Brown and Wright [eds.], Herpetology of the North American Deserts: Proceedings of a Symposium, pp. 255–271. Southwestern Herpetologists Soc. Special Publ. 5, Van Nuys, California.), which is roughly equivalent to the combined latitudinal limits of the Great Basin, Mohave, and Sonoran deserts. Ecological adjustments associated with the exceptionally high density for *A. t. aethiops* observed at Estación Ortíz by JLE (N = 176 collected in 4 days in 2004), based on a small clutch size, include a lengthy growing season (> 200 days), early reproductive maturity at a small body size in the second summer of life, and likely production of multiple clutches (see McCoy and Hoddenbach 1966. Science

154:1671–1672). In comparison, the much lower densities for *A. t. tigris* observed in the Snake River Valley in Canyon, Ada, Owyhee, and Elmore counties in southwestern Idaho (N = 243 specimens collected in > 20 days in 1967 and 1968; Burkholder and Walker 1973, *op. cit.*), the most northerly area (ca. 43°26'N) in which habitat, body size, and reproductive characteristics for this species have been assessed (Taylor et al. 1994. Copeia 1994:1047–1050), is based on a shorter growing season (ca. 150 days), maturation at a larger SVL in the third summer of life (SVL 69–75 mm), and annual production of single clutches of similar size.

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CTENOSAURA BAKERI (Utila Spiny-tailed Iguana). **PREDATION**. *Ctenosaura bakeri,* an endemic to the Isla de Utila (Islas de la Bahia, Honduras), dwells exclusively in mangrove swamp (Köhler 1995. Salamandra 31:93–106). Little information exists on its life history. Hence, here I present observations of predation on juvenile and adult *C. bakeri*.

At 1145 h on 3 September 1999, I observed a *Boa constrictor imperator* drop from a Black Mangrove tree, *Avicennia germinans*, on the inland mangrove edge near Iron Bound on the north coast of Utila (16°07'22"N, 86°54'16"W). The snake was in the process of constricting an adult female *C. bakeri* across its abdominal region. After the snake killed the lizard, prey and predator were collected to prevent ingestion. The iguana measured 192 mm SVL and 474 mm total length and had a mass of 235 g. The snake measured 1400 mm total length and was released at the site of capture after examination. Predation by the snake was photodocumented. A second case of predation was recorded at 1030 h on 6 June 2000 in the mangrove swamp at Big Bight Pond on the eastern part of Utila (16°06'20"N, 86°53'29"W). A Turkey Vulture (*Cathartes a. aura*) was observed grasping an adult male *C. bakeri* and flew away. The iguana, estimated at 700 mm total length, had been resting about 20 m from my point of observation on the exposed branch of a Black Mangrove tree.

At 0930 h on 22 June 2000, while checking the nesting sites at Iron Bound, a large (ca. 700 mm total length) male Basilisk (*Basiliscus vittatus*) was spotted among the beach vegetation. On approach, the basilisk started running over a distance of about 3 m and caught a freshly hatched *C. bakeri* (ca. 170 mm total length) that ran by and swallowed it head first.

At 1042 h on 31 July 2001, I observed a group of Great-tailed Grackles (*Quiscalus m. mexicanus*), consisting of the two adults and two immatures, enter the mangrove swamp at Iron Bound. During this summer dry season, water levels were low and no water was present in many places; at this time, juvenile *C. bakeri* usually remain among the mangrove roots. As I observed one of the adult grackles rummaging through the roots, I saw it hunt and kill 4 iguanas within 10 min. The prey items were fed to the immature birds, which swallowed the juvenile *C. bakeri* head first. Predation by the grackle was videotaped.

Published observations of predation on *C. hemilopha*, *C. pectinata,* and *C. similis* exist (e.g., Carothers 1981. Behav. Ecol. Sociobiol. 8:261–266; Mora 1987. J. Herpetol. 21:334–335; Ramírez-Bautista and Uribe 1992. Herpetol. Rev. 23:82), but these observations are the first records of predation on *C. bakeri*.

Martina Koch, Simone Mosbacher, and Florian Beck assisted in the field.

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CTENOSAURA HEMILOPHA (Cape Spiny-Tailed Iguana). **REPRODUCTION.** *Ctenosaura hemilopha* is known from Baja California south of Loreto to the Cape region and Cerralvo Island (Grismer 2002. Amphibians and Reptiles of Baja California Including Its Pacific Islands and the Islands in the Sea of Cortés, University of California Press, Berkeley, 399 pp.). The purpose of this note is to provide information on its reproductive cycle from histological examination of gonads from museum specimens.

A sample of 10 males (mean SVL = 177 mm ± 43 SD, range: 119–233 mm) and 11 females (SVL = 173 mm ± 25 SD, range: 153–237 mm) was examined from the Museum of Vertebrate Zoology (MVZ), Berkeley; and the Natural History Museum of Los Angeles County (LACM), Los Angeles. Histological procedures follow Goldberg and Beaman (2003. Herpetol. Rev. 34:143). Testes from 2 males (LACM 51838, 129 mm SVL; LACM 51840, 127 mm SVL) collected 4–6 March 1969 were in recrudescence just prior to the start of spermiogenesis (germinal epithelium dominated by primary spermatocytes and spermatids). A testis from 1 male (LACM 51839, 192 mm SVL), collected 4–6 March 1969 was undergoing early spermiogenesis (seminiferous tubules contained small amounts of sperm). Testes from 2 males (LACM 128245, 222 mm SVL; LACM 128246, 207 mm SVL) collected 30 April 1978, and 1 male (LACM 128248, 233 mm SVL) collected 7 May 1978, were undergoing spermiogenesis (lumina of seminiferous tubules lined by spermatozoa; rows of metamorphosing spermatids present). Testes from 1 male (LACM 19360, 209 mm SVL) collected 4 July 1959, 2 males (LACM 9850, 119 mm SVL; LACM 9852, 149 mm SVL) collected 17–18 July 1960, and 1 male collected on 19 July 1977 (LACM 126586, 183 mm SVL) were regressed (seminiferous tubules contained spermatogonia and Sertoli cells; germinal epithelium was exhausted). Presence of males undergoing spermiogenesis in April–May suggests that *C. hemilopha* breeds during spring, before late summer as suggested by Asplund (1967. Amer. Midl. Nat. 77:462–475).

The ovary from 1 female (LACM 51837, 157 mm SVL) col-

lected 4–6 March 1969, was undergoing early yolk deposition (follicles contained a ring of basophilic yolk granules). Yolk deposition was further advanced in a second female (LACM 51836, 153 mm SVL) collected 4–6 March 1969, with a total of 13 follicles (5.8 mm ± 1.1 SD diameter). However, whether all follicles would have completed development is unclear. No yolk deposition was underway in 9 females (SVL, collection date in parens): LACM 94820 (155 mm, 29 June 1967), LACM 126585 and 126587 (237 mm and 155 mm, respectively, both 16 July 1967), LACM 19361 (195 mm, 12 August 1964), MVZ 11489 (170 mm, 22 August 1929), LACM 19358 (163 mm, 28 August 1961), LACM 94821 (173 mm, 14 October 1968), MVZ 11476 (165 mm, 15 October 1928), and MVZ 11482 (178 mm, 30 October 1928). These data support that in *C. hemilopha*, yolk deposition is completed some time in spring. Asplund (*op. cit.*) observed hatchlings of *C. hemilopha* in late August, suggesting that eggs were deposited in spring.

We thank D. Kizirian (LACM) and D. Wake (MVZ) for permission to examine specimens.

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EUMECES FASCIATUS (Five-lined Skink). **HATCHLINGS**. Many aspects of the biology of *Eumeces fasciatus* are well known, but most data involve populations from the northern and eastern portions of its range. (e.g., McCauley 1939. Copeia 1939:93–95; Fitch 1954. Univ. Kansas Mus. Nat. Hist. Publ. 8:1–156). Further information regarding hatchling morphometrics is generally restricted to measurements of SVL and mass. For this reason, we report here on hatchlings from a nest found in southeast Texas.

On 4 July 2004, we discovered a nest of 11 intact eggs under an irregularly shaped porous limestone (28 cm wide × 39 cm long × 28 cm high) at the base of a pecan tree (*Carya illinoensis*) surrounded by mixed grasses and debris that nearly concealed the limestone. This site, in an abandoned pecan orchard, is now a wooded lawn near the town of Hull, Liberty County (30°11'24.3"N, 94°40'46.4"W: elev. 24 m). The nest chamber was dome-shaped, measuring ca. 10 cm wide × 15 cm deep × 3 cm high. The entrance to the chamber was a natural crevice in the stone that opened toward the tree. The nest ceiling was a concavity beneath the stone, whereas the substrate beneath the eggs was bare soil excavated to a slight depression. An adult female *E. fasciatus* (ca. 60 mm SVL) accompanied the eggs. When the stone was lifted, she huddled on top of the eggs, but did not flee, even as the stone was carefully replaced. Examination of the nest at 1100 h the next day revealed that the adult had left and two of the eggs were slit and empty. No evidence of the hatchlings existed nearby. The remaining 9 eggs were collected and reared in a sealed container on moist potting soil. Hatchlings were each weighed and measured within 12 h of hatching. Method of taking measurements follows Smith (1946. Handbook of Lizards, Lizards of the United States and Canada. Comstock Publishing Associates. Ithaca, New York. 557 pp.)

All eggs hatched between 6 and 8 July 2004. Morphometric data were recorded for each hatchling (Table 1.) Mean values were as follows: 26.8 mm SVL (SD = 0.6), weight of 0.4 g (SD = 0.02), 62.8 mm total length (SD = 1.5), 7.7 mm head length (SD = 0.2), 4.2 mm ocular head width (SD = 0.2), 10.0 mm forelimb length (SD = 0.5), and 2.2 mm hind limb length (SD = 0.6).

TABLE 1. Morphometric data for 9 *Eumeces fasciatus* hatchlings from Liberty County, Texas. SVL = snout–vent length, TTL = total length, HL = head length, OHW = ocular head width, FLL = forelimb length, HLL = hindlimb length.

Hatchling (mm)	SVL (g)	Weight (mm)	TTL (mm)	HL (mm)	OHW (mm)	FLL (mm)	HLL (mm)
1	26	0.36	59	7.5	4.2	10.3	10.9
2	27	0.40	62	8.0	4.6	9.2	13.0
3	26	0.42	64	7.8	4.3	9.5	12.4
4	27	0.42	64	7.8	4.1	10.7	12.4
5	27	0.41	62	7.4	4.1	9.6	12.1
6	27	0.40	64	7.8	4.1	9.6	12.2
7	26	0.41	63	7.9	4.2	9.7	13.0
8	27	0.41	63	7.8	4.2	10.5	12.0
9	28	0.42	64	7.3	4.1	10.5	12.1

The sizes (as SVL) and masses of these hatchlings are similar to those reported from Kansas (Fitch, *op. cit.*) and Maryland (McCauley, *op. cit.*). Data are lacking to compare remaining measurements. These data represent the first documentation of morphometric information for *E. fasciatus* hatchlings from the southwestern edge of its range.

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GAMBELIA WISLIZENII (Long-nosed Leopard Lizard). **PREDATION**. Despite a broad distribution, few reports of *Gambelia wislizenii* predators exist. Based on stomach contents, Ortenburger (1928. Mem. Univ. Michigan Mus. 1:1–243) identified *Masticophis flagellum* as a common predator of *G. wislizenii*. To my knowledge, the only other predators noted to date are larger conspecifics (McCoy 1967. Am. Midl. Nat. 77:138–146; Montanucci 1967. Herpetologica 5:119–126). Here I provide an observation of domestic cat (*Felis catus*) predation on *G. wislizenii* from southeastern Oregon.

Around 1000 h on 28 June 2003 on the west edge of the Alvord Desert in the hamlet of Fields, Harney Co. (42º15.8'N, 118º40.5'W; elev. 1290 m), I saw an average-sized *F. catus* pounce from the edge of an unidentified shrub into a patch of grass. When it lifted its head, the cat was holding an adult *G. wislizenii*, ca. 90 mm in snout-to-vent length and with no visible nuptial coloration, by the lizard's neck. The lizard was immobile and appeared to be dead. The cat lowered the lizard back to the ground and although the cat's mouth was not visible through the grass, its head and shoulders made movements indicative of the tearing apart and ingestion of prey. I observed the cat for ca. 2 minutes, at which point it was apparently still ingesting the lizard. This entire observation

occurred in a small patch of unidentified mixed shrubs and grasses between the east side of State Route 205 and a grove of trees surrounding a small pond, < 100 m from the nearest house.

Cats prey on a wide variety of animals, including lizards (Fitzgerald and Turner 2000. *In* Turner and Bateson [eds.], The Domestic Cat: The Biology of Its Behaviour, 2nd ed., pp. 151–175. Cambridge University Press, Cambridge). For example, cats take an estimated 2.9–9.4 million lizards annually in Virginia (Mitchell and Beck 1992. Virginia J. Sci. 43:197–207). Cats are also thought to have driven some lizard species extinct (e.g., Iverson 1978. Biol. Conserv. 14:63–73). However, this is the first record of cat predation on *G. wislizenii*, or any *Gambelia* species (Fitzgerald and Turner, *op. cit.*). Knowledge of predators of *G. wislizenii* is important because their predators are likely to be similar to those of the closely related and federally Endangered *Gambelia sila* (Tollestrup 1982. Am. Midl. Nat. 108:1–20). The potential impact of feral and free-ranging domestic cats should be considered in the management of *Gambelia* lizards.

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HEMIDACTYLUS PLATYCEPHALUS (Flat-headed Tropical House Gecko). **REGIONAL INTEGUMENTARY LOSS**. Regional integumentary loss (RIL, *sensu* Bauer et al. 1989 J. Exp. Biol. 145:79–102), an anti-predator strategy complementary to tail autotomy, is reported for at least 10 genera of gekkonids (Bauer et al., *op. cit.*) and seems to evolve mainly in insular contexts (Bauer and Russell 1992. Ethol. Ecol. Evol. 4:343–358). Here, we add *Hemidactylus* to the list of genera that display this behavior and comment on the insular context.

During a field trip to the Comoro Islands (West Indian Ocean) in October–November 2003, MAC and DJH collected more than 50 *Hemidactylus* specimens by hand for genetic analysis from the four main islands (Mayotte, Grande Comore, Anjouan, and Moheli). More than the 90% of *H. platycephalus* spontaneously and systematically released part of the skin when handled (even if gently), without bleeding or any other apparent damage. In a second trip to Tanzania in October 2004, DJH and SR recorded similar observations for the same species in Zanzibar, Pemba, and the Tanzanian coast. Both insular and mainland populations of *H. platycephalus* showed RIL and genetic analysis did not reveal evidence for an insular origin of this species (Rocha et al. 2005. Mol. Phyl. Evol., in press). Remarkably, other members of this genus collected in similar numbers at the same sites (*H. brooki*, *H. frenatus*, and *H. mercatorius* in the Comoros; *H. mercatorius* in Zanzibar, Pemba, and mainland Tanzania) did not display such strategy. Because the distinction was congruent with the estimates of relationships based on DNA sequence data (Rocha et al., *op. cit*.), RIL could be used as another character to identify *H. platycephalus*, at least in this area. To our knowledge, this is the first report of RIL in *Hemidactylus*, although the skin of *H. fasciatus* has been described as thin and weak similar to that of gekkonids for which RIL has been reported (Bauer et al., *op. cit.*).

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IGUANA IGUANA (Green Iguana). **NESTS and NESTING**. Widespread in tropical America, *Iguana iguana* occurs in a range of climates. Despite this broad-ranging condition, reproductive data are described for few populations (Alvarado et al. 1995. Southwest. Nat. 40:234–237; Bock and Rand 1989. Copeia 1989:978–986; Klein 1982. Brenesia 19–20:301–310; Rodda and Grajal 1990. Amphibia-Reptilia 11:31–39). *Iguana iguana* breeds seasonally throughout its range from Mexico to Brazil (Rand and Greene 1982. Iguanas of the World: Their Behavior, Ecology, and Conservation. Noyes Publ., Park Ridge, New Jersey), but reproductive data from Brazil are lacking. Here, we help fill this gap with preliminary data from northern Brazil.

During September–November 2001, we obtained data on some nests of *I. iguana* at Reserva Biológica do Rio Trombetas. The reserve, a 385,000-ha area located in the northwest part of state of Pará, municipality of Oriximiná, is on the northeast bank of Rio Trombetas (01°46'S, 55°52'W; elev. ca. 46 m). Nesting occurred in sand banks (tabuleiros) formed by dropping river water levels. Our data are based on five nests of *Iguana* discovered between 16 and 25 September at Tabuleiro do Farias and Tabuleiro do Jacaré. Based on regular surveys in the area, we estimated that nests were discovered ca. 10 days after egg laying. In order to limit predation on the nests following their disturbance, after recording the original position of each egg, we transferred the eggs to similar holes excavated in the same sand bank where they could be monitored continuously.

Nest dimensions (depth between the surface and incubation chamber, and the horizontal distance between the nest entrance and incubation chamber) were measured to the nearest centimeter. Egg data were obtained from two clutches measured immediately after their discovery using calipers to the nearest 0.05 mm and weighed to the nearest 1g with Pesola spring scales. We analyzed change in egg volume and mass in a 20-egg clutch between the day of initial measurements and the 70th day of incubation using a Wilcoxon signed rank test. Hatchlings were also measured (SVL) and weighed immediately after hatching.

Two nests were located in areas totally exposed to the sun; vegetation at least partially shaded the other three nests. Nest depth ranged from 30 to 120 cm (mean = 67.2 cm, s = 41.0) and distance between the nest entrance and incubation chamber from 100 to 463 cm (mean = 311 cm, s = 169). Clutch sizes were 20, 21, 22, 24, and 33. Mean egg length for the two clutches measured (33 and 20 eggs, data for each in this order hereafter) was 4.5 cm (s = 0.2, range: 4.2–5.0 cm) and 4.9 cm (s = 0.2, range: 4.7–5.3 cm), mean egg width was 3.4 cm (s = 0.1, range: 3.2–3.5 cm) and 2.9 cm (s = 0.1, range: 2.7–3.1 cm) and mean egg mass was 28.3 g (s = 0.9, range: 27.0–31.0 g) and 21.4 g (s = 0.9, range: 19.5–23.0 g). Increase in egg volume and weight during the incubation period was significant ($P < 0.01$ for both). Hatchlings (N = 6, all from first nest) averaged 7.2 cm SVL (s = 0.1, range: 7.1–7.3 cm), 19.9 cm tail length (s = 0.6, range: 19.0–20.5 cm), and 14.9 g in mass (s = 0.9, range: 14.0–16.0 g).

Rio Trombetas Green Iguanas laid larger clutches (mean = 24, range: 20–33, N = 5) than Green Iguanas from Curaçao, off the north coast of Venezuela (mean = 17 eggs, range: 10–31, N = 23; Fitch 1985. Misc. Publ. Mus. Nat. Hist. Univ. Kansas 76:1–76), but smaller clutches than those reported elsewhere in Mexico and Central America (means = 29.7–39.5, overall range: 13–60, N = 145; Alvarado et al., *op. cit*.; Fitch 1973. Univ. Kansas Sci. Bull. 50:39–126; Fitch 1985, *op. cit*.; Klein, *op. cit*.; Miller 1987. Zoo Biol. 6:225–236). Rand (1984. *In* Seigel et al. Vertebrate Ecology and Systematics: A Tribute to Henry S. Fitch. Mus. Nat. Hist., Univ. Kansas, Lawrence. 278 pp.) noted that clutch size increases with body size. Egg mass varied between our two monitored clutches but was greater than that reported for eggs from Mexico (mean = 15.2 g, range: 12.1–17.7 g; Alvarado et al., *op. cit*.). If a smaller clutch size as one nears the equator is a real trend, it may be related to an increase in mass of individual eggs. Size of Rio Trombetas hatchlings was also larger than that reported for Curaçao (mean = 6.6 cm, range: 6.2–6.8, N = 23; Bakhuis 1982. J. Herpetol. 16:322–325), similar to those reported for Michoacan (mean = 7.2 cm, range: 6.1–8.5, N = 327; Alvarado et al., *op. cit*.), but smaller than hatchlings from northern Colombia (range: 7.0–8.6; Rand and Greene, *op. cit.*). Variation we observed in size and weight of clutches and hatchlings may reflect variation in maternal size (Rand, *op. cit.*), but we lack data to test this hypothesis.

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IGUANA IGUANA (Green Iguana). **PREDATION.** *Iguana iguana* is exotic to Florida, but has been reported in the wild there since the 1960s, with breeding colonies reported since the 1980s (Meshaka et al. 2004. The exotic amphibians and reptiles of Florida, Krieger Publishing Company, Malabar, Florida, USA. 155 pp.). *Iguana iguana* is currently known to breed at diverse sites on the Florida mainland and in the Keys (Meshaka et al., *op. cit.*). As indigenous predators may represent one controlling influence on exotic Florida herpetofauna (Butterfield et al. 1997. *In* Simberloff et al. [eds.], Strangers in Paradise, pp. 123–138, Island Press, Washington, DC), we report here an observation of Yellow-crowned Night Heron (*Nyctanassa violacea*) preying on *I. iguana* from the Florida Keys.

At ca. 0800 h on 5 June 2004 (ca. 27°C air temperature), EMS observed a juvenile *N. violacea* that had just captured a hatchling (ca. 150 mm SVL) *I. iguana* by the old Bahia Honda Bridge in Bahia Honda State Park on Bahia Honda Key (24°39'17"N, 81°16'52"W; elev. ca 2 m). Based on size, the lizard had probably hatched the previous August (Meshaka et al., *op. cit.*).

The event was noteworthy not only because it involved another case of a juvenile wading bird foraging in a terrestrial situation and preying on an exotic species (Smith and Engeman 2004. Herpetol. Rev. 35:169–170), but because natural predators of *I. iguana* have not been recorded in Florida. Most foraging by *N. violacea* occurs in shallow water, with crustaceans the primary prey (Bancroft and Strong 1996. *In* Rodgers, Jr. et al. [eds.], Rare and Endangered Biota of Florida, pp. 450–456, University Press of Florida, Gainesville). Herons and egrets have been known to capture and consume exotic lizards in terrestrial situations (Franz 2001. Herpetol. Rev. 32:253; Smith and Engeman, *op. cit.*), but prior to this observation only dogs had been reported as predators on *I. iguana* in Florida (Meshaka et al., *op. cit.*). This is also the first observation of a hatchling *I. iguana* on Bahia Honda Key, although ES has observed adult *I. iguana* here for at least 5 yrs.

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LEIOLOPISMA TELFAIRII (Telfair's Skink). **CAUDAL LURING**. Caudal luring is a technique employed by sit-and-wait foragers from a number of squamate lineages (e.g., Simon et al. 1999. Herpetol. Rev. 30:102–103), and typically involves the use of tail movement to attract potential prey within striking distance (Pough et al. 2004. Herpetology. Pearson Education Inc. New Jersey, 726 pp.). Among lizards, caudal luring has only ever been recorded in *Lialis burtonis* and was observed to occur only when the prey evaded an initial strike (Murray et al. 1991. Copeia 1991:509–516.). Here we report observations made during a field study that suggest that *Leiolopisma telfairii* might employ caudal luring as an opportunistic technique to enhance predation on other lizards.

Telfair's Skink, a historically common species throughout the island assemblage associated with Mauritius, has declined markedly because of ship-facilitated introduction of Black Rats (*Rattus rattus*), which has resulted in the species now being confined to Round Island, 22.5 km off the NE coast of Mauritius (Jones 1993. Proc. Roy. Soc. Art. Sci. Mauritius V:71–92). *Leiolopisma telfairii*, the largest living skink in Mauritius, attains a size over 160 mm SVL (Pernetta 2004. Microhabitat and Dietary Preferences of Telfair's Skinks (*Leiolopisma telfairii*): Implications for their Translocation. MSc thesis, University of East Anglia, Norwich, United Kingdom. 41 pp.). Fecal analysis of 59 individuals recorded 20 different food items and confirmed its omnivorous status (Pernetta, *op. cit*.). Evidence of saurophagy, in the form of scales and bones of Bojer's Skinks (*Gongylomorphus bojerii bojerii*), was recorded in three separate fecal samples and occurs from a young age (Fig. 1.).

While collecting data on *L. telfairii* ecology, we made observations of 3 adults (≥ 100 mm SVL) employing a novel behavior in attempting to capture Bojer's Skinks. On all three occasions (22 April, 15 May, and 1 June 2004), adult Telfair's Skinks had been observed making an initial unsuccessful attempt to capture adult (ca. 60 mm SVL) Bojer's Skinks. Despite the fact that an attempt at predation was made, the Bojer's Skinks remained within view of the pursuing *L. telfairii*. Each *L. telfairii* then stopped, curled their tail around until the tip was parallel to their head, and undulated the last ca. 5 cm of their tail several times while remaining

FIG. 1. A juvenile *Leiolopisma telfairii* (56 mm SVL) with an adult? *Gongylomorphus bojerii bojerii* (35 mm SVL) regurgitated during handling on Round Island, Mauritius.

otherwise motionless. Each Bojer's Skink exhibited an obvious attraction to the tail undulation and moved to within 10–15 cm of the Telfair's Skinks. Once within this distance, all the Telfair's Skinks made a lunge at the Bojer's Skinks, but no episode resulted in the successful capture of the smaller skinks.

Our observations of this behavior suggest that Telfair's Skinks might be using an opportunistic form of caudal luring similar to that employed by *Lialis burtonis*. Notably, *L. telfairii* exhibits few characteristics common among species that frequently employ caudal luring. Caudal luring has generally been associated with sit-and-wait foragers with differently colored tail tips (Pough et al. 2004, *op. cit.*). *Leiolopisma telfairii* is an omnivore that employs both sit-and-wait and active foraging modes (Pernetta, pers. observ.) and lacks variation in tail tip color. Saurophagy by *L. telfairii* is a deviation from the usual diet of arthropods observed among Scincidae (Greer 2001. J. Herpetol. 35:383–395), and might result from these island lizards broadening their diets to compensate for limited prey availability (Cooper and Vitt 2002. J. Zool. [London] 257:487–517). These observations constitute the second recorded use of caudal luring by a lizard and the first record of its use within Scincidae.

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TEIUS TEYOU (NCN). **BEHAVIOR.** Arm or hand waving is considered a pursuit-deterrent signaling evolved in many teiid lizards (Cooper et al. 2004. Behavior 141:297–311). This behavior is undescribed in the genus *Teius*. Hence, we provide observations of hand waving in *T. teyou* from western Brazil.

Observations were made in rocky areas near the municipality of Corumbá, state of Mato Grosso do Sul (19º10'49"S; 57º32'17.2"W; elev. 117 m). From May 2003 to April 2004, we observed *T. teyou* perform hand waving behavior on 34 different occasions (juveniles, N = 14; subadults N = 11; adults N = 9). Hand waving in *T. teyou* consists of lifting and waving the forelimbs, alternating the arms. In almost all cases, the initial wave was made with the arm closest to the observer. Each time the behavior was performed, the lizard-observer distance was ≥ 2 m. The waving lizard fled if the observer approached rapidly or made abrupt movements. Lizards continued to wave as they moved away from the observer until they were ca. 5 m away; at that distance, they resumed normal foraging behavior.

In contrast to hand waving behavior in *Cnemidophorus murinus*, which waves primarily while stationary and uses only the foreleg closest to the investigator (*fide* Cooper et al., *op. cit.*), *T. teyou* typically wave their arms as they are moving away, ceasing waving at a presumptively safe distance. *Cnemidophorus lemniscatus* also waves preferentially with one arm, although both arms are occasionally used (Magnusson 1996. Herpetol. Rev. 27:60). Similar to species of *Cnemidophorus*, *T. teyou* waves their arms looking directly at the predator (the observer), implying that this behavior functions to signal predators.

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SERPENTES

BOTHROPS ATROX (Common Lancehead). **MATING**. The mating season for *Bothrops atrox* in the Brazilian Amazon is poorly understood. Martins and Oliveira (1998. Herpetol. Nat. Hist. 6:78-150) reported two observations of mating in April for Adolph Ducke Reserve (40 km N of Manaus, Brazil) and Federsoni (1978/79. Mem. Inst. Butantan 42/43:159–169) reported a mating in captivity that lasted nearly 24 h. On 11 May 2004 (rainy season) at 0530 h we found a pair of *B. atrox* mating between the logs of a bridge over the stream Barro Branco at Adolph Ducke Reserve (02º55'S 59º59'W). The male was ca. 100 cm TL and the female was ca. 150 cm TL. We did not attempt capture them. A large lateral bulge just anterior of the female's cloaca evidenced intromission. When disturbed, the female moved into shallow water, dragging the male along. The pair was observed at one hour intervals for three hours, and were still mating when last observed at dusk (ca. 1800 h). On 31 January 2002 at ca.1600 h local people found a second pair *of B. atrox* mating in a secondary forest bordering Lake Cururu near the Solimões River and town of Manacapuru (03º32'36.6"S 60º42'30.7"W), ca. 90 km SW of Manaus. The locals reported that a dog, which attacked the mating snakes, died from envenomation. After the attack the snakes continued to mate until the locals killed them. Both the male (84 cm SVL) and female (122 cm SVL) were deposited in the Instituto Nacional de Pesquisas da Amazônia Herpetological Collection (INPA-H 11674 and 11675).

In both of these observations, the female was dark brown and

larger, while the male was lighter (yellowish) brown and smaller. Although sexual dichromatism has not been reported in *B. atrox*, it has been reported for closely related species such as adult *Bothrops moojeni* (Leloup 1975. Acta Zool. Pathol. Antverp. 62:173–201), juvenile *B. asper* (Burger and Smith 1950. Science 112:431–433), and newborn *B. jararacussu* (Marques and Sazima 2003. Herpetol. Rev. 34:62).

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COLUBER CONSTRICTOR (Racer). **REPRODUCTION**. In many animal species a single mating is sufficient for reproductive success. Consequently, female reproductive success might not typically increase as a result of mating with multiple males (Barry et al. 1992. Behav. Ecol. Sociobiol. 30:193–199). Conversely, evidence from the European Adder (*Vipera berus*) suggests that multiple mating by females might benefit offspring viability (Madsen et al. 1992. Nature 355:440–441), and polyandry (and multiple paternity) have been reported from an increasing variety of snake taxa (Garner et al. 2002. Copeia 2002:15–23). Because it is generally thought that male snakes are unable to force copulations, behaviors such as multiple mating would be dictated by female choice (however see Shine et al. 2000. Behav. Ecol. Sociobiol. 48:392–401).

During the spring of 2004 in Rutherford County, Tennessee (USA), a radio tagged female *Coluber constrictor* was observed on four separate occasions either copulating with, or in close proximity to, three different males. On 28 April, she copulated with a telemetered male. The pair were joined for ca. two minutes before separating. On 4 May, the same female was observed copulating with a second male. The pair continued to copulate for ca. one minute before separating because of disturbance. On 8 May, the female was again located, and a third male *C. constrictor* was observed 3 m from the female's location. The male snake exhibited typical trailing behavior in the direction of the female. On 10 May, the female was located and found to be underground, and the telemetered male first observed mating with her on 28 April was within 10 cm of the opening of the hole she occupied. These observations demonstrate, for the first time, that the mating system of *C. constrictor* includes polyandry. These observations also suggest that males may court the same female multiple times.

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COLUBER CONSTRICTOR CONSTRICTOR (Northern Black Racer). **BEHAVIOR.** Entanglement of snakes, including *C. constrictor*, in plastic netting has been documented by Stuart et al. (2001. Hepertol. Rev. 32:162–164) in terrestrial habitats. Robin Jung (pers. comm.) reported that in Shenandoah National Park, Virginia, 42 leaf litter bags in each of nine streams in a month-long sampling period yielded two dead Northern Watersnakes (*Nerodia sipedon*) and a dead Northern Green Frog (*Rana clamitans*). We used leaf litter bags (plastic netting; Pauley and Little 1998. Banisteria 12:32–36) to study streamside salamander communities in a small stream in Anderson County, Tennessee. We placed 18 litter bags in a first-order stream at the University of Tennessee Forestry Experiment Station and checked them twice a week from April through August for three seasons (2001–2003). During the second year of study, four adult *C. constrictor* were found on separate occasions (18 and 27 June, 18 and 23 July) entangled in separate leaf litter packs (963, 1045, and ca. 700 mm SVL; one unmeasured). Although each was unable to escape from the netting, only one was dead. One *Pseudotriton ruber* larva (35 mm total length) and one unidentified salamander larva (14 mm total length) were found alive in two of the litter bags after the snakes had been cut out of their bags.

These racers may have become entangled in the leaf litter bags while foraging for food. Ernst and Ernst (2003. Snakes of the United States and Canada. Smithsonian Inst. Press, Washington, DC, 668 pp.) describe *C. constrictor* habitat in the east as being dry with some water available nearby and noted that potential habitats are sometimes adjacent to swamps and marshes. Within the same study site described above, we have observed radio-tagged *C. constrictor* along stream margins, but have not found them foraging in streams. Mitchell (1994. The Reptiles of Virginia. Smithsonian Inst. Press, Washington, DC, 352 pp.) lists numerous prey of *C. constrictor*, including Northern Dusky Salamanders (*Desmognathus fuscus*), Northern Watersnakes (*N. sipedon*), and Common Gartersnakes (*Thamnophis sirtalis*). Besides this reference and Ernst and Ernst (2003, *op. cit.*), there are few records of racers preying on salamanders. Our single record of a live *N. sipedon* in a leaf litter bag on 7 June 2001 supplements Jung's observation (see above). Although stream foraging has not been described for *C. constrictor*, our capture records in stream litter bags, in conjunction with their catholic diet, suggest that racers may occasionally forage in water. Researchers using litter bags in streams to study salamanders should be aware of the potential danger to frogs and snakes.

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CROTALUS ATROX (Western Diamond-backed Rattlesnake). **DIET**. Although mammals constitute the majority of prey items taken by *Crotalus atrox*, several reports have documented that birds represent a small percentage of their diet (Spencer 2003. Geographic Variation in the Diet, Morphology, and Reproduction of a Widespread Pitviper, *Crotalus atrox*. Ph.D. dissertation. Univ. Texas, Arlington, Texas. 177 pp.; Werler and Dixon 2000. Texas Snakes: Identification, Distribution, and Natural History, Univ. of

Texas Press, Austin. 372 pp.). The majority of bird predations have been documented from stomach content analysis (Beavers 1976. Southwest. Nat. 20:503–515; Spencer, *op. cit.*). Herein we report a previously undocumented bird species as prey for *C. atrox*.

At 1520 h on 12 October 2002 a small adult *C. atrox* (ca. 800 mm SVL) was observed striking, killing, and consuming an adult Western Meadowlark (*Sturnella neglecta*) along the Colorado River Aqueduct in Pinto Gap (ca. 8 km NE of the Eagle Mountain Pumping Plant), San Bernardino County, California (USA). The bird landed on a concrete bank within 0.3 m of the rattlesnake, which lay coiled under an adjacent Brittlebush (*Encilia farinosa*). The snake struck ca. 5 sec after the bird landed and held onto it for ca. 6 minutes before it was immobilized and ingested.

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CROTALUS CATALINENSIS (Santa Catalina Island Rattlesnake). **DIET and MORTALITY.** On 19 April 2004 a thin, gray-phase male *Crotalus catalinensis* (580 mm SVL, 50 mm TL) was found dead under an Iron Tree (*Ebenopsis confinis*) on Isla Santa Catalina, México. An exceptionally large *Dipsosaurus catalinensis* (Cachorón Lizard; 130 mm SVL, 250 mm TL) was lodged in the snake's mouth and esophagus. Developmental stages of fly (*Sarcophaga* and *Cochliomyia*) larvae on the corpses suggest that death occurred approximately a week earlier. In addition, we have observed prey remains consistent with *D. catalinensis* in 13 of 83 (15.7%) scats obtained from *C. catalinensis* since 2003.

Examples of large snakes eating larger prey are common in the literature (e.g., Klauber 1982. Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind. Univ. of California Press, Berkeley, California. 350 pp.) and cost-benefit trade-offs associated with this behavior are addressed by Arnold (1993. *In* Seigel and Collins [eds.], Snakes: Ecology and Behavior, pp. 87–115. McGraw-Hill, New York.). This is the first published record of *D. catalinensis* in the diet of *C. catalinensis*, and the first observation of attempted ingestion of a seemingly fatal meal by *C. catalinesis*. Both predator and prey are endemic to Isla Santa Catalina (Grismer 2002. Amphibians and Reptiles of Baja California, Including its Pacific Islands and the Islands in the Sea of Cortés. University of California Press, Berkeley, California. 409 pp.).

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CROTALUS VIRIDIS VIRIDIS (Prairie Rattlesnake). **DIET.** Many diet studies implicitly assume that items found in gastrointestinal tracts were taken alive, and the importance of carrion in the diet of some snakes might be underestimated (DeVault and Krochmal 2002. Herpetologica 58:429–436). Evidence for scavenging by snakes continues to accumulate and scavenging appears to occur fairly frequently among pitvipers and aquatic snakes (DeVault and Krochmal, *op. cit.*).

Just after noon on 24 June 2003 we found an adult *C. viridis* (ca. 900 mm TL) directly below an active Ferruginous Hawk (*Buteo regalis*) nest on the USDA-Forest Service Rita Blanca National Grasslands in Dallam County, Texas. The snake had ingested a large food item. Forced regurgitation revealed the freshly ingested cranial half of a *Cratogeomys castanops* (Yellow-faced Pocket Gopher) whose total length was estimated at 120 mm.

Buteo regalis frequently consume pocket gophers (Giovanni 2004. Prey Partitioning Between Sympatric Grassland Raptors. M.S. Thesis. Texas Tech University, Lubbock. 84 pp.) and prey remains often accumulate at the base of their nests (Marti 1987. *In* Giron Pendelton et al. [eds.] Raptor Management Techniques Manual. Raptor Food Habits Studies, pp. 67–80, National Wildlife Federation, Washington, D.C.). As there was no sign of the posterior half of the food item, it appears that the *C. castanops* was scavenged by the snake after falling from the nest. Raptor nest sites might provide convenient scavenging sites during the birds' breeding season months. DeVault and Krochmal (*op. cit.*) reviewed three prior cases of scavenging in this species, but this is the first incidence of finding scavenged food in the stomach of *Crotalus viridis*.

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DIADOPHIS PUNCTATUS STICTOGENYS (Mississippi Ring-necked Snake). **DIET.** *Diadophis punctatus* are known to feed on plethodontid salamanders (Ernst and Barbour 1989. Snakes of Eastern North America. George Mason Univ. Press, Fairfax, Virginia. 282 pp.) and *D. punctatus stictogenys* are commonly encountered on rocky hillsides in mountainous regions of Arkansas (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

On 10 September 2004 we found a *D. p. stictogenys* (ASUMZ 28733; 217 mm SVL, 44 mm tail length) in direct contact with an adult female *Plethodon albagula* (SVL 69 mm) in a crevice ca. 10 m from the entrance to Spillway Mine, Garland County, Arkansas. A single *P. albagula* egg was found on the floor of the mine below the snake and salamander. The snake was captured (1600 h) and put on ice (1700 h). Necropsy (2100 h) revealed eight eggs (ASUMZ 28734; six fully intact and two ruptured) in the snake's stomach. The six unruptured eggs averaged 5.59 mm in diameter. The snake weighed 4.93 g before necropsy and 3.68 g after the eight eggs (0.94 g total mass) were removed.

Konvalinka and Trauth (2003. Herpetol. Rev. 34:378) report a *Thamnophis sirtalis sirtalis* (Eastern Gartersnake) preying upon an adult *P. albagula* in this mine shaft. Furthermore, *D. p. stictogenys* has been seen in this same mine shaft during previous nesting seasons (three observations) and in one instance was observed preying upon an egg mass (R. R. Jordan, pers. observ.). Female *P. albagula* brood their clutches in crevices and on ledges on the mine shaft walls from August through December (Trauth et

al., *op.cit.*), and female *Plethodon cinereus* are known to abandon eggs when attacked by *D. punctatus* (Bachman 1984. Herpetologica 40:436–443). Thus, although the microclimate of the mine appears to be optimal for *P. albagula* nesting, we hypothesize that the openness of the brooding site increases the risk of predation.

We thank R. R. Jordan, B. A. Wheeler, and the U.S. Forest Service for assistance.

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IMANTODES CENCHOA (Chunk-headed Snake, Bejuquilla). **DIET**. The diet of *Imantodes cenchoa* is comprised primarily of *Anolis* lizards and frogs (Henderson and Nickerson 1976. J. Herpetol. 10:205–210; Myers 1982. Amer. Mus. Novitates 2738:1–50; Scott 1983. *In* Janzen [ed.], Costa Rican Natural History, p. 402. The University of Chicago Press, Chicago), but also includes eggs of leaf-breeding anurans such as *Agalychnis* (Scott and Starrett 1974. Bull. So. California Acad. Sci. 73:86–94). On 21 May 2004 an adult female *I. cenchoa* (MHUA 14312, 759 mm SVL, 1093 mm TL, 35 ml volume) was collected from a disturbed primary forest at “El Chaquiral” farm (6º59'00"N, 75º08'05"W; ca. 1700 m elev.) in El Retiro, Anorí municipality, Antioquia Department, Colombia. A female *Anolis mariarum* (61.5 mm SVL, 4 ml volume) was in the snake’s stomach and had been ingested head-first. This is the first report of *Anolis mariarum* in the diet of *I. cenchoa* throughout their distribution in Colombia.

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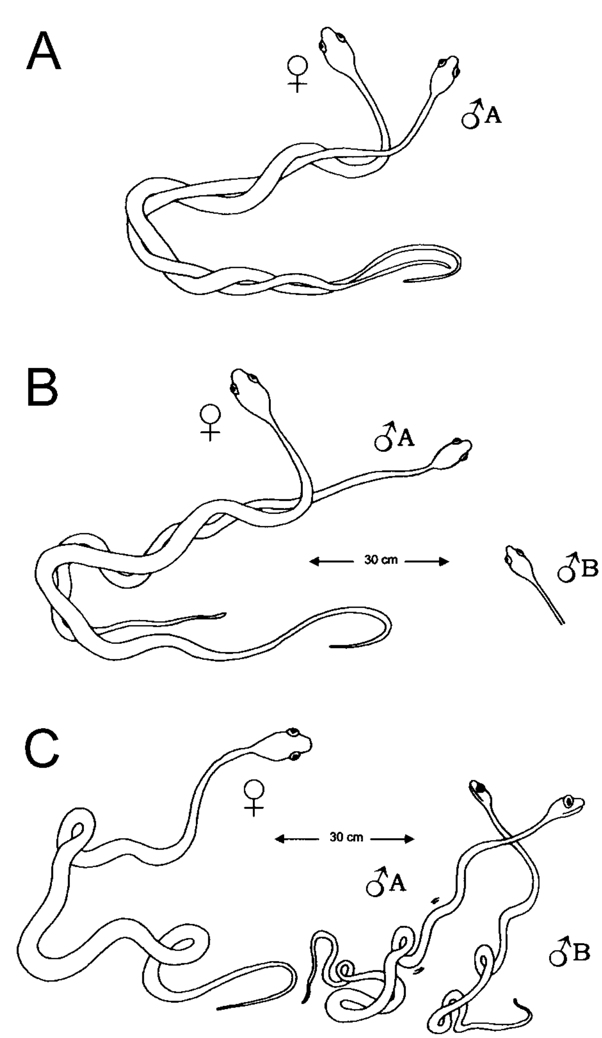

FIG. 1. Mating and fighting in *Imantodes cenchoa*.

IMANTODES CENCHOA (Chunk-headed Snake). **MATING.** Records of mating in Neotropical snakes are scarce, especially for Amazon species (Feio et al. 1999. Herpetol. Rev. 30:99; Cechin and Hartmann 2001. Herpetol. Rev. 32:187). Here, we report mating and fighting by arboreal *Imantodes cenchoa* (Colubridae) in the field. At 1910 h on 8 October 2001 a female (MPEG 20023, 792 mm SVL, 23.2 g) and two males (MPEG 20025, 760 mm SVL, 13.9 g [male A]; MPEG 20024, 742 mm SVL 14 g [male B]) were observed at the top of a tree (3.5 m high) in primary forest at “Estação Científica Ferreira Penna” (1°42'30"S, 51°31'45"W), Pará, Brazil. The female and male A were entwined and obviously mating (Fig. 1A). Male B was 30 cm away on an adjacent branch at the same level. Male B displayed undulating parallel movements and tongue-flicked, but did not touch the mating pair (Fig. 1B). After 20 minutes of observation, the mating pair separated and male B remained distant. Male A approached male B and laterally undulated the anterior portion of his body (but stayed in the same place) for ca. one minute. At this point male A contacted male B, with the anterior portion of his body, forcing male B down and away (Fig. 1C). This sequence was repeated several times before male B retreated. The female remained immobile during the males’ interactions**.** After the observations, the specimens were collected and dissected; all were sexually mature and devoid of prey remains.

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LAMPROPELTIS PYROMELANA (Sonoran Mountain Kingsnake). **MAXIMUM LENGTH.** The maximum length reported for *Lampropeltis pyromelana* is 1088 mm TL (Boundy 1995. Bull. Chicago Herpetol. Soc. 30[6]:109–122; Boundy and Balgooyen 1988. Herpetol. Rev. 19:26–27). On 7 July 1995 at

1248 h we captured a male *L. p. pyromelana* at 2037 m in Indian Creek Canyon, Animas Mountains (Hidalgo County, New Mexico, USA) that measured 1114 mm TL (945 mm SVL) and weighed 139 g. The snake was PIT tagged (7F7B0F4840) and released. Between 1994 and 2002 we captured (including recaptures) 55 *L. pyromelana* in the Animas Mountains. Males averaged 627 ± 23 (SD) mm SVL (N = 45, range 274–945) and 741 ± 30 mm TL (N = 40, range 331–1114). Females averaged 635 ± 43 mm SVL (N = 10, range 258–712) and 740 ± 49 mm TL (N = 10, range 313–839).

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LEPTOPHIS AHAETULLA MARGINATUS (Southern Green Parrot Snake). **DIET**. *Leptophis ahaetulla marginatus* is a diurnal, arboreal snake known to prey on lizards, birds and their eggs, and hylid frogs (Oliver 1948. Bull. Am. Mus. Nat. Hist. 92:280; Lopez et al. 2003. Herpetol. Rev. 34:68–69). We discovered a Veined Treefrog (*Phrynohyas venulosa*; SVL 66 mm) in the stomach of an adult female *L. a. marginatus* (SVL 875 mm) collected in Foz do Iguaçu (25°33'S, 4°34'W), Paraná, Brazil and deposited in the Instituto Butantan (IB 44678). *Phrynohyas venulosa* exude sticky, toxic secretions that deter predation by some colubrids (*Drymarchon corais*, Leary and Razafindratsita 1998. Amphibia-Reptilia, 19:442–446; *Leptodeira annulata*, Manzanilla et al. 1998. Herpetol. Rev. 29:39–40). However, *P. venulosa* have been recorded in the diet of other colubrids: *Liophis poecilogyrus* (Jorge-da-Silva et al. 2003. Herpetol. Rev. 34:69–70) and *Leptophis mexicanus* (Henderson and Nickerson 1977. J. Herpetol. 11:230–231. This is the first record of predation of *P. venulosa* by *Leptophis ahaetulla*.

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NAJA MELANOLEUCA (Forest Cobra). **LONGEVITY.** Some species of large snakes are known to be relatively long-lived. Bowler (1975. Longevity of Reptiles and Amphibians in North American Collections. SSAR Herpetol. Circ. 6. 32 pp.) reports over 14 years for *Dendroaspis angusticeps*, 17 years for *Naja naja*, and 29 years for *Naja melanoleuca*; all captive snakes maintained in zoos. In early July 1971, Melbourne Zoo, in Victoria, Australia, received a pair of Forest Cobras (*Naja melanoleuca*) from John Leakey in Kenya, as part of a larger shipment of reptiles. Both snakes were adults (ca. 160 cm TL) and were placed on public exhibit in the Zoo's Reptile House. One of the snakes died 14 days after arrival. The remaining specimen, a female, was anaesthetized on 17 February 2004, for surgical examination of an abdominal mass. An abscess on her left ovary and compromised liver were discovered, and the snake failed to recover from surgery. At the time of her death, she weighed ca. 2200 g and measured 2035 mm SVL (2390 mm TL). She had been in the collection for 32 years, 7 months, and 4 days. Allowing an estimated age of at least two years at the time of her arrival, we conservatively estimate that she exceeded 34 years of age at the time of her death. As far as can be determined, this represents a longevity record for this species and perhaps for elapids overall.

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NERODIA SIPEDON (Northern Watersnake). **STOMACH CONTENTS**. The diet of *Nerodia sipedon* consists mainly of fishes and amphibians, with a small percentage of reptiles, mammals, birds, and invertebrates (Gibbons and Dorcas 2004. North American Watersnakes: A Natural History. University of Oklahoma Press. 438 pp.). On 2 June 2004 at Dow Lake in Athens, Ohio (USA), a single *N. sipedon* was captured and its stomach contents palpated. This adult female (690 mm SVL, 797 mm TL, 220 g) regurgitated an acorn from a White Oak (*Quercus alba*). No other items were regurgitated.

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OXYBELIS FULGIDUS (Green Vine Snake). **DIET**. *Oxybelis fulgidus* is diurnal and primarily arboreal when active (Martins and Oliveira 1998. Herpetol. Nat. Hist. 6:78–150) and preys primarily on small lizards (*Ameiva*, *Anolis*, and *Norops*) and birds (*Pipra*, *Traupis*, and *Volatinia*; Leenders and Colwell 2003. Herpetol. Rev. 34:152; Martins and Oliveira, *op. cit*.). Although *O. fulgidus* is primarily an ambush predator (Henderson and Binder 1980. Milwaukee Publ. Mus. Contrib. Biol. Geol. 37:1–38), it occasionally actively forages for prey (Martins and Oliveira, *op. cit*.; Leenders and Colwell, *op. cit.*). Here, we describe the behavior of an *O. fulgidus* preying upon a bird. At ca. 1445 h on 8 May 2004, at Parque da Araras (03º03'0.81"S; 60º17'0.93"W), Manaus, Amazonas, Brazil, we watched an adult *O. fulgidus* (ca. 1500 mm TL) capture and consume an *Elaenia* sp. (Tyrannidae: Passeriformes). The snake was ca. 7 m up in a tree when the bird perched near it. The snake seized the bird in the left scapular region and held it for ca. 8 minutes, at which point it had become immobilized by the snake's Duvernoy's gland secretions. Ingestion lasted ca. 20 minutes.

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PITUOPHIS CATENIFER SAYI (Bullsnake). **PREDATION**. Although Coyotes (*Canis latrans*) have been mentioned as a predator of broadly sympatric *Pituophis catenifer* (e.g., Ernst and Ernst. 2003. Snakes of the United States and Canada. Smithsonian Books, Washington. 668 pp.; Koch and Peterson. 1995. Amphibians and Reptiles of the Yellowstone and Grand Teton National Parks. University of Utah Press, Salt Lake City. 188 pp.), few definitive reports of such predation exist in the literature. Furthermore, these few reports are dated and concentrated in the western United States. Fitch (1949. Am. Midl. Nat. 41:513–579) published detailed data regarding coyotes preying upon *P. catenifer* in California. Johnson (1936. J. Mammal. 17:169–170) reported witnessing a coyote kill and consume what he believed was a *P. catenifer* in Arizona. However, according to his report, he was never closer than within 200 ft of the coyote or the snake, did not report a scientific name for the snake, and was never able to inspect the carcass of the snake for positive specific or subspecific identification. Here we report evidence of *C. latrans* predation on *P. catenifer* and provide information suggesting that predation might occur at relatively high frequency.

During the summer of 2004 we radio-tracked 23 *P. catenifer sayi* in the Lower Wisconsin River Valley, Sauk County, Wisconsin (USA). On 2 July 2004 we located a radio-tagged female *P. catenifer sayi* (1195 mm SVL, 1010 g) in a *C. latrans* den. After a week of no movement, we believed the snake might have been consumed by a *C. latrans*. On 15 July 2004 we searched the area surrounding the den entrance and found a pile of *C. latrans* scat that appeared to have been passed several days earlier. This scat contained many small rodent bones and a large number of snake ventral scales. The size and shape of these scales suggested they were those of *P. catenifer* and not one of the other three snakes known from this study site (*Coluber constrictor*, *Heterodon platirhinos*, *Lampropeltis triangulum*).

Furthermore, between 16 May and 18 August 2004, six additional radio-tracked adult (4M:2F) *P. catenifer* were killed and eaten by carnivorous mammals in lowland oak savannah habitat immediately adjacent to open sand prairie and bluffs. In two instances, the transmitters were found within a *C. latrans* den; in two other instances the chewed carcass of the snake (with transmitter) was discovered; and in the remaining two instances, the transmitter (with evidence of carnivorous mammal teeth marks) was found with no carcass. Although all six of these observations are consistent with predation by *C. latrans*, in only one case was scat containing snake scales found adjacent to the coyote den entrance. Although we also radio-tracked 21 *P. catenifer* during the spring and summer of the preceding year (2003), none was preyed upon.

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PROTOBOTHROPS JERDONII XANTHOMELAS (Chinese Mountain Pitviper). **REPRODUCTION.** Few data exist in herpetological literature on the reproductive biology of any of the three subspecies of *Protobothrops jerdonii*. Pope (1935. The Reptiles of China. Amer. Mus. Nat. Hist., New York. 604 pp.) summarized data on litter size from females originating from Szechwan Province, China. Smith (1981. The Fauna of British India, Ceylon, and Burma. Reptilia and Amphibia, Vol. III, Serpentes. Today and Tomorrow's Printers and Publishers, New Delhi. 583 pp.) noted that young from Burma are "7 to 8 inches" long. Here I report a litter born to an adult female *Protobothrops jerdonii xanthomelas* (710 mm SVL, 135 mm TL, and 98.8 g after parturition) collected from the wild in Szechwan Province, China on 16 June 2004. On 3 August 2004 she gave birth to six neonates in captivity. Neonates had a mean SVL of 209.5 mm ± 5.4 SD (range = 199–219 mm), a mean TL of 42.3 mm ± 4.3 SD (range = 37–49 mm), and a mean mass of 6.3 g ± 0.45 SD (range = 5.85–6.98 g).

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PSEUDOERYX PLICATILIS PLICATILIS (Eel Snake)**. REPRODUCTION**. Little is known about the reproductive biology of *Pseudoeryx plicatilis*, and what few isolated anecdotal observations exist pertain to *P. plicatilis mimeticus* (Cunha and Nascimento 1981. Bol. Mus. Paraense Emílio Goeldi, nov. sér: Zool. 109:1–20). On 7 January 2002, D. Amaral collected an adult female *P. plicatilis plicatilis* (1370 mm SVL, 1577 mm TL) and her clutch of 49 eggs from Santarém (2°26'S, 54°42'W) on the right bank of the River Tapajós, Pará State, Brazil. The female and her freshly laid eggs (covered with viscous liquid when found) were found inside a drainage pipe and donated to our lab. The eggs contained fully developed juveniles. Forty-eight of 49 eggs hatched between 7 and 10 January 2002; the remaining egg contained a fully developed snake that failed to hatch. Female hatchlings (N = 26) averaged 186 mm SVL (171–200, SD = 8.8), 222 mm TL (202–236, SD = 7.7), and 8.0 g (5.6–9.3, 0.9). Male hatchlings (N = 22) averaged 180 mm SVL (168–187, SD = 4.8), 224 mm TL (207–234, SD = 6.3), and 7.8 g (5.5–10.4, SD = 0.9). The juveniles were kept in captivity until they had shed, which ranged from 11 to 18 days after hatching. The specimens are deposited in the scientific collection of the Laboratório de Pesquizas Zoologicas (LPZ) of the Faculdades Integradas do Tapajós (FIT).

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PSEUSTES POECILONOTUS and ***PSEUSTES SHROPSHIREI*** (Puffing Snakes). **DIET**. *Pseustes poecilonotus* is known to prey on birds (Falconidae, Emberizidae), bird eggs

(Cracidae), and occasionally on lizards and small mammals (Martins and Oliveira 1998. Herpetol. Nat. Hist. 6:78–150). There is no published information regarding *Pseustes shropshirei* diet. On 9 January 1991 a specimen of *P. poecilonotus* (Universidad San Francisco de Quito y Fundación Herpetológica Orcés; FHGO-USFQ 0192) was collected on the Río Payamino at Pozo Gacela, Province of Napo, Ecuador, that contained one adult beetle (Coleoptera: Scarabeidae), one moth (Lepidoptera), parts of a grasshopper (Orthoptera), parts of a bug (Hemiptera), and two legs of a woodpecker (Piciformes: Picidae). On 25 March 1994 a specimen of *P. shropshirei* (FHGO-USFQ 0892) collected at Piñas, Buenventura, Province of El Oro, Ecuador, contained a capsule of seeds from an undetermined plant (ca. 2 cm in diameter) and two white brittle-shelled eggs (ca. 3 cm in diameter) with partially developed avian embryos.

I thank Jean-Marc Touzet, Ana María Velasco, Daniel Proaño, María Olga Borja, Ma. Elena, and Laura Heredia for assistance.

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RAMPHOTYPHLOPS MULTILINEATUS (Striped Blind Snake). **BEHAVIOR**. Scolecophidians typically are regarded as fossorial. However, recent reviews (Das and Wallach 1998. Herpetol. Rev. 29:15–16; Gaulke 1995. Asiatic Herpetol. Res. 6:45–48) report both literature and novel records of arboreality in scolecophidians. Most of these records involve observations of snakes 0.5–5 m up the trunk of trees or climbing in limbs or palm fronds. However, Taylor (1922. The Snakes of the Philippine Islands. Bureau of Printing, Manila. 312 pp.) reported the occurrence of *Ramphotyphlops cumingii* (in his description of *Typhlops dendrophis*) in the root masses of aerial ferns (*Asplenium* sp.) from "high forest trees" where he suggested they feed on ant larvae and centipedes. We report here on climbing behavior in a specimen of *Ramphotyphlops multilineatus* (verified by V. Wallach) from the Crater Mountain Biological Research Station at Wara Sera, Chimbu Province, Papua New Guinea (6°43'S, 145°05'E). These snakes and their close relatives often prey upon ant pupae, larvae, and adults as well as termites (Shine and Webb 1990. J. Herpetol. 24:357–363; Webb and Shine 1993.Copeia 1993:762–770; Webb et al. 2001. J. Zool. London 250:321–327). This specimen (BSFS 11672, National Museum and Art Gallery of Papua New Guinea in Port Moresby) was collected at a height of 8 m from an interior chamber of a carpenter ant nest at the base of an epiphytic staghorn fern growing on the side of a large tree.

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SALVADORA MEXICANA (Mexican Patch-nosed Snake). **REPRODUCTION.** *Salvadora mexicana* is known to be oviparous (García and Ceballos 1994. Field Guide to the Reptiles and Amphibians of the Jalisco Coast, México. Fundación Ecológica de Cuixmala, A.C., Centro de Ecología, UNAM, México, D.F.), but to my knowledge there is no other published information on its reproduction. The purpose of this note is to provide additional information on the reproductive cycle of *S. mexicana* based on histological examination of gonads removed from museum specimens.

I examined three female (703 ± 109 mm SVL, range 596–813 mm) and four male (747 ± 44 mm SVL, range 710–805 mm) *S. mexicana* from the herpetology collections of the Natural History Museum of Los Angeles County (LACM) and the University of Arizona (UAZ). Histological procedures follow Goldberg (2004. Herpetol. Rev. 35:59). Spermiogenesis was in progress and the vas deferens contained sperm in all four males examined (LACM 136964, June, 716 mm SVL; LACM 25930, July, 756 mm SVL; LACM 75063, July, 805 mm SVL; LACM 58144, September, 710 mm SVL) indicating a prolonged period of sperm production. A female (LACM 2691; 700 mm SVL) collected in June from Jalisco contained 4 oviductal eggs. A female (LACM 74033; 813 mm SVL) collected in July from Guerrero contained three enlarged follicles (mean length = 27.4 mm ± 4.4 SD). Another female (UAZ 26331; 596 mm SVL) captured in August from Colima was undergoing yolk deposition (= secondary vitellogenesis *sensu* Aldridge 1979. Herpetologica 35:256–161), suggesting that some females might produce a second clutch of eggs the same year. These are the first clutches reported for *S. mexicana.*

I thank D. A. Kizirian (LACM) and G. L. Bradley (UAZ) for permission to examine specimens.

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SISTRURUS CATENATUS (Eastern Massasauga). **MATING ACTIVITY**. Narrative reports of reproductive behaviors by free-ranging snakes are infrequent, yet accretion of such observations is essential to characterizing mating systems and reproductive phenology. Here we describe reproductive behaviors observed during the course of a radio-telemetric study of adult *Sistrurus catenatus* conducted during summer and fall of 1993 in Will County, Illinois (Wilson and Mauger 1999. *In* B. Johnson and M. Wright [eds.], Second International Symposium and Workshop on the Conservation of the Eastern Massasauga Rattlesnake, *Sistrurus catenatus catenatus*, pp. 110–134, Toronto Zoo, Toronto, Ontario).

On 27 July at 2000 h we found an unmarked male coiled on top of a radio-tagged female (10L; 570 mm SVL), but the male escaped into tall dense vegetation. On 29 July at 2000 h we observed a male (possibly the same male) coiled on top of 10L. The male (8L9L; 665 mm SVL) was removed and surgically implanted with a radio-transmitter. On 2 August at 1900 h, another male (7L; 600 mm SVL) found on top of 10L was captured. On 07 August we released 7L next to 10L, although he moved away and subsequently was never found with 10L. During the time 7L was removed, no other males were found with 10L. Male 8L9L was released on 07 August at his last point of capture but did not immediately approach 10L, even though the snakes were close. On 12 August 8L9L was again coiled on top of 10L and for the next 19

days remained either coiled on top of, next to, or in close proximity (< 2m) to her. On 17 August 8L9L and 10L were coiled together with the posterior third of their bodies intertwined. We could not determine if the cloacae were in apposition, nor did we observe any other behaviors characteristic of courtship or copulation. By 31 August 8L9L was coiled alone 15 m from 10L and no subsequent interactions between the pair were observed. On 17 September male 8L9L was found coiled atop another female (8R; 550 mm SVL). After capturing and marking 8R, we released her at 8L9L's location on 18 September and she moved away and 8L9L did not follow. Subsequent observations were not possible due to failure of 8L9L's transmitter on 20 September.

After a prolonged period of accompaniment by 8L9L, 10L made frequent movements and on 9 September at 1350 h was found copulating with another male (3L, 590 mm SVL). At 1415 h they separated, possibly because of our presence. Although we tracked snakes on a daily basis as late as early November, no further reproductive behavior was observed by 10L after 9 September. Our third snake, male 6R (555 mm SVL), showed no reproductive behavior throughout the study.

Multiple observations of males coiling on top of females and the prolonged accompaniment exhibited by 8L9L are behaviors consistent with female defense polygyny. However, because we did not observe any male-male interactions, it is unclear if these behaviors constitute mate-guarding. Male *S. catenatus* have also been observed coiled on top of females during the mating season at Lake Carlyle, Illinois (M. J. Dreslik and B. C. Jellen, pers. comm.). A similar behavior (termed "stacking") has been observed in *Crotalus atrox* from central Arizona (J. O'Leile, pers. comm.). Although we only observed female 10L copulating with male 3L, her coiling with two other males, including the prolonged accompaniment by male 8L9L, suggests the potential for multiple mating by females.

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SPILOTES PULLATUS (Tiger Ratsnake). **REPRODUCTION.** *Spilotes pullatus* is a diurnal, semi-arboreal colubrine snake (Marques and Sazima 2004. *In* Marques and Duleba [eds.], Estação Ecológica Juréia-Itatins: Ambiente Físico, Flora e Fauna, pp. 254–274. Holos, Ribeirão Preto, S.P.), that is widely distributed in Brazil (Peters and Orejas-Miranda 1986. Catalogue of Neotropical Squamata. Smithsonian Institution Press, Washington, D.C. 284 pp.).

On 13 November 2003 a female *S. pullatus* (IB 69849: 1650 mm SVL, 210 mm tail length, 920 g after oviposition), collected in Pedro de Toledo (24°16'29"S, 47°13'58"W), São Paulo, southeastern Brazil, was brought to Instituto Butantan (IB). On the same day it laid 12 eggs, averaging 48.2 mm in length (range = 39.8–62.0 mm) and 29.6 mm in width (range = 25.5–34.0 mm). Clutch size reported here exceeds that previously reported for *S. pullatus* (5–10 eggs; Marques and Sazima, *op. cit.*). Relative clutch mass (RCM) was 0.36, which is similar to that reported for other oviparous snakes (Seigel and Fitch 1984. Oecologia 61:293–301). During incubation, ten eggs became infected by fungi and did not hatch. One newborn (male, 350 mm SVL, 115 mm tail length, 15 g) hatched on 8 March 2004. The other egg was dissected on 13 March 2004 and a dead but fully developed neonate was discovered inside (IB 71360; female, 364 mm SVL, 115 mm tail length, 19 g). Marques and Sazima (*op. cit.*) suggested that reproduction in *S. pullatus* is seasonal, although this inference was based on a limited number of preserved specimens (three vitellogenic individuals from July to October, and one with oviductal eggs in November), and one observation of oviposition in October and hatching in January. Our observation is consistent with the notion of seasonal reproduction, with oviposition early in the rainy season and hatching near the end of the rainy season.

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STORERIA STORERIOIDES (Mexican Brown Snake). **REPRODUCTION.** Relatively little has been published regarding reproduction in *Storeria storerioides*. Guillette (1981. Herpetologica 37:11–15) reported that it is viviparous with mating in the fall. Ramírez-Bautista et al. (1995. J. Herpetol. 26:12–13) reported a mean litter size of 5.4 (range 3–10, N = 5) in *S. storerioides* from the state of México. On 27 April 2004 at 1300 h a female *S. storerioides* (Colección Herpetologica, Instituto de Investigaciones sobre los Recursos Naturales, Universidad Michoacana; INIRENA 483) measuring 244 mm SVL (52 mm TL) was found among pine-oak leaf litter 5 km W of Uruapán, Michoacán, México (19°22'4"N, 102°04'6"W, 1660 m elev.). On 23 June 2004 she gave birth in captivity to three neonates, after which she weighed 5 g. The neonates measured (mean ± SD) 69.3 ± 16.2 mm SVL (range: 59–88 mm SVL), 14.0 ± 2.6 mm TL (12–17 mm TL), and 0.1 ± 0.05 g (0.1–0.2 g).

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THAMNOPHIS VALIDUS CELAENO (Baja California Gartersnake). **MORTALITY**. The most common macrobiological source of mortality for gartersnakes is predation by various verte-

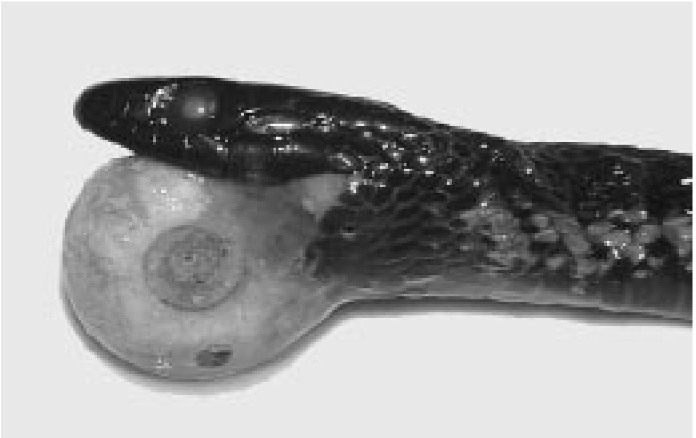

FIG. 1. Subadult *Thamnophis validus celaeno* (UABC 1016) with lower mandibles lodged in the aperture of a freshwater snail (Planorbidae: Planorbella subcrenatum).

brates (Rossman et al. 1996. The Garter Snakes: Evolution and Ecology. Univ. Oklahoma Press, Norman. 332 pp.). To our knowledge, mortality caused by invertebrates has not been reported (but see Schwendiman 2004. Herpetol. Rev. 35:73). Here we describe an apparent accidental case of subadult mortality caused by an aquatic gastropod.

On 02 April 2003 at ca. 1700 h we collected a subadult *Thamnophis validus celaeno* (UABC 1016; 303 mm SVL) from Arroyo Boca de la Sierra in the Sierra la Laguna, ca. 5 km NW of Miraflores (23°23.118'N, 109°49.022'W), Baja California Sur, México. The specimen was found dead on a sandy bank near a pool of water at the base of a concrete dam. The lower mandibles were firmly lodged within the aperture of an aquatic snail's (Planorbidae: *Planorbella subcrenatum*) shell; thus preventing the snake from closing its mouth (Fig. 1). These snails were abundant in the shallows of this and surrounding pools. The diet of *T. v. celaeno*, specifically for populations from the Sierra de la Laguna, is described as consisting entirely of larval and adult anurans and small fish (de Queiroz et al. 2001. Copeia 2001:1034–1042). However, given that snails/slugs have been reported in the diets of other *Thamnophis* species (e.g., *T. elegans*, *T. ordinoides*, *T. sirtalis*; Rossman et al. 1996, *op. cit.*), we examined the stomach contents of UABC 1016 along with two other specimens (UABC 1071, 1316) collected the same day. No prey items were discovered in all three specimens. Nonetheless, we presume that this event represents an accidental occurrence of mortality during a feeding attempt, yet it is possible that the snake did not target this specific prey item. It has been suggested that *T. validus* are less adapted to visual underwater feeding than are other strongly aquatic garter snakes and instead rely more on a tactile open-mouth foraging method (Conant 1969. Bull. Am. Mus. Nat. 142:1–140; de Queiroz 2003. Ethology 109:369–384). It is presumed that the individual died from starvation and/or exhaustion after trying to remove the snail from its mandibles.

We thank Kathryn Perez at the University of Alabama for helping identify the snail.

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TRIMORPHODON BISCUTATUS (Lyre Snake). **DIET.** On 9 April 2003 at 1950 h we observed an adult *Trimorphodon biscutatus* hunting Gray Sac-winged Bats (*Balantiopteryx plicata*) as they exited a small cave known as the Coat of Tláloc located in Area Natural Protegica Sierra Montenegro, Morelos, México (18°30'44.3"N, 99°00'39.8"W, 1104 m elev.). Our observation adds to a growing body of literature that suggests *T. biscutatus* feeds fairly frequently on colonial bats (Krutzsch 1944. J. Mammal. 25:410–411; Sánchez-Hernández and Ramírez-Bautista 1992. Herpetol. Rev. 23:121; Stager 1942. J. Mammal. 23:92).

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TRIMORPHODON TAU (Mexican Lyre Snake). **REPRODUCTION**. Information on reproduction in *Trimorphodon tau* consists of one report of a clutch of seven eggs from a female collected 18 July (McDiarmid and Scott. 1970. Contrib. Sci. 179, Los Angeles County Mus. 43 pp.). Here I report additional information on *T. tau* reproduction. Fifteen males (mean SVL = 548 ± 48 mm SD, range = 477–650 mm) and eight females (705 ± 108 mm SVL, range = 545–870 mm) were examined from the herpetology collections of Arizona State University (ASU), the Field Museum of Natural History (FMNH), Natural History Museum of Los Angeles County (LACM) and the University of Arizona (UAZ). Snakes were collected 1953–1977. Histological procedures follow Goldberg (2004. Herpetol. Rev. 35:59). One August female (LACM 122906, 630 mm SVL) contained 8 enlarged follicles (> 8 mm length) that likely would have ovulated and represent the second published clutch for *T. tau.* One February female (FMNH 71531, 688 mm SVL), three July females (LACM 53024, 545 mm SVL; LACM 125589, 870 mm SVL; LACM 103390, 740 mm SVL), two August females (LACM 122904, 730 mm; UAZ 36377, 823 mm) and one December female (LACM 53206, 617 mm) were not undergoing yolk deposition (= secondary vitellogenesis, *sensu* Aldridge 1979. Herpetologica 35:256–261). All males were undergoing spermiogenesis (= sperm formation). This included one February male (FMNH 71532, 480 mm SVL), one April male (LACM 9157, 561 mm SVL), four July males (ASU 6377, 590 mm SVL; ASU 6684, 562 mm SVL; LACM 127811, 552 mm SVL; LACM 125587, 565 mm SVL), six August males (ASU 6651, 650 mm SVL; ASU 6663, 573 mm SVL; ASU 6712, 495 mm SVL; LACM 7109, 477 mm SVL; LACM 7110, 533 mm SVL; LACM 7111, 572 mm SVL), two September males (UAZ 27023, 480 mm SVL; UAZ 45492, 580 mm SVL) and one November male (LACM 9509, 562 mm SVL). The presence of males undergoing spermiogenesis in winter, spring, summer, and autumn

suggests *T. tau* has a prolonged testicular cycle similar to its congener *Trimorphodon biscutatus*. Males of *T. biscutatus* from Arizona were undergoing spermiogenesis in January and March–October (Goldberg 1995. Southwest. Nat. 40:334–335).

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TROPIDOPHIS PILSBRYI (NCN). **SIZE RECORD.** On 19 September 1980 Orlando H. Garrido and José F. Milera collected a female *Tropidophis pilsbryi* from the grounds of the Asunción Hotel, Maisí, Guantánamo Province, Cuba. This specimen (CZACC 4.12076; Colecciones Zoológicas del Instituto de Ecología y Sistemática, Havana City Province, Cuba) measures 371 mm snout–vent length and 47 mm tail length. A second female *T. pilsbryi* (CTR 27; "Charles T. Ramsden" Collection, deposited at the Instituto de Ecología y Sistemática) collected from Babiney, Hoyo del Río Guaso, Monte Líbano, Guantánamo Province, Cuba by Charles T. Ramsden on 17 February 1931, was erroneously identified as *Tropidophis maculatus* by the collector and later by Orlando H. Garrido and measures 307 mm snout–vent length and 41 mm tail length. The first specimen has 175 ventrals and 36 subcaudals, while the second specimen has 166 ventrals and 28 subcaudals. The previously reported maximum length for this species is 295 mm SVL (Hedges and Garrido 2002. J. Herpetol. 36:157–161). These specimens present external pelvic spurs and also extend the previously reported range of variation in both ventral and subcaudal counts from 160–169 to 160–175 ventrals and from 29–35 to 28–36 subcaudals (Hedges and Garrido 2002, *op. cit.*).

We thank Elier Fonseca and Lourdes Rodríguez Schettino for suggestions on the manuscript.

Submitted by **MICHEL DOMÍNGUEZ** (e-mail: micdom2002@yahoo.es) and **LUIS V. MORENO**, División de Colecciones Zoológicas, Instituto de Ecología y Sistemática, Carretera de Varona km 3, Capdevila, Boyeros, A.P. 8029, C.P. 10800, Ciudad de La Habana, Cuba.

TROPIDOPHIS WRIGHTI (NCN). **REPRODUCTION**. *Tropidophis wrighti* is endemic to Cuba and ranges from Northern Sancti Spiritus Province to Guantanamo Province (Schwartz and Henderson 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History. Florida Univ. Press, Gainesville. 720 pp.). On October 2001 a gravid female *Tropidophis wrighti* (335.5 mm total length) was discovered under a stone in an ecotone between pine forest and xeromorphic sub-thorny thicket on the Pinares de Mayari Plateau, in Sierra de Nipe (645 m elev.), Holguín, Cuba. This female contained a 154.0 mm (TL) neonate. Both specimens are deposited in the herpetological collection at the Institute of Ecology and Systematics (CZACC 4.9479-480). To the best of our knowledge, the only other record of clutch size or neonatal morphometrics in the genus *Tropidophis* is Petzold's (1969. Salamandra 5:124–140) report of a neonate *T. semicintus* (160 mm and 1.5 g, respectively).

Submitted by **ALEJANDRO FERNÁNDEZ VELÁZQUEZ**, Centro de Investigaciones y Servicios Ambientales y Tecnológicos, Grupo de Recursos Naturales, Holguín, Cuba (e-mail: ale@cisat.holguin.inf.cu); and **ROBERTO ALONSO,** Divisón de Zoología de Vertebrados, Instituto de Ecología y Sistemática, Carretera de Varona km 3, Capdevila, Boyeros, AP 8029, CP 10800, Ciudad de la Habana, Cuba (e-mail: zoologia.es@ama.cu).

GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 36, Number 1 (March 2005). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extension reports unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA MACULATUM (Spotted Salamander). USA: NORTH CAROLINA: Henderson Co: 5.6 km SW Tuxedo. 28 March 1997. David A. Pike. Verified by Jeffrey C. Beane. North Carolina State Museum (NCSM slide DAP 97-385). First vouchered county specimen (NCSM files). Egg masses were also observed in a breeding pond at the same locality on 29 March 1997.

Submitted by **DAVID A. PIKE**, Glatting Jackson, Inc., Environmental Services Group, Orlando, Florida 32801,USA (e-mail: dapike22@hotmail.com); **DAVID G. COOPER**, North Carolina State Museum of Natural Sciences, 11 West Jones Street, Raleigh, North Carolina 27601, USA; and **DALE A. JACKAN**, 311 Merrick Road, Tryon, North Carolina 28782, USA.

ENSATINA ESCHSCHOLTZII KLAUBERI (Large-blotched Ensatina). MEXICO: BAJA CALIFORNIA: Sierra de Juárez, ca. 19 km airline S of Laguna Hanson. Two specimens were recorded. The first specimen was seen at Rancho Las Cuevitas, 0.7 km E of, 31˚53.021'N, 115˚55.780'W, 1540 m elev., in pine-oak forest. 8 May 2005. C. D. Heim, B. Alexander. Museum of Vertebrate Zoology (MVZ 249145, photo voucher). The second specimen was located at Rancho Baja Largo del Sur, 2.0 km NW of, 31˚52.304'N, 115˚55.850'W, 1602 m elev., in pine-oak forest, on NE-facing slope, during a rainy day. 29 July 2005. J. H. Valdez-Villavicencio, B. D. Hollingsworth, T. J. Devitt, C. R. Mahrdt, J. A. Soto-Centeno. Universidad Autónoma de Baja California (UABC 1433). Verified by D. B. Wake. First records from the Sierra de Juárez and represents an isolated population that fills a 240 km distributional gap between the Sierra San Pedro Mártir, B.C. (Mahrdt et al. 1998. Herpetol. Nat. Hist. 6[1]:73–76; MVZ 229220–1) and Alpine, San Diego Co., California (Stebbins 1949. Univ. California Publ. Zool. 48[6]:377–526; SDSNH 32525–7). The two Sierra de Juárez localities are 1.5 km from each other in a north–south direction. Unconfirmed reports also exist from the vicinity of Laguna Hanson in the Sierra de Juárez (see overview in Grismer 2002. Amphib-

ians and Reptiles of Baja California Including its Pacific Islands and the Islands in the Sea of Cortés. Univ. California Press, Berkeley and Los Angeles, California. p. 61).

Submitted by **CHARLES D. HEIM**, P.O. Box 528, Kernville, California 93238, USA; **BRAD ALEXANDER**, P.O. Box 1734, Kernville, California 93238, USA (e-mail: alexba@earthlink.net); **ROBERT W. HANSEN**, 16333 Deer Path Lane, Clovis, California 93619, USA (e-mail: rwh13@csufresno.edu); **JORGE H. VALDEZ-VILLAVICENCIO**, Facultad de Ciencias, Universidad Autónoma de Baja California, Km. 103 Carretera Tijuana-Ensenada, A.P. 1653, C.P. 22800, Ensenada, B.C. (e-mail: j_h_valdez@yahoo.com.mx); **THOMAS J. DEVITT**, Museum of Vertebrate Zoology, 3101 Valley Life Sciences Building, University of California, Berkeley, California 94720, USA (e-mail: tdevitt@berkeley.edu); **BRADFORD D. HOLLINGSWORTH**, **J. ANGEL SOTO-CENTENO**, and **CLARK R. MAHRDT**, Department of Herpetology, San Diego Natural History Museum, P.O. Box 121390, San Diego, California 92112-1390, USA (e-mails: bhollingsworth@sdnhm.org [BDH]; asoto@sdnhm.org [JASC]; and Cmahrdt@aol.com [CRM]).

ANURA

ANDINOPHRYNE OLALLAI (Tandayapa Andes Toad). COLOMBIA: NARIÑO: Municipio de Barbacoas: Corregimiento Ortiz y Zamora: Vereda El Barro. Reserva Natural Río Ñambi (1°18'N, 78°05'W), 1500 m elev. Highway Pasto-Tumaco Km 130. 13 October 2001 and 29 March 2002. Colección Zoológica. Universidad de Nariño. Pasto. (PSO 0055–57) and Instituto Ciencias Naturales. Universidad Nacional de Colombia. Bogota (ICN 47711). Verified by J. Lynch. Species previously known only from the type locality, Tandayapa, Pichincha Province, NW Ecuador (0°1'S, 78°46'W) (Hoogmoed 1985. Zool. Med. 59: 251–273). First country record, extends known distribution 160 km NW from the type locality.

Submitted by **JOHANNA MURILLO PACHECO** Corporación Llanera de Ornitología KOTSALA, Calle 8 # 41-125, Villavicencio, Colombia (e-mail: avejohis@yahoo.com); **BELISARIO CEPEDA QUILINDO**, Universidad de Nariño, Facultad de Ciencias Naturales y Matemáticas, Departamento de Biología. Sede Torobajo. Calle 16 # 30-07 Apart. 202, Pasto, Colombia (e-mail: becequi2000@yahoo.com.mx); and **CRISTIAN FLOREZ PAI**, Fundación Ecológica Los Colibríes de Altaquer - FELCA. A.A 384 Pasto, Colombia (e-mail: ffelcacolombia@yahoo.com).

BARYCHOLOS PULCHER (NCN). ECUADOR: PROVINCIA DE AZUAY: Tamarindo (79°33'W, 02°47'S, 400 m). 04 August 1996. J.-M. Touzet et al. Universidad San Francisco de Quito & Fund. Herpetológica Orcés, Quito (FHGO-USFQ 623, 748, collected in the leaf litter). Verified by W. Ron Heyer. This endemic frog is known from western lowlands of Ecuador along the transition zone between rainforest and dry seasonal forest from 30 to 600 m; with previous records in the provinces of Esmeraldas, Manabí, Guayas, Los Ríos, and Pichincha (Heyer 1969. Contrib. Sci. Los Angeles Co. Mus. Nat. Hist. 155:1–14). First province record, extends its range ca. 70 km NE from the nearest known locality (7 km SE Buenavista, province of Oro; Heyer, *op. cit*.).

Submitted by **DIEGO F. CISNEROS-HEREDIA**, College of Biological and Environmental Sciences, Universidad San Francisco de Quito, Ave. Interoceánica y calle Diego de Robles, Campus Cumbayá, Edif. Maxwell. Casilla Postal 17-12-841, Quito, Ecuador; e-mail: diegofrancisco_cisneros@yahoo.com.

BUFO GUTTATUS (Spotted Toad, Smooth-sided Toad): ECUADOR: PROVINCIA SUCUMBÍOS, Reserva de Producción Faunística Cuyabeno: Puerto Bolívar, (00°05'19"S, 76°08'31"W, 240 m elev.) 05, 07 and 14 August 2003. M. Guerrero, P.A.Menéndez and M.R.Bustamante. Museo de Zoología, Pontificia Universidad Católica del Ecuador, Quito, Ecuador (QCAZ 26013–4, 26414). 4 km N of Tarapoa (00°07'24"S, 76°20'24"W, 230 m elev.). 20 July 2000. D. F. Cisneros Heredia, M. Brandt, A. León, and C. Ponce. Laboratorio de Anfibios y Reptiles FHGO-USFQ Universidad San Francisco de Quito (DFCH-USFQ 0715). PROVINCIA ORELLANA: Parque Nacional Yasuní: Tiputini Biodiversity Station (00°37'05"S, 76°10'19"W, 215 m). 23 November 1996. D. Romo. (QCAZ 10211). 11 August and 23 November 1999. D. F. Cisneros Heredia and K. Swing. (DFCH-USFQ 0270, DFCH-USFQ 0710). Estación Científica Yasuní (00°40'16.7"S, 77°24'01.8"W, 250 m). 20 February 2002. I. Tapia and G. Carotti. (QCAZ 19247). All verified by L. A. Coloma. Frost (1985. Amphibian Species of the World. A Taxonomic and Geographical Reference. Allen Press and the Association of Systematics Collections, Lawrence, Kansas; and 2002. Amphibian Species of the World. [on line]. V2.21 [15 July 2002]). Museum of Natural History. New York, http://research.amnh.org/herpetology/amphibia/index.html) reports this species from Colombia, Guyanas, Venezuela, Amazonian and central Brazil and Ecuador, although no published records with associated voucher specimens were available for Ecuador. Because no vouchers existed, Coloma and Quiguango-Ubillús (2000–2004. Anfibios de Ecuador: Lista de Especies y Distribución Altitudinal [online]. Ver. 1.3 [2 April 2001]). Museo de Zoología, Pontificia Universidad Católica del Ecuador. Quito, Ecuador. « http://www.puce.edu.ec/zoologia/vertebrados/amphibiawebec/index.html) did not include *B. guttatus* in the list of Ecuadorian amphibians. These specimens represent the first vouchered records from Ecuador. Estación Científica Yasuní extends the range of the species ca. 990 km to the west from the nearest known locality "east of Departamento de Vichada" in Colombian Amazonia (Ruíz-Carranza et al. 1996. Rev. Acad. Colomb. Cienc. 20[77]:366–415).

Submitted by **MARTÍN R. BUSTAMANTE** and **PABLO A. MENÉNDEZ**, Museo de Zoología, Centro de Biodiversidad y Ambiente, Escuela de Biología, Pontificia Universidad Católica del Ecuador, Av. 12 de Octubre y Roca, Aptdo. 17-01-2184, Quito, Ecuador (e-mail: mrbustamante@puce.edu.ec); and **DIEGO F. CISNEROS-HEREDIA**, Laboratorio de Anfibios y Reptiles FHGO-USFQ, Universidad San Francisco de Quito, Av. Interoceánica y calle Diego de Robles, edif. Newton Plaza, of. NP004, Casilla Postal 17-12-841, Quito, Ecuador (e-mail: diegofrancisco_cisneros@yahoo.com).

BUFO MARINUS (Cane Toad). LESSER ANTILLES: ST. VINCENT: The Grenadines: Mustique Island, northern part of island by pond at Buttercup House on eastern side of the north end of airstrip, at about sea level. 9 February 2004. M. R. Paice. MPM - P718 (photograph). Verified by Robert W. Henderson. First record

for Mustique Island, although it has been recorded from St. Vincent in general (Schwartz and Henderson 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History. Univ. Florida Press, Gainesville, Florida, xvi + 720 pp). This exotic species, first noticed by islanders in early 2003, was likely an accidental introduction with building material. At least four other individuals were observed near the airstrip, so a breeding colony has probably been established on the island.

Submitted by **MICHAEL R. PAICE**, 8D Rochdale Way, London SE8 4LY, UK; e-mail: mrpaice@yahoo.co.uk.

ELACHISTOCLEIS PIAUIENSIS (Piaui Oval Frog): BRAZIL: CEARÁ: MUNICIPALITY OF MOMBAÇA: Fazenda Minador (05º40'08.25"S, 39º38'20.43"W, elev. 401 m). 15 July 2004. E. Maranhão dos Santos, P. Thieres Pinto de Brito, F. Oliveira Amorim, and I. Joventino Roberto. Verified by M. Trefault Rodrigues and E. M. Xavier Freire. Coleção Herpetologica do Departamento de Botânica, Ecologia e Zoologia, Instituto de Biociência, Universidade Federal do Rio Grande do Norte (CHBEZ 1028). Adult specimen (SVL 21.4 mm). Previously known only from the type locality: Picos, State of Piauí, in northeastern Brazil (Caramaschi and Jim 1983. Herpetologica 39[4]:390–394). First state record, extends the known distribution 258 km SW.

Submitted by **EDNILZA MARANHÃO DOS SANTOS**, Pós-graduação em Psicobiologia, Universidade Federal do Rio Grande do Norte, 59078-970, Natal, RN, Brazil; **FABIANA OLIVEIRA AMORIM**, Laboratório de Ecofisiologia Comportamental, Departamento de Morfologia e Fisiologia Animal, Universidade Federal de Pernambuco, 52171-900, Recife, PE, Brazil; **PAULO THIERES PINTO DE BRITO** and **IGOR JOVENTINO ROBERTO,** Associação de Pesquisa e Preservação de Ecossitemas Aquáticos – AQUASIS. Rua Praia de Iparana, SESC Iparana, Iparana, 61600-000, Caucaia, Ceará, Brazil.

ELEUTHERODACTYLUS CYSTIGNATHOIDES (Rio Grande Chirping Frog). USA: TEXAS: BRAZORIA CO.: City of Alvin, 2216 FM 517. 18 March 2004. Michael James McCoid. Texas Natural History Collection 63681. Verified by Travis LaDuc. First record for this county (Frost 2004. Amphibian Species of the World: an Online Reference. Version 3.0 (22 August, 2004). http://research.amnh.org/herpetology/amphibia/index.php. American Museum of Natural History, New York, USA. The specimen was collected at 0645 h from beneath discarded cardboard. There had been rain the previous evening. Many additional animals were heard calling suggesting the population has been established for some time.

Submitted by **MICHAEL JAMES McCOID**, Department of Pathology, University of Texas Medical Branch, 301 University Blvd., Galveston, Texas 77555-0609, USA; e-mail: mjmccoid@utmb.edu.

GASTROPHYRNE CAROLINENSIS (Eastern Narrow-mouthed Toad). USA: ARKANSAS: JOHNSON CO.: Clarksville city limits. 12 May 2005. Joe Kremers. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 29326). Verified by Stanley E. Trauth. New county record and fills a gap along Arkansas River Valley (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

Submitted by **HENRY W. ROBISON**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA (e-mail: hwrobison@saumag.edu); and **JOE KREMERS**, 2019 Clark Road, Clarksville, Arkansas 72830, USA.

HUIA ABSITA (NCN). VIETNAM: QUANG NAM PROVINCE: Ngoc Linh Mountain Range: Tra My District: 15˚11'41"N, 108˚02'25"E, 930 m asl. 10 March 1999. 15˚09'37"N, 108˚02'26"E, 920–1060 m asl. 26–28 March 1999. Nguyen Quang Truong. American Museum of Natural History (AMNH A-163698 and AMNH A-163729, respectively). Verified by Bryan L. Stuart. First country record for Vietnam (Stuart and T. Chan-ard 2005. Copeia 2005:279–289).

Submitted by **RAOUL H. BAIN**, Center for Biodiversity and Conservation, American Museum of Natural History, Central Park West at 79th Street, New York, New York 10024, USA (e-mail: bain@amnh.org); and **NGUYEN QUANG TRUONG**, Department of Zoology, Institute of Ecology and Biological Resources, Vietnamese Acadaemy of Science and Technology, 18 Hoang Quoc Viet St., Cau Giay, Hanoi, Vietnam (e-mail: truongnq@iebr.vast.ac.vn).

HYLA POLYTAENIA (Striped Treefrog). BRAZIL: ESPÍRITO SANTO: MARECHAL FLORIANO: Alto Nova Almeida (20º 24'S, 40º 49'W). 17 October 2004. R. B. Ferreira. Museu Nacional, Rio de Janeiro (MNRJ 38954). Verified by C. A. G. Cruz and U. Caramaschi. Previously recorded only from the states of Minas Gerais and Rio de Janeiro (Cruz and Caramaschi 1998. Bol. Mus. Nac., Rio de Janeiro, Zool. 392:1–19). First state record extends known distribution ca. 350 km eastwards from Caraça Natural Park, in Minas Gerais, and ca. 300 km to the northeast of Santa Maria Madalena, in Rio de Janeiro (Cruz and Caramaschi, *op. cit.*).

Submitted by **RODRIGO BARBOSA FERREIRA**, Departamento de Biologia, Universidade Federal do Espírito Santo, 29075-910, Vitória, ES, Brazil (e-mail: rodrigoecologia@yahoo.com.br); and **DAVOR VRCIBRADIC**, Departamento de Ecologia, Instituto de Biologia, Universidade do Estado do Rio de Janeiro, 20550-011, Rio de Janeiro, RJ, Brazil (e-mail: davor@centroin.com.br).

HYLA WEYGOLDTI (Weygoldt´s Tree Frog). BRAZIL: MINAS GERAIS: MUNICIPALITY OF ALMENARA: Fazenda Limoeiro, (16º01'77"S, 40º49'96"W). February 2003 and January 2004. P. L. Ferreira, R. N. Feio, and D. L. Pantoja. Museu de Zoologia João Moojen de Oliveira, Universidade Federal de Viçosa (MZUFV 4883–5373). Verified by C. A. G. Cruz. Previously known only from the type locality, in the Municipality of Santa Tereza, Espírito Santo, eastern Brazil (Cruz and Peixoto 1985. Arq. Univ. Fed. Rural Rio de Janeiro 8:63). First state record, extends northern range ca. 450 km airline from type locality.

Submitted by **PAULA LEÃO FERREIRA, DAVI LIMA PANTOJA,** and **RENATO NEVES FEIO,** Museu de Zoologia João Moojen de Oliveira, Universidade Federal de Viçosa, 36571-000, Viçosa, Minas Gerais, Brazil.

LEPTODACTYLUS MYSTACINUS. ARGENTINA: SAN JUAN: DEPARTAMENTO VALLE FÉRTIL: 250 km San Juan city on Las Tumanas river, Ruta Provincial N° 510 (30°52'S, 67°20'W), Janu-

ary 2004. E. Sanabria, L. Quiroga, and F. Cano. Herpetological Collection, Instituto y Museo de Ciencias Naturales, Universidad Nacional de San Juan, Argentina (IMCN-UNSJ 5011). Verified by G. Blanco. Previously known from Argentina in Misiones, Corrientes, Formosa, Chaco, southward to Rio Negro and Chubut, westward to La Pampa and San Luis (Cei 1980, Mon. II Mus. Reg. Sci. Nat. Torino, 609 pp.). First province record, extends the known range ca. 110 km NW of the nearest locality (San Luis Province).

Submitted by **EDUARDO A. SANABRIA, LORENA B. QUIROGA,** and **JUAN C. ACOSTA,** Departamento de Biología e Instituto y Museo de Ciencias Naturales, F.C.E.F. y N., Universidad Nacional de San Juan, Avenida España 400 (N) C.P. 5400, San Juan, Argentina.

OSTEOPILUS SEPTENTRIONALIS (Cuban Treefrog). UNITED STATES VIRGIN ISLANDS: St. John: Virgin Islands National Park, Lameshur Bay Trail, 130 m from end of State Hwy. 107 (18°19'20.3"N, 64°43'44.6"W). 22 June 2001. J. Hardin Waddle. Virgin Islands National Park Collection (VIIS0001563–1567). Verified by Kenneth L. Krysko. First record for St. John and fills the gap between St. Thomas and St. Croix, U.S. Virgin Islands and Tortola and Necker Islands, British Virgin Islands (Schwarz and Henderson 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distribution, and Natural History. Univ. Florida Press, Gainesville, Florida, 720 pp.; Meshaka 2001. The Cuban Treefrog in Florida: Life History of a Successful Colonizing Species. Univ. Press of Florida, Gainesville, Florida, 208 pp.; Owen et al. 2005. Herpetol. Rev. 36:76). Specimens were collected from trees along a hiking trail and from abandoned buildings near Lameshur Bay along southern shore of the Island.

Submitted by **J. HARDIN WADDLE**, Florida Cooperative Fish and Wildlife Research Unit, U.S. Geological Survey, Big Cypress National Preserve, 33100 Tamiami Trail, Ochopee, Florida 34141, USA (e-mail hardin_waddle@usgs.gov); **MARQUETTE E. CROCKETT**, Florida Cooperative Fish and Wildlife Research Unit, Box 110485, University of Florida, Gainesville, Florida 32611-0485, USA; and **KENNETH G. RICE,** U.S. Geological Survey, Florida Integrated Science Center, 3205 College Avenue, Ft. Lauderdale, Florida 33314, USA.

PHYLLOMEDUSA SAUVAGII. ARGENTINA: SAN JUAN: Departamento Valle Fértil: 250 km San Juan city on Astica, Ruta Provincial N° 510 (30°59'S, 67°22'W), January 2004. M. Jordan and E. Herrera. Herpetological Collection, Instituto y Museo de Ciencias Naturales, Universidad Nacional de San Juan, Argentina (IMCN-UNSJ 5010). Verified by G. Blanco. Previously known from Jujuy, Formosa, Chaco, Corrientes, Cordoba, Salta, Santiago del Estero, Santa Fe, La Rioja flats westward and San Luis provinces in Argentina (Cei 1980. Mon. II Mus. Reg. Sci. Nat. Torino, 609 pp.; Lavilla et al. 2000. Categorización de los Anfibios y Reptiles de la República Argentina. Asociación Herpetológica Argentina, 97 pp; Lavilla and Cei 2001. Mon. XXVIII Mus. Reg. Sci. Nat. Torino, 179 pp.). First province record, extends the known range ca. 150 km W of the nearest locality (Potrero de los Funes, San Luis Province) (Avila and Carrizo 2003. Acta Zool. Lilloana 47[1–2]:93–115; Lavilla and Cei 2001, *op. cit*.).

Submitted by **EDUARDO A. SANABRIA, LORENA B. QUIROGA,** and **JUAN C. ACOSTA,** Departamento de Biología e Instituto y Museo de Ciencias Naturales, F.C.E.F. y N., Universidad Nacional de San Juan, Avenida España 400 (N) C.P. 5400, San Juan, Argentina.

PLEURODEMA NEBULOSUM (Mendoza Four-eyed Frog). ARGENTINA: NEUQUÉN: Departamento Añelo (38°21'S, 68°47'W): Arroyo Ojos de Agua. 14 November 1976. O. de Ferrariis. Museo Argentino de Ciencias Naturales "Bernardino Rivadavia," Buenos Aires, Argentina (MACN 36078); Auca Mahuida (37°53'S, 68°31'W). April 1945. O. Adams (MACN 7980). Departamento Catan-Lil (39°33'S, 70°35'W): Charahuilla. 04 February 1973. O. de Ferrariis. Colección del Centro Nacional de Investigaciones Iológicas, housed at MACN (CENAI 7081). First province records, extends known distribution 275 km W from previous closest record (General Roca, La Pampa Province; Gallardo 1965. Rev. Mus. Arg. Cs. Nat. B. Rivadavia [Zool.], 1 [2]:57–77). SALTA: Departamento Cafayate (26°06'S, 65°57'W): Cafayate. 11 January 1991. J. McGuire. Fundación Miguel Lillo, Tucumán, Argentina (FML 5245); Cafayate, on Ruta Nacional Nº 68, between 8 and 12 km N of its intersection with Ruta Provincial Nº 40. 11 January 1991. R. Etheridge (FML 5246, three specimens); Cayafate, Los Médanos. 02 January 1993. N. Abdala (FML 5232, three specimens). Departamento San Carlos (25°53'S, 65°56'W): San Carlos, ca. 10 km E from Animaná. 04 January 1993. E. O. Lavilla (FML 5234, two specimens). First vouchered specimens reported, attributed to Salta Province by Lavilla (1999. Anfibios. *In* E. O. Lavilla and J. A. González [eds.], Biodiversity of Agua Rica, Catamarca, Argentina. Fund. M. Lillo - BHP Copper). Departamento Anta (24°55'S, 64°28'W): Finca Los Colorados. 13 January 2000. E. O. Lavilla and R. Heyer (FML 9094–96). First department record. Salta Province reports extends known distribution 350 km NE from previous closest record (Andalgalá, Catamarca Province; Lavilla 1999, *op. cit.*). TUCUMÁN: Departamento Tafí del Valle: Quilmes (26º30'S, 66º00'W). 18 January 1975. R. Laurent and C. Halloy (FML 2427, 43 specimens). New province record, referred to by Laurent as Tucumán Province (1969. Acta Zool. Lilloana 25[7]:81–96). This report extends known distribution 102 km NE from previous closest record (Andalgalá, Catamarca Province; Lavilla 1999, *op. cit.*). Boundary between CATAMARCA and TUCUMÁN Provinces: Arroyo los Médanos, between Santa María and Amaicha del Valle. 20 January 1975. R. Laurent and C. Halloy (FML 2425, 3 specimens); ca. 10 km from bridge of Santa María River. 25 January 1975. R. Laurent and C. Halloy (FML 2429, 2 specimens). New record for this area, extends known distribution ca. 111 km N from previous closest record (Andalgalá, Catamarca Province; Lavilla 1999, *op. cit.*). All specimens verified by Esteban O. Lavilla. The previous geographical range of this species includes the western Argentine provinces from Catamarca to Río Negro (Aun and Martori 1999. Herpetol. Rev. 30[4]:231; Cei 1980. Amphibians of Argentina. Monit. Zool. Ital. [N.S.] Monogr. 2: [i-xii] + 1–609) and Tucumán Province (Laurent 1969, *op. cit.*).

Submitted by **DAIANA PAOLA FERRARO**, Sección Herpetología, División Zoología Vertebrados, Museo de La Plata, Paseo del Bosque S/N° (1900) La Plata, Buenos Aires, Argentina; e-mail: dferraro@fcnym.unlp.edu.ar.

PSEUDACRIS FERIARUM FERIARUM (Upland Chorus Frog). USA: TEXAS: LA SALLE CO.: Approximately 12 km E of Cotulla on Hwy 97, ca. 30 m S of the highway. 13 March 2004. Joshua R. Engelbert and Robert C. Jadin. Verified by Jonathan A. Campbell. UTA – Collection of Vertebrates (UTA Slide No. 31331–32). Caught in small flooded area about an hour before sunset, during intermittent rain. Photographed and released. New county record (Dixon 2000. Amphibians and Reptiles of Texas. 2nd Ed. Univ. of Texas A&M Press, viii + 421 pp.).

Submitted by **ROBERT C. JADIN** (e-mail snakeman1982@hotmail.com) and **JOSHUA R. ENGELBERT**, Northeastern State University, Tahlequah, Oklahoma 74464, USA (e-mail: okieherper@yahoo.com).

PSEUDIS PARADOXA (NCN). VENEZUELA: FALCÓN: MUNICIPIO MAUROA: embalse de Matícora (10°40'N, 70°55'W). 28 January 2000. T. Barros. Museo de Biología de La Universidad del Zulia, Maracaibo (MBLUZ-A-0102). Verified by G. Rivas Fuenmayor. The species occurs east of the Andes from Colombia, Venezuela and the Guianas to northern Argentina. (La Marca 1992, Catálogo Taxonómico, Biogeográfico y Bibliográfico de las Ranas de Venezuela, Cuadernos Geográficos, No. 9, Universidad de Los Andes, Mérida, 197 pp.). In Venezuela it has a wide distribution in the lowland savannas below 300 m (Barrio 1998. Acta. Biol. Venez. 18[2]:1–93; Gorzula and Señaris 1998. Contribution to the Herpetofauna of the Venezuelan Guayana I. A Data Base, Scientia Guaianae, No. 8, Caracas, 269 pp.; Pefaur and Rivero 2000. Amph. Rept. Cons. 2[2]:42–70; Rivero 1964. Carib. J. Sci. 4[1]:307–319). First state record and northernmost locality for the country, extends known range ca. 130 km N from La Ceiba in Trujillo state (Barrio, *op. cit.*).

Submitted by **FERNANDO ROJAS RUNJAIC** (e-mail: rojas_fernando@hotmail.com), **TITO BARROS BLANCO** (e-mail: trbarros@cantv.net), and **EDWIN INFANTE RIVERO (**e-mail: edwinfantembluz@hotmail.com), La Universidad del Zulia, Facultad Experimental de Ciencias, Museo de Biología de La Universidad del Zulia, Sección de Herpetología, Apartado Postal 526, Maracaibo 4011, Venezuela.

PSEUDIS TOCANTINS (NCN). BRAZIL: MARANHÃO: MUNICIPALITY OF PORTO FRANCO: 'Fazenda Maravilha' (06º00'38.2"S, 47º25'43.9"W), 162 m elev. 07 January 2005. E. M. Lucas. Célio F. B. Haddad collection, Departamento de Zoologia, Universidade Estadual Paulista, Rio Claro, São Paulo (CFBH 8132). Verified by C. F. B. Haddad. Species previously known from type locality, Municipality Porto Nacional, state of Tocantins, Brazil (10º42'S, 48º25'W, 212 m elev., Caramaschi and Cruz 1998. Rvta. Brasil. Zool. 15:929–944); Bananal Island National Park region (10º28'12"S, 50º28'48"W), Municipality of Santa Terezinha, State of Mato Grosso, and Municipality of Britania (15º14'34"S; 51º 10'44"W), state of Goias, Brazil (Brandão et al. 2003. Phyllomedusa 2:69–70). First state record, extends the distribution ca. 595 km N from type locality in Tocantins State.

Submitted by **ELAINE M. LUCAS**, Departamento de Ecologia, Universidade de São Paulo, CP 11461,CEP 05508-900, São Paulo, Brazil; and **CINTHIA A. BRASILEIRO**, Museu de História Natural, Instituto de Biologia, Universidade Estadual de Campinas, CP 6109, 13083-970 Campinas SP, Brazil (e-mail: elainelg@ib.usp.br).

RANA PALMIPES (Amazon River Frog). BRAZIL: ALAGOAS: Passo de Camarajibe (09°15'S, 35°26'W). 13–17 January 1988. H. R. Silva, L. C. Carcerelli, C. C. Geovannini, and D. Teixeira. Museu Nacional - Universidade Federal do Rio de Janeiro. Rio de Janeiro, Brazil (MNRJ 9903). 26–30 June 1988. D. Teixeira. (MNRJ 9797). Murici (09°19'S, 35°56'W). 8 January 1988. D. Teixeira, H. R. Silva, L. C. Carcerelli, C. A. Caetano, L. Geovannini, and L. A. Caetano. (MNRJ 9725). BAHIA: Caravelas (17°45'S. 39°15'W). 1876. Rathbun (Comm. Geol. do Brasil). (MNRJ 494). MATO GROSSO: Matupá (10º03'S, 54º58'W). 6 March 1990. C. Yamashita. (MNRJ 35796–97). PARÁ: Cachimbo (08°57'S, 54°54'W). 25 September – 9 October 1956. L. Travassos, Oliveira, and Adão col. (MNRJ 3319, 13764–71). Jacareacanga (06°16'S, 57°39'W). July 1951. H. Sick. (MNRJ 35795). All verified by José P. Pombal, Jr. The species has a broad distribution in northern South America (Miranda-Ribeiro 1923. Rev. Mus. Paulista 13:801–809), but published data are lacking for most of Brazilian Amazon according to Bernardi et al. 1999. Herpetol. Rev. 30:176–177. The species occurs in Bolivia, Brazil, Colombia, Ecuador, Guyana, French Guyana, Peru, Trinidad, and Venezuela. In Brazil, the published distribution is limited to states of Amazonas, Mato Grosso, Pará, Paraíba, Pernambuco, and Rio Grande do Norte (Bernardi et al. 1999, *op.cit*; Hillis and de Sá 1988. Herpetol. Monogr. 2:1–26; Strussmann and Carvalho 1998. Herpetol. Rev. 29:183–185). Herein, we present the first state records for Alagoas and Bahia, northeastern Brazil. These new records extend by ca. 1170 km the southern range limits for this species in northeastern Brazil. The other records corroborate occurrence of the species in the Brazilian Amazon.

Submitted by **CLARISSA CANEDO** and **MARCOS BILATE**, Departamento de Vertebrados, Museu Nacional/UFRJ, Quinta da Boa Vista s/n, São Cristovão, Rio de Janeiro, RJ, Brazil, 20940–040; e-mail: canedo@mn.ufrj.br.

RANA SPHENOCEPHALA (Southern Leopard Frog). USA: ARKANSAS: CLEVELAND CO: Roadside ditch 5.1 km SW of Rison, AR (Sec. 27, T9S, R11W). 20 May 2005. H. W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 29327). Verified by Stanley E.Trauth. New county record in southern Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

Submitted by **HENRY W. ROBISON** and **JANET RADER**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA; e-mail: hwrobison@saumag.edu.

RHACOPHORUS ORLOVI (Orlov's Tree Frog). VIETNAM: GIA LAI PROVINCE: AN KHE DISTRICT: Buon Luoi Village, 20 km NW of Kannack Town (14°20'N, 108°36'E), on leaf of an Araceae plant near a stream, 700–750 m elev., 1700–1900 h, 06 April 1995. Nikolai L. Orlov and Ilya Darevsky. FMNH 253156. Verified by Robert F. Inger. First record for southern Vietnam. Known previously from Ninh Binh, Nghe An, Ha Tinh (type locality), and Quang Binh Provinces in northern and central Vietnam (Ziegler and Köhler 2001. Sauria 23:37–46; Orlov et al. 2002. Russ. J. Herpetol. 9:81–104; Ziegler et al. 2002. Herpetol. Rev. 33:146). This record extends the known range of the species at least 350 km southward. This specimen was reported as

Rhacophorus bimaculatus (type locality Mindanao, Philippines) by Inger et al. 1999 (Fieldiana, Zool., N.S. 92:1–46) and Orlow and Ho (2000. Herpetofauna 22:5–15), and is illustrated in life in the latter reference. Ziegler and Köhler (2001. Sauria 23:37–46) did not examine this specimen, but suggested that it might be referable to *R. cyanopunctatus* (type locality Surat Thani Province, southern Thailand) based on its locality. Other records of *R. bimaculatus* from Vietnam (Gia Lai and Kon Tum Provinces in Orlov et al. 2002. Russ. J. Herpetol. 9:81–104) might also refer to *R. orlovi*. Orlov et al. 2002 (Russ. J. Herpetol. 9:81–104) remarked that *R. bimaculatus*, *R. cyanopunctatus*, *R. hoanglienensis* (type locality Lao Cai Province, northern Vietnam), and *R. orlovi* form a complex of closely-related species, and this might account for misidentifications.

Submitted by **BRYAN L. STUART**, The Field Museum, Department of Zoology, 1400 S. Lake Shore Drive, Chicago, Illinois 60605-2497, USA; e-mail: bstuart@fieldmuseum.org.

SPEA INTERMONTANA (Great Basin Spadefoot) USA: OREGON: Union Co.: (45°15'885"N, 117°57'574"W, 845.5 m elev.). 13 May 2005. Laura A. Mahrt. Verified by Burr Betts. Eastern Oregon University Vertebrate Museum (A05-1). New county record (Leonard et al. 1993. Amphibians of Washington and Oregon, Seattle Audubon Society, Seattle.168 pp.).

Submitted by **LAURA A. MAHRT**, Science Office, One University Blvd., Eastern Oregon University, La Grande, Oregon 97850, USA (e-mail: lmahrt@eou.edu); and **M. CATHY NOWAK** Ladd Marsh Wildlife Area, 59116 Pierce Road, La Grande, Oregon 97850, USA (e-mail: mcnowak@eoni.com).

SCINAX FUSCOVARIUS (Snouted Treefrog). ARGENTINA: CATAMARCA: El Alto Departament: Rosario de Abajo (ca. 28º37'S, 65º25'W), 500–750 m elev. 5 February 2004. D. Baldo and S. D. Rosset. Verified by G. R. Carrizo. Herpetological collection Museo de La Plata, La Plata, Buenos Aires, Argentina (MLP-DB 2666–2667). Male and female in amplexus, found on the bank of a small stream in the Sierra de Ancasti. Species previously known from Corrientes, Chaco, Entre Ríos, Formosa, Jujuy, Misiones, Salta, Santiago del Estero, Santa Fe, and Tucumán (Lavilla et al. 2000. *In* Lavilla et al. [eds.], Categorización de los Anfibios y Reptiles de la República Argentina, pp. 11–34, Edición Especial Asociación Herpetológica Argentina, Tucumán, Argentina). First province record, extends the species range ca. 80 km S from Tucumán (Lavilla et al., *op. cit.*).

Submitted by **DIEGO BALDO**, Laboratorio de Genética Evolutiva y Molecular, Departamento de Genética, Facultad de Ciencias Exactas, Químicas y Naturales, Universidad Nacional de Misiones, Félix de Azara 1552, 3300 Posadas, Misiones, Argentina, and **SERGIO D. ROSSET**, Instituto de Limnología "Dr. Raúl A. Ringuelet" cc 712, 1900 La Plata, Buenos Aires, Argentina.

TESTUDINES

ACANTHOCHELYS MACROCEPHALA (Pantanal Swamp Turtle). BRAZIL: MATO GROSSO DO SUL: Corumbá (Nhumirim Farm: 18°57'S, 56°37'W) and Aquidauana (Rio Negro Farm: 19°34'S, 56°14'W). 1–15 October 2002. M. A. Kinas and F. L. Souza. Verified by A. S. Abe. Zoological Collection of Department Biology, Universidade Federal de Mato Grosso do Sul, Brasil (ZUFMS-CHEL: 0001–0007). Intact carapace, plastron and bones found around bays and salt lagoons. These are the first species records for Mato Grosso do Sul State, better defining the Paraguay River basin as the core geographical distribution area for this species. These records are ca. 260 km straightline south from Mato Grosso State and 290 km N of Puerto Casado, Paraguay, the closest locality records (Rhodin et al. 1984. Herpetologica 40:38–46).

Submitted by **MARCO AURÉLIO KINAS**, Universidade Federal de Mato Grosso do Sul, Centro de Ciências Biológicas e da Saúde, Departamento de Biologia, 79070-900, Campo Grande, Mato Grosso do Sul, Brazil; **RODINEY DE ARRUDA MAURO**, Empresa Brasileira de Pesquisa Agropecuária, Caixa Postal 154, 79002-970, Campo Grande, Mato Grosso do Sul, Brazil; and **FRANCO LEANDRO SOUZA**, Universidade Federal de Mato Grosso do Sul, Centro de Ciências Biológicas e da Saúde, Departamento de Biologia, 79070-900, Campo Grande, Mato Grosso do Sul, Brazil (e-mail: flsouza@nin.ufms.br).

CUORA GALBINIFRONS (Indochinese Box Turtle). VIETNAM: LAO CAI PROVINCE: Van Ban District: Hoang Lien Mountain Range: Nam Tha forest, 21°55'23"N, 104°22'43"E, ca. 640 m elev. 01 September 2004. Raoul H. Bain, Nguyen Quang Truong, and Doan Van Kien. Institute of Ecology and Biological Resources (IEBR 1497, with field tag AMNH FS-16418). Verified by Bryan L. Stuart. In Vietnam, this species has been reported only from some central and northeastern provinces. This is the first record for northwestern Vietnam including Lao Cai Province (Nguyen et al. 1996. A Checklist of Amphibians and Reptiles of Vietnam. Agricultural Publishing House of Vietnam, Hanoi, pp. 115–116).

Submitted by **NGUYEN QUANG TRUONG** and **DOAN VAN KIEN**, Department of Vertebrate Zoology, Institute of Ecology and Biological Resources, 18 Hoang Quoc Viet, Hanoi, Vietnam; and **RAOUL BAIN**, Center for Biodiversity and Conservation, American Museum of Natural History, Central Park West at 79th Street, New York, New York 10024, USA.

AMPHISBAENIA

AMPHISBAENA DUBIA (Uncertain Worm Lizard): BRAZIL: MINAS GERAIS: Ritápolis (20°59'47"S, 44°16'20.5"W). 07 December 2002, collector unknown. Coleção Herpetológica, Universidade Federal de Juiz de Fora, Juiz de Fora, Minas Gerais (CH-UFJF 209). Verified by S. Potsch de Carvalho e Silva. Previously known from Santa Catarina, Paraná, and São Paulo States, Brazil, and Formosa, Argentina (Gans 1964. Breviora 205:1–11; Montero 1996. Cuad. Herpetol. 10[1–2]:25–45; Vanzolini 2002. Papéis Avulsos Zool. S. Paulo 42[15]:351–362). First state record, extends known distribution ca. 230 km NE from Campos do Jordão, São Paulo State, the nearest previously known locality (Gans 1964, *op. cit.*)

Submitted by **JOSÉ DUARTE DE BARROS FILHO**, Laboratório de Anfíbios e Répteis, Universidade Federal do Rio de Janeiro, Rio de Janeiro-RJ, Cx.P. 68044, CEP 21944-970, Brazil (e-mail: jduartef@biologia.ufrj.br); **BERNADETE MARIA DE SOUSA** (e-mail: bernadete.sousa@ufjf.edu.br) and **ROSE MARIE HOFFMANN DE CARVALHO** (e-mail: rosemarie@acessa.com), Laboratório de Herpetologia, Universidade Federal de Juiz de Fora, Minas Gerais, Brazil.

LACERTILIA

ANOLIS CAROLINENSIS CAROLINENSIS (Northern Green Anole). USA: ARKANSAS: CHICOT CO.: Lake Village city limits (Sec. 3, T16N, R2W). 30 May 2005. H. W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 29328). Verified by Stanley E.Trauth. New county record in extreme southeastern Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

Submitted by **HENRY W. ROBISON** and **JANET RADER**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA; e-mail: hwrobison@saumag.edu.

ANOLIS PENTAPRION (Lichen Anole). MÉXICO: VERACRUZ: MUNICIPALITY OF LAS CHOAPAS: Batería Los Soldados (17°57'49.4"N; 94°06'52.2"W), 7 m elev. 5 July 2003. José Luis Aguilar López. Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México (MZFC 16574). Verified by Edmundo Pérez Ramos. Second record for Veracruz and bridges the distributional gap between recorded localities in the Los Tuxtlas region, ca. 132 km to the NE, and records ca. 225 km ESE from near Palenque, Chiapas (Lieb 2001. *In* Johnson et al. [eds.], Mesoamerican Herpetology: Systematics, Zoogeography, and Conservation, pp. 53–64. Centennial Mus. Spec. Publ. No. 1, University of Texas at El Paso). The specimen was found on a tree branch in a tropical semideciduous forest.

Submitted by **JOSE LUIS AGUILAR LÓPEZ**, Laboratorio de Herpetología, Escuela de Biología, Benemérita Universidad Autónoma de Puebla, C.P. 72570, Puebla, México (e-mail: bothrops_asper@hotmail.com); **LUIS CANSECO MÁRQUEZ** (e-mail: lcm@correo.unam.mx) and **URI OMAR GARCÍA VÁZQUEZ**, Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, A.P. 70-399, México, D.F. 04510, México.

ANOLIS SAGREI (Brown Anole). USA: FLORIDA: OKALOOSA CO: Fort Walton Beach, Uptown Station shopping center, 99 Eglin Parkway (FL Hwy 85), 30°25'9"N, 86°36'22"W. 16 July 2002. David C. Bishop. Verified by Kenneth Krysko. University of Florida (UF 133632, 133633). New county record (Campbell 1996. Herpetol. Rev. 27:155–157). Male and female captured in copulation. Another female and four juveniles observed.

Submitted by **DAVID C. BISHOP**, Department of Fisheries and Wildlife Sciences, Virginia Tech University, Blacksburg, Virginia 24061-0321, USA; e-mail: dabishop@vt.edu.

BACHIA HETEROPA LINEATA (NCN). VENEZUELA: TRUJILLO: MUNICIPIO PAMPANITO: Urbanización "El Prado" (9°25'N, 70°27'W), 480 m. 20 November 2002. C. Cuevas. Museo de Biología de La Universidad del Zulia, Maracaibo (MBLUZ-R-0763). Specimen found on sandy ground in residential garden. ZULIA: MUNICIPIO JESÚS MARÍA SEMPRÚN: Casigua-El Cubo (8°45'N, 72°30'W). 12 August 1965. R. Hernández. Museo de Historia Natural La Salle, Caracas (MHNS 2497). Both verified by G. Rivas. The distribution of this subspecies is restricted to Venezuela (Dixon 1973. Univ. Kansas, Mus. Nat. Hist., Misc. Publ. [57]:47 pp.). The previously known range included the Capital District and Falcón, Yaracuy, and Portuguesa states (Dixon, *op. cit*.; Donoso-Barros 1968. Carib. J. Sci. 8[3–4]:105–122; Esqueda et al. 2001. Herpetol. Rev. 32[3]:198–200; Markezich 2002. Herpetol. Rev. 33[1]:69–74; Mijares and Arends 1999. Herpetol. Rev. 30[2]:115). First records for these two states of the Maracaibo Lake Basin, and the westernmost localities for the subspecies. MHNS 2497 extends the distribution ca. 210 km W (airline) from the nearest known locality (Markezich, *op. cit*.).

Submitted by **FERNANDO ROJAS** (e-mail: rojas_fernando@hotmail.com) and **EDWIN INFANTE (**e-mail: edwinfantembluz@hotmail.com), La Universidad del Zulia, Facultad Experimental de Ciencias, Museo de Biología de La Universidad del Zulia, Sección de Herpetología, Apartado Postal 526, Maracaibo 4011, Venezuela.

CHALCIDES OCELLATUS OCELLATUS (Ocellated Skink). LIBYA: NAULT PROVINCE (Sha'abeyyat Nalut): Ain Al-Khenjari (31°59'33"N, 11°36'12"E). Collected from an oasis ca. 190 km SW of Tripoli. 21 March 2004. Asmaa Mohammad Ali. Muséum National d'Histoire Naturelle, Paris (MNHN 2004.0084). SVL = 97 mm. Verified by Ivan Ineich. Several other individuals were also collected from the same locality during spring and summer. First provincial record (Schleich et al. 1996. Amphibians and Reptiles of North Africa. Koeltz Scientific Publishers, Koeningstein; Frynta et al. 2000. Acta. Soc. Zool. Bohem. 64:17–26).

Submitted by **ADEL A. IBRAHIM,** Faculty of Education at Al-Arish, Suez Canal University, North Sinai, Egypt; e-mail: Laudakia@hotmail.com.

CNEMIDOPHORUS LONGICAUDA (Long-tailed Whiptail). ARGENTINA: CHUBUT: TELSEN: Sand flats along Telsen stream, on the edges of Ruta Provincial 61, 40.3 km S junction Ruta Provincial 1 (42°44'48.8"S, 66°59'54.8"W, 117 m elev.). 02 February 2005. N. Frutos and L. Camporro. Herpetological Collection Museo de La Plata, La Plata, Buenos Aires (MLP.S 2584). Verified by N. Basso. First province record (Cei 1986. Mon. IV. Mus. Reg. Sc. Nat. Torino: 1–427), and southernmost record for the species, extending known range 238 km S (airline) from Valcheta, Rio Negro province (Cabrera 2004. Amphibia-Reptilia 25:265–275).

Submitted by **NICOLAS FRUTOS** (e-mail: frutos@cenpat.edu.ar), **LEONARDO CAMPORRO** (e-mail: leocamporro@hotmail.com), and **LUCIANO JAVIER AVILA (**e-mail: avila@cenpat.edu.ar), CENPAT-CONICET, Boulevard Almirante Brown s/n, U9120ACV, Puerto Madryn, Chubut, Argentina.

EUTROPIS LONGICAUDATA (Long-tailed Sun Skink). MYANMAR: MANDALAY DIVISION: PYIN-OO-LWIN DISTRICT: Tha Baik Kyin Town, Shwe-U-Daung Wildlife Sanctuary (headquarters) (22°53'29.3"N, 95°59'27.7"E, WGS84). 28 September 2000. Htun Win and San Lwin Oo. California Academy of Sciences (CAS) 216129. SHAN STATE: YWANGAN TOWNSHIP: Panlaung-Pyadalin Cave Wildlife Sanctuary, entrance to Pyadalin Cave (21°07'58.4"N, 96°20'25.0"E, WGS84). 14 July 2002. Rhonda S. Lucas, Guin O.U. Wogan, Jens V. Vindum, Htun Win, Thin Thin, Kye Soe Lwin, Awan Khwi Shein, and Hla Tun. CAS 230469. SHAN STATE: YWANGAN TOWNSHIP: Panlaung-Pyadalin Cave Wildlife Sanctuary (21°07'17.3"N, 96°21'19.1"E, WGS84).

Rhonda S. Lucas, Guin O.U. Wogan, Jens V. Vindum, Htun Win, Thin Thin, Awan Khwi Shein, and Hla Tun. CAS 230538. All identifications verified by George R. Zug. New country record. Given that *E. longicaudata* (formerly known as *Mabuya longicaudata*: see Mausfeld et al. 2002. Zool. Anz. 241:281–293) occurs in a broad area of southeastern Eurasia and adjacent islands, including Taiwan, Hong Kong, Hainan, southern continental China, and parts of Southeast Asia (Manthey and Grossmann 1997. Amphibien und Reptilien Südostasiens. Natur und Tier–Verlag, Münster, 512 pp.; Taylor 1963. Univ. Kansas Sci. Bull. 44:687–1077), the species might actually represent a complex of more than one morphologically similar species. Further detailed studies examining both morphological and genetic variation among samples from throughout the entire range of *E. longicaudata* are needed.

Submitted by **MARLENE GONZALEZ**, University of San Francisco, College of Arts and Sciences, 2130 Fulton Street, San Francisco, California 94117, USA; and **JENS V. VINDUM**, Department of Herpetology, California Academy of Sciences, 875 Howard Street, San Francisco, California 94103, USA.

LIOLAEMUS OLONGASTA (NCN). ARGENTINA: MENDOZA: Departamento Las Heras: 60 km Mendoza city on Puesto Sta. Clara de Abajo, Ruta Provincial N° 319 (32º40'S, 69º10'W), January 2004. L. Quiroga and E. Sanabria, Herpetological Collection, Instituto y Museo de Ciencias Naturales, Universidad Nacional de San Juan, Argentina (IMCN-UNSJ 5009). Verified by G. Blanco. This species is distributed in two localities in extreme western La Rioja Province at elevations between 900 and 1600 m and west of San Juan Province to the Cerrillo Barboza (Etheridge 1993. Boll. Mus. Reg. Sci. Nat. Torino 11[1]:137–199; Avila et al. 1998. Cuad. Herpetol. 12[1]:11–29). First province record. Extends known range (Avila et al. 1998, *op cit.)* ca. 75 km SW of the nearest locality (Cerrillo Barboza, Departmento Rawson, San Juan Province).

Submitted by **EDUARDO A. SANABRIA, LORENA B. QUIROGA,** and **JUAN C. ACOSTA,** Departamento de Biología e Instituto y Museo de Ciencias Naturales, F.C.E.F. y N., Universidad Nacional de San Juan, Avenida España 400 (N) C.P. 5400, San Juan, Argentina.

MESOSCINCUS ALTAMIRANI (Tepalcatepec Skink). MÉXICO: MICHOACÁN: Municipality of Huetamo: Rancho El Zipiate, 8 km from the west bank of the Río Balsas (18°37'03"N, 100°54'54"W), 330 m elev. 04 November 2003. D. Suazo and J. Alvarado. Colección Herpetologica, Instituto de Investigaciones sobre los Recursos Naturales, Universidad Michoacana (HINIRENA 452). GUERRERO: Municipality of Zirandaro: Rancho El Tecolote, 500 m from the east bank of the Río Balsas (18°30'48"N, 101°00'37"W), 215 m elev. 27 March 2004. D. Suazo and I. Suazo. HINIRENA 481 . Both specimens verified by Alfredo Estrada-Virgen.

Each specimen was found in the southern part of the Río Balsas Basin and both represent substantial range extensions for the species. HINIRENA 481 is the first record from Guerrero and is a ca.180 km range extension NW from nearest known record at the type locality, Apatzingán, Michoacán. The location of HINIRENA 452 is ca.155 km SE of the type locality. Both skinks were located in areas containing tropical dry forest.

Submitted by **JAVIER ALVARADO-DIAZ** (e-mail: jadiaz@zeus.umich.mx) and **IRERI SUAZO-ORTUÑO**, under CIC,Universidad Michoacana Project 5.5, Laboratorio de Herpetología, Instituto de Investigaciones sobre los Recursos Naturales, Universidad Michoacana, Av. San Juanito Itzicuaro s/n, Col San Juanito Itzicuaro, Morelia, Michoacán 58330, México.

SCINCELLA SILVICOLA CAUDAEQUINAE (Horsetail Falls Ground Skink). MÉXICO: COAHUILA: Municipality of Arteaga: Los Lirios, ca. 8 km E of Arteaga (25˚24'00"N, 100˚28'18"W). 30 May 1998. David Lazcano Villarreal. Colección Herpetología de la Universidad Autónoma de Nuevo León (UANL 5255). Verified by Andrés Alberto Mendoza-Hernández. First record for Coahuila, extending its known range ca. 42.5 km (airline) NW of Laguna Santiago, Nuevo León (Smith 1951. Univ. Kansas Sci. Bull. 34:195–200). The specimen was found in pine forest.

Submitted by **URI OMAR GARCÍA-VÁZQUEZ**, Museo de Zoología, Facultad de Ciencias, UNAM, A.P. 70-399, México D.F. 04510, México (e-mail: urigarcia@gmail.com); **DAVID LAZCANO-VILLARREAL (**e-mail: dvlazcano@hotmail.com), **MARIA CRISTINA GARCIA-DE LA PEÑA**, and **GAMALIEL CASTAÑEDA**, Laboratorio de Herpetología, Universidad Autónoma de Nuevo León. A.P. 513, San Nicolás de los Garza, Nuevo León, 66450, México.

SCINCOPUS FASCIATUS FASCIATUS (Banded Skink). LIBYA: NAULT PROVINCE (Sha'abeyyat Nalut): Badr Village (32º02'27"N, 11º32'38"E). Collected from a farm ca. 200 km SW of Tripoli. 2 March 2004. Amna Al-Bahi. Muséum National d'Histoire Naturelle, Paris (MNHN 2004.0081). SVL = 149 mm. Verified by Ivan Ineich. First provincial record (Frynta et al. 2000. Acta. Soc. Zool. Bohem. 64:17–26) and second country record (Sindaco 1995. Bull. Mus. Reg. Sci. nat. Torino, pp. 117–122; Schleich et al. 1996. Amphibians and Reptiles of North Africa. Koeltz Scientific Publishers, Koeningstein). The known range of this species extends from south Mauritania to Sudan (Schleich et al. 1996, *op. cit.*). This is the only specimen of the species collected during a survey from November 2003 to July 2004.

Submitted by **ADEL A. IBRAHIM** Faculty of Education at Al-Arish, Suez Canal University, North Sinai, Egypt; e-mail: Laudakia@hotmail.com.

SPHENOMORPHUS INCERTUS (Stuart's Forest Skink). HONDURAS: CORTÉS: Sierra de Omoa, Parque Nacional El Cusuco, near Centro de Visitantes (15º30'N, 88º13'W), 1570 m elev. 2 March 2005. Josiah H. Townsend. Florida Museum of Natural History (UF 144061). Verified by Kenneth L. Krysko. First record for Cortés, Parque Nacional El Cusuco, and the Cordillera de Merendón (Wilson and McCranie 2004. Herpetol. Bull. 87:13–24), and bridges a distributional gap between localities located 100 km E in Refugio de Vida Silvestre Cerro Texíguat, Yoro, Honduras (Wilson and McCranie 1994. Amphibia-Reptilia 15:416–421) and 185 km W near Purulha, Baja Verapaz, Guatemala (KU 187230–32). The skink was found on a trail going through mixed pine-broadleaf forest.

Submitted by **JOSIAH H. TOWNSEND**, Tropical Conservation and Development Program, Center for Latin American Stud-

ies and Division of Herpetology, Florida Museum of Natural History, University of Florida, Gainesville, Florida, 32611-7800, USA; e-mail: jtownsend@flmnh.ufl.edu.

UROSAURUS ORNATUS LATERALIS (Coastal Tree Lizard). MEXICO: CHIHUAHUA: Municipio Morís: Santa María (28°12'20.9"N, 108°31'36.7"W), 794 m elev. 23 September 2003. Julio A. Lemos-Espinal. Herpetological collection of Unidad de Biología, Tecnología y Prototipas (UBIPRO 11638, 11711–2). Verified by Richard L. Holland. First record for Chihuahua, extending its known range ca. 75 km from nearby San Miguel, Sinaloa (Hardy and McDiarmid 1969. Univ. Kansas Publ. Mus. Nat. Hist. 18[3]:39–252) and Guirocoba, Sonora (Bogert and Oliver 1945. Bull. Am. Mus. Nat. Hist. 83:297–426).

Submitted by **HOBART M. SMITH**, Department of EE Biology, University of Colorado, Boulder, Colorado 80309-0334, USA (e-mail: hsmith@colorado.edu); **JULIO A. LEMOS-ESPINAL** (under DGAPA-PASPA and CONABIO projects BE002, CE001 and CE002), Laboratorio de Ecología, UBIPRO, Facultad de Estudios Superiores Iztacala, UNAM, Apartado Postal 314, Avenida de los Barrios 1, Los Reyes Iztacala, Tlalnepantla, edo. de México, 54000 México (e-mail: lemos@servidor.unam.mx); and **DAVID CHISZAR,** Department of Psychology, University of Colorado, Boulder, Colorado 80309-0345, USA; e-mail: chiszar@clipr.colorado.edu.

SERPENTES

AGKISTRODON PISCIVORUS LEUCOSTOMA (Western Cottonmouth). USA: TEXAS: Caldwell Co.: 0.9 mi. W of Martindale on Hwy 1979 (N29°50.009', W97°50.529'), 520 ft elev. 5 May 2005. James R. Dixon. Verified by Kathryn Vaughan, Texas A&M University Texas Cooperative Wildlife Collection (TCWC 89762). New county record (Dixon 2000. Amphibians and Reptiles of Texas. Second Edition. Texas A&M University Press, College Station, Texas, 421 pp.). The female specimen was found DOR just east of the Blanco River bridge, and measured 65 cm SVL, tail 10.2 cm.

Submitted by **SHAWN F. McCRACKEN**, Texas State University, Department of Biological Sciences, 601 University Drive, San Marcos, Texas 78666-4615, USA (e-mail: smccracken@txstate.edu); **JAMES R. DIXON**, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, Texas 77843-2258, USA; and **MICHAEL R. J. FORSTNER**, Texas State University, Department of Biological Sciences, 601 University Drive, San Marcos, Texas 78666-4615, USA.

BOTHROPS PUNCTATUS (Chocoan Forest Pitviper). COLOMBIA: DEPARTAMENTO DE ANTIOQUIA: Municipality of Yolombó: Quebrada La Cancana (6°48'N, 75°06'W) ca. 1000 m. elev. 09 May 1997. J. Aubad. Museo de Herpetología Universidad de Antioquia, Medellín, Colombia (MHUA 10041, adult male). Municipality of Amalfi: 6°53'N, 75°09'W. 04 Oct 1990. J. Asprilla. Serpentario Universidad de Antioquia, Medellín, Colombia (SUA 552). Municipality of San Luis (6°02'N, 74°59'W). 13 Jul 1990. (SUA 483). 22 Apr 1997. J. Asprilla (SUA 2220). Verified by W. W. Lamar. This species has been considered endemic from Chocoan lowland rainforest from eastern Panama to northwestern Ecuador (Campbell and Lamar 2004. The Venomous Reptiles of the Western Hemisphere. Cornell University Press). The easternmost record in Colombia is Municipality of Urrao (Antioquia) on the Cordillera Occidental. First record for Cordillera Central, it documents the occurrence of the species in the Río Cauca and Río Magdalena Basins to eastern Chocó, and extends the distribution almost 125 km northeast and 130 km east from Urrao, a previously known locality in Antioquia (Campell and Lamar, *op. cit.*).

Submitted by **JUAN MANUEL DAZA-R.**, Grupo Herpetológico de Antioquia, Instituto de Biología, Universidad de Antioquia, oficina 7-121. A.A. 1226, Medellín, Colombia (e-mail: juandaza35@hotmail.com); **JUAN CARLOS QUINTANA**, and **RAFAEL OTERO**, Serpentario Universidad de Antioquia. A.A. 1226, Medellín, Colombia (e-mail: jquintana@epm.net.co).

CLELIA HUSSAMI (Mussurana). BRAZIL: RIO GRANDE DO SUL: São Francisco de Paula (29°02'S, 50°23'W), Floresta Nacional de São Francisco de Paula. 18 January 2004. R. Fleck. Coleção de Répteis, Museu de Ciências Naturais da Fundação Zoobotânica do Rio Grande do Sul (MCN.15175, female, 606 mm SVL + 80 mm tail). Verified by F. L. Franco. Previously reported only from Santa Catarina and Paraná states (Morato et al. 2003. Phyllomedusa 2:93–100). This record corroborates the suggested association of *C. hussami* to the Araucaria forest biome (Morato et al., *op. cit*.). First state record and southernmost record for the species, extends known distribution ca. 230 km airline S from Fraiburgo, Santa Catarina (Morato et al., *op. cit*.).

Submitted by **MÁRCIO BORGES-MARTINS (**e-mail: marciobmartins@fzb.rs.gov.br), **JONATAS GONÇALVES ROSSETTI**, and **ANA CAROLINA ANÉS**, Núcleo Regional de Ofiologia de Porto Alegre, Museu de Ciências Naturais da Fundação Zoobotânica do Rio Grande do Sul, Rua Dr. Salvador França, 1427, CEP 90690-000, Porto Alegre, Rio Grande do Sul, Brazil.

CONIOPHANES MERIDANUS (Peninsular Stripeless Snake). MEXICO: Quintana Roo: Municipality of Othón P. Blanco: Chetumal (18°30'22"N, 88°17'05"W). 01 February 2005. Magdalena Hernández and Pierre Charruau. Herpetological Collection, Museum of Zoology, El Colegio de la Frontera Sur, Chetumal, Quintana Roo (ECO-CH-H 2716). Verified by Gunther Köhler. Southernmost record for the species on the Yucatán Peninsula, extending the range ca. 80 km SW of the closest known locality in central Quintana Roo on road to Noh Bec, 15.6 km N of jct. with Hwy. 307 (Lee 1996. The Amphibians and Reptiles of the Yucatán Peninsula. Cornell University Press, Ithaca, New York. 500 pp.).

Submitted by **PIERRE CHARRUAU** (e-mail: rcedev@ecosur-qroo.mx) and **J. ROGELIO CEDEÑO-VÁZQUEZ (**e-mail: rogeliocv@mexico.com), El Colegio de las Frontera Sur, Unidad Chetumal, Av. Centenario km 5.5, 77900 Chetumal, Quintana Roo, México.

CORALLUS CANINUS (Emerald Tree Boa). COLOMBIA: ANTIOQUIA: Municipio de Cáceres: 7°35'N, 75°20'W, 500 m elev. 21 March 1994. A. Ramírez. Verified by R. Powell. Museo de Ciencias Naturales Universidad de Antioquia, Medellín, Colombia (MUAREP 001). The species has a wide distribution in the Guianas and Amazonia, but records from north or west of the

Andes have, until recently, lacked voucher specimens. First record from Depto. Antioquia, and second verified record from north of the Colombian Cordillera Central and Cordillera Occidental. This record and that of Renjifo and Lundberg (1999. Anfibios y Reptiles de Urrá. Ed. Colina, Medellín, Colombia) from Depto. Cordoba are the only documented records for the species north of the Colombian Andes. Present record extends the known distribution ca. 110 km SW of the Depto. Cordoba locality, and ca. 240 km NW of Muzo (Depto. Boyacá) on the western slope of the Cordillera Oriental.

Submitted by **JUAN MANUEL DAZA-R.,** Grupo Herpetológico de Antioquia, Instituto de Biología, Bloque 7-121, Universidad de Antioquia, A.A. 1226, Medellín, Colombia (e-mail: juandaza35@hotmail.com); and **ROBERT W. HENDERSON**, Section of Vertebrate Zoology, Milwaukee Public Museum, Milwaukee, Wisconsin 53233-1478, USA (e-mail: rh@mpm.edu).

DRYMOLUBER BRAZILI (Brazilian Woodland Racer). PARAGUAY: CANINDEYU DEPARTMENT: Mbaracayu Forest Natural Reserve: Horqueta mí (24°08'09.2"S, 55°19'21.3"W). 2004. S. Fernández and F. Ramírez. Museo Nacional de Historia Natural del Paraguay, Asunción, Paraguay (MNHNP 11025, female, SVL 291.5 mm, TL 120.5 mm). Verified by N. Scott. Previously known only from Brazil (Amaral 1977. Serpentes do Brasil. Iconografía colorida. Ed. Melhoramentos & Inst. Nac. Livro, Edit. Univ. Sao Paulo, 248 pp.; Nogueira 2001. Herpetol. Rev. 32[4]:286; Argôlo 2004. Herpetol. Rev. 35[2]:191; Lehr et al. 2004. Copeia 2004[1]:46–52). First country record, extends range ca. 167 km S of Ponta Porã, Mato Grosso do Sul, Brazil, the southernmost locality known for the species (Lehr et al., *op.cit.*).

Submitted by **PIER CACCIALI**, Museo Nacional de Historia Natural, Sucursal 1, Ciudad Universitaria, San Lorenzo, Paraguay (e-mail: pier_cacciali@yahoo.com); **SIXTO FERNÁNDEZ** and **FREDDY RAMÍREZ**, Fundación Moisés Bertoni, Prócer Carlos Argüello 208, CC 714, Asunción, Paraguay (e-mail mbertoni@mbertoni.org.py).

ENULIUS FLAVITORQUES (Pacific Long-tailed Snake). MÉXICO: PUEBLA: Municipality of Izucar de Matamoros: ca. 1 km SE Tepenene (18°28.91'N, 98°23.80"W), 1237 m elev. 08 August 2002. J. Wiens, T. Reeder, and A. Nieto-Montes de Oca. MZFC 15973. Verified by Edmundo Pérez Ramos. First record for Puebla, extending its known range 54 km SE from 3 km E "El Limón" Tepalcingo, Morelos (Castro-Franco and Aranda-Escobar 1984. Estudio Preliminar Sobre la Ecología de los Reptiles del Estado de Morelos. Unpublished bachelor´s thesis. Universidad Autónoma del Estado de Morelos. 124 pp.). The snake was found active at night on a rock in tropical semideciduous forest.

Submitted by **LUIS CANSECO-MÁRQUEZ** (e-mail: lcm@correo.unam.mx), **ANDRÉS ALBERTO MENDOZA-HERNÁNDEZ**, and **ADRIÁN NIETO-MONTES DE OCA**, Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, Apartado Postal 70-399, México, Distrito Federal 04510, México.

LEPTOPHIS DEPRESSIROSTRIS (Satiny Parrotsnake). PERÚ: LAMBAYEQUE: FERREÑAFE: Laquipampa: Quebrada Negrahuasi (6º20'58"S, 79º28'32"W, 600 m elev.). 25 August 2001. P. J. Venegas. Museo de Historia Natural Universidad Mayor de San Marcos, Lima, Perú. (MHNSM 21536 adult male, 21537 adult female). Verified by W. W. Lamar. Previously known from Atlantic slopes of Nicaragua, Costa Rica, and Panama, and Pacific Slope of Colombia and Ecuador, and a questionable record from Peru (Peters and Orejas-Miranda 1970. Bull. U.S. Nat. Mus. 297:164). Recorded for Peru only from Depto. Loreto (Carrillo de Espinoza e Icochea 1995. Publ. Mus. Hist. Nat. UNMSM[A] 49:1–27). First department record, first record from the Pacific slope of the Cordillera Occidental in northwestern Peru, and southernmost distribution of the species on the Pacific slope of South America.

Submitted by **PABLO J. VENEGAS,** Facultad de Medicina Veterinaria de la Universidad Nacional Pedro Ruiz Gallo, Alfonso Ugarte 93, Pimentel, Chiclayo, Perú; e-mail: sancarranca@yahoo.es.

LEPTOTYPHLOPS SALGUEIROI (Espirito Santo Blindsnake). BRAZIL: RIO DE JANEIRO: Municipality of Niterói: Itaipú (22º58'S, 43º03'W). 29 May 2005. C. C. Ratto. Museu Nacional – Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil (MNRJ 13124, adult male 211mm TL). Verified by P. Passos. The species occurs in southeastern Atlantic Rain Forest, in southern Bahia, Espírito Santo, and eastern Minas Gerais, Brazil (Passos et al. 2005. Bol. Mus. Nac., N. S., Zool., Rio de Janeiro 520:1–10). First state record. Extends range ca. 170 km S from Minas Gerais, municipality of Recreio (Passos et al. 2005, *op. cit.),* formerly the southernmost locality.

Submitted by **MARCOS BILATE** (e-mail: marcosbilate@ig.com.br) and **ELIZA RIBEIRO COSTA**, Museu Nacional, Universidade Federal do Rio de Janeiro, Departamento de Vertebrados. Quinta da Boa Vista, São Cristóvão, Rio de Janeiro, RJ, 20940-040, Brazil.

OPHEODRYS AESTIVUS (Rough Greensnake). USA: ARKANSAS: Lonoke Co.: 1 km E Cabot, Hwy. 38 (T4N, R9W, S8). 22 May 2005. Nick Goodwin and Jeff Shaver. Verified by Stanley E. Trauth. Arkansas State University Museum of Zoology Herpetological Collection (ASUMZ 29317). New county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **MICHAEL V. PLUMMER**, Department of Biology, Box 12251, Harding University, Searcy, Arkansas 72149, USA (e-mail: plummer@harding.edu); and **JEFF SHAVER,** Cabot High School, 401 North Lincoln, Cabot, Arkansas 72023, USA (e-mail: Jeff.Shaver@cps.k12.ar.us).

OPHEODRYS VERNALIS (Smooth Greensnake). USA: IOWA: Woodbury Co.: Owego Wetland Complex (42°16'72.3"N, 96°9'26.8"W). 24 June 2003. Christian Cox, Matthew Morrill, Aubrey Heupel, and Eugenia Farrar. Verified by Fredric Janzen. Iowa State University Research Collection ISUA-E-200520. New county record (Christiansen and Bailey 1994. Snakes of Iowa. Iowa Department of Natural Resources. Nongame Tech. Ser. No. 1, 16 pp.).

Submitted by **CHRISTIAN L.COX** (e-mail: nazg@iastate.edu), **EUGENIA S. FARRAR** (e-mail: esf@iastate.edu), Department of Ecology, Evolution and Organismal Biology, Iowa State University, Ames, Iowa 50011-3223, USA; and **JANE D. HEY**, Department of Biology, Morningside College, Sioux City, Iowa 51106, USA (e-mail: hey@morningside.edu).

PAREAS MARGARITOPHORUS (White-spotted Slug Snake). SINGAPORE: Khatib Bongsu (01˚25.993'N, 103˚51.207'E, ca. 7 m elev.). 26 December 2004. Benjamin Lee and Puay Koon Koh. Verified by Kelvin K. P. Lim. Raffles Museum of Biodiversity Research Zoological Reference Collection, The National University of Singapore (ZRC.2.6115). Adult, 350 mm in total length. Found crushed, probably by a motor vehicle, in a rural coastal area of degraded secondary forest and back mangrove. First specimen-based record from Singapore, also representing the southernmost extent of the species' range. In 2003 an individual snake, most likely belonging to this species, was found along Mandai Road and photographed, but was not collected (K. K. P. Lim, pers. comm.). Another individual of this species was found dead at Sungei Buloh Wetland Reserve on 15 April 2005. This individual, though measured (300 mm in total length) and photographed, was not collected (James W. M. Gan and K. K. P. Lim, pers. comm.). *Pareas margaritophorus* is distributed over continental Southeast Asia from southern China to northern Peninsular Malaysia (Cox et al. 1998. A Photographic Guide to Snakes and other Reptiles of Peninsular Malaysia, Singapore and Thailand. Asia Books, Bangkok, 144 pp.) as far south as Kedah and Kelantan (based on material at the Raffles Museum of Biodiversity Research: K. K. P. Lim, pers. comm.). The present record is unusual because this species has yet to be reported from southern Peninsular Malaysia. However, artificial introduction of the present specimen or other recent specimens (see above) is unlikely, because this species is apparently not traded commercially.

Submitted by **BENJAMIN LEE,** Central Nature Reserve, Conservation Division, National Parks Board, 601 Island Club Road, Singapore 578775 (e-mail: canopyben@gmail.com); and **PUAY KOON KOH**, National Parks Board HQ, 1 Cluny Rd, Singapore 259569.

REGINA GRAHAMI (Graham's Crayfish Snake). USA: IOWA: WOODBURY CO.: Owego Wetland Complex (42˚16'74.6"N, 96˚8'10.2"W). 24 June 2003. Christian Cox, Aubrey Heupel, and Eugenia Farrar. Verified by Fredric Janzen. Iowa State University Research Collection ISUA-E-200521. New county record (Christiansen and Bailey 1994. Snakes of Iowa. Iowa Department of Natural Resources. Nongame Tech. Ser. No. 1, 16 pp.).

Submitted by **CHRISTIAN L. COX** (e-mail: nazg@iastate.edu), **EUGENIA S. FARRAR** (e-mail: esf@iastate.edu), Department of Ecology, Evolution and Organismal Biology, Iowa State University, Ames, Iowa 50011-3223, USA; and **JANE D. HEY** (Department of Biology, Morningside College, Sioux City, Iowa 51106, USA (e-mail:hey@morningside.edu).

SISTRURUS CATENATUS TERGEMINUS (Western Massasagua). USA: TEXAS. ERATH CO.: 19 May 2001 at 1240 h an adult female was found DOR on county road 149 ca. 5.6 miles N of Hwy 377. 32˚25.83'N and 98˚02.05'W, 1053 ft elev. First county record (Dixon 2000. Amphibians and Reptiles of Texas, A&M University Press. 421 pp.). Verified by Eric N. Smith. University of Texas at Arlington Collection of Vertebrates (UTACV R 52937).

Submitted by **CARL J. FRANKLIN**. Amphibian and Reptile Diversity Research Center, The University of Texas at Arlington Department of Biology. Arlington, Texas 76019, USA (e-mail: Franklin@uta.edu); and **MICHAEL SMITH**, Dallas Fort Worth Herpetological Society, 7111 Layla Road, Arlington, Texas 76016, USA (e-mail: Masmith51@yahoo.com).

SONORA SEMIANNULATA (Groundsnake). USA: ARKANSAS: MARION CO.: ca. 3.6 km S AR Hwy 202, off County Road 113 (T20N, R15W, S01, SE1/4, NE1/4); (NAD 27 Conus) N36.44178, W92.53421. 15 April 2005. Joseph R. Milanovich. Verified by Chris T. McAllister. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 29257). New county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. Arkansas Press, 421 pp.) and the first verified Arkansas specimen collected since 1958 (Dowling 1958. Southwest. Nat. 27:228–230). This represents ca. 170 km eastern range extension within Arkansas and extends the range southward from Missouri (Johnson 2000. The Amphibians and Reptiles of Missouri. Missouri Dept. Conserv., Jefferson City. 400 pp.).

Submitted by **JOSEPH R. MILANOVICH, JANE ANFINSON, TROY J. BADER, RICHARD J. BAXTER, STEVE C. BRANDEBURA, SARAH A. DEVINEY, WAYLON R. HILER, JILL LEARNED, MICKEY W. MATTHEWS, CHARLES R. MCDOWELL, ROBERT G. NEAL, NATHAN T. STEPHENS, JOHN P. STEWART, BENJAMIN A. WHEELER,** and **STANLEY E. TRAUTH,** Department of Biological Sciences, Arkansas State University, P.O. Box 599, State University, Arkansas 72467-0599, USA; e-mail: strauth@astate.edu.

TRETANORHINUS MOCQUARDI (Swamp Snake). ECUADOR: PROVINCE OF ESMERALDAS: Atacames (00º52'12"N, 79º50'32"W, 8 m elev.), 13 and 25 February 1990, V. Cevallos and E. Kramer. Universidad San Francisco de Quito & Fundación Herpetológica G. Orcés, Quito, Ecuador (FHGO-USFQ 121–5, 187; collected at night in water, at a shrimp pond near coastline). Verified by J.-M. Touzet. The species was known from Panama, with no records from Colombia (Dunn 1939. Copeia [4]:212–217; Peters and Orejas-Miranda 1970. USNM Bull. 297). Uetz (1995–2005. The EMBL Reptile Database. Online. EMBL Heidelberg. <http://www.reptile-database.org>) mentioned the species from Ecuador, citing Almendáriz (1992 [1991]) *In* Barriga et al. [eds.], Lista de Vertebrados de Ecuador. Revista Politécnica, Quito XVI [3]:89–162); however, the author does not mention the species in that paper, nor subsequent lists (Coloma et al. 2000–2004. Reptiles de Ecuador. Online. Museo de Zoología, PUCE Quito, Ecuador <http://www.puce.edu.ec/zoologia/>). First vouchered country record. Extends known distribution ca. 900 km S from nearest localities in Panama (Dunn, *op. cit.*).

Submitted by **DIEGO F. CISNEROS-HEREDIA**, Colegio de Ciencias Biológicas & Ambientales, Universidad San Francisco de Quito, Ave. Interoceánica y calle Diego de Robles, Campus Cumbayá, Edif. Maxwell. Casilla Postal 17-12-841, Quito, Ecuador; e-mail: diegofrancisco_cisneros@yahoo.com.

BOOK REVIEWS

Herpetological Review, 2005, 36(3), 341–343.

Checklist of Amphibians and Reptiles in Thailand, by Jarujin Nabhitabhata, Tanya Chan-ard, and Yodchaiy Chuaynkern. "2000" [2004]. Office of Environmental Policy and Planning (OEPP), Bangkok, Biodiversity Series, Volume 9. 152 pp., color plates, map. Softcover. Free. ISBN 974-87704-3-5.

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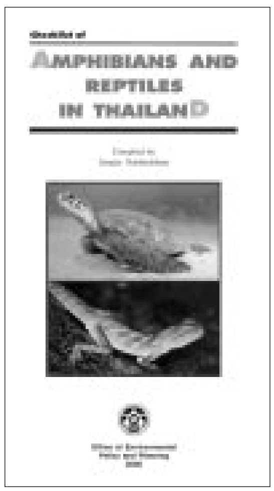

This new publication, co-authored by three experienced herpetologists from the Thai National Science Museum (Pathum Thani) is the first comprehensive list of Thai reptiles and amphibians giving details on their distribution within the country and aiming to list all provinces from which each taxon has been recorded so far. Before describing the contents of this new and welcome addition to the herpetological bibliography on Thailand, a remark should be made about its publication date. Although "September, 2000" is indicated in the book, it was actually not printed before 2004 (T. Chan-ard and Y. Chuaynkern, pers. comm.).

The practically-conceived, pocket-sized book includes a) an administrative map of Thailand (p. 3), with different colors grouping the provinces in five divisions, corresponding to north, west, center, east, southeast and south regions; b) a foreword by the Secretary General of the Thai Office of Environmental Policy and Planning (p. 4); c) a "compilers' note" (pp. 5–6); d) a table of contents, showing the orders and families of the taxa treated (pp. 7–8); e) two colour plates of amphibians (19 species) and four of reptiles (34 species), showing, among others, some rarely illustrated taxa like *Caluella guttulata* and *Glyphoglossus molossus* (Microhylidae), *Gehyra lacerata* (Gekkonidae) and *Tropidophorus microlepis* (Scincidae) (pp. 9–14), although with photographs of small size and average quality; f) a table of amphibian species (pp. 15–48); g) a table of reptile species (pp. 49–143); h) a short bibliography with 126 references (pp. 144–151). The tables are divided into four columns: 1) taxon/species; 2) common names (in English, and in Thai with transliteration into English); 3) "locality", giving the Thai regions and provinces of occurrence, often with indication of the district or locality – distribution outside Thailand is not given; 4) "reference", detailing the sources for the species records.

In the locality column, the provinces of occurrence are grouped in geographical areas: north, northeast, east, southeast, central, southwest, and south, i.e. more divisions than the six appearing on the map. Moreover, the grouping of provinces in the two tables does not correspond to that in the map (see for example the distribution of *Leptobrachium smithi* on pp. 16–17, where the provinces of Kanchanaburi, Phetchaburi, Prachuap Khiri Khan and Uthai Thani are referred to a "southwest" area). Another example, among many, is the placement of Hua Hin (Prachuap Khiri Khan Province) in southwestern Thailand on p. 104 and in southern Thailand on p. 105.

The amphibian table lists 132 species, which is lower than the number of species actually recorded in 2004. Chan-ard (2003), in his excellent photographic field guide on Thai amphibians, indeed included 141 species. Although the compilers' note indicates a total of 325 reptile species, the table actually includes 326. The most recent herpetological works included in the bibliography date back from 2001, so all recent major works and additions to the amphibian and reptile faunas were not included. Since 2000, many gecko species have been added to the fauna of Thailand: *Cnemaspis phuketensis* Das & Leong, 2004, *Cyrtodactylus chanhomeae* Bauer, Sumontha & Pauwels, 2003, *C. sumonthai* Bauer, Pauwels & Chanhome, 2002, *C. thirakhupti* Pauwels, Bauer, Sumontha & Chanhome, 2004 and *C. tigroides* Bauer, Sumontha & Pauwels, 2003, and *Dixonius hangseesom* Bauer, Sumontha, Grossmann, Pauwels & Vogel, 2004, as well as two skinks, *Tropidophorus latiscutatus* Hikida, Orlov, Nabhitabhata & Ota, 2002 and *T. matsuii* Hikida, Orlov, Nabhitabhata & Ota, 2002. Asian skinks long placed in the genus *Mabuya* are now refered to the genus *Eutropis* Fitzinger, 1843 following Mausfeld et al. (2002) and Mausfeld and Schmitz (2003). The snake list includes 177 species, while 181 species (and in total 185 species and subspecies) were listed by David et al. (2004). Three additional species and one genus have been added since: *Lycodon cardamomensis* (Pauwels et al. 2005), *Macrocalamus lateralis* (Chan-ard et al. 2002; David and Pauwels 2004) (Colubridae) and *Trimeresurus fucatus* (Vogel et al. 2004; all peninsular localities of *T. popeiorum* seem in fact referrable to *T. fucatus*) (Crotalidae). It should also be noted that the binomen *Boiga ocellata* Kroon, 1973 is a junior subjective synonym of *Boiga siamensis* Nootpand, 1971 (Pauwels et al. 2005), that Thai *Trimeresurus* "*stejnegeri*" were shown to be in fact *T. gumprechti* and *T. vogeli* (David et al. 2001, 2002), and that *Trimeresurus venustus* was clearly shown to be specifically distinct from *T. kanburiensis* (David et al. 2004). Thai populations of *Psammophis condenarus* (sic) (Merrem, 1820) should be better regarded as *Psammophis indochinensis* Smith, 1943 (Pauwels et al. 2003).

The subspecific level is not considered in the tables. However, it would have stressed the existence of some endemic subspecies (endemic species are marked with an asterisk and, according to the foreword, this list is aimed to contribute to biodiversity conservation), notably *Draco maculatus divergens* Taylor, 1934 (known only from Chiang Mai Province), *Eutropis macularia malcolmi* (Taylor & Elbel, 1958), *E. m. postnasalis* (Taylor & Elbel, 1958) and *E. m. quadrifasciata* (Taylor & Elbel, 1958) (all three of doubtful but unresolved taxonomic status; still to be conservatively considered endemic to Loei Province), *Elaphe porphyracea*

coxi Schulz & Helfenberger, 1998 (Chaiyaphum and Loei provinces), and *Gongylosoma baliodeirum cochranae* (Taylor, 1962) (Chanthaburi Province).

The main weakness of this opus is the lack of documentation for the species records. For 75 of the 132 amphibian species, one finds "per. com." sources, by the three authors (!) and six other persons. The records of 28 amphibian species (21% of all 132 species) are even exclusively based on "personal communications", thus without any reference to a published work or museum collection material. In addition, the source for *Leptolalax gracilis* is a reference that is not listed in the bibliography. For some of these 28 species, Thai material was however published, and all 28 except *Rana andersonii* were treated and illustrated by Chan-ard (2003). The only source indicated for *Chaperina fusca* is "Taksintham (per. com.)"; the species was mentioned as *Chaperina* cf. *fusca* by Chan-ard (2003), thus expressing some doubt as to its identity. The source for *Kaloula baleata* is indicated as "Chan-ard (per. com.); Nabhitabhata (per. com.)" and the species is said to occur in the provinces of Krabi, Phuket, Ratchaburi, Surat Thani, Trang and Yala. One of the authors however co-authored a paper studying specimens from the provinces of Phang-Nga, Phuket and Trang (Pauwels et al. 1999). The records of *Rana milleti* from Chanthaburi, Chachoengsao, Nakhon Nayok and Nakhon Ratchasima provinces are indicated as originating from "per. com." by the three authors, without any other reference, but Chan-ard (2003) and Chuaynkern et al. (2004) reported specimens from the provinces of Chachoengsao, Nakhon Ratchasima and Ubon Ratchathani. What is called *Huia nasica* from Kanchanaburi Province was recently shown to be a distinct species, *Huia melasma* Stuart & Chan-ard, 2005. The problem of undocumented records is slightly less dramatic in reptile species. There are 271 species at least in part recorded on the basis of "per. com."; this is in fact the only source for 18 reptile species (by the authors or by a certain Damman), which represents 6 % of the total of 326 reptiles. Again, if literature had been better exploited, some published references could have been mentioned to justify many records. For instance, *Dogania subplana* is said to be based on a "per. com.", but among other references, Chan-ard et al. (1999) illustrated specimens from Surat Thani and Satun provinces. *Cyclemys tcheponensis*, listed on the basis of "Nabhitabhata (per. com.)", was however listed from Thailand, including Chiang Mai Province, on the basis of several specimens studied by Fritz and Ziegler (1999). The agamid *Pseudocalotes microlepis* is mentioned from three provinces, based on "per. com." but was already recorded from Thailand by Hallermann and Böhme (2000) (see also Pauwels et al. 2003). The record of *Fordonia leucobalia* is based only on "per. com.", but the species was already mentioned from Thailand by Frith and MacIver (1978). Idem for *Ahaetulla mycterizans*, listed, among others, by Chan-ard et al. (1999). The source for the record of *Lycodon butleri* is indicated as "Nabhitabhata (per. com.)"; however the species was mentioned twice by Cox (1991a-b), who indicated that the identification had been verified by J. Nabhitabhata. The record of *Ptyas fusca* is presented as known from "South (from animal dealer); Chan-ard (per. com.)", although the species was recorded from a precise locality by Pauwels et al. (2000). The records of the agamid *Bronchocela smaragdina*, the geckos *Cnemaspis flavolineata* and *Cyrtodactylus feae*, the skinks *Lipinia surda* and *Lygosoma corpulentum*, the colubrids *Oligodon catenatus* and *O. theobaldi*, *Stegonotus borneensis*, and of the sea snakes *Disteira nigrocinctus* and *D. obscurus*, and *Hydrophis inornatus*, based only on personal communications, definitely require confirmation through voucher material. *Hemidactylus b. brookii*, listed without any source from Thailand by Chan-ard et al. (1999) but confirmed from the country by Bauer et al. (2002), is not listed. Many of the records from Kaeng Krachan and Pala-U, in Phetchaburi and Prachuap Khiri Khan provinces, are based on material and observations gathered during field surveys in December 2002 and July 2004 and published by Pauwels and Chanard (2005).

Although we did not check each locality record, we noted some errors. *Cantoria violacea* is cited from Sai Yok, in Kanchanaburi, on the basis of "Gairder and Smith (1915)". These authors did not list *Cantoria violacea*, but *Simotes violaceus* Cantor, a synonym of *Oligodon cyclurus* Cantor, but long used for Thai and Indochinese populations in place of *Oligodon cinereus* (Günther, 1864) (see Smith 1943), which is the valid name for these populations. Many important distributional data on endangered species, such as *Chitra chitra* (Kitimasak and Thirakhupt 2002), *Pelochelys cantorii* (Pauwels et al. 2003), or *Crocodylus siamensis* (Platt et al. 2002), were published between 2000 and 2004.

Some references listed in the text are missing in the bibliography: Bohme (sic) (1982); Chuaynkern (2001) (pp. 45, 93); Cochran (1922) (p. 77); Colwell et al. (1977) (p. 105); Fritz and Bbst (sic) (1999) (p. 53); Grossmann (1992) (p. 235); Grossmann and Tillack (2001) (pp. 98, 111); Lauhajinda et al. (1999) (p. 17); Lauprasert and Thirakhupt (2001) (p. 93); Nutaphand (1990) (p. 50); Schaffer (sic) (1991) (pp. 60-61); Steiof et al. (1991) (p. 69); Welch (1980) (p. 116); Welch et al. (1990) (p. 151); and Wuster (sic) et al. (1997) (p. 132). Listing the works done by Thai authors is of special importance, since these references, often in Thai language, are regularly overlooked by Occidental researchers. Some references are wrongly indicated in the main text: "Gunther (sic) (1961)" on p. 91; "Inger and Elbel (1977)" on p. 92 (Inger and Colwell, 1977); Manthey and Grossmann "(1977)" on p. 55 (1997); Taylor and Elbel "(1950)" on p. 25 (1958). The literature section is largely incomplete. One would have hoped to find a complete list of the numerous herpetological publications of the three authors, but, as two examples among many others, the intensive surveys of the second and third authors (Chan-ard 1996; Chan-ard et al. 2002) in Hala-Bala Wildlife Sanctuary, an area of great zoogeographical importance, or the first record of the Anguidae from Thailand (Nabhitabhata 1987) are absent.

Many of the undocumented species records concern species of difficult identification, or outside of their previously known range, thus with a special zoogeographical or conservation importance. In some cases new taxa could be involved, and the availability of internationally available voucher specimens is crucial. The high proportion of species partly or entirely recorded on the basis of observations made by the authors of the checklist gives, on the one hand, an idea of the huge field experience of the three authors, and on the other hand it stresses the importance of publishing detailed accounts of herpetological collections, in order to firmly document the listing of taxa. Also, it gives an idea of the richness of the mostly unpublished collections of the Thai National Science Museum, on which many records are based, as stressed by the authors in the compilers' note. This museum houses the most

important collection of reptiles in Thailand, more significant than those of Chulalongkorn University and the Queen Saovabah Memorial Institute of the Thai Red Cross in Bangkok.

The present checklist, in spite of the shortcomings listed above, is a very useful work that serves as a perfect companion to the field guide on frogs by Chan-ard (2003) and to the book on amphibians and reptiles of Thailand and Peninsular Malaysia by Chan-ard et al. (1999). Moreover, This checklist, available at the Thai National Science Museum in Pathum Thani and at the OEPP in Bangkok, has an unequaled advantage over all other herpetological books on Thailand: it is free. Although this checklist is a welcome addition to published material on the herpetofauna of Thailand, an updated second edition with more emphasis on voucher specimens and on the source literature would be desirable. Thai amphibian and reptile faunas are far from being adequately known, in spite of the extensive series of investigations made by both Western and Thai herpetologists. A work like this distributional checklist is the right way to present an overview of the Thai fauna, from which taxonomic and biogeographical data can be easily derived. Pending the eventual availability of a more carefully prepared, updated second edition, we highly recommend the prompt acquisition of the present list by all herpetologists and biologists working on the fauna of southeast Asia.

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Cusco Amazónico: The Lives of Amphibians and Reptiles in an Amazonian Rainforest, by W. E. Duellman. 2005. Cornell University Press, Ithaca, New York (www.cornellpress.cornell.edu). xv + 433 pp. Hardcover. US $74.95. ISBN 0-8014-3997-3.

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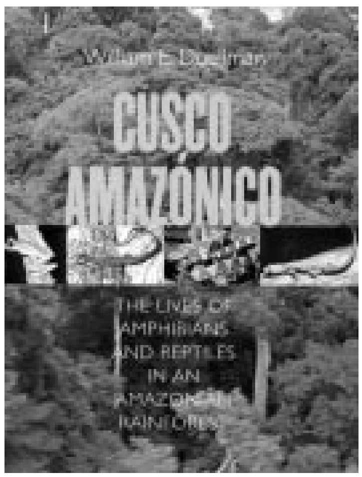

Neotropical rainforests are home to an incredible diversity of amphibians and reptiles, and the taxonomy and systematics of tropical species is becoming clearer, especially with the advent of molecular techniques. However, basic natural history data are still lacking for most Neotropical species, even relatively common ones, due to their generally low abundance and the difficulties associated with studying vertebrates in the tropics. In the field of herpetology, William E. Duellman has devoted a large portion of his career to studying the diversity and natural history of the Neotropical herpetofauna. His latest book, *Cusco Amazónico: The Lives of Amphibians and Reptiles in an Amazonian Rainforest*, is the culmination of decades of work, both in the field and laboratory, on an assemblage of Peruvian herpetofauna. His study site, Cusco Amazónico (now Reserva Amazónica), is located in southeastern Peru along the Madre de Díos River near the Peruvian-Bolivian border. Reserva Amazónica has been highlighted for its high herpetofaunal diversity (e.g., Doan and Arizábal 2002), and Duellman's recent work describes in wonderful detail the natural history of this area, including the geography, topography, weather patterns, vegetation, and of course, the amphibians and reptiles.

Cusco Amazónico is divided into five distinct sections that together encompass the abiotic factors affecting the herpetofauna, community aspects of the herpetofauna, and descriptions with ecological data for each species occurring at the site. The first section includes the introduction, which provides background on the study area and describes the methodology used in data collection. The next section describes the vegetation and physical characteristics of the environment in a very readable (even for a herpetologist) and comprehensive manner. The work of other researchers on the abiotic characteristics of the site complements the amphibian and reptile data, resulting in a comprehensive description of the Reserva Amazónica site rarely seen in the herpetological literature. The third section presents a site-specific summary of the general natural history, species diversity, abundance, and biomass of the herpetofauna. These summaries are incredibly interesting, and give an accurate picture of the overall dynamics of the site. Finally, the last two sections, one for amphibians and one for reptiles, provide thorough dichotomous keys and detailed data for all species recorded from the site or expected to occur at the site based on nearby collection records. Each species account includes nomenclature, morphological characteristics, occurrence, reproduction, and diet information recorded primarily from Reserva Amazónica and supplemented by other literature, which helps to yield a very detailed literature cited section that highlights the herpetology of the Amazon basin as a whole. Helpful attributes of the amphibian section include descriptions of most tadpoles and sonograms of the advertisement calls of many frog species, most of which were previously undescribed.

Two sets of color plates are provided for visual reference, one for amphibians and the other for reptiles. In general, the photography is of good to excellent quality; however, some pictures are dark or out-of-focus, especially those of the rarer species. In many cases where great variation in morphology exists, several photos are included, making the plates more useful for identification purposes. However, in the case of *Oxyrhopus melanogenys*, Duellman notes that this snake has a unique color morph at Cusco Amazónico (page 379); a photograph of a more typical color morph would be helpful for comparative purposes, but noting this in the text provides the reader with a citation to investigate this further.

One obvious benefit of the dichotomous keys is that they are printed in both English and Spanish. This greatly increases the usefulness of the keys and ensures that Peruvians and other Latin American researchers can also take advantage of this work. We visited Reserva Amazónica in late 2004 through early 2005, and had the opportunity to use the keys in a field setting. There are a paucity of works dealing with both reptiles and amphibians from this region, and Duellman's keys are the most comprehensive published to date. In general, the keys were as descriptive and comprehensive as available data allow, although we found a few mistakes, particularly in the reptile key. For example, *Oxyrhopus melanogenys* was identified as *Clelia clelia* using the dichotomous key. Although the two species have similar dorsal scalation and juvenile patterns, after consulting Dixon and Soini (1977), we determined that this was in error. When working with such diversity, and sometimes with very few specimens, mistakes are to be expected and otherwise seemed minimal throughout the book. In fact, just having this material on reptiles and amphibians available in one edition is a huge benefit to neotropical ecologists working in the field.

In particular, we wish to highlight the Epilogue, which relates the field experiences of a biologist at Reserva Amazónica. The interesting twist is that the setting is in a futuristic time period when technology and rainforest knowledge are more advanced. This portion of the book adds a touch of mystery and fantasy to what neotropical fieldwork may be in the future, but we will stop our summary here to prevent spoiling the ending…

For those seriously interested in tropical areas, or areas with high herpetofaunal diversity, this book is a must-have for your collection. *Cusco Amazónico* is the most comprehensive book published on South American herpetofauna to date, displacing

Duellman's (1978) sought-after classic *The Biology of an Equatorial Herpetofauna in Amazonian Ecuador* for this honor. Indeed, this book is rivaled among other volumes on Neotropical amphibians and reptiles only by Jay Savage's *The Amphibians and Reptiles of Costa Rica: A Herpetofauna between Two Continents, Between Two Seas*. Duellman has set the standard for tropical works extremely high, and those looking to publish a work encompassing amphibians and reptiles residing in the tropics will have a difficult time matching the quality of this book.

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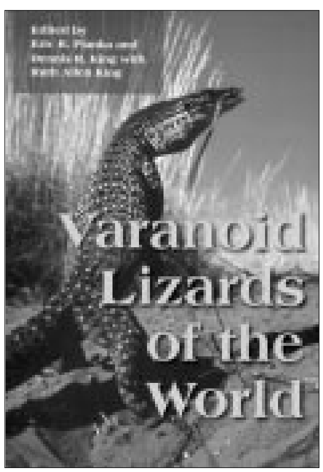

Monitor lizards and their close relatives have always been a source of interest and fascination among herpetologists and laymen alike. Despite this, until the 1980s general works on varanids were largely limited to those by Mertens (1942a; 1942b; 1942c) for the living species and Fejérváry (1918; 1935) for the extinct taxa. Recently, interest in these lizards has undergone a renaissance with the publication of important volumes devoted to individual taxa, for example: Auffenberg (1981; 1988: 1994), Lenz (1995), and Murphy et al. (2002), as well as general works and symposia, such as: Böhme and Horn (1991), Bennett (1998), Horn and Böhme (1999), and Green and King (1999), and books on varanid paleontology (Molnar 2004). This brief listing does not even begin to account for the enormous wealth of current publications focused on the husbandry of these forms. This new book, edited by Pianka, King, and King, which purports to be a "comprehensive account of virtually everything important that is known about monitor lizards and their allies," is divided into three major sections. The first is focused largely on phylogeny and biogeography, the second and longest is committed to species by species descriptions, and the third discusses the evolution of body size and its importance to reproduction and also examines captive care.

In their introduction Eric Pianka and Dennis King briefly explain that their goal was to compile a single volume reference work about monitor lizards and their allies that touches not only on the systematics of individual species, but also examines their collective biogeography, paleontology, and other important features of their biology. A significant discussion of the paleontology of varanoids by Australian paleoherpetologist Ralph Molnar follows the introductory chapter and occupies 58 pages of this 602-page book. It is the most detailed and up-to-date paleontological review of the group and it also contains a very useful annotated inventory of terrestrial fossil varanoids, updating that of Estes (1983).

There are occasional confusing or erroneous statements in Molnar's review. For example, he notes that the oldest "necrosaur" traces back to the Albian of Utah (Early Cretaceous, about 112-99 million years mya). This can only be the fossil originally described by Cifelli and Nydam in 1995. However, this fossil was later shown by Nydam (2000) to be that of *Primaderma*, which is a monstersaurian not a "necrosaur." Molnar at first refers to *Primaderma* as the oldest land-dwelling platynotan. Later when he discusses monstersaurs in detail, Molnar claims that members of this taxon date back to at least the Late Cretaceous, and that the oldest forms were found in Asia. However, a mere paragraph afterward, Molnar states: "*Primaderma nessovi* is the oldest known monstersaur…its remains were found in the [Early Cretaceous] Cedar Mountain Formation of Central Utah" (page 28). Unfortunate oversights such as this should not have escaped the editors.

The first section of the book concludes with two relatively brief chapters. One, by Pianka and Molnar, is concerned with the biogeography and phylogeny of varanoids generally, although its focus is on the genus *Varanus*. The final chapter in the first section, contributed by Jennings and Pianka, summarizes hypotheses about the tempo and timing for the radiation of Australian monitor species. Their analysis suggests that Australian goannas have undergone repeated and episodic speciation, that the increasing aridity of Australia during the later Tertiary apparently helped drive this diversification and radiation, and that the Australian varanid radiations appear to parallel those of pygopods.

In Part II, the individual species accounts are broken up into four sub-groupings: African varanid species, Asian varanid species, Australian varanid species, and other varanoids. Each subsection contains its own bibliography, and virtually all species descriptions contain all or most of the following subdivisions: nomenclature, geographic distribution, fossil record, diagnostic characteristics, description, size, habitat and natural history, reproduction, movement, population genetics, physiology, fat bodies, testicular cycles, and parasites. Range maps varying in their level of detail are also usually included. Some species acounts are supplemented by tables summarizing morphometric, physiological, or breeding data, or graphs, such as that showing the relation-

ship between body mass and snout-vent length in *Varanus gouldii*. Nearly all species accounts provide a black and white photo above the text for each description, along with duplicate, but separately organized color print, showing a typical representative, usually an adult. These photographs vary in quality, size, and detail.

The African varanid section had a wide range of authors and, as with all the other sections, the amount of detail varied from species to species. All known African species (*Varanus albigularis*, *V. exanthematicus*, *V. griseus*, *V. niloticus*, *V. ornatus*) and the relatively recently described Middle Eastern *V. yemenensis* (Böhme et al. 1987, 1989 [**note**: these two citations are incorrectly listed in the book's bibliography and are corrected here]) are discussed. The account by Michael Stanner describing the desert monitor, *Varanus griseus*, consumes the greatest percentage of this section, about 45%, but fails to resolve whether or not this species is actually venomous as some earlier reports claimed (Ballard and Antonio 2001; Sopiev et al. 1987).

The Asian monitor section describes 23 species, with that for *Varanus salvator* split into two separate segments: one devoted to the nominate form and the other to the various subspecies. It is heavily dominated by German authors and, therefore, many of the species descriptions include diagnostic characters containing references to hemipeneal (and sometimes hemiclitoral) characters that are derived from Böhme (1988). Unfortunately, no general discussion of the specialized terms regarding these important genital characters is provided in this volume and the book's glossary also lacks any definitions to assist unfamiliar readers. Considering that these and many other authors place great significance on these morphological characters to differentiate many varanid species, this deficiency must be corrected in any future editions to ensure comprehensiveness.

In the Asian monitor section several individual species members of the so-called "*Varanus indicus* group" are described separately from the nominate taxon and similar partitioning was also made for members of the "*V. prasinus* group" (which in this volume includes: *V. kordensis*, and *V. macraei*; but not *V. beccari*, and *V. bogerti*). None of the Asian monitor chapters are as detailed as that for *V. griseus*, however, the two segments concerned with *V. salvator* and its subspecies, when combined, come close. The others, all succinct reviews, average about four or five pages each.

The section on Australian monitors has the greatest number of authors and, not surprisingly, the majority are Australians (the one dealing with *V. keithhornei* was even contributed by "Croc Hunter" Steve Irwin). One significant difference between this section and those for the African and Asian monitors is that each Australian species contains a list of specimens in the major Australian museum collections. Many of these specimen lists appear quite exhaustive and all are potentially very useful to any varanid researcher doing work on these species. Unlike for the previous two sections, I could not detect any missing or incorrectly cited references, but similar to these earlier sections, the amount of detail provided for any given Australian species varies. Generally, these descriptions were all concise and averaged somewhere between six and ten pages.

The "Other Varanoids" section contains accounts for *Lanthanotus*, both living species of *Heloderma*, and the Late Cretaceous monstersaur, *Estesia mongoliensis*. *Estesia*, which did not merit a color photo, although a black and white print of the skull leads the chapter, is the only fossil taxon treated in its own individual segment (about two pages) despite the fact it was discussed earlier in Molnar's chapter. Not even the gigantic Australian varanid, *Varanus priscus* [*Megalania prisca*] warranted its own chapter, although this latter species went extinct much more recently in the Pleistocene. All subspecies for *Heloderma* are discussed within the chapters about the two species and their range maps also include subspecies information (both chapters are by *Heloderma* expert, Daniel Beck). Eric Pianka's short chapter on *Lanthanotus* is notable for demonstrating how little is known about this important taxon, particularly concerning its diet and times of activity, as well as reproductive, thermoregulatory, and foraging behaviors.

The book concludes with a two-chapter section. The first, by Pianka, draws an important relationship between body size and reproductive tactics, and basically argues that body size influences reproduction more strongly than phylogeny, particularly: egg mass, clutch size, clutch mass, neonate snout-vent length, and neonate body mass. Pianka also notes that clutch sizes for larger species are normally smaller than those produced by the smaller species and that maternal snout-vent length is a more potent influence on clutch size within a given species than between any two species. The final chapter, by Hans-Georg Horn, examines the captive care of monitors with an eye toward biological, technical, and legal difficulties, and he discusses many relevant issues including: difficulties providing the proper diets, distinguishing males from females, the problems involved with distinguishing between two species showing very similar appearance, problems involving the proper lighting and construction of enclosures, and the effects of various laws, including CITES legislation, on the captive conservation of monitors.

This book will likely be an important single-volume source about varanoid lizards for some time to come. Despite some mostly minor editorial oversights, including those mentioned above, some of which may have resulted from the sudden and unfortunate death of Dennis King during the production of this volume, I believe this book to be a welcome and important addition to the library of any herpetologist. Its importance lies not only in what information it manages to include within its covers, but also in its indication of the significant work still remaining for the more complete understanding and conservation of these important reptiles.

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Die Mimikry zwischen Eidechsen und Laufkafern (Mimicry Between Lizards and Ground Beetles), by Almuth D. Schmidt. 2004. Edition Chimaira, Frankfurt am Main, Germany (www.chimaira.de). 374 pp. Hardcover. ¤ 58.00 (approximately US $75.00). ISBN 3-930612-69-0.

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For more than a century, warning coloration and mimicry have fascinated evolutionary biologists and natural historians. In fact, these phenomena helped convince late 19th Century biologists of the power of natural selection.

During the 20th Century, studies of mimicry were common; but reptiles and amphibians were bit players in these studies. A few species were notable exceptions, of course (e.g., coral snakes, egg-eating snakes; reviewed in Pough 1994); but these involved one herp mimicking another. Cases of a herp mimicking an invertebrate are rare (Autumn and Han 1989; Gans 1987; Parker and Pianka 1974; Vitt 1992) and often anecdotal.

In 1977 we proposed that a ground-dwelling lizard in the Kalahari Desert mimicked a beetle (Huey and Pianka 1977). The possibility that a lizard could mimic a beetle must have seemed ludicrous to many, and no doubt some of our colleagues wondered whether we'd spent too much time out in the Kalahari sun. Our evidence was circumstantial; but we were convinced that this was mimicry, and that it involved both color and locomotor behavior.

The model is the juvenile lacertid lizard, *Heliobolus lugubris*, and the mimic is a carabid beetle, *Anthia* spp. Adult *H. lugubris* are sand colored and reasonably cryptic, but juveniles are decidedly conspicuous against the red Kalahari sand. Juveniles have jet-black bodies, with broken white stripes—only their tails are sand colored (Fig. 1). No other lacertid in the Kalahari changes color so dramatically during ontogeny. Nor does any other lacertid of which we are aware.

Both juvenile and adult *H. lugubris* are wide foragers (Huey and Pianka 1981), but they differ strikingly in the way they move. Adults move like normal lacertids (with lateral undulations), but juveniles often move stiff legged, with their backs arched and their tails pressed to the ground (Fig. 1). When the juveniles 'metamorphose' to the adult coloration, they switch from arch-walking to a normal walking style. Juvenile *H. lugubris* are the only lizards known to use arch-walking.

We didn't do a formal phylogenetic analysis, but we realized that two unique features of the juveniles (coloration, arch walking) must be evolutionarily derived and thus called for explanation. When we looked around the Kalahari, we soon noticed carabid beetles (*Anthia*). These beetles are black-and-white, a classic aposematic pattern, and often abundant. Locals refer to them as "oogpisters" (which translates euphemistically as "eye squirter"), because these beetles squirt from their abdomen a noxious mixture of formic acid, tiglic acid, and other compounds (Scott et al. 1975). As far as we were aware, no vertebrate predator ate these noxious beetles.

To us the observed patterns strongly suggested that the beetles were noxious models and that juvenile *H. lugubris* (approximately the same size as the beetles) were Batesian mimics, involving both color and movement. We noted that juveniles of this species had a

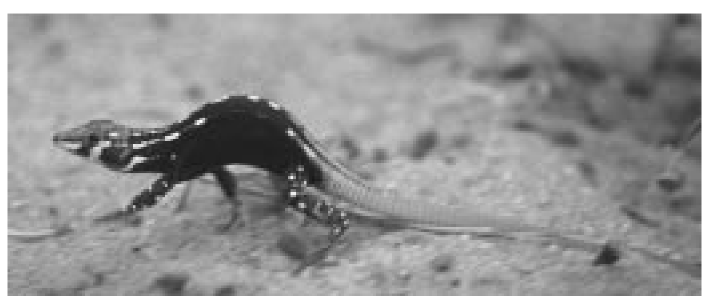

Fig. 1. An arch-walking juvenile *Heliobolus lugubris* (photograph courtesy of A. Schmidt).

low tail-break frequency relative to other juvenile lacertids in the Kalahari, and we interpreted this as evidence of the efficacy of the mimetic resemblance (but see Schoener 1979).

In the late 1990s we began to hear rumors that a German graduate student (Almuth Schmidt) was studying this mimicry complex for her thesis. She has published a few papers on this over the years, but has now synthesized her work in a well-illustrated book. Naturally, we were excited to see her book, to find out how well our ideas stood up, and to learn what new evidence she had uncovered.

Her book is largely in German (a language that has sadly decayed from our brains during ontogeny). Fortunately, all of the table and figure legends are in both English and in German; and the book has a 3-1/2 page summary in English. So the essence of her study is accessible even to an English-restricted audience.

Schmidt worked mainly in two nature reserves in the Limpopo Province of South Africa, rather than in the Kalahari. She presents a diverse set of studies involving careful observations as well as clever experiments. Her studies solidly reinforce the idea of mimicry. Here is a small sample of the kinds of evidence she has garnered:

1) The geographic range of the lizards overlaps with that of abundant carabid beetles (a dozen species of *Thermophilum* and three species of *Anthia*), which serve as models.

2) As juvenile lizards grow, their color and patterns shifts progressively, matching the color of size-matched species of beetles!

3) In staged encounters with beetles, most predators (birds, mammals, monitor lizards) consistently avoided the beetle after being sprayed only once. Thus beetles are indeed strongly noxious, and seemingly unforgettable.

4) Arch-walking juveniles were avoided 100% of the time by visually hunting snakes, but were invariably attacked by the same snakes if they moved normally. Thus arch walking is highly effective against visual predators. (Note: it was against us, too! More than once we briefly confused juvenile lizards for beetles.)

5) Most remarkably, juveniles change their behavior when encountering different snakes. When they encounter a visual hunter, they either remain immobile or use arch-walking. But, when they encounter a snake that hunts using olfaction, they run away at high speed!

Schmidt's studies are inventive and comprehensive, and she has put together one of the most impressive studies of models and mimics we've seen. Her findings will be of considerable interest not only to herpetologists, but also to any behavioral and evolutionary ecologists interested in predation, aposematic coloration, and mimicry. In particular, her discovery that juveniles modify their evasive behavior in response to different kinds of predators is remarkable and deserves to be widely highlighted.

Acknowledgments.—We thank Almuth Schmidt for permission to publish her photograph of an arch-walking *H. lugubris* and for discussion.

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The Musk Turtle Book, by John B. Iverson, with a **Section on Husbandry**, by Richard Cary Paull. 2003. Green Nature Books, P.O. Box 105, Sumterville, Florida 33585, USA. 78 pp. Soft cover. US $29.95 + $3.95 postage. ISBN 1-888089-58-X.

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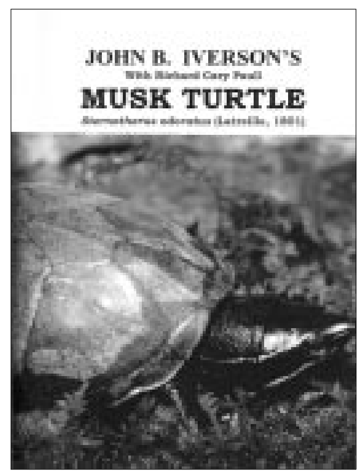

Musk turtles are ubiquitous denizens of many types of fresh waters in North America. Populations can be very large, and as such these little turtles are likely important components of aquatic ecosystems as both predators and prey. Anyone who has kept Stinkpots in an aquarium knows that they are quite entertaining and easy to maintain, and it is fortunate that commercial collecting has been restricted in many states because they undoubtedly would be popular in national and international trade. There are a number of musk turtles other than Stinkpots (*S. carinatus, S. depressus, S. minor*), however, and despite this little book's title, these are not covered except exceedingly cursorily in Paull's 5 page section on "Other Musk Turtles."

The book (really a booklet) consists of 40 pages of large bold text by Iverson on the natural history of Stinkpots, 9 pages on husbandry and other musk turtles by Paull, 4 pages of biography (including pictures of the Iverson family and Paull with his granddaughter), and 19 pages of literature cited (with references to early 2003). Only a bare minimum of information on Stinkpot morphology, physiology, or factors other than those relating to natural his-

tory, are included. The book appears to be printed on high quality vellum without using any special publishing program, which in turn makes photographs reproduce very poorly (almost black in some cases) and allows text to be seen through the page. The booklet is paper bound, with a clear front page protector over a color photograph of *Sternotherus odoratus*. The cover provides one version of the title, whereas page 3 has a completely different version (I have shortened both to avoid excessive and confusing verbiage). Maps are identical to those in Iverson (1992), except for a very poor map on page 12 depicting localities for *S. odoratus*. Photos include pictures of turtles and habitats, with some photos taking entire pages.

I almost don't know where to begin, for I consider John Iverson to be one of the most respected turtle scientists active today. There is probably no one who knows more about "little brown turtles" than he does, so my impressions of the booklet become all the more difficult to convey. Iverson reviews the literature on the life history and ecology of Stinkpots quite thoroughly and in great detail, although he adds no new insights or data. I could not find any missing studies of note; if a reader wants facts on natural history, they are here. However, the sheer volume of the literature makes the litany of facts difficult to assimilate, as the reader is embalmed in statement after statement, for example, of "(so and so) reported (x to y) eggs in (wherever)." Simply putting more of this repetitive information (e.g. growth increments, nesting dates, incubation duration) in tables would have helped. Iverson also makes little attempt to put studies of Stinkpots in context with other chelonians, except when they are included with his meta-studies, such as on biomass or survivorship. This is not a book to read, but one that could be consulted for raw information.

A few things need clarification. I presume Iverson means latitudinally rather than altitudinally when discussing reproductive cycles (page 24); if *S. odoratus* is diurnal, as suggested, why does mating and nesting often occur at night (pages 27 and 28); variable sex ratios may not need a complex explanation (pages 36–37) since stochastic variation may occur for a variety of reasons in any one year (in other words, turtle biologists focus too much weight on results from short-term studies of sex ratios, rather than on the long-term population structure); turtles do not hibernate (a physiological ecology term involving endotherms), but become dormant.

I don't have any idea of whom the intended audience of the book might be. All the Stinkpot facts are beyond the interests of most herpetoculturists and amateur naturalists, and the fairly uninformative section on husbandry would insult most turtle aquarists (Paull takes much space talking about tortoises, for some reason). One cannot read this booklet because of its non-literary style, and the price is completely outrageous; I can't imagine herpetologists paying > $30 for this booklet rather than consulting Ernst et al. (1994) and the recent published literature. The poor quality of reproduction, the frequent editorial mistakes (scientific names not italicized, occasional use of English metrics, the heading 'Activity Patern' misspelled), the out-of-place folksy comments by Paull (page 32: "the musk turtle enjoys diving almost as much as boys do on a hot day"), the lack of attention to nomenclature (Stinkpot versus the all-inclusive 'musk turtle'), and the gushy biographies are overwhelming.

The authors could have collaborated to produce a valuable reference, even if privately published (Green Nature Books is Paull's personal publishing outlet), by using a good publishing program, by taking the time to edit the text for style, by opting for consistency in style between authors, and by using paper compatible with photographs. What were the authors thinking?

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Verzeichniss der Reptilien, welche auf einer Reise im nördichen America beobachtet wurden, by Maximilian, Prince of Wied. 1865 (reprint 2004). Bibliomania!, Salt Lake City, Utah (www.herplit.com). 152 pp., 7 handcolored plates. Leatherbound edition US $875. ISBN 1–932871–04–7; unbound edition US $675. ISBN 1–932871–03–9.

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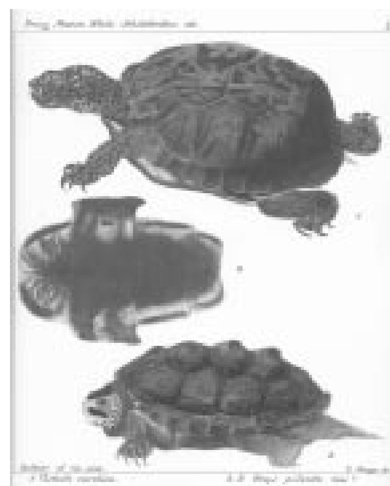

In 1832, Prince Alexander Philipp Maximilian of the German principality of Wied-Neuwied – former major general in the Prussian army during the Napoleonic wars and veteran explorer of Brazil – embarked on his second and last great expedition, at the age of 50. Together with his Swiss artist, Karl Bodmer, and a team of five assistants, Maximilian traveled by means of small boats over nearly 2700 miles from Saint Louis, Missouri, to Fort McKenzie (near present-day Great Falls, Montana), along the then-treacherous Missouri River. Besides his other credentials, Maximilian was a naturalist and ethnologist, trained by Johann Blumenbach, and he sought to explore what was then "Indian country" beyond the border states of Missouri and Illinois. He was the first trained scientist to do so and his book, "Reise in das innere Nord-Amerika . . . in den Jahren 1832 bis 1834" (published 1839–1841), records his ethnological observations with notes on natural history including herpetology.

Maximilian's definitive scientific report on the amphibians and reptiles – the book reviewed here – was published much later, in

1865, only two years before his death. At that time it was the only extensive account covering the herpetofauna of central North America, thus filling the enormous gap between the region east of the Mississippi River that had been monographed by Holbrook in his two editions of "North American Herpetology" and the various reports on the herpetology of the Pacific Coast based primarily on foreign naval explorations (Russian, French, and British). Maximilian's book is comprehensive, covering 48 species (16 amphibians, 32 reptiles) with detailed descriptions of adults and (where available) juveniles, their colors in life, dimensions, and including extensive natural history notes. It is the fundamental first summary of the herpetology of the Great Plains and also includes Maximilian's observations made along the Ohio River (especially in Pennsylvania and southern Indiana) before he began his ascent of the Missouri.

As such, this book is a classic work that richly deserved reprinting, especially since original copies nowadays fetch prices of US$2000 and more. A reprint of this book is thus welcome, but this is no ordinary reprint. To the contrary, the seven beautifully drafted and accurate plates (five of them depict turtles, the other two the large aquatic salamanders *Cryptobranchus* and *Necturus* plus details of some snake heads; five plates are foldouts) were all originally drawn by Bodmer and are handcolored, both in the original and in this reprint. The latter is a remarkable achievement, given the difficulty to match the originals, and this represents the only herpetological work on North American herpetology with handcolored plates that has been issued in more than a century! These were faithfully colored by Lara Carroll. Copies of the book are available in two states: (1) exquisitely bound with leather spine, raised bands, and marbled paper covers, and (2) unbound, so that the purchaser can have the volume bound to a particular style. The volume is quarto in format, measuring 9 3/4 x 12 1/4 inches (25 x 31 cm).

As with the plates, the text is an exact facsimile of the original in every detail. The rear side of the title page, which is blank in the original, has the only new text added to the reprint. Here, the publisher gives details of the reproduction; it notes the copy number in the limited edition of only 100, and is individually signed by the publisher and colorist. The text and plates are printed on 100% cotton, mould-made, acid-free paper, a distinct improvement over the original in which the paper is routinely browned with age and often foxed due to its poor quality. The only other change from the original is that the final two pages (the errata and an explanation of the plates) are combined on a single leaf in the reprint.

Compared to reprints of classical herpetological works issued by various commercial firms in Europe, South Africa, Japan, and Australia, and including those by the SSAR over the past 45 years, this reprint surpasses them all in the standard of production. It meets the highest criteria and is of a quality of materials and appearance that Prince Maximilian's classic work deserved to have had in 1865!

Herpetological Review, 2005, 36(3), 350–351.

Amphibians and Reptiles of Montana, by J. Kirwin Werner, Bryce A. Maxell, Paul Hendricks, and Dennis L. Flath. 2004. Mountain Press Publishing Company, P.O. Box 239, Missoula, Montana, USA. xii + 262 pp. Softcover. US $20.00. ISBN 0-87842-500-4.

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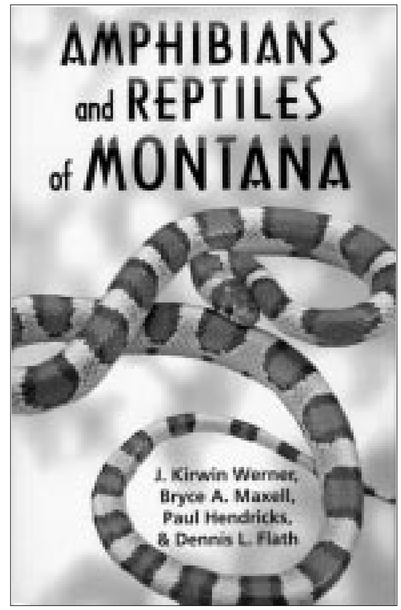

Two-hundred years have elapsed since the first formal scientific survey of Montana's biota; since that time, 31 species of amphibians and reptiles have been documented from the state. *Amphibians and Reptiles of Montana* summarizes the state of knowledge on the distribution, natural history and conservation status of Montana's herpetofauna. As a state field guide, this book has a large niche to fill; only a handful of recent, comprehensive summaries on amphibians and reptiles exist for the upper Great Plains (Hammerson 1999; Jundt 2000; Russell and Bauer 2000) and surrounding areas (Koch and Peterson 1995; Oldfield and Moriarty 1994; St. John 2002).

The introduction starts with "A Brief History of Herpetology in Montana." This section begins with a short discussion on the role of herpetofauna in the culture of Native Americans of Montana. From there the authors overview a rough chronology of the various and often famous naturalists who studied in Montana, starting with Meriwether Lewis and William Clark's explorations of 1804–1806 to Edward Drinker Cope in the 1860's to present day efforts of herpetologists. Overall, this section is lucid and interesting, but very brief at slightly over eight pages long.

In the "Biology of Amphibians and Reptiles" the authors discuss biological phenomena such as ectothermy, diversity, metamorphosis, food sources, predator relationships, diseases and deformities. The review is accurate and accessible to laypeople. "The Montana Landscape: Habitats for Herpetofauna" covers Montana's spectacular landscape features, from the alpine tundra and boreal forest of the Rocky Mountains, to the five major river systems, and the moonscapes of southeastern Montana's badlands. "Observing Amphibians and Reptiles in the Field" covers the basic steps in observing, capturing and handling reptiles and amphibians. The authors emphasize a conservation ethic in observing and collecting while recognizing the potential role of public reporting

of reptile and amphibian observations. In the "Conservation and Management" section the authors detail conservation concerns, both abroad and within the state.

The majority of the book is composed of species accounts for the 31 amphibians and reptiles found within the state and the six amphibians and reptiles that are of questionable occurrence. Each account includes sections on distribution, notes on identification, taxonomy, habitat/behavior, reproduction/development, remarks and scientific name etymology. The taxonomy is up-to-date and follows SSAR approved lists (Crother 2000). The distribution maps include a full range map and statewide dot locality map (which combines observations and museum vouchers). The species accounts are generously illustrated (most have at least four color photographs), which document color variants, various life stages and natural behaviors. The information in the accounts is accurate but little of it appears to be derived from data on Montana's amphibians and reptiles.

An "Identification Guide" overviews the diagnostic characteristics of adult, larval stages and eggs of all amphibians and reptiles (reptile eggs are not included) in Montana. The guide is well illustrated with color photographs and black and white drawings for each species/stage. This helpful feature ensures that readers will not have to flip back and forth from the species accounts to the keys while attempting to identify an animal. While not a formal dichotomous key, the identification guide should prove useful for anyone to make a solid identification of a reptile or amphibian in hand. I worked through the keys for several species and did not find any mistakes.

The book finishes with several appendices, which include a table of species by eco-region, reproductive characteristics of amphibians and reptiles, contact information for various agencies, an observation report form and a snakebite action sheet. In the tables of the reproductive characteristics, the authors give an impressive summary on the reproductive biology of reptiles and amphibians found in Montana. However, the tables suffer significantly by the complete lack of citations. The book wraps up with a glossary of terms used in the book, an index and a state checklist. The bibliography deserves special mention because it is a "selected bibliography"; this is particularly frustrating, as this belies the fact that the book is well researched at over 500 references consulted.

The front cover includes a county map of Montana and the back cover has a printed ruler. The book is fairly sturdy and appears to be up to the rigors of fieldwork. Finally, a state field guide that was meant to be brought into the field!

I noted very few errors in the text itself; more significant were the photographs that were out of context (e.g., dead animals posed as live and aquatic larvae on land; pgs. 9, 59, 64, 107, 175). For example, the description of handling a snapping turtle (p. 106) states not to handle large animals by the tail, whereas the picture on the opposing page shows someone carrying an adult snapping turtle by the tail. More importantly, I found the nearly complete lack of citations to be the most significant omission of the book. Presumably, the authors did this to keep the text readable for lay-people, however a compromise could have been reached if they simply included significant references at the end of each species account (e.g., Russell and Bauer 2000). Fortunately, all the references are included in a separate publication (Maxell et al. 2003), but will only be accessible those willing to track down that publication.

Overall, Werner et al. have done a fine job on Montana's state field guide. *Amphibians and Reptiles of Montana* should be a handy reference for lay-people, educators, students, state and federal wildlife biologists, and anyone with an interest in the natural history of Montana's biota. Herpetologists will also want to pick up the companion publication (Maxell, et al. 2003) which more formally summarizes the distribution, history, museum records, dichotomous keys and complete bibliography. Between these two books (Maxell et al. 2003, Werner et al. 2004), the authors have created an excellent reference set on Montana's amphibians and reptiles that compares favorably with many state herpetological guides in print. Anyone interested in reptiles and amphibians of the west and great plains regions should have this book on their shelf.

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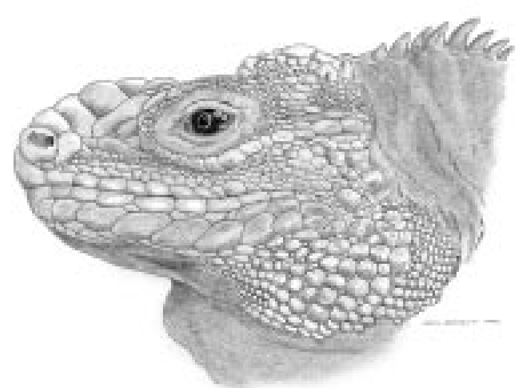

Cyclura cychlura cychlura (Andros Island Iguana). Illustration by John Bendon (Lizardwizard@btinternet.com).

Symposium on Conservation of Mesoamerican Herpetofauna

A symposium entitled "Conservation and Herpetology: The Middle American Connection" will be held 31 March and 1–2 April 2006 at the Kendall Campus of Miami-Dade Community College in Miami, Florida, USA. Symposium participants will address topics of the significance and conservation status of the megadiverse Mesoamerican herpetofauna (Mexico through Panama). The keynote speaker with be the noted conservation biologist Simon N. Stuart. A peer-reviewed symposium volume is planned, based on the presentations at the symposium and invited papers. Information is available from Larry David Wilson, organizer, by e-mail at: lwilson@mdc.edu.

INFORMATION FOR CONTRIBUTORS

Herpetological Review is a peer-reviewed quarterly that publishes, in English, articles and notes of a semi-technical or non-technical nature, as well as book reviews, institutional features, commentaries, regional and international herpetological society news, and letters from readers directed to the field of herpetology. Articles reporting the results of experimental research, descriptions of new taxa, or taxonomic revisions are not published in ***HR***, but should be submitted to the ***Journal of Herpetology*** (see inside front cover for Editor's address). To submit a manuscript to ***HR***, please consult the SSAR webpage at:

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FIG. 1. Male *Sistrurus catenatus catenatus* from the Upper Wapsipinicon River, Bremer County, Iowa, USA, engaged in combat.

op. cit.), several similarities exist, specifically, 1) displaying with the anterior portion of the body elevated in an S-shape and laterally swaying to gain superior position, 2) topping—one male gains the superior position and pushes the anterior portion of the other male to the ground in a quick movement, and 3) continuous contact of the posterior portion of the body. One notable difference was observed; an exaggerated posture of bending over backwards was observed on several occasions during this encounter. In male combat it is predicted that the larger male will typically prevail, which might result in increased reproductive opportunities for the larger male (Schuett and Gillingham 1989. Amphibia-Reptilia 10:243–266; Shine 1994, *op. cit.*). The apparent winner of this bout was M2, who was longer than M1, but weighed less.

I thank Robb Goldsberry, Wendy VanDeWalle, Stacey Carlson, John Goedeken, and James L. Christiansen for assistance. The Iowa Department of Natural Resources and the U.S. Fish and Wildlife Service provided funding.

Submitted by **TERRY J. VANDEWALLE,** Earth Tech, Inc., 501 Sycamore Street, Suite 222, Waterloo, Iowa 50703, USA; e-mail: terry.vandewalle@earthtech.com.

TROPIDOPHIS WRIGHTI (NCN). **SIZE RECORD.** A male *Tropidophis wrighti* collected at Vista Alegre, Santiago de Cuba City, Santiago de Cuba Province in 1946 was maintained in captivity and fed with *Anolis* for more than two years (it died on 20 June 1949). The specimen (CTR 2; "Charles T. Ramsden" Collection deposited at Instituto de Ecología y Sistemática, Havana City Province, Cuba) measures 488 mm snout–vent length, 64 mm tail length, 14.5 mm head length, and 8.4 mm head width, and has 23 dorsal scale rows at midbody, 202 ventrals, 37 subcaudals, four spot rows, 28–31 body spots and 4-4 subcaudal spots. The previously reported maximum length for *T. wrighti* is 330 mm SVL (Hedges 2002. Bull. Nat. Hist. Mus. Lond. [Zool.] 68[2]:83–91). With this size record, *T. wrighti* becomes the second largest species of *Tropidophis* in Cuba, surpassed only by *T. melanurus*.

We thank Elier Fonseca, Lourdes Rodríguez Schettino, and Luis F. de Armas for suggestions on the manuscript.

Submitted by **MICHEL DOMÍNGUEZ** (e-mail: micdom2002@yahoo.es), **LUIS V. MORENO**, División de Colecciones Zoológicas, Instituto de Ecología y Sistemática, Carretera de Varona km 3, Capdevila, Boyeros, A.P. 8029, C.P. 10800, Ciudad de La Habana, Cuba; and **MICHEL SÁNCHEZ**, IPA "Villena-Revolución," Ave. Van Troi y Final, Reparto General Peraza, Boyeros, Ciudad de La Habana, Cuba.

GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 36, Number 1 (March 2005). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extension reports unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA MACULATUM (Spotted Salamander). USA: TENNESSEE: CARROLL CO.: Tennessee National Guard Milan Reserve, just SE of Halls Branch ca. 0.4 miles SE of Headquarters on TN Hwy 104 (35°54'13"N,88°39'20"W). 20 November 2004. John Maxwell. Austin Peay State University Museum of Zoology, APSU 6298 (color photo). Verified by A. Floyd Scott. One adult found under rotting log in shallow depression. New county record that augments the scant amount of existing data on the distribution of the species in west Tennessee (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. [Hard copy and Internet versions, the latter of which includes links to information on amphibians in Tennessee having appeared since 1996], http://www.apsu.edu/amatlas/, accessed 10 February 2005).

Submitted by **JOHN MAXWELL**, 5581 Cole Street, McKenzie, Tennessee 38201, USA; e-mail: redhawk_202@hotmail.com.

AMBYSTOMA TALPOIDEUM (Mole Salamander). USA: VIRGINIA: CAMPBELL Co: Brookneal, man-made pond 300 m SE of State Rd. 643, ca. 2 km from intersection of State Rd. 643 and U.S. Highway 501 (37°07'09.5"N, 78°59'02.4"W), 10 May 2004. Paul R. Moosman, Jr., Deanne L. Moosman, and Jeremy C. Pillow. Verified by Craig Guyer. Photographs deposited in the Alabama Herp. Atlas Project at Auburn University (AUM-AHAP-0785a and AUM-AHAP-0785b). Larvae and metamorphs were observed in an ephemeral pond surrounded by pasture. Only 15 other breeding sites have been documented in Virginia (Hayslett 2003. M.S. Thesis, Longwood College).

Submitted by **PAUL R. MOOSMAN, JR.**, Department of Biological Sciences, 331 Funchess Hall, Auburn University, Alabama 36849-5414, USA (e-mail: moosmpr@auburn.edu); **DEANNE L. MOOSMAN**, Alabama Cooperative Fish and Wildlife Research Unit, 103 Swingle Hall, Auburn University, Alabama 36849-5419, USA (e-mail: swartdl@auburn.edu); and **JEREMY C. PILLOW**, 7308 Lewis Ford Rd., Gladys, Virginia 24554, USA.

SIREN INTERMEDIA (Lesser Siren). USA: ILLINOIS: JERSEY Co.: Stump Lake, wetland S of IL Hwy. 100, ca. 1.0 km S from Stump Lake Road to unnamed road; from unnamed road ca. 2.1 km W (39°00'42"N; 090°33'51"W). Larva ca. 4 cm in TL at time of capture. Red stripe present on mouth and jaw. Late May, early June of 2002, Emily Dustman. INHS-2004.02 (Photo taken after 1 year in captivity). Verified by J. K. Tucker. New county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, 282 pp.). MADISON Co.: Horseshoe Lake, backwater adjacent to IL Hwy. 111, ca. 1.3 km S of dam (38°41'02"N; 090°04'10"W). Multiple larvae ranged from 5–7.5 cm TL at time of collection. Yellow stripes present on mouth and jaw. 27 June 2004. Emily Dustman. INHS-2004.24. Augments an Academy of Natural Sciences (Philadelphia) specimen collected by Cope (no date) as the only Madison County records (C. A. Phillips, pers. comm.).

Submitted by **EMILY DUSTMAN,** 82 Eastmoor Drive, Wood River, Illinois 62095, USA; e-mail: LmnLime03@yahoo.com.

ANURA

BARYCHOLOS TERNETZI (Chimbo Frog). BRAZIL: MARANHÂO: Municipality of Balsas (07°43'36"S, 46°17'15" W). 9 September 2000. L. Barreto and C. Arzabe. Museu Nacional de Rio de Janeiro, Brazil (MNRJ 36480–36481). Verified by J. P. Pombal Jr. Species previously known from Minas Gerais, Goiás, Mato Grosso, and Tocantins States, and the Distrito Federal, Brazil. First state record, extends known distribution 405 km NE from the closest previous record Porto Nacional (10°42'29"S, 48°25' 02" W), Tocantins State (Caramaschi and Pombal Jr. 2001. J. Herpetol. 35:357–360).

Submitted by **LARISSA BARRETO**, Departamento de Oceanografia e Limnologia, Universidade Federal do Maranhão, Campus do Bacanga, Av. dos Portugueses s/n, 65080-040, São Luís MA, Brazil (e-mail: lara@elo.com.br); and **CRISTINA ARZABE**, Embrapa Meio-Norte, Setor de Recursos Naturais e Desenvolvimento Sustentável, Av. Duque de Caxias N. 5650, B. Buenos Aires, 64006-220, Teresina PI, Brazil (e-mail: arzabe@cpamn.embrap.br).

BUFO HENSELI. BRAZIL: Paraná: Municipality of São João do Triunfo (25°34'18"S. 50°05'56"W), 780 m elev. 25 October 2003. A. M. X. Lima. C. F. B. Haddad collection, deposited in Departamento de Zoologia, Universidade Estadual Paulista, Rio Claro, São Paulo, Brazil (CFBH 7566). Verified by C. F. B. Haddad. Captured by pitfall trap. Previously recorded from the states of Rio Grande do Sul e Santa Catarina (Baldissera-Jr et al. 2004. Arquivos do Museu Nacional, Rio de Janeiro 62[3]:255–282). First state record, extends known distribution ca. 250 km to NE.

Submitted by **ANDRÉ MAGNANI XAVIER DE LIMA** (e-mail: andremxlima@uol.com.br), **RENATO GARCIA RODRIGUES, SHANNA BITTENCOURT, LUIZ HENRIQUE CONDRATI**, Laboratório de Inventário Florestal, Universidade Federal do Paraná, CEP 80210-170, Curitiba, Paraná, Brazil; and **REGINALDO ASSÊNCIO MACHADO**, Faculdade de Ciências Médicas de Cacoal, CEP 78976-005, Cacoal-Rondônia, Brazil.

BUFO PUNCTATUS (Red-spotted Toad). USA: NEW MEXICO: TORRENCE Co.: Abo ruins unit, Salinas Pueblo Missions National Monument, UTM (NAD27) 13S, 373436 E, 3812380 N, ca. 1829 m elev. 18 May 2001. Trevor B. Persons and Shawn C. Knox. MSB/USGS Biological Survey Collection, BS/FC 7868. Verified by Cindy Ramotnik. New county record (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. University of New Mexico Press, Albuquerque, 431 pp.).

Submitted by **TREVOR B. PERSONS** (e-mail: Trevor.Persons@nau.edu) and **ERIKA M. NOWAK** (e-mail: Erika.Nowak@nau.edu), USGS Southwest Biological Science Center, Colorado Plateau Research Station, Box 5614, Northern Arizona University, Flagstaff, Arizona 86011-5614, USA.

BUFO WOODHOUSII (Woodhouse's Toad). USA: TEXAS: KLEBERG Co.: Padre Island, Road P22, 6 rd mi S of State Route 361 (27.5316°N, 97.25802°W, ± 5 m, NAD27 CONUS). 15 Oct 2004. Rachel E. Seabury. Verified by Travis J. LaDuc. TNHC 63255 (TNHC-FS 91). 92 mm SVL; adult female collected AOR at 2000 h. This is the first specimen reported for this county and is the northernmost record for the south Texas range of *B. woodhousii* (Dixon 2000. Amphibians and Reptiles of Texas, 2nd edition, Texas A&M University Press, 421 pp.). This record partially fills the gap between the south Texas and central Texas populations, with the hiatus in the coastal distribution still including the mainland of Kleberg County as well as the next two counties to the north, Nueces and San Patricio (Dixon 2000, *op. cit.*). Dixon (2000, *op. cit.*) suggested that *B. woodhousii* was extirpated from south Texas, and although this might be true for the mainland, this record suggests that individuals persist on Padre Island.

Submitted by **RACHEL E. SEABURY**, Section of Integrative Biology, One University Station (C0930), University of Texas, Austin, Texas 78712, USA; **DAVID W. HALL**, and **GREGORY B. PAULY,** Section of Integrative Biology and Texas Memorial Museum, One University Station (C0930), University of Texas, Austin, Texas 78712, USA.

COCHRANELLA DAIDALEA (Alban Cochran Frog). COLOMBIA, DEPARTAMENTO DEL CESAR. MUNICIPIO GONZÁLEZ: Vereda San Cayetano (12°25'30.1"N, 73°24'3.4'"W), ca. 1600 m

elev. 10 Sept 2004. Museo de Herpetología Universidad de Antioquia, Medellín, Colombia (MHUA 3271–3272). 13 Sept 2004 (MHUA 3273–3278). J. M. Daza-R. Verified by J. D. Lynch. Species endemic to Colombia and has been known only from Cundinamarca and Santander departments (Ruiz-Carranza and Lynch 1991. Lozania 59:1–8). First department record, extends known distribution to northern part of Cordillera Oriental, ca. 138 km NW from Municipio Tona, the northernmost locality previously mentioned (Ruiz-Carranza and Lynch, *op. cit.*).

Submitted by **JUAN MANUEL DAZA-R.** (e-mail: juandaza35@hotmail.com) and **LUCAS S. BARRIENTOS**, Grupo Herpetológico de Antioquia, Instituto de Biología, Bloque 7-121, Universidad de Antioquia, A.A. 1226, Medellín, Colombia.

ELEUTHERODACTYLUS CAVERNIBARDUS (NCN). BRAZIL: AMAZONAS: Municipality of Barcelos, Serra do Tapirapecó, base camp at southern versant of Pico Tamacuari (1°12'30"N, 64°45'13"W, 930–1200 m elev.). 6–7 May 2004. P. M. S. Nunes. Museu Nacional, Rio de Janeiro, Brazil (MNRJ 36183–36186). Collected at night on the ground in forest bordering a river. Verified by C. A. G. Cruz. Previously known only from the type locality, "from the north base of Pico Tamacuari, 1160–1200 m elevation, Sierra Tapirapecó, Amazonas, Venezuela (1°13'N, 64°42'W)" (Myers and Donnelly 1997. Amer. Mus. Nov. 3213:1–71; Frost 2004. Amphibian Species of the World: An online reference. Version 3.0. 22 August 2004. http://research.amnh.org./herpetology/amphibia/index.html). First documented record for Brazil.

Submitted by **ULISSES CARAMASCHI** and **HELIANNE DE NIEMEYER**, Departamento de Vertebrados, Museu Nacional/UFRJ, Quinta da Boa Vista, 20940-040 Rio de Janeiro, RJ, Brazil; e-mail: ulisses@acd.ufrj.br.

ELEUTHERODACTYLUS CYSTIGNATHOIDES (Rio Grande Chirping Frog). USA: TEXAS: Brazoria Co.: City of Alvin, 2216 FM 517. 18 March 2004. Michael James McCoid. Texas Natural History Collection 63681. Verified by Travis LaDuc. First record for this county but the species has been recorded in neighboring counties (Frost 2004. Amphibian Species of the World: an Online Reference. Version 3.0 [22 August, 2004]. http://research.amnh.org/herpetology/amphibia/index.php. American Museum of Natural History, New York). The specimen was collected at 0645 h from beneath discarded cardboard. There had been rain the previous evening. Many Rio Grande Chirping Frogs had been heard calling from areas all around this house suggesting the population was fairly large and has been established for some time.

Submitted by **MICHAEL JAMES McCOID**, Department of Pathology, University of Texas Medical Branch, 301 University Blvd., Galveston, Texas 77555-0609, USA; e-mail: mjmccoid@utmb.edu.

HYLA MICROCEPHALA (Yellow Treefrog). HONDURAS: ISLAS DE LA BAHIA: Isla De Utila: 1.3 km from Utila on the road to Pumpkin Hill Beach (16°06'76"N, 86°53'29"W). 17 September 2001. Alexander Gutsche. Museo Natural de Historia, Tegucigalpa (UNAH 4355, 4356). Verified by James R. McCranie. First record for Isla de Utila (Köhler 1998. Senck. Biol. 77:139–145). Both specimens were captured within a temporarily flooded wetland, covered with grasses and cattails.

Submitted by **ALEXANDER GUTSCHE**, Humboldt-Universität zu Berlin, Inst. für Biologie, Abt. Sinnesbiologie, Invalidenstr. 43, D-10115 Berlin, Germany; e-mail: alexander-gutsche@web.de.

HYLA NANA (Dwarf Treefrog). ARGENTINA: TUCUMÁN: DEPARTAMENTO MONTEROS: Capitán Cáceres (27°12'S, 65°38'W). 3 March 2005. M. L. Ponssa. Verified by G. Scrocchi. Herpetological Collection Fundación Miguel Lillo, San Miguel de Tucumán, Argentina (FML 16064–70, adult males calling on low vegetation of temporal ponds; 16071 adult female). The species range includes diverse areas of Brazil, Paraguay, Bolivia, Uruguay, and the Argentine provinces of Salta, Formosa, Chaco, Santa Fe, Misiones, Corrientes, Entre Ríos, and Buenos Aires (Lavilla et al. 2000. Categorización de los Anfibios y Reptiles de la República Argentina. Asociación Herpetológica Argentina, pp. 11–34). First province record and the southernmost in the western range; extends the known distribution ca. 550 km S from its closest record, Aguas Blancas in Salta (Langone and Basso 1987. Com. Zool. Mus. Hist. Nat. Montevideo 11[164]:1–17). Historically, this area consistsed of montane forests (Andean Yungas), but at present is strongly disturbed by crops and human settlements.

Submitted by **MARÍA LAURA PONSSA** and **ESTEBAN LAVILLA,** Instituto de Herpetología, Fundación Miguel Lillo, Miguel Lillo 251, San Miguel de Tucumán, 4000, Argentina; e-mail: mlponssa@arnet.com.ar.

HYOPHRYNE HISTRIO (Bahia Yellow Frog). BRAZIL: BAHIA: Itambé Municipality, União farm (15°16'S, 40°27'W). 19 August 2003. A. J. S. Argôlo. Museu de Zoologia da Universidade Estadual de Santa Cruz, Ilhéus (MZUESC 3771). Verified by E. F. Spirandeli Cruz. The species was known only from the Ilhéus Municipality (Frost 1985. Amphibians Species of the World. A Taxonomic and Geographical Reference. Allen Press, Inc., Lawrence, Kansas. vi +732 pp.) and was recently rediscovered at the Una Municipality 60 km S of Ilhéus (Dixo 2004. Phyllomedusa 3:77–79). Both localities lie in the domain of the Atlantic rainforest. This record extends range ca. 150 km W from Una and also points out mesophytic forest as habitat of the species.

Submitted by **ANTÔNIO JORGE SUZART ARGÔLO**, Universidade Estadual de Santa Cruz – UESC, Km 16 Rodovia Ilhéus-Itabuna, CEP 45650-000, Ilhéus, Bahia, Brazil; e-mail: lachesis@uesc.br.

MELANOPHRYNISCUS PACHYRHYNUS. URUGUAY: DEPARTAMENTO DE CERRO LARGO: Cuchilla de Mangrullo (32°14'S; 53°51'W; 265 m elev.). 16 May 2004. C. Borteiro, S. Borteiro, F. Gutiérrez, F. Kolenc, and M. Tedros. Verified by M. Di-Bernardo and R. Maneyro. Vertebrates Zoology Collection, Facultad de Ciencias, Universidad de la República, Montevideo, Uruguay (ZVCB 11097–11098). Previously known only from type locality, São Lourenço do Sul, Rio Grande do Sul, Brazil (Caramaschi and Cruz 2002. Arquivos do Museu Nacional, Rio de Janeiro 60:303–314). First country record, extends the known range of the species ca. 300 km SW.

Submitted by **CLAUDIO BORTEIRO**, Departamento de Fisiología, Facultad de Veterinaria, Universidad de la República, Uruguay (e-mail: caiman@adinet.com.uy); **FRANCISCO**

KOLENC, Cátedra de Bioquímica y Biofísica, Facultad de Odontología, Universidad de la República, Uruguay; **MARCELO TEDROS,** China 2202, 12800, Montevideo, Uruguay; and **FRANCISCO GUTIÉRREZ**, 19 de Abril 3490, 11700, Montevideo, Uruguay.

PHYSALAEMUS AGUIRREI (Linhares Dwarf Frog). BRAZIL: MINAS GERAIS: MUNICIPALITY OF NANUQUE (17°50'S, 40°21'W, 104 m elev.). 4–7 June and 2–5 September 2002. R. R. Carvalho-Jr. Museu de Ciências Naturais, Pontifícia Universidade Católica de Minas Gerais, Belo Horizonte, Minas Gerais (MCNAM 2915, 3016–34). Collected using pitfall traps on the leaf litter at forest fragment within Atlantic domains. Verified by U. Caramaschi and C. A. G. Cruz. Published distribution for the species is the type locality, Refúgio Sooretama, Linhares, Espírito Santo, Brazil (Frost 2000. Amphibian Species of the World. An Online Reference. http://research.amnh.org/herpetology/amphibia/) and Caravelas, Bahia, Brazil (Sluys 1998. Herpetol. Rev. 29:49). First state record, represents the westernmost record for the species and extends the known distribution ca. 120 km W from Caravelas (Sluys 1998, *op. cit.*).

Submitted by **RONALD REZENDE DE CARVALHO JÚNIOR** and **LUCIANA BARRETO NASCIMENTO**, Pontifícia Universidade Católica de Minas Gerais, Av. Dom José Gaspar 290, Coração Eucarístico, 30536-610, Belo Horizonte, MG, Brazil; e-mail: rcjunior.bh@terra.com.br.

PHYSALAEMUS MAXIMUS (NCN). BRAZIL: MINAS GERAIS: MUNICIPALITY OF OURO PRETO (20°29'S, 43°35'W, 1248 m elev.). November 2004. D. P. B. da Costa, B. de Assis, and P. H. Bernardo. Laboratório de Zoologia dos Vertebrados, Universidade Federal de Ouro Preto, Ouro Preto, Minas Gerais, Brazil (LZV 301A and 330A). Verified by R. N. Feio. Previously known only from the type locality in the mountains of Serra do Brigadeiro (20°42'S, 42°29'W, 1375 m elev.), Municipality of Arapongas, Minas Gerais (Feio et al. 1999. Copeia 1999:141–145). Present record extends known distribution ca. 120 km SW from the type locality.

Submitted by **DÉLIO BAÊTA, BRENO DE ASSIS, PEDRO HENRIQUE BERNARDO, VINÍCIUS DE AVELAR SÃO PEDRO, LEANDRO DE OLIVEIRA DRUMMOND,** and **MARIA RITA SILVÉRIO PIRES,** Laboratório de Zoologia dos Vertebrados, Universidade Federal de Ouro Preto, 35400-000, Ouro Preto, MG, Brazil; e-mail: scaldarum@gmail.com.

PSEUDACRIS CRUCIFER CRUCIFER (Northern Spring Peeper). USA: ARKANSAS: LONOKE CO: Roadside ditch 4.6 km S Lonoke (Sec. 36, T1N, R9W). 6 March 2005. H. W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28987). Verified by Stanley E. Trauth. New county record in east-central Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville).

Submitted by **HENRY W. ROBISON**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA; e-mail: hwrobison@saumag.edu.

PSEUDACRIS FERIARUM FERIARUM (Upland Chorus Frog). USA: TEXAS: LA SALLE CO.: Approximately 12 km E of Cotulla on Hwy 97. Approximately 30 m S of the highway. 13 March 2004. Joshua R. Engelbert and Robert C. Jadin. Verified by Jonathan A. Campbell. UTA – Collection of Vertebrates (UTA Slide No. 31331–31332). Caught in small flooded area about an hour before sunset, during intermittent rain. Photographed and released. New county record (Dixon 2000. Amphibians and Reptiles of Texas. 2nd Ed. Univ. of Texas A&M Press, viii + 421 pp.).

Submitted by **ROBERT C. JADIN** (e-mail snakeman1982@hotmail.com) and **JOSHUA R. ENGELBERT** (e-mail: okieherper@yahoo.com), Northeastern State University, Tahlequah, Oklahoma 74464, USA.

RANA PALUSTRIS (Pickerel Frog). USA: OHIO: CLERMONT CO: Washington Twp, Chilo Locks and Dam (38°47'23.8"N, 81°07'45.0"W). 27 March 2004. Keith Robinson. Verified by John W. Ferner. Cincinnati Museum Center (CMNH H 9675). New county record (Davis and Menze 2000. Ohio Biological Survey Misc. Contr. No. 6). Walker (1946. Ohio Historical Society) reported a Clermont County specimen (CSNH 1447); however, it is a misidentified *Rana pipiens*.

Submitted by **JEFFREY G. DAVIS**, Cincinnati Museum Center at Union Terminal, Geier Center Department of Research and Collections, 1301 Western Avenue, Cincinnati, Ohio 45203-1130, USA; and **KEITH ROBINSON**, Clermont County Park District, 2228 Highway 50, Batavia, Ohio 45103, USA.

SCAPHIOPUS HOLBROOKII (Eastern Spadefoot). USA: OHIO: MEIGS CO: Letart Twp: Adams Road (ca. 0.5 km E of State Route 338), 38.907528°N, 81.907000°W. 17 May 2003. Scott Moody and Jeffrey G. Davis. CMNH H9508 – H9511. Tadpoles raised to metamorphosis. New county record (Davis and Menze 2000. Ohio Biological Survey Misc. Contr. No. 6). COSHOCTON CO: Lafayette Twp: State Route 93 in city of West Lafayette, 40.260139°N, 81.743667°W. 26 May 2003. Dan Eggan and Jeffrey G. Davis. CMNH H9400 –H9401. New county record (Davis and Menze, *op. cit.*). TUSCARAWAS CO: Salem Twp: Fillman Bottom Road E of city of Port Washington, 40.335361°N, 81.505222°W. 01 June 2003. Dan Eggan and Jeffrey G. Davis. CMNH H9467 - H9504. Tadpoles raised to metamorphosis. New county record (Davis and Menze, *op. cit.*). All verified by John W. Ferner.

Submitted by **SCOTT M. MOODY**, Ohio University, Department of Biology, Irvine Hall, Athens, Ohio 45701-2939, USA; **JEFFREY G. DAVIS**, Cincinnati Museum Center at Union Terminal, Geier Center Department of Research and Collections, 1301 Western Avenue, Cincinnati, Ohio 45203-1130, USA; and **DAN EGGAN**, 101 West Fourth Street, West Lafayette, Ohio 43845, USA.

TESTUDINES

ACTINEMYS MARMORATA (Pacific Pond Turtle). MEXICO: BAJA CALIFORNIA NORTE: Rio Santo Tomas, 16 air km E Santo Tomas near Rancho Las Aguillas (31.54998°N, 116.22561°W), 400 m elev., 26 March 2004. Los Angeles County Museum of Natural History voucher photographs (LACM PC 1401–1402). Observed by Robert Lovich, Barry Downer, and Clark Mahrdt. Photos verified by Jeffrey E. Lovich. This species occurs

in several Pacific river drainages west of the Sierra Juarez and Sierra San Pedro Martir peninsular range, south to Arroyo Grande, east of El Rosario in northwestern Baja California (Grismer 2002. Amphibians and Reptiles of Baja California including its Pacific Islands and the Islands in the Sea of Cortés. University of California Press, Berkeley and Los Angeles, California; Grismer and McGuire 1993. Bull. South. California Acad. Sci. 92:2–24). One adult male *Actinemys marmorata* was observed in riparian habitat in a boulder-strewn pool ca. 1–2 m in depth. The Río Santo Tomas individual represents a new inland record for this drainage located ca. 43 km upstream from vouchers collected in 1952 and 1957 in the estuary of the Rio Santo Tomas (UAZ 22057 and LACM 105323, respectively), and confirms the persistence of this population in a rapidly developing agricultural region. Anecdotal reports for this species in Upper Rio Santo Tomas occur in Roberts (1981. California Riparian Systems Conference, UC Davis, Sept. 17–19; 1982. Proc. Desert Tortoise Council 1982 Symp., pp. 154–161).

Submitted by **ROBERT E. LOVICH**, AC/S Environmental Security, Box 555008, Marine Corps Base, Camp Pendleton, California 92055-5008, USA; **CLARK R. MAHRDT**, Herpetology Department, San Diego Natural History Museum, P.O. Box 1390, San Diego, California 92112, USA; and **BARRY DOWNER**, Herpetology Department, The Zoological Society of San Diego, P.O. Box 120551, San Diego, California 92112-0551, USA.

LACERTILIA

ANOLIS CAROLINENSIS (Green Anole). USA: HAWAI'I: Honolulu Co.: O'ahu, Moku o Lo'e (Coconut Island) in Kane'ohe Bay, 21°26.2'N, 157°47.6'W, 11 March 2004. J. Panza and R. Powell. Milwaukee Public Museum (MPM-P 720). Verified by A. C. Echternacht. First record for the island (F. Kraus, in litt., 29 March 2005). This population had become established since March 2002, when extensive surveys of the island's lizards were conducted by RP.

Submitted by **JANELLE M. PANSZA** and **ROBERT POWELL**, Department of Biology, Avila University, Kansas City, Missouri 64145, USA; e-mail: powellr@mail.avila.edu.

ANOLIS SAGREI (Cuban Brown Anole). USA: HAWAI'I: Honolulu Co.: O'ahu, Moku o Lo'e (Coconut Island) in Kane'ohe Bay, 21°26.2'N, 157°47.6'W, 6 March 2004. R. Powell. Milwaukee Public Museum (MPM-P 719). Verified by A. C. Echternacht. First record for the island (F. Kraus, in litt., 29 March 2005). This population had become established since March 2002, when extensive surveys of the island's lizards were conducted by RP.

Submitted by **ROBERT POWELL** and **JANELLE M. PANSZA**, Department of Biology, Avila University, Kansas City, Missouri 64145, USA; e-mail: powellr@mail.avila.edu.

CNEMIDOPHORUS ABAETENSIS (Sand Dune Lizard). BRAZIL: BAHIA: Municipality of Mata de São João, sand dune (12°25'S, 37°54W). July 2003. 5 m elev. M. A. de Freitas and W. Guerreiro. Laboratório de Animais Peçonhentos e Herpetologia da Universidade Estadual de Feira de Santana, Feira de Santana, Bahia, Brazil (LAPH/UEFS 439). Municipality of Entre Rios, sand dune (11°55'S, 38°04'W), July 2004. 5 m elev. M. A. de Freitas and T. F. S.Silva (LAPH-UEFS 440). All specimens were found in "restinga" habitats and verified by E. Dias. The species was known only from type locality at Parque do Abaeté, Salvador, Bahia (Dias et al. 2002. Copeia 2002:1070–1072). These new records extend the species range ca. 100 km N from the type locality.

Submitted by **MARCO ANTONIO DE FREITAS**, **THAIS FIGUEIREDO SANTOS SILVA**, and **WAGNER GUERREIRO**, Rua Sotero Gomes n 05, Vila de Abrantes. CEP 42-800-000 Camaçaré, Bahia, Brazil; e-mail: philodryas@hotmail.com.

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). ARIZONA: Yuma Co.: Yuma, Dorn St. and 18th Place, 14 Sept 2002 (LACM 153071); La Paz Co.: Parker, 14th and Reata St., 9 Aug 2003 (LACM 155077). Mohave Co.: Lake Havasu City, Beachcomber RV Resort, 8 Aug 2002 (LACM 153041); Willow Valley, 0.25 mi. W of Hwy. 95, 7 July 2000 (LACM 152942). All specimens verified by Kent Beaman, Natural History Museum of Los Angeles County. A museum search revealed an earlier unpublished record from La Paz County, consisting of two collected at Ehrenberg in 1988 (UAZ 47784–85), verified by George Bradley, University of Arizona.

The introduced Mediterranean House Gecko was first documented for Arizona in the mid 1960s and early 1970s at Tucson and Phoenix (Robinson and Romack 1973. J. Herpetol. 7:311–312). A literature search revealed one published record for western Arizona. Stebbins (2003. A Field Guide to Western Reptiles and Amphibians, 533 pp. Houghton Mifflin Co., New York) lists this species at Yuma. It is not clear if a voucher specimen exists to support this record (R. C. Stebbins, pers. comm.). Our voucher supports the earlier Yuma County record. Our findings shows that *H. turcicus* is now widely established along the lower Colorado River in southwestern Arizona.

Submitted by **DAVID M. GOODWARD**, 22430 Pico St., Grand Terrace, California 92313, USA (e-mail: davegoodward@earthlink.net); **BRENDAN CUMMINGS**, Center for Biological Diversity, P.O. Box 493, Idyllwild, California 92549, USA (e-mail: bcummings@biologicaldiversity.org); and **MICHAEL WILCOX**, AMEC Earth and Environmental, Inc., 3120 Chicago Avenue, Suite 110, Riverside, California 92507, USA (e-mail: michael.wilcox@amec.com).

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). USA: LOUISIANA: Caddo Parish: Shreveport: 500 W. 61st Street. 23 October 1976, Mattson. Verified by Beth E. Leuck. Louisiana State University in Shreveport Museum of Life Sciences (LSUS 3998–99). This species was listed by Hardy (1979. Bull. Mus. Life Sci., LSUS [2]:1–11) as occurring in Caddo Parish, Louisiana, but no specific locality was given. Additional records obtained subsequent to 1976 include LSUS 4000–1, 4255–67, 4275–6, 4394–403, 5243, 5330, 7349, 7377, 8120–1, 8231, 8235, 8715, 8772–3, and 8925. This collection consists of 42 specimens collected over 28 years from 15 localities and 15 collection dates (7 Jan–29 Nov). Localities prior to 1989 (31 specimens) were collected at or near grocery warehouses in Shreveport. Subsequent localities include eight specimens that are from residential neighborhoods throughout Shreveport and Caddo Parish. This is the first specific locality record for this species in Caddo Parish.

Submitted by **LAURENCE M. HARDY** (e-mail: lhardy@pilot.lsus.edu), **AMANDA C. CRNKOVIC** (e-mail: acrkovi@pilot.lsus.edu), and **LARRY R. RAYMOND** (e-mail: lraymond@caddo.org), Museum of Life Sciences, Louisiana State University in Shreveport, One University Place, Shreveport, Louisiana 71115-2399, USA.

OPHISAURUS ATTENUATUS (Slender Glass Lizard).USA: TEXAS: MILLS CO.: 12 May 2001. DOR Hwy 84 ca. 3 miles E of FM 2005. University of Texas at Arlington Collection of Vertebrates (UTA R-52936). Verified by Eric N. Smith. New County Record (Dixon 2000. Amphibians and Reptiles of Texas, A&M University Press. 421 pp.).

Submitted by **CARL J. FRANKLIN**, Amphibian and Reptile Diversity Research Center, The University of Texas at Arlington Department of Biology. Arlington, Texas 76019, USA; e-mail: Franklin@uta.edu.

PODARCIS MURALIS (Common Wall Lizard). USA: INDIANA: CLARK CO.: (38.2769, 85.7644): Clarksville. *Podarcis muralis* was first observed by ZW on river bank stabilizations adjacent to The Falls of The Ohio State Park Educational Center on 25 June 2004. An adult male was subsequently captured on 8 July 2004. This specimen was sent to Russell Burke at Hofstra University (Hempstead, New York) for identification and tissue collection then deposited at the Chicago Field Museum of Natural History (FMNH 266504). Nate Engbrecht collected additional tail tissue from two subadults on 25 September, 2004 and released the specimens immediately at their point of capture. GD observed two juveniles which hatched in 2004, judging from their size, and one adult on 30 September 2004. A molecular analysis of tissue samples was performed at the Laboratory for Molecular Systematics of the Natural History Museum in Vienna, Austria whose aid we gratefully acknowledge. The Indiana specimens proved to be genetically identical in their mitochondrial cytochrome b sequence to specimens from Cincinnati (Schweiger and Deichsel 2003. Herpetol. Rev. 34:166–167, Gene Bank accession no. AY194855). The method described in Schweiger and Deichsel (2003, *op. cit.*), was used for analysis of the Clarksville specimens as well. The reference sequences most similar to the sequences of the Clarksville and Cincinnati samples were from individuals collected in a region between the Tyrolian Inn Valley and the southern border of the Alps near Lake Garda in Italy. This similarity confirms the origin alleged by Deichsel and Gist (2001. Herpetol. Rev. 34:230–232), Lake Garda. However, because a revision of the systematics of *P. muralis* is still in progress, the subspecific status of the Clarksville and Cincinnati specimens remains unresolved. We conclude that a reproducing colony of *P. muralis* established itself in Clarksville, Indiana. It is unknown how the lizards got there from Cincinnati. Release cannot be excluded, but rafting on flotsam is possible as well. Prokoph (2003. Die Eidechse 14[2]:61–63, English translation at www.lacerta.de) documents rafting of members of a European *Lacerta agilis* colony formerly living on a jetty during the flood event of the Elbe river near Meissen, Germany in August 2002. Flotsam deposits between Cincinnati and Clarksville will be searched for *Podarcis* in an effort to support the rafting hypothesis. The Clarksville population represents the first documented observations of *P. muralis* in Indiana.

Submitted by **ZACHARY WALKER,** Wildlife Diversity Section, Indiana Department of Natural Resources Division of Fish and Wildlife, 553 E. Miller Drive, Bloomington, Indiana 47401, USA (e-mail: zwalker@dnr.IN.gov); and **GUNTRAM DEICHSEL**, Friedr.-Ebert-Str., 62, Biberach a.d.Riss, Germany D-88400 (e-mail Guntram.Deichsel@bc.boehringer-ingelheim.com).

PTYCHOGLOSSUS BREVIFRONTALIS (Boulenger's Large-scaled Lizard). BRAZIL: AMAZONAS: Municipality of Manaus, Reserva Florestal Aldolpho Ducke (02°55'S, 59°59'W). 27 April 2004–14 August 2004. M. G. M. Pinto and W. E. Quatman. Verified by T. C. S. Ávila-Pires. Coleção de Anfíbios e Répteis do Instituto Nacional de Pesquisas da Amazônia (INPA-H 12477–481), collected in pitfall traps in a "terra firme" forest. Previously known from the state of Rondônia in Brazil (Vanzolini 1986. Levantamento herpetológico da área do estado de Rondônia sob a influência da rodovia BR 364. Programa Polonoroeste, subprograma Ecologia Animal, Relatório de Pesquisa nº 1:1–50. MCT/CNPq), from Surinam-Brazil border (Hoogmoed 1973. Biogeographica 4:1–419) and from Ecuador, Bolivia, and Peru (Avila-Pires 1995. Lizards of Brazilian Amazonia. Zool. Verh. Leiden. 299:1–706). First state record, fills the gap in the distribution and indicates that this species ranges throughout the Amazon Basin. Extends known range ca. 670 km from the nearest northern record at Acarai Mountains, Surinam-Brazil border (Hoogmoed 1973, *op. cit*); ca. 900 km from the nearest southern record in the state of Rondônia, Brazil (Vanzolini 1986, *op.cit.*), and ca. 1100 km from the nearest western record in Valpés state, Colombia (Ayala 1986. Caldasia 15[71–75]:555–575).

Submitted by **MARIA GORETTI M. PINTO** and **WILLIAM E. QUATMAN**, Coordenação de Pesquisas em Ecologia, Instituto Nacional de Pesquisas da Amazônia –INPA, CP. 478, CEP 69.011-970, Manaus, AM, Brazil; e-mail: mgorettimp@yahoo.com.br.

SERPENTES

CORALLUS ANNULATUS (Annulated Tree Boa). COLOMBIA: DEPARTAMENTO DE ANTIOQUIA: Municipio Yarumal, Corregimiento El Cedro, Vereda Medialuna (7°12'21"N, 75°19'17"W) ca. 610 m. elev. 17 April 1997. J. M. Daza-R. Museo de Herpetología Universidad de Antioquia, Medellín, Colombia (MHUA 14015). Verified by R. W. Henderson. This species is distributed from extreme southeastern Guatemala to Rio San Juan in Colombia (Henderson et al. 2001. Stud. Neotrop. Fauna Environ. 36:39–47). In Colombia this species was reported from Chocoan lowland forests in Municipio Cabeceras near the Rio San Juan and only one record from Municipio Girón, Department of Santander. This is the first record for the Department of Antioquia and the northern part of the Cordillera Central in northwestern of Colombia. Vereda Medialuna is part of the Nechí River Basin that in turn is a tributary of Cauca River near the end of the Cordillera Central and is ca. 382 km NE of Cabeceras (Departamento de Chocó) and ca. 239 km W of Girón (Departamento de Santander). This record fills the distributional hiatus of this species between the Chocoan region and Rio Magdalena Basin and is evidence that the Chocoan biogeographic region extends through the northern part of the Cordillera Central (Hernández-Camacho et al. 1992.

Acta Zool. Mex. Spec. Vol., pp. 175–190).

Submitted by **JUAN MANUEL DAZA-R.**, Museo Herpetológico de Antioquia, Instituto de Biología, Bloque 7-121, Universidad de Antioquia, A.A. 1226, Medellín, Colombia; juandaza35@hotmail.com.

DRYMARCHON CAUDOMACULATUS. VENEZUELA: ZULIA: Municipio Machiques de Perijá, San José de Perijá, Hacienda San Sebastián (9°59'N, 72°24'W). 07 May 2004. E. Infante Rivero and P. Velozo Delgado. Museo de Biología de La Universidad del Zulia, Maracaibo, Venezuela (MBLUZ-R-0835). Verified by M. Natera. *D. caudomaculatus* has been considered an endemic species of the Falcón state in Venezuela, with its distribution restricted to one small area of this state in the northwest of the country (Wüster et al. 2001. Herpetol. J. 11:157–165). This is the first state record for Zulia and the westernmost locality, extending the known distribution ca. 337 km (air line) SW of the nearest locality in Taratara, Falcón state, (Wüster et al., *op. cit.*).

Submitted by **EDWIN E. INFANTE-RIVERO** (e-mail: edwinfante@yahoo.com), **PABLO VELOSO DELGADO** (e-mail: pabiux@hotmail.com), and **FERNANDO J. M. ROJAS-RUNJAIC** (e-mail: rojas_fernando@hotmail.com), La Universidad del Zulia, Facultad Experimental de Ciencias, Museo de Biología de La Universidad del Zulia, Sección de Herpetología, Apartado Postal 526, Maracaibo 4011, Venezuela.

DRYMARCHON CORAIS EREBENNUS (Texas Indigo Snake). USA: TEXAS: Bandera Co.: Adult male 268 cm TL was found and killed by a visitor at Lost Maples State Park on 19 February 2001. Other specimens have been occasionally found DOR (in the vicinity, but this is the first known specimen to be salvaged and vouchered). University of Texas at Arlington Collection of Vertebrates (UTACV R 52917). Verified by Harry W. Greene. New county record (Dixon 2000. Amphibians and Reptiles of Texas, A&M University Press. 421 pp.)

Submitted by **CARL J. FRANKLIN**, Amphibian and Reptile Diversity Research Center, The University of Texas at Arlington, Department of Biology, Arlington, Texas 76019, USA; e-mail: Franklin@uta.edu.

FARANCIA ABACURA REINWARDTII (Western Mudsnake). USA: TEXAS: San Patricio Co: 11.27 km W of Aransas Pass on State Hwy 35 (27∞56'03"N, 97∞15'05"W). 9 June 2003. M.R.J. Forstner. Verified by J. R. Dixon. Texas A&M University, Texas Cooperative Wildlife Collection. TCWC 88276. New county record (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M University Press, College Station, Texas. 421 pp.). This adult male was found dead on the shoulder of State Highway 35 at midmorning. The specimen had a snout–vent length of 802.0 mm and a tail length of 173.0 mm. Muscle tissue was removed and placed in the frozen tissue collection at Texas State University-San Marcos (MF 9639) and the specimen itself was preserved (MJF 10627) and accessioned into the Texas Cooperative Wildlife Collection (TCWC 88276) at Texas A&M University in College Station, Texas.

Submitted by **ADAM W. FERGUSON** and **M.R.J. FORSTNER**, Department of Biology, Texas State University, 601 University Drive, San Marcos, Texas 78666, USA; e-mail: af1021@txstate.edu.

LEPTOTYPHLOPS BRASILIENSIS (Blind Snake). BRAZIL: MINAS GERAIS: Municipality of Três Marias (18°12'00"S, 45°15'00"W). 1987. Museu Nacional, Rio de Janeiro, Brazil (MNRJ 4616, juvenile female 99 mm SVL, 8 mm TL). Verified by R. Fernandes. First state record for the State of Minas Gerais and third known locality, extends the distributional range ca. 680 km S of Barreiras, State of Bahia (Rodrigues and Puorto 1994. J. Herpetol. 28:393–394). Seventh known specimen, recorded previously from Estação Ecológica Uruçuí-Una, State of Piauí. (Curcio et al., 2002. Phyllomedusa 1[2]:101–104).

Submitted by **ROBERTA R. PINTO, PAULO PASSOS,** and **ULISSES CARAMASCHI**, Museu Nacional, Universidade Federal do Rio de Janeiro, Departamento de Vertebrados, Quinta da Boa Vista, São Cristóvão, Rio de Janeiro, RJ, 20940-040, Brazil; e-mail (RRP): robertarich@mn.ufrj.br.

LEPTOTYPHLOPS UNGUIROSTRIS. PARAGUAY: DEPARTAMENTO BOQUERÓN: Estancia "Toro Mocho" (23°30'S, 60°31'W). 24 October 2003. P. Cacciali and F Brusquetti. Museo Nacional de Historia Natural del Paraguay, San Lorenzo, Paraguay (MNHNP 10625, female, SVL 101 mm, TL 2 mm). Verified by N. Scott. Mentioned previously in Argentina from Río Negro to Salta and Formosa (Kretzschmar 1996. Acta zool. lilloana 43[2]:275–279; Lanari and López 2000. Herpetol. Rev. 31:182); cited from southern Paraguay without specific localities or voucher specimens (Peters and Oerejas Miranda 1970. Catalogue of the Neotropical Squamata: Part I, Snakes. Bull. U.S. Nat. Mus. 297:1–347; Cei 1993. Reptiles del Noroeste, Nordeste y Este de la Argentina. Mus. Reg. Scien. Natur. Torino, Monogr. XIV, Turín, Italy. 949 pp.; McDiarmid et al. 1999. Snake Species of the World. Vol. 1. Herpetol. League. 511 pp.; Leynaud and Bucher 1999. Acad. Nac. Cien. Miscelánea. 98, 46 pp.). Present record confirms the presence of the species in Paraguay, and extends range ca. 192 km SE of Formosa (Lanari and López, *op. cit.*); 346 km E of Finca Pozo Largo (Kretzschmar, *op. cit.*) and 447 km NW of Corrientes (Giraudo 2001. Serpientes de la Selva Paranaense y del Chaco Húmedo. L.O.L.A. Monogr. 17: 285 pp.; Álvarez et al. 2002. Atlas de Anfibios y Reptiles de las Provincias de Corrientes, Corrientes, Chaco y Formosa (Argentina). Fac. Cienc. Exac. Nat. y Agrim., Universidad Nacional del Nordeste. 156 pp).

Submitted by **PIER CACCIALI** (e-mail: pier_cacciali@yahoo.com) and **FRANCISCO BRUSQUETTI** (e-mail: fbrusquetti@yahoo.com), Museo Nacional de Historia Natural, Sucursal 1, Ciudad Universitaria, San Lorenzo, Paraguay.

OPHEODRYS AESTIVUS (Rough Greensnake). USA: KENTUCKY: Mercer Co.: near Shreve, DOR. 13 July 1979. Albert Westerman. Verified by Jeffrey G. Davis. Thomas More College Herpetology Collection (TMC R263). County record (Meade. 1993. Ph.D. Dissertation, University of Southern Mississippi).

Submitted by **MATTHEW C. FERNER**, Skidaway Institute of Oceanography, 10 Ocean Science Circle, Savannah, Georgia 31411, USA; and **JOHN W. FERNER**, Department of Biology, Thomas More College, Crestview Hills, Kentucky 41017, USA (e-mail: john.ferner@thomasmore.edu).

PHALOTRIS NASUTUS. BRAZIL: MATO GROSSO DO SUL: AQUIDAUANA: Rio Negro Farm (19°33.30' S, 56°13.44' W). 10 January 2004. E. Wang and V. L. Ferreira. Verified by F. Franco. Zoology Collection, Laboratório de Zoologia, Campus de Corumbá, Universidade Federal de Mato Grosso do Sul, Corumbá, Mato Grosso do Sul, Brazil (CEUCH 3032). Adults collected in pitfall traps with drift fence in semi-deciduous forest surrounding soda water lake. The species was recorded in Cerrado biome in central Brazil (Distrito Federal, Goiás, Minas Gerais, São Paulo, Mato Grosso and Mato Grosso do Sul states) by Lema (2002. Comun. Mus. Ciênc. tecnol. PUCRS, 15[2]:201–214) and Lema (2003. Comun. Mus. Ciênc. tecnol. PUCRS, 16[1]:17–37), and very likely for Alta Floresta in N Mato Grosso state by Ferrarezzi (1993. Memórias do Instituto Butantan 55[1]:21–38). This record is the second for Mato Grosso do Sul state and extends the known distribution for this species ca. 410 km NW from Xavantina (21°15"S, 52°44"W) (Lema 1999. Herpetol. Rev. 30:175), ca. 420 km SW from Emas National Park region (18°06.53'S, 52°55.20'W), in the state Goiás that bounds the states of Mato Grosso do Sul and Mato Grosso (Valdujo and Nogueira 2001. Herpetol. Rev. 32:129) and ca. 1000 km S of Alta Floresta in Mato Grosso state, if its identification in the last locality is confirmed (Memorias do Instituto Butantan 55[1]:21–38).

Submitted by **VANDA LÚCIA FERREIRA,** Lab. Zoologia, Campus de Corumbá, Universidade Federal de Mato Grosso do Sul, CxP. 252, CEP 79301-970, Corumbá, MS, Brazil (e-mail: vandaf@ceuc.ufms.br); **ELLEN WANG** (e-mail: nyctibeus@yahoo.com), Earthwatch Institute, Rua Doze de Outubro, 2323, 19015-090 Presidente Prudente, SP, Brazil; and **JEFFREY ALAN HIMMELSTEIN** (e-mail: kiantunich@aol.com), Biology Department, William Paterson University, 300 Pompton Road, Wayne, New Jersey 07470, USA.

STEGONOTUS CUCULLATUS (Slatey Grey Snake). AUSTRALIA: QUEENSLAND: Townsville: Mount Stuart Road, Mount Stuart (19°21'19"S, 146°49'01"E). 29 October 2003. Ray Lloyd. Verified by Andrew Amey. Queensland Museum, QMJ81126. Fresh DOR, adult male (SVL 771mm), found in open eucalypt woodland at 2200 h after heavy rains. This represents the southernmost record of the species, extending its range by 35 km from Herveys Range, Townsville, the previous southern limit for the species, from which two specimens (QMJ61798 and QMJ67364) were collected.

Submitted by **DANE TREMBATH**, Applied Ecology Research Group, University of Canberra, Canberra, Australian Capital Territory, Australia 2601 (e-mail: Trembath@aerg.canberra.edu.au); and **RAY LLOYD**, 6 Beach Street, Corinella, Victoria, Australia 3984 (e-mail: Ray.Lloyd@jcu.edu.au).

STENORRHINA FREMINVILLEI COLOMBIA: SUCRE: Municipio de San Marcos, road to "La Mojana," site Cuiva near: 08°39'40"N, 75°08'05"W, near a "Zapal," in the morning, in shrub. Instituto de Investigaciones Biológicas Alexander von Humboldt, Villa de Leyva, Boyacá, Colombia (IAvH 3444). 7 December 1986. A. Fajardo. CHOCÓ: Municipio de Riosucio: Parque Nacional Natural Los Katios, Vereda Peye. February 1976. J. V. Rodríguez and H. Pavas (IAvH 1964); Vereda Tilupo. 5 April 1978. J. V. Rodríguez and H. Pavas (IAvH 1957). Verified by J. M. Renjifo. Previously known from Atlantic versant from the isthmus of Tehuantepec to central Honduras and from Guerrero, Mexico, south to the Meseta Central Occidental of Costa Rica on the Pacific slope. Scattered records also exist in Costa Rica on the Meseta Central Oriental and northeastern Atlantic lowlands near the base of Cordillera Central and the Cordillera of Tilarán (Savage 2002. The Amphibians and Reptiles of Costa Rica: a Herpetofauna Between Two Continents, Between Two Seas. University Chicago Press, Chicago, Illinois. 934 pp.). First record for Colombia (and South America). Southernmost record for the species, extends known distribution about 1000 km S from Cordillera the Tilarán, the closest locality previously mentioned (Savage, *op.cit.*).

Submitted by **EMIL JOSÉ HERNÁNDEZ-RUZ**, Investigador Asociado, Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Apartado aéreo 7495, Bogotá, D.C., Colombia; e-mail: emilhjh@yahoo.com.

STORERIA DEKAYI (Dekay's Brownsnake). USA: KENTUCKY: BRECKINRIDGE CO.: Hwy 259 in Yellow Bank Refuge, DOR. 17 April 1982. Albert Westerman. Verified by Jeffrey G. Davis. Thomas More College Herpetology Collection (TMC R262). County record. Validates a previous county record cited without a voucher specimen by Meade (1993. Ph.D. Dissertation, University of Southern Mississippi).

Submitted by **JOHN W. FERNER** and **AMY WILSON**, Department of Biology, Thomas More College, Crestview Hills, Kentucky 41017, USA; e-mail: john.ferner@thomasmore.edu.

STORERIA DEKAYI WRIGHTORUM (Midland Brownsnake). USA: ARKANSAS: LITTLE RIVER CO: 2.0 km E Ashdown off St. Hwy. 32. 13 November 2004. Z. D. Ramsey. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28840). Verified by Stanley E. Trauth. New county record completely filling hiatus in extreme southwestern Arkansas (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.) and near recent record of *S. d. wrightorum* from adjacent Sevier County (Ramsey and McAllister 2004. Herpetol. Rev. 35:193).

Submitted by **ZACHARY D. RAMSEY** and **CHRIS T. McALLISTER,** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA; e-mail: chris.mcallister@tamut.edu.

Erratum

We mistakenly credited Erik Wild as the photographer of a photo from the SSAR annual meeting that appeared on page 308 of the December 2004 issue of HR (vol. 35, number 4). The image should have been credited to Julian Lee.

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New Amphibian and Reptile Records from Cojedes State, Venezuela

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Cojedes state, with a surface area of 14,800 km^2, is situated in the west-central part of Venezuela (northern border with Carabobo state: 10º00'N, upper Tinaquillo River; southern border with Barinas state: 08º35'N; eastern border with Guárico state: 68º00'W; western border with Portuguesa state: 68º50'W). The northwest section is within the Coastal Range, and forms the western limit for some species, such as *Atelopus cruciger* (Rivas 1998), *Hyalinobatrachium antisthenesi, Cochranella revocata* (Señaris and Ayarzagüena 2005) and *Anolis squamulatus* (Rivas and Manzanilla 1999 "2001"). The center and south are part of Los Llanos, supporting such species as *Bufo granulosus*, *Hyla crepitans, Phrynohyas venulosa, Leptodactylus fuscus, Tropidurus hispidus*, *Chironius carinatus*, *Leptodeira annulata*, *Liophis melanotus* (Rivero-Blanco and Dixon 1979).

Two main seasons exist in Cojedes, a wet one, from May to October, and a dry one, from November to April. The lowest elevations of Cojedes (ca. 50 m elev.) are found in the south, along the boundary with Portuguesa (Esteros de Chiriguana). The highest point is the Nirgua Massif, north of "Fila Refilete" (1520 m elev.).

Despite its central location in Venezuela and its proximity to the Venezuelan capital, Caracas, Cojedes is one of the least explored states in Venezuela. Only a few works mention its herpetofauna. Prior to this work only 24 amphibian species had been recorded (Barrio-Amorós 1998; Manzanilla et. al. 2000; Rada 1989–1990; Rivas 1998; Rivas and Manzanilla 1999a, b; Señaris and Ayarzagüena 2005) along with only 10 species of reptiles (Cole et al. 1990; Dixon et al. 1993; Donoso-Barros 1966; Pritchard and Trebbau 1984; Rivas and Fuentes 2000; Rivas and Manzanilla 1999 "2001"; Roze 1966).

In this work we report five amphibians and 33 reptiles new to Cojedes, based mainly on voucher specimens in the Museo de Historia Natural La Salle, Caracas (MHNLS) and Museo de la Estación Biológica de Rancho Grande, Aragua (EBRG). We have also exhaustively reviewed literature pertaining to Cojedes herpetofauna. We followed La Marca (1997) for the taxonomic treatment of reptiles, except for anoline lizards, where we followed Nicholson (2002). We followed Barrio-Amorós (1998) for the taxonomic treatment of amphibians and major bioregions.

ANURA

BUFONIDAE

Bufo humbolti (Sapo Granuloso). Municipio Girardot: Hato Los Caballos, 68 km S of Tinaco, 210 m elev. 25 February 1978. Miguel Lentino and Alfredo Paolillo. Verified by F. Rojas. MHNLS 6978–6979. First state record, 60 km NNE from nearest known locality, Río Guanare, Portuguesa (Barrio-Amorós 1998).

Bufo margaritifer complex. (Sapo Crestado). Municipio San Carlos: Cerro Azul, Fila La Blanquera, 1300 m elev. 25 February 1979. Alfredo Paolillo. Verified by F. Rojas. MHNLS 7493–7494. First state record. This complex is widely distributed in Venezuela and includes several species, with a new taxon recently described as *Bufo sclerocephalus* (Mijares-Urrutia and Arends 2001). In Colombia, at least 13 species are under the name *Bufo typhonius* (Vélez 1995).

HYLIDAE

Flectonotus pygmaeus (Ranita Marsupial Pigmea). Municipio San Carlos: Cerro Azul, Fila La Blanquera 1350 m elev. 03 April 1980. Luis Paéz. Verified by A. Paolillo. MHNLS 8100–8101. First state record. This record is between localities in Carabobo and Falcón states (Barrio-Amorós 1998).

Gastrotheca ovifera (Rana Marsupial Común). Municipio San Carlos: Cerro Azul, Fila La Blanquera, 1350 m elev. 31 March 1980. Alfredo Paolillo. Verified by F. Rojas. MHNLS 8095. First state record. This record is between previously known localities in Carabobo and Yaracuy states (Barrio 1999a).

Gastrotheca walkeri (Rana Marsupial Cornuda). Municipio San Carlos: Cerro Azul, Fila La Blanquera, 1350 m elev. 2 April 1980. Ignacio Agudo. Verified by J. C. Señaris. MHNLS 8106. First state record. This record is between previously known localities in Aragua and Yaracuy states (Barrio 1999b).

LACERTILIA

AMPHISBAENIDAE

Amphisbaena alba (Morrona, Culebra de Dos Cabezas). Municipio San Carlos: San Carlos, campus Cojedes, Fundación La Salle de Ciencias Naturales, 148 m elev. 9 April 1979. Unknown collector. Verified by J. C. Señaris. MHNLS 13828. First state record, ca. 190 km NE of the closest record, La Colonia, Portuguesa (Markezich 2002). This specimen was collected during the day after a heavy rain.

GEKKONIDAE

Gonatodes vittatus (Limpia Casa). Municipio San Carlos: San Carlos, 120–140 m elev. 9 September 1997. Gilson Rivas. Verified by J. C. Señaris. MHNLS 13829, adult male. First state record (Rivero-Blanco 1979). This specimen was collected on a building wall. This species shows a continuous distribution along the coast from Trinidad to Colombia, and although the distribution depicted by Rivero-Blanco (1979) includes a dot in Lara state the specimen is not referenced in the appendix of examined material. Anthropogenic transport might be responsible for the presence of *G. vittatus* in San Carlos. These animals have been seen and collected only in association with buildings. The material used in the construction of these structures is known to come from the coast. Gorzula and Señaris (1998) report a similar case in Venezuelan Guayana. Markezich (2002) reported this species from Portuguesa, without speculating on its origin.

Phyllodactylus ventralis (Tuqueque). Municipio Girardot: Rio Portuguesa, 15 km S El Baul, 90 m elev. 16 January 1966. Jon Bilbao and Carlos Galan. Verified by A. Paolillo. MHNLS 2422, a juvenile. First state record (Dixon and Huey 1970). Extends the range 85 km NW from the nearest locality, Hato Masaguaral (Staton and Dixon 1977). The species is distributed through north-central Venezuela to some localities in the east (Dixon and Huey, *op. cit.*).

Thecadactylus rapicauda (Salamanqueja). Municipio San Carlos: El Candelo, SW de La Sierra, Tucuragua, 640 m elev. 09 April 1979. Daniel Loureiro. Verified by A. Paolillo. MHNLS 7653. First state record. This monoptypic species has a wide distribution in Venezuela, but is apparently absent from the Llanos. This bioregion is occupied by other large geckos (*Phyllodactylus ventralis* and *Hemidactylus palaichthus*). It is very possible that *T. rapicauda* contains more than one species (see Mijares-Urrutia and Arends 2000).

IGUANIDAE

Iguana iguana (Iguana Verde). Municipio Girardot: río Tinaco, 20 km NW El Baul. 06 February 1978. R. Godshalk. EBRG 1078; Municipio Pao de San Juan Bautista: Hato Galeras del Pao, 190 m elev. 24 August 1995. Ramón Rivero. EBRG 3178. All verified by R. Rivero. First state records. This species has a wide distribution in all lowlands of Venezuela, but has few documented records. The Cojedes localities are about 110 km from the closest ones in Guanarito, Portuguesa (Markezich 2002).

POLYCHROTIDAE

Norops auratus (Cotejo). Municipio San Carlos: San Carlos, 120–140 m elev. 11 February 1998. Alejandro Cuesta. Verified by J. C. Señaris. MHNLS 13871. First state record; 150 km NE de Guanare (Markezich 2002). The species is widely distributed north and south of the Orinoco River, in the states of Aragua, Apure, Barinas, Falcón, Guarico, Sucre, Amazonas, and Bolívar (Donoso-Barros 1968; Gorzula and Señaris 1998; Manzanilla et al. 1996; Mijares and Arends 1993; Ramos and Busto 1989–1990).

Norops chrysolepis (Cotejo). Municipio San Carlos: Cerro Azul, Fila La Blanquera, 1350 m elev. 02 April 1980. Reinaldo Correa. Verified by A. Paolillo. MHNLS 8096, adult male. First state record, ca. 200 km NE from Mesa Cavacas, Portuguesa (Markezich 2002). This species is also known in the literature as *Anolis nitens nitens* (see Avila-Pires 1995; Markezich 2002).

TEIIDAE

Ameiva ameiva (Cotejo). Municipio Girardot: Hato la Laguna de Junco km 80 road from Tinaco to El Baul. 18 April 1980. Alfredo Paolillo. Verified by F. Rojas. MHNLS 8421. First state record, ca. 200 km NE from Portuguesa state records (Markezich 2002). Staton and Dixon (1977) refer to specimens from La Guanota (Apure) and Masaguaral (Guarico) 120 and 180 km SE, respectively.

Cnemidophorus lemniscatus complex (Cotejo). Municipio San Carlos: La Sierra, 06 August 1946. Luis Carbonell. Verified by G. Marcuzzi. MHNLS 115. First state record. The species in this complex have a wide distribution in northern South America (Avila-Pires 1995; Donoso-Barros 1966).

Tupinambis teguixin (Mato Pollero). Municipio Pao de San Juan Bautista: Hato Galeras del Pao, 190 m elev. 29 August 1995. Ramón Rivero. Verified by R. Rivero. EBRG 3190. First state record. This is another widely distributed species with few documented records in Venezuela. The locality is ca. 170 km NW from closest records in Portuguesa (Markezich 2002).

TROPIDURIDAE

Tropidurus hispidus (Cotejo). Municipio San Carlos: Hato Itabama, 38 km SW of Las Vegas. 80 m elev. 26 September 1976. Carlos de Lima. Verified by J. C. Señaris. MHNLS 6625–6626, juvenile. First state record, ca. 170 km NE from Fundo Sabana Grande, Portuguesa (Markezich 2002).

SERPENTES
BOIDAE

Corallus ruschenbergerii (Falsa Mapanare, Dormilona). Municipio Girardot: Río Tinaco, Hato San Blas. 03 February 1978. Robert Goshalk. EBRG 1090; Municipio Girardot: Hato Mata Clara, between Hato Piñero and El Baul. M. Gonzalez. 03 April 1998. EBRG 3458. All verified by R. Rivero. These specimens are the first records from the state. Hato Mata Clara is 160 km E from closest record in La Colonia, Portuguesa (Markezich 2002). Henderson (1993) plotted some dots on his map of the species that could lie within Cojedes, but no specimens examined were cited. Cojedes samples are not found in the Henderson (1997) appendix of examined material.

Epicrates maurus (Tornasol). Municipio San Carlos: San Carlos, 120–140 m. 26 June 1985. Pedro Miraval. Verified by J. C. Señaris. MHNLS 13833. First state records, ca. 190 km NE from nearest record in Portugesa (Markezich 2002), and 157 km NW from Hato Masaguaral, Guárico (Staton and Dixon 1977). We consider *E. maurus* a valid species (see Chippaux 1986; Gorzula and Señaris 1998).

COLUBRIDAE

Atractus univittatus. Municipio San Carlos: Potrero Largo, Manrique. 19 April 1979. Verified by Walter Schargel. MHNLS 13834. First state record, ca. 160 km NE from La Colonia, Municipio Guanare (Markezich 2002). This species was previously known only from the Coastal Range and from the foothills of Andean cordillera of Mérida in Portuguesa (Markezich 2002; Roze 1966).

Erythrolampus bizona (Falsa Coral). Municipio San Carlos: San Carlos, Boca Toma. 16 April 1973. José Blondet. Verified by G. Marquez. MHNLS 6058. First state record. This locality is 130 km NE from Mesa de Cavacas, Portuguesa (Markezich 2002), and about 110 km SW from Valencia, Carabobo (Roze 1966).

Helicops angulatus (Mapanare de Agua). Municipio Rómulo Gallegos: Parcelamiento La Blanca, 130 m elev. 1996 (exact date not given). Numa Hurtado. Verified by J. C. Señaris. MHNLS 14580–14581. First state record. This species is widely distributed throughout the Orinoco Basin in Venezuela, from the state of Sucre to the east (Rivas and Oliveros 1997) to Portuguesa in the West (Markezich 2002).

Leptodeira annulata ashmeadii (Falsa Mapanare). Municipio

Girardot: El Baul. 12 September 1995. Fabiola León and Luis Merlo. Verified by J. C. Señaris. MHNLS 13296–13299. First state record. 90 km NW from the nearest locality, Hato Masaguaral (Staton and Dixon 1977). This species is widely distributed in Venezuela (Markezich 2002; Roze 1966). These specimens were found DOR. Staton and Dixon (1977) consider this species ubiquitous in the central llanos.

Leptophis ahaetulla (Lora). Municipio San Carlos: Hato Itabama, 38 km SW of Las Vegas. 80 m elev. 1 August 1976. Alfredo Paolillo. Veified by J. C. Señaris. MHNLS 6446. First state record. Represents a range extension of ca. 150 km NE from Portuguesa (Markezich 2002; Roze 1966). This species is in need of a taxonomic review as some varieties might deserve species status (Markezich 2002; Oliver 1942).

Liophis lineatus (Sabanera). Municipio San Carlos: Hato Itabama, 38 km SW of Las Vegas. 80 m elev. 14 August 1976. Miguel Lentino and Alfredo Paolillo. Verified by F. Rojas. MHNLS 6449. First state record and northern most record for the species in Venezuela, ca. 65 km NE Acarigua, Portuguesa (Michaud and Dixon 1987; Roze 1966), and 148 km NW from Hato Masaguaral, Guárico (Staton and Dixon 1977).

Liophis melanotus melanotus (Sabanera). Municipio San Carlos: Hato Itabama, 38 km SW of Las Vegas. 80 m elev. 3 August 1976. Alfredo Paolillo. Verified by F. Rojas. MHNLS 6457. First state record, ca. 65 km NE Acarigua, Portuguesa (Dixon and Michaud 1992).

Masticophis mentovarius (Conejera, Cazadora). Municipio San Carlos: San Carlos. Francisco Delascio. Verified by A. Paolillo. 24 August 1978. MHNLS 7070. First state record. This species is widely distributed in semi-arid regions and dry forests through northern Venezuela, including Margarita Island, and lowlands of northern Bolívar (Gorzula and Señaris 1998; Hernández and Rada 1992; Roze 1966). Cojedes locality is 67 km SW of Bejuma (Carabobo) and 310 km NW of Espino in Guárico (Roze 1966).

Mastigodryas biffosatus striatus (Tigra). Municipio San Carlos: San Carlos. 23 May 1985. Collector unknown. Verified by J. C. Señaris. MHNLS 13870. First record for Cojedes, and 150 km NE of closest record in Portuguesa (Markezich 2002). This species is distributed through dry regions of northern Venezuela (Roze 1966).

Mastigodryas boddaertii (Cazadora). Municipio San Carlos: carretera Tierra Caliente-La Sierra. 9 October 1975. Wilson Damo. Verified by J. C. Señaris. MHNLS 6359. First state record. This locality is 120 km S of the closest record in Borburata, Carabobo (Hernández and Rada 1993; Roze 1966). The known distribution of this species shows that *M. boddaertii* is the only member of the genus that frequents forests with relatively high humidity.

Oxyrhopus petola (Falsa Coral). Municipio Rómulo Gallegos: Parcelamiento La Blanca, 130 m elev. 1996 (specific data not given). Numa Hurtado. Verified by J. C. Señaris. MHNLS 15129, juvenile. First state record (Roze 1966). This form is not assigned to any described subspecies, as the great variation of color pattern in the same population makes taxonomic resolution difficult (Starace 1998).

Pseudoboa neuwiedii (Coral Macho). Municipio Girardot: El Baul. 12 September 1995. Fabiola León and Luis Merlo. Verified by J. C. Señaris. MHNLS 13301–13302. First state record, 90 km NW from Hato Masaguaral, Guárico (Staton and Dixon 1977), and ca. 200 km NE from closest Portuguesa record (Markezich 2002). These specimens were found DOR.

Sibon nebulata. Municipio San Carlos: San Carlos. 19 April 1979. Verified by L. F. Navarrete. MHNLS 13837–13838. In Venezuela this species is known from the Andes (including the Sierra de Périja), the coastal range (including Margarita island) and southern Venezuela in the state of Bolívar. The species inhabits relatively humid forest and is apparently absent in the dry forest lowland know as los Llanos. These specimens represent a new state record from Cojedes, ca. 60 km E of Agua Blanca and ca. 145 SW from Guarico (see Peters 1960 and Roze 1966 for known Venezuelan records).

Tantilla melanocephala. Municipio San Carlos: Quebrada La Lapentera, Cerro Azul. 2 April 1980. Ignacio Agudo and Alfredo Paolillo. Verified by J. C. Señaris. MHNLS 8107–8110. First state record and first record for the Venezuelan lowlands known as Los Llanos (Wilson and Mena 1980), this site is at 100 km SW from Belén, Carabobo state (Roze 1966) and 150 km NE de Mesa de Cavacas, Portuguesa (Markezich 2002).

Thamnodynastes cf. *pallidus*. Municipio Rómulo Gallegos: Parcelamiento La Blanca, 130 m elev. 1996 (exact date not given). Numa Hurtado. Verified by J. Manzanilla. MHNLS 15130–15131. First state record (Roze 1966). In this genus more than one taxon remains without formal description. We tentatively identify this specimen as *T. pallidus*, as *T. strigilis* is a synonym (Cei et al. 1992).

Xenodon severus (Sapa). Municipio San Carlos: Cerro Azul, Fila La Blanquera, 1350 m elev. 1 April 1980. Reinaldo Correa. Verified by J. C. Señaris. MHNLS 8163, an adult female. First state record ca. 100 km SW from Puerto Cabello, Carabobo (Roze 1966). This locality is the easternmost in the interior Coastal Range. The specimen contains an adult *Bufo margaritifer* in its stomach.

ELAPIDAE

Micrurus isozonus (Coral). Municipio Girardot: carretera El Baul-Hato Piñero. 31 December 1989. Rafael Hoogesteijn. EBRG 2406; Municipio: Tinaco. 05 April 2000. Gilson Rivas. EBRG 3651; Municipio Tinaco: Hato Piñero. No date. John Polisar. EBRG 3662. All verified by R. Rivero. First state records (Roze 1966, 1996). This is another widely distributed species in the Llanos region, with a few documented records. The closest known locality is in Maracay, Aragua, ca.75 km NE (Roze 1966).

VIPERIDAE

Crotalus durissus (Cascabel). Municipio Pao de San Juan Bautista: Laya, Las Minas. 16 December 1999. Ramón Rivero. EBRG 2310; Municipio Girardot: Hato Piñero. No date: John Polisar. EBRG 3661. All verified by R. Rivero. First state records (Vanzolini and Callefo 2002). This species complex is widely distributed in lowlands and uplands throughout Venezuela (Roze 1966). Is likely that the species complex embraces more than one species, and for this reason we do not assign these specimens to any proposed subspecies. In our opinion the subspecies *Crotalus d. cumanensis, C. d. ruruima,* and *C. d. pifanorum* are sufficiently different to be

considered full species. Another endemic Venezuelan species of *Crotalus*, *C. vegrandis*, is considered by some authors as a subspecies of *C. durissus* (McDiarmid et al. 1999).

LEPTOTYPHLOPIDAE

Leptotyphlops albifrons (Cieguita). Municipio Girardot: Hato Piñero, Estación Biológica. 14 November 1996. John Polisar. Verified by J. Manzanilla. MHNLS 13823. First state record, ca. 200 km NE from Guanare, Portuguesa (Markezich 2002). This specimen, along with the next species, represent the first Scolecophidan records from Cojedes (Roze 1966).

Leptotyphlops macrolepis (Cieguita). Municipio San Carlos: San Carlos, 120–140 m elev. 11 November 1989. Mariano Blanco. Verified by J. Manzanilla. MHNLS 13831. First state record, ca. 180 km NE from Mesa de Cavacas, Portuguesa (Markezich 2002).

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New Records for Amphibians from Counties in South-Central Tennessee

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Continuing field work in areas of the southern Highland Rim and Cumberland Plateau of central Tennessee has yielded several new county records for species of salamanders and frogs. Most of these records, presented below, are from the contiguous counties of Lincoln, Franklin and Marion, while a few are from Lawrence and Lewis counties.

Records were considered new if the species in question was not reported from one of the above-listed counties by Redmond and Scott (1996) or in literature on Tennessee herpetology published since that date.

All collections were made by one or more of the authors (under authority of Tennessee Wildlife Resources Scientific Collecting Permit No. 1662) and documented with voucher specimens deposited in Austin Peay State University's Museum of Zoology (APSU). Species and subspecies identifications were verified by William H. Redmond. Nomenclature follows that proposed by Crother (2000).

CAUDATA

Ambystoma maculatum. (Spotted Salamander). LAWRENCE CO.: Laurel Hill Wildlife Management Area, wetland between dirt road and Natchez Trace Parkway at mile marker 373 (35°21'32"N, 87°33'05"W). 19 March 2004. APSU 17621. Adult female in vernal pool in deciduous forest. LEWIS CO.: Lewis State Forest, wetland just south of unnamed road ca. 0.2 km E of intersection with Fire Tower Road (35°30'14"N, 87°36'09"W). 19 March 2004. APSU 17624. Adult male under rotting log near woodland pool. MARION CO.: Prentice Cooper State Forest, pond adjacent to picnic area at intersection of Snooper's Rock Road and Tower Road (Suck Creek Mountain Road in Tennessee Atlas and Gazetteer) (35°06'04"N, 85°25'44"W). 6 March 2004. APSU 17639. One adult male from man-made pond in mixed pine-oak woodland.

Ambystoma opacum. (Marbled Salamander). LAWRENCE CO.: Laurel Hill Wildlife Management Area, wet woods between Laurel Hill Lake Road and Natchez Trace Parkway at mile marker 373 (35°21'32"N, 87°33'05"W). 19 March 2004. APSU 17622. Three larvae from vernal pool in deciduous forest. LEWIS CO: Lewis State Forest, wetland just south of unnamed road ca. 0.2 km E of intersection with Fire Tower Road (35°30'14"N,87°36'09"W). 19 March 2004. APSU 17623. Three larvae from vernal pool in deciduous forest. MARION CO: Prentice Cooper State Forest, pond just W of Tower Road (Suck Creek Mountain Road in Tennessee Atlas and Gazetteer) at junction with Snooper's Rock Road near picnic area (35°06'08"N, 85°25'48"W). 6 March 2004. APSU 17644. Five larvae from pond in deciduous forest.

Ambystoma talpoideum. (Mole Salamander). MARION CO.: 1) Prentice Cooper State Forest, pond adjacent to picnic area at intersection of Snooper's Rock Road and Tower Road (Suck Creek Mountain Road in Tennessee Atlas and Gazetteer) (35°06'04"N, 85°25'44"W). 6 March 2004. APSU 17638. One adult female from man-made pond in deciduous forest; 2) Prentice Cooper State Forest, pond along east side of Tower Road (Suck Creek Mountain Road in Tennessee Atlas and Gazetteer) ca. 1.5 km S of state forest boundary (35°09'16"N, 85°24'59"W). 5 March 2004. APSU 17646. Two larvae from small pond in woods opening.

Gyrinophilus porphyriticus porphyriticus. (Northern Spring Salamander). MARION CO.: Prentice Cooper State Forest, spring along south side of Tower Road (Suck Creek Mountain Road in Tennessee Atlas and Gazetteer) ca. 11.25 km S of state forest boundary (36°06'14"N, 87°25'51"W). 5 March 2004. APSU 17633. Older larva from near mouth of spring at edge of deciduous forest.

Pseudotriton ruber ruber. (Northern Red Salamander). LINCOLN CO.: along north side of McFerrin Lane, 0.5 km W of McDeal Road, 1.5 air km NNW of Camargo (35°05'44"N, 86°38'28"W). 5 March 2004. APSU 17633. One adult in moist rotting log near mouth of spring in deciduous forest.

ANURA

Acris crepitans crepitans. (Northern Cricket Frog). MARION CO.: Prentice Cooper State Forest, along west side of Tower Road (Suck Creek Mountain Road in Tennessee Atlas and Gazetteer) at junction with Davis Pond Road (35°05'23"N, 85°25'57"W). 8 May 2004. APSU 17641. Adult at small pond in deciduous forest.

Bufo americanus americanus (Eastern American Toad). Lincoln Co.: along south side of McFerrin Lane, 0.1 km west of McDeal Road, 1.4 air km NNW Camargo (35°05'42"N, 86°38'20"W). 19 March 2004. APSU 17617. Adult male at cattle pond in open field.

Hyla cinerea (Green Treefrog). Marion Co.: floodplain of Tennessee River at river mile 118.5 opposite town of South Pittsburg along north side of TN Hwy 156 (35°00'54"N, 85°41'19"W). 11 June 2004. APSU 17645. Adult male in floodplain marsh, several others calling in vicinity. In addition to representing a new Marion County record, this discovery extends the known range of the species some 80 km up the Tennessee River drainage from the closest known downstream site in Marshall County, Alabama (Mount 1975).

Pseudacris crucifer crucifer (Northern Spring Peeper). Marion Co.: pond along east side of Tower Road (Suck Creek Mountain Road in Tennessee Atlas and Gazetteer) ca. 1.5 km south of state forest boundary (35°09'16"N, 85°24'59"W). 5 March 2004. APSU 17631. Adult male from small pond in woods opening.

Pseudacris feriarum (Upland Chorus Frog). Marion Co.: Prentice Cooper State Forest, along west side of Tower Road (Suck Creek Mountain Road in Tennessee Atlas and Gazetteer) across from Lusk Cemetery, ca. 1.0 km south of lookout tower (35°07'29"N, 85°25'54"W). 5 March 2004. APSU 17629. Adult male in roadside ditch.

Rana catesbeiana (American Bullfrog). Marion Co.: Richard City, Chance Road 0.5 km from junction with Irondale Road (35°00'07"N, 85°44'11"W). 6 March 2004. APSU 17630. One juvenile on road in suburban area.

Rana clamitans melanota (Northern Green Frog). Lewis Co.: Lewis State Forest, tributary to Jacks Branch just east of Fire Tower Road, 0.5 km S of junction with TN Hwy 48 (35°30'40"N, 85°35'51"W). 19 March 2004. APSU 17626. One juvenile in pool of nearly dry creek in deciduous forest.

Rana sphenocephala utricularius (Southern Leopard Frog). Lewis Co.: Lewis State Forest, Fire Tower Road 0.5 km S of junction with TN Hwy 48 (35°30'40"N, 85°35'51"W). 19 March 2004. APSU 17626. One juvenile in roadside ditch bordered by deciduous forest. Marion Co.: floodplain of Tennessee River at river mile 118.5 opposite town of South Pittsburg along north side of TN Hwy 156 (35°00'54"N, 85°41'19"W). 11 June 2004. APSU 17647. Juvenile in floodplain marsh.

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Distribution Records of Amphibians and Reptiles in South Dakota

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Ballinger et al. (2000) recently reviewed and summarized specimen-based distribution records for amphibians and reptiles in South Dakota, and concluded that knowledge of the regional herpetofauna is incomplete and many county records remain to be documented. We herein report additional county records collected during 2003 and 2004. We consulted regional accounts (Chiszar et al. 1994; Dunlap 1967; Fischer et al. 1999; Fishbeck and Underhill 1959; Over 1923) and the range maps of Ballinger et al. (2000) to determine county records. Unless stated otherwise our identifications were verified by Michael G. Hopewell. Voucher specimens were deposited in the Campbell Museum (CUSC), Clemson University, Clemson, South Carolina, USA.

ANURA

Pseudacris triseriata (Western Chorus Frog). Marshal Co.: 4 km N of Veblen (45°53'16"N, 97°17'27"W). 21 August 2004. Laurs B. J. Williams. CUSC 2250. Adult captured in wetland during intense chorus following evening thunderstorm. This record fills a gap in the distribution of *P. triseriata* in northeastern South Dakota; previously reported in the surrounding counties of Roberts, Clay, and Brown (Ballinger et al. 2000).

Rana catesbeiana (American Bullfrog). Jackson Co.: Craven Creek at Highway 44, 1 km S of Wanblee (43°33'32"N, 101°39'39"W), Pine Ridge Indian Reservation. 16 June 2004. Steven G. Platt and Zannita Fast Horse. CUSC 2253. Adult frogs and tadpoles abundant in man-made impoundment along Craven Creek and also in beaver ponds at Long Creek, 5 km E of Wanblee (43°34'40"N, 101°36'41"W). Our record extends distribution northwards ca. 46 km from populations reported in Bennett and Shannon counties

(Ballinger et al. 2000; Fischer et al. 1999).

TESTUDINES

Chelydra serpentina (Snapping Turtle). FALL RIVER CO.: Highway 18, 4.8 km S of Hot Springs. 3 June 2003. Steven G. Platt. CUSC 2264. Juvenile turtle crossing road along Fall River. Although locally common in suitable habitat (e.g., Hammer 1969), our record constitutes only the fifth specimen of *C. serpentina* from counties west of the Missouri River in South Dakota. A DOR adult found on Highway 18 Bridge at the Cheyenne River, 1 km S of Maverick Junction was heavily damaged and not collected.

Chrysemys picta bellii (Western Painted Turtle). FALL RIVER CO.: Limestone Butte Lake (43°09'36"N; 103°09'47"W), 7.2 km SE of Olerichs, Buffalo Gap National Grassland. 26 May 2004. Steven G. Platt and Zannita Fast Horse. CUSC 2267. Our collection consisted of eight of 86 dead turtles found in drying lakebed. Mortality probably resulted when low water levels during the winter of 2003–04 exposed overwintering turtles to desiccation and lethal temperatures. Previously reported in adjacent Shannon and Custer counties (Ballinger et al. 2000; Fishbeck and Underhill 1959).

LACERTILIA

Eumeces multivirgatus (Many-lined Skink). SHANNON CO.: approximately 2 km E of Wakpamani (43°02'13.9"N; 102°06'31.4"W), Pine Ridge Indian Reservation. 15 June 2004. Steven G. Platt. CUSC 2236. Our record constitutes the third specimen from South Dakota. Previously reported from sandhills in Tripp County and adjacent Bennett County (Ballinger et al. 2000; Malaret 1977). Our specimen was found beneath a clump of dried cattle (*Bos taurus*) dung in lightly grazed sandhill habitat. Others likewise report finding *E. multivirgatus* under dried cattle dung (Hammerson 1999; Taylor 1935).

Holbrookia maculata (Common Lesser Earless Lizard). SHANNON Co: 3 km E of Wakpamani (43°02'15.4"N; 102°06'23.4"W), Pine Ridge Indian Reservation. 15 June 2004. Steven G. Platt. CUSC 2265. Found in sandhills among sparse grass. *Holbrookia maculata* also reported from sandhills in adjacent Bennett County (Ballinger et al. 2000; Fishbeck and Underhill 1959; Maralet 1977).

Sceloporus undulatus (Eastern Fence Lizard). SHANNON Co: Bluffs along BIA Highway 27, 2.6 km S of county line (43°39.954'N; 102°31.534'W), Pine Ridge Indian Reservation. 16 June 2003. Steven G. Platt, Zannita Fast Horse, and Laurs B. J. Williams. Verified by Richard R. Montanucci. CUSC 2161. Found among *Juniperus* sp. on steep slope above eroded White River badlands. Previously reported from sandhills in extreme southern Shannon County at the Nebraska State Line (Ballinger et al. 2000). Our record extends the known distribution ca. 77 km northwards and represents the northernmost record in South Dakota. An additional specimen was collected from sandhills, 2.5 km E of Wakpamani (43°01'56.3"N; 102°07'08.8"W), Pine Ridge Indian Reservation. 11 June 2004. Steven G. Platt and Zannita Fast Horse. *Sceloporus undulatus* is locally abundant at this site with *Holbrookia maculata*.

SERPENTES

Lampropeltis triangulum (Milksnake). SHANNON CO.: 38 km E of Buffalo Gap on BIA Highway 2 (43°28'39"N; 102°55'06"W), Pine Ridge Indian Reservation. 23 June 2003. Steven G. Platt, Zannita Fast Horse, and Laurs B. J. Williams. CUSC 2160. DOR adult male found in extensive grassland. FALL RIVER CO.: 8 km W Edgemont along Highway 18, 1.5 km N of Highway, Buffalo Gap National Grassland. 22 June 2004. Steven G. Platt. CUSC 2266. Two additional snakes observed, but not collected. All snakes were found in rodent tunnels beneath rocks on the rim of steep-sided, but shallow canyons in arid grassland with a significant component of sagebrush (*Artemisia tridentata*). These records fill the distribution gap in extreme southwestern South Dakota; previously reported from Bennett County to the east, and Custer and Pennington counties to the north (Ballinger et al. 2000; Fishbeck and Underhill 1959).

Storeria occipitomaculata (Northern Red-bellied Snake). ROBERTS CO.: 32.1 km NE of Sisseton on County Road 1E at Interstate 29 overpass (45°56'09"N; 96°50'40"W). 27 September 2004. Laurs B. J. Williams. CUSC 2268. Fifth record from eastern South Dakota; also reported in the eastern counties of Lincoln, Minnehaha, and Deuel, although specimens from the latter county lack specific locality data (Ballinger et al. 2000).

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BOOK REVIEWS

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Guide to the Amphibians and Reptiles of Japan, by Richard Goris and Norio Maeda. 2004 (printed as "2005" in the inside cover). Krieger Publishing Company, Krieger Drive, Malabar, Florida 32950, USA (www.krieger-publishing.com). viii + 285 pp. Hardcover. US $69.50. ISBN 1-57524-085-8.

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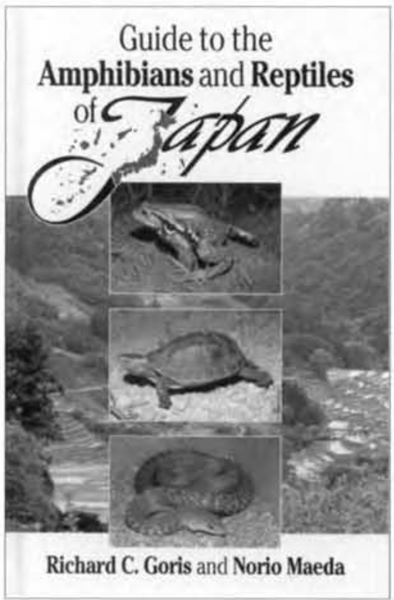

Since its initial insularization in the early Miocene, Japan has experienced a series of land bridge connections to the adjacent Eurasian land mass and been subjected to extensive insularization through complicated tectonic movements (e.g., Chinzei and Machida 2001; Kizaki and Oshiro 1980). Such paleogeographical dynamics, along with its high geomorphological and climatic diversity, have contributed greatly to the taxonomic diversity and endemicity of the herpetofauna of this island country (Hikida 2002; Matsui 1996; Ota 1998).

Comprehensive syntheses of the Japanese herpetofauna in the form of monographs or encyclopedic guides have been attempted by several authors (e.g., Nakamura and Uéno 1963; Sengoku 1979; Sengoku et al. 1996; Stejneger 1907). However, most such works were published in Japanese, and thus had a limited utility to non-Japanese researchers interested in the Japanese herpetofauna. Recent rapid progress in the study of herpetological diversity in Japan (e.g., see reviews by Matsui [2000] and Ota [2000a]) has necessitated up-dating of even the latest carefully prepared works (e.g., Sengoku et al. 1996). The *Guide to the Amphibians and Reptiles of Japan* (henceforth referred to as GARJ), as the latest book to treat the Japanese herpetofauna comprehensively, should be expected to meet these requirements.

Richard C. Goris, the senior author of this book, is a long-time resident of Japan, and is one of the founding members and past President of the Herpetological Society of Japan. While focusing on the anatomy and neurophysiology of the pit organ of snakes, Goris (1966) published *The Reptiles of Japan*, a landmark book introducing in Japanese the reptiles of the main islands and adjacent islets. Norio Maeda, the junior author, is a nature photographer. In the herpetological world, he is famous as the senior author of the *Frogs of Japan*, a bilingual encyclopedic guide (Maeda and Matsui 1989, 1999).

Following the table of contents, the main text of GARJ begins with four pages of general introduction entitled "The Herpetological Environment in Japan." In this section, the authors highlight, with a beautiful photograph of its typical spring landscape, the terrace paddy system in the main islands of Japan called "satoyama" or "yato." They argue that the natural history of Japanese amphibians and reptiles is centered on such habitats. Then, the authors attempt a brief chronological review of major events threatening amphibians and reptiles of "satoyama" since the Pacific War, such as the use of insecticides in paddy fields and intensive collecting of particular species with high commercial value. In this section, the authors also provide a map of the whole Japanese territory (exclusive of a few islands northeast of Hokkaido) divided into four panels—to different scales—and number many of the islands that they define as "herpetologically important." A key below the map names each numbered island or island group.

"Satoyama" is certainly one of the most characteristic habitat types for amphibians and reptiles on the main islands of Japan. However, such an environment is almost completely lacking in the Ryukyu Archipelago, to which, according to the latest Red List of Japan, eight of 14 endangered amphibians and 17 of 18 endangered reptiles are confined (Matsui et al. 2000). To most of those endangered taxa of the Ryukyus, loss of their primary habitat, the humid broadleaf forest, seems to be the most essential threat at present (Ota 2000a).

From the fifth page of the text, accounts, each occupying 1.5–3 pages, are given for 20 species of Urodela, 37 species and five subspecies of Anura, ten species of Testudines, 31 species and one subspecies of Lacertilia, and 38 species and five subspecies of Serpentes. These include not only the native taxa, but also most of the exotic taxa that have already established feral populations in Japan. Nevertheless, a few other established exotics, such as *Chelydra serpentina* and *Trimeresurus mucrosquamatus* (Japan Ecological Society 2002), are not included and even one long-recognized native species of salamander, *Hynobius dunni*, is missing from GARJ.

Each account begins with the scientific name (including authorship), followed by the Japanese and English names, and the subsections "Identification," "Confusing Species," "Distribution," "Reproduction," "Habits," and "Notes." A map, in which the distribution of each taxon is denoted in red, is also provided. Accounts for each anuran species or subspecies include another subsection, "Voice," in which the male acoustic characteristics are briefly described. Likewise, another subsection, "VENOMOUS," is added to the account for each venomous snake. Color photographs are also given in accounts for all species and subspecies except *Emoia atrocostata atrocostata*, *Perochirus ateles*, *Achalinus formosanus chigirai*, *Amphiesma vibakari danjoense*, *Calamaria pfefferi*, *Emydocephalus ijimae*, and *Pelamis platura*.

GARJ is attractive in appearance and gives the impression of being highly useful, particularly to non-Japanese herpetologists interested in the Japanese fauna. Indeed, it offers various interesting and useful pieces of information, including some that can only be provided by a native English speaker with long residence and involvement in herpetological activity in Japan, like Dr. Goris.

Immediately after starting to read its contents in detail, however, I could not help feeling embarrassed because of the high number of obvious errors, inappropriate wordings, and misleading expressions occurring throughout the text.

First of all, several scientific names include obvious errors. For example, the generic name of the tree lizards, *Japalura*, is consistently spelled as *Japarula*. The ending of the specific epithet of the Iwasaki's coral snake should be "*-i*" (i.e., *macclellandi*), but is "*-ii*" in GARJ. Also, the specific epithet of the Iijima's turtle-headed sea snake is correctly spelled *ijimae*, not *iijimae*. The authorship for the scientific name *Cistoclemmys flavomarginata evelynae*, should be Ernst & Lovich, 1990, not (Gray, 1863). Likewise, the authorship of *Hydrophis ornatus maresinensis* is Mittleman, 1947, not (Gray, 1842). The authorships of amphibians and reptiles described in Siebold's (1838) *Fauna Japonica* had once been attributed to Schlegel, 1838 (e.g., see Nakamura and Uéno 1963), but Hoogmoed (1978) clarified that Temminck should be the senior author of those names (also see Zhao and Adler 1993). In GARJ, anuran species described in *Fauna Japonica* (*Bufo japonicus japonicus*, *Rana rugosa*, and *Buergeria buergeri*) are correctly attributed to Temminck & Schlegel, 1838, but curiously enough, Schlegel alone is still credited with authorship of the other species first described in that work (i.e., *Hynobius naevius*, *H. nebulosus*, and *Takydromus tachydromoides*).

Iwasaki's coral snake *Sinomicrurus macclellandi iwasakii* was first described as *Callophis iwasakii*. So, in the current combination, the author should appear in parentheses—(Maki, 1935). The same is true of the authorship of the mourning gecko *Lepidodactylus lugubris*, which was originally described under the generic name *Platydactylus*. In contrast, the authorship of the Otton frog, *Rana subaspera*, should not be in parentheses because Barbour (1908) assigned this species to *Rana* in its original description. This also applies to the author citations for *Eumeces elegans*, *E. japonicus*, *Trimeresurus okinavensis*, and *T. tokarensis*. The specific epithet of the pelagic sea snake should be "*platura*," not "*platurus*," as was recently clarified by Lanza and Boscherini (2000). The date of publication of Hallowell's report is 1861, not 1860, despite the fact that the latter date is printed on its front page (see Zhao and Adler 1993). In GARJ, this is correctly expressed in the citations for frogs (*Rana nigromaculata*, *Buergeria japonica*, and *Rhacophorus viridis*), but not for the newt (*Cynops ensicauda*) or the reptiles (*Ateuchosaurus pellopleurus*, *Cryptoblepharus boutonii nigropunctatus*, *Eumeces latiscutatus*, *E. marginatus*, *Cyclophiops semicarinatus*, and *Trimeresurus flavoviridis*), for which publication dates remain listed as 1860. Incorrect publication dates are also given for *Eretmochelys imbricata* Linnaeus (1776, actually 1766) and *Gehyra mutilata* (Wiegmann)(1835, actually 1834; see Zhao and Adler 1993).

For some scientific names, format of presentation is not consistent with that for the others. The authorship for *Anolis carolinensis*, for example, is shown simply as "(Voigt)" without year of publication (1832). Authorships are not given at all for *Calamaria pavimentata miyarai* and *Elaphe carinata yonaguniensis* (both Takara, 1962). In the scientific names of the species described by Albert Günther, the author's name is spelled as "Günther" for *Hyla japonica* and *Rana dybowskii*, "Gunther" for *Rhacophorus schlegelii* and *Sinomicrurus japonicus japonicus*, and "Guenther" for *Elaphe carinata carinata*. Such an inconsistency, though not completely erroneous, could be misleading to readers.

Taxonomic arrangements and relevant statements are questionable for several taxa. For example, the Ryukyu ground gecko, *Goniurosaurus kuroiwae*, is placed in the family Gekkonidae, despite morphological and phylogenetic distinctness of this and related species, which justifies their separation from the other geckos as a distinct family, the Eublepharidae (e.g., Bauer 2002; Kluge 1987; Underwood 1954). The generic name *Apeltonotus* is used for the Sakishima grass lizard (as *Apeltonotus dorsalis*), although recent phylogenetic studies have invariably indicated its status as a junior synonym of *Takydromus* (Arnold 1997; Lin et al. 2002; Ota et al. 2002). Likewise, *Cistoclemmys* is still used as the generic name for the yellow-margined box turtle, despite recently published convincing evidence for its synonymy with *Cuora* (Honda et al. 2002). In an account for *Chelonia mydas*, the authors note that the Japanese populations have been assigned to the subspecies *C. m. agassizii*. This is not the case at all. The *C. mydas* populations breeding in the Japanese territory, while occasionally referred to as *C. m. japonica* (e.g., Nakamura and Uéno 1963), have never been assigned to this primarily southern Pacific subspecies. I suspect that the authors have misinterpreted a recent report on the discovery of a few *C. m. agassizii* from the Japanese sea (Kamezaki et al. 1998; Ota 2001).

The name *Rana limnocharis* is applied not only to the marsh frog populations of the central Ryukyus and the main islands, but also to the southern Ryukyu populations without any annotation. This is confusing because in another recent publication (Maeda and Matsui 1999), Maeda recognized the latter populations as distinct at the species level. Likewise, the authors synonymize a recently described subspecies of the coral snake, *Sinomicrurus japonicus takarai* Ota, Ito & Lin, 1999, with *S. j. boettgeri* (Fritze, 1894), but without clarifying the reason for doing so.

The greatest taxonomic confusion is seen in the arrangement of the Ryukyu populations of the genus *Amphiesma*. In GARJ, *A. ishigakiense* (Malnate & Munsterman, 1960) is retained as a subspecies of *A. pryeri* (Boulenger, 1887) as *A. pryeri ishigakiensis* (the ending of this subspecific epithet is also inappropriate: see Toriba 1994). Moreover, both "subspecies" are shown in their distribution maps to occur sympatrically in the Miyako and Yaeyama Groups of the southern Ryukyus. Actually, a recent study demonstrated that *ishigakiense* is distinct from *pryeri* sensu stricto not only in coloration and reproductive mode as mentioned in GARJ, but also in scalation, karyotype, and hemipenial morphology. The study also clarified that distribution of the latter is confined to the central Ryukyus (Ota and Iwanaga 1997). Furthermore, recent morphological and chromosomal analyses revealed that the Miyako Group populations of *Amphiesma* deserve recognition as another distinct species under the resurrected name *A. concelarum* Malnate, 1963 (Ota and Iwanaga 1997; Ota and Takahashi 1997).

The worst aspect of GARJ lies in the presentation of geographic distributions. As is mentioned above, the authors presented an introductory map of Japan with a key to names of "herpetologically important" islands. First of all, adequacy in selection of islands for the key is questionable, because it fails to choose several islands with which prominent herpetological events or properties are associated, such as Minamitorishima Island (an islet from which

TABLE 1. Distributional errors at the island level in the maps for terrestrial taxa in GARJ.

Species/Subspecies	Erroneous island records	Islands erroneously omitted	Sources
Hynobius okiensis	An island drawn in the north of Noto Peninsula (see text)	Oki (or Okinoshima)	Sato (1943), Sengoku et al. (1996)
Hynobius tsuensis	Oki (or Okinoshima)	Tsushima	Sato (1943), Sengoku et al. (1996)
Cynops ensicauda	Kikaijima	Akajima, Zamamijima	Ota (1986), Hayashi and Matsui (1988)
Tylototrton (Echinotriton) andersoni		Ukejima	Ota and Okada (2003)
Bufo japonicus formosus		Hokkaido[1)]	Saito et al. (1996)
Hyla japonica		Kuchierabujima[2)], Iwojima	Hikida et al. (1992), Morita (1996)
Rana catesbeiana	Okierabujima	Kumejima[1)], Kohamajima[1)]	Hikida et al. (1992), Ota (1999)
Rana limnocharis		Izenajima, Haterumajima[3)] Yonagunijima[3)]	Ota (1981), Toda et al. (1997)
Rana nigromaculata		Hokkaido[1)], Tanegashima	Takenaka (1997), Morita and Ogata (1997)
Rana okinavana		Kakeromajima	Hayashi (1996)
Rana porosa porosa		Hokkaido[1)]	Saito et al. (1998)
Rana rugosa		Hokkaido[1)]	Saito and Dewa (2000)
Buergeria japonica		Islands of the Tokara Group	Hikida et al. (1992)
Microhyla ornata	Yonagunijima	Kumejima, Akajima, Zamamijima Tokashikijima, Suwanosejima[1)]	Toyama (1983, 1984), Hikida et al. (1992)
Pelodiscus sinensis	Haterumajima[4)]	Yonagunijima[1)], Amamioshima[1)] Kikaijima[1)], Minamidaitojima[1)]	Sato and Ota (1999)
Chinemys reevesii		Okinawajima[1)]	Masuno et al. (1999)
Mauremys japonica		Tanegashima	Morita and Ogata (1997)
Mauremys mutica		Yonagunijima, Akajima[1)]	Yasukawa et al. (1996)
Japalura polygonata ishigakiensis	Taramajima, Taketomijima Kuroshima	Yonagunijima[5)]	Ota (1983, 2003)
Ateuchosaurus pellopleurus		Islands of the Tokara Group	Hikida et al. (1992)
Eumeces barbouri	Yoronjima	Tokashikijima, Kumejima	Toyama (1984), Ota et al. (1991a)
Eumeces elegans	Haterumajima		Ota (1981)
Eumeces japonicus[6)]		The remaining islands of the Osumi Group, Danjo Islands	Matsuo (1994), Motokawa and Hikida (2003)
Eumeces kishinouyei		Haterumajima	Ota (1981)
Eumeces marginatus		Suwanosejima, Nakanoshima	Motokawa and Hikida (2003)
Eumeces stimpsonii		Haterumajima	Ota (1981)
Gehyra mutilata		Haterumajima[1)]	Ota and Yamashita (1985)
Gekko hokouensis	Haterumajima	Honshu[1),7)], Hachijojima[1)]	Okada (1998), Ota et al. (1995, 2004)
Gekko tawaensis		Kyushu[8)]	Kawata (1982), Okada and Toda (1999)
Hemidactylus frenatus		Kitadaitojima, Minamidaitojima	Ota and Toyama (1992), Ota (1994)
Hemiphyllodactylus typus		Ishigakijima[1)], Taramajima[1)]	Kikukawa and Toda (1998), Ota (2001)
Lepidodactylus lugubris	Iheyajima, Izenajima	Kitadaitojima, Minamidaitojima	Yamashiro et al. (2000)
Takydromus smaragdinus		Kodakarajima	Hikida et al. (1992)
Takydromus tachydromoides		The remaining islands of the Osumi Group	Nagai (1938), Hikida et al. (1992), Morita (1996)
Ramphotyphlops braminus		Uotsurijima, Kitadaitojima Minamidaitojima, Hachijojima[1)] Tanegashima[1)], Chichijima[1)]	Ota et al. (1991b, 1995), Ota and Toyama (1992) Kazuki (2001)
Achalinus werneri		Tokashikijima	Ota and Toyama (1989)
Amphiesma pryeri[9)]	Islands of the Miyako and Yaeyama Groups		Ota and Iwanaga (1997)
Amphiesma ishigakiense[10)]	Islands of the Miyako Group		Ota and Iwanaga (1997)

TABLE 1. Continued.

Dinodon orientale	Iwojima of the Iwojima Group	Iwojima of the Osumi Group	Nagai (1938)
Dinodon r. rufozonatum		Uotsurijima	Ota et al. (1993)
Elaphe carinata yonaguniensis	Haterumajima	Yonagunijima	Takara (1962), Ota (1981)
Elaphe climacophora		Yakushima, Tanegashima Kuchierabujima[2)]	Nagai (1938), Morita and Ogata (1997)
Elaphe quadrivirgata		The remaining islands of the Osumi Group	Nagai (1938), Morita (1996)
Lycodon ruhstrati multifasciatus		Irabujima	Takahashi (1996)
Trimeresurus elegans	Haterumajima	Taketomijima, Kuroshima, Kohamajima, Okinawajima[1)]	Takara (1962), Ota (1999)
Trimeresurus flavoviridis	Akajima, Zamamijima	Iheyajima, Tokunoshima	Takara (1962)
Trimeresurus okinavensis		Izenajima, Tokunoshima	Takara (1962)
Trimeresurus tokarensis	Unnumbered island in the immediate south of Takarajima	Kodakarajima	Takara (1962)

1) Demonstrably or supposedly of artificial origins (Ota, 1999; Lever, 2003).
2) A small island of the Osumi Group, immediately east of Yakushima Island. Drawn in the distribution maps in GARJ, but not named.
3) Maeda and Matsui (1999) regarded populations from these and other adjacent islands as distinct from *R. limnocharis* at the species level. See text.
4) Information has recently been obtained that suggests the occurrence of *P. sinensis* on Haterumajima Island. However, this needs verification (Ota et al., 2004).
5) The Yonagunijima population of *Japalura polygonata* is now regarded as a distinct subspecies, *J. p. donan* Ota, 2003. See text.
6) The name *Eumeces latiscutatus* (Hallowell, 1861) was long applied to all main island *Eumeces* populations. Motokawa and Hikida (2003) clarified that this is actually a senior synonym of *E. okadae* Stejneger, 1907 (see pp.165-167 of GARJ), and that *E. japonicus* Peters, 1864 should be applied to all main island populations of the genus except for those in the Izu Peninsula.
7) An established population of artificial origin is known from Wakayama Prefecture, southwestern Honshu (Okada, 1998).
8) An established population is known from Oita Prefecture, eastern Kyushu (Kawata, 1982; Okada and Toda, 1999).
9) Referred to as *Amphiesma pryeri pryeri* in GARJ. See text.
10) Referred to as *Amphiesma pryeri ishigakiensis* in GARJ. See text.

Perochirus ateles was first recorded by Burt and Burt [1932] and still remains as one of the only two known localities of the species within the Japanese territory), Kuchinoshima Island (where the northernmost populations of *Buergeria japonica* and *Eumeces marginatus*, and the southernmost, introduced population of *Elaphe quadrivirgata* occur; Hikida et al. 1992), Akusekijima Island (where a distinctly isolated population of *Mauremys mutica* occurs [Yasukawa et al. 1996], and an enigmatic, unidentified *Eumeces* population occurred until being extirpated by introduced weasels a few decades ago: Hikida et al. 1992), Tonakijima Island (type locality of *Goniurosaurus kuroiwae orientalis*), and Nakanokamishima (or Nakanouganjima) Island (where *Dinodon rufozonatum walli* exhibits marked gigantism and peculiar carrion eating habits; Kohno and Ota 1991). Why the authors chose other small islets with apparently much less herpetological importance, such as Taketomijima Island of the southern Ryukyus, is unclear.

Secondly, terminology in the introductory map, particularly in the part of the Ryukyu Archipelago (sensu Ota [1998], i.e., defined as the whole fringing archipelago located between Kyushu, Japan and Taiwan), is not only impractical but also highly confusing. For example, the authors, while dividing the northeastern half of the archipelago (belonging to Kagoshima Prefecture) into three island groups (Tanegashima Group [more conventionally Osumi Group], Tokara Group, and Amami Group), combine all islands in the southwestern half (belonging to Okinawa Prefecture) as the "Okinawa Group." Such a grouping, while possibly bearing some political significance, makes it difficult to refer to some of the biogeographically most distinct units precisely. For example, although many amphibian and reptile species are shared between Okinawajima plus adjacent islets (i.e., the Okinawa Group sensu Ota [1998]) and the Amami Group, far fewer are common between the former and the southern Ryukyus (i.e., the Miyako Group and the Yaeyama Group sensu Ota [1998])(e.g., see Ota 2000b). As a result, the authors use some additional unconventional terms, such as the "Okinawa Archipelago," "Miyako Archipelago," and "Yaeyama Archipelago" in the text. Because these terms are not defined in GARJ or in any other literature, their use could be confusing to non-Japanese readers in particular.

The part of the introductory map showing the Tokara Group largely accurately depicts shapes, relative sizes, and relative locations for more than half of its component islands. However, their associations with island names are totally in error. On the map, the third, fourth, fifth, and sixth islands of the main row from the southwest are referred to as Takarajima, Kotakarajima (actually Kodakarajima), Suwanosejima, and Nakanoshima Islands, respectively. However, Suwanosejima Island is actually the second, and Nakanoshima Island the third island depicted on the map (the southernmost and the fourth are Akusekijima and Kuchinoshima Islands, respectively: see above), whereas the fifth and sixth islands do not exist in reality. Takarajima and Kodakarajima are scaled out and are not shown in this or other parts of the map. These errors are particularly regrettable in that they make it difficult for readers to recognize the location of the so-called Watase's Line, the most profound biogeographical subdivision line for the Japanese herpetofauna that lies on the tectonic strait between Kodakarajima and Akusekijima Islands of the Tokara Group

(Hikida et al. 1992; Ota 1998, 2000b).

There are numerous questionable pieces of information and obvious errors in the distribution maps for many taxa. Some of these are more or less related to taxonomic issues. For example, GARJ does not give an account at all for *Hynobius tenuis*, a salamander species described by Nambu (1991). This implies, though not clearly stated anywhere in the book, that the authors follow the view of Matsui et al. (2002), who regarded this nominal species as synonymous with *H. hidamontanus* Matsui, 1987. Nevertheless, in the distribution map for *H. hidamontanus*, the range of *H. tenuis* (located north of the range of *H. hidamontanus* sensu Matsui [1987]) is not shown. Likewise, GARJ does not refer to *Japalura polygonata donan* Ota, 2003, an endemic subspecies of Yonagunijima Island described in the end of 2003. There are two possible reasons for this: 1) the authors negate such distinctiveness of the Yonagunijima population as argued by Ota (2003), or, more likely, 2) the manuscript of GARJ was completed and forwarded to the printer prior to publication of that description. In either case Yonagunijima should have been marked in red on the distribution map of *J. p. ishigakiensis*, to which its tree lizard population had previously been assigned (Ota 1983). In the distribution map for *Scincella boettgeri*, Uotsurijima Island in the Senkaku Group is marked, as are islands of the Miyako and Yaeyama Groups. It is certain that a skink of the genus *Scincella* occurs on Uotsurijima, but its specific status remains undetermined (Ota et al. 1993) so the basis for the authors' allocation to *S. boettgeri* is unclear.

Maps for a few taxa endemic to particular islands exhibit simple and obvious errors. For example, in the map for *H. okiensis*, an island drawn to the north of Noto Peninsula, which actually does not exist, is marked instead of Oki (or Okinoshima) Island, the only known locality for this species (Sato 1943; Sengoku et al. 1996). Errors of the same kind are seen in the maps for *H. tsuensis* and *Elaphe carinata yonaguniensis*. From these and numerous other obvious errors in the distribution maps for terrestrial taxa (see Table 1 for errors at the island level), I cannot help but wonder if the authors examined the primary sources of relevant information by themselves, or whether they seriously checked their maps while proof-reading.

Even for the maps for terrestrial taxa that are not listed in Table 1, I have concern for the accuracy of information. Of the four large forest-dwelling frogs on Okinawajima Island, for example, *Rana narina* is shown to have much broader range on the island, including its middle part, than the remainder, *R. holsti*, *R. ishikawae*, and *R. namiyei*, that are strictly confined to the northern mountain range. Actually, none of the four species occurs in the middle part of the island, and differences among their ranges are subtle, at best, on the map of this scale (Matsui et al. 2000). In the map for *Hemidacyulus bowringii*, the authors marked all islands of the central and southern Ryukyus. Such a presentation will be interpreted by most readers as indicating that this gecko is recorded from all islands in these regions. It is certain that some previous books for general readers, such as Sengoku (1979), referred to the distribution of *H. bowringii* simply as "the Ryukyu Archipelago." However, this does not necessarily mean that the species occurs on *all* islands of the Ryukyus. Actually, to the best of my knowledge, there is, for example, no record of *H. bowringii* from Iheyajima Island. The same is true for the maps for *H. frenatus*, *Lepidodactylus lugubris*, and *Cryptoblephaus boutonii nigropunctatus*, in which all islands of the Ogasawara Group are marked in red, resulting in false accuracy.

It is far more difficult to outline the range of marine species. However, I have to point out several problems in the distribution maps for marine taxa in GARJ that are unnecessarily misleading to readers. For example, coastal waters of Japan, as far northeast as central Honshu on both the Pacific and the Sea of Japan sides, are shaded red in the map for *Caretta caretta*. This suggests that the authors intend to show the range of waters only in the vicinity of nesting beaches of this species, because sighting, by-catch, and stranding records of this sea turtle are also known from as far northeast as northern Honshu (e.g., Biodiversity Center 2001; Nakamura and Uéno 1963). Obviously, however, this is not the case for the map of *Chelonia mydas*, because, although the nesting beaches of this species in Japan are confined to the Ogasawara Group and the Ryukyu Archipelago (e.g., Suganuma 1994), the shaded area in the map also includes waters adjacent to Kyushu, Shikoku, and the Pacific side of western Honshu. If the authors intended to show the range of *C. mydas* including non-nesting records, coastal waters as north as the northernmost tip of Honshu should have been shaded, and this is also true for *E. imbricata* (see published records compiled by Suganuma [1994] and Kamezaki [1994], respectively).

Distribution maps for the sea snakes also suffer in the same way. For example, red-shaded areas in the maps other than that for *Pelamis platura* are invariably confined to waters adjacent to the central and southern Ryukyus. However, the range of *Emydocephalus ijimae* actually includes the shallow water around the Tokara Group (see Ota [1997] for compiled published records). Likewise, for two oviparous species, *Laticauda laticaudata* and *L. semifasciata*, the northernmost egg-laying sites are known on Iwojima Island of the Osumi Group ("Satsunan-Iwojima" in GARJ). In the northern Ryukyus, a few other egg-laying sites are also known for these two species (Nagai 1928; also see Ota [1995] for compiled published data).

In the text of GARJ, there are also a number of questionable statements and inconsistencies of various categories that might be misleading to readers. For example, the authors state that "the Honshu populations of *Mauremys mutica* are thought to stem from introductions from the Chinese mainland," although available information regarding the relevant traffic in the past (e.g., Takashima 1940) and morphological data (Yasukawa et al. 1996) suggest Taiwan to be the most likely origin for these populations. The authors, while noting for some species the artificially introduced origin of certain populations (see above example of *M. mutica*), do not mention this for other species that actually have feral populations within Japan (e.g., all Ryukyu populations of *Pelodiscus sinensis* are of artificial origin: Sato and Ota 1999). For some species, such as *Ramphotyphlops braminus*, *Dinodon rufozonatum rufozonatum*, and *Pelamis platura*, distributions outside the Japanese territory are also mentioned, whereas such information is completely omitted for other species including those that actually have broad extralimital distributions (*Salamandrella keyserlingii*, *Hemidactylus frenatus*, *Laticauda colubrina*, etc.). Such an inconsistency in the extent of documented range among the species will lead to overestimation by the readers of the level of endemism of the Japanese herpetofauna.

In the "Reproduction" subsection for *Ramphotyphlops braminus*, the authors describe its eggs to be 3–4 mm long, but available data indicate that they are actually much longer, varying from 11.2–20 mm (Kamosawa and Ota 1996). They mention that *Cyclophiops herminae* is "probably oviparous, but data are lacking." Actually, observation of a clutch of nine shelled eggs has already been reported for this species (Ota 1996). Obviously, reproductive traits are documented for some species on the basis of data not only from the Japanese populations but also from extralimital populations (e.g., see data given for *Hydrophis cyanocinctus*). For other species, however, data only from domestic populations are considered. It is mentioned, for example, in the account for *Hemidactylus bowringii* that the species is "probably oviparous, but data are lacking," although relevant information is available for its non-Japanese populations (e.g., Ota and Lin 1997). The authors write that *Opisthotropis kikuzatoi* feeds on tadpoles, fish, aquatic insects, and freshwater crustaceans. However, the small crab is the only food item presently known for this endangered, strictly protected species (Nakachi et al. 1993; Ota and Mori 1985). For this snake, the authors also write that one museum specimen collected in October contained eggs in the oviducts. Actually, however, the specimen had been in captivity for several months when it was fixed in October, and it had fairly enlarged ovarian follicles, not oviductal eggs, at fixation (Ota and Mori 1985).

The authors noted that *Tylototriton* (*Echinotriton*) *andersoni* is "now protected by law *in parts* of its range." However, with the recent designation of its Amami populations as a natural monument by the Kagoshima Prefectural Government, the species is now actually protected in its *whole* range. For some species, such as *Rana holsti*, the endangered and protected status are mentioned. For other protected species, including those even at higher red list status and conservation priority (*R. ishikawae*, *Opisthotripis kikuzatoi*, etc.; Matsui et al. 2000), those aspects are not mentioned at all. Such an inconsistency is of particular concern, because it will be misleading to potential collectors of amphibians and reptiles.

In summary, how should I evaluate GARJ? This is the first comprehensive English guide to the Japanese amphibians and reptiles. In this book, more than 95% of the Japanese species are introduced with beautiful photographs. These two facts alone will make GARJ a worthwhile purchase, despite its rather expensive price. However, readers, especially those who want to utilize the book as a source of data for their professional research, should keep in mind that this book is not carefully edited or bibliographically precise, and that it has many errors, misleading inconsistencies, and false accuracies as criticized above.

In Japan, quite a few herpetological data are published every year in periodicals and books written chiefly or exclusively in Japanese. Outside Japan, however, most such data remain unnoticed, or even if noticed, are often excluded from citation in journals whose editors regard such sources of data as the "gray literature." A book like GARJ should have been a good place to gather and synthesize such "hidden" data, but unfortunately the authors did not take advantage of this opportunity. This fact, as well as continuing discoveries on the actual diversity and characteristics of the Japanese herpetofauna (e.g., Matsui et al. 2004; Ota 2003, 2004), makes it greatly desirable to carefully revise this book or, alternatively, to publish more carefully prepared books of this kind in near future.

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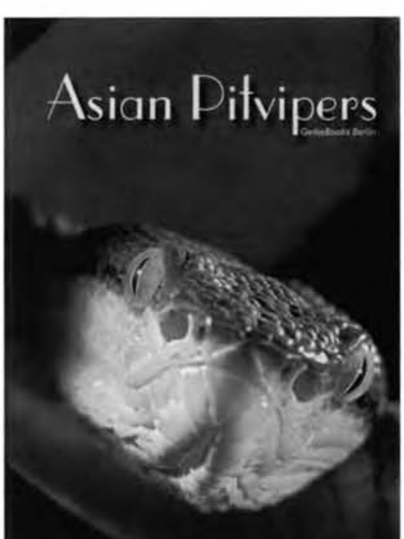

This large format hardbound book (21.0 x 29.5 cm) is a breathtakingly beautiful work of art. In fact, the title of this book would more appropriately have been "Photographic Atlas of Asian Pitvipers," which more accurately describes its contents. The quality of the photography is excellent, on par with that of Chanard et al. (1999), Orlov et al. (2002), and Whitaker and Captain (2004), as the majority of photographs

were taken by Gumprecht, Orlov, Grossmann, Tillack, and Captain. The color photos are enhanced by the glossy texture of the paper.

In addition to the 312 pages of photos (1179 figures), there are 42 pages of text (with four pages of scale counts and a 26-page checklist), eight pages of bibliography, a four-page index, and two pages of photographic credits. The summary scale counts given in the table include dorsal scale rows, ventrals, subcaudals, and supralabials with the ventrals and subcaudals listed separately for males and females. Rare states of dorsal scale rows and supralabials are listed parenthetically.

Useful additions to the checklist include the original citation, listing of the type material and type locality, distributional range by country and state, a list of significant references pertaining to the taxon, and systematic comments noting recent taxonomic changes or controversial opinions regarding the status. The paper by Malhotra and Thorpe (2004), which revised Asian pitviper taxonomy with the resurrection of three genera and proposal of four new genera, appeared too late for the authors to follow the latest nomenclature. However, a conversion table is presented on page 11 for reference. The changes include *Ovophis* (with separation of *Garthius*) and *Trimeresurus* (with separation of *Cryptelytrops*, *Himalayophis*, *Parias*, *Peltopelor*, *Popeia*, and *Viridovipera*).

The snakes are presented in alphabetical order by genus and species (the same arrangement as the checklist). The photos vary in size and range from 1–8 per page, the number per page being most commonly 3 (158 pp.), followed by 4 (83 pp.), 5 (29 pp.), 6 (28 pp.), 2 (6 pp.), 8 (5 pp.), 1 (2 pp.), and 7 (1 p.). In addition to 44 habitat shots, the number of photos of each genus is as follows: *Calloselasma* (17), *Deinagkistrodon* (12), "*Gloydius*" (97, with 12 of *Garthius*), *Hypnale* (15), *Ovophis* (87), *Protobothrops* (123), *Triceratolepidophis* (14), "*Trimeresurus*" (686, with 234 of *Cryptelytrops*, 37 of *Himalayophis*, 80 of *Parias*, 12 of *Peltopelor*, 57 of *Popeia*, and 72 of *Viridovipera*), *Tropidolaemus* (71), and *Zhaoermia* (13). These are both aesthetically arranged and conveniently grouped such that all of the photos on a given page are of the same species. Full-body (dorsal, lateral, and ventral) shots of snakes predominate, followed by close-ups of the head (dorsal, lateral, and ventral), tails, hemipenes, egg clutches with hatching neonates, and feeding specimens. When living material is not available, good color photos are provided of preserved and type specimens. Neonates, juveniles, and adults are figured. Some of the photographs (or nearly identical photos) in this book were previously published in other works, including Chan-ard et al. (1999), Orlov et al. (2002), and Whitaker and Captain (2004).

My chief criticisms of the book are the complicated method of numbering plates, lack of identification keys to the genera and/or species, and lack of synonymies for all taxa. Instead of consecutively numbering the photos, the figures are renumbered with Roman numerals on each page, necessitating reference to two values to denote a particular photo (i.e., p. 253 no. II, 253 II, or 253-II). This will make reference to these figures in the literature complicated, lengthy, and possibly misleading.

In a monumental work such as this, which will obviously be the volume on Asian Crotalinae for years to come, it would be expected that a key to at least the included genera and possibly also the species be included. Such keys should not have been difficult to produce considering the authors experience and vast array of excellent photographs.

Synonymies of different names, junior synonyms, and various combinations are vitally important in a work of this magnitude. However, the authors provide only the original combination for each species or subspecies. It is difficult or impossible to assign other names without a good synonymy. Thus, David and Ineich (1999) or McDiarmid et al. (1999) are essential companions to the present atlas even though recent taxonomic changes have been included in the taxonomic listing of the present work. In comparison with the taxonomy of McDiarmid et al. (1999), Gumprecht et al. (2004) includes recognition of the genera *Protobothrops* and *Zhaoermia* and the species *Gloydius brevicaudus*, *Ovophis tonkinensis*, *O. zayuensis*, *Trimeresurus andersoni*, *T. insularis*, *T. malcolmi*, *T. mcgregori*, *T. venustus*, and *T. yunnanensis*; transference of both subspecies *caucasicus* and *stejnegeri* from *Gloydius intermedius* to *G. halys*; synonymizing *Gloydius saxatilis* with *G. intermedius* and *Trimeresurus karanshahi* with *T. tibetanus*; and inclusion of the newly described *Gloydius tsushimaensis*, *Trimeresurus gumprechti*, and *T. vogeli*).

In addition, I noted a two minor typographical errors: *Cryptelytrops andersonii* vs. *andersoni* (p. 11), *Tropidolaemus wagleri* Boie, 1827 vs. *Tropidolaemus wagleri* (Boie, 1827) (p. 41) and a single taxon, *Gloydius blomhoffii dubiatus* Gloyd (1977), was omitted. A few other taxonomic changes and additions are too recent to have been incorporated into the book. The validity of *Cryptelytrops kanburiensis* and *C. venustus* has recently been supported by David et al. (2004). A new species, *Trimeresurus truongsonensis*, has been described from Vietnam by Orlov et al. (2004). It resembles *Cryptelytrops kanburiensis* and *C. venustus* and should probably be referred to that genus. A revision of *T. popeiorum* by Vogel et al. (2004) contains the description of two new species, *T. fucatus* and *T. nebularis*, plus the elevation of the subspecies *T. p. barati* and *T. p. sabahi* to full species status (=*Popeia* of Malhotra and Thorpe, 2004).

This book is not only a terrific bargain for the quality and quantity of the color work but also a must for all herpetologists, toxicologists, biologists, and naturalists. It provides a much needed synopsis of the pitvipers of Asia with excellent photographs to aid in the identification of any species. I highly recommend this book for both the scientist and layman as it is the most comprehensive treatment of Asian pitvipers to date.

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In this book the authors attempt to present current information on captive care and natural history of most of the snakes of the United States and Canada. The work is a compilation and updating of two earlier volumes by the authors (Rossi 1992; Rossi and Rossi 1995). The goal of the authors was to present a diversity of information from a wide variety of sources in a format that would be useful to herpetoculturists and professionals wishing to maintain captive North American snakes. For each species they offer both basic natural history information and observations on captive care obtained from amateur and professional herpetologists. They do this by combining personal communications, regional literature from field guides, and scientific paper—primarily from the herpetological journals. Information derived from their own efforts to keep most of the species make up another part of the data presented, particularly for many of the lesser known snakes. Because of the scattered nature of the literature, those keeping snakes often have little information on the natural history of the species and many tend to keep all snakes under the same captive conditions. This book organizes the relevant information in a single source, and in so doing makes a significant contribution to the work of herpetoculturists and others keeping snakes.

Part I of the book is a long, detailed review of the methods for maintaining snakes in captivity. Although most of this information is not new, having it in this volume will be useful for persons with limited experience keeping members of this group, e.g., biologists beginning projects with new species or amateurs beginning in the hobby. It will, however, contribute little to experienced hobbyists, although observations from the authors' own experiences do add some interesting details.

Parts II and III consist of individual species accounts for nonvenomous and venomous snakes, respectively. The accounts include information on natural history and captive conditions and care. A typical account includes a short description, a range map, and a color plate of each species plus a table with a summary of captive requirements (maintenance difficulty index, cage size, appropriate substrate for the cage, and prey types eaten). The information is attractively presented and easy to read, even if it does not add tremendously to our knowledge of most of the species dealt with. We do, however, give the authors a lot of credit for keeping unusual species, such as hooknose snakes, that require spiders and scorpions as food. Indeed, this book might encourage more research on the many species that have typically been rejected as laboratory animals because too little was known about their requirements in captivity. For some such species almost nothing is known about behavior and future captive studies could make real contributions.

There are a few taxonomic problems with this volume, the black-and-white drawings are not very professional, and the scientific literature is not complete. Nonetheless, overall the authors accomplished what they set out to do. They have produced an attractive and readable summary of information as how to best maintain individual species of snakes found in the United States and Canada. The book will be of value to both amateur and professional herpetologists keeping snakes and also anyone else wishing to learn a little more about some of the less well-known North American species.

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Islands and the Sea: Essays on Herpetological Exploration in the West Indies, edited by Robert W. Henderson and Robert Powell. 2003. Society for the Study of Amphibians and Reptiles, Ithaca, New York. viii + 304 pp. Hardcover. US $48.00. ISBN 0-916984-62-1.

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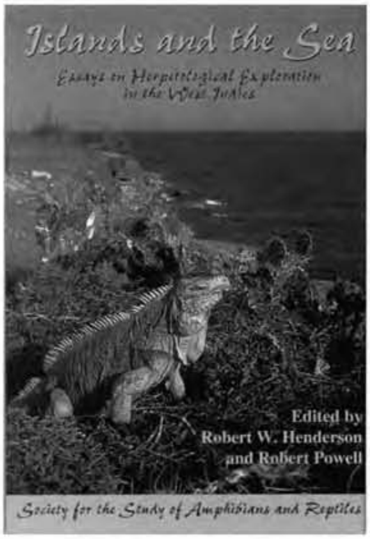

This wonderfully eccentric volume put me in a nostalgic and envious state of mind. From about the age of nine onward I checked out publications about nature from public and military base libraries wherever our family lived, seeking information on the box turtles, house geckos, and other "creepy crawlies" I'd caught, as well as longing, in some immature way, to understand why they enthralled me. Some of those books also undoubtedly fueled my naive wanderlust. Early on there was *Bring 'Em Back Alive*, by Frank Buck, and *I Married Adventure*, by Osa Johnson—but all that sticks in my mind from the former is a captive tapir that attacked the swashbuckling animal collector, and of the latter my only lasting impressions are of its fake zebra skin binding and Martin Johnson's abrupt death in a plane crash. I also read over and over again the popular works of Raymond L. Ditmars and Clifford H. Pope, each consisting mainly of factual summaries, whereas Carl Kauffeld's legendary *Snakes and Snake Hunting* evoked in me the joys of finding and catching herps. None of those books said much about becoming a professional biologist or how I might earn a living studying frogs and snakes, information that I gleaned instead from correspondence with Charles Bogert, Roger Conant, Henry Fitch, Laurence Klauber, William Milstead, and other luminaries. I still remember their unstintingly generous letters when I answer queries from youthful aspirants, but until now I've had no detailed accounts to recommend of the day-by-day *doing* of contemporary herpetology.

In fact, the editors' stated "primary goal" for *Islands and the Sea* "was to document the constantly evolving history of research" in the Caribbean, as well as to educate, to encourage further herpetological investigations in the region, and to entertain. After a thoughtful introduction by Henderson and Powell, there are 29 essays by 30 authors arranged in sections for the Bahamas, Cuba, Jamaica, Hispaniola, Puerto Rico, and the Lesser Antilles. One could complain about the small size of many of the black and white photos, but if the alternatives were their exclusion or a prohibitively expensive book, the series editor made the right decision. The few other things about which one might grumble, like a surprising number of inappropriately hyphenated words and some political commentaries that seem a bit unbalanced, are trivial in the face of the many strong points of this volume. Overall the editors have succeeded admirably in each of their goals, as well as provided a welcome set of readings for novice herpetologists.

The contributors to *Islands and the Sea* include undergraduates, graduate students, well-seasoned researchers, and a "retired" expert now in his 90s; among them are five women and seven citizens of Caribbean nations. Their prose is often straightforwardly descriptive, but it is rarely plodding and sometimes profound. There are some excellent opening hooks, of which my favorites are by Richard Sajdak ("Feeling less like General Douglas MacArthur than probably anyone in history, I jumped off the deck of the boat into warm knee-deep water"), Rafael Joglar ("I was born on an island where everybody is crazy about frogs"), Karim Hodge ("Six hundred years ago, when the devil was still a boy, Anguilla reclined in complete innocence at the junction of the Caribbean Sea and Atlantic Ocean"), and Ellen Censky ("I woke suddenly with my heart racing and my voice caught in my throat"). The essays mostly recount particularly memorable field trips, the goals of which were faunal inventories or even finding some particular taxon; others concern a doctoral dissertation project (Censky's "Dog Island Days"), long-term population monitoring (John Iverson and his students' "Adventures of the Iguana Patrol"), and the integration of science with education (Allison Alberts' "Conserving the Remarkable Reptiles of Guantanamo Bay").

Islands and the Sea is replete with fascinating natural history anecdotes, of which the one that most surprised me was Sixto Incháustegui's mention of female *Crocodylus acutus* that carry their babies for several kilometers, from nest sites on islets in a saline lagoon to fresh water on "mainland" Hispaniola. Every essay conveys the adventure of fieldwork and expresses a concern for conservation; over and over, the authors speak unabashedly, even poignantly of their love for people, animals, plants, and places. Scattered throughout the volume are thrills and scary times, an occasional personal epiphany, and even a moving tribute to a lost mentor.

Of course the text is specific to islands, and it conveys an authentic feel for the sights and smells of oceans and nearby terrestrial habitats, of the hazards of boat travel and the simple pleasures of rural living. There are also recollections of magical places and the discovery of previously unseen species, those universals of field biology that could just as well have happened high in the Hindu Kush or around some Saharan oasis. Although in some sense all of the essays convey details of historical interest, the editors' primary goal of shedding light on the chronicles of Caribbean herpetology is especially well satisfied in their own essay and in the fine accounts by Orlando Garrido, James Lazell, Michel Breuil, Stanley Rand, and George Gorman. Future analyses are best served by history that doesn't shy from the strengths and weaknesses of its human participants, and thus I particularly appreciated the candid perspectives on the early years of Harvard-based *Anolis* research. And as emphasized by almost every author, these hundreds of islands still offer unanswered questions galore for 21st century scientists.

Islands and the Sea offers an eloquent, honest, and informative look at the lives and work of a diverse bunch of field biologists, one that will appeal to established professionals and neophytes alike. This book helped me remember again why and how I got into science, and I've already given my review copy to a talented teenager. She too wants to be a herpetologist.

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TABLE 1. Presence of physical characteristics in male and female *Uroplatus henkeli*.

Sex	N	Vertebral stripe	Dorsal striations	Cranial markings
Male	50	19 (38.0%)	50 (100%)	2 (4.0%)
Female	50	0	0	45 (90.0%)

The horizontal black marking on the cranium (Fig. 2) was observed in 90% of the females and 4% of the males (Table 1). Thus our data are strongly suggestive of juvenile sexual dimorphism in *Uroplatus henkeli*.

Acknowledgments.—We thank Keith Benson, Orinna Clark, and Jim Clark for their helpful comments with the text.

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NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 36, Number 1 (March 2005).

CAUDATA

ENSATINA ESCHSCHOLTZII OREGONENSIS* x *PICTA (Oregon x Painted Salamander Intergrade). **BEHAVIOR.** *Ensatina eschscholtzii* is the most widespread and common plethodontid salamander in western North America, with the range extending from southern British Columbia to northern Baja California (Stebbins 1985. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin Co., Boston, Massachusetts. 336 pp.). However, little is known about the climbing behavior of this salamander. In addition, little is known about the climbing behavior of *Batrachoseps attenuatus* or *Taricha granulosa* (Hayes and Hayes 2003. Herpetol. Rev. 34:45–46; Aubry 2000. J. Wildl. Mgmt. 64:1041–1052; Jones and Aubry 1985. Herpetol. Rev. 16:26; Stebbins 1954. Univ. California Publ. Zool. 54:47–124).

An extended period of observation of the climbing behavior of terrestrial salamanders and their use of stumps as habitat was performed from 23 Nov 2001 to 29 Mar 2003. The site is located within the coastal redwood region of Humboldt County, in a semi-rural area of Westhaven, California USA (T8N R1E SW1/4 Sec 31; elev. ca. 100 m) (Sundell and Norman 2003. Herpetol. Rev 33:4). The stumps were Redwood (*Sequoia sempervirens*) that were logged five decades ago. The forest canopy consisted of old-growth Sitka Spruce and second growth Redwood, with few Red Alder (*Alnus rubra*) and Cascara Buckthorn (*Rhamnus purshiana*) in the understory.

On 29 Jan 2001, two subadult female *E. eschscholtzii* intergrades were found on a Redwood stump (stump #1) covered with introduced English Ivy (*Hedera helix*) under a piece of Redwood bark in site 5. The stump was 6 m diam with Evergreen Huckleberry (*Vaccinium ovatum*) and spruce seedlings present on top of the stump ca. 1 m off the ground. The cover object measured 30 x 20 x 4 cm with a temperature of 11.4°C in the covered litter and English Ivy roots. The first female measured 7.3 cm TL and 3.6 cm SVL (measured to the anterior edge of cloaca), the other female measured 7.6 cm TL and 3.9 cm. SVL

On 16 Feb 2002, an *E. eschscholtzii* adult male intergrade (10.4 cm TL, 4.6 cm SVL) and a *B. attenuatus* were found 1.2 m off the ground on another redwood stump (stump #2), under litter, which was 8°C measured at a depth of 9 cm. The stump measured 5.2 m diam and was covered by False Lily-of-the-Valley (*Maianthemum dilatatum*) and two young spruce trees, which measured 4 cm in diameter.

On 2 Mar 2002, an adult male *E. eschscholtzii* intergrade (9.3 cm TL, 4.5 cm SVL) was found under litter on stump #2. This male was marked as LF2 RF2. The litter temperature was 7.3°C, which was measured at a depth of 9 cm. In addition, springtails, centipedes, and arachnids were located in the litter.

On 16 Mar 2002, an adult female, *E. eschscholtzii* (10.5 cm TL, 5.1 cm SVL) was found on another redwood stump (#3), 4.5 m diam. This salamander was wedged between pieces of outer bark, located 1.6 m off the ground.

The first stump was inspected again on 6 April 2002, and produced a female Rough Skinned-Newt (*Taricha granulosa*) (11.7 cm. TL, 4.7 cm SVL). The newt was found under the same piece of bark as the previous Ensatina salamanders found on top of stump #1. Also, present under the cover object with the newt was an adult *B. attenuatus*, which escaped capture.

On 16 Nov 2002, a subadult female *E. eschscholtzii* (7.6 cm TL, 4.1 cm SVL), was found under litter on stump #2, with a litter temperature of 10.8°C. Then again, on 25 Jan 2003, an adult male *E. eschscholtzii* (9.6 cm TL, 5.0 cm SVL), was found on the same stump, with a litter temp of 13.0°C. However, this was a recapture of the adult male (LF2RF2), first captured on 2 Mar 2002, on the same stump #2. Again, three more *B. attenuatus* juveniles were located under litter on top of the same stump. The litter had a temperature of 9.8°C at a depth of 9 cm.

On 15 Mar 2003, a subadult Wandering Salamander (*Aneides vagrans*) (7.4 cm TL, 4.1 cm SVL) was located on a Redwood stump (stump #4) with a subadult *B. attenuatus* (7.2 cm TL, 3.2 cm SVL), under a Redwood cover object 78 cm x 40 cm x 28 cm, which was located 1.5 m. above the forest floor. Stump #4 measured 3.1 m diam. The temperature in the interstitial space was 12.0°C.

Finally, on 29 Mar 2003, three more subadult *B. attenuatus* were located under litter on top of stump #2, which had a litter temperature of 11.7°C covering the coiled salamanders.

These observations emphasize the colonization of tree stumps

by the terrestrial salamanders *E. eschscholtzii* and *B. attenuatus*, and the semi-aquatic salamander, *T. granulosa*, which are not known for their arboreal behavior. In addition, these observations might indicate additional areas that should be searched during salamander surveys to increase the number of individuals observed.

Bradford R. Norman and Thomas A. Kirk assisted with field observations. In addition, I thank the landowners, John and Carol Wiebe, for their support and enthusiasm for this project and permission to conduct observations on their property.

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EURYCEA BISLINEATA (Northern Two-lined Salamander). **LARVAL MICROHABITAT**. Published accounts of the microhabitat of *E. bislineata* larvae include hiding under small stones at the bottom of small pools in streams, under stones at the water's edge, under leaves and on the bottom in slow-moving pools in streams, on the bottom of a glacial lake, and in a small farm pond (Bahret 1996. J. Herpetol. 30:399–401; Brophy and Pauley 2001. Herpetol. Rev. 32:98–99; Dunn 1926. The Salamanders of the Family Plethodontidae. Smith Coll., Northampton, Massachusetts, 446 pp.; Hudson 1955. Herpetologica 11:202–204; Petranka 1998. Salamanders of the United States and Canada, Smithsonian Inst. Press, Washington, DC. 587 pp.). We have observed larvae under rocks in open water, among leaf litter in small pools in mountain streams, and along the stream edge in coarse, wet gravel. Use of living vegetation by these larvae has not been reported previously.

We surveyed a section of the Staunton River 10–500 m upstream from its confluence with the Rapidan River in Shenandoah National Park, Madison County, Virginia, on 20 August 2001 in an ongoing study of streamside salamanders. Until 27 June 1995 the Staunton River was a cool mountain stream with moss-covered rocks and boulders under a full forest canopy. A major rain event that day exceeding 60 cm in a 6-h period caused massive flooding and completely altered the structure of the stream and its surrounding environment (Smith et al. 1996. Water Res. Bull. 32:3099–3113). The stream was scoured several meters deep and the entire canopy, ground vegetation, and original substrate was lost. The open stream corridor was subsequently invaded by early colonizing vegetation such as Woolly Mullen (*Verbascum thapsus*) on the banks above the stream and Spotted Touch-me-not (*Impatiens capensis*) along the water's edge.

We observed an aggregation of ca. 50 *E. bislineata* larvae under and within a thick, filamentous root mass of a Spotted Touch-me-not at the stream edge. Root filaments were ~50 cm long and extended ~20 cm from the overhanging bank into the water in a stream pool. Larvae swam easily in and out of the root mass but were difficult to capture unless they were coaxed into free water. The small interstices among the root filaments appeared to provide adequate cover from syntopic predators such as Brook Trout (*Salvelinus fontinalis*) and salamanders (*Gyrinophilus porphyriticus*, *Desmognathus monticola*). Larval size (TL 21–41 mm, mean 27.2 + 4.5; N = 19) suggested they may have been a mix of one- and two-year old age classes (Petranka, *op cit.* and refs. therein). Ten other larvae captured in the stream that day were 25–59 mm TL. Larval *Eurycea* spp. might aggregate in microhabitats opportunistically that provide concealment. This might help to explain why they are captured in large numbers in leaf litter bags (e.g., Waldron et al. 2003. Applied Herpetol. 1:23–36).

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EURYCEA BISLINEATA (Northern Two-lined Salamander). **LARVAL SIZE.** Maximum larval size in this species varies geographically. Here we report on maximum larval size at the southern edge of the range of this salamander.

On 19 July 2003 we captured seven *E. bislineata* larvae in a small woodland stream on a steep slope within a portion of the Fredericksburg and Spotsylvania National Military Park (NPS) in the City of Fredericksburg, Virginia (30°18"28'N, 77°27"17'W). We assigned these larvae to *E. bislineata* based on the location of the site at the southern edge of its known range (Petranka 1998. Salamanders of the United States and Canada, Smithsonian Inst. Press, Washington, DC. 587 pp.; Mitchell and Reay 1999. Atlas of Amphibians and Reptiles in Virginia. Spec. Publ. No. 1, Virginia Dept. Game and Inland Fisheries, Richmond, Virginia. 122 pp.). The habitat was in mixed hardwoods near a heavily-traveled urban road adjacent to the floodplain of the Rappahannock River. Water temperature was 20ºC. The seven larvae ranged from 51–79 mm TL (29–43 mm SVL). One 74 mm TL individual had reduced gills, whereas the largest one and a 70 mm TL individual had large, filamentous gills. All three of the largest larvae had the dark lateral pattern typical of adult *E. bislineata* in this area (Fig. 1). The occurrence of such large larvae at the southern edge of its range suggests that larval periods of three years may not be limited to cold water environments in the north or that other factors may influence age and size at metamorphosis in this species.

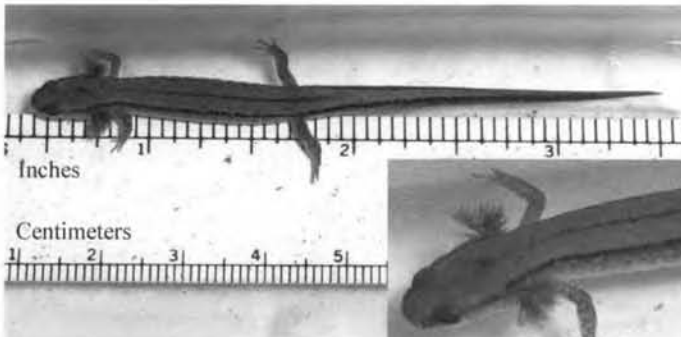

FIG. 1. *Eurycea bislineata* larva (79 mm total length) with large gills from Fredericksburg, Virginia. Photo by W. Brown.

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HEMIDACTYLIUM SCUTATUM (Four-toed Salamander) **NESTING ECOLOGY**. Little is known about the nesting ecology of *Hemidactylium scutatum* in Wisconsin (Vogt 1981. Natural History of Amphibians and Reptiles of Wisconsin. Milwaukee Public Museum). During late May and early June 2002, we conducted surveys for nesting *H. scutatum* at three separate ponds at The Ridges Sanctuary and Toft Point State Natural Area (hereafter RS-TP) in Door County, Wisconsin, USA (T30N R28E Secs 3, 4, 9, 10, 15, 16, 17, 21, 22). Dominant woody vegetation surrounding the ponds included White Cedar (*Thuja occidentalis*), Paper Birch (*Betula papyrifera*), Tamarack (*Larix laricina*), Black Spruce (*Picea mariana*), Eastern Hemlock (*Tsuga canadensis*), and Speckled Alder (*Alnus rugosa*). Emergent vegetation within the ponds included Cattail (*Typha latifolia*), sedges (*Carex* sp.), and Marsh Marigold (*Caltha palustris*). All ponds had considerable moss (mostly *Sphagnum* sp.) growth along their perimeters.

The nest survey consisted of searching mosses, moss-covered islets, sedge mats, and fallen logs along the margins or within the ponds. Once a nest was located, we recorded the vertical position of the nest in relation to the water surface, the water depth (cm) below the nest, the snout–vent length (SVL) (mm), and total length (TL) (mm) of all females present, and the number of eggs. We classified nests into four categories based on the nest forms described by Breitenbach (1982. J. Herpetol. 341–346). Nest forms included: 1) solitary, 2) solitary with neighboring nests on the same islet, 3) double (eggs of no more than two females), and 4) multiple (eggs of three or more individuals). Solitary nests were defined as having no more than 40 eggs, all of which were the same stage of development. Double nests were defined as having between 41–79 eggs, whereas multiple nests were defined as having greater than 80 eggs. We considered double and multiple nests to be joint or communal.

Thirty *H. scutatum* nests were located within cavities in moss. No nests were located in sedge mats or decaying logs. Nests were positioned between 7–19 cm (mean 12.87, SD 3.81) above the water surface. Water depth below the nest ranged from 1.5–12 cm (mean 7.76, SD 3.28). Fifteen of the 30 nests had a female attendant at the time of discovery. No more than one female was found in any nest. Female SVL ranged from 33.26–43 mm (mean 36.46, SD 2.47 mm) and TL ranged from 65.66–94.96 mm (mean 84.49, SD 8.06 mm). The total number of eggs per nest ranged from 17–200 (mean 51.30, SD 37.02). Of the 30 nests found, the majority were classified as either solitary (40%) or double (37%). Four nests were solitary with neighboring nests on the same islet, and only three nests were considered multiple. The three multiple nests contained 100, 115, and 200 eggs and all lacked a female guardian. Approximately 46% of nests were considered joint.

Nest searches at RS-TP provided the first site examination of nesting *H. scutatum* in Wisconsin. The relative frequency of joint nesting during Spring 2002 at RS-TP was higher than most published accounts (Gilbert 1941. Copeia 1941:47; Wood 1953. Amer. Nat. 87:77–86; Harris and Gill 1980. Herpetologica 36:141–144.; Breitenbach 1982. J. Herpetol. 16:341–346), however Blanchard (1934. Copeia 1934:137–138) found 61% of nests in a Michigan population to be communal. This research was funded by The Ridges Sanctuary and Cofrin Center of Biodiversity, University of Wisconsin-Green Bay.

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HEMIDACTYLIUM SCUTATUM (Four-toed Salamander) **TERRESTRIAL MICROHABITAT.** Although *Hemidactylium scutatum* spends the majority of its life on the forest floor, few studies have focused on their terrestrial microhabitat preferences outside of the nesting season. Between August and late October 2001, we located *H. scutatum* during the day by searching 10 m^2 quadrats in a mature upland conifer forest at Toft Point State Natural Area in Door County, Wisconsin, USA (T30N R28E Sec 16). Each quadrat was searched for 15 min by both researchers and consisted of investigating cover objects (coarse woody debris, leaf litter, rocks, and decaying stumps). Once a specimen was found, we recorded the vertical position of the salamander (subsurface, surface under shelter, or exposed), the substrate immediately below the salamander (moss, soil, decaying wood, or leaf litter), and other amphibian species present within the quadrat.

Searches of 105 quadrats revealed the presence of 22 *H. scutatum*. Twelve (55%) were found on the surface under shelter, 8 (36%) were found beneath the soil surface, and only 2 (9%) were found exposed on the surface. Most subsurface encounters occurred when examining the contents of rotten stumps. The substrate directly beneath 10 (45%) salamanders was organic soil, decaying wood was found under 5 (23%), leaf litter under 4 (18%) and moss under 3 (14%). Other amphibians found during surveys included *Pseudacris crucifer*, *Rana sylvatica*, *Ambystoma laterale*, and *Plethodon cinereus*. The Chi-square test of independence (a = 0.05) revealed that *H. scutatum* was positively associated with all species except *Plethodon cinereus*. Our research supports the observations of Schaaf and Moore (1969. J. Herpetol. 3:180), Vogt 1981. Natural History of Amphibians and Reptiles of Wisconsin. Milwaukee Public Museum) and others, which suggest that *H. scutatum* spends its time outside the breeding season beneath cover objects on the forest floor or becomes fossorial. The Cofrin Center of Biodiversity, University of Wisconsin-Green Bay funded this research.

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ANURA

BUFO FOWLERI (Fowler's Toad). **PREDATION**. In Canada, *Bufo fowleri* occurs in three disjunct populations (Rondeau, Long Point, and the Eastern Basin, largely encompassed by Niagara County). This disjunct distribution and fluctuations in abundance have resulted in the Committee on the Status of Endangered Species (COSEWIC) listing *B. fowleri* as a Threatened species. As a Threatened species, knowing potential sources of predation is especially important. Here we report the predation of a juvenile *B. fowleri* by two Ring-Billed Gulls (*Larus delawarensis*) in James N. Allan Provincial Park, Ontario, Canada within the Niagara region (N42.848 W079.664).

During the late afternoon of 16 Aug 2003 while conducting a

survey of toadlet abundance along the park beach, we observed a pair of Ring-billed Gulls on the beach pulling at a juvenile toad. When the gulls were disturbed, they flew out ca. 20 m into Lake Erie where the toad was dropped. The gulls landed beside the toad and swallowed it.

To our knowledge, this is the first reported predation of *B. fowleri* by gulls. Estimating the occurrence and sources of predation for such a threatened species has important conservation and management ramifications. We thank the Ontario Ministry of Natural Resources, and Ontario Parks for permission to conduct research and David Judd for his hospitality in the field.

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BUFO OCELLATUS (NCN). **DEATH FEIGNING**. Death feigning or thanatosis (Edmunds 1974. Defense in Animals. Longman, New York, 357 pp.), is a common behavior among frogs (Sazima 1974. J. Herpetol. 8:376–377; Duellman and Trueb 1986. Biology of Amphibians. McGraw-Hill, New York; Azevedo-Ramos 1995. Rev. Bras. Biol. 55:45–47). On 7 Aug 2003, in Unaí municipality (46°7'W, 16°9'S) when handling an adult male *Bufo ocellatus* (42.8 mm SVL), we observed death feigning behavior in this species. The specimen adopted a motionless posture, keeping his limbs close to the body and eyes closed. After 45 sec. in this position, the frog started moving, attempting to escape. However, when restrained it reinflated the lungs and released bladder liquid. Both behaviors are similar to those described for *B. paracnemis* (Zamprogno et al. 1998. Herpetol. Rev. 29:96–97) and probably are widespread among other species of this genus. The function of death feigning may be related to increasing the chances of being lost by a predator and/or to minimization injuries when seized by a predator (Sazima, *op. cit.*).

A voucher specimen (AAG-UFU 2484) is housed in the Museu of Biodiversidade do Cerrado, Universidade Federal de Uberlândia, Minas Gerais, Brazil. We thank Ariovaldo A. Giaretta for critically reading the manuscript and the owners of the Fazenda Sagres S. A. for logistic support.

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CHIASMOCLEIS VENTRIMACULATA and ***HAMPTOPHRYNE BOLIVIANA*** (NCN). **EFFECT OF PECCARY-HUNTING ON BREEDING HABITATS.** Anthropogenic influences on amphibian population declines can be categorized as direct habitat degradation and large-scale environmental changes (Blaustein et al. 1994. Conserv. Biol. 8:60–71; Dunson and Wyman 1992. J. Herpetol. 26:349–352; Fellers and Drost 1993. Biol. Conserv. 65:177–181; Harte and Hoffman 1989. Conserv. Biol. 3:149–158; Lind et al. 1996. Herpetol. Rev. 27:62–65).

The microhylid species *Chiasmocleis ventrimaculata*, *Ctenophryne geayi*, and *Hamptophryne boliviana* are sympatric throughout their western range, the Upper Amazon Basin of Ecuador and Peru. Since 1977, ecological data were gathered at the Peruvian Field Station Panguana where temporal blackwater ponds are typical spawning places for these species. At a large pond ca. 1200 m^2 spawning is coincident with an increase in precipitation followed by a short rainless period at the beginning of the rainy season. In addition to this pond there are small water-filled depressions, some of them muddy puddles used by collared and white-lipped peccaries (*Tayassu tajacu* and *T. pecari*) throughout the year. Like pigs, these peccaries are always moving in search of food and water, leaving the ground churned. They often return to the same mud wallows. Both species consume a wide range of food including fruit, roots, mushrooms, insects, snails; they occasionally feed on small vertebrates, e.g., lizards, snakes, frogs, and turtles. Their presence in a certain area is episodic and unpredictable. At Panguana *T. tajacu* is more common than *T. pecari* (Hutterer et al. 1995. Ecotropica 1:3–20).

These peccaries are eminent landscape architectures, increasing the diversity of aquatic plant and animal species. Anthropogenic influences on the herpetofauna of Panguana has been observed for a couple of years. One observation is the disappearance of many of the small temporary ponds, which can be caused directly by clearing woodlands or indirectly by hunting peccaries. Two of the small breeding ponds of *Hamptophryne boliviana*, *Chiasmocleis ventrimaculata*, and probably *Ctenophryne geayi* have disappeared. These ponds, known by the author since 1977, have formerly been puddles frequently used by peccaries. Since about 1992 footprints could not be found and the depressions gradually disappeared.

At the Río Pachitea and its confluence both peccaries are widely hunted, comprising a major part of daily proteins and skins (Redford and Robinson 1987. Am. Anthropol. 89:650–667). Detailed investigations are necessary to understand how this local hunting pressure depleting peccary populations affects amphibians and their reproduction. Similar studies will be necessary on tapirs (*Tapirus terrestris*) as amplecting pairs and egg clutches of *Hamptophryne boliviana* could be found in water-filled trails of peccaries and tapirs (Schlüter 1984. Doct. Dissert. Univ. Hamburg).

I thank the Instituto National de Recursos Naturales and Jesús H. Córdova (MHNSM) for their generous cooperation. Hans-Wilhelm Koepcke and his daughter Juliane Diller provided an opportunity to continue investigations on the herpetofauna of Panguana, and Gunther Köhler provided comments on the manuscript. Fieldwork was partly supported by the Förderverein of the SMNS and the Deutsche Forschungsgemeinschaft (DFG).

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COLOSTETHUS DEGRANVILLEI (Degranville's Rocket Frog). **REPRODUCTION**. While photographing *Colostethus degranvillei* in French Guyana, Cacao in a village 80 km from the capital Cayenne (4°33'32"N, 52°28'11"W), 500 m elev., 7 June 1999 (1415 h), we observed three small frogs on the back of an adult frog. When first observed we thought these were small tad-

poles. The small frogs were dark brown with small blue dots. When disturbed, the small frogs would remain on the back of the parent. This suggests the tadpoles were normal, non-feeding larvae and they likely remained on the back of the male through metamorphosis. This area was very humid with normal temperatures around 30ºC this time of year, at the end of the rainy season.

This observation represents a new mode of reproduction not previously reported (Duellman and Trueb 1985. Biology of Amphibians. Johns Hopkins Univ. Press, Baltimore and London).

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LEPTODACTYLUS MYSTACINUS (Mustached Frog). **DEIMATIC BEHAVIOR**. Deimatic behavior is a mechanism of secondary defense, which has the function of increasing the possibility of survival of an animal after it has been detected by the predator (Robinson 1969. Evol. Biol. 3:225–259). This behavior has been described in Leptodactylidae, especially *Pleurodema* and *Physalaemus* (Martins 1989. J. Herpetol. 23:305–307 and references therein). However, little is known about its occurrence in the genus *Leptodactylus*. *Leptodactylus mystacinus* is broadly distributed in eastern Brazil (Frost 2002. Amphibians Species of the World: an online inference 2:21). Herein, I report deimatic behavior of *L. mystacinus* collected in Nanuque City, Minas Gerais State, southeastern Brazil, on 4 Nov 2001, during faunal rescue activities for Hidroeletric Usine of Santa Clara (UHE Santa Clara - 17°53'S, 40°11'W). This locality is an extension of the geographic distribution of this species and the first occurrence in the Mucuri River Basin. When collected, the specimen exhibited a defensive position similar to that of *Physalaemus nattereri*. The first stage consisted of inflating the lungs, followed by lowering of the back and suspending the posterior region of the body. During this display, the forelegs remained close to the body. This posture makes it difficult for capture by predators and allows the individual to use its head or legs for defense (Sazima and Caramaschi 1986, *op cit.*). The individual remained in this position for only a few seconds. When again threatened, the individual abandoned the deimatic behavior and fled, seeking shelter. This species lacks well-developed and conspicuous inguinal glands. Glandular secretions were not observed. This behavior has also been observed in *Physalaemus fuscomaculatus* and *P. deimaticus*, although its functional significance is not well understood. A voucher specimen is deposited in the Reference Herpetologics Collection of the Pontifícia Universidade Católica de Minas Gerais (MCNAM 2636).

I thank the Companhia Energética Santa Clara for financial support, the Instituto Brasileiro de Meio Ambiente e dos Recursos Naturais Renováveis for collecting permits, Msc. Conrado A. B. Galdino for help, and Dr. Renato N. Feio for suggestions and comments on this manuscript.

Submitted by **RONALD REZENDE DE CARVALHO JÚNIOR**, Museu de Ciências Naturais, PUC.Minas, Cx.P. 1686, CEP 30535-610, Belo Horizonte, MG, Brazil; e-mail: rcjunior.bh@terra.com.br.

MERTENSIELLA LUSCHANI (Luschan's Salamander). **ENDOPARASITES.** *Mertensiella luschani* is a salamandrid that is known from the mountains of southeastern Anatolia, Turkey, and the Aegean islands of Karpathos, Saria, and Kasos (Frost [ed.] 1985. Amphibian Species of the World: A Taxonomic and Geographical Reference. Published as a joint Venture of Allen Press, Inc. and The Association of Systematics Collections, Lawrence, Kansas. 732 pp.). To our knowledge, there are no reports of helminths from *M. luschani.* The purpose of this note is to report two species of Nematoda from *M. luschani.*

Fifty *M. luschani* (mean SVL 141 mm ± 22 SD, range: 85–175 mm) were collected August 1997 and April 2001 in Antalya, Turkey (36°52'N, 30°45'E, elev. 150 m). Salamanders were preserved in 10% formalin and stored in 70% ethanol. The esophagus, stomach, and small and large intestines were opened and separately examined for helminths under a dissecting microscope. Nematodes were cleared in a drop of concentrated glycerol and studied as a temporary wet-mount under a compound microscope. Two species of Nematoda were identified: *Angiostoma aspersae* (from the small intestine) and *Cosmocerca longicauda* (from the large intestine). Prevalence (number of infected salamanders/salamander sample x 100) and mean intensity (mean number helminths per infected salamander ± 1 SD and range) were: *A. aspersae* (34%, 1.3 ± 0.77 SD, range: 1–4); *C. longicauda* (3.0 ± 2.0 SD, range: 1–7). Selected nematodes were deposited in the United States National Parasite Collection, Beltsville, Maryland as *A. asperase* (USNM 94459) and *C. longicauda* (USNM 94460). Voucher salamander specimens were deposited at Uludag University, Department of Biology, Bursa, Turkey.

Angiostoma aspersae was originally described from specimens taken from the snail *Helix aspersa* collected in France (Morand 1986. Bull. Mus. Nat. Hist. Nat, Paris, 4e sér., A 11:111–115). *Mertensiella luschani* is the first salamander species reported to harbor *A. aspersae*; but more work is necessary to determine if this nematode directly infects salamanders or is only a byproduct of diet. *Cosmocerca longicauda* has previously been reported from other European salamandrids: *Triturus alpestris, T. cristatus, T. helveticus, T. montandoni, T. vulgaris* (Baker 1987. Mem. Univ. Newfoundland, Occas. Pap. Biol. 11:1–325). It is apparently palearctic in distribution. *Angiostoma aspersae* and *Cosmocerca longicauda* in *M. luschari* are new host records; Turkey is a new locality record.

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PHYSALAEMUS BILIGONIGERUS (False-eyed Frog). **ENDOPORASITES.** Here we present data on helminths infecting *Physalaemus biligonigerus*. The study was carried out in a soybean cropland of the middle region of Argentina (31º14'46"S, 63º33'8"W, Córdoba Province) during December 2002 to March

2003. We collected 19 adult *P. biligonigerus* (7 males and 12 females; SVL 35–36 mm ± 1.96 mm).

All frogs were infected by helminths. The number of helminth species per individual host varied from 1–3 (most frequently three) and was not related to frog size (SVL, r = 0.22; p = 0.85). Three helminth species were recovered: one acanthocephalan, *Acantocephalus lutzi*, and two nematodes, *Rhabdias* sp., and *Physaloptera* sp. (found only as larvae cysts). Voucher specimens were deposited at the Faculty of Biochemistry and Biological Sciences Parasite Collection (FBCBPC 1000-3). Data on prevalence and infection intensities (*sensu* Bush et al. 1997. J. Parasitol. 83:575–583) for each helminth species and their respective sites of infection are given in Table 1. *Physalaemus biligonigerus* represents a new host record for *Acanthocephalus lutzi* and for the genera *Physaloptera* and *Rhabdias*.

Although the sample size is small, our data suggest that the population of *P. biligonigerus* that inhabited soybean cropland has a relatively high frequency of helminth infection, with the nematode *Physaloptera* being most prevalent. Stress, in the form of pesticide exposure, may decrease the host amphibians' ability to resist infection, resulting in higher parasite loads (Kiesecker 2002. Proc. Natl. Acad. Sci. 99:9901–9904). Despite the risk, anuran populations in the midwestern Córdoba Province coexist with soybean crops that are the dominant land use in this region. In addition, these anurans are exposed to pesticides used to protect these crops. Further studies are necessary to confirm the relationship between pesticide exposure and parasite infection.

We thank Graciela Navore and Mónika Hamann for suggestions.

TABLE 1. Prevalence (in percentage and absolute values) and intensity of infection (mean ± standard deviation, with range in parentheses) of helminths found in *Physalaemus biligonigerus* (N = 19).

	Helminth Prevalence	Mean intensity (range)	Site of infection
Acanthocephala			
Acanthocephalus lutzi	26.32% (5)	5 ± 3.5 (2–10)	Intestines
Nematoda			
Rhabdias sp	36.84% (7)	5 ± 3.8 (2–13)	Lungs
Physaloptera sp. (larvae)	84.21% (16)	28.7 ± 17.6 (3–50)	Stomach, cysts

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RANA BOYLII (Foothill Yellow-legged Frog). **PREDATION**. Introduced aquatic predators are known to negatively effect amphibian populations both directly and indirectly (Kats and Ferrer. 2003. Diversity and Distributions 9:99–110). The Signal Crayfish (*Pacifastacus leniusculus*) is native to the Pacific Northwest and has been introduced into numerous Sierra Nevada drainages which are currently populated by *R. boylii* including the Pit, Stanislaus, South Fork Trinity (Jamie Bettaso, pers. comm.), and the North Fork Feather rivers. Failed recruitment at several *R. boylii* breeding sites on the Pit River led to speculation about possible negative impacts of the signal crayfish on *Rana boylii* populations (Pacific Gas and Electric Company, unpubl. data).

In conjunction with visual encounter surveys on the regulated Cresta Reach of the North Fork Feather River (Butte Co., California), we installed an Aqua Vu® underwater video camera system to monitor *R. boylii* egg masses and tadpole groups.

Analysis of over 92 hours of videotape revealed several predation events upon a *R. boylii* egg mass. On 23 June 2003 at 1819 h an adult *P. leniusculus* was observed feeding on a *R. boylii* egg mass (depth 21 cm; water temp 16°C; distance from shore 80 cm; 0636000 N, 4410200 E; NAD 27, Zone 10; 427 m elev.). During this observation the crayfish exhibited defensive behavior when another adult crayfish approached and appeared to initiate feeding, and was successfully driven off. Periodic feeding continued by the defending crayfish (entire event lasted 19.2 minutes; video verified by L. Kats), and recently hatched larvae were observed fleeing the egg mass during feeding. *Pacifasticus leniusculus* was commonly observed near egg masses and tadpole groups during video monitoring in both diurnal and nocturnal conditions.

During visual encounter surveys, we noted at least three observations of larvae with tail injuries suggestive of predation attempts by crayfish (injuries resembled clean, scissors-like cuts). Larval tail injuries have also been noted by other biologists working on the Poe Reach of the North Fork Feather River (A. Pool, pers. comm.). These observations are consistent with studies showing that Signal Crayfish are adept at consuming anuran larvae using their claws and walking legs, with unsuccessful prey handling resulting in tail loss (Axelsson et al. 1997. Amphibia-Reptilia 18:217–228). Our observations of Signal Crayfish depredating and molesting *R. boylii* egg masses suggest that they might also contribute to the dislodging of egg masses, leaving them vulnerable to further losses associated with river flow fluctuations.

We also observed a predation attempt upon a *R. boylii* larva. On 27 June 2003 at 2059 h an undetermined species of young-of-the-year fish (ca. cyprinid) attempted to consume a recently-hatched *R. boylii* larva (depth 18 cm; water temp. ca. 14°C; distance from shore 160 cm; 0636281 N, 4411255 E; NAD 27, Zone 10; 427 m elev.). The outcome of this observation remains uncertain because of low light conditions and unclear movements of the larva after the fish captured it in its mouth. During this observation other young-of-the-year fish were observed pecking the substrate in the area where several hundred recently-hatched *R. boylii* larvae were located.

Studies conducted in Europe showed that the presence of exotic *P. leniusculus* caused tail injuries, decreased metamporph size and survivorship of *Rana temporaria* (Nyström et al. 2001. Ecology 82:1023–1039). Recent work conducted in the Sierra Nevada has demonstrated that *P. leniusculus* is more likely to be found in close

proximity to reservoirs and in regulated vs. unregulated systems (Light 2003. Freshwater Biol. 48:1886–1897). Preliminary analysis of 328 historical *R. boylii* localities within the entire range shows that 90 (27.4%) of the localities have a dam of any size upstream and 67 (20.4%) have at least one large dam (>15 m high) upstream (A. Lind, unpubl. data). These data suggests that a significant proportion of *R. boylii* populations may be vulnerable to impacts caused by introduced Signal Crayfish. Recent observations by Rombough and Hayes (2005. Herpetol. Rev. 36:163–164) describe Signal Crayfish preying upon the embryos of *R. boylii* within the natural range of the crayfish. This indicates that historically, northern populations of this frog have had some experience with crayfish predators.

Further studies should address: 1) other possible indirect effects of *P. leniusculus* on *R. boylii* populations such as changes in larval behavior, development, and survivorship, 2) the extent of Signal Crayfish distribution within the range of *R. boylii*.

A condensed version of the video clip can be viewed at: http://www.garciaandassociates.com/sanfran.htm. We thank Pacific Gas and Electric Company biologists A. Pool, C. Seltenrich, W. Roberts, C. Herrala, and M. Carbiener for helpful advice and assistance under the FERC 1962 project; J. Minton for assistance with field work and camera system configuration; L. Kats for review of video; A. Lind for helpful advice and information.

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RANA BOYLII (Foothill Yellow-legged Frog). **PREDATION: EGGS AND HATCHLINGS**. Direct observations of predation on eggs and embryos of North American ranid frogs exist (Chivers et al. 2003. Oikos 92:135–142; Evenden 1948. Copeia 1948:219–220; Rathbun 1998. Herpetol. Rev. 29:165; Saenz et al. 2003. Copeia 2003:646–649), but the typical brevity of such events often results in inferring their occurrence (e.g., Howard 1978. Ecology 59:789–798; Van Wagner 1996. Selected Life History and Ecological Aspects of a Population of Foothill Yellow-legged Frogs (*Rana boylii*) from Clear Creek, Nevada City, California. MSc Thesis, California State University, Chico, California. 143 pp.). Further, smaller size and poorly developed predator-evasion ability make hatchling ranid frog larvae vulnerable to a larger predator set than older larvae (Licht, *op. cit.*). Despite this larger array of predators, hatchling mortality, like egg mortality, is also often inferred, typically from a rapid decline in numbers during the immediate post-hatching period (e.g., Calef 1973. Ecology 54:741–758; Licht 1974. Can. J. Zool. 52:613–627). Such data underscore the belief that aquatic larvae sustain the greatest mortality among ranid frog life stages (e.g., Calef, *op. cit.*; Cecil and Just 1979. Copeia 1979:447–453; Herreid and Kinney 1966. Ecology 47:1039–1040; Licht, *op. cit.*). For these reasons, we provide direct observations of predation on both the eggs and hatchling larvae of *Rana boylii* from Oregon, USA.

During a survey of *R. boylii* oviposition sites during 16–30 May 1997, one of us (MPH) made observations of egg predation at two different sites along the South Umpqua River east of Tiller (Douglas Co., Oregon). At the first site, 9 *R. boylii* egg masses were located on a bedrock shelf in shallow (< 25 cm) water, and were attached to both the downstream side of cobbles or boulders (N = 6) and to the margin of a flow-protected bedrock crease (N = 3). Flow velocities adjacent to egg masses were 0.5–0.8 m/sec. An adult (ca. 100–110 mm TL) Signal Crayfish (*Pacifastacus leniusculus*), native regionally, was seen next to each of two of these egg masses. At one egg mass, MPH observed a crayfish use its mouthparts and anterior walking legs to manipulate a 3-cm lobe of the egg mass gently oscillating in the current about 4 cm above the substrate. Over a 10-min interval, the crayfish removed and ate three embryos (ca. Gosner Stage 11) before being attracted to detritus drifting nearby. Examination of the area where the crayfish had fed revealed five torn egg capsules, four with missing embryos and one with a 1-mm fragment of an embryo. A second adult crayfish was first observed moving over the substrate near one of the egg masses in the bedrock crease. When the crayfish, approaching from downstream, got within 10 cm of the mass, it changed direction, moved directly to the egg mass and began to pull at an elongate, partly torn lobe. In less than a minute, the crayfish had torn off a piece of the lobe containing 15–20 eggs and retreated into the bedrock crease, where it continued to pick at and tear the jelly with its walking legs. Six embryos were seen removed from the jelly over a 20-min period before observations were discontinued. Although most was discarded, the crayfish also consumed some capsular jelly. At the second site, five *R. boylii* egg masses were seen attached to bedrock near the base of a 0.5-m cascade; flow velocities near the egg masses were 0.7–1.1 m/sec. During examination of these masses, MPH observed another crayfish move upwards through a 3–4 cm crease in the bedrock partly covered by two of the egg masses, both with embryos in tail bud stage (Gosner Stage 17). The crayfish moved into a semi-concealed position between the egg masses and proceeded to pull at the jelly of the lower mass with its anterior walking legs. During 35 min of observation, the crayfish opened eight capsules, successfully extracting seven embryos, and was still picking at the jelly when observations were discontinued.

In the course of a study of *R. boylii* during 2000–2003, CJR made a series of observations along the South Santiam River, 10 km E of Sweet Home (Linn Co. Oregon; 44°25'N, 122°34'W; elev. 192 m). Site geology is distinctive; erodable conglomerates within hard competent tuffs result in a relatively flat bedrock surface scoured bare of almost all loose rock < 0.5 m in diameter and within which exists a series of troughs and scour pools holding mostly smaller cobble and gravel. All observations occurred during the interval after oviposition (June–early July), when river width is 100–120 m and water depth at marginally located oviposition sites is ca. 30 cm.

On 27 June 2000, a 30-mm (total length) pebble-case caddisfly larva (*Dicosmoecus gilvipes*) was observed crawling on the surface of a *R. boylii* mass (Gosner stage 14). The caddisfly was seen to grasp each capsule with its legs, turn it over and repeatedly probe into the jelly with its mandibles. During this manipulation of at least four different eggs, CJR saw the larva thrust its mandibles through the jelly, reach the embryo, and chew it for a few seconds before withdrawing its head from the capsule. The caddisfly larva reached four embryos, but it ate less than one-third of the most-chewed embryo during 5 min of observation. On 4

June 2003, a similar-sized *D. gilvipes* larva was observed burrowing through the jelly of a *R. boylii* egg mass (Gosner Stage 11) using its legs and mandibles. In contrast to the aforementioned larva, this larva chewed a path directly toward an embryo. On reaching the embryo, it consumed the embryo entirely, leaving an empty capsule and then moved to another egg. In ca. 5 min, the *D. gilvipes* larva had eaten at least three embryos. On seven other occasions, similar-sized *D. gilvipes* larvae were seen probing the surface of *R. boylii* egg masses with their mandibles; in one instance, a larva was observed with a *Rana boylii* egg mass fragment containing 50 embryos attached to its pebble case.

During 8 min of observation on 11 July 2000, seven (five ca. 60 mm fork length (FL) and two ca. 20 mm FL) Speckled Dace (*Rhinichthys osculus*) and one Reticulate Sculpin (*Cottus perplexus*; ca. 60 mm FL) were observed picking *R. boylii* hatchlings (Gosner Stage 20) from the surface of an egg mass and nearby cobble substrate. The mass, in a 30-cm deep pool with low flow (< 1 m/sec), had an indirect connection (> 20 cm depth) to the river. The larger fish typically swallowed *R. boylii* hatchlings whole, one plucking several larvae from within the jelly, but the two smaller dace only picked at the hatchlings. On the same date, ca. 50 m upstream, CJR observed another mixed-species group of 15 cyprinid fishes (including dace, Northern Pikeminnow [*Ptychocheilus oregonensis*], and Redside Shiner [*Richardsonius balteatus*]), all ca. 60 mm FL, capturing hatchling *R. boylii* (Gosner Stage 22) larvae in a similar manner around three egg masses in a shallow (ca. 8 cm deep) pool with a ca. 10 cm deep connection to the river. A school of > 100 smaller (10–15 mm FL) cyprinid fry were also in the pool, but were not seen attempting to prey on *R. boylii* larvae.

On 6 June 2003, CJR observed five (40 mm FL) dace and a sculpin (80 mm FL) feeding on the eggs and jelly of a recently laid (Gosner Stage 4) *R. boylii* egg mass in water 19 cm deep. Predatory behavior was similar to the previous accounts, except that both the dace and sculpin picked off and consumed bits of jelly in addition to eating any embryos that became exposed. Several embryos and some of the surrounding jelly were eaten in this manner over 4 min of observation.

On 12 June 2003, CJR observed a mixed-species school of about 60 (30–50 mm FL) cyprinid fishes (mostly dace, but also Northern Pikeminnow and Redside Shiner) feeding on the aging jelly of an *R. boylii* egg mass and its (Gosner Stage 20) hatchling larvae. The ca. 20 cm deep pool in which this egg mass was located was almost completely disconnected from the active channel. Many larvae had emerged from the mass; these larvae both clung to the sides of the mass and settled into interstitial spaces in the surrounding cobble, from which the fish were picking them. At least 10 *R. boylii* hatchlings were consumed during 10 min of observation.

In addition to these observations of predation, all four fish species described herein were documented in *R. boylii* oviposition pools on > 11 other occasions (at least one of which involved direct predation of *R. boylii* embryos) when *R. boylii* egg masses were present.

Previous to our observations, the only published report of unambiguous predation on eggs of *R. boylii* is that of Evenden (*op. cit.*), who removed eggs from the stomachs of some of 35 Rough-skinned Newts, *Taricha* [as *Triturus*] *granulosa*, from the South Santiam River (Oregon). Wiseman et al. (2005. Herpetol. Rev. 36:162–163) also documented Signal Crayfish predation of *R. boylii* eggs from within the introduced range of this crayfish in northern California. In contrast, no previous reports of hatchling predation exist.

Oregon Department of Fish and Wildlife provided funding for CJR, and the US Forest Service provided logistic support for CJR and funding for MPH; this work represents a contribution from the Science Division of the Habitat Program of the Washington Department of Fish and Wildlife. Permits to handle *R. boylii* were issued by the Oregon Department of Fish and Wildlife.

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RANA BOYLII **(Foothill Yellow-legged Frog). PHYSIOLOGICAL SKIN COLOR TRANSFORMATION.** Color change as well as lightening and darkening of skin tones have been documented in several anurans (King et al. 1994. Copeia 1994:422–432; King and King 1991. Can. J. Zool. 69:1963–1968). Nussbaum et al. (1983. Amphibians and Reptiles of the Pacific Northwest. Univ. Idaho Press, Moscow, Idaho. 332 pp.) reported that individual *Rana boylii* are capable of lightening and darkening, however, we are unaware of any detailed documentation of this phenomenon in this species. The anuran dermis layer contains three types of chromatophores that may be responsible for pigment change: iridophores, xanthophores, and melanophores. Melanophores are the pigment cells responsible for lightening and darkening of the skin. This skin tone change is the most common color transformation documented in anurans. Here we report a field observation of skin color transformation in *R. boylii*. *Rana boylii* is a stream-breeding frog that reputedly dwells almost exclusively along running waters where it is associated with both in-stream and stream margin habitats. However, we often find frogs on adjacent uplands such as gravel bars and moist vegetated areas within the floodplain (unpubl. data). *Rana boylii* are heliotherms that thermoregulate by basking on heated surfaces such as sun-warmed rocks. On 16 Oct 2003 at ca 1040 h during a survey on Hurdygurdy Creek, Del Norte County, California, USA, we captured an adult female *R. boylii* (52 mm SUL) on an upland floodplain area 5.5 m from the wetted edge. The primary substrate was cobble and recent rains had produced a newly fallen moist leaf litter layer. The frog was found sitting in a shady spot on top of yellowish leaf litter. We measured, weighed, and pit-tagged the frog and took a photo of the ventral side of the frog's chin (Fig. 1). We have been routinely collecting photos of frog chins to determine if the mottling patterns on their chins can be used to identify individual frogs. In addition, we took a full body photo because this frog had a very distinct, nearly white, pale tan color (Fig. 1). *Rana boylii* dorsal skin coloration can be highly variable (light gray, olive green, brown, brick red); however, of 196 captured and marked adult frogs (>40 mm SUL) at our study site over the last two years, this particular frog was noticeably lighter in color than any other we

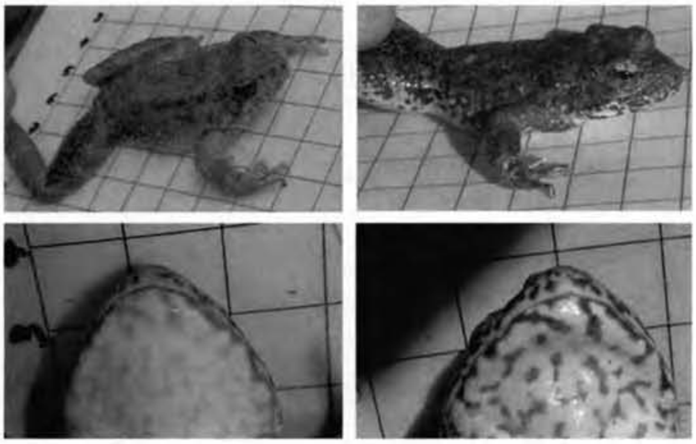

FIG. 1. Dorsal body and ventral side chin photos of the captured *Rana boylii*. Photos in the left column were taken at initial capture (1040 h). Photos in the right column were taken at second capture (1300 h).

have captured. Her chin mottling was very faded as well.

At ca. 1300 h when returning from the completed survey we captured an adult female frog ca 2.5 m from the location of the previously mentioned frog. The frog was sitting in a shallow silt-bottomed puddle surrounded by dark colored cobbles on the same upland floodplain area. Because this frog was nearly black in color, we initially assumed it to be a new capture. Upon closer inspection, the frog was newly pit-tagged and upon reading the pit-tag we discovered it was the same frog captured earlier in the survey. We immediately re-photographed her full body and chin (Fig. 1), and took additional photos 15 min and 1.5 h later when both body color and chin mottling color were subsequently paler, although not as pale as the initial capture. Our observations indicate that *Rana boylii* can undergo relatively rapid color transformations, changing from light to dark shades and back to light shades. The cue that prompts this color darkening and lightening and the function of the change is unknown. Because of the numerous variables between captures of this individual (background substrate, photoperiod, temperature, time since disturbance), we cannot speculate on the stimuli or the function of the observed changes.

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RANA CASCADAE (Cascades Frog). **PREDATION.** Many potential predators of *Rana cascadae* have been reported, however no studies have actually documented predation by the garter snakes, *Thamnophis atratus* and *T. sirtalis*. During a radio telemetry study of *R. cascadae* within the Trinity Alps Wilderness, Trinity County, California, USA, we confirmed predation on three adult *R. cascadae* and suspect another by these garter snakes.

On 23 June 2003 we palped a radio-tagged adult male *R. cascadae* (22.5 g, 58 mm SUL) that had been tracked for the previous 3 days from an adult *T. atratus* (850 mm TL). On 12 Aug 2003 we palped a radio-tagged adult female *R. cascadae* (30.7 g, 71 mm SUL) that had been tracked for the previous 26 days from an adult *T. sirtalis* (720 mm TL). On 25 Aug 2003 we palped a radio-tagged adult female *R. cascadae* (24.5 g, 61 mm SUL) that had been tracked for the previous three days from an adult *T. sirtalis* (700 mm TL). From 1–5 Sept 2003, out of five tracking attempts, we could not visually locate a radio-tagged female *R. cascadae* (22.3 g, 58.9 mm SUL) that had been tracked for the previous 25 days. Strong signals were coming from terrestrial bank burrows ca. 2 m from water. Subsequently, on 07 Sept 2003 we found the transmitter along with its attachment ribbon, both were coated with a slimy film. It is likely this individual was also eaten by an adult *Thamnophis* sp. All three confirmed predation events occurred near lentic water bodies, where *R. cascadae* reproduction was documented in 2003 (J. Garwood, unpubl. data). On 23 Sept 2003 we observed an adult *T. sirtalis* capturing and eating *R. cascadae* tadpoles by herding groups of them into small shallow alcoves of a pond. On 13 Oct 2003 we observed a subadult *T. sirtalis* (ca. 450 mm TL) probing its head into cracked mud interstitial areas at a dry pond. The interstitials within the mud contained hundreds of recently metamorphosed *R. cascadae* and *Hyla regilla* taking refuge. We observed one predation event of a post-metamorphic *R. cascadae* by this snake.

These observations of predation document that *T. atratus* and *T. sirtalis* prey on larval, metamorph, and adult *R. cascadae*. These snakes were seen regularly during our telemetry study and we suspect they are a major predator of *R. cascadae*.

We thank Clara Wheeler, Ryan Bourque, and Terra Fuller for field assistance.

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SCAPHIOPUS COUCHII (Couch's Spadefoot). **ENDOPARASITES.** Previous reports of endoparasites in *S. couchii* are the monogenean *Pseudodiplorchis americanus* (Tinsley and Earle 1983. Parasitology 86:501–517), the cestode *Distoichometra bufonis* and the nematodes *Aplectana incerta, A. itzocanensis*, and *Oswaldocruzia pipiens* (Goldberg and Bursey 1991. J. Helminthol. Soc. Washington 58:142–146; Tinsley 1990. Am. Zool. 30:313–324), all reported from Arizona. The purpose of this note is to report a new host record and new locality records for helminths in *S. couchii*.

Fourteen *S. couchii* (mean SVL 44.6 mm ± 12.2 SD, range: 27–60 mm) were collected from Cochise County, Arizona in 1972 (N = 10) or Pima County, Arizona in 1971 (N = 4). Eight *S. couchii* (SVL 50.3 mm ± 11.4 SD, range: 28–64 mm) were collected in Hidalgo County, New Mexico in 1972. Spadefoots were deposited in the Museum of Zoology, University of Michigan, Ann Arbor as UMMZ 230124–230137 (Arizona) and UMMZ 230138–230145 (New Mexico). The esophagus, stomach, small and large intestines, lungs, and urinary bladder were opened and separately examined for helminths under a dissecting microscope. The body cavity was also examined for helminths. Monogeneans and cestodes were regressively stained in hematoxylin and studied as

whole-mounts; nematodes were cleared in a drop of concentrated glycerol and studied as wet mounts.

Found from Arizona were one species of Monogenea *P. americanus* (urinary bladder) (prevalence: number infected spadefoots/sample examined x 100 = 7%, mean intensity ± 1 SD: mean number helminths per infected spadefoot and range = 1.0), two species of Cestoda *D. bufonis* (prevalence 29%, mean intensity 6.3 ± 5.0, 1–11) and *Nematotaenia dispar* (both small intestines; prevalence 14%, mean intensity 12.0 ± 5.7, 8–16) and two species of Nematoda *A. incerta* (prevalence 36%, mean intensity 100.8 ± 122.4, 2–305) and *A. itzocanensis* (prevalence 14%, mean intensity 46.5 ± 62.9, 2–91; both large intestines). Found from New Mexico were *P. americanus* (prevalence 38%, mean intensity 1.0) and *A. incerta* (prevalence 38%, mean intensity 62.0 ± 48.3, 23–116). Helminths were deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland as: Arizona, *Aplectana incerta* (94447), *A. itzocanensis* (94448), *Distoichometra bufonis* (94445), *Nematotaenia dispar* (94446), *Pseudodiplorchis americanus* (94444); New Mexico, *A. incerta* (94451), *P. americanus* (94449–50).

Kuntz (1941. Proc. Oklahoma Acad. Sci.21:33–34) reported two species of cestodes from *S. couchii* but did not designate which species they were. *Nematotaenia dispar* is a new host record for *S. couchii;* New Mexico is a new locality record. *Pseudodiplorchis americanus* from New Mexico is a new locality record.

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TESTUDINES

CARETTA CARETTA (Loggerhead Seaturtle). **PREDATION.** Documenting predation on hatchling seaturtles is important for population demographers when developing research and conservation strategies. Hatchling predation by crabs, raccoons, and other terrestrial species are well known. Unfortunately, most marine predators are seldom identified to species and are lumped into groups such as sharks and fish (Stancyk 1995. Biology and Conservation of Sea Turtles. Smithsonian Institution Press, pp. 139–152). Establishing the identity of fish species that consume *Caretta caretta* hatchlings off the southeastern coast of the United States is difficult because the turtles emerge and enter the surf at night, and determining the magnitude of the nocturnal predation is even more challenging. Stewart and Wyneken (2004. Bull. Mar. Sci. 74:325–335) produced the first study to address nearshore hatchling predation in the southeastern U.S. They reported tarpon (*Megalops atlanticus*) and catfish (*Arius felis*) as the major identified nearshore predators of hatchling Loggerheads (four each) at Juno Beach, Florida, as well as several unknown predators.

On 20 July 1998, a fishery observer aboard a shark gillnet boat 22.2 km NE of Cape Canaveral, Florida took photos of a crew member cleaning the catch of Atlantic Sharpnose Sharks (*Rhizoprionodon terraenovae*). The observer noted that several hatchling Loggerhead Seaturtles had been recently consumed in the three shark stomachs cut open. The three sharks had two hatchlings each. Unfortunately, because of the large number of sharks on board, no more stomachs were cut open because the sharks were being processed for market. These are small (< 80 cm), abundant sharks and frequently school near the Loggerhead nesting beaches in summer months (Dodrill 1977. Ph.D. dissertation. Florida Inst. Technol., Melbourne. 304 pp.). These sharks also occur further offshore near the edge of the Gulf Stream, where surface downwelling and strong northerly currents concentrate hatchling turtles in lines of *Sargassum* weed (Witherington 2002. Mar. Biol. 140:843–853). Earlier, Witham (1974. Copeia 1974:548) reported eight hatchling Loggerhead Seaturtles and one Green Seaturtle (*Chelonia mydas*) from the stomach of a dolphin fish (*Coryphaena hippurus*) captured near a patch of floating *Sargassum* weed 19 km E of the nesting beach at St. Lucie Inlet.

Stewart and Wyneken (*op. cit.*) felt that the nearshore predation rate was probably higher than the offshore predation rate because the predators are (hypothetically) concentrated on the reef line. However, the hatchlings are only subjected to a short period (ca. 15 min) of exposure as they move from the beach to deeper water at night. It is possible, however, that the predation rate in deeper water may be significantly higher than the nearshore predation rate because the *Sargassum* weed lines concentrate hatchlings into a narrow nektonic buffet for dolphin fish and sharpnose sharks for months.

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GLYPTEMYS INSCULPTA (Wood Turtle). **JUVENILE MOVEMENTS AND HOME RANGE.** Here we report movements and home ranges of two juvenile *Glyptemys insculpta* in southern New Hampshire, including the longest-distance movements from streams reported for the species. Thirty-six juveniles (lacking secondary sexual characteristics as described by Harding and Bloomer [1979. Bull. New York Herpetol. Soc. 15:9–26]) were hand-captured and marked by marginal scute notching; age estimates were determined by counting growth annuli on the right abdominal scute. Age-0 hatchlings (N = 54) that emerged during the study period were not included as juveniles. Two juveniles, one from each of two convergent streams (Stream A, Stream B), were fitted with 18-g radio transmitters and located throughout the active season every other day from 8 April 1993 to 30 May 1994 (N = 66, N = 77 recaptures per turtle). Methods used for determining home ranges follow Tuttle and Carroll (2003. Chelonian Cons. Biol. 4:656–663).

An additional 34 juveniles (mean CL = 96.9 ± 34.4, range = 34.9–154.7 mm; mean number of annuli = 5.9 ± 3.8, range = 1–15; measurements are ± 1 SD) captured that were not affixed with radio transmitters were found either in a stream (N = 5) or within 70 m of a stream (mean = 15.7 ± 23.4 m, N = 29). Among younger age classes, first-year juveniles hatched in 1992 (N = 6) were found within 1.8 m of the water in dense vegetation bordering a stream; all 2-yr-old juveniles (N = 4) were found within 10 m of a stream.

Radio-tagged Juvenile #1 (CL = 143 mm, mass = 490 g, annuli = 11) occupied a small home range (0.7 ha, as calculated by the convex polygon method) in an area that included Stream B and the sloping edge of a hayfield that was located 60 m from the stream and that was separated from the stream by alder swamp

habitat and a dirt road. The juvenile traveled back and forth between the hayfield bank and the stream throughout the active season. Usually the turtle was found in dense grass cover or cryptically basking on top of the flattened grass where the height of the surrounding vegetation provided the turtle with cover. This juvenile entered hibernation on 4 October in water ca. 0.6 m in deep, within a few meters of its capture location on the stream bottom on 8 April.

Radio-tagged Juvenile #2 (CL = 122 mm, mass = 280 g, annuli = 8) had a convex polygon home range size of 27.6 h, which was comparable to the mean size of adult male home ranges (23.9 ha) in this population (Tuttle and Carroll 2003, *op. cit.*). Until 4 July, the turtle remained in or near Stream A most of the time, although it traveled long distances in the stream. Twice it was found on the edge of a hayfield ca. 150 m from water. By 9 July, Juvenile #2 had moved 0.5 km from the stream to its terrestrial summer range located in upland mixed forest where it was most often found hidden in piles of slash or dense successional vegetation at a crossroads of previously-used logging trails. During this period the turtle traveled as far as 865 m from the stream. Although Juvenile #2 returned to Stream A on 29 August, it did not enter hibernation until 19 October.

There was a 39-fold difference in convex polygon-calculated home range size between the two juveniles. Stream A was bordered by a large expanse of upland forest with a sparsely vegetated herbaceous layer. Suitable summer habitat that included disturbed areas near logging road junctions were located at much longer distances from Stream A. Conversely, Juvenile #1 had sufficient cover located within close proximity of Stream B. In contrast to Stream A, Stream B was bordered by 75% more alder swamp habitat containing rich organic soils where adult Wood Turtles were observed to forage for earthworms. Home ranges for adults along Stream B were generally smaller and more linear in shape, with the turtles remaining closer to the stream (Tuttle and Carroll 2003, *op. cit.*). Home ranges of telemetered juveniles from each of the two streams in our study fit a similar spatial pattern.

These data show that juvenile *G. insculpta* can occupy home ranges as large as 27.6 ha and use summer habitat as far as 865 m from a stream. Our results augment previously recorded movements and home range observations of *G. insculpta* and indicate that potentially long terrestrial movements and access to cover should be considered when planning conservation and management strategies for this species.

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GLYPTEMYS (CLEMMYS) MUHLENBERGII (Bog Turtle). **PREDATION.** On 27 April 1986, during a study of a population of *Glyptemys muhlenbergii* in Sussex County New Jersey, USA, a predated and empty shell of *G. muhlenbergii* was located. On 23 September 1986 three additional predated, and empty, *G. muhlenbergii* shells were located, and one of the Common Snapping Turtle, *Chelydra serpentina*; all appeared to be fresh kills. Descriptions of the chelonians follow: *G. muhlenbergii*: 11 year old female SCL = 83 mm, plastron intact, head and limbs missing, heavy chew marks on anterior portion of carapace and plastron; 9-year old female SCL = 87 mm, plastron intact, head and limbs missing; 12-year old female SCL = 78 mm, plastron intact, head and limbs missing; 4-year old female SCL = 58 mm cracked carapace only, plastron missing. *Chelydra s. serpentina*: SCL = 71mm carapace only, plastron missing.

The four *G. muhlenbergii* represented 13.8% of the known population at that time. The habitat consists of a two hectare cow pasture crossed by intermittent small streams. All shells were located on the edges of these streams within one meter of waters edge. The predators had located the chelonians by rolling back mats of *Sphagnum* sp. and leaving the chelonians exposed. Numerous tracks of the Raccoon, *Procyon lotor*, were observed around each of the predated shells. The tracks were followed back to a brush pile, measuring seven meters in diameter and three meters high, of cut saplings of Red Maple, *Acer rubrum*, and Alder, *Alnus* sp., that the farmer had cut from the wetland and piled prior to removal from the area. Inspection of the brush pile located two sub-adult Raccoons, which were suspected to be the predators of the chelonians. This report should warn land managers and habitat rehabilitators against piling cuttings of cleared debris, even temporarily, which might create shelter for potential predators.

All shells have been deposited in the New Jersey State Museum: accession number MH2003.20. This study was performed under permit from The State of New Jersey dated 31 March 1986.

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KINOSTERNON SONORIENSE (Sonoran Mud Turtle). **DIET**. Hulse (1974. J. Herpetol. 8:195–199) concluded from an examination of stomach contents that *Kinosternon sonoriense* was an opportunistic carnivore that fed mainly on invertebrates, though plants, fish, and ranid frogs were occasionally eaten. Ligon and Stone (2003. Herpetol. Rev. 34:241–242) reported two observations of *K. sonoriense* feeding on adult *Bufo punctatus*. Here, we add a reptile and a bird to the list of dietary items consumed by *K. sonoriense*. Both observations were made in small pools in the Peloncillo Mountains, Hidalgo Co., New Mexico (USA), in the same canyon as the observations reported by Ligon and Stone (*op. cit.*).

On 7 August 2004, at ca. 1000 h, we observed an adult female *K. sonoriense* (101.7 mm midline carapace length [MCL], 151 g) capture and kill a Black-necked Gartersnake (*Thamnophis cyrtopsis*, 348 mm SVL, 23.3 g). The observation began when we noticed splashing in a pool (ca. 12 m^2 area, ca. 10 cm deep) beside the trail. When first observed, the turtle's jaws held the snake by the neck, ca. 10 cm behind the snake's head. During the first 10 sec. of the encounter, the snake attempted to bite the turtle on the carapace at least twice. Within two minutes, the snake was dead and the turtle was eating the snake. At this point the turtle seemed to notice us and released the snake, moving away from us, toward the edge of the pool. We then captured and measured the turtle and collected the snake. The skin had been stripped off the dead snake from the point where the turtle had grasped the snake forward to the head, and there was a large piece of neck muscle missing. We released the turtle and deposited the snake in the Univer-

sity of Central Oklahoma Collection of Vertebrates (UCO 1001).

On 10 August 2004, at ca. 1800 h, we encountered an adult male *K. sonoriense* (114.5 mm MCL, 169 g) in a small pool (ca. 1 m^2 area, ca. 15 cm deep) with a dead Mockingbird (*Mimus polyglottos*). The intact, feathered head and wings of the bird were floating on the water surface. Below the water surface was the bird's skeleton, which had been picked nearly clean of soft tissue. The turtle had bird flesh on its face and foreclaws. After we identified the turtle, we photographed the bird and observed the turtle feeding on scraps of the bird that had settled to the bottom of the pool. We do not know how the bird died and are uncertain as to whether our observation involved predation or scavenging.

Mud turtles are common in shallow pools in our study area (Stone 2001. Southwest. Nat. 46:41–53). The obvious benefits of inhabiting these pools include hydration and opportunities to eat invertebrates, which are common in pools. Our observations, coupled with those of Ligon and Stone (*op. cit.*), suggest that pools might provide opportunities for mud turtles to eat relatively large vertebrates, and that vertebrates might be more important to the diet of *K. sonoriense* than previously thought.

We thank J. Hellack and W. Radke for identifying the bird from photographs. We thank the College of Graduate Studies & Research at the University of Central Oklahoma for financial support. This study was conducted under permits issued by the New Mexico Department of Game and Fish (Permit 2905) and the U.S. Forest Service (Authorization ID: SUP0080).

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MACROCHELYS TEMMINCKII (Alligator Snapping Turtle). **AERIAL BASKING.** *Macrochelys temminckii* is generally believed to be largely aquatic, with only females leaving the water for the purpose of depositing eggs (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington, D.C., 578 pp.). We are aware of only two published records of aerial basking in *M. temminckii* (Ewert 1976. Herpetologica 32:150–156 and Shelby and Jensen 2002. Herpetol. Rev. 33:304); both involved juveniles and in the latter report basking was inferred but not actually witnessed.

On 5 May 2003 at ca. 1000 h in the Big Thicket National Preserve in eastern Texas, USA, a sub-adult *M. temminckii*, ca. 35–40 cm carapace length, was observed basking on a fallen tree above a creek. The turtle appeared to have been there for some time as its shell and the log were dry. At this point the creek was perhaps 8–10 m wide and 1.5–2 m deep with a moderately flowing current. The fallen tree trunk that the turtle was basking on was ca. 60 cm diameter with the uprooted end on the bank and the other end submerged in the creek. The tree trunk emerged from the water near the center of the creek at a 30–40° angle. To reach the basking spot, the turtle presumably climbed onto the submerged end of the tree and walked up the trunk 3–4 m to a spot 1 m above the surface of the water. It was positioned anterior end facing upward. We estimated air temperature at 24–29.5°C, with clear to partly cloudy skies. After watching the turtle for a period of 10–12 minutes, during which time it remained motionless, we approached for a closer view and an attempt to photograph the animal; at that point, the turtle dropped into the water, submerged, and disappeared from view.

A single *Graptemys* sp. was clearly observed basking on a nearby log simultaneously. Ewert (1976, *op. cit.*) also noted the proximity of "about seven" basking *Graptemys pseudogeographica sabinensis* and the similarity of chosen basking sites of the two species.

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PODOCNEMIS EXPANSA (Amazonian Giant River Turtle). **PREDATION**. Grillotalpid crickets have been reported as turtle egg predators, specifically on *Dermochelys coriacea* in Guyana (Maros et al. 2003. Mar. Ecol. Prog. Ser. 249:289–296; Schouten et al. 1997. Stud. Nat. Hist. Carib. Region 73:63–69), and *Podocnemis expansa* in Colombia (Valenzuela 2001. J. Herpetol. 35:368–378). These reports note mole crickets as turtle egg predators but not as predators of hatchling turtles. Here we report on mole cricket predation on hatchling *P. expansa* in Venezuela.

In late March 2003, during the nesting season of *P. expansa* on Playita Island, middle Orinoco River, between Apure and Bolívar states, Venezuela, we found turtle nests with several dead hatchlings, as well as live hatchlings with injures to the head, neck, forelimbs, and hindlimbs. These injures were caused by two-clawed mole crickets, *Scapteriscus* sp. We noticed that nest infestation by mole crickets occurred near the end of the dry season and beginning of the rainy season (between March and May). Additionally, we observed that each infested nest contained a single cricket, typically an adult or in the last instar.

Although many nests were infested, the predation rates on hatchlings turtles were probably not significant. Hatchling predation in the nest by *Scapteriscus* sp. might be incidental to egg predation, which would explain the broken and damaged eggs in the nests late in incubation. Egg predation on *P. expansa* by *Scapteriscus* sp. crickets is here inferred, based on the published evidence (Maros et al., *op. cit.*; Schouten et al., *op. cit.*; Valenzuela, *op. cit.*) while the hatchling turtle predation is based on direct observation.

This note adds to the knowledge of the predators of *P. expansa* hatchlings and eggs, which is essential information for refinement of the conservation program for this endangered species.

The crickets were deposited at Museo de Biología de la Universidad del Zulia (MBLUZ-I-1123).

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SIEBENROCKIELLA CRASSICOLLIS (Black Marsh Turtle). **FIRE SCARS**. Occurrence of fire scars on the shells of turtles is best described for the North American box turtle (*Terrapene carolina*) (Dodd et al. 1997. Herpetol. Nat. Hist. 5:66–72; Rose 1986. Southwest. Nat. 31:131–134; Smith 1958. Turtox News 36:234–237). Scars often result from the turtle being exposed to fire while partially buried in terrestrial habitats with the mid-dorsal and posterior areas of the carapace burned most frequently. *Siebenrockiella crassicollis* has been described as a bottom-walking aquatic turtle that inhabits deep ponds, marshes, sluggish streams, and swamps (Ernst and Barbour 1989. Turtles of the World. Smithsonian Inst. Press, Washington, D.C.; Iskandar 2000. Turtles and Crocodiles of Insular Southeast Asia and New Guinea. PALMedia Citra, Bandung, Indonesia; Liat and Das 1999. Turtles of Borneo and Peninsular Malaysia. Nat. Hist. Publ. [Borneo], Sabah, Malaysia). It is known to walk on land, presumably during movements between aquatic habitats (Liat and Das, *op. cit.*). We report here on observations of fire scars in a sample of *S. crassicollis* that suggests heretofore unrecognized terrestrial activity.

A large sample of *S. crassicollis* was among the 7500 turtles putatively from Malaysia that were confiscated by Hong Kong authorities on 11 December 2001. Approximately 3200 of the 16 species of turtles were shipped to the United States in January 2002 for processing and distribution to rescue centers, zoos, veterinarians, and university research programs (Hudson and Buhlmann 2002. Turtle and Tortoise Newslett. 6:11–14). A total of 1002 *S. crassicollis* was received in three shipments (Ades and Crow 2002. Turtle and Tortoise Newslett. 6:2–7). All had apparently been harvested aquatically, as some had fish hooks in their mouths or necks. During the triage, marking, and measuring process we discovered that several of these turtles were scarred on the carapace in various configurations with varying amounts of the keratin apparently removed by fire. A total of 45 *S. crassicollis* had such scars (4.49% of the total sample). Eighteen were males (129–202 mm carapace length) and 27 were females (137–199 mm CL); all were adults. In the data set available, two (both females) had scars on > 50% of the carapace, 13 (5 males, 8 females) had scars on 21–50% of the shell, and 19 (8 males, 11 females) had one or more smaller areas burned away. Fourteen turtles (6 males, 8 females) were burned on the dorsum of the carapace, 4 on the left side (2 each), 6 on the right side (3 each), and 14 on the rear of the carapace (5 males, 9 females). None of the fire scars was fresh and all were healed, indicating that each turtle survived its burns. Our interpretation of these scars as being derived from fire damage is consistent with those seen in other species such as *Terrapene carolina* (e.g., Dodd et al. 1997, *op. cit.*).

The existence of extensive fire scars on the carapaces of these bottom dwelling aquatic turtles (Ernst and Barbour, *op. cit.*) suggests that some individuals spent time buried terrestrially in habitats consisting of leaf litter or dead grass, possibly during times of the year when local residents set fires to grasslands and the grass understory in open forests; such fires are set annually (often in the spring) in parts of Asia to help generate fresh vegetative re-growth (KAB and JCM, pers. obs.). Our observations suggest that populations of *S. crassicollis* may inhabit seasonally-ponded wetlands with fluctuating hydrologies, but the reasons for a presumed terrestrial phase in the life history of *S. crassicollis* are not known. Investigation into this aspect of their behavior may reveal patterns of terrestrial habitat use heretofore unrecognized by chelonian biologists.

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LACERTILIA

ACANTHOCERCUS ATRICOLLIS (Blue-headed Tree Agama). **ENDOPARASITES.** *Acanthocercus atricollis* is known from central and western Kenya, the southern half of Uganda, northern Rwanda and parts of Tanzania (Spawls et al. 2002. A Field Guide to the Reptiles of East Africa. Academic Press, San Diego. 543 pp.). To our knowledge, the only nematode species previously found in *A. atricollis* is *Strongyluris ornata* (Harwood 1935. J. Tennessee Acad. Sci. 19:132–141). The purpose of this note is to report two additional nematode species from *A. atricollis.*

Ten *A. atricollis* (4 females, 6 males) (mean SVL = 103 mm ± 14 SD, range = 69–123 mm) collected at Ntandi, (01°15'S, 29°59'E;1872 m) Uganda in June–July 1967 and deposited in the herpetology collection of the Natural History Museum of Los Angeles County (LACM 38748–38754, 38756–38758) were examined for helminths. The esophagus, stomach, small intestine, and large intestine were opened and separately examined for helminths under a dissecting microscope. The body cavity was also searched. Nematodes were placed in a drop of concentrated glycerol and allowed to clear for 24 h. They were then placed on a glass slide, cover-slipped and examined under a compound microscope. Found in the stomach were 42 *Abbreviata benoiti* (prevalence, infected lizards/lizards examined x 100 = 80%; mean intensity, mean number nematode per infected lizard = 5.3 ± 8.6 SD; range: 1–16). Found in the coelom were 7 *Saurositus agamae* (prevalence, 40%, mean intensity, 1.8 ± 1.0 SD; range: 1–3). The nematodes were deposited in the United States National Parasite Collection: *Abbreviata benoiti* (USNPC 94765) and *Saurositus agamae* (USNPC 94766).

Horchner and Weissenberg (1965. Zeit. Parasit. 25:491–500) described *Abbreviata benoiti* from *Acanthocercus cyanogaster* from the Congo. *Acanthocercus atricollis* is the second host reported to contain this nematode. *Saurositus agamae* has previously been reported from the agamids *Laudakia caucasica* (Sharpilo 1976. Izdat. "Naukova Dumka." Kiev, Russia. 287 pp.), *Agama agama* (Macfie 1924. Ann. Trop. Med. Parasit. 18:409–412), and *Agama mossambica* (Bain 1969. Ann. Parasit. Hum. Comp. 44:581–594). *Acanthocercus atricollis* represents a new host record for *Abbreviata benoiti* and *Saurositus agamae*; Uganda is a new locality record.

We thank Aaron Bauer (Villanova University) for confirming the identity of *Acanthocercus atricollis*.

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AMPHISBAENA IBIJARA (NCN). **PREDATION**. Snakes, especially elapids, are important predators of amphisbaenians (Marques and Sazima 2004. *In* Marques and Duleba [eds.], Estação Ecológica Juréia-Itatins Ambiente Físico, Flora e Fauna, pp. 257–277, Ribeirão Preto, Holos Editora; Cunha and Nascimento 1993. Bol. Mus. Para. Emílio Goeldi, Sér. Zool., Belém, [9]:1–191). Here, we augment documentation of elapid predation on amphisbaenians with an observation of predation on the recently described *Amphisbaena ibijara* (Rodrigues et al. 2003. Phyllomedusa 2:22–26) by the fossorial *Micrurus ibiboboca* in NE Brazil.

At 2324 h on 9 March 2004, we collected an adult female *M. ibiboboca* (628 mm SVL) as it was resting on litter in an eucalyptus plantation near the municipality of Urbano Santos (3°12'28"S, 43°24'12"W; elev. 41 m), State of Maranhão, and placed it in a plastic bottle. The next morning, the snake regurgitated an adult male *A. ibijara* (198 mm SVL) with its anterior end partially digested and therefore was presumably ingested head first (Fig. 1).

Micrurus ibiboboca exhibits both diurnal and nocturnal activity, and is regionally common (Lima 2003. Composição e diversidade de serpentes em um mosaico de habitats no município de Urbano Santos, Maranhão. Dissertação de mestrado, Mus. Para. Emílio Goeldi, Belém-PA. 61 pp.). The frequency of *M. ibiboboca* predation on *A. ibijara* is not known, but might be common because both species appear to be common and use the same microhabitat. This represents the first record of an *A. ibijara* predator.

FIG. 1. *Amphisbaena ibijara* with the front end of body partially digested.

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ANOLIS CAROLINENSIS (Green Anole). **BEHAVIOR.** Native to the southeastern United States (Smith 1946. Handbook of Lizards of the United States and Canada. Cornell Univ. Press. Ithaca, New York, 557 pp.), *A. carolinensis* was first reported in the wild in the Hawaiian archipelago on Oahu in 1950 (McKeown 1996. A Field Guide to Reptiles and Amphibians in the Hawaiian Islands. Diamond Head Publishing, Inc, Los Osos, California. 172 pp.). It has since spread to adjacent islands and was first documented from Kauai in 1987 (Mayer and Lazell 1992. Bull. Ecol. Soc. America 73:265). Based on observations in 1991 and 1994, Michael (1996. Elepaio 56:1–4) described a population of *A. carolinensis* and its persistence following a major hurricane. However, these visits provided only limited opportunity to draw parallels in behavior between this introduced population and populations of *A. carolinensis* in their native range. Moreover, data on introduced *A. carolinensis* populations are sparse. Hence, this report, which describes a follow-up visit made to the same site in 1998 earlier in the season than previous visits, afforded the opportunity to better describe similarities in *A. carolinensis* behavior to populations in its native range.

Between 26 June and 6 July 1998, I made observations of *A. carolinesis* living in landscape vegetation on the landward side of the Kuhio Shores condominium complex, located 3 km S of Koloa Town on the southern shore of Kauai. This is the same location studied in July–August 1991 and 1994; Michael (*op. cit.*) describes general aspects of this site. In 1992, Hurricane Iniki made landfall on southern Kauai and inflicted substantial damage to the condominium structure as well as the landscaping in which the *A. carolinesis* lived. Structural and landscape repairs were near completion during the 1994 visit. Landscape maintenance was less intensive in 1994 as compared to 1991 or 1998; watering was done every few days and little or no systematic raking or debris removal was apparent. Intensive landscape maintenance was not begun until reconstruction was completed so as not to interfere with repairs. By 1998, daily landscape maintenance such as watering, raking of debris, and pruning resumed to pre-Iniki levels.

In 1998, landscape plants consisted of a similar mixture of species of ornamental groundcover, shrubs, palms, and other trees as described in Michael (*op. cit.*). Multiple vegetation layers and an interconnected overstory of trees were the result of increased care (water, pruning, fertilizing). Groundcover plants were the same species but increased watering roughly doubled the height (to ca. 20 cm) of the stem-leaf matrix over that in 1994. The landscaped area was a roughly L-shaped unit ca. 3 m wide between the parking lot and condominium walkways; the short leg of this L was ca. 20 m and the long leg was ca. 50 m. In 1998, except for concrete walkways, groundcover occupied the entire landscaped area in a continuous bed, whereas in 1994, bare dry soil separated only a few isolated clumps of plants (ca. 3 x 3 m). In 1998, as in 1991, daily watering occurred. In 1998, three smaller palms replaced the single large palm tree near to which all *A. carolinesis* were observed in 1991 and 1994; each of the three palms was ca. 10 cm in diameter and 5–8 m tall.

Similar to previous years, I visual-encounter surveyed for *A. carolinesis* daily during daylight hours, usually mid-morning and mid-afternoon. Each lizard was classified as to gender (male, female, or unknown) and age group (adult, juvenile, or hatchling; *fide* Michael, *op. cit.*). Most animals were sexed using behavior and appearance, but not marked. Males were larger and had larger heads than females, displayed dewlaps and sagittal crests (no significant dewlap or sagittal crest in females) and engaged in fights with other *A. carolinesis* (rare in females). I also made random observations of *A. carolinesis* at four additional localities (Koloa Town, Lihue, Kapaa, and Kilauea) around Kauai. While less systematic than observations made at Kuhio Shores, they offered a point of reference for study of the Kuhio Shores population.

I recorded an average of 2.6 *A. carolinesis*/day (s = 1.7, range: 1–6, N = 8 days) in 1998, a mean of 2.7 *A. carolinesis*/day (s = 1.6, range: 1–6, N = 11 days) in 1991, and a mean of 2.3 *A. carolinesis*/day (s = 2.3, range: 1–4, N = 11 days) in 1994. No significant differences were found in the numbers of *A. carolinesis* encountered among years (Kruskal-Wallis test: df = 2, $P = 0.8928$). However, I observed only adult green *A. carolinesis* at Kuhio Shores in 1998, whereas in 1991 and 1994, 87% (N = 26) and 84% (N = 21) of the *A. carolinesis* I found were non-adults. Numbers of adults and non-adults in 1991 were not significantly different from adult and non-adult numbers in 1994 (Fisher's Exact Test: $P > 0.9999$), but adult and non-adult numbers in 1998 were significantly different from those in each of 1991 and 1994 (Fisher's Exact Test: $P < 0.0001$; adjusted a for three tests was 0.17). Observations of *A. carolinensis* made around the island during each year visit paralleled those made at Kuhio Shores, i.e., most *A. carolinesis* seen during the 1991 and 1994 visits were non-adults, whereas only adults were seen in 1998. In 1998, it also appeared that adults responded to the observer by displaying, and thus, drew attention to themselves. In 1991 and 1994, the few adults observed did not initially respond to the observer; they remained still or fled but did not bob or display dewlaps or sagittal crests.

Anolis carolinensis numbers were similar among years, but the salient aspect of observations was finding exclusively adults, especially behaviorally prominent males, in 1998. As similar observations were made throughout Kauai in 1998, the age group pattern of observations was not localized. This difference might reflect typical behavior for these age groups through a seasonal breeding cycle. In its native range, *A. carolinesis* breed from early May to late July (Jenssen and Nunez 1998. Behaviour 135:981–1003). The 1991 and 1994 visits were in late July–early August, whereas the 1998 visit occurred in late June–early July. Greater visibility, particularly of males in 1998, differed from the two previous visits. This pattern would fit observations of free-ranging *A. carolinesis* in their native range, where males spent most of their time near the ground and displayed more than 15 times as often during May–July versus August–September (Jenssen et al. 1995. Herpetol. Monogr. 9:41–62). This behavior changed significantly at the July/August boundary, when males switched from being socially oriented to being largely solitary animals (Jenssen et al., *op. cit.*).

Lack of juveniles during the 1998 observations has at least two likely explanations. The first is that eggs had not yet hatched. In Florida, egg-laying occurs during May–July with hatching occurring as early as mid-June (Smith 1946, *op. cit.*). The 1998 visit might have occurred just before hatching. The second possibility is that hatchlings were less detectable in the lusher vegetation present in 1998. In 1991 and 1994, the hatchlings were observed on the surface of groundcover; juvenile behavior would also had to have changed in 1998 for them to remain undetected. Focused observations over at least the June–August interval would be necessary to clarify the basis of this pattern.

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CHAMAELEO MONTIUM (Mountain Chameleon). **REPRODUCTION.** *Chamaeleo montium* inhabits submontane to montane forests, secondary forests, and farm bush at 550–1200 m elevation in SW Cameroon (Hofer et al. 2003. J. Herpetol. 37:203–207). The species has a light green ground color in both resting or unexcited states (Neças 1995. Chamäleons. Bunte Juwelen der Natur. Edition Chimaira, Frankfurt. 249 pp.). Maturity occurs in the first year, gestation in two months (Neças, *op. cit.*) and reproduction appears to be aseasonal (pers. obs). Detailed field studies of this species are lacking. Hence, we describe aspects of *C. montium* reproductive behavior, including mate attendance, copulation, rejection, and coloration in SW Cameroon.

The study site, a cultivated garden adjacent to secondary forest and farmbush, was in the village of Nyasoso (4°49'289"N, 9°40'826"E; elev. 850 m) at Mt. Kupe, South West Province. The study period, 10 November 2002 to 29 March 2003, encompassed all of the dry season and the beginning of the rainy season. We observed an adult female (75 mm SVL) with missing tail tip which facilitated identification. We conducted observations on this female opportunistically, with multiple observations occurring on several days, especially when a male was nearby. We viewed chameleons from a 2-m distance, which did not appear to disturb their behavior. On 10 November, we observed a male (No. 1) with the female. Both chameleons were found at a height of ca 1.8 m in a *Penianthus* (shrub)/guava tree (*Psidium*) growth. The male was following the female, which walked very slowly away. When walking ceased, the female continued movement with a slow rocking motion; the female was dark brown to black in color with yellow spots on the head. The male was light green with bright yellow lateral stripes, head crowned with turquoise; small white spots were sprinkled throughout the head and body, and his throat was inflated.

The male mounted the female for copulation, pressing his chin flat against the female's body, head coloration remaining brilliant while the stripes and spots faded. The female remained dark, pressed her body flat against the branch and lifted the base of her tail slightly. The male's tail moved under the female's as he attempted to press his cloaca against hers. Duration of this courtship and copulation sequence was ca. 20 min. This male exhibited postcopulatory mate guarding, that is, he remained next to but not in contact with the female, throughout this and the following day. The female's color returned to green the following day. We marked the male with a small dot of brown paint on the flank before his departure; this mark did not appear to affect any behaviors involving himself and other chameleons.

On 2 December, we again observed this female exhibiting a

dark brown color and found a second male chameleon (No. 2) ca. 20 cm away. On 3 and 4 December, the color of the female had returned to green with bright yellow spots over the rump; Neças (*op. cit.*) indicates that this color pattern represents a rejection coloration for this species. Number 2 was resting ca. 10 cm away and was dark with turquoise spots around the crown of its head. Positioning of the two chameleons varied from head to tail—male posteriorly—or tail to tail. We similarly gave this male a unique paint mark. On 5 December, the female exhibited black coloration and aggressively chased male No. 2 away. Her dark coloration remained throughout the following day. This sequence characterizes a mating rejection (Cuadrado 2000. Ethology 106:79–91).

The female was found to be gravid (verified by abdominal palpation) on 5 January. This female was observed 74 times in the 56-day period, and no other males were seen in the vicinity of the female, so the eggs might be the result of the previously described presumably successful mating observed with male No. 1. On 17 January, the female was observed perched close to the ground; she was palpated, but lacked calcified eggs; egg deposition is thought to have occurred on that date (68 days post- mating).

On 23 January, male No. 1 was again found tending this female. Mating was observed at 1600 h on the following day, with a similar pattern and duration as previously described. This male was again with the female for two days, departing on 26 January. Abdominal palpation revealed the presence of eggs on 5 March. Based on behavior and abdominal palpation, the female is thought to have laid eggs on 25 March, 61 days post mating.

Notably, male No. 1 appeared twice precisely when the female was receptive and was not detected nearby when she was not. This same male was observed interacting with an unknown female at a second location mid-January, so might have been engaged in reproductive pursuits throughout our study period. Whether male *C. montium* are attuned to the temporal patterns of females which exhibit repeated reproduction is unknown.

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CNEMIDOPHORUS COSTATUS BARRANCARUM (Barranca Whiptail Lizard) **REPRODUCTION**. We augment preliminary findings on reproduction for *Cnemidophorus costatus barrancarum* (= *Aspidoscelis costata barrancarum*; Reeder et al. 2002. Amer. Mus. Novitat. 3365:1–61) presented in Walker et al. (2003. Herpetol. Rev. 34:365). We dissected 60 specimens in the Herpetological Collection of Unidad de Biología, Tecnología y Prototipos (UBIPRO) collected by JLE at the periphery of the range of the subspecies in southwestern Chihuahua, México, in 2002 (9015–9018, 9053, 9071–9073, 9240–9243, 9280, 9287, 9331, 9347, 9354, 9355, 9365, 9374, 9420, 9471, 10599, 10600, 10625, 10626. 10633, 10651, 10652) and 2003 (11334–11336, 11365, 11366, 11392–11396, 11475–11482, 11503–11506, 11508–11510, 11528–11533) in addition to the 14 collected by him in 2000 (5908–5910, 55918, 5940) and 2001 (7316–7319, 7328–7330, 7369, 7373) and previously discussed by Walker et al. (2003, *op cit.*). Data are presented by sex as ratios, ranges of variation, and/or means (to one digit after the decimal) ± 1 SE. Numbers of males and females of *C. c. barrancarum*, respectively (in parens), by year were: 2000 (1:4); 2001 (2:7); 2002 (16:13); 2003 (22:9). Numbers of males and females, respectively (in parens), by size (as 10 mm SVL increments) in the UBIPRO sample were: 40–49 mm (0:2); 50–59 (4:1); 60–69 (2:6); 70–79 (7:10); 80–89 (10:10); 90–99 (9:4); and 100–112 (9:0). Data for the 2002 and 2003 samples, added to information in Zweifel (1959. Bull. Amer. Mus. Nat. Hist. 112:57–116) and Walker et al. (2003, *op. cit.*), update knowledge of reproductive characteristics for *C. c. barrancarum* as follows: clutch size, 4.3 ± 0.33 (range 2–8, N = 24) eggs; mean size of adult females, 81.3 ± 1.65 (range 67–97, N = 27) mm SVL; mean size of adult males, 88.9 ± 1.96 (range 69–112, N = 36) mm SVL. One female (UBIPRO 11478 of 97 mm SVL) contained only two left and no right yolked ovarian follicles; implying reproductive senescense if large size reflects old age. Another female (UBIPRO 11532 of 88 mm SVL) had a clutch arrangement not seen among hundreds of *Cnemidophorus* lizards JMW has previously dissected. Besides the presence of 4 left and 3 right yolked ovarian follicles of 8.0–9.5 mm in diameter, the left oviduct of this individual contained an unusually large egg of 8.0 x 19.0 mm. Females of *Cnemidophorus* with oviductal eggs typically have either no yolked ovarian follicles (usual case) or very small ones of 3–4 mm in diameter. Clutch size was positively correlated with SVL (adjusted r^2 = 0.47, N = 24) and removal of the outlier UBIPRO 11478 markedly strengthened the relationship (adjusted r^2 = 0.70).

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CNEMIDOPHORUS NEOMEXICANUS (New Mexico Whiptail Lizard). **REPRODUCTION**. Studies of reproductive characteristics in parthenogenetic *Cnemidophorus neomexicanus* (= *Aspidoscelis neomexicana*; Reeder et al. 2002. Amer. Mus. Novitat. 3365:1–61) in New Mexico (Medica 1967. Bull. South. California Acad. Sci. 66:251–276; Christiansen 1971. Amer. Mus. Novitat. 2442:1–48) have revealed few reproductively active females in July and none in August samples. In the most detailed study (Christiansen 1971, *op. cit.*), gravid females were collected as early as 27 April and as late as 19 July; however, only 12/75 (16%) females in July samples were gravid.

We used University of Arkansas Department of Zoology (UADZ) specimens collected by JEC in southwestern New Mexico to add significant details to knowledge of reproduction in *C. neomexicanus*. Eight adults of this species collected on 6 (UADZ 6180–6183, 6195, 6196 from 21.3 km NW of jct New Mexico Hwy 90 and US Hwy 70 on 70 W) and 7 (UADZ 6188, 6189 from 12.2 km NW of jct New Mexico Hwy 90 and US Hwy 70 on 70

W) August 1998 in Hidalgo County included two gravid females: UADZ 6188 (69 mm SVL, 10.2 g) and UADZ 6189 (70 mm SVL, 10.0 g). Each had two eggs of ca. 9 x 15 mm, one in each oviduct. Nine adults collected on 10 (UADZ 7070–7074) and 12 (UADZ 7093–7096) August 2002 2.9 km N of the Grant County boundary on New Mexico Hwy. 464, included a gravid female UADZ 7074 (68 mm SVL, 10.2 g) with one egg in each oviduct of ca. 9 x 15 mm. These observations based on August collections extended the known reproductive cycle of *C. neomexicanus* by almost a month by a similar percentage of reproductive females (3/17, 17.6%) as was reported among July females from Bernalillo County by Christiansen et al. 1971 (*op. cit.*). Moreover, based on reports of incubation periods of 46 (Christiansen 1971, *op. cit.*) to 54 (Medica 1967, *op. cit.*) days in *C. neomexicanus*, the gravid individuals identified in this note extend potential egg hatching dates in this species from between 19 July and 16 August (Christiansen 1971, *op. cit.*) to as late as October. Such late-season neonates would have a feeding and growth period of about a month before the onset of suboptimal fall temperatures in Hidalgo and Grant Counties, New Mexico. Variable hatching dates over more than two months might account for the wide range of SVLs observed among second-year individuals of *C. neomexicanus* in some April–June collections from southwestern New Mexico. Yearly temperature conditions and amount and timing of rainfall likely strongly influence the reproductive cycle in this species.

Specimens of whiptail lizards were collected in New Mexico under authority of permits granted to the authors by the New Mexico Department of Game and Fish.

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CNEMIDOPHORUS SEXLINEATUS (Six-Lined Racerunner). **BEHAVIOR**. Among diverse thermoregulatory behaviors that vertebrates perform, alternate foot-lifting behavior has been documented in the South African Namib Desert lacertid, *Aporosaura anchietae* (Louw and Holm 1972. Madoqua 1:67–85). Characterized by brief synchronous lifting of trans-leg pairs, this behavior is performed to avoid prolonged contact with hot substrates. Here, we report similar behavior in the Six-Lined Racerunner, *Cnemidophorus sexlineatus,* from central Florida.

We made these observations while conducting research on the Florida Sand Skink (*Neoseps reynoldsi*) in July 1994 on a rosemary scrub habitat in Orange County near Orlando (24°21'31"N, 81°35'28"W; elev. 30 m). Scrub habitat is characterized by low stature oak canopies, with a midstory of palmetto and other woody plants, and herbaceous and lichen ground cover. During the summer, sand surface temperatures can reach 44.4°C (Collazos 1998. Microhabitat Selection in *Neoseps reynoldsi*, the Florida Sand-swimming Skink. MSc Thesis, University of South Florida. 81 pp.). We cornered an adult (ca. 100 mm SVL) *C. sexlineatus* at the base of a thick-trunked (ca. 14 cm diam) Myrtle Oak (*Quercus myrtifolia*). During a 15-sec observation period, this individual performed at least four bouts of alternate foot-lifting behavior before it disappeared into a nearby Saw Palmetto (*Serenoa repens*) thicket.

We are unaware of any reference to alternate foot-lifting behavior in association with agonistic interactions in any animal taxa. Given the high surface temperatures (air temperature ranged from 33.3 to 37.2°C based on local weather data), we believe that this behavior was a thermoregulatory response rather than anti-predator behavior directed at us as observers. The context of further observations will be needed to verify our interpretation of this behavior. Alternate foot-lifting behavior has been anecdotally observed in few lizards other than *A. anchietae* (i.e., *Cnemidophorus lemniscatus*, Laurie Vitt, pers. comm.), but has seldom if ever been published. If our interpretation is correct, this would represent the first time that alternate foot-lifting behavior, putatively thermoregulatory, has been reported in *C. sexlineatus*.

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CNEMIDOPHORUS SEXLINEATUS VIRIDIS (Prairie Racerunner). **MAXIMUM BODY SIZE**. Recently, the maximum total length of *Cnemidophorus sexlineatus viridis* (= *Aspidoscelis sexlineata viridis*) was reported as 267 mm (84 mm SVL; Toal and Collins 2003. Herpetol. Rev. 34:59) as determined from an adult female from the southern Ozarks of Missouri (Barry County). Herein, I report on a new maximum body size for this species from Arkansas.

On 28 December 1974, I unearthed an adult female *C. sexlineatus viridis* from a hibernation burrow on a roadside embankment, 5.1 km N Dover off State Hwy 7 (Pope County; 35°27.98'N, 93°8.25'W; elev. 218 m). This female was 90 mm SVL at the time of collection and had a 115 mm partly regenerated tail (regenerated portion = 77 mm). Re-measurement of the female on 28 February 2004 yielded the original SVL, which exceeds the previously reported maximum by 6 mm.

The specimen was deposited in the Arkansas State University Museum of Zoology herpetological collection (ASUMZ 28204) and collected under the authority of an Arkansas Game & Fish Commission scientific collection permit.

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COLEODACTYLUS MERIDIONALIS (NCN). **PREDATION**. *Coleodactylus meridionalis* is a poorly known litter-dwelling gekkonid lizard distributed in the Caatinga and Atlantic Rainforest of northeastern Brazil (Vanzolini et al. 1980. Répteis das Caatingas, Academia Bras. Ciências, São Paulo. 161 pp.). Recently, Dias et al. (2003. Herpetol. Rev. 34:142–143) provided data on diet and feeding habits for *C. meridionalis* from "restinga" (an herb and shrub association on sand dunes along the Brazilian coastline), a habitat within the Brazilian Atlantic rainforest biome. Here, we report a predation event on an individual of *C. meridionalis* by a

sympatric tropidurid lizard, *Tropidurus hygomi*, from a restinga site in northeastern Brazil.

During analysis of the stomach contents of 24 *T. hygomi* from Dunas do Abaeté (12°57'03"S, 38°22'30"W; elev. 15 m), municipality of Salvador (Bahia State), one of us (MMFV) found remnants of a *C. meridionalis* in the stomach of an adult female *T. hygomi* (46.2 mm SVL). Comparison with vouchers of *C. meridionalis* from the Museu de Zoologia da Universidade Federal da Bahia (MZ-UFBA) confirmed the identity of the prey. The female *T. hygomi* was deposited at the MZ-UFBA (UFBA-LAG 639).

Tropidurus hygomi is a diurnal, heliothermic, terrestrial tropidurid endemic to "restinga" habitats of northeastern Brazil (Vanzolini and Gomes 1979. Papéis Avulso de Zoologia [São Paulo] 21:243–259). This species, typically a sit-and-wait predator, displays opportunistic feeding behavior on invertebrates and small vertebrates, including other lizards (Vargens 2003. Ecologia de *Tropidurus hygomi* [Sauria: Tropiduridae] na restinga do Abaeté – Salvador –Bahia. Bachelor's Thesis, Departamento de Zoologia, Univ. Fed. da Bahia, 45 pp.). At Dunas do Abaeté, *T. hygomi* uses mostly habitats covered with leaf litter, the microhabitat where *C. meridionalis* is typically found, thereby facilitating encounters. Small litter-dwelling lizards like *C. meridionalis* are rarely surface visible, so opportunistic foraging might best explain their predation by sympatric tropidurids, including *T. torquatus* (Araújo 1991. Rev. Brasil. Biol. 51:857–867; Teixeira and Giovanelli 1999. Rev. Brasil. Biol. 59:11–18), *T. hispidus* (Vitt and Carvalho 1995. Copeia 1995:305–329; Vitt 1995. Occ. Pap. Oklahoma Mus. Nat. Hist. 1:1–29), and *T. semitaeniatus* (Vitt, *op.cit.*).

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COPHOSAURUS TEXANUS (Greater Earless Lizard). **SAUROPHAGY.** *Cophosaurus texanus*, a generalist invertebrate consumer, is known to prey on members of at least 12 different arthropod orders (Maury 1995. J. Herpetol. 29:266–272). Its diet is well known, but neither saurophagy nor cannibalism has been reported. Here, we provide observations of cannibalism and saurophagy for *C. texanus* from Nuevo Leon, México.

At 1246 h on 28 September 2002 in Casa Blanca Canyon near the municipality of Santa Catarina (25°38'13.7"N, 100°42'39.1"W; elev. 1360 m), we observed a female *C. texanus* (48 mm SVL, 59 mm tail) capture and eat a small conspecific male (25 mm SVL). Local habitat is desert scrub and chaparral on a calcareous geology. The female *C. texanus*, which was perched on a rock of ca. 30 cm high, ran a 0.5 m distance to capture the young male that was perched on a smaller rock. The male, captured by one side of the head (after dissection, a semi-circular depression was observed in the parietal region), was swallowed with slow undulatory movements; ingestion took about 3 min. The ingested lizard's tail was in three parts (total length ca. 25 mm). The female (UANL 6341) was collected, dissected, and deposited in the herpetological collection of the Universidad Autónoma de Nuevo León. Dissection of the stomach also revealed the forelimb and the hindlimb of a *Sceloporus couchii,* presumably from the same individual. Based on comparison of the limb fragments with preserved specimens, the ingested *S. couchii* was ca. 26 mm SVL.

Our observations show that *C. texanus* can prey on small lizards, including conspecifics. We thank Marc P. Hayes and Glafiro Alaniz F. for their help with this note.

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CROCODILURUS AMAZONICUS (Jacarerana). **DIET.** *Crocodilurus amazonicus* is a semi-aquatic macroteiid (males 80–248 mm SVL; females 83–320 mm SVL) widely distributed in the Amazon Basin (Ávila-Pires 1995. Zool. Verh. Leiden 299:1–706). Little is known of its ecology; beyond general information on its semi-aquatic habit, one report on its diet exists (Márcio Martins in Avila-Pires, *op. cit.*) noting that 10 young *Bufo marinus*, a large odonate, and one hemipteran were found in the stomach of an adult. Here, we add to the sparse dietary data with the first record of a reptile in *C. amazonicus* diet.

During a field survey for the project "Herpetofauna das savanas amazônicas: subsídios para sua preservação" in August 2003 in the city of Humaitá, State of Amazonas, Brazil (7°30'22"S, 63°01'15"W; elev. 60 m), we collected a series of 30 *C. amazonicus* on the margin of the Puruzinho River. In examination of the stomach contents of an adult (200 mm SVL) female, we found an intact young male *Helicops polylepis* (Colubridae: Xenodontinae) with a total length of 310 mm.

Helicops polylepis is a semi-aquatic, nocturnal snake that is also widely distributed in Amazonia (Cunha and Nascimento 1978. Publ. Avul. Mus. Par. Emílio Goeldi 31:1–218; da Silva and Sites 1995. Conserv. Biol. 9:873–901). As *Crocodilurus* spends most of the time in water or near water, frequent opportunity to encounter *H. polylepis* might exist.

The lizard was deposited in the Coleção Herpetológica da Universidade de Brasília, (CHUNB 32594). We thank Adrian Garda and Alexandra Bezerra for field assistance. The "Fundação O Boticário de Proteção a Natureza" provided financial support to D. O. Mesquita.

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CTENOPHORUS FIONNI (Peninsula Dragon Lizard). **CANNIBALISM**. Cannibalism has been reported in many reptiles (Mitchell 1986. Cannibalism in Reptiles: A Worldwide Review. SSAR, Oxford, Ohio. 37 pp.), but has rarely been recorded among Australian agamids. One such agamid, *Ctenophorus fionni*, is restricted to rocky habitats on the Eyre Peninsula in South Australia. Little is known of this medium-sized lizard (96 mm max. SVL), which seems to be largely insectivorous (Johnston 1997. Behavioural Ecology of the Peninsula Dragon lizard *Ctenophorus fionni*. Ph.D. dissertation. Flinders University, Adelaide, 307 pp.). Here, I report the first record of cannibalism for this species.

During a mark-recapture study of *C. fionni* on 2 February 1992, I caught an adult male (71.5 mm SVL, 14.0 g) at Secret Rocks (33°12'S, 135°51'E; elev. 279 m), South Australia. While processing this lizard, I found a second, recently killed individual of the same species in his gullet. The dead lizard was subsequently regurgitated (Fig. 1). The size of the regurgitated lizard (32 mm SVL) and the timing of the observation indicate that it was a hatchling (Johnston 1999 J. Herpetol. 33:694–698). After being photographed, the adult male was released and the dead juvenile was discarded.

The South Australian National Parks & Wildlife Service, and the Flinders University Animal Ethics Committee granted permits for this work.

FIG. 1. Male *Ctenophorus fionni* regurgitating a conspecific juvenile, Secret Rocks, South Australia, 2 February 1992.

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CYCLURA CYCHLURA INORNATA (Allen Cays Iguana). **MORTALITY**. Mortality in adult *Cyclura cychlura* is rarely reported. Apart from recent records of predation on *Cyclura c. cychlura* on Andros Island in the Bahamas (Knapp 2004. Caribbean J. Sci. 40:265–269), no observations of natural mortality are recorded for this species (e.g., see Coenen 1995. Bahamas J. Sci. 2:8–14). Hence, we report a distinctive instance of mortality from the Allen Cays, northern Exuma Islands, Bahamas.

During mid-afternoon 12 May 2004, we discovered a female Allen Cay Iguana (27.0 cm SVL, 35.5 cm tail, 530 g) trapped between the multiple trunks of a tree (cf. *Drypetes diversifolia* fide Sandra Buckner) on Leaf Cay, an island in the Allen Cays (Fig. 1; see Iverson et al. 2004. Herpetol. Monogr. 18:1–36 for map and aerial photograph). This female was originally toe-clipped and PIT-tagged on 11 March 1998 at a SVL of 26.2 cm and an estimated age of 12.5 years; she had been recaptured during field work in 2001, 2002, and 2003 (weighing 705 g at the last capture). She was lethargic and somewhat emaciated when removed from between the branches, weighing 148 g less than estimated based on a regression equation relating SVL to mass for 168 other females captured on Leaf Cay during the same trip. She was still very sluggish when released 48 h later, following attempts to rehydrate her and nourish her with force-fed bananas. Although this iguana was still alive when discovered, we had previously found three mummified carcasses or nearly intact skeletons of subadult or small adult Allen Cay iguanas wedged between tree trunks on Leaf Cay in June 2001, and one on nearby U Cay (= Southwest Allen Cay) in May 2002. We also observed a mummified carcass of an adult *Cyclura rileyi* on Bush Hill Cay in the Exuma Land and Sea Park, central Bahamas on 21 May 2003 that had been similarly trapped in the crotch of a tree.

No predators capable of wedging an iguana between tree trunks occur on these islands. However, arboreality is common in the genus *Cyclura* (Iverson 1979. Bull. Florida St. Mus. Biol. Sci. 24:175–358), and the observed mortality likely occurred as individuals descended from trees where they had been feeding and/or thermoregulating. Many West Indian trees have multiple trunks and smooth bark; we suspect that the often poorly controlled descent (i.e., sliding) of these iguanas down tree trunks creates enough momentum to sometimes pin them between tree trunks such that they are unable to extricate themselves. This would explain why we have never observed the phenomenon in young iguanas or smaller cohabiting lizard species despite over 18,000 person-hours of field work over 25 years. The lack of similar observations for large adult *C. cychlura* may be a function of their reduced arboreality. This form of accidental death might occur with some frequency among subadult or small adult West Indian rock iguanas. We are unaware of similar records of mortality for any other lizard.

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CYCLURA LEWISI (Grand Cayman Blue Iguana). **HATCHLINGS.** Little is known of the behavior and ecology of hatchling *Cyclura* (Sauria: Iguanidae) and nothing is known about this age group in endangered *Cyclura lewisi*. Hence, we provide preliminary data on *C. lewisi* hatchling behavior and sizes.

On 26 August 2001, we measured and observed wild *C. lewisi* hatchlings from two nests that had been enclosed prior to emergence at the Queen Elizabeth II Botanic Park, Grand Cayman (19°19'N, 81°10'W; elev. 2 m). Hatchlings were measured after emergence, then allowed to recover for 5–10 min. Subsequently, one wall of the enclosure was removed, and hatchlings were allowed to exit at their own pace to minimize altering their behavior. We then followed five of them for focal animal observations, but lost sight of all of them in < 1 h.

All iguanas tongue-touched the ground as they moved away from the nest site. One hatchling headbobbed several times (2–4 bobs per episode) as it moved away, but we did not see the other iguanas display in this way. Three of five hatchlings climbed into trees within 20 min of leaving the nest enclosure, suggesting that hatchling *C. lewisi* might be more arboreal than adult conspecifics. Within 10 min of release, we witnessed an attempted predation on one hatchling by a snake, the Grand Cayman Racer (*Alsophis cantherigerus caymanus*). The iguana, apparently reacting instinctively to the snake's strike movement, escaped by jumping away and running ca. 3 m while the snake retreated back into a low wall, probably disturbed by the observer's presence. We had previously witnessed snakes trying to gain access to hatchling *C. lewisi* in enclosures, but this was the first direct observation of attempted snake predation on *C. lewisi* hatchlings in the wild.

One hatchling returned to the nest chamber on the same day after leaving the nest site and enclosure. The iguana might have been going to use the nest as a nocturnal retreat, but we accidentally disturbed it during nest excavation that evening.

Two of five hatchlings tested a potential food item within 10 min of leaving the nest enclosure, but each rejected the item (a dried piece of grass and a logwood leaf, *Haematoxylum campechianum*). Less than 15 min after leaving the enclosure, one hatchling spent 35 sec drinking rainwater from the edge of a pond. Another hatchling purposefully ate soil, a behavior we have also seen in adults.

Wild hatchlings had absorbed most of their yolk sac by the time they emerged, had closed umbilicae, were dry, and seemed markedly thinner than conspecifics immediately after the latter hatched from eggs incubated under controlled conditions. Captive hatchlings were wet at hatching, had abdomens swollen with yolk and visibly unsealed umbilicae, and showed no interest in food or water until 2–3 weeks after hatching. The difference in yolk supply between captive-hatched and wild-emerged iguanas, coupled with the immediate drinking and foraging behavior displayed by the latter, implies a post-hatching underground residence time in the wild. Hatchlings of other species of iguanas (subfamily Iguaninae) have been suggested to remain in the nest chamber for several days to two weeks before emergence (Wiewandt 1977. Ph.D. dissertation. Cornell University, Ithaca, New York; Christian and Tracy 1982. *In* Burghardt and Rand [eds.], Iguanas of the World: Behavior, Ecology, and Conservation, pp. 366–379. Noyes, Park Ridge, New Jersey).

Wild hatchlings averaged 94.3 mm SVL ($s = 7.4$ mm, $N = 6$), and were significantly smaller than captive-bred hatchlings (mean SVL = 100.8 mm, $s = 3.6$ mm, $N = 17$; Student's t test, $t = 2.865$, $P = 0.009$). The difference in size between wild and captive hatchlings might reflect differences in moisture levels or temperatures during incubation or differences in egg size relating to the age or nutritional state of the mothers (Packard and Packard 1988. *In* C. Gans and R. B. Huey [eds.], Biology of the Reptilia, vol.16, pp. 523–605. Alan R. Liss, New York).

Our observations were collected during research approved by the National Trust for the Cayman Islands and the Queen Elizabeth II Botanic Park.

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ENYALIOIDES COFANORUM (Cofan Wood Lizard). **REPRODUCTION**. *Enyalioides cofanorum* is a terrestrial hoplocercid known from the Amazonian lowlands of Ecuador and Peru. A female collected from Santa Cecilia, Ecuador in March 1972 had two ovarian eggs (ca. 26 mm long) and another collected in July contained two oviductal eggs (ca. 28 mm long) (Duellman. 1978. Misc. Publ. Mus. Nat. Hist. Univ. Kansas 65:1–352). Five adult females collected at Santa Cecilia averaged 104 mm snout–vent length (SVL; range: 91–115 mm; Duellman 1973. Herpetologica 29:228–231). Here, I augment the limited data on this species with observations made in eastern Amazonian Ecuador.

On 31 July 2001, a female *E. cofanorum* was collected resting horizontally on a branch 0.5 m above ground in primary terra firme forest at the Tiputini Biodiversity Station (0°37'05"S, 76°10'19"W; elev. 215 m). This field station, managed by the Universidad San Francisco de Quito, is located 280 km ESE of Quito on the north bank of the Tiputini River next to Yasuni National Park, Orellana Province, Ecuador (Cisneros-Heredia 2003. *In* De la Torre and Reck. [eds.], Ecología y Ambiente en el Ecuador: Mem. I Congr. Ecología y Ambiente, Ecuador País Megadiverso. CD. Universidad San Francisco de Quito, Ecuador). The lizard was gravid and dissection revealed five shelled eggs. Eggs had a mean length of 25.6 mm (24.9–26.0 mm), a mean width of 10.4 mm (10.0–11.3 mm), a mean mass of 1.8 g (1.7–1.9 g; total clutch mass = 9.1 g), and a mean volume of 1.5 cm^3 (1.4–1.7 cm^3). The lizard was 95.7 mm SVL, 120.8 mm tail length, and mass (without eggs) of 27.9 g. The female and eggs (DFCH-USFQ 0558) were deposited at the Universidad San Francisco de Quito.

Based on these data, clutch size in *E. cofanorum* ranges from 2 to 5. This range is smaller, but overlaps that of *E. laticeps*, a sympatric arboreal/terrestrial congener with larger clutches (5–7 eggs, mean = 6.2), smaller eggs (15.0–16.6 mm, mean = 15.6 mm) and larger females (107–125 mm SVL, mean SVL = 114 mm; Duellman 1978, *op. cit.*; Vitt and De la Torre 1996. Research Guide Lizards of Cuyabeno. Mus. Zool. QCAZ-PUCE Monogr. 1:1–165).

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EUMECES FASCIATUS (Five-lined Skink). **PREDATION**. Terrestrial predators pose a risk to many lizards; however, aquatic predators might also threaten terrestrial lizards that use the edges of aquatic habitats (Pianka and Vitt 2003. Lizards: Windows to the Evolution of Diversity. Univ. California Press, Berkeley. 333 pp.). Here, I report a predation event by a fish on *Eumeces fasciatus*.

At 1120 h on 31 July 2002, while fishing in Bay Creek, Pope County, Illinois (37°31'21"N, 88°39'15"W; elev. 164 m), I caught an adult (ca. 140 mm fork length) long-eared sunfish (*Lepomis megalotis*) that had eaten a juvenile *E. fasciatus* (29.2 mm SVL). The skink, still in the buccal cavity of the fish, appeared to have been recently consumed.

Known predators of *E. fasciatus* include various birds, mammals, snakes, and other lizards (Fitch 1954. Univ. Kansas Publ. Mus. Nat. Hist. 8:1–156), but predation by fish is unreported. Fish are atypical predators as *E. fasciatus* usually occupies forested habitats (Smith 1961. Illinois Nat. Hist. Surv. Bull. 28:1–298). The surrounding habitat of Bay Creek is oak-hickory forest and *E. fasciatus* is common on exposed rocks bordering the creek. The *L. megalotis* was caught along the bottom edge of a 10–12 m vertical sandstone cliff at a point where the creek undercut the rock. The skink likely fell into the water from the steep rock escarpment above the creek and was then consumed.

I thank Scott Hegrenes, John Petzing, Erin Shepard, Lindsay Shepard, and Laurie Vitt. The *E. fasciatus* (INHS 18552) was deposited in the Illinois Natural History Survey herpetology collection in Champaign, Illinois.

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GAMBELIA WISLIZENII (Long-nosed Leopard Lizard). **NECROPHILIA**. Reports of mating or attempted mating with a dead conspecific or heterospecific individual are limited to the monogamous Australian skink, *Tiliqua rugosa* (How and Bull 1998. Herpetol. Rev. 29:240) and the Brazilian snake, *Tachymenis brasiliensis* (Amaral 1932. Mem. Int. Butantan 7:91–94). Here, I describe an occurrence of this behavior in *Gambelia wislizenii* from west-central Nevada, USA.

On 23 June 2004 at midday during color-manipulation experiments to investigate the role of breeding coloration in mate choice, I observed a male *G. wislizenii* attempting to mate with a brightly colored road-killed female in the South Magazine area of the Hawthorne Army Depot (HWAD), Hawthorne, Mineral Co. (38°30'0.8.3"N; 118°37'16.7"W; elev. ca. 1350 m). Judging from the carcass, the female had probably been killed within a few hours, but was clearly dead (her intestinal tract had been expelled from the impact and ants had begun scavenging the carcass). When found, the male was biting the right shoulder of the dead female, a behavior that is performed to initiate copulation (K. Fallahpour, unpubl. data). I watched the pair from a distance of 2–3 m for 5 min. The male froze in position and watched me for the duration of the observation. Thereafter, I approached the pair slowly and attempted to separate the male from the dead female by nudging him with a metal rod. After ca. 1 min of trying to separate them, the male dragged the dead female about 3 m away under a shrub on the road edge. At this point, the dead female was lying on her back, but the male maintained his grasp of her shoulder with his mouth. After an additional 5 min no other behavior was observed. I then approached the male again and began nudging him in an attempt to separate the pair. He released the female but remained next to her. I then introduced the male to a previously captured female *G. wislizenii* that was painted white to mask her breeding coloration. I placed the female ca. 1 m from the male using a cotton-thread harness attached to a thin monofilament line tethered to a fishing pole. The male immediately approached the tethered female and courted her: tongue flicked her, crawled on top of her, and bit her on the neck in an apparent attempt to initiate copulation. This continued for ca. 5 min. I then separated the two by removing the female. The male immediately ran back to the dead female, circled around her once, and bit her neck again. I watched him for an additional 5 min as he continued to attempt to copulate with the dead female.

During the breeding season, female *G. wislizenii* develop vibrant red-orange coloration on the sides of the head, body, and the ventral side of the tail (Montanucci 1967, Herpetologica 23:119–126). This bright coloration is absent in males and has been suggested to play a role in mate-choice decisions such as sex recognition, courtship stimulation, courtship rejection, or aggression avoidance (Cooper and Greenberg 1992, *In* Gans and Crews [eds.], Biology of the Reptilia, Vol. 18, pp. 298–422. Univ. Chicago Press, Chicago, Illinois). However, the role of breeding coloration in *G. wislizenii* has not been tested empirically, and anecdotal observations (summarized in Cooper and Greenberg, *op. cit.*) provide conflicting interpretations (receptive vs. unreceptive to mating). During this observation, the male attempted to copulate with a colored female just as readily as with a plain female. This would seem to support the hypothesis some investigators have suggested, i.e., that female breeding coloration in *G. wislizenii* might not be important to male mate selection (Fallahpour and Espinoza 2004. Integ. Comp. Biol. 43:847; Moore 1983. The Function of Orange Breeding Coloration in the Social Behavior of the Long-nosed Leopard Lizard [*Gambelia wislizenii*]. MS Thesis, Oregon State Univ., Corvallis, Oregon).

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and Comparative Biology, the American Society of Ichthyologists and Herpetologists, and CSU Northridge for funding my research. R. E. Espinoza and M. P. Hayes provided helpful comments on the note.

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GONATODES HUMERALIS (NCN). **OVIPOSITION SITE.** Most studies of reproduction in Brazilian lizards focus on the ecological aspects of the reproductive cycle. Oviposition sites are infrequently described. Among Amazonian *Gonatodes*, oviposition data exist only for *G. humeralis*. Eggs have been found behind loose bark on a tree trunk or base, between roots and among dead leaves, in termite nests, hidden below the surface in fine organic debris, concealed in a space below a stone, or in the hollow of a partly decayed tree branch (Avila-Pires 1995. Lizards of Brazilian Amazonia [Reptilia: Squamata]. Zoologische Verhandelingen. 706 pp. and references therein). Here, we describe a previously unrecorded oviposition microhabitat for *G. humeralis* in NE Brazil. Between 27 February and 11 March 2004, we found 10 eggs in the axils of five bromeliads (species not identified) in a mesophyllous secondary forest in the municipality of Urbanos Santos (3°12'28"S; 43°24'12"W; elev. 41 m), state of Maranhão. We found 1–3 *G. humeralis* eggs in each bromeliad (mean = 2; SD = 1), laid 15–23 cm (mean = 20 cm; SD = 2.6 cm; N = 10) above the ground. The eggs averaged 0.17 g in mass (SD = 0.02, range: 0.13–0.20), 7.4 mm in length (SD = 0.3, range = 7.0–8.0), and 6.4 mm in width (SD = 0.2; range: 6.0–6.6). The eggs were incubated in plastic containers and moistened every two days. Nine of the eggs hatched between 22 April and 01 May 2004; all were identified as *G. humeralis*. Hatchlings averaged 16.3 mm SVL (SD = 0.5, range: 15.5–16.9) and 0.13 g in mass (SD = 0.02, range: 0.11–0.15). The hatchlings were released after measurement.

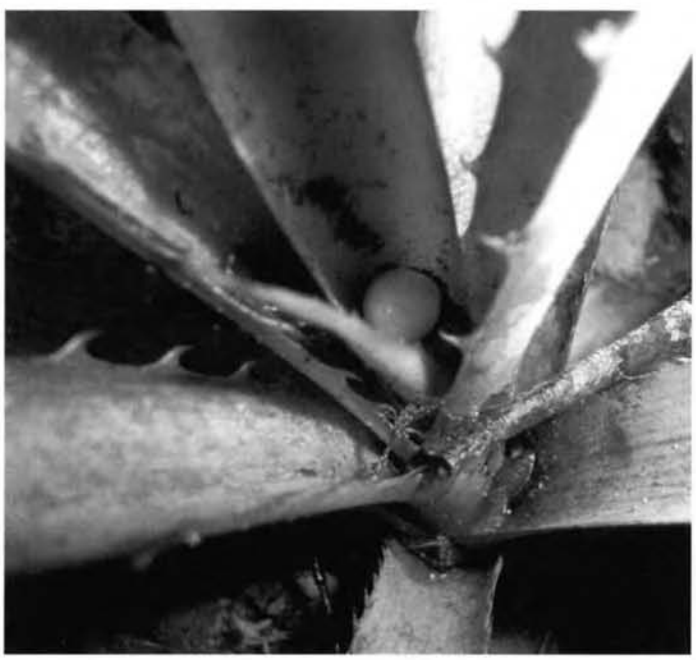

FIG. 1. *Gonatodes humeralis* egg in a terrestrial bromeliad axil.

Leaves of the oviposition bromeliads were characterized by sharp thorns along their margins (Fig. 1), which might provide protection for the eggs of *G. humeralis* against some predators. Accumulated water in these bromeliad axils also created a humid microhabitat that might minimize the risk of egg desiccation. Thus, the axils of some terrestrial bromeliads axils might offer a favorable incubation microhabitat for *G. humeralis* eggs. Data exist on *G. humeralis* using bromeliads at night (Nunes 2002. Ecologia da Floresta Amazônica-Curso de Campo, PDBFF-INPA, Manaus, 2nd ed., 163 pp.) and during the day up to heights of ca. 9 m (as *G. annularis*: Beebe 1944 cited in Avila-Pires 1995, *op. cit.*), but this is the first report of *Gonatodes* laying eggs in terrestrial bromeliads.

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HEMIDACTYLUS MABOUIA (Tropical House Gecko). **PREDATION.** According to Vaughan (1976. J. Mammal. 57:227–248), the Heart-nosed Bat (*Cardioderma cor*) preys mainly on

FIG. 1. Heart-nosed bat, *Cardioderma cor*, eating a *Hemidactylus mabouia*. Photo by Leigh Ecclestone.

large, ground-dwelling beetles, but centipedes and scorpions and occasionally small bats are also consumed. Here, we report a direct observation of one Heart-nosed Bat feeding on a *Hemidactylus mabouia*.

While working on an informational exhibit on the harmless snakes of Kasigau at the Taita Discovery Center (TDC), Edwin Selempo, head naturalist for the TDC, heard the unmistakable sound of small bones being crunched overhead. Just 3.5 m above us was a *C. cor* hanging by its hindfeet from the thatch roof, munching on the hindquarters and tail section of what was left of a *H. mabouia*. By the time DW retrieved his camera, just the tail section above the cloaca could be seen protruding from the bat's mouth (Fig. 1). We watched the bat consume most of the tail as it flew from one part of the ceiling to another, avoiding two other heart-nosed bats attempting to steal the, as yet, uneaten tail. Observations were made at 0800 h on 30 July 2004, under the roof of an open-air classroom at the Taita Discovery Center, Rukinga Ranch, Taita/Taveta District-Coast Province, Kenya.

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HOPLODACTYLUS MACULATUS (Common Gecko). **AGGREGATIONS**. Aggregative behavior has been observed in many squamate lineages (e.g., Brattstrom 1974. Amer. Zool. 14:35–49; Cooper and Gartska 1987. Copeia 1987:807–810; Gregory 2004. Herpetologica 60:178–186). However, lizard aggregations in diurnal retreat sites are rarely documented (Shah et al. 2003. Behaviour 140:1039–1052). Hence, we report here on the demographic structure of an unusually large (N = 94), diurnal aggregation of *Hoplodactylus maculatus* on a New Zealand island. On 17 May 2004 (autumn), we surveyed the *H. maculatus* occupying wooden, pest-control bait boxes as diurnal retreat sites. The bait boxes, deployed on the shoreline of Mana Island (40°40'S, 174°00'E) to control accidental rodent (e.g., *Rattus* sp.) incursions, ranged in size from 8.3 to 12.4 L, each with an internal central 0.5 L bait partition where the geckos commonly congregated beneath the bait holder. Fourteen bait boxes were surveyed between 1000 and 1500 h.

A total of 183 *H. maculatus* were found within the 14 bait boxes, with a mean of 13 ± 6 SE geckos per box. However, one bait box contained about half (N = 94) of all geckos captured, and two lacked geckos entirely. The aggregation of 94 geckos (39 juveniles, 11 males, 44 females) was very densely packed within the 0.5 L partition of the bait box, filling the entire area to capacity. Snout–vent length of adult males was slightly larger than adult females (72.7 ± 0.7 and 69.0 ± 0.7 SE mm respectively; $F_1 = 10.330$, $p = 0.002$) and did not differ between the large and smaller aggregations ($F_1 = 2.015$, $p = 0.160$). Overall, 36% of geckos in bait boxes were juvenile or sub-adult, 16% adult males and 48% adult females. The adult sex ratio varied substantially among bait box aggregations (range = 1:7 to 2:0 m:f). The only other lizard species found within the bait boxes was the skink *Oligosoma lineoocellatum*, one of which was found in a bait box with six *H. maculatus*, but not within the bait partition containing geckos.

Hoplodactylus maculatus, a moderate-sized (to 82 mm SVL) widespread, endemic, nocturnal gecko (Gill and Whitaker 2001. New Zealand Frogs and Reptiles, David Bateman, Auckland, New Zealand. 112 pp.), is frequently observed in diurnal aggregations. However, few aggregations have been documented, and details and measurements of aggregations have not been reported. For example, on Stephens Island, Cook Strait, up to 200 individuals were found beneath a corrugated iron sheet (Bauer 1990. Phylogenetic Systematics and Biogeography of the Carphodactylini [Reptilia: Gekkonidae]. Bonn. Zool. Monogr. 30, 217 pp.) and on Mana Island mixed age and sex groups of 10–15 individuals are common, with occasional large aggregations of >60 individuals (Whitaker 1993. Unpubl. report, New Zealand Department of Conservation, Wellington, New Zealand. 53 pp.).

Hoplodactylus maculatus is unlikely to aggregate because of a lack of suitable retreat sites, as the shore platform provides a complex habitat of rocks and logs that could be readily used. Aggregation, despite an abundance of retreat sites, could imply that the benefit may derive from social groups (Shah et al., *op. cit.*). However, the high variance in adult sex ratios suggests that aggregations may not always represent family groups or harems. Aggregative behavior in the nocturnal gecko *Nephrurus milii* might have evolved to provide facultative control over rates of thermal exchange (Shah et al., *op. cit.*), which offers a possible explanation for aggregations of *H. maculatus*. Other *Hoplodactylus* species have also been observed to aggregate in mixed size and sex class groups, including *H. duvaucelii* (Robb 1980. New Zealand Amphibians and Reptiles in Colour. Collins, Auckland, New Zealand. 128 pp.) and *H.* sp. 'Otago-Southland large' (Southey 1986. Unpubl. report, New Zealand Wildlife Service, Queenstown). Aggregation might be widespread and frequent in the genus *Hoplodactylus,* but its purpose needs clarification.

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LEIOCEPHALUS CARINATUS ARMOURI (Northern Curly-tailed Lizard). **ENTANGLEMENT IN HUMAN-MADE MATERIALS**. Reports exist of reptiles caught in persistent, man-made debris. These materials result in deformity or death to freshwater turtles (Dietz and Ferri 2003. Herpetol. Rev. 34:56; McLeod 1994. Herpetol. Rev. 25:116–117; Odum 1985. Herpetol. Rev. 16:113) or tortoises (Engeman et al. 2004. Herpetol. Rev. 35:54–55); entanglement, injury, and death to upland snakes (see review in Stuart et al. 2001. Herpetol. Rev. 32:162–164); and, entanglement and death to desert lizards (Stuart et al., *loc cit.*). Here we add to these reports with an observation of *Leiocephalus carinatus armouri* found entangled in a metal ring.

At ca. 0830 h, 26 October 2003, a sunny day with a temperature ca. 25°C, one of us (CLD) observed an adult (71.0 mm SVL) *L. c. armouri* with a metal ring (22 mm exterior diameter, ca. 17–18 mm interior diameter) caught around its body just forward of the

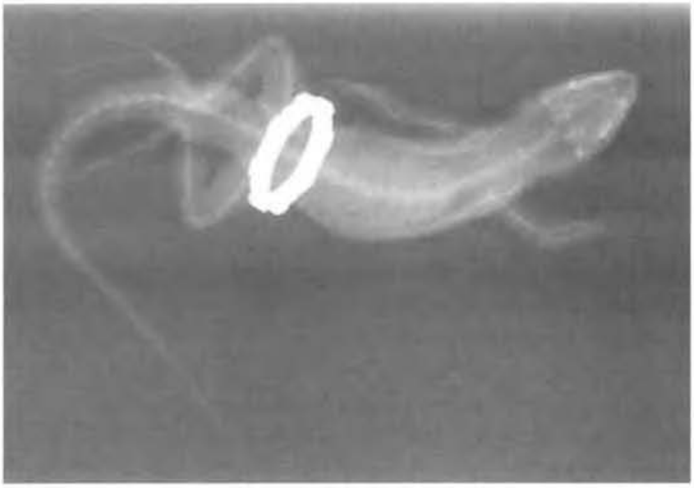

FIG. 1. Radiograph of *Leiocephalus carinatus armouri* entangled in a metal ring.

pelvic girdle (Fig. 1). The site was the parking lot of "Loggerhead Plaza" (14255 US Highway 1 in Juno Beach [Palm Beach Co.], Florida). The town of Juno Beach is within a relatively contiguous 90 km of the surveyed, occupied range of this exotic species in Florida (Smith and Engeman 2003. Florida Park Service Tech. Rep., Hobe Sound, Florida; Smith et al. *In press*. International Biodeterioration and Biodegradation).

The lizard was first observed basking on a curb in the parking lot. Under normal conditions, *L .c. armouri* is very fast fleeing when making an escape to a burrow or other refugium (Smith and Engeman, *loc. cit.*; Meshaka et al. 2004. The Exotic Amphibians and Reptiles of Florida, Krieger Publishing Company, Malabar, Florida. 166 pp.). Although this lizard attempted to elude capture, mobility was hindered by the metal ring, and it was unable to fully extend its hind legs, causing it to drag the distal portion of its body.

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MICROLOPHUS QUADRIVITTATUS (NCN). **CANNIBALISM.** *Microlophus quadrivittatus* is a lizard restricted to the southern part of the coastal desert in Peru (Carrillo and Icochea 1995. Pub. Mus. Hist. Nat. UNMSM 49:1–27). Its diet consists of intertidal invertebrates, marine algae, and some dipterans (Donoso-Barros 1966. Reptiles de Chile. Ediciones Univ. Chile, Santiago. 458 pp.; Perez and Jahncke 1998. Bol. Inst. Mar del Peru 17:81–86), but cannibalism is unreported. Here, we provide the first report of cannibalism in this species.

At 1200 h on 23 March 2000, we captured an adult male *M. quadrivittatus* (146 mm SVL, 85 g, MHNSM 18598) among rocks near the sea shore at Coles Point (17°42'S; 71°22'W; elev. 5 m), Departamento de Moquegua, Peru. The stomach of the adult male *M. quadrivittatus* contained a conspecific juvenile (ca. 70 mm SVL, 8.9 g., MHNSM 18599). The juvenile lacked apparent bite marks, but its tail was partially broken. Additionally, we examined the stomach contents of 20 other *M. quadrivittatus* from this same locality, but this was the only record of cannibalism among them (unpubl. data).

Adults and juvenile of *M. quadrivittatus* show differences in their microhabitat use that would reduce opportunities for cannibalism (Donoso 1948. Bol. Mus. Nac. Hist. Nat. 34:213–216), but the frequency of this phenomenon remains unknown.

Both specimens were deposited in the Department of Herpetology collection of the Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos, Lima, Peru. We thank Carlos Frederico D. Rocha and Edgar Lehr for beneficial comments on versions of this manuscript.

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NEOSEPS REYNOLDSI (Sand Skink). **LONGEVITY**. Skinks in general are relatively long-lived (e.g., *Eumeces fasciatus* can live up to 10 years; Fitch 1965. Univ. Kansas Mus. Nat. Hist., Misc. Publ. [42]:1–60). Fossorial skinks have exceptionally low metabolic rates (Andrews and Pough 1985. Physiol. Zool. 58:214–231; Withers 1981. Copeia 1981:197–204) and thus might be expected to be particularly long-lived. *Neoseps reynoldsi* is a fossorial skink for which estimates of longevity range from 3 (Telford 1959. Copeia 1959:110–119) to 7 years (Sutton 1996. MSc thesis, Univ. of South Florida, Tampa. 45 pp.). Here, we present mark-recapture information on a *N. reynoldsi* from Archbold Biological Station, Highlands Co., Florida that exceeds previous estimates of longevity.

On 11 March 2002, we captured a marked (left foreleg removed) *N. reynoldsi* (62 mm SVL, 1.3 g) under a coverboard. During 1994 an individual (54 mm SVL) at this study site was given this mark. No individuals at this site have been marked since 1994. *Neoseps reynoldsi* have greatly reduced limbs with one (forelegs) or two (hindlegs) small digits per foot. That the mark was from natural loss is unlikely because, 1) the entire left foreleg was removed, and 2) of ~100 *N. reynoldsi* captured by KGA none has ever been missing entire limbs. Mark-recapture data suggest that *N. reynoldsi* reach 54 mm SVL in the second or third year of life (Sutton, *op. cit.*). If this individual was at least two years old in 1994, it must be at least 10 years old now. The long life span of *N. reynoldsi* might be explained in part by life history (clutch size of two, reproducing at most once/year; Ashton, unpubl. data) and physiological correlates of fossoriality (i.e., low metabolic rate; Andrews and Pough, *op. cit.*; Withers, *op. cit.*).

Permit WX01623 from the Florida Fish and Wildlife Conservation Commission to KGA made these observations possible.

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OLIGOSOMA LINEOOCELLATUM (Spotted Skink). **LONGEVITY, SITE FIDELITY.** New Zealand reptiles are widely known for their great longevity and low reproductive output (Cree 1994. New Zealand J. Zool. 21:351–372; Daugherty et al. 1993. TREE 8:437–442). For example, Tuatara (*Sphenodon punctatus*) have a minimum longevity of 81 yrs (N. Nelson, pers. comm.), geckos (*Hoplodactylus duvaucelii* and *H. maculatus*) live for at least 36 yrs (Thompson et al. 1992. J. Royal Soc. New Zealand 22:123–130; Bannock et al. 1999. New Zealand J. Ecol. 23:101–103), the skink *Cyclodina whitakeri* has a minimum longevity of 16–18 yrs (Towns and Ferreira 2001. Biol. Cons. 98:211–222), and the skink *Oligosoma suteri* can live for a minimum of 12 yrs (Towns and Ferreira, *op. cit.*). However, conclusions about the generality of great longevity in New Zealand reptiles are based on limited data; few records exist for many free-living reptile species because of the lack of long-term mark-recapture studies on many New Zealand reptiles. Here, we augment longevity information on New Zealand reptiles with a report for the spotted skink, *O. lineoocellatum.*

During studies of skink habitat use, *O. lineoocellatum* were individually marked on two Cook Strait islands: North Brother Island in 1999 (Phillpot 2000. MSc thesis. Victoria University of Wellington) and Stephens Island in 1991–1992 (East et al. 1995. New Zealand J. Zool. 22:249–261). Six of the 332 skinks marked on North Brother Island were recaptured by JMH in 2004. All six skinks recaptured were marked as adults in 1999 (SVL > 62.1 mm; Spencer et al. 1998. New Zealand J. Zool. 25:457–463). As New Zealand skinks are thought to take ca. 3 yrs to reach maturity (Whitaker 1976. Forest and Bird 202:8–11), our most conservative estimate of longevity for *O. lineoocellatum* is 8 yrs in the wild. New Zealand lizards often exhibit strong site fidelity (e.g., Barwick 1959. Trans. Royal Soc. New Zealand 86:331–380), which is supported by the recapture of five of the six skinks on North Brother Island within 15 m of their initial capture sites. However, one individual was recaptured ca. 60 m from its original capture point, which demonstrates that limited dispersal is possible. On nearby Stephens Island, 360 *O. lineoocellatum* were individually marked in 1991–1992. No marked lizards were recaptured by CLS despite intensive pitfall-trapping at the same sites in November 2002 and March 2003 in which 397 and 340 animals, respectively, were caught in the same grids, and the recapture rate reached 80% by the end of each survey. As these skinks were not permanently marked, it is not possible to investigate site fidelity across seasons. However, during a trapping season, 70% of recaptured skinks (marked by non-permanent marker pen) were recaptured in the same trap, and 96% were recaptured within 7 m of initial capture. Because of strong site fidelity and the capture of a large number of *O. lineoocellatum* during the re-survey, a reasonable chance exists that skinks marked in 1991–1992, and still surviving, would have been recaught. We therefore suggest that maximum longevity in the wild is less than 14 yrs for *O. lineoocellatum.*

Our finding that *O. lineoocellatum* live for 8 to <14 yrs in the wild agrees with findings for other New Zealand skinks (e.g., Towns and Ferreira, *op. cit.*). In comparison to other skinks (e.g., Read 1998. Aust. J. Zool. 46:617–629), New Zealand species are relatively long-lived with low reproductive output, possibly as a result of the physiological limitations of living at colder temperatures (Cree, *op. cit.*) and historical lack of predation by mammals (Daugherty et al., *op. cit.*).

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OPHISAURUS ATTENUATUS LONGICAUDUS (Slender Glass Lizard). **CLUTCH SIZE and BROODING**. Reproductive data among North American glass lizards (*Ophisaurus*) has been obtained largely from *O. ventralis* (e.g., Fitch 1989. Occas. Pap. Mus. Nat. Hist. Univ. Kansas 125:1–50; Vinegar 1968. Bull. California Acad. Sci. 67:65–68; Witz and Wilson 1993. Florida Field Nat. 21:36–37). Except for Fitch (*op. cit.*), who reported clutch sizes of 5–16 for *O. a. attenuatus* in Kansas, and Mount (1975. The Reptiles and Amphibians of Alabama. University of Alabama Press. Tuscaloosa, Alabama. 347 pp.), who noted two gravid *O. a. longicaudus* from Alabama contained 5 and 10 oviductal eggs, reproductive data on *O. attenuatus* are lacking. Hence, here I report the first record of clutch size, egg size, and brooding behavior in *O. a. longicaudus* from Tennessee, USA.

At 1045 h on 2 July 2004, I discovered an adult female slender glass lizard with eggs (Fig. 1) in a depression under a wooden cover board in the southwestern portion of Arnold Air Force Base in Franklin County (35°21'22"N, 86°09'00"W; elev. 335 m). To minimize disturbance, neither the female nor the eggs were physically manipulated; only eggs that could be measured without handling were used to estimate egg size. Using a single data logger-linked thermocouple, air and substrate temperatures were measured at four locations 90° to each other ca. 0.5 m from the nest, and taken ca. 7 cm above and 3 cm below the substrate, respectively. I also obtained a nest temperature by positioning the thermocouple between the eggs and the body of the female.

The nest was located in a young, open Loblolly Pine (*Pinus taeda*) forest with < 25% canopy cover and a graminoid-dominated groundcover. Located ca. 10 m from the edge of an adjacent closed canopy pine forest, the nest was ca. 20 m from a seldom-used gravel road separating this area from a 2-yr-old clear-cut containing early successional vegetation comprised primarily of grasses and woody debris.

The female, ca. 1 m total length, was coiled around eight eggs; three eggs measured were estimated to be 2.3 x 1.4 cm. At 1100 h,

the air and substrate were 24.2°C and 25.2°C, respectively. The nest temperature, taken within 1 min of the substrate temperatures, was 26.7°C. The female remained motionless during measurements of egg sizes and temperatures.

Clutch size is within the range reported for *O. attenuatus* (Fitch, *op. cit.*; Mount, *op. cit.*), and both clutch size and egg sizes observed were similar to those for the congeneric *O. ventralis* (Gras-Riedel 1993. Salamandra 28:161–170; Schwab 1992. Herpetol. Rev. 23:60; Witz and Wilson, *op. cit.*). Further, the female being coiled around the eggs is a characteristic part of what has been termed brooding among North American *Ophisaurus* (Mount, *op. cit.*). This behavior is thought to be maintained through hatching in late summer-early autumn (Mount, *op. cit.*), but its function is poorly understood. Smith (1946. Handbook of Lizards: Lizards of the United States and Canada. Comstock Publ. Co., Inc. Ithaca, New York. 557 pp.) suggested that brooding in *Ophisaurus* increases nest temperature, presumably enhancing offspring development. However, given the small temperature differences (0.2–0.4°C) previously observed between the body of the female and the substrate, a thermoregulatory benefit was deemed unlikely (Noble and Mason 1933. Amer. Mus. Novitates 619:1–21; Vinegar, *op. cit.*). My recording of a nest temperature at least 1.5°C higher than the substrate temperature may restore confidence in the thermoregulatory importance of brooding, however demonstration that it enhances embryonic development is needed. Based on female *Ophisaurus* failing to protect their eggs after being exposed to potential nest predators, Noble and Mason (*op. cit.*) concluded that it was also doubtful that females remain with the eggs for the sole purpose of defense. The lack of female response I observed during intrusion to the nest might support this idea, but does not exclude the possibility that remaining with the eggs may deter small predators.

I thank Arnold Air Force Base for providing support for field work.

FIG. 1. An adult female *Ophisaurus attenuatus longicaudus* coiled around a clutch of 8 eggs in Franklin County, Tennessee.

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OPHISAURUS VENTRALIS (Eastern Glass Lizard) **PREDATION.** Atypical encounters can result in opportunistic predation on unusual reptilian prey (Smith and Engeman 2003. Herpetol. Rev. 34:245–246; Woodin and Woodin 1981. Florida Field Nat. 9:64). Using tactile probing, the White Ibis (*Eudocimus albus*) feeds mainly on fiddler crabs and insects, but also selectively consumes crayfish, crabs, insects, and frogs in greater proportions during nesting season (Kushlan and Bildstein 1992. *In* A. Poole and F. Gill [eds.], The Birds of North America. pp. 1–20. The Academy of Natural Sciences, Philadelphia; and AOU, Washington, DC.). Here, we report an instance of predation by White Ibis on an *Ophisaurus ventralis* in southeastern Florida.

At ca. 0845 h, 24 February 2004, a cloudy day with an air temperature ca. 23°C, JAM observed five adult White Ibis foraging in the lawn and sandy patches below a palm tree in a backyard in Vero Beach (27°38.444'N, 80°25.071'W; elev. 4 m). The ibises were soil-probing with their bills when one individual stood up with what was clearly an *O. ventralis* of about 45 cm (total length) in its bill. The ibis tried to reposition the lizard for swallowing when JAM inadvertently disturbed it; consequently, it flew off with the glass lizard still in its bill.

A small colony of *O. ventralis* has existed under the deck of the house, and in the leaf litter in this backyard since at least 2001 (unpubl. data). The event was noteworthy because white ibises are largely crustacean diet-specialized wading birds that were foraging in a terrestrial situation, and captured a fossorial reptile. The typical predators of *Ophisaurus* include snakes, hawks, and carnivorous mammals (Means 1992. *In* Moler [ed.], Rare and Endangered Biota of Florida, pp. 247–250, University Press of Florida, Gainesville; Beane 1995. Wildlife Profiles, NC Wildlife Resources Commission, Raleigh, North Carolina. 2 pp.). Likewise, we know of no similar depredation reports for *O. ventralis* in the literature.

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PHELSUMA LATICAUDA LATICAUDA (Golden Dust Day Gecko). **NECTARIVORY.** *Phelsuma l. laticauda*, a highly territorial, arboreal day gecko endemic to Madagascar and the Comoros Islands, has been introduced to Farquhar Island (southern Seychelles) and Hawaii, where it can reach locally high densities (McKeown 1996. A Field Guide to the Reptiles and Amphibians of the Hawaiian Islands. Diamond Head Pub. Inc. California. 172 pp.). Here, I report on nectar consumption and potential pollination behavior in introduced Hawaiian *P. l. laticauda*.

Between 1600 and 1900 h on 27 July 2001, several *P. l. laticauda* were observed in Kona, on the west coast of the island of Hawaii (19°36'00"N, 155°59'25"W; elev. ca. 30 m), drinking nectar from flowers of *Strelizia nicolai* (Strelitziaceae) and coming in contact with both the stamens and stigmas of *S. nicolai*.

Strelizia nicolai was also introduced to Hawaii from subtropical

South Africa for ornamental purposes (Hensley et al. 1998. Bird of Paradise. Univ. Hawaii Coop. Ext. Pub. OF-27, Honolulu, Hawaii), and the behavior I observed suggests that *P. l. laticauda* has the potential to facilitate its pollination. Flower visitation and pollination in the wild has been reported in other species of *Phelsuma* (Nyhagen et al. 2001. J. Trop. Ecol. 17:755–761 and references therein), and the genus is known to be highly nectarivorous and frugivorous in captivity, a pattern that the appellation "hummingbirds of lizarddom" reflects (Rundquist 1995. Day Geckos. TFH Publications, Inc., Neptune City, New Jersey. 64 pp.). This, together with a largely island-based distribution where the diversity of pollinators is usually low (Olesen and Jordano 2002. Ecology 83:2416–2424), suggests that specialized plant-lizard interactions worthy of research attention might occur in the genus *Phelsuma*.

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SCELOPORUS OLIVACEUS (Texas Spiny Lizard). **ECTOPARASITISM**. The chigger mite *Eutrombicula alfreddugesi*, the most frequent cause of mite infestation in the United States, burrows into the outer skin, producing a characteristic itch and associated inflammation (Potts 2001. Postgrad. Med. 110:57–64). Several studies have documented infestations of this mite in sceloporine lizards (*Sceloporus undulatus*: McAllister 1980. Proc. Arkansas Acad. Sci. 34:125; *S. grammicus microlepidotus* and *S. palaciosi*: Gadsden 1988. Acta Zool. Mex. [n.s.] 30:21–31); however, infestation of *S. olivaceus* is unreported. Here, we report chigger mite parasitism in *S. olivaceus* from northern México.

In October 2003, during a study on the herpetofauna at the Parque Ecológico Chipinque in the municipalities of Garza García and Monterrey, Nuevo León (25°34'50"N, 100°21'55"W; elev. 1365 m), we captured 13 adult *S. olivaceus* with a noose or by hand. Data obtained for each lizard included sex (hemipenal eversion used to identify males), snout–vent length (SVL, to nearest mm), weight (W, with a 30-g Pesola™ spring scale) and the total number of chigger mites carried (T_m). To obtain the latter, we carefully examined lizards, but especially the neck pockets, axillae, and postfemoral pleats. The mites were removed at the place of capture using wetted cotton swabs. The red color of the mites allowed counting them on the surface of the cotton with a magnifying glass and collecting them. Lizards were released at the place of capture. We used Talleklint-Eisen and Eisen criteria (1999. Exp. Applied Acarology 23:731–740) to categorize infestation intensity: low (1–6 mites per individual), moderate (7–15), or high (> 15). A Kolmogorov-Smirnov goodness of fit test revealed SVL, W, and T_m to be normality distributed, so we used t-tests to compare means of SVL, W, and T_m between males and females. We also carried out regression analysis between SVL and T_m, and W vs T_m for both sexes. We assumed all tests to be significant at $a = 0.05$; measurements are reported as mean ± SE.

We captured 13 *S. olivaceus* (7 males and 6 females), all of which carried chigger mites. Mean SVL (86.6 ± 7.1 mm) and W of females (23.5 ± 4.6 g) was significantly greater than the mean SVL (44.8 ± 6.1 mm) and W (5.1 ± 2.7 g) of males (SVL: t = 3.40, $P = 0.007$; W: t = 4.42, $P = 0.001$). Of the 7 males, one each showed a low and a moderate infestation, but in the remainder (71.4%; N = 5), infestation was high. Of the 6 females, half had low and half had high infestations. Mean T_m for males (47.5 ± 12.7; range: 3–100) and females (23.1 ± 10.5; range: 1–60) were similar (t = 1.44; $P = 0.170$). We found no relationship between SVL and T_m for males (r = 0.26; $F_{1,5} = 0.38$; $P = 0.564$; N = 7) and females (r = 0.10, $F_{1,4} = 0.04$; $P = 0.847$; N = 6); or between W and T_m for each sex (males: r = 0.59, $F_{1,5} = 2.72$; $P = 0.164$; N = 7; females: r = 0.70, $F_{1,4} = 3.92$; $P = 0.119$; N = 6). Mites were found exclusively in the neck pockets of males and females.

No significant relationship was found between SVL and W or T_m in males or females, so mite infestation might not reduce the physical condition of *S. olivaceus* as Schall et al. (2000. J. Herpetol. 34:160–163) and Vrcibradic et al. (2000. Herpetol. Rev. 31:174–175) discuss in their respective studies involving *S. occidentalis* and *Geckobiella texana*, and *Mabuya macrorhyncha* and *E. alfreddugesi*. However, our samples were small, and more data will be required to verify the lack of relationship. Mites being concentrated in neck pockets for both sexes supports the idea that neck pockets may be preferred when space exists to attach inside them. This can benefit the host as functionally important areas, like the eardrums and axillae (Salvador et al. 1999. Herpetologica 55:1–7) are not used.

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SCELOPORUS UNDULATUS UNDULATUS (Eastern Fence Lizard). **KYPHOSIS AND SCOLIOSIS**. Kyphosis and other malformations of the vertebral column like scoliosis are well known in turtles (e.g., Nixon and Smith 1949. Turtox News 27:28–29; Rhodin et al. 1984. British J. Herpetol. 6:369–373; Stuart 1996. Bull. Chicago Herpetol. Soc. 31:60–61) and occasionally reported for snakes usually as a result of developmental malformations (Frye 1991. *In* Frye [ed.], Biomedical and Surgical Aspects of Captive Reptile Husbandry, Vol. 2, pp. 393–420, Krieger Publ. Co., Mabalar, Florida; Gray et al. 2003. Bull. Chicago Herpetol. Soc. 38:4–6). Most malformations reported for lizards include bifurcations of the tail that usually are results of injuries (Blair 1960. The Rusty Lizard. Univ. Texas Press, Austin, Texas, 185 pp.; Scott 1982. Herpetol. Rev. 13:46; Smith 1946. Handbook of Lizards. Cornell Univ. Press, Ithaca, New York, 557 pp.). Reports of other types of abnormalities are rare. Tinkle (1967. Misc. Publ. Mus. Zool. Univ. Michigan 132:1–182) listed a juvenile female *Uta stansburiana* with a crooked tail, apparently a case of scoliosis. In this note, we describe the first case of a sceloporine lizard with both kyphosis and scoliosis.

On 25 September 2002, we caught a juvenile female *Sceloporus undulatus* (48 mm SVL, 78 mm tail, 6.8 g) on leaf litter in mixed hardwoods and pine adjacent to a vernal pool in the Colonial

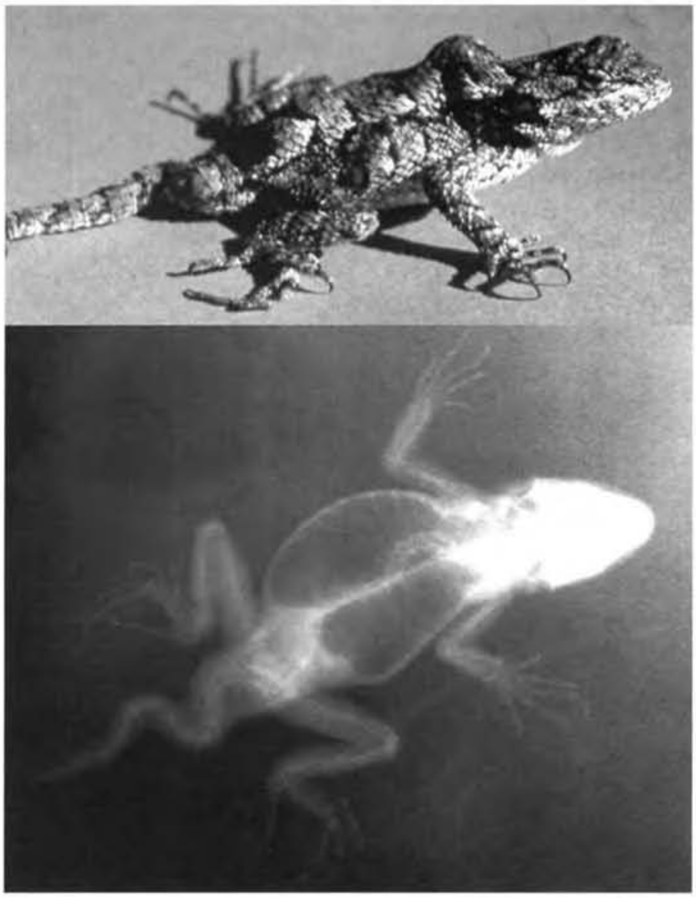

FIG. 1. *Sceloporus undulatus* from Virginia with multiple kyphosis and scoliosis.

National Historical Park, 4.3 km S Yorktown, York County, Virginia (37°11'39"N, 76°30'45"W; elev. 13 m). She exhibited two vertical curvatures of the spine (kyphosis), one behind the pectoral region and one over the pelvic girdle (Fig. 1). The anterior one was also curved to the left and the posterior one was curved to the right. In addition, her tail had three, alternating lateral curves near the base (scoliosis). This lizard experienced no obvious limitations in mobility or prey capture as she was maintained in captivity on live crickets until 19 June 2003. She actively pursued all prey introduced into her cage and grew 14 mm SVL during this period. We released her on that date at the site of capture.

We thank Judy Greene of Savannah River Ecology Lab for helping to secure the radiograph.

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SCINCELLA LATERALIS (Ground Skink). **ARBOREAL BEHAVIOR**. Ground Skinks are active foragers that prey on small terrestrial invertebrates (Brooks 1967. Ecol. Monogr. 37:71–87), but the behavioral ecology of this species is not well known (Akin 1998. Can. J. Zool. 76:87–93). In mixed hardwood forests of eastern North America, Ground Skinks typically are described as being diurnal, generally occurring in leaf litter (Mitchell 1994. The Reptiles of Virginia. Smithsonian Institution Press. 352 pp.). Here, we report an observation of nocturnal foraging in an arboreal microhabitat by this typically diurnal, terrestrial species.

While collecting harvestmen (Arthropoda, Sclerosomatidae) on an undeveloped forested portion on the Virginia Wesleyan College campus, Norfolk/Virginia Beach, Virginia (36°51'52"N, 76°11'34"W; elev. 4 m), we observed an adult (41 mm SVL) male *S. lateralis* actively foraging on small flying insects while climbing a tree. The habitat is mesic mixed hardwood forest with a tree canopy dominated by White Oak (*Quercus alba*), Southern Red Oak (*Quercus falcata*), and Red Maple (*Acer rubrum*); a dogwood (*Cornus florida*) understory; and an herb layer of Poison Ivy (*Rhus toxicodendron*), English Ivy (*Hedera helix*), Sassafras (*Sassafras albidum*), and occasional patches of Mayapple (*Podophyllum peltatum*). Ground Skinks occur, but are infrequent, in this habitat.

On 9 June 2004 at 2100–2115 h EST, we observed a ground skink slowly climbing the trunk of a small (20 cm diam) Black Gum (*Nyssa sylvatica*). When first spotted, the lizard was 80 cm above the ground. Using a red light headlamp, we observed the skink slowly move to a deep scar in the trunk at a height of 122 cm. During its ascent, the skink repeatedly moved its head laterally and tongue flicked frequently. Periodically, tongue flicks were followed by swift head movements that seemed directed at tiny flying insects hovering or landing near the lizard. During our 15-min observation period, the lizard approached several small black ants, juvenile wood roaches, and small harvestmen. It repeatedly attempted to capture the small flying insects, but ignored the larger arthropods. After it stopped climbing, we captured the lizard to measure it and verify its gender. We subsequently released it at the base of the tree.

Our observation is the first report of *S. lateralis* actively foraging at night in an arboreal microhabitat. This observation implies that these lizards might opportunistically climb plants in a manner similar to that reported for other typically terrestrial species, e.g., *Plethodon cinereus* (Jaeger 1978. Copeia 1978:686–691).

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TRACHYLEPIS SPILOGASTER (Kalahari Tree Skink). **ENDOPARASITES.** *Trachylepis spilogaster* occurs in arid savannah from Kimberley and Lower Orange River in Northern Cape Province, through Botswana and Namibia to southern Angola (Branch 1998. Field Guide to Snakes and other Reptiles of Southern Africa, Ralph Curtis Books, Sanibel Island, Florida. 399 pp.). Goldberg and Bursey (2001. Onderstepoort J. Vet. Res. 68:143–147) reported the cestode *Oochoristica truncata* and the nematodaes *Parapharyngodon rotundatus, Spauigodon petersi, Thubinaea fitzsimonsi,* and unidentified ascarid larvae from *T. (Mabuya) spilogaster* from Botswana. The purpose of this note is to report an additional species of Nematoda, *Abbreviata paradoxa,* in *T. spilogaster.*

Coelomic cavities of 334 (201 from Botswana, 133 from Republic of South Africa) were examined for helminths. One

female *T. spilogaster* collected 12 May 1970 (73 mm SVL, LACM 80927) from Cape Province, Republic of South Africa contained one nematode. The nematode was cleared in a drop of concentrated glycerol on a glass slide, cover-slipped, examined under a compound microscope, and identified as a female *Abbreviata paradoxa.* It was deposited in the United States National Parasite Collection, Beltsville, Maryland as USNPC (95027).

The physalopterid nematode, *A. paradoxa* is previously known from the scincids, *Trachylepis (Mabuya) occidentalis* and *Trachylepis (Mabuya) striata* from South Africa (Goldberg and Bursey, *op. cit.*), the varanids *Varanus albigularis* from South Africa (Linstow 1908. Denk. Med. Natur. Ges. 13:19–28), *Varanus bengalensis* from India (Baylis 1939. The Fauna of British India, including Ceylon and Burma. Nematoda. Vol. II. Taylor and Francis, London, 408 pp.), and *Varanus griseus* from Russia (Andrusko and Markov 1956. Vest. Leningrad Univ., Biol. Ser. 21:61–71), and the colubrid *Psammophis sibilans* from Sudan (Ortlepp 1922. Proc. Zool. Soc. London 72:999–1107). Members of the nematode family Physalopteridae utilize a wide variety of arthropods as intermediate hosts (Anderson 2000. Nematode Parasites of Vertebrates. Their Development and Transmission, 2nd ed. CABI Publishing, Oxon, U.K. 650 pp.), which the vertebrate host then typically consumes to complete the physalopterid life cycle. *Trachylepis spilogaster* is a new host record for *A. paradoxa.*

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VARANUS CF. GOULDII (Gould's Monitor). **RITUAL COMBAT.** Observations of male-male fighting in free-ranging monitors are rare. In particular, male ritual combat has only been partially described from southwestern Australia (Thompson and Withers 1992. West Austr. Nat. 19:21–29). Here we describe a case of ritual combat in *V. cf. gouldii* from northeastern Australia.

Our observations were made at Castle Hill, Townsville, Queensland (19°15'0"S, 146°48'40"E; elev. 142 m). At 1700 h on 16 January 2004, we came upon two *V. cf. gouldii* engaged in classic varanid ritual combat (*fide* Auffenberg 1994. The Bengal Monitor. Univ. Florida Press, Gainesville, 561 pp., for captive *V. nebulosus*). When first seen the two monitors were in a bipedal stance on the road shoulder (Fig. 1). They were engaged in a brachial embrace, twisting and turning in a wrestling match that continued for ca. 7 min. The lighter-colored male (Male 1) then managed to climb higher on his opponent (Male 2) and push him into the body-arch position (see Auffenberg, *op. cit.*). Within < 2 min Male 1 had pushed Male 2 to the ground on his back, although they still remained in brachial embrace. Male 2 then struggled free, but immediately returned to bipedal stance, and another bout of wrestling began. By this time, road traffic was backing up as a crowd had gathered and several tourists approached the lizards for photo shots. The monitors stopped, apparently noticing the humans for the first time. They dropped to the ground and ran off in the same direction into the nearby eucalypt woodland. Total observation time was about 15 min.

FIG. 1. Adult males of *Varanus cf. gouldii* in bipedal stance during ritual combat at Castle Hill, Townsville, Queensland.

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SERPENTES

ACRANTOPHIS DUMERILII (Dumeril's Ground Boa). **DIET**. Madagascar is well known for the presence of a conspicuous boid fauna including *Sanzinia madagascariensis, Acrantophis madagascariensis,* and *A. dumerilii* (Vences and Glaw 2003. Salamandra 39:181–206). The adults of these species prey mainly upon mammals and birds, whereas juveniles are believed to prey upon lizards and frogs, as is the case for many other boids (Glaw and Vences 1994. A Fieldguide of the Amphibians and Reptiles of Madagascar. Vences and Glaw Verlag, Cologne. 480 pp.). Here we report predation by *Acrantophis dumerilii* on an insect. On 22 January 2004 at 2130 h we found a female *A. dumerilii* within the Isalo Massif in central-southern Madagascar next to Ilakaka (Ranohira Fivondronana, Fianarantsoa Faritany, 22°49.85'S and 45°17.75'E, 680 m elev.). The snake (ca. 1700 mm TL, and ca. 3.5 kg) was coiled around its prey, on the dry bed of an intermittent river. We delicately unrolled the specimen and discovered a Madagascan Giant Hissing Cockroach, *Gromphadorhina*

portentosa (Museo Regionale di Scienze Naturali, MRSN-FAZC 11962). The roach measured 70 mm TL and weighed 10 g. Our observations suggest that giant hissing cockroaches are quite common in this area. Predation by large constrictors upon insects was until now undescribed, and this observation suggests that *A. dumerilii* opportunistically forages.

We thank Jasmin E. Randrianirina for assistance and the Nando Peretti Foundation for funding.

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ADELPHICOS QUADRIVIRGATUS NEWMANORUM (Newman's Earth Snake). **PREDATION.** Invertebrate predation on snakes has only infrequently been documented or photographed (Bayliss 2001. Herpetol. Rev. 32:49; Greene 1988. *In* Gans and Huey [eds.], Biology of the Reptilia, Vol.16, Ecology B, Defense and Life History, pp 1–152. Alan R. Liss, New York; Hill and Phillipps 1981. A Colour Guide to Hong Kong Animals. Government Printer, Hong Kong. 281 pp.; Mayne and Babb 2004. Herpetol. Rev. 35:399; McCormick and Polis 1982. Biol. Rev. 57:29–58; McKeown 1963. Australian Spiders. Angus and Robertson, Sydney. 287 pp.; Owens 1949. Herpetologica 5:148). One author found a snake in a spider web (Zippel and Kirkland 1998. Herpetol. Rev. 29:46). Here we describe a spider feeding on a snake carcass.

The following observations were made 19 June 2003 during a herpetological survey in the Sierra Madre Oriental in the Area Natural Protegida La Estanzuela (25°31'54"N, 100°16'38"W; 900 m elev.), near Monterrey, Nuevo Leon, México. A dead female *Adelphicos quadrivigatus newmanorum* (UNAL 6233; 370 mm TL) was found suspended in a spider's web about 20 cm above a small, nearly perennial stream (ca. 1–3 m wide and 60–150 cm deep). An adult female *Dolomedes tenebrous*, an aquatic spider in the family Pisauridae, was eating the snake's carcass. Pisaurid spiders (Nursery Web or Fishing Spiders) run across water surfaces and dive after prey. They live near the banks of creeks and ponds. The spider had consumed much of the snake's flesh in an area extending from ca. 33 to 40 mm posterior of the snout. This specimen represents only the second *A. q. newmanorum* collected in the state of Nuevo Leon (Contreras 1989. Publ. Biol. Fac. Ciencias Biol., Univ. Auton. Nuevo Leon 3:35–36). We thank Wade C. Sherbrooke for reviewing this note.

FIG. 1. *Dolomedes tenebrous* consuming *Adelphicos quadrivigatus*.

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AGKISTRODON PISCIVORUS (Western Cottonmouth). **FORAGING BEHAVIOR**. In a drained reservoir on Loggy Bayou Wildlife Management Area (Bossier Parish, Louisiana, USA) on 24 May 2004 we startled a young-of-the-year (40–60 mm) *Rana sphenocephala* (Southern Leopard Frog). During its escape the frog crossed the path of a 400–500 mm *Agkistrodon piscivorus*. The snake seized the frog in mid-air. One of us (MLM) lightly tapped the snake's rostrum with a snake stick and it released the frog, which jumped away without apparent ill effects. The ability to capture a moving airborne prey item provides important information regarding the biomechanical aptitude and foraging behavior of pitvipers. The lack of noticeable venom effects on the frog suggests that some pitvipers might not envenomate some types of prey. Because frogs do not pose a danger to snakes during prey handling, envenomation would not provide any protective benefits to the snake during prey handling, although envenomation might decrease the risk of losing prey.

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ALSOPHIS RUFIVENTRIS (Red-bellied Racer). **FORAGING AND DIET**. Despite being widespread in the West Indies, little has been recorded regarding foraging behavior in the colubrid genus *Alsophis*. *Alsophis rufiventris* occurs on Saba and St. Eustatius and has been extirpated on St. Christopher and Nevis. From 3–24 June 2004, we observed four feeding events by *A. rufiventris* on The Quill, a dormant volcano on St. Eustatius. We twice saw snakes eating *Anolis schwartzi*. During one of those encounters, the snake began ingestion before the lizard was completely immobilized. The entire feeding event took ca. 2 min. The second encounter occurred on the rim of The Quill. The snake was on a fallen log about 1 m above the substrate when it struck at something under the leaves of a dead bromeliad. We disturbed the snake by lifting the leaves for a closer look, and the snake fled

with an adult *A. schwartzi* in its mouth. We also saw two instances of snakes eating reptilian eggs (most likely those of *A. schwartzi*). In one instance, a snake was tongue-flicking in leaf litter at a single spot for several minutes, until it grasped and swallowed a small white egg. In the other instance, we disturbed a snake that had been rooting in litter. It dropped a collapsed reptilian egg as it fled.

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AMPHIESMA STOLATUM (Striped Keelback). **PREY SIZE**. At 0946 h on 16 July 2003, a male *Amphiesma stolatum* (430 mm SVL, 35.66 g) was found ingesting a Spectacled Toad (*Bufo melanosticus*; 55 mm SVL, 14.07 g) on the tiled entrance of the Biological Resource Department building of National Chiayi University, Taiwan (23º28'18"N, 120º29'04"E). The toad was being consumed vent first, and the head and forelimbs were protruding from the snake's mouth. At first the snake tried to flee with the prey item in its mouth. It moved ca. 40 cm and then regurgitated the toad in an attempt to escape.

Published records suggest *A. stolatum* has a broad diet, including insects, amphibians, fish, earthworms, lizards, and scorpions (Das 2002. A Photographic Guide to Snakes and Other Reptiles of India. New Holland Publishers Ltd., London. 19 pp.). Colubrids commonly prey on creatures about 20% of their own mass (Greene 1997. Snakes: The Evolution of Mystery in Nature. University of California Press, Berkeley. 351 pp.), but in this case the prey/predator mass ratio was 39.5%. To our knowledge this is the largest recorded predator/prey mass ratio for this species.

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ANILIUS SCYTALE (Red Pipesnake). **CANNIBALISM.** Cannibalism is a common occurrence among reptiles (Polis and Myers 1985. J. Herpetol. 19:99–107). *Anilius scytale*, a South American aniliid, is found in Venezuela, Guyana, French Guiana, and Suriname, and Amazonian portions of Colombia, Ecuador, and Brazil (Cunha and Nascimento 1993. Bol. Mus. Emílio Goeldi 9:1–191). Primarily fossorial and occasionally aquatic and terrestrial when active, it is almost always associated with water bodies (Martins and Oliveira 1998. Herpetol. Nat. Hist. 6:78–150). Anecdotal information indicates *A. scytale* feeds primarily on elongate fossorial and aquatic vertebrates (Beebe 1946. Zoologica 31:11–52; Greene 1983. Amer. Zool. 23:432–441), including an observation of feeding on *Atractus torquatus* (Martins and Oliveira, *op. cit.*). A preserved adult male *A. scytale* (MPEG 7243; 430 mm CRC), from the municipality of Capitão Poço (01°44'41"S, 47°03'54"W), Pará, Brazil, contained a conspecific juvenile male (315 mm CRC), ingested head first. The prey represents 74.1% of the predator's total length. This is the first report of cannibalism for *A. scytale*. The low incidence of cannibalism in the *Anilius scytale* (as well as in other species of snakes and lizards) suggests that the predator might not discriminate between conspecifics and other prey items when opportunistically foraging (Pontes et al. 2003. Herpetol. Rev. 34:154).

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ATRACTASPIS IRREGULARIS (Mole Viper or Stiletto Snake). **REPRODUCTION**. *Atractaspis irreglaris* is distributed through east, central, and west Africa (Chippaux 2001. Les Serpents d'Afrique Occidentale et Centrale. Collection Faune et Flore Tropicales 35. Institut de Recherche pour le Développement Editions, Paris. 292 pp.; Spawls et al. 2002. A Field Guide to the Reptiles of East Africa. Academic Press, London. 543 pp.). In east Africa, mating has been observed in September and six eggs were reported in a specimen from Uganda (Spawls et al. 2002, *op. cit.*). In March 2004, we captured a gravid female *A. irregularis* in a garden in Yaoundé, Cameroon (3.5°N, 11.5°E) that subsequently laid three eggs on 8 April 2004. The eggs were measured in the week following oviposition, they had a mean length of 49 mm (SD = 7.8, range = 43–58). The eggs were incubated in a sealed plastic container on moistened dry grass. The temperature in the container ranged from 26.0–29.1°C and the humidity from 61–100%. The eggs hatched sometime between 21 and 29 June 2004. The hatchlings averaged 6.83 g in mass (0.59 SD, range = 6.00–7.25), 209.7 mm SVL (0.39 SD, range = 206–215), and all three had 16 mm long tails.

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BOIGA DENDROPHILA (Mangrove Snake). **DIET**. The diet of *Boiga dendrophila* includes a diversity of vertebrates, including lizards, snakes, birds, and mammals (Greene 1990. Proc. California Acad. Sci. 46:193–207). Herein I report a novel species and order (Scandentia) in the diet of *B. dendrophila*. While radio-tracking a Large Treeshrew (*Tupaia tana*; 190–240 g) on the morning of 18 September 2003 at the Danum Valley Field Center in northeast Borneo (4°58'N, 117°48'E), I found a large *B. dendrophila* coiled around a tree branch ca. 5 m off the ground. I determined that the radio signal of the *T. tana* was emanating from the general location of the *B. dendrophila*, which was noticeably distended at mid-body. Neither the snake nor the radio signal moved the rest of that day. The next day the snake had moved ca. 100 m and was found by tracking the radio signal. After a third day, neither the signal nor the snake could be located despite a thorough search. *Tupaia tana* is one of the most numerous diurnal mammals in lowland Bornean rainforests (45–55 individuals/ km^2; Emmons 2000. Tupai: A Field Study of Bornean Treeshrews. Univ. California Press, Berkeley. 269 pp.) and might represent a significant component of the diet of *B. dendrophila* on Borneo. I thank H. W. Greene for reviewing this manuscript.

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BOIGA KRAEPELINI (Taiwanese Tree Snake). **DIET**. *Boiga kraepelini* is the only member of this genus that naturally occurs in Taiwan, where it inhabits low to medium elevation habitats island-wide. At 0800 h on 28 March 2003 an adult female *B. kraepelini* (1318 mm TL) was found dead on the side of a road next to an electrical pole, near the main entrance of the Taitung Animal Propagation Station (22°49'08"N, 121°04'58"E, elev. 132 m). Upon dissection we found a 32.7 g dove chick in the specimen's stomach. The chick is probably either a Red Turtle Dove (*Streptopelia tranquebarica*) or a Spotted Dove (*Streptopelia chinensis*), both of which are very common in this area. *Boiga kraepelini* is known to prey on a variety of vertebrates, including birds, lizards, and mice (The Transition World - Guidebook of Amphibians and Reptiles of Taiwan. SWAN, Taipei, pp. 176–177). To the best of our knowledge, this is the first report of predation by *B. kraepelini* on a dove chick.

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BOTHRIECHIS SCHLEGELII (Eyelash Palm Pit-viper, Bocaracá). **ATTEMPTED PREDATION**. *Herpetotheres cachinnans* (Laughing Falcon) is a common resident of lowland forest on both the Caribbean and Pacific slopes (up to 1850 m elevation) of Costa Rica (Stiles and Skutch 1989. A Guide to the Birds of Costa Rica. Cornell University Press, Ithaca, New York. 511 pp.). *Herpetotheres cachinnans* is known for its almost exclusive diet of snakes, including a "coral snake or a mimic thereof," vine snakes (*Oxybelis*), micas (*Spilotes pullatus*), and a "slender, green, arboreal snake" (Skutch 1983. *In* Janzen [ed.], Costa Rican Natural History, pp. 593–594. University of Chicago Press, Chicago, Illinois; Skutch 1999. Trogons, Laughing Falcons, and Other Neotropical Birds. Texas A&M University Press, College Station, Texas. 222 pp.). To my knowledge there have been no reports of pitvipers in the diet of laughing falcons. At 1515 h on 18 February 1999, I observed a *H. cachinnans* with a *Bothriechis schlegelii* at Parque Nacional Carara (09°46'27.0"N, 84°36'20.0"W). The adult *H. cachinnans* dropped the adult male *B. schlegelii* from a branch ca. 3 m above the ground. The snake's spine was severed and it lay motionless. The *H. cachinnans* remained perched over the snake with out moving until dusk (ca. 1730 h), when it flew off without the snake.

The *B. schlegelii* was deposited in the Texas Cooperative Wildlife Collections at Texas A&M University (TCWC 83394). I thank John H. Malone and Lee Fitzgerald for reviewing a draft of the manuscript. The inventory was conducted under MINAE RESOLUCION N°. 237-98-OFAU.

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BOTHROPS ERYTHROMELAS (Caatinga Lancehead). **REPRODUCTION**. *Bothrops erythromelas* inhabits xeric and semi-arid regions in northeastern Brazil under clusters of bromeliad, *Bromelia laciniosa* (Amaral 1923. Proc. New England Zool. Club 8:96–97) and riparian forests (Vanzolini et al. 1980. Répteis das Caatingas. Acad. Bras. Ciênc. Rio de Janeiro. 161 pp.). Lira-da-Silva et al. (1994. Revista Brasileira de Zoologia 11:187–193) collected a gravid female in the wild from Paulo Afonso, Bahia, Brazil. On 11 Jan 1993 (after ca. 123 days of gestation), this snake gave birth in captivity to 11 neonates (mean SVL = 192 mm ± 2.5 SD, range = 168–192). Machado and Cotta (1998. XXII Congresso Brasileiro de Zoologia, Abstract 1118.) reported that eight male and eight female *B. erythromelas* mated in captivity April–May 1991, with six females giving birth (mean = 11.4 neonates) in December and January after ca. 240 days of gestation. Here we report data on two litters of *B. erythromelas* born in captivity on 20 November 1998 and 11 November 2002, both from females collected in the wild. The first female was collected in March 1998 from Maracás, Bahia, Brazil (13°44'S, 40°43'W; 964 m) and gave birth after ca. 257 days of gestation to six live female neonates (IB 60518–60523; mean SVL = 184 mm ± 48 SD, range = 179–190; mean mass = 4.17 g ± 1.17 SD, range = 3.0–6.0 g). The second gravid female (590 mm SVL, 174 g) was collected in October 2002 from Brumado, Bahia, Brazil (14°20'S; 41°66'W, 422 m elev.) and gave birth after 32 days in captivity to two male and four female live offspring (mean SVL = 196 mm ± 5 SD, range = 190–205).

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BOULENGERINA ANNULATA STORMSI (Storm's Water Cobra). **ATTEMPTED PREDATION**. *Boulengerina annulata* is a stout-bodied piscivorous cobra found in and near the waters of the Congo Basin (Spawls et al. 2002. A Field Guide to the Reptiles of East Africa. Academic Press, London, England. 543 pp.). *Boulengerina a. stormsi* is restricted to Lake Tanganyika.

On the morning of 17 June 2003, we found a recently-killed adult female *B. a. stormsi* (1175 mm SVL; 1440 mm TL) floating a few meters from the Kasaba Lodge jetty (08°35'N, 30°30'E), Kasaba Bay, Lake Tanganyika, Zambia. There were a total of 16 punctures clustered in four main areas of trauma, two of which completely severed the spine. The first trauma area was 37–64 mm posterior of the snout, and featured a 9 mm entry wound at the rear of the head. The spine was severed, the palate punctured, and there was an apparent exit wound through the lower jaw. Another puncture wound was 27 mm posterior to the primary wound at the edge of the ventral scales. The second trauma area was 207–248 mm posterior of the snout, and included a 10 mm diameter puncture that severed the spine and exited the right body wall. Two superficial wounds were 37 and 41 mm behind the primary wound. The third trauma area was 351–378 mm posterior of the snout and included a 5 mm puncture on the right dorsum (anterior) and a superficial wound on the lower left side (posterior). The fourth trauma area was 511 mm posterior of the snout and consisted of an 11 mm axial gash on the left dorsal surface that exited the body wall on the lower right side.

These injuries are inconsistent with the most obvious threats to *B. a. stormsi* in Kasaba Bay: contact with an outboard engine, inadvertent entanglement in a fisherman's gill net, deliberate human persecution, or attack by Nile Crocodile (*Crocodylus niloticus*), Clawless Otter (*Aonyx capensis*), or Hippo (*Hippopotamus amphibius*). We believe the wounds are the result of attempted predation by a bird-of-prey. The arrangement of the punctures in four groups along the anterior half of the body, the specific damage to the head, and the complete penetration of the spine and body in several places are consistent with attack by a raptor. The African Fish Eagle (*Haliaeetus vocifer*) was the only large raptor observed during our visit; we saw five individuals along the shoreline opposite the lodge. Fish Eagles usually take live and dead fish from the water surface, but have also taken juvenile Nile Crocodiles (*Crocodylus niloticus*) and Serrated Terrapins (*Pelusios sinuatus*; Broadley 1974. Honeyguide 78:11–19). They have also been observed capturing a swimming Green Snake (*Philothamnus* sp.; Sweeney 1971. Snakes of Nyasaland. A. Asher & Co., Amsterdam. 200 pp.) and stealing an unidentified snake from a Martial Eagle (*Polemaetus bellicosus*; van Vuuren 1984. African Wildlife 38:30). Snouted Cobras (*Naja annulifera*) and Mozambique Spitting Cobras (*Naja mossambica*) have been consumed by various other African raptors (Broadley 1959. Bull. Mus. Comp. Zool. 120:1–100; Lendrum 1979. Ostrich 50:203–214; Steyn 1973. Ostrich 44:1–22; Steyn 1980. Ostrich 51:54–55; Sweeney 1961, *op. cit.*). Water cobras are routinely exposed to aerial predators when surfacing to breath. It is possible that the apparent pre-ecdysis condition of the cobra, indicated by opaque eyes, may have made it less alert and more vulnerable to aerial predation. Though the damage inflicted in this case was clearly sufficient to kill the cobra, there was no evidence of feeding on the corpse. The specimen was preserved in ethanol and left with Kalambo Lodge, Zambia. We thank Toby Veall, Tabatha Bruce, Don Broadley, and Harry Greene for assistance and thank YAP Films and Animal Planet for funding "O'Shea's Big Adventure Series 4: Water Cobra."

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CHARINA BOTTAE (Rubber Boa). **RELATIVE PREY MASS.** *Charina bottae* is known to feed primarily on small mammals (especially their young), occasionally larger mammals (e.g., chipmunks, nestling rabbits), and squamate reptiles and their eggs (Rodriguez-Robles et al. 1999 J. Zool. London 248:49–58; St. John 2002. Reptiles of the Northwest. Lone Pine Publ. Renton, Washington. 272 pp.). Rodriguez-Robles et al. (1999, *op. cit.*) reported a predator-prey mass ratio of 0.65 for an adult *C. bottae* that had ingested six nestling Deer Mice (*Peromyscus maniculatus*). Here, I report an estimated predator-prey mass ratio for *C. bottae* more than double of that previously reported.

On 17 July 2004, at 0310 h I captured a female *C. bottae* (235 mm SVL, 6.3 g) on the Vantage Highway, 29.8 km E of Ellensburg, Kittitas County, Washington, USA. Manual palpation of this specimen indicated six distinct prey items. The most anterior prey item was palpated out of the stomach and identified as a nestling murid rodent (most likely a Sagebrush Vole, *Lagurus curtatus*). The mass of this nestling was 1.54 g. The contours (the body and head of each nestling could be felt) of the remaining five prey items indicated that they were as intact as the nestling palpated from the stomach. Assuming that the remaining five prey were conspecific nestlings, each with a mass equivalent to that of the first, the total mass of ingested prey would equal 9.24 g for a predator-prey mass ratio of 1.46. A value such as this is on par with some of the highest recorded for any snake species (e.g., 1.57 for *Bitis caudalis*, Branch et al. 2002. Herpetol. Rev. 33:137–138; 1.72 for *Crotalus cerastes*, Mulcahy et al. 2003. Herpetol. Rev. 34:64). Such feats of ingestion typically involve a single large prey item, usually much larger in diameter than the head of the snake consuming the meal. In this case, the ingestion ratio (width of prey item/width of the snakes head) was much lower than if it were to consume a single larger prey item.

I thank D. Darda, M. Lahti, P. Mattocks, R. Hoyer, and A. St. John for assistance.

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CHARINA BOTTAE (Rubber Boa). **DIET**. *Charina bottae* feed primarily on mammals, although lizards, birds, and squamate eggs

are sometimes taken (Rodríguez-Robles et al. 1999. J. Zool., Lond. 248:49–58). Rubber Boas have been reported to raid rodent nests and consume multiple individuals during a single feeding event (Rodríguez-Robles et al. 1999. J. Zool. 248:49–58). Their blunt tails often show evidence of injury (Hoyer 1974. Herpetologica 30:275–283) and may serve to misdirect attacks by predators (Greene 1973. J. Herpetol. 7:143–161) or protective mother rodents (Hoyer and Stewart 2000. J. Herpetol. 34:354–360).

On 10 July 2004 we collected an adult male *C. bottae* (457 mm SVK, 64 mm TL, 61.4 g) from inside a fallen Lodgepole Pine (*Pinus contorta*) at the edge of an open meadow in mixed coniferous forest at Sagehen Creek Field Station, Nevada County, California (39.43228°N, 120.24150°W, 2014 m elev.). The boa voluntarily regurgitated two adult Montane Voles (*Microtus montanus*) shortly after capture. The combined mass of the prey was 38.4 g, a relative prey mass (prey mass/predator mass) of 0.63. To the best of our knowledge, this is the first verified report of *C. bottae* predation on *M. montanus*, although Fitch (1936. Am. Midl. Nat. 41:513–579) mentions a possible record. The voles and boa are deposited in the Museum of Vertebrate Zoology (MVZ 245392).

We thank J. Patton and E. Lacey for assistance.

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CHRYSOPELEA ORNATA, C. PARADISI (Flying Snakes). **BEHAVIOR**. Animals subject to airborne predation are known to react defensively to stimuli moving overhead. For example, Tinbergen (1948. Wilson Bull. 60:6–51) demonstrated that raptor-like silhouettes elicit defensive responses in gallinaceous birds. However, relatively few studies have examined such behavior in reptiles (Macias Garcia and Drummond 1995. Ethology 101:101–111; Fine 1999. J. Herpetol. 33:128–131). Here we report orienting responses of *Chrysopelea ornata* and *C. paradisi* to visual stimuli of overhead flyers. These observations were made during experiments designed to evaluate takeoff and gliding performance of these species in semi-natural conditions (Socha 2002. Ph.D. Thesis, Univ. Chicago).

On separate occasions, we observed two *C. ornata* specimens visually track airplanes that flew overhead in the course of an aerial performance study in Lockport, Illinois. A branch (1 m long) was affixed horizontally to a scaffolding tower at a height of 8.3 m in the middle of an open, grassy field. In a typical flight trial, the snake was placed at the proximal end of the branch with its head facing outward; most snakes immediately moved to the distal end of the branch and jumped. In one trial, the snake (92 cm SVL, 158 g) moved to the end of the branch and stopped. While resting, the snake made a sudden move with its head, shifting its anterior body (ca. 8 cm) upward from horizontal to the vertical and twisting to the right, as if pointing up into the sky. We looked in the same direction and determined that the snake was directly facing an orange and tan Southwest Airlines passenger jet (casting a ca. 3 cm silhouette) as it moved slowly across the sky. The snake tracked the plane in saccadic fashion as it crossed from right to left, making three separate twisting movements. At the time of our initial sighting, we could not hear the airplane. Once the plane disappeared from view, the snake returned to its original posture. Several weeks later, JS observed identical plane-watching behavior in a second *C. ornata* (89 cm SVL, 150 g) and photographed the snake's posture (Fig. 1). The total duration of this behavior was ca. 30 s.

While conducting experiments at the Singapore Zoological Gardens, JS observed one instance of a similar visual orienting

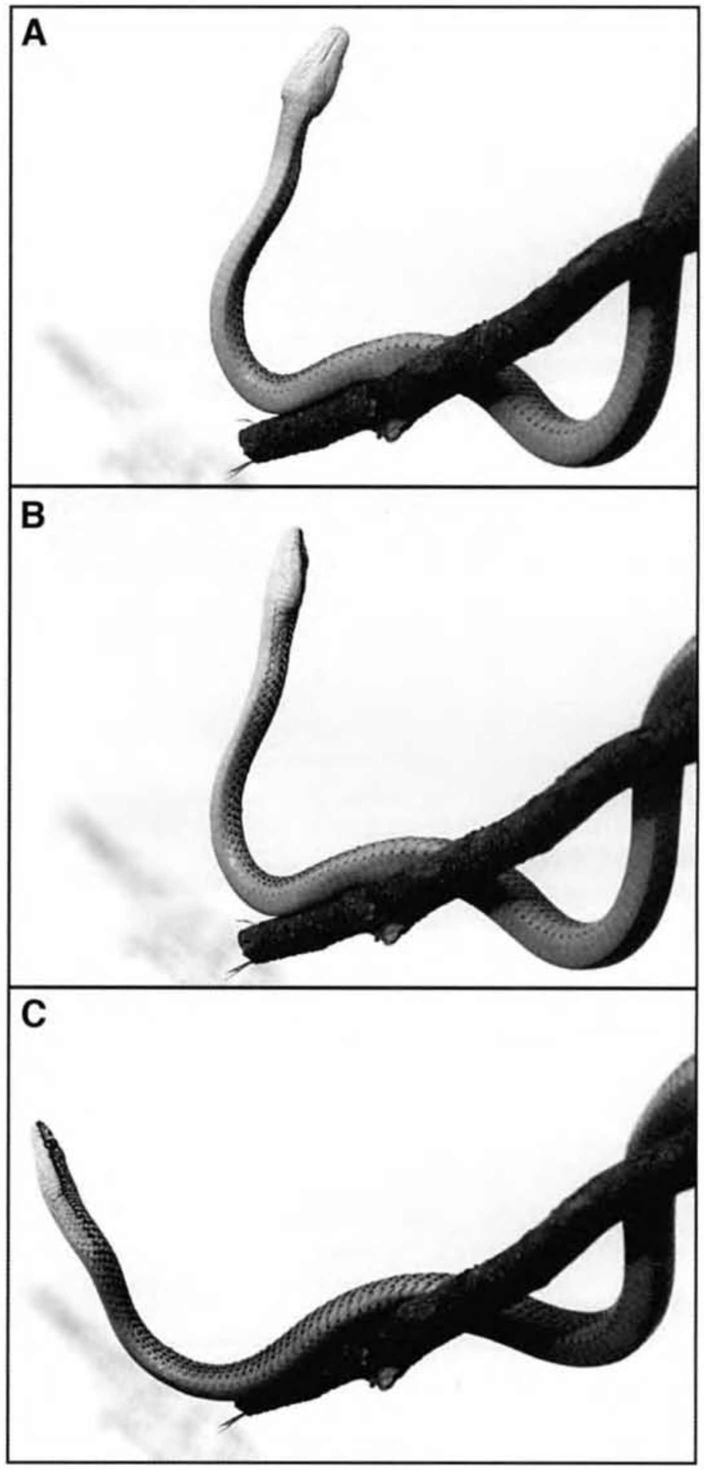

FIG. 1. *Chrysopelea ornata* visually tracking an airplane as it passed overhead through the sky. Temporal sequence is from top to bottom.

behavior in *C. paradisi*. This time, the stimulus was an unidentified bird (wingspan ca. 1 m) and the snake (85 cm SVL, 83 g) was facing to the left with ca. 15 cm of the anterior end in the air and the remainder of the body perched along the branch. The bird flew overhead, passing from the left to right at an estimated height of 100 m. The snake first reacted to the bird at a distance of ca. 200 m by turning its head 20° to the right and upward at an angle of 45°. The snake tracked the bird in saccadic fashion, making four discrete movements and rotating through a total angle of ca. 90° over 13 s. During this behavior, the snake moved its head from side-to-side intermittently with an amplitude of a few mm. After the bird was out of view, the snake returned to a forward-facing position.

Vision was presumably responsible for the initial detection of the overhead flyers in these observations. The first plane spotted by a *C. ornata* specimen was relatively small, and although the ophidian auditory system is more sophisticated than popularly believed (Young 2003. J. Comp. Physiol. B 167:481–493), it seems improbable that the snake was alerted by a sound that we could not hear (at any frequency, the threshold of audibility is lower in humans than in snakes; Hartmann 1997. Signals, Sound, and Sensation, American Institute of Physics, Woodbury, New York; Young 2003, *op. cit.*). Furthermore, the bird detected by the *C. paradisi* specimen appeared to make no sound.

Although our behavioral observations were made in semi-natural conditions, these data suggest two broad predictions regarding *Chrysopelea*. First, birds are important predators of flying snakes in the wild; this prediction can be tested through natural observations or dietary studies. Furthermore, possible links between detection of predators and initiation of takeoff may lend insight into the conditions under which aerial locomotion in snakes evolved. Second, we predict that flying snakes have excellent vision relative to most non-flying snakes, which can be tested by examining the distribution of morphological characters associated with keen visual acuity across a phylogenetically appropriate sample of snake taxa. Although snakes are generally thought to have poor vision, some taxa (e.g., *Ahaetulla* spp., Walls 1942. Bull. Cranbrook Inst. Sci. 19:1–785) possess foveae, which function to increase visual acuity in a diversity of animals (Ross 2003. *In* Anthropoid Origins: New Visions, pp. 463–521. Kluwer Academic/ Plenum Publishers, New York). We predict that *Chrysopelea* spp., with their unique command of aerial navigation and possible pre-takeoff target selection (Socha 2002, *op. cit.*) have functional foveae.

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CROTALUS ATROX (Western Diamondback Rattlesnake). **PREDATION.** At ca. 1000 h on 20 March 2004, we observed from a distance of ca. 60 m a Bobcat (*Lynx rufus*) with a rattlesnake on San Bernardino National Wildlife Refuge, Cochise Co., Arizona. The *L. rufus* swiped and bit at the snake, and eventually grabbed and tore a piece of flesh from it. The snake then struck at the *L. rufus*, which jumped several feet into the air. The *L. rufus* subdued the snake, picked up its prey, and walked in front of the parked vehicle at a distance of ca. 10 m (Fig. 1). At this time the snake was identified as *Crotalus atrox*, and appeared to exceed 100 cm TL. The *L. rufus* proceeded to a riparian area, where it disappeared.

At 2330 h on 13 August 2004, we observed a *L. rufus* carrying a dead *C. atrox* crossing New Mexico Highway 61 at 38.1 km N and 12.2 km W of Deming, New Mexico. The *L. rufus* dropped the snake on the pavement and then slowly wandered off in a disoriented manner. It zigzagged and held its head down, suggesting it had been struck one or more times. The body of the *C. atrox* (MSB 71139; 970 mm SVL, 605 g) had numerous puncture wounds, primarily over the posterior 2/3 of the body. Many tail punctures were evident and the rattle string appeared to have been ripped off during the encounter with the *L. rufus*.

Shaw and Campbell (1974. Snakes of the American West. Alfred A. Knopf, Inc., New York 330 pp.) mention, "Coyotes, foxes, wildcats, and badgers all will eat rattlesnakes." Klauber (1997. Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind. University of California Press, Berkeley. 1580 pp.) describes a *L. rufus* consuming a dead *Crotalus mitchelli* (Speckled Rattlesnake). To the best of our knowledge, there are no accounts of *L. rufus* taking live *Crotalus*, and *Crotalus* are not listed as prey items for *L. rufus* in the mammalian literature (Lariviere and Walton 1997. Mammalian Species 563:1–8). We thank C. Painter for advice and assistance.

FIG. 1. Bobcat (*Lynx rufus*) with a Western Diamondback Rattlesnake (*Crotalus atrox*) that it had just killed in the San Bernardino Valley, Cochise County, Arizona.

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CROTALUS HORRIDUS (Timber Rattlesnake). **REPRODUCTION.** In many snakes, including rattlesnakes, female ecdysis and male-male fighting are associated with the reproductive cycle (Aldridge and Duvall 2002. Herpetol. Monogr. 16:1–25; Duvall et al. 1992. *In* Biology of the Pitvipers, pp. 321–335 [and citations therein], Selva Press, Tyler, Texas). Here we report female ecdysis, courtship, male-male combat, and copulation among three *Crotalus horridus*, all within a few hours.

On 4 August 2001 at 1245 h, we encountered a male *C. horridus* (M1; ca. 1150 mm TL) courting a female conspecific (ca. 900 mm TL) on a forested talus slope adjacent to a *C. horridus* den in northeastern New York. The female had begun shedding, and most of the skin on her head had already been sloughed. After ca. 20 minutes, the male effected cloacal apposition, although we do not believe the pair was copulating at that time. Approximately 65 minutes later, a second male (M2; ca. 1000 mm TL) steadily and directly ascended the slope and approached the courting pair. The two males began fighting immediately upon contact. The males repeatedly rose and fell, proceeding progressively further down the slope and eventually out of view (15–20 m). Meanwhile, the female crawled under nearby rocks and completed shedding. Approximately 15 min later, M1 returned upslope alone, searched for the female for several minutes, and upon finding her resumed courtship. Twenty minutes later, M2 returned upslope, eventually re-encountering the courting pair. The courting male (M1) left the female and approached M2, resulting in M2's rapid retreat down the slope. M1 followed for several meters, with no contact between them. The female then moved upslope, toward the den. M1 and M2 continued searching for the female for about 20 min, whereupon we briefly departed. Upon our return, ca. 15 min later, we found M1 again courting the female, and ca. 20 min later observed intromission. Another 20 min later, M2 returned upslope, encountered the copulating pair, and began courting the female. M1 did not appear to react. The female moved slowly upslope while M1 attempted to stay in place. We terminated observations ca. 30 min later at 1630 h. At this time, M1 and the female were still copulating and M2 continued courtship behaviors.

Our observations are consistent with evidence that both female ecdysis and male fighting are associated with the mating season in rattlesnakes (Aldridge and Duvall, *op. cit.*; Duvall et al., *op. cit.*; and citations therein). Although some studies suggest that defeated male pitvipers are less likely to re-engage in combat or attempt to court females (Schuett 1997. Anim. Behav. 54:213–224), in this case, a seemingly defeated (and smaller) male repeatedly returned to the vicinity of a dominant male to pursue and court a female.

We thank W. S. Brown, E. McGowan, B. Coupe, R. Stechert, K. B. Merrow, and L. Aubertin for guidance and/or assistance.

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CROTALUS SCUTULATUS (Mohave Rattlesnake). **BEHAVIOR**. Klauber (1956. Rattlesnakes, Their Habits, Life Histories, and Influence on Mankind. Univ. California Press, Berkeley, California. 1476 pp.) cites several reports of rattlesnakes occupying prairie dog (*Cynomys* sp.) towns in the general vicinity of Prairie Dogs and, in some cases, Burrowing Owls (*Athene cunicularia*). However, Klauber (1956, *op. cit.*) describes reports of animals (besides other snakes, but specifically mentioning Burrowing Owls) hibernating with rattlesnakes as "fortuitous," adding, "it is to be doubted whether these go beyond the other animals' accidentally selecting an adjacent refuge."

On 11 November 2003, I located a radio-tagged male *C. s. scutulatus* (826 mm SVL) in an abandoned Kit Fox (*Vulpes macrotis*) burrow in the western Mojave Desert in San Bernardino County, California, USA (34.50°N, 117.25°W). The burrow consisted of seven entrances occupying an area of 4.5 m x 6.0 m. Each burrow entrance angled down and generally toward the center of the group of openings. The snake's presence in the burrow was verified electronically on 15 occasions during the following four months, although he was never visually observed over the winter. On thirteen of those occasions, a single *A. cunicularia* was observed at the burrow (either standing at one of the burrow entrances, peeking over the soil mound at an entrance, or taking flight). During this period, numerous fresh avian scats and regurgitated owl pellets accumulated around the burrow entrances. Throughout the winter, the snake's strongest radio signal emanated from near the center of the group of burrow entrances and presumably corresponded to his underground location. Although it is clear that at least one owl occupied the burrow continuously between 11 November 2003 and 29 February 2004, its underground proximity to the rattlesnake could not be determined. However, based on the burrow entrances utilized by the owl, the location of the snake's strongest radio signal, and the converging angles of the entrances, it is estimated that they spent much of the winter within 3 m of each other. On 13 March 2004, I located the snake on the surface ca. 15 m from the burrow; the owl was not observed at the burrow on this day, but a White-tailed Antelope Ground Squirrel (*Ammospermophilus leucurus*) was observed moving among the burrow openings.

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CROTALUS SIMUS TZABCAN (Neotropical Rattlesnake). **DIET**. Although *Crotalus simus tzabcan* is known to consume a variety of rodents, lizards, and birds (Lee 1996. The Amphibians and Reptiles of the Yucatán Peninsula. Cornell University Press, Ithaca, New York, 500 pp.; Campbell 1998. Amphibians and Reptiles of Northern Guatemala, the Yucatán, and Belize. University of Oklahoma Press, Norman, Oklahoma, 400 pp.), relatively few specifically identified prey have been reported. On 13 November 2003 at 0900 h we found a juvenile *C. s. tzabcan* (525 mm SVL, 87 g) dead on the road near Chetumal City, Quintana Roo, México (18°32'45"N, 88°16'04"W). The snake contained a

subadult male House Mouse (*Mus musculus*) that it had swallowed headfirst. The mouse measured 81 mm total length and weighed 15.3 g. Both the *C. s. tzabcan* (ECO-CH-H 2192) and the *M. musculus* (ECO-CH-M 2127) are deposited in El Colegio de la Frontera Sur, Chetumal, Quintana Roo, México. We thank E. Escobedo for identifying the mouse.

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DRYMARCHON CORAIS (Indigo Snake). **DIET.** *Drymarchon corais*, the longest North American snake, is known to consume a variety of prey items, including frogs, rodents, and other snakes, including venomous ones (Belson 2000. Herpetol. Rev. 31:105; Moler 1992. Rare and Endangered Biota of Florida. Vol. 3. Amphibians and Reptiles. University Press of Florida, Gainesville, Florida. 291 pp; Wright and Wright 1957. Handbook of Snakes of the United States and Canada, Vol. 1. Comstock Publishing Associates, Ithaca, New York. 564 pp.). Here we report two novel foraging observations for *D. corais*.

On 25 October 1996 while conducting a bird survey in Tamaulipan Thorn Scrub at the Ejido Vistahermosa (25°45'45"N, 99°35'05"W; 400 m elev.), in the municipality of Linares, Nuevo León, México, we found an Olive Sparrow (*Arremonops rufivirgatus*), a Golden-fronted Woodpecker (*Melanerpes aurifrons*), and a Common Ground-dove (*Columbina passerina*) entangled in our mist net. An adult *D. corais* (155 cm TL) was found consuming the *A. rufivirgatus* and part of the net at 1103 h. The snake was also tangled within the net, and we separated it from the net and released it.

On 23 June 2003 while conducting a herpetological survey in a Matorral Submontane biotic community in the municipality El Carmen (26°43'25"N, 101°21'45"W; 489 m elev.), Nuevo Leon, México, we found an adult male *D. corais* (150 cm TL). While held in a collecting bag, this specimen regurgitated five young *Gopherus berlandieri* (4.2, 3.6, 3.3, 3.2, and 3.1 cm plastron length). Two of the tortoises were still partially encased by egg membrane. The tortoises were preserved (deposited at UANL-FCB- Laboratorio Herpetologia) and the snake was released.

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ELAPHE ALLEGHANIENSIS (Eastern Ratsnake). **FORAGING BEHAVIOR.** Egg-eating is well known in ratsnakes, although aspects of the behavior vary. The basic method is for the snake to position the egg for swallowing, work the jaws over the egg to get it into the mouth and anterior neck, and use the lateral neck muscles to push it down into the stomach. Ratsnakes are known to swallow eggs entirely and digest the shells and contents in the stomach (Brimley 1941–1942. Carolina Tips 4–5:19–26; Gibbons 1999. Waterfowl Mag. 17[4]:23–24, 38–39). They are also known to break the egg inside the esophagus, swallow the contents, and regurgitate or swallow the empty shell (Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Inst. Press, Washington, DC. 668 pp.; Werler and Dixon 2000. Texas Snakes, Identification, Distribution, and Natural History. Univ. Texas Press, Austin, Texas. 437 pp.). Eggs may be broken using constriction of neck muscles or by pushing them against the hypapophyses of the cervical vertebrae (Mullin 1996. Amphibia-Reptilia 17:387–394). We describe egg eating in the Eastern Ratsnake in which the egg is broken by behavioral action.

At ca. 1300 h on 23 May 2002 an adult *E. alleghaniensis* was observed entering a chicken coop in Greene County, Virginia (UTM 17S 0719511, 4246647, NAD 83). The surrounding habitat is mixed hardwood/pine forest. After the snake entered the chicken coop, it immediately entered a large wooden nest box and consumed several eggs before video and still cameras were procured to record the consumption of others. The following description is based on these recordings. The snake located each egg in the box via tongue flicking and once found, prodded the egg with its snout. On two attempts, the snake opened its jaws to grab one of the "ends" of the egg, but one egg was grabbed in the middle and then "jaw walked" until one of the ends was located. Through a combination of pushing against the egg (still in contact with the substrate) and alternating movements of the jaws, the egg was worked toward the back of the mouth. Once the lower mandibles were completely around the egg and it was no longer in contact with the substrate, the head and ca. 7–10 cm of the neck were lifted so that they were nearly perpendicular with the ground. At this point the egg was positioned posterior to the teeth but anterior to the muscles in the throat. It appeared that by lifting the egg, the snake was using gravity to aid in passing the egg beyond this critical point. Once the egg moved further into the throat, the snake lowered its head and neck region back into contact with the ground. A series of muscle contractions moved the egg into the throat ca. 10 cm posterior to the jaws. The snake then created a sharp bend in its neck just anterior to the egg and raised ca. 5 cm of its body off the ground just posterior to the egg. With an abrupt, rapid, forward movement, the snake pushed the section of its neck anterior to the egg downward against the substrate in an effort to break the egg. The section of the neck holding the egg maintained contact with the substrate during this entire motion. The snake appeared to break the eggs via concentrated downward pressure against the substrate. The bend in the neck just anterior to the egg presumably prevented the egg from moving back into the oral cavity during the application of this pressure. There was a distinct cracking or popping sound when the egg broke. The snake cracked eggs in one motion when on a hard surface (wood floor), but had to make several attempts when on softer material (wood chips). Once the egg was broken the shell and contents were moved to the stomach through a series of muscle contractions. This same snake (identified by a scar) was found in the chicken coop with a

distended stomach again on 19 June 2002. Cracked eggshells were easily palped in the stomach. Whether this mode of breaking eggs is learned or innate is unknown. It does demonstrate that ratsnakes use several means to break avian eggs during consumption.

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ELAPHE ALLEGANIENSIS (Eastern Ratsnake). **DIET**. Ratsnakes are well known predators of birds and their eggs (Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Inst. Press, Washington, DC. 668 pp.; Wright and Wright 1957. Handbook of Snakes of the United States and Canada. Cornell Univ. Press, Ithaca, New York. 1005 pp.). Ratsnakes consume a variety of large avian prey, including fledgling ducks, wading birds, and large woodpeckers. Western Ratsnakes (*Elaphe obsoleta*) have successfully preyed upon fledgling Pileated Woodpeckers (*Dryocopus pileatus*; Moore 1984. Bull. Oklahoma Ornithol. Soc. 17:32–33). Central Ratsnakes (*E. spiloides*) have unsuccessfully attempted to prey on *D. pileatus* (Noland 1960. Kentucky Warbler 36:29–30), perhaps because of the behavior of the male parent which is known to kill large ratsnakes (Nolan 1959. Wilson Bull. 71:381–382). An Eastern Ratsnake (*E. alleganiensis*) attempted predation on a fledgling *D. pileatus* in Pennsylvania (Hoyt 1957. Ecology 38:246–256), but the bird was removed from the snake's mouth before it could be swallowed. *Elaphe alleganiensis* have also been reported to spend up to five days in *D. pileatus* nest cavities without taking the nestlings (Kilham 1959. Wilson Bull. 71:191). Thus, unambiguous records of *E. alleganiensis* predation on *D. pileatus* are lacking. Here I report a confirmed instance of *E. alleganiensis* predation on *D. pileatus*, the largest extant woodpecker in the range of this snake.

On 17 June 1997, C. T. Georgel and I found a dead adult male *E. alleganiensis* with a large lump in its body on the ground in a training area on Fort Belvoir (U.S. Army), Fairfax County, Virginia (38°41'17.5"N, 77°10'49.8"W). Humans had apparently killed the snake, as the head, neck, and tail had been severed and presumably discarded. When entire, I estimate the snake measured 180 cm TL. Field dissection revealed a large (ca. 25 cm from tip of the beak to the distal end of the pygostyle; 200 g), late-stage fledging *D. pileatus* in its stomach that had been swallowed headfirst. Both the snake and woodpecker were in advanced stages of decomposition.

Submitted by **JOSEPH C. MITCHELL**, Department of Biology, University of Richmond, Richmond, Virginia 23173, USA; e-mail: jmitchel@richmond.edu.

ELAPHE GUTTATA GUTTATA (Red Rat Snake). **DEFENSIVE BEHAVIOR**. Body posture and body motion, such as flattening, tail rattling, and head bobbing, are important aspects of the behavioral repertoire of many reptilian species. Here we report a previously undescribed behavior in *E. guttata*. One of us (JUV) captured a 795 mm SVL (927 mm TL) female *E. guttata* at the western terminus of Malabar Road, Brevard County, Florida, USA. The snake was briefly restrained by hand, with the anterior two thirds of its body, including its head, free and off the ground. In this position, the snake engaged in repeated bouts of defensive behavior each characterized by vertical head bobbing followed by a defensive strike. Between strikes, the suspended snake maintained an S-shaped coil posture. A second juvenile *E. guttata* captured on FH 13 bordering the north edge of the Bradwell Bay Wilderness in Wakulla County, Florida displayed similar head-bobbing behavior, while on the ground (unrestrained) and without exhibiting other characteristically defensive behaviors (i.e., strikes, tail vibration, body-bridging, S-coil, etc). In the popular literature, head bobbing, head jerking, or head twitching behavior has been described in a number of distantly related species including *Lampropeltis calligaster*, *Crotalus cerastes*, and *Sistrurus miliarius* (see Ernst and Ernst 2003. Snakes of the United States and Canada, Smithsonian, Washington). Head bobbing and/or head shaking is a well-known mechanism for visual communication of information between conspecific lizards (*cf.* Carpenter 1961. Copeia 1961:396–405 [*Dipsosaurus dorsalis*]; Carter 1990. Mem. Queensland Mus. 29:333–338 [*Varanus varius*]; Echelle et al. 1971. Herpetologica 27:271–288 [*Anolis* sp.]) and tortoises (Auffenberg 1965. Copeia 1965:335–342). In snakes, however, such behavior is little known, and its adaptive significance is unclear. The fact that the behaviors reported here occurred during encounters with potential predators suggests that this response represents either a displacement activity (an apparently irrelevant act appearing during motivational conflict) or some form of anti-predator mechanism.

Submitted by **JAMES U. VAN DYKE** and **MICHAEL S. GRACE**, Department of Biological Sciences, Florida Institute of Technology, 150 West University Boulevard, Melbourne, Florida 32901, USA; e-mail (MSG): mgrace@fit.edu.

ELAPHE OBSOLETA (Texas Ratsnake). **DIET**. Although it is well documented that *Elaphe obsoleta* commonly consume avian prey, juveniles are known to prey on small mammals, amphibians, lizards and their eggs, but not birds (Ernst and Ernst 2003. The Snakes of North America. Smithsonian Books, Washington and London. 668 pp; Werler and Dixon 2000. Texas Snakes. University of Texas Press, Austin, Texas. 437 pp.). We collected a juvenile female *E. obsoleta* (16.7 g, 360 mm SVL) on 20 April 2003 from a wooden nest box that had contained six Carolina Chickadee (*Poecile carolinensis*) nestlings. The snake had eaten one of the nestlings, which was subsequently weighed (5.2 g) and preserved in formalin. Ingestion ratio and weight ratio (Greene 1983. Amer. Zool. 23:431–441) were 1.25 and 0.311, respectively.The snake and its prey were deposited at the University of Texas at Arlington (UTA R-52380). This specimen was also reported as a county record by Braman and Fontenot (2003. Herpetol. Rev. 34:388). On 4 May 2003, another juvenile *E. obsoleta* was removed from a nest box (from which Carolina Chickadee nestlings had recently fledged) a few hundred yards from where the first was caught.

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EPICRATES INORNATUS (Puerto Rican Boa). **CANNIBALISM.** Cannibalism is rare not only in snakes, but in reptiles in general (Polis and Myers 1985. J. Herpetol. 19:99–107; Pough et al. 2001. Herpetology. Prentice Hall, Upper Saddle River, New Jersey, 612 pp.). Here, we document cannibalism in *Epicrates inornatus*, a medium-sized boa that frequents forest floors, trees, and vines at the entrance of caves. Its diet includes invertebrates, frogs, lizards, birds, bats, and introduced small mammals (mainly black rats; Wiley 2003. Carib. J. Sci.39:189–194). *Epicrates inornatus* is widely distributed in Puerto Rico and is especially abundant in the northern karst region (Rivero 1998. The Amphibians and Reptiles of Puerto Rico, 2nd ed. Editorial de la Universidad de Puerto Rico, San Juan. 510 pp.). On 11 August 2004 at 0715 h, we found a sub-adult *E. inornatus* (ca. 100–150 cm TL) constricting and preying upon a conspecific juvenile (ca. 50 cm TL) in a karst valley in Sabana Seca (18°27'N, 66°12'W), northern coastal Puerto Rico. The juvenile was being swallowed headfirst and was ca. 1/4 consumed when first observed. We watched and photographed the boas for ca. 15 minutes before leaving and during this time the snake being consumed did not move and was presumed dead. Thus, it is unclear whether this observation of cannibalism is a result of conspecific predation or scavenging.

We thank T. M. Aide for assistance.

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MASTICOPHIS FLAGELLUM FULIGINOSUS (Baja California Coachwhip). **DIET.** There are various reports on the diet of *Masticophis flagellum* in the USA and mainland Mexico (see Brown 1979. Brimleyana 1:113–124; Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Books, Washington, D.C. 668 pp.; Palmer and Braswell 1995. Reptiles of North Carolina. Univ. North Carolina Press, Chapel Hill. 412 pp.; Wilson 1973. Cat. Am. Amphib. Rept. 145.1–145.4; Wright and Wright 1957. Handbook of Snakes of the United States and Canada. Cornell Univ. Press, Ithaca. Vol. I, 564 pp.), but accounts of the feeding habits of this snake in the Baja California peninsula and offshore islands are comparatively few (Cliff 1954. Trans. San Diego Soc. Nat. Hist. 12:67–98; Grismer 2002. Amphibians and Reptiles of Baja California. Univ. California Press, Berkeley. 399 pp.; Van Denburgh 1922. Occ. Pap. California Acad. Sci. 10:615–1028; Walker et al. 1966. Copeia 1966:585–588; Ward and Clark 1988. Herpetol. Rev. 19:36–37).

On the afternoon of 18 June 2004, we found a road-killed, adult male *M. flagellum* (CIBNOR 0547, 940 mm SVL, 343 mm TL, 306.1 g [without prey item]) on Baja California Sur Road (BCS) 53, 16.3 km NW of the intersection between México Hwy. 1 and BCS 53, Municipio de Comondú, Baja California Sur, México (25°23'20.2"N, 111°50'17.4"W). Upon preserving the specimen the following morning, a female *Cnemidophorus tigris rubidus* (= *Aspidoscelis tigris rubida*, fide Reeder et al. 2002. Am. Mus. Novit. 3365:1–61; Reddish Whiptail; CIBNOR 0548, 85 mm SVL, 210 mm TL, 16.7 g) was found in the snake's stomach. The lizard, swallowed tail-first, did not appear to have any vehicle-induced wounds, and thus we believe that it was alive when captured by the snake. The snake and its prey were deposited in the herpetological collection of the Centro de Investigaciones Biológicas del Noroeste (CIBNOR), La Paz, Baja California Sur, México.

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Submitted by **JAVIER A. RODRÍGUEZ-ROBLES**, Department of Biological Sciences, University of Nevada, Las Vegas, 4505 Maryland Parkway, Las Vegas, Nevada 89154-4004, USA (e-mail: javier.rodriguez@ccmail.nevada.edu); and **PATRICIA GALINA-TESSARO,** Centro de Investigaciones Biológicas del Noroeste, S.C., División de Biología Terrestre, Baja California Sur, México (e-mail: pgalina04@cibnor.mx).

MASTICOPHIS LATERALIS EURYXANTHUS (Alameda Striped Racer). **DIET**. On 26 April 2004, at ca. 1300 h, a *Masticophis lateralis* (ca. 750 mm TL) was observed by a group of birders from a distance of about 8 m (using binoculars and spotting scopes) in White Canyon, Mount Diablo State Park, Contra Costa County, California, USA. The snake was first observed about 5 m above the ground in a Coast Live Oak (*Quercus agrifolia*) with an adult Lesser Goldfinch (*Carduelis psaltria*) in its mouth. After several minutes, the snake released the Goldfinch onto a clump of oak leaves, re-positioned itself, and began to consume the bird again. While gripping the branch with the lower third of its body, and with the bird in its mouth, the snake extended about two-thirds of its body straight up to a higher branch with its grip on the lower branch as its only support. After reaching the upper branch, it continued to climb while simultaneously swallowing the bird. The snake finished swallowing the Goldfinch after about 20 minutes, and was last seen on a branch about 6 m high near the trunk of the tree.

Masticophis lateralis are known to eat lizards, frogs, snakes, and birds (Stebbins 1985. A Field Guide to Western Reptiles and Amphibians, 2nd ed. Houghton Mifflin Co., Boston, Massachusetts. 366 pp.). However, in at least one study (Swaim 1994. Aspects of the Ecology of the Alameda Whipsnake *Masticophis lateralis euryxanthus*. Unpubl. Master's thesis. California State University, Hayward. 140 pp.), stomach contents of field-captured *M. l. euryxanthus* were exclusively lizards and documentation of specific avian prey items is lacking in the literature.

We thank R. Stallcup and B. K. Sullivan for assistance.

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MICRURUS ALTIROSTRIS (Southern Coral Snake). **ARBOREALITY**. On 3 April 2004 at 1620 h at Águas Claras (30º08'N, 50º53'W), municipality of Viamão, Rio Grande do Sul state, Brazil, we observed an adult (ca. 80 cm total length) *Micrurus*

altirostris in a tree, ca. 1.5 m above the ground. The snake was supported by fine twigs and thorns and appeared to be moving toward an unidentified colubrid snake (20 cm TL) that was ca. 40 cm above it. *Micrurus altirostris* is known to prey on elongate reptiles like amphisbaenids and snakes and is primarily terrestrial (Achaval and Olmos 2003. Anfibios y Reptiles del Uruguay. Montevideo. Graphis. 136 pp.; Lema 2002. Os Répteis do Rio Grande do Sul: atuais e fosséis: biogeografia-ofidismo. Porto Alegre. EDIPUCRS. 264 pp.). This is the first report of arboreal behavior in *M. altirostris*. Arboreality in *Micrurus* has previously been reported for only four species: *M. nigrocinctus* (Schmidt and Smith 1943. Publ. Field Mus. Nat. Hist., Zool. Ser. 12:129–134), *M. fulvius* (Carr 1994. A Naturalist in Florida: A Celebration of Eden. Yale University Press, New Haven, Connecticut. 264 pp.), *M. circinalis* (Sajdak 2000. Herpetol. Rev. 31:105), and *M. surinamensis* (Hartdegen and Aucone 2001. Herpetol. Rev. 32:264).

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NERODIA ERYTHROGASTER NEGLECTA (Copper-bellied Watersnake). **SIZE RECORD**. *Nerodia erythrogaster neglecta* occurs in a variety of aquatic ecosystems along the Ohio River and its tributaries. Conant and Collins (1998) reported size records for the Yellow-bellied Watersnake (*N. e. flavigaster*) (1499 mm TL), the Blotched Watersnake (*N. e. transversa*) (1473 mm TL), and the Red-bellied Watersnake (*N. e. erythrogaster*) (1575 mm TL), but did not report maximum length for *N. e. neglecta*. The previous record length recorded for *N. e. neglecta* is 1415 mm TL (Minton 1972. Amphibians and Reptiles of Indiana. Indiana Acad. Sci. Monogr. No. 3, 346 pp.). On 2 May 2004 at 1245 h, we discovered a female *N. e. neglecta* basking on a log in a swamp along the lower Cache River (Johnson County, Illinois). The snake measured (using a tailor's flexible tape) 1220 mm SVL and 1507 mm TL. Ventral scutes numbered 164. The specimen was released at its capture site.

Submitted by **JASON E. WALLE** and **MARY T. MANDT**, Department of Biology, Murray State University, Murray, Kentucky 42071, USA.

REGINA ALLENI (Glossy Crayfish Snake). **COLORATION.** On 18 October 2002, I collected a subadult *Regina alleni* while sifting through mats of aquatic vegetation in the Hellhole Swamp (Francis Marion National Forest, Berkeley County, South Carolina). Typical *R. alleni* are dark brown dorsally, yellow or light brown ventrally with a double row of black half moons on each ventral scale. The animal I collected was solid black, except the ventral half moons and chin were white. This represents a previously unreported color phase of this species. This animal has been deposited in the Clemson University Herpetology Collection (CUSC 2200).

Submitted by **COREY E. ROELKE,** Clemson University, Department of Biological Sciences, 132 Long Hall, Clemson, South Carolina 29634-0314, USA; e-mail: croelke@clemson.edu.

SISTRURUS CATENATUS CATENATUS (Eastern Massasauga). **MALE-MALE COMBAT.** Male-male combat has been documented in numerous pitvipers, and among rattlesnakes is frequently reported in the genus *Crotalus* (Carpenter 1986. Smithsonian Herpetol. Inform. Serv. 69:1–18; Shine 1994. Copeia 1994:326–346). However, within the genus *Sistrurus*, fewer reports exist and most are from captive snakes. Carpenter (1979. Copeia 1979:638–642) reported on a combat ritual between two captive male *S. miliarius*, Armstrong and Murphy (1979. Univ. Kansas Mus. Nat. Hist., Special Publ. 5:1–88) observed it in captive *S. ravus*, and Johnson (1988. *In* Rosenberg [ed.], Proceedings of the 12th International Herpetological Symposium on Captive Propagation and Husbandry, New York-New Jersey Metropolitan Area, June 15–18, 1988, pp. 71–78) observed combat in captive *S. c. catenatus*. Shepard et al. (2003. Herpetol. Rev. 34:155–156) observed aggressive behavior in the field between two male *S. c. catenatus*, one of which was already copulating when the second male arrived and did not respond aggressively. However, the intruding male exhibited behavior that resembled that reported for *S. miliarius* (Carpenter 1979, *op. cit.*).

On 22 August 2003 at 1740 h, I observed a radio-tagged male *S. c. catenatus* (M1) in combat with a previously unknown male (M2) along the Upper Wapsipinicon River, Bremer County, Iowa, USA. The two snakes were in a dense stand of *Sparganium eurycarpum*, *Scirpus validus*, *Polygonum lapathifolium*, and *P. sagittatum* ca. 1.2–1.8 m tall. When first observed, the anterior halves of both snakes were nearly vertical and their snouts were pointed upward, while the posterior thirds of their bodies were intertwined. They then began a lateral swaying movement with the anterior portions of their bodies occasionally making contact and eventually one wrapping over the other apparently in an attempt to gain superior position (Fig. 1). This behavior continued for ca. 2–3 minutes until one snake would rapidly push the other snake to the ground. The two snakes would then take 1–2 minutes to reposition and the sequence would begin again. A continuous series of these small bouts continued for ca. 55 minutes (until 1835 h). Fighting ceased when M1, after being pushed to the ground, suddenly moved away. M2 stayed at the location and searched with tongue flicking and quick head movements for ca. 1–2 minutes, at which time he moved off in a direction opposite that of M1. Rapid tongue flicking occurred during the entire period of observation, and no rattling or biting was observed. After the encounter, I captured, measured and weighed M2 (632 mm SVL, 270 g). M1 measured 586 mm SVL and weighed 286 g on 27 July 2003. A short search was made for female snakes in the area, and although none was found, a female might have been in the area but remained undetected.

To my knowledge, this is the first report of male combat in the field for *S. c. catenatus*. When compared to the display postures and topping sequence described for *S. miliarius* (Carpenter 1979,

FIG. 1. Male *Sistrurus catenatus catenatus* from the Upper Wapsipinicon River, Bremer County, Iowa, USA, engaged in combat.

op. cit.), several similarities exist, specifically, 1) displaying with the anterior portion of the body elevated in an S-shape and laterally swaying to gain superior position, 2) topping—one male gains the superior position and pushes the anterior portion of the other male to the ground in a quick movement, and 3) continuous contact of the posterior portion of the body. One notable difference was observed; an exaggerated posture of bending over backwards was observed on several occasions during this encounter. In male combat it is predicted that the larger male will typically prevail, which might result in increased reproductive opportunities for the larger male (Schuett and Gillingham 1989. Amphibia-Reptilia 10:243–266; Shine 1994, *op. cit.*). The apparent winner of this bout was M2, who was longer than M1, but weighed less.

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TROPIDOPHIS WRIGHTI (NCN). **SIZE RECORD.** A male *Tropidophis wrighti* collected at Vista Alegre, Santiago de Cuba City, Santiago de Cuba Province in 1946 was maintained in captivity and fed with *Anolis* for more than two years (it died on 20 June 1949). The specimen (CTR 2; "Charles T. Ramsden" Collection deposited at Instituto de Ecología y Sistemática, Havana City Province, Cuba) measures 488 mm snout–vent length, 64 mm tail length, 14.5 mm head length, and 8.4 mm head width, and has 23 dorsal scale rows at midbody, 202 ventrals, 37 subcaudals, four spot rows, 28–31 body spots and 4-4 subcaudal spots. The previously reported maximum length for *T. wrighti* is 330 mm SVL (Hedges 2002. Bull. Nat. Hist. Mus. Lond. [Zool.] 68[2]:83–91). With this size record, *T. wrighti* becomes the second largest species of *Tropidophis* in Cuba, surpassed only by *T. melanurus*.

We thank Elier Fonseca, Lourdes Rodríguez Schettino, and Luis F. de Armas for suggestions on the manuscript.

Submitted by **MICHEL DOMÍNGUEZ** (e-mail: micdom2002@yahoo.es), **LUIS V. MORENO**, División de Colecciones Zoológicas, Instituto de Ecología y Sistemática, Carretera de Varona km 3, Capdevila, Boyeros, A.P. 8029, C.P. 10800, Ciudad de La Habana, Cuba; and **MICHEL SÁNCHEZ**, IPA "Villena-Revolución," Ave. Van Troi y Final, Reparto General Peraza, Boyeros, Ciudad de La Habana, Cuba.

GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 36, Number 1 (March 2005). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extension reports unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA MACULATUM (Spotted Salamander). USA: TENNESSEE: CARROLL CO.: Tennessee National Guard Milan Reserve, just SE of Halls Branch ca. 0.4 miles SE of Headquarters on TN Hwy 104 (35°54'13"N,88°39'20"W). 20 November 2004. John Maxwell. Austin Peay State University Museum of Zoology, APSU 6298 (color photo). Verified by A. Floyd Scott. One adult found under rotting log in shallow depression. New county record that augments the scant amount of existing data on the distribution of the species in west Tennessee (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. [Hard copy and Internet versions, the latter of which includes links to information on amphibians in Tennessee having appeared since 1996], http://www.apsu.edu/amatlas/, accessed 10 February 2005).

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TECHNIQUES

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A Simple Method to Accurately Measure Small Squamate Offspring

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Offspring size is a key life history trait that is often reported in inter- and intraspecific comparisons in reptile studies. Tests of the evolutionary or ecological significance of offspring size rely on accurate measurements, particularly when differences might be small and yet biologically significant. This is particularly important for small squamates as a variety of "allometric engineering" techniques for altering offspring phenotype (sensu Sinervo et al. 1992) have become established for testing a variety of evolutionary hypotheses (e.g., Olsson et al. 2002; Sinervo and DeNardo 1996; Wapstra 2000; Warner and Andrews 2002). These techniques have been particularly useful for providing explicit tests generated from life history theory, such as optimum trade-offs between offspring size and number. However, observed differences in offspring size may be quite small. Mass and length are the two primary measures of offspring size usually reported. From these two measures an index of condition is often reported (residual of the regression of length against size). Although mass is easily and precisely measured using sensitive bench-top balances (± 0.0001 grams), it may fluctuate widely in response to, for example, hydration levels, recent feeding activity, and stress-induced urination and/or defecation; these variables may affect, for example, growth rate analyses (Dunham et al. 1978). In contrast, measures of length are not prone to rapid fluctuations, but are difficult to measure accurately and precisely. Measures of length are usually reported as snout–vent length (SVL) and total length. Measures of tail length are sometimes reported and are likely to become more common as it is recognized that even small variations in tail length may have important fitness consequences (e.g., Shine et al. 1997; Shine and Downes 1999).

"Water surface tension" method of length measurement

In the majority of studies where offspring size is reported, measurement of length is relatively crude (e.g., rulers ± 1 mm). In some cases, more precise methods of measurement are used (e.g., digital calipers ± 0.01 mm) but it is rarely reported how the animals were restrained to provide reliable and/or repeatable measurements. As part of an ongoing life-history study that includes a variety of experimental manipulations of offspring size (e.g., Wapstra 2000; Wapstra and Swain 2001) I have developed a technique that allows accurate and repeatable measurements of offspring size that is particularly suitable for small species and their offspring. The technique has been predominantly used on newborn Snow Skinks (*Niveoscincus ocellatus*). Snow Skinks are small (adults 3–8 g and up to 70 mm SVL), ground-dwelling skinks common in Tasmania, Australia. They are viviparous, producing a litter of 1–5 newborns that each weigh 370–650 mg with a SVL of 27–32 mm. The method is extremely rapid and simple to use and greatly reduces the incidence of tail loss that can occur in many species when they are handled for measurement.

An individual lizard is dipped in cool water and then placed in a small sealable sample bag. The surface tension of the water on the "wet" lizard causes the individual to gently adhere (dorsally and ventrally) to the bag. This gentle restraint usually has the effect of calming the lizard and minimizing movement. The bag is then placed on a flat surface with the lizard ventral side up, thus exposing the vent. Using a blunt probe it is possible to gently manoeuvre the lizard's body into an outstretched position for measurement with a pair of digital calipers (Fig 1). With some experience, repeatable measurements are obtained because it is relatively simple to estimate when the individual is uniformly straight (scales are uniformly spaced with no lateral contraction). Lizards are often stationary for approximately one minute, enough time for independent measures of SVL, total length, and tail length. Furthermore, reliable measures of head size (length and width) can be easily obtained using a low power compound or dissecting microscope fitted with an eyepiece graticule. To demonstrate the repeatability of this technique I re-measured 59 newborn *Niveoscincus ocellatus* offspring blind one day after their initial measurement (Fig. 2). There is a strong correlation between the two measurements ($r^2 = 0.9656$) and data for SVL are continuous (between 28.05 mm and 31.48 mm), rather than the categorical data (28, 29, 30, 31) resultant from cruder methods of length measurement. In some situations, it may be necessary to use means of more than one independent measurement. No side effects on newborns (even those only minutes old) have been observed with this method.

While this method has been predominantly used on small newborn Snow Skinks, it has also been successfully used for individuals up to 6 months old, providing accurate size estimates for growth analyses. Beyond 6 months, the lizards are approaching 1 g and 40 mm SVL, and are easily able to break the surface tension. The

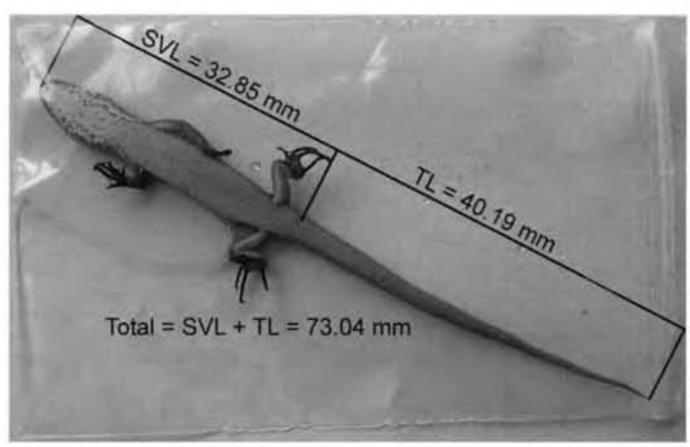

Fig. 1. Measurement of newborn Snow Skinks (*Niveoscincus*) using "water surface tension" technique. With care and the use of a blunt probe the lizard is straightened for accurate measurement of both snout–vent length and tail length.

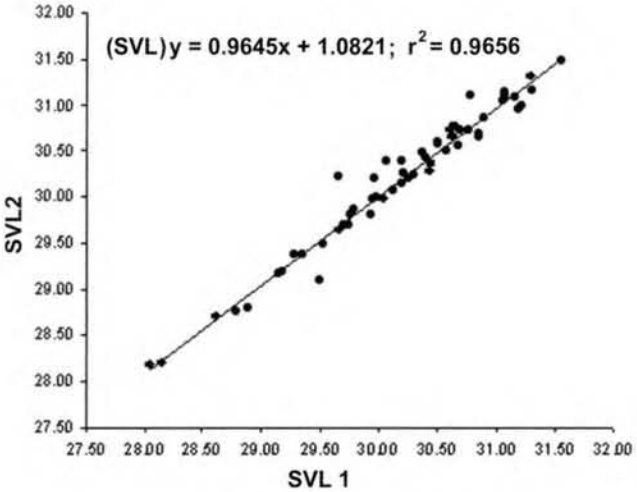

FIG. 2. Repeatability of measurements of snout–vent length (SVL) for newborn *Niveoscincus ocellatus* (SVL 1 was measured on day of birth, SVL 2 was a blind remeasure one day later; N = 59).

method has also been successful on small agamids, gekkonids, and lacertids, and is likely to be successful on a wide variety of taxa, particularly those with relatively smooth scales.

Acknowledgments.—The techniques described were developed for use in life history analyses in Snow Skinks with approval of Animal Ethics Committees from the University of Tasmania (No 94070) and Macquarie University (No. 2001/011, 2003/009). Lizards were caught under permit from Tasmanian Department of Primary Industries, Water and the Environment (Nature Conservation Branch, permit numbers 95109, 95363, and 96190). The work was supported by the Australian Research Council (DP0211364).

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A Plot-based System of Collecting Population Information on Terrestrial Breeding Frogs

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Basic information on animal populations, such as density, age or size distribution, and reproductive output, is important in order to understand their ecology and behavior. Reliable population information is essential for conservation efforts. Recent discussions of amphibian population declines (e.g., Blaustein 1994; Pechmann and Wilbur 1994) have underlined the importance of having good baseline information on as many species as possible. However, it is difficult to obtain funding for routine monitoring activities, and even when funding can be found, it is still necessary to balance the desire to collect more complete information with the constraints of time and resources. It is also important to document monitoring protocols thoroughly in order to allow for valid comparison between data sets (Oakley et al. 2003).

A variety of standardized techniques are available for use with amphibians (Heyer et al. 1994). In addition, the researcher must choose a combination of methods tailored to the focal species and the goals of the study. Many studies include population size or density as a key parameter of interest. Two recent studies have reported that capture-recapture analysis is the preferred method for estimating density of frogs in the genus *Eleutherodactylus* (Fogarty and Vilella 2001; Funk et al. 2003).

I have been attempting to quantify population parameters for a long-term study of the Puerto Rican frog, *Eleutherodactylus coqui* (hereafter the coquí), since 1981 (Woolbright 1991; 1996). The purposes of the study were to determine how populations vary through time as well as to compare different localities. Long-term population studies can provide valuable ecological information that cannot be obtained in any other way. However, the reliability of the data can be compromised when multiple data collectors use slightly different methodologies. Because there is no way to control for differences in observer perceptions, it is essential to control all other aspects of the methodology. In addition, survey methods should eliminate or control for all sampling biases that can be anticipated.

This report details the methods currently in use in my Puerto Rican study. They were developed by trial and error between 1981 and 1987, and have been fairly stable with only minor modifications since then. They include a suite of measurements that can be conveniently taken at the same time in a standardized plot-based survey. In my opinion they represent a good compromise between the need for detailed quantitative data and the need to sample multiple sites with limited time and resources. These methods work well for the coquí in the mid-elevation Tabonuco forests of the Luquillo Experimental Forest in northeastern Puerto Rico. We have more recently applied them to assessing the invasion of this species into Hawaii (Woolbright et al., in prep.). Because the coquí shares ecological characteristics with numerous other species of

Eleutherodactylus throughout the tropical Americas, the methods may also be useful to people wishing to study these species.

It is important to note that the coquí is a terrestrial breeder whose behavior does not include regular migration to breeding habitats. Migratory behavior complicates activity patterns and could introduce a variety of unanticipated biases into survey results. Therefore these methods may not be appropriate for species that migrate to breeding sites away from the normal home range.

Plot Design and Overview.—Study plots are 20 x 20 meters, divided into four 5-m strips to guide sampling. The plot size and shape were chosen to limit the number of frogs whose home ranges overlapped plot boundaries while still allowing the same observers to survey two plots per night. Two replicate plots are located at each site of interest.

Four nocturnal, time-constrained searches are conducted in each plot. I determined that number by keeping track of what proportion of adults captured each night had already been marked. Typically, after two nights of normal frog activity in a plot, more than half of the adults observed on the third night have been previously marked. However, adult activity can be lower than normal because of weather patterns, even on nights that are appropriate for surveys (see below). I added the fourth survey in an attempt to ensure that surveys included at least three nights of normal frog activity. In 1987 we conducted 14 surveys of one pair of plots to estimate the benefit of additional sampling effort. Because night 3 featured low frog activity, we reached 50% adult recaptures on night 4. After that the percentage increased slowly to a maximum of 76% adult recaptures on night 14. I concluded that additional nights of fieldwork beyond four provided diminishing returns. I also believe that it is impossible to reach 100% recaptures because of "floaters" that do not have territories but rather move through the habitat.

All adult frogs sighted during visual searches are captured and marked by clipping toes. For the long-term population study, we have used unique toe-clips because we are interested in data on the individual frog, such as growth rates and life span. However for relative density estimates, the use of cohort marking shortens the time spent marking and checking marks. Juvenile frogs are counted but not captured or marked. They can be quite numerous (361 in one plot on one night in 1992), so marking would take a significant amount of time. Their toes are too small for clipping, and I have not discovered a suitable alternative. In order to determine their size distribution, juvenile frogs are measured on one night of each survey period by holding a plastic ruler over them and assigning each juvenile to a 5-mm size class (6–10, 11–15, 16–20, 21–25 mm).

I have used capture-recapture data from adult frogs in these plots in statistical estimates of population density (as reported in Stewart and Woolbright 1996). However, as long as the probability of capture remains similar for the populations being compared, I believe that the total number of adults per four nights can be used directly as an index of relative population density (as reported in Woolbright 1991, 1996). This method suffers from a negative bias as a population estimator, and so it should be used only to compare similar plots. In addition, the magnitude of the bias is expected to increase with habitat structure and to vary with temperature and moisture conditions.

The maximum number of juveniles counted on a single night is used as an estimate of juvenile density. Although adults can be concealed by vines, epiphytes and other structure, juveniles tend to either be in the leaf litter or exposed on the herb layer close to the forest floor. At least in the interior forest in which the Puerto Rico plots are located, this layer is easily viewed. The biggest source of variation in juvenile counts from night to night is what proportion of juveniles has climbed up out of the leaf litter. Thus I believe the maximum nightly count is the best estimate we have of the total number of juveniles present. This estimate also clearly suffers from a negative bias. During periods of habitat disturbance and recovery, such as Hurricane Hugo and individual treefall events, I have been less confident in our juvenile counts because of a reduced ability to see juvenile perches clearly. This would also be a problem in more open or weedy habitats.

Adults are defined as 25 mm or more in snout-to-urostyle length (SVL). This cutoff was determined by observations of the body size at which male vocal slits open. It is intended to reflect the minimum size at which this species might be considered of reproductive age. It is considerably smaller than the actual size of reproductive adults at middle elevations of the Luquillo Forest, where calling males average 36 mm SVL and gravid females average 45 mm SVL (Woolbright 1989). Field workers carry a plastic ruler to use in determining whether or not borderline cases should be considered adults. Body size is recorded at the first capture of the survey period by placing the frog in a plastic bag, flattening it against a surface, and measuring the distance between the anterior tip of the snout and the posterior tip of the urostyle to the nearest 0.5 mm with dial calipers. Gender, reproductive condition, and pattern morph are also recorded for each adult at each capture (see below).

We also keep records of any predators seen during plot checks. We keep track of the common invertebrates that are known to eat frogs: crab spiders (genera *Stassina* and *Olios*), wolf spiders (Ctenidae), amblypigids (*Phrynus longipes*), tarantulas (*Avicularia laeta*), and scorpions (*Tityus obtusus*). The total number of predators counted per night is summed over the four-night period and used as a relative measure of predator density. We also note any sightings of rats, land crabs, cats, snakes, or other species of frogs in the plots, although these are usually too infrequent for statistical treatment.

Sound pressure level is recorded at the beginning of each night at the first plot surveyed. We have historically used a type 2 SPL meter (Realistic Company, Model 42-3019, Fort Worth, Texas) set on "C weighting" and "slow." After arriving at the plot, all headlamps are extinguished for 2 min to allow any frogs that were disturbed to start calling again. Four readings are then taken by pointing the SPL meter upslope, downslope, across grade to the right, and across grade to the left. Each position is held for 30 seconds and a minimum reading is obtained by noting the lowest point the needle hits during the 30-sec period. Frequently the four minimum readings are all the same; otherwise an average of the readings is used. Recent investigations have suggested that this technique may need to be revised (Benevides et al., in prep.).

Other data routinely collected at the beginning of each night are the time of night, wet and dry bulb readings on a sling psychrometer, a subjective statement about the amount and timing of rain in the last 24 h, and a characterization of the current condition of the leaf litter and foliage as wet, spotted, damp, or dry.

Time of night.—Based on the frogs' daily cycle of activity (Woolbright 1985), plot surveys are conducted at night, but generally before midnight. Coquíes emerge from their diurnal retreats at dark and move to their nocturnal perch sites from which they will either call or forage. Surveys do not begin until full dark when frogs have had time to get to their perches. In Puerto Rico this means starting no earlier than 1900 h in the winter and 2000 h in the summer. Depending on weather, frogs will begin to disappear from their perch sites as early as midnight. Therefore plot surveys end no later than 2400 h in the winter and 0100 h in the summer. Our standard routine is to start at the beginning of this time window and check no more than two plots per night. These times would need to be adjusted for use with a species that had a different activity pattern.

Weather.—Some frogs do not come out on extremely dry nights. The best nights for surveys are those when the leaf litter is wet and there has been at least some rain in the last day or so. Plot checks should not be done on nights that follow periods in excess of five days without rain. When heavy rain is falling, the frogs will move under cover and be hard to find. Therefore surveys should not be done on nights of continuous storms. For the occasional rainfall that lasts only a portion of the evening, we stop the search clock and turn off headlamps until the rain stops.

Traffic.—Plot checks are done by two people, walking together along the 5-m wide strips that comprise each plot. A third person can follow behind as an observer and/or data recorder, but that person should not search for frogs. More than three people at a time are not allowed in a plot because of excessive light levels that scare the frogs, as well as potential habitat damage.

Search pattern.—Each 20 x 20 m plot is divided into four 5-m wide strips to facilitate sampling. Strips generally run parallel to the contour of the plot to prevent walking up and down slope, which can lead to habitat damage. On the first night, searching should start at the top of the plot, go across the top strip, then turn around and come back the second strip, turn around and go across the third strip, turn around and come back the bottom strip. Within a strip, one person is responsible for searching from the string on one side to the middle of the strip, and the other is responsible for the middle to the string on the other side. The two searchers should consult frequently about where the middle is, and they should stay next to each other so that one does not get ahead and scare the frogs on the other side of the strip. On alternate nights, searching should start at the bottom of the plot and work to the top. On alternate nights, the two observers should switch which side of the strip they work. Note that the observer works both sides of the string dividing two strips of the plot—that is the person working the string by the next strip turns around and comes down the other side of that same string when searching the next strip. Thus, where observers start determines their location for the rest of that plot. Assuming the same two plots are done together on subsequent nights, we alternate which plot gets checked first and which second.

Searching constraints.—We count both adult and juvenile coquíes, but their perches tend to differ, so it is important to search both types of locations. Adults tend to be found on stems, tree trunks, foliage surfaces, rocks, and dead sticks from ground level up to the canopy. Juveniles are usually closer to the ground, on the small herbaceous vegetation layer from the ground up to about 50 cm. Lights should be no brighter than is necessary to see the frogs, and care is taken to avoid shining lights into areas of a plot that have not yet been searched. These are visual searches only. Searchers are instructed not to track down a calling male by the sound of his calls and not to search for frogs by opening curled leaves or other closed areas unless a frog can be seen from the outside. Violation of these restrictions can bias sex ratio patterns.

Searching time.—Searches are time-constrained. It is necessary to spend the same amount of time searching during each plot check to avoid biases introduced by people who search more or less than others. The search time for all plot checks is 1 h, specifically divided into 15 min per strip. Time is tracked using a stopwatch, and the timekeeper instructs the team to speed up or slow down in order to reach the end of the strip at the end of 15 min. If 15 min ends before the search is completed, the rest of the strip is skipped. If the end of the strip is reached before the time is up, searching continues for the full 15 min.

Search time does not include time spent handling frogs. For juveniles, this is not an issue because they are only being counted anyway. For adults, time spent handling and processing can be much greater than search time. For that reason, the stopwatch is paused upon capturing an adult and restarted when the adult is released. No searching is allowed during that time; all searching is constrained to one hour and tracked on the stopwatch.

Marking adults by toe-clipping.—Each adult captured in the plots is marked by clipping a unique combination of toes. We clip toes on all four limbs, but remove no more than one toe per limb. It is important to remove each toe completely. Toe pads regenerate, as does about one digit's worth of length. Thus if only part of the toe is removed, it will not be a distinguishable mark after it heals. Toes that have been clipped are still there and do have pads; they are just shorter than normal. In order to see old marks, a good image of the relative toe lengths on an unmarked frog is required. All field workers should spend time looking at unmarked frogs before their first survey. I do not usually include the rear "thumbs" in the toe-clipping system because they tend to lie along the leg where they are difficult to see. However during the period of time after Hurricane Hugo, when population densities were high and field seasons were more frequent, we ran out of numbers and used the thumbs to increase the number of unique marks available.

We have seen very little movement of marked frogs between plots. However, as a precaution, we use the same series of toeclips for any plots that are within about 50 m of each other.

Pattern morphs.—The coquí has a variety of different patterns (several examples can be seen in Rivero and Segui-Crespo 1992). As part of the plot data we also note the dorsal pattern of each frog marked. I use a subset of the 20-odd patterns identified by M. Stewart (pers. comm.) in the 1970's, but I omit those of her morphs that can be easily confused in the field and just use the most distinctive ones. This results in a set of morph numbers that makes no intuitive sense:

morph 5 - an irregular set of round, light or red polka dots on the back,
morph 6 - an interocular bar,
morph 9 - wild type: solid or mottled with no strong clear stripes or dots,
morph 11 - a clear light hairline stripe mid-dorsally running down the spine,

morph 11W - as above, but a wide stripe that is very noticeable, and

morph 16 - 2 dorsolateral stripes, either light or red in color.

(Note that morphs can be combined, as in 11 + 16, 6 + 11, etc.)

Determining gender.—It is not always possible to tell what sex a frog is, but there are certain clues. First, males call and have vocal sacs under their chins. Any male that has recently called will have a baggy vocal sac that is easily detected by rubbing his chin gently. Most mature males have vocal sacs that can be detected in the same way, although they will not be as baggy or obvious if the male has not been calling.

Mature females grow much larger than mature males. Although the size of all coquíes varies with locality, and notably with elevation, mature females are larger than mature males in all populations I have studied. In the vicinity of El Verde Field Station in Puerto Rico, males can get up to about 40 mm SVL and females can grow into the mid 50's (Woolbright 1989). A frog larger than 35 mm should have a vocal sac unless it is a female.

Eggs are visible through the female's body wall if present, starting with females of about 38 mm. Look on the posterior lateral surface of the abdomen adjacent to the leg for a white patch. Large eggs can be distinguished individually, while smaller ones appear as a mass. It is important to look for eggs immediately upon picking up the frog, as they will swallow air which quickly obscures the egg mass. Eggs are laid when the yolks are about 3–4 mm in diameter. If eggs are larger than this, or if they visibly contour the abdomen, it is probably a male's stomach. Egg eating is fairly common among males.

If none of these clues to sex is useful in a particular frog (usually the 25–33 mm group), then assigning gender involves guessing. Body proportions are a little different between the sexes, with females having slightly wider heads proportional to body size, and slightly longer and leaner bodies at the sizes at which males are starting to call. Experience looking at mature frogs can improve accuracy in distinguishing these differences.

Reproductive condition.—For every adult captured, we assign a reproductive condition, according to the following system. Reproductive condition is recorded as a superscript to the gender symbol (e.g., $♂^3$ or $♀^2$).

Condition 3 means that a frog is in the pool of actively reproductive animals on that night. This category includes males that are calling and females that have eggs in the 3–4 mm range. It is important to examine a male's posture before capture. If he is in the "push-up" position (Pough et al.'s 1983 "high alert") then he was calling, even though he might have stopped temporarily because of disturbance. We record males in this posture with baggy throats as callers to avoid underestimating how many frogs are calling that night. For females, the distinction between eggs big enough to lay tonight and eggs not quite big enough is subjective. However, there are not many females with 3–4 mm eggs.

Condition 2 means gender is confirmed, but the adult is not in the active breeding pool on that night. For a male this means he has a vocal sac, but was not calling. For females this means that eggs are visible, but less than 3 mm in diameter. Condition 1 means gender was not determined conclusively. Either it's too big to be a male, or the body proportions look like one sex or the other, or it's just a guess. I make many mistakes with the 25 mm frogs.

The standardized system of population monitoring detailed here provides a variety of quantified information about key characteristics of the local population. It is suitable to use for a baseline population study that can detect potentially important changes in population parameters. At the same time, it is rapid enough to accomplish on a limited budget and/or as a side project during other fieldwork.

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Effectiveness of Three Capture Methods for the Terrestrial Sacramento Mountains Salamander, *Aneides hardii*

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A variety of methods are used to survey amphibians, and the appropriate technique should be selected based on the goals of the study, the biology of the species being studied, and the resources available (Heyer et al. 1994). Studies of terrestrial salamanders have principally employed area- or time-constrained searches, pitfall traps with or without drift fences, quadrat sampling, and visual surveys (Corn and Bury 1990; Heyer et al. 1994). We investigated the effectiveness of three capture methods for the terrestrial Sacramento Mountains Salamander (*Aneides hardii*), a state-listed threatened species endemic to three mountain ranges in south-central New Mexico. It is critical to develop effective inventory and monitoring methods for rare species, and this study was specifically designed to select the most appropriate method to monitor *A. hardii*. Like many plethodontid salamanders, this species is particularly challenging to survey across a large number of plots because of its limited period of activity. *Aneides hardii* is only active above ground during mid-June through mid-September and is most active during the monsoonal rains of mid-July through mid-September (Degenhardt et al. 1996).

Previous studies of *A. hardii* have primarily used area-constrained searches (Borg 2001; Ramotnik and Scott 1989; Staub 1986) and time-constrained searches (Ramotnik 2001; Scott and Ramotnik 1992). However, repeatedly overturning cover objects in searches conducted seasonally can degrade salamander microhabitats (Smith and Petranka 2000). Therefore, we designed our study to compare area-constrained searches with two arrangements of pitfall traps that result in less repeated disturbance. Pitfall traps are commonly used for long-term monitoring or research plots (Corn 1994). Previous studies have demonstrated that pitfall traps are more effective at capturing certain species (Corn and Bury 1990, 1991; Enge 2001). For example, Corn and Bury (1990, 1991) had little success capturing *Aneides ferreus* in pitfall traps in the Pacific Northwest, attributing this to its close association with downed wood. In contrast, they commonly caught *Ensatina eschscholtzii*, which is generally more active on the forest floor (Corn 1994). Although *A. hardii* also is closely associated with downed wood and other cover objects, we believed that pitfall trapping might be an effective survey method. *Aneides hardii* has been unintentionally captured in invertebrate pitfall traps (Ramotnik 2001) and has been found active on the forest floor at night (D. Jones, pers. comm.).

We first evaluated, in the laboratory, the effectiveness of two types of pitfall trap lids for capturing salamanders and preventing escape. Both lid types were placed on a 2.37-L plastic bucket. One was a small plastic funnel with the narrow end removed and foam insulating tape placed around the circumference of the wide end to seal the small gap between the funnel and the plastic bucket. The other was a modified plastic lid into which we taped a flexible plastic sheet with eight evenly spaced cut flaps. We buried two traps in large tubs (N = 2) of soil from the Sacramento Mountains so that the openings were flush with the soil surface. We placed two individual *A. hardii* into each tub, and videotaped these trials over 4 h at night under low lighting. We tested six funnel-lid traps and eight plastic-flap lid traps.

We found that salamanders never escaped after entering a trap, regardless of lid type. However, lid type appeared to affect salamander entry into a trap. We observed salamanders deliberately walking partially down the entry into the funnel-lid traps, turning around, and coming back out. The plastic-flap lids tended to be more effective, as salamanders often walked onto a flap and fell in (6 of 8 [75%] tests in comparison to funnel-lid traps, 3 of 6 [50%] tests). We used the plastic-flap lid exclusively on our pitfall traps in the field.

During June 2003 in the Sacramento Mountains, New Mexico, we established four 7600-m^2 plots that were chosen for their similarity in vegetation, elevation, and disturbance history. Each plot contained three subplots with differing capture methods (Fig. 1). The subplots were separated by 50-m long buffer strips and consisted of an area-constrained search, a pitfall trap array with drift fences, and a grid arrangement of pitfall traps without drift fences. The area-constrained search subplots were 30 x 40 m (1200 m^2). The pitfall trap array with drift fences covered ca. 1232 m^2 and contained two triads with six pitfall traps each for a total of 12 traps. Each triad consisted of three 10-m drift fences constructed of 50-cm tall aluminum flashing buried ca. 20 cm in the soil, with a pitfall trap at each end of the fence. The fences radiated outward beginning 4 m from the center and were angled 120° from each other (Bury and Corn 1987). The grid design covered 1200 m^2 and consisted of 20 pitfall traps spaced 10 m apart in a 4 x 5 grid (Aubry 2000; Corn and Bury 1990, 1991; Grialou et al. 2000).

Although the two arrangements with pitfall traps differed in number of traps, they were comparable because each subplot contained approximately the same amount of sampling area. In both pitfall trap arrangements, traps were buried flush with the ground and covered with a 25 x 25 cm piece of plywood elevated with metal stakes ca. 5 cm above the edge of the trap (Block et al. 1998; Corn and Bury 1990). Moist sponges were placed in the bottom of the traps to prevent salamander desiccation (Parris et al. 1999; Rothermel and Semlitsch 2002).

Trapping occurred between 21 July and 19 September 2003, the period of the highest rainfall in the Sacramento Mountains. We operated traps for 61 days on two plots and for 47 days on the other two plots. We originally planned to operate traps on two plots during the first half of the rainy season and on the other two plots during the second half. However, because of unusually dry conditions during the first half of the season, we extended the trapping period for the first set of traps such that all traps were operated simultaneously for the second half of the rainy season, which was also drier than usual. Because we captured so few salamanders in the study, we did not disregard the captures from early in the season in order to equalize the trapping periods. We

checked pitfall traps every other day.

We searched two of the area-constrained search subplots three times, and the other two were searched twice with an interval of 14 days between searches. This unequal number of searches on subplots was also a result of dry conditions early in the study. Area-constrained searches entailed turning cover objects > 5 cm long that could be safely lifted by one person. All captured salamanders were uniquely marked with subcutaneous injections of fluorescent elastomer to examine recapture rates (Davis and Ovaska 2001). We determined the sex and measured the snout–vent length, total body length, and mass of each captured individual.

Only 77 salamanders were captured in the field experiment, preventing a statistical comparison of the three capture methods. We never recaptured a marked salamander. We captured 62 salamanders (80%) in the four area-constrained search subplots (mean, SD: 6.20 ± 5.47 salamanders captured per day), 13 salamanders (17%) in the four subplots containing pitfall trap arrays with drift fences (mean, SD: 0.06 ± 0.58 salamanders captured per day), and two salamanders (3%) in the four pitfall-grid arrangement subplots (mean, SD: 0.01 ± 0.10 salamanders captured per day). Salamanders were only captured in pitfall traps of either arrangement after a rainfall event.

Area-constrained searches required less sampling effort and yielded the highest mean number of salamanders captured per day. The amount of time required to sample and install subplot types was not equal. Both pitfall trap arrangements took less time to sample than area-constrained search subplots; however, pitfalls were surveyed more frequently, resulting in more time spent on the pitfall trap arrangements. Because of the need for repeated sampling, travel time to reach pitfall grids could greatly affect sampling effort. Area-constrained searches took ca. 3 person-hours to conduct (surveyed 2 or 3 times), and it took about 1 person-hour to check pitfall traps of either arrangement (checked 47 or 61 times). In addition, the amount of time to install pitfall trap arrangements was greater than area-constrained searches. Each array of pitfall traps and drift fences required ca. 72 person-hours to install. Fallen logs and obstacles in the soil, such as tree roots and large rocks, on our study plots made burying drift fences difficult. The grid arrangement of pitfall traps was less time consuming to install; each took ca. 20 person-hours. Corn and Bury (1990) also reported that installation of trap arrays with drift fences was time intensive, with arrays taking about twice the amount of time to install as a grid arrangement of pitfall traps without drift fences. The installation of area-constrained search subplots entailed marking the boundaries of each plot with pin flags, which took ca. 1 person-hour.

The study area received less rainfall during summer 2003 than the average summer precipitation of the previous 15 years. We obtained historical precipitation data from Cloudcroft, New Mexico, ca. 15 km from the study area (National Climatic Data Center 2004). The total precipitation for July–September 2003 was 22.12 cm, while the average total rainfall in July–September from 1988 through 2002 was 36.85 ± 8.71 cm (SD).

Ramotnik and Scott (1989) reported a mean surface density of 6 salamanders/100 m^2 from area-constrained searches conducted in 1986 and 1987 in the Sacramento Mountains. In this study, we found 1.3 salamanders/100 m^2 in area-constrained searches.

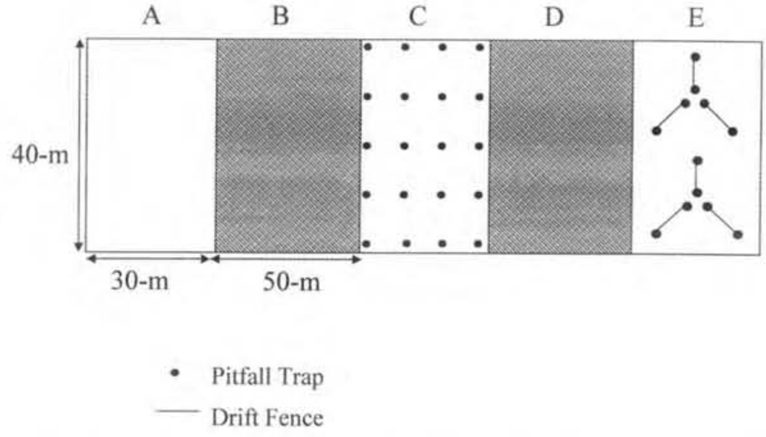

FIG. 1. Layout of the subplots within each 7600-m^2 plot. A is the area-constrained search subplot, B and D are the 50-m long buffer strips, C is the grid arrangement of pitfall traps subplot, and E is the pitfall trap array with drift fences subplot. Drawing is not to scale.

Ramotnik and Scott (1989) surveyed in August and September 1986, during which the average monthly precipitation was 13.77 ± 11.21cm (SD). They surveyed June–August 1987, but only the June precipitation data were available (12.37 cm). For comparison, the average monthly rainfall during our study period was 7.37 ± 4.35 cm (SD). Our lower capture rates during area-constrained searches may have been the result of relatively drier conditions.

Although it is difficult to make inferences about the most successful method based on these data, our results suggest that pitfall trapping is not a consistently effective sampling method for this species, especially in a dry year. When conditions are dry, plethodontid salamanders forage and seek refuge under cover objects (Feder 1983; Jaeger 1980). Feder (1983) suggested that plethodontid movement is limited by dry conditions because their skin is not resistant to water loss. Therefore, during drought conditions, *A. hardii* is most likely to be closely associated with cover objects where humidity is higher. In years of low precipitation, area-constrained searches appear to be the most reliable method for capturing salamanders. Area-constrained searches should be conducted as infrequently as possible, however, because overturning cover objects repeatedly may dessicate microhabitats.

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Capture Success of Northern Map Turtles (*Graptemys geographica*) and Other Turtle Species in Basking vs. Baited Hoop Traps

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Live-trapping with baited funnel or unbaited traps is commonly used to study turtle populations and assemblages. The most common baited funnel trap is the collapsible 'hoop trap' (Lagler 1943a; Legler 1960; Plummer 1979) which consists of three or four metal rings covered by fish net and one or two funnel-shaped entrances, or some variation of this design (Iverson 1979; Kuchling 2003). Turtles are attracted by bait (usually fish) held in a perforated container suspended inside and enter a funnel-shaped entrance which hinders escape. The most common unbaited trap is the floating basking trap which capitalizes on the proclivity for basking in some species. Basking traps generally have ramps, boards, or treadles leading over a floating frame which surrounds a mesh bag or wire basket (Cagle 1950; Lagler 1943a; Plummer 1979). Turtles climb onto the boards to bask but fall into the center once disturbed and cannot escape. An important concern in any trapping program, including turtle trapping, is trap bias (Frazer et al. 1990; Ream and Ream 1966). Ideally, a trap design will not disproportionately sample any sex or age group in a population, or any individual species in an assemblage study.

Considering the relatively large size and wide distribution of the Northern Map Turtle (*Graptemys geographica*) (Ernst et al. 1994), few studies exist in the literature compared to other species. In general, map turtles are well known for their basking aggregations and wary behavior which prevents close approach and hand captures (Daigle et al. 1994; Ernst et al. 1994). Basking aggregations often occur on exposed dead trees or rocks, or on banks, in large bodies of water. Many North American freshwater turtles are omnivorous and respond to baits in traps. However, map turtles are more specialized in their diets and prefer mollusks, crayfish, and insects (Ernst et al. 1994; Lagler 1943b). Although map turtles

do enter hoop traps, they are thought to be mostly unresponsive to baits (Lagler 1943a; Plummer 1979; but see Fuselier and Edds 1994).

We designed a variation of the basic basking trap to capture Northern Map Turtles. Our objective was to compare the effectiveness of floating basking traps with standard hoop traps for capturing map turtles or other basking species.

We manufactured floating basking traps using 4" white PVC pipe and 90° elbows which were glued to provide a waterproof floating frame (ca. 2 x 4 ft). We constructed a smaller rectangular frame of 1/2-inch black flexible plastic water pipe or copper water pipe with 90° elbows. Before glueing or soldering the last joint of the small frame together, we wove 1-inch mesh polyethylene fish netting along the piping to form a bag. We attached the smaller frame to the underside of the PVC frame with plastic cable ties to provide a netted interior from which turtles cannot easily escape. To the top of the PVC frame we attached a basking platform (13 mm x 15 cm wide boards) that had hinged (door hinges) ramps leading to the water at each end. Upon our approach, turtles would run off the platform and be caught inside the floating frame. Traps were secured against drifting by either tying them to a fixed object or using a concrete block as an anchor.

The hoop traps were commercially manufactured (M. Purchase, Lawrence, Michigan; Superior Net and Twine, Thunder Bay, Ontario). Each trap had three 44-cm diameter circular (flattened bottom) steel rings, which were 42 cm apart and covered by 2.54 cm mesh fish netting. We suspended a perforated can containing fresh fish bait from the middle ring. Hoop traps were set near observed basking sites by stretching them out and fastening them to 2 x 2-inch wooden stakes so that they were mostly submerged but still permitted turtles to breathe. When stretched, a single inward pointing mesh funnel allowed turtles to enter but restricted their exit from the trap.

To compare the efficiency of basking with hoop traps, we conducted an experiment in Point Pelee National Park, Ontario (42°10'N, 82°30'W). Point Pelee contains one of the largest coastal marshes (10 km^2) in the lower Great Lakes and is characterized by ponds (1–1.5 m deep) interspersed among cattail/reed mats. Our previous research has established that the relative abundance (most to least abundant) of turtle species at Point Pelee is *Chrysemys picta*, *Chelydra serpentina*, *Graptemys geographica*, *Emydoidea blandingii*, and *Sternotherus odoratus* (Browne and Hecnar 2003).

We trapped in May and June of 2002, a time when map turtles actively bask in peripheral range locations in Canada (Daigle et al. 1994; Gordon and MacCulloch 1980). We set basking traps and baited hoop traps in a large marsh pond where we previously observed map turtle activity. Because map turtles bask in groups even when basking sites are not limited (Flaherty and Bider 1984) we tied our basking traps to emergent woody debris.

We set three basking traps for 16 days in May and 15 days in June. On the same days, we set either eight hoop traps (13 days) or seven (3 days) hoop traps in May, and eight traps (15 days) in June. To test the hypothesis of equal trap effectiveness between the two trap types (ie. 1:1 capture ratio), we compared the number of actual captures to expected captures based on trap effort using a William's corrected G-test (Table 1). In calculating expected captures, we corrected for differential trap effort by multiplying total captures by the proportion of trap days for each trap type (see Table 1). Significantly more map turtles were captured in basking traps than hoop traps in both May ($G = 176.1$, 1 df, $P<0.001$) and June ($G = 18.0$, 1 df, $P<0.001$). Significantly more *G. geographica* were captured in basking traps in May than in June ($G = 47.0$, 1 df, $P<0.001$).

TABLE 1. Northern Map Turtle captures by trap type and month. Expected captures were calculated by multiplying total captures for each month by relative trap effort (i.e., May basking trap expected captures = 74 x [48/173]).

Month	Trap Type	Captures	Effort (trap d)	Expected Captures
May	Basking	73	48	20.5
May	Hoop	1	125	53.5
June	Basking	11	45	3.5
June	Hoop	2	120	9.5

We did not capture any male *G. geographica* in hoop traps during our study. However, we captured all sex and age classes (31% male, 65% female, 4% juveniles) in basking traps. The female to male capture ratio for our basking traps was greater than 2:1. Gordon and MacCulloch (1980) captured almost the opposite ratio (61% male, 36% female, 2% juveniles) in basking traps in Quebéc. Considering that both studies were conducted at similar latitude, used similar traps, and were in the same season, the sex ratio difference likely reflects differences in actual population sex ratio rather than trapping bias.

Our basking trap was also very effective in catching Painted Turtles in areas that were not common basking spots for map turtles (Browne and Hecnar 2003). McKenna (2001) also reported higher trapping success for basking traps than hoop traps for painted turtles and captures in basking traps appeared unbiased for size or sex. However, Thomas et al. (1999) compared captures between basking and hoop traps for *Trachemys scripta* and found sex biases and seasonal differences in capture efficiency.

MacCulloch and Gordon (1978) designed a floating basking trap to study Northern Map Turtles in Québec. Their trap has a floating wooden frame and was successful at capturing all sizes of turtles without apparent sex bias. Our results highlight the effectiveness of the simple floating basking trap we designed for capturing map turtles and potentially for other basking species. It is also clear that multiple techniques should be used to minimize trapping biases among species as others have suggested (see Plummer 1979; Ream and Ream 1966). Marchand (1945) used 'water goggling' by being towed by a boat and then rapidly swimming to hand capture map turtles. Chaney and Smith (1950) located basking map turtles during the day then returned during the night to hand capture individuals from submerged vegetation. Although hand captures can be productive, they tend to be a highly biased method (Bider and Hoek 1971). Others have used binoculars or spotting telescopes to conduct visual surveys of basking map turtles from a distance (Daigle et al. 1994; Lindeman 1998). These visual surveys have low disturbance and can provide data on basking behavior or relative abundance but they do not provide as much detailed information as trapping.

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A Comparison of Two Pitfall Trap Designs in Sampling Boreal Anurans

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The ecology of amphibians in Canada's boreal forest is poorly documented (but see Constible et al. 2001; Hannon et al. 2002; Leclair et al. 2000; Roberts and Lewin 1979). Sound ecological techniques are needed to properly assess population sizes, distributions and habitat use patterns (Paszkowski et al. 2002). Use of pitfall traps with drift fences is a common and effective method to assess the presence and abundance of many species of amphibians (Bury and Corn 1987; Corn 1994). They are easy to construct (although installation can represent a significant time investment), generally less expensive and require less maintenance than use of funnel traps (Jenkins et al. 2003).

The conventional pitfall trap is constructed from two coffee cans (one with bottom removed) fastened together with duct tape and a plastic funnel made from a margarine container (with bottom removed) inserted at the top (Corn 1994). New research has since evaluated the effectiveness of pitfall traps to improve monitoring and increase our knowledge of sampling biases for various species and habitat types. In general, the best pitfall trap is a wider bucket or can (Mitchell et al. 1993) that is dark in color (Crawford and Kurta 2000) and has a rim or funnel to prevent individuals from escaping (Mazerolle 2003). The objective of our study was to compare in a boreal landscape the total number of anuran captures per species and age class (< 1 yr, ≥ 1 yr) between a pitfall trap similar to the conventional model (see Corn 1994) with one encompassing modifications to the previous design.

Methods.—We conducted this study adjacent to beaver ponds in the boreal foothills eco-region on the eastern slopes of the Rocky Mountains near the town of Lodgepole, Alberta, Canada (53°06'N, 115°19'W) during summer 2003. Common species in the region are the Wood Frog (*Rana sylvatica*), Boreal Chorus Frog (*Pseudacris maculata*), Western Toad (*Bufo boreas*), and Common Garter Snake (*Thamnophis sirtalis*; Russell and Bauer 2000). All three species of anurans were heard calling on the study ponds in the spring prior to pitfall trapping.

Our study compared two types of pitfall traps: an 'old' versus 'new' model. The 'old trap' was similar to, but smaller than, the one described in Corn (1994): we used 1.5 coffee cans (1 kg size) rather than 2 coffee cans (1.36 kg size). The inserted funnel in the coffee can was a margarine container (907 g) with the bottom cut out (Fig. 1). The 'new trap' was a 7.6-L plastic bucket; black in color with a soft-sloping funnel constructed from polyethylene plastic (i.e., vapor barrier) and duct tape (Fig. 1). This trap type was wider than the old model (23 cm vs. 15 cm diam). However, trap depth, diameter of the funnel hole, and distance of the funnel hole to the bottom of the trap were similar between trap types

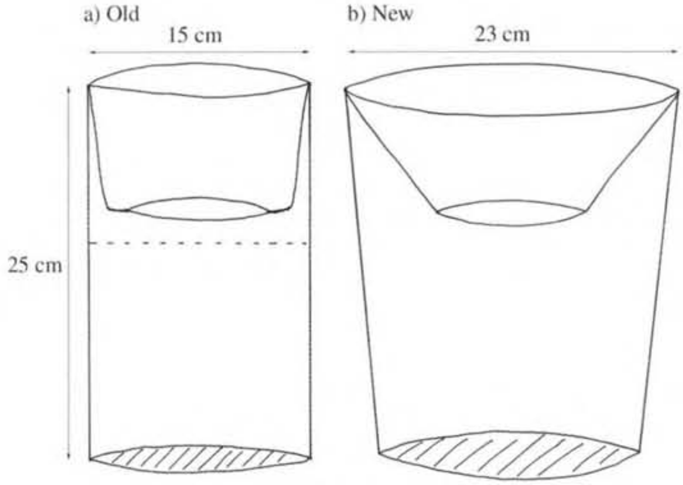

FIG. 1. Pitfall trap dimensions and design for the 'old trap' (Fig. 1a) made from 1.5 coffee cans (1 kg size) with a margarine container (hard) funnel, and the 'new trap' (Fig. 1b) constructed from a 7.6-L black plastic bucket with a sloping, polyethylene (soft) funnel.

(Fig. 1). A small quantity of moss was added to the bottom of each trap to keep animals moist and shaded (we did not use cover boards above traps). A stick (1.0 cm diam) was also inserted into each trap to allow small mammals to escape (Perkins and Hunter 2002). Traps were installed in pairs along drift fences; each fence consisted of one new trap placed at one end and one old trap at the opposite end. The drift fence was a polyethylene sheet 5 m long and 30 cm wide above ground with ca. 5 cm of plastic buried in the soil. All fences were 5–10 m from, and parallel to, the shoreline associated with four beaver ponds within a 200 km^2 study area. Approximately 20% of the shoreline of each pond was covered with drift fences resulting in 10, 9, 8, and 6 fences randomly located on the four ponds for a combined total of 33 trap pairs. Pitfall traps were opened from June 28 to July 30, 2003 and checked every 3–4 days.

Captured anurans were identified to species and age class (< 1 yr or young-of-year and ≥ 1 yr or "adult") and a sample of individuals were measured for snout–urostyle length (SUL) and mass. Individuals categorized as young-of-the-year (YOY) were < 21 mm SUL for Boreal Chorus Frogs and < 27 mm SUL for Wood Frogs and Western Toads, or had remnants of a larval tail (in some cases anurans with a larval tail were counted but not measured for SUL). All anurans were released 5–10 m from their point of capture. Animals were not marked (e.g., toes clipped) because previous pitfall trapping in 2001 and 2002 resulted in very low recapture rates for anurans in the area (< 2%; C. E. Stevens and C. A. Paszkowski, unpubl. data).

We determined if there were differences in the total number of individuals captured per species and age class between old and new traps from all 33 fences combined (N = 33) using a Wilcoxon paired-sample test. We chose this analysis because each data set consisted of a non-normal distribution even after square-root and logarithmic transformations, and because trap types were installed in pairs to account for possible microhabitat differences among fence locations that can affect capture rates (deMaynadier and Hunter 1999; Melbourne 1999). We accepted significance at the 5% level.

Results.—Sixty-six pitfall traps captured 1274 anurans: 1111 YOY Wood Frogs, 84 YOY Boreal Chorus Frogs, 43 adult Wood Frogs, 32 adult Western Toads, 4 adult Boreal Chorus Frogs, 0 YOY Western Toads (Table 1), and 0 snakes. Significantly more individuals were captured in new versus old pitfall traps for adult Wood Frogs (z = -2.28, $P = 0.022$) and YOY Boreal Chorus Frogs (z = -4.03, $P < 0.001$; Table 1). However, there were no significant differences in numbers caught between trap types for YOY Wood Frogs (z = -0.13, $P = 0.893$) and adult Western Toads (z = -1.28, *P*

TABLE 1. Total number of captures and number of drift fences that captured higher numbers of individuals in 'new pitfall traps' (i.e., plastic buckets with polyethylene funnels) versus 'old pitfall traps' (i.e., coffee cans with margarine funnels) adjacent to 33 drift fences (5 m length) per anuran species and age class on four beaver ponds in west-central Alberta during 28 June to 30 July 2003. *P* determined by a Wilcoxon paired-sample test and reflects differences in captures between trap types. Mean (± standard error) snout–urostyle length (SUL) for each category is based on a sample of captured individuals that were measured during the trapping period.

	Anurans < 1 yr old				Anurans ≥ 1 yr old			
	Old Trap Captures	New Trap Captures	New Trap Fences†	*P*	Old Trap Captures	New Trap Captures	New Trap Fences†	*P*
Wood Frog	476	635*	15 (4)	0.89	13	30	13 (16)	0.03
SUL (mm)	21.6 ± 0.1	21 ± 0.1			39.5 ± 2.6	38.4 ± 1.4		
	N = 351	N = 344			N = 13	N = 30		
Boreal Chorus Frog	7	77	21 (10)	< 0.01	1	3	2 (30)	na
SUL (mm)	16.1 ± 0.9	17.3 ± 0.2			46.8 ± na	26.8 ± na		
	N = 6	N = 72			N = 1	N = 3		
Western Toad	0	0	0 (0)	na	12	20	11 (16)	0.2
SUL (mm)	na	na			50.8 ± 4.9	45.9 ± 2.9		
					N = 12	N = 20		

na = Value not available because of low number of captures

* Relatively large value due to one new trap that captured 168 individuals, whereas the paired old trap caught 60 YOY wood frogs only

† Number of fences or trap pairs with higher captures in the new trap, including number of fences with equal captures between trap types in brackets

= 0.202; Table 1).

Discussion.—The new pitfall trap design was as effective or more effective in trapping boreal anurans than the more commonly used coffee can design (e.g., Corn 1994). This difference might reflect anuran avoidance of the silver color inside the coffee cans or the white color associated with the margarine container used as the funnel (Crawford and Kurta 2000). In addition, adult ranids may avoid the narrower traps (i.e., coffee cans) by jumping over the hole. The structure and shape of funnels in pitfall traps could also influence their effectiveness in trapping anurans. For example, the margarine container in our study had a hard rim or lip that could provide a solid platform for individuals inside the trap to grasp with their forelimbs or to rest on, rather than falling into the deeper can, particularly for YOY Boreal Chorus Frogs (CES, pers. obs). In contrast, the funnel in the plastic bucket was a soft or flexible polyethylene sheet with a constant sloping surface that lacked distinct surfaces for support (Fig. 1).

Very few adult Boreal Chorus Frogs and no YOY Western Toads were captured in our study. Hylids, in general, are difficult to sample with pitfall traps because of their ability to climb vertical structures (Dodd 1991). The lack of captures of YOY Western Toads, however, may reflect the fact that partial fencing of ponds failed to intercept individuals that emerged in a non-uniform pattern rather than failings of the trap designs. For example, newly metamorphosed toads may have emerged from concentrated locations in the pond where the water was warm or highly oxygenated (Noland and Ultsch 1981). It is also possible that the beaver ponds in our study were poor larval environments for toads (e.g., too cold, inadequate food) leading to low juvenile recruitment to metamorphosis.

Our field experience with both types of pitfall traps suggests that the plastic bucket-polyethylene funnel design is easier to construct than the one made from a coffee can and margarine container. The special cutting device and time needed to remove the bottom of coffee cans and cut tin to create the 1.5 coffee can was not required for the plastic bucket. In addition, large numbers of plastic buckets can be stacked because of their tapered design (Fig. 1) and carried into field locations with greater ease than when using non-stackable coffee cans. Cans can also rust with extended use and eventually need to be replaced. Finally, although coffee cans and margarine containers can be obtained for free, the costs of plastic buckets and polyethylene plastic are relatively low when bought in large quantities: \$2 per 7.6-L plastic bucket, and \$13 per 46 m^2 roll of polyethylene plastic (Cdn dollars).

In summary, the new model (plastic bucket with flexible polyethylene funnel) was a better pitfall trap than the old model (coffee can with margarine container) both in terms of ease of use and trapping performance. Funnel designs may play a key role in reducing the number of hylids and large ranids that escape from traps. Understanding the biases of various methods and improving ecological techniques to monitor more accurately population trends is critical to the conservation of anurans in boreal habitats.

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Attachment of Radio Transmitters in a Rock Iguana, *Cyclura lewisi*

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Tracking with radio telemetry is an important tool for studying aspects of the behavior and ecology of animals, including movements and habitat use. In endangered lizards, such as iguanas of the genus *Cyclura*, radio tracking may yield valuable insights about habitat and area requirements that may aid in management and conservation. Radio tracking is a particularly important monitoring technique for *Cyclura* because they have large home ranges (up to 9 ha) that may shift seasonally (Rose 1982; Wiewandt 1977; Mitchell 1999). Unfortunately, no optimal method of attaching radio transmitters has been demonstrated for *Cyclura*, although many have been attempted.

Cycluran iguanas are found on islands throughout the West Indies, where they commonly live in habitats with rocky limestone substrates, using jagged rock sinkholes as retreats (Alberts 2000). This rocky substrate, and possibly the low-growing vegetation often found on these islands, contribute to the frequent detachment and loss of radio transmitters attached externally to these iguanas. The following methods of external attachment have been tried in different species of *Cyclura*, with varying levels of success: waist belts (Mitchell 1999), neck collars (with hatchlings, N. Perez, pers. comm.), vests worn over the anterior portion of the body (Hates et al. 2000), duct taping transmitters to tails (C. Knapp, pers. comm.), and suturing transmitters below dorsal crests (F. Burton, pers. comm.).

Two additional methods have been used to secure radio transmitters in *Cyclura*: feeding transmitters in food to iguanas (Christian et al. 1986, Goodyear and Lazell 1994) and surgically implanting transmitters into the body cavity (F. Burton, A. Alberts, pers. comm.). The former method is only useful for short-term data collection, as the transmitter is expelled during defecation after 4–7 days (Goodyear and Lazell 1994). The latter method, which has been used in several other lizards (Schauble and Grigg 1998; Sound and Veith 2000; Wikelski 1999), seems the best way to ensure long-term monitoring of an iguana because the transmitter is secured inside of the body. However, the implant procedure requires anesthesia and surgery, which increase risk to the animal and cost to the researcher due to the need for veterinary staff (desirable and often required for surgical implantation because all species of *Cyclura* are protected). Furthermore, no studies have been published on the long-term effects of transmitter implantation on lizards, so the risk of decreased fitness due to transmitter implantation is unknown. Because of the long life span in *Cyclura* (up to 60 years, Iverson et al. 2004), negative consequences of transmitter implantation could take years to manifest.

During a study on the spatial ecology of *Cyclura lewisi* (formerly *C. nubila lewisi*, see Burton 2004) on Grand Cayman in 2002, I used two methods to attach radio transmitters to iguanas. Transmitters were attached to five large males (36–49 cm SVL, 80–118 cm TL, 2.2–5.1 kg) in 11 instances by suturing below the posterior dorsal crest (Fig. 1). Transmitters were attached to seven females and one small male (27–38 cm SVL, 69–93 cm TL, 0.9–2.7 kg) in 17 instances by gluing to the posterior dorsum. Suturing was not used with these smaller iguanas because their smaller dorsal crests may be vulnerable to tearing if the transmitters became caught on rocks or vegetation. Suturing radio transmitters to animals has been previously described in fish (e.g., Erkinaro et al. 1999) and snakes (e.g., Ciofi and Chelazzi 1991). To my knowledge, however, no published study has reported suturing transmitters below the dorsal crest in lizards. Therefore, the purposes of this paper are to describe the technique of suturing transmitters to iguanas, to assess the impacts of this method on the lizards in this study, and to compare the short-term reliability of gluing and suturing methods.

Iguanas were not anesthetized for either method of attaching transmitters, but were fully restrained both manually and with large cloth straps secured with Velcro®. For method 1, radio transmitters (Holohil Systems, Ltd. model AI-2, cylinder 45 mm x 15 mm diameter with whip antennae 23 cm length, 6 month battery) that had a flat metal mounting plate (75 mm x 8 mm) on the bottom were encapsulated in liquid plastic. This unit was glued to the dorsum of the iguana just anterior to the base of the tail alongside the dorsal crest using cyanoacrylate gel. Other studies with lizards have used similar methods of attaching transmitters externally with glue or epoxy (Cuadrado 1998; Griffiths and Christian 1996; Sabo 2003).

In method 2, the posterior dorsum of the iguana was first cleaned with 70% isopropyl alcohol. Then the transmitter (same model as above) was sutured below the dorsal crest in the following manner, which is similar to a bead-tagging technique described by Rodda et al. (1988) that is currently used by many researchers working with *Cyclura*. The dorsal crest of the iguana was held firmly in hand while a 16-gauge needle was used to puncture the skin just below the origin of the dorsal scales. The needle was pushed through neoprene pads on each side of the crest, and nylon-coated steel leader wire (60 lb strength, 0.7 mm diam) was then threaded through the needle and pads. This was done in two places on the posterior dorsal crest, and the needle was subse-

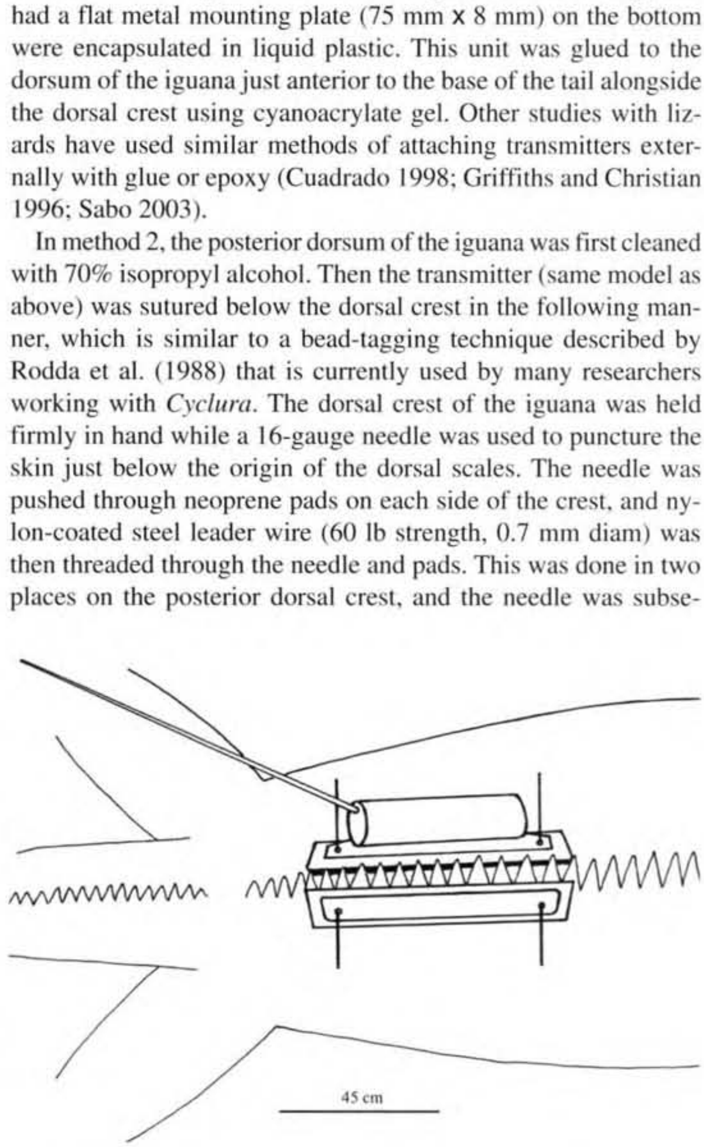

FIG. 1. Diagram of the method used to suture a radio transmitter below the dorsal crest of an iguana.

quently removed from the skin, leaving the leader wire in place below the dorsal crest. Next, the radio transmitter and backing plate were attached on opposite sides of the dorsal crest by leading the wire through the holes in each. Glass beads (ca. 4 mm diam with ca. 1.4 mm diam hole) were threaded onto the terminal portions of the wire, and the wire ends were secured with leader sleeves. The glass beads are not a necessary part of the design, but were added in this case because the holes in the radio transmitter mounts and backing plates were larger in diameter than the leader sleeves. The total mass of either type of transmitter package before gluing or suturing averaged 35–40 g, which was less than 5% of the body mass of iguanas and therefore acceptable within common standards (Macdonald and Amlaner 1980).

No adverse effects of gluing transmitters to iguanas were noticed. These transmitters were removed from iguanas by cutting them out of the plastic casing, leaving only a small patch of plastic on the dorsum which fell off before or during the next shedding. The effects of the suturing technique involved occasional slight bleeding immediately after puncturing the skin, and small puncture wounds evident upon removal of transmitters. No infection of the puncture sights was noted during or after radio tracking iguanas in this study. One year post-removal, these wounds had healed and were small when compared to scars resulting from intraspecific interactions. In some cases, puncture wounds were slightly expanded during wear (still < 2 mm diam), probably because the transmitter had become caught on vegetation and pulled away from the body in the animal's struggle to free itself. I witnessed such events wherein iguanas became temporarily entangled in vegetation because of radio transmitters, but in no case did this affect the movement of an iguana for more than one minute. Future use of the suturing method should modify this study's design to minimize the potential for transmitters to catch on rocks or vegetation. Transmitters should not have sharp edges or any places where vegetation could become caught, especially on the anterior side.

One major assumption in radio tracking studies is that animal movements are not affected by the techniques that researchers use (White and Garrott 1990). Although I could not verify this assumption for all individuals, the following observations lead me to believe that radio transmitters did not heavily influence the behavior of iguanas. No iguana was observed biting or excessively scratching or inspecting the radio transmitter and associated attachment site on the body. Iguanas were always more wary of researchers after capture and handling, but there was no evidence that this was more pronounced in cases where transmitters were attached (using either method). Iguanas did not appear to respond to the puncture sites after transmitters were sutured to them. In fact, one male was observed successfully copulating with a female less than fifteen minutes after having a transmitter sutured to him.

Only the short-term reliability of gluing and suturing methods was assessed because the number of radio transmitters was limited in this study and transmitters were periodically removed and reused on different iguanas. Eight of 17 (47%) transmitters that were glued to iguanas fell off within two weeks. Of the remaining glued-on transmitters, several were removed within one month for use on other iguanas, and four were removed after 30 days. One transmitter that could not be retrieved was still on an iguana when the study ended 45 days after attachment by gluing.

Only two of 11 (18 %) transmitters that where sutured to iguanas fell off within two weeks. These were the first two transmitters to be attached with this method, and loss resulted within two days from a failure to completely clamp the leader sleeves securing the apparatus. Once this problem was resolved, all sutured transmitters remained attached until removed intentionally by a researcher. Of these remaining nine transmitters, three were removed at 16–17 days, five were removed at 29–32 days, and one was left on as a long-term trial. Unfortunately, this iguana was run over by a vehicle 48 days after transmitter attachment. One of the sutures ripped through the dorsal crest of the iguana during the accident, and the transmitter was removed immediately afterward.

The two methods of transmitter attachment were used on different sized iguanas, and I could not investigate whether there was any relationship between body size and length of transmitter attachment. However, I believe that the low reliability of glued-on transmitters was because of the attachment method and not the body size of iguanas, inferred because of the way in which transmitter detached. Transmitters that had been glued-on detached at the site of gluing because of a failure of the adhesive or the sloughing or tearing off of old skin that was about to shed. Presumably these could occur in all sexes and sizes of iguanas. Additionally, if greater movement rates were responsible for increased snagging and detachment of transmitters, we would expect to see the opposite results of those presented here on reliability of methods, as male *C. n. lewisi* have greater or equal movement rates than females (Goodman 2004).

Burton (pers. comm.) used a similar suturing technique in 1993 to attach transmitters to two *C. n. lewisi*, except that design lacked the neoprene pads and backing plate incorporated in the current study. One of these transmitters remained attached for six months, while the other remained attached for at least two months, after which the iguana disappeared. Based on Burton's experience in 1993 and the results of radio tracking conducted in 2002, suturing transmitters to the dorsal crest seems more reliable than gluing transmitters to the dorsum with cyanoacrylate gel.

The main potential drawback to the suturing method, transmitters getting snagged on rocks or vegetation, was not a large problem in this study and can probably be further minimized with slight design improvements. Benefits of suturing transmitters to iguanas, compared to other attachment methods include cost efficiency, short-term attachment reliability, and less invasiveness than internal implantation. Although long-term safety and reliability of attachment need to be examined in more detail, this method of suturing radio transmitters to iguanas appears promising for researchers working with large lizards.

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Comet Assay Used to Detect Genotoxic Effects of Mining Sediments in Western Toad Tadpoles (*Bufo boreas*)

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Water contaminated by mining sediments can have lethal and sublethal effects on amphibians (e.g., Hopkins et al. 1997; Lefcort et al. 1998; Porter and Hakanson 1976; Rowe et al. 1998). However, not all mining sediments are alike. Depending on the parent-rock material, pH levels, and hydrological patterns, the heavy metal concentrations of sediment effluents can be highly variable (Robb and Robinson 1995) and, consequently, range from being highly toxic to relatively benign for amphibians. Thus, different management strategies ranging from intensive reclamation to no action may effectively reduce the threat from mining sediments (Robb and Robinson 1995).

Amphibian survivorship, development, and behavior studies can assess the toxicity of mining sediments (e.g., Lefcort et al. 1998; Porter and Hakanson 1976; Rowe et al. 1998). However, such studies could take weeks to months to complete reducing the number of sites examined in a field season. A more time efficient approach may utilize genotoxic assays of amphibian larvae *in situ* (or caged for short time periods) to assess the toxicity of sediment effluents. One promising technique is single-cell gel (SCG) electrophoresis.

Singh et al. (1988) first developed alkaline SCG electrophoresis for quantification of low levels of DNA damage in human lymphocytes. The technique is referred to as the "comet" assay because the DNA fragments from affected cells migrate further than intact DNA, resulting in a streaked appearance. The length to width ratio of the streak is an indication of the DNA damage (Singh et al. 1988). The comet assay has been modified for many plants and animals for genetic ecotoxicology research (Cotelle and Férard 1999). For amphibians, the comet assay has been used *in situ* and in field and laboratory studies to detect DNA fragmentation in nucleated erythrocytes resulting from exposure to organic toxicants such as herbicides, pesticides, and petrochemicals (Clements et al. 1997; Ralph et al. 1996; Ralph and Petras 1997, 1998a,b). However, it is not known whether this technique is effective for assessing the toxicity of heavy metals on amphibians (but see De Boeck et al. 2000 for effects of heavy metals on human lymphocyte DNA).

We examined the effectiveness of the comet assay to detect the toxic effects of mining sediments on Western Toad (*Bufo boreas*) larvae in Montana. We first used survival and growth studies, in the field and in the lab, to demonstrate the toxic effects of sediments from an abandoned gold/silver mine. We then used the comet assay to test for DNA fragmentation resulting from exposure to the same mining sediments.

The abandoned Nellie Grant Mine is ca. 38 km S of Helena, Montana, in the Helena National Forest. Before reclamation work in 1998, water drained ca. 200 m from the mine site into a multi-pooled, sedge-grass wetland (Frohner Meadows) through piles of waste rock and mine tailings. Sediment and water samples taken in 1993 were acidic (mean pH = 6.0) and contained significant levels of arsenic, lead, and other heavy metals (Blundell et al. 1997a,b). The primary drainage from the mine bisected Frohner Meadows, heavily contaminating the lower elevation pools while leaving the upper elevation pools relatively unaffected. Our amphibian surveys in 1998 and 1999 found no breeding populations in the lower pools of the wetland, whereas Western Toad, Columbia Spotted Frog (*Rana luteiventris*), and Long-toed Salamanders (*Ambystoma macrodactylum*) were found breeding in the upper pools.

In the summers of 1998 and 1999, we reared Western Toad tadpoles in field enclosures made of nylon window screening with a wood frame (100 x 50 x 50 cm). The tadpoles were collected from the upper region of the wetland within a day of hatching. We placed six replicate enclosures in pools upstream from the effluent and six replicate enclosures in pools downstream from the effluent (i.e., 12 enclosures total). We introduced 30 tadpoles into each enclosure in 1998 and 50 tadpoles into each enclosure in 1999. We left the enclosures undisturbed for 21 d in 1998 and 28 d in 1999, and then counted the number of tadpoles surviving in each enclosure. We used an independent samples t-test to test for differences in the proportion of surviving tadpoles between the upper and lower regions of the wetland. One replicate enclosure in the upper region in 1999 was eliminated from analysis after being destroyed by a moose.

We collected Western Toad eggs from six clutches in June 2000 from Park Lake (32 km S of Helena, Montana), a site that receives no runoff from the Nellie Grant Mine. We housed the eggs in 38-L aquaria in the laboratory until hatching. After hatching, the tadpoles were divided and used in two laboratory studies: a survivorship/growth study and a comet assay study.

We collected sediment from a pond in the lower region of Frohner Meadows to use as experimental substrate in both studies. "Playground" sand (purchased at a hardware store and washed several times with water) was used as a control substrate. For both studies, experimental chambers consisted of 3.8-L aquaria with ca. 1 cm of substrate (either experimental or control) covering the bottom. We filled the aquaria with dechlorinated water and allowed the sediment to settle for 24 h prior to tadpole introduction.

For the survivorship and growth study, we examined three pH levels with the two substrate treatments, resulting in six treatment conditions: Frohner sediment pH 5.0, pH 6.0, and pH 7.0, and sand substrate pH 5.0, pH 6.0, and pH 7.0. We replicated each treatment four times. The 24 aquaria were arranged randomly on a laboratory bench. We then placed ten tadpoles (stages 25–30; Gosner 1960) in each aquarium. We adjusted the pH of each aquarium daily and fed the tadpoles 0.25 g of rabbit pellets every other day. After 14 d, we counted and weighed each of the survivors and calculated the average mass of survivors in each aquarium. We used two-factor analysis of variance (ANOVA) to test for the effects of sediment type and pH on tadpole mass and on the proportion of tadpoles surviving.

For the comet assay, we examined two pH levels (5.0 and 7.0) with the two substrate treatments resulting in four treatment conditions (the absence of the pH 6.0 treatment level in the comet assay was logistically necessary to reduce the number of aquaria requiring daily maintenance). We established two replicates of each treatment for a total of eight aquaria and introduced 10 tadpoles (stages 30–36; Gosner 1960). Again, we adjusted the pH daily, and fed the tadpoles every other day. After 14 d, surviving tadpoles were euthanized and bled for use in the comet assay (six individuals per treatment condition).

For the comet assay, we generally followed the procedure described by Ralph et al. (1996). We labeled frosted microscope slides for each individual tadpole, treatment type, and direction of electrophoresis and then coated each slide with a layer of 1 percent normal melting point agarose prepared with 10 mM phosphate buffered saline (PBS, pH 7.4) and microwaved for 25 sec. Slides were placed in an Immuno Frame, and allowed to dry in the refrigerator at 4°C.

We performed all subsequent steps in the dark under dim yellow light to prevent DNA damage. Tadpoles were humanely euthanized, blotted dry with a paper towel and then minced with scissors into a lid of a Coplin jar. We then added 10–12 drops of 10% Hank's balanced salt solution (HBSS, Ca^{2+} and Mg^{2+} free) and allowed the contents to sit for 10 min. Nucleated erythrocytes represented the majority of harvested cells.

We pipetted the suspension of blood cells into a 1500 ml microtube. From this stock, we pipetted 300 ml into a separate microtube. We then placed a drop of the remaining stock on a microscope slide and examined it at 400x to make sure that blood cells were present and that there were no more than three to four cells in a field of view at this magnification. If too many cells were present, we diluted the sample with HBSS.

We prepared low melting point agarose (0.5%) with PBS and microwaved it for 20 sec. Once the agarose had cooled to 37°C, we pipetted 600 ml into each microtube sample containing a 300 ml blood cell sample. Tapping the tubes mixed the resulting 900 ml of solution, which we then pipetted onto a frosted microscope slide prepared earlier. To prevent loss of the agarose mixture, we left the slides on the Immuno Frame. Coverslips were placed on the slides and the entire Immuno Frame was transferred to a level surface in a refrigerator (4°C) and left for 2 h to allow the agarose to polymerize.

To allow DNA fragments in the nucleus to migrate, cell membranes were lysed before electrophoresis using a mixture of 30 ml of 5 M sodium chloride, 15 ml of 400 mM disodium ethylenediamine-tetra-acetate (EDTA, pH 10), 6 ml of 100 mM Tris (hydroxymethyl) aminomethane hydrochloride (Tris-HCl, pH 10), 6 ml of dimethyl sulfoxide (DMSO) and 0.6 g of N-lauroylsarcosine, adjusted to a pH of 10 and final volume of 60 ml. We placed the sample slides into staining trays with the lysing solution for 2 h at room temperature.

We made an electrophoresis buffer by mixing 30 ml of 10 N sodium hydroxide and 5 ml of 200 mM EDTA (pH 10), adjusted the pH to be greater than 13, and then brought the volume to 1 L. We placed the sample slides in BioRad, Mini-Sub Cell GT gel units, and immersed them in about 1.5 cm electrophoresis buffer, for 15 min at 4°C. We then ran the units at 4°C for 30 min and regulated the current at 265 mA with the BioRad, Power Pac 1000 power supply. Following electrophoresis, we neutralized the slides

with two washes (each 5 min in duration) by immersing them in staining trays containing 30 ml of 400 mM Tris (pH 7.5) at room temperature.

We prepared a stock stain by dissolving 0.7 mg bis-benzimide in 0.25 ml of Tris-EDTA (TE) buffer. The working solution was a 1:1000 dilution of the stock in TE buffer. We stained slides by immersing them in staining trays with 25 ml of the working solution for 2 h at room temperature.

We examined each slide at 400x magnification using an epifluorescence microscope (Nikon EFD-3) equipped with a 330–380 nm excitation filter, a 420 nm barrier filter, and a 400 nm dichroic mirror. After beginning at an arbitrary point, we scanned slides in a straight line and measured the first 25 nucleic DNA clusters encountered that did not overlap other clusters or their "tails." We measured the length and width of each nucleic DNA cluster with an ocular micrometer and calculated the average length-to-width ratio for each individual tadpole. We then used two-factor ANOVA to test for the effects of substrate type and pH on the length-to-width ratio of DNA clusters.

The 1998 and 1999 field studies suggested that the effluent draining from the Nellie Grant Mine was lethal to Western Toad tadpoles. The proportion of tadpoles surviving in enclosures located above the effluent (mean ± SE: 0.81 ± 0.06) was higher (t statistic = 4.8, df = 9, $p<0.001$) than the proportion of tadpoles surviving in enclosures below the effluent (0.14 ± 0.12).

Sediments from the lower region of Frohner Meadows also had lethal and sub-lethal effects on tadpoles reared in the laboratory in 2000 (Table 1). The proportion of tadpoles surviving was higher in aquaria with sand substrate (0.93 ± 0.07) than in aquaria with sediment from Frohner Meadows (0.56 ± 0.08). The average mass of surviving tadpoles was higher in aquaria with sand substrate (0.27 g ± 0.03) than in aquaria with sediment from Frohner Meadows (0.08 g ± 0.01). The pH levels had no significant effect on survivorship or mass (Table 1).

Sediments from Frohner Meadows interacted with pH to influence the length-to-width ratios of DNA clusters (Table 1). Overall, length-to-width ratios were larger in aquaria with sediment from Frohner Meadows than in aquaria with sand substrate (Fig. 1; Tukey HSD post-hoc test, $p<0.001$). There was no difference in length-to-width ratios between treatments of pH 5.0 versus pH 7.0 in aquaria with sand substrate (Fig. 1; Tukey HSD, $p = 0.997$). However, the pH 7.0 treatment had a larger length-to-width ratio than the pH 5.0 treatment in aquaria with sediment from Frohner Meadows (Fig. 1; Tukey HSD, $p<0.001$).

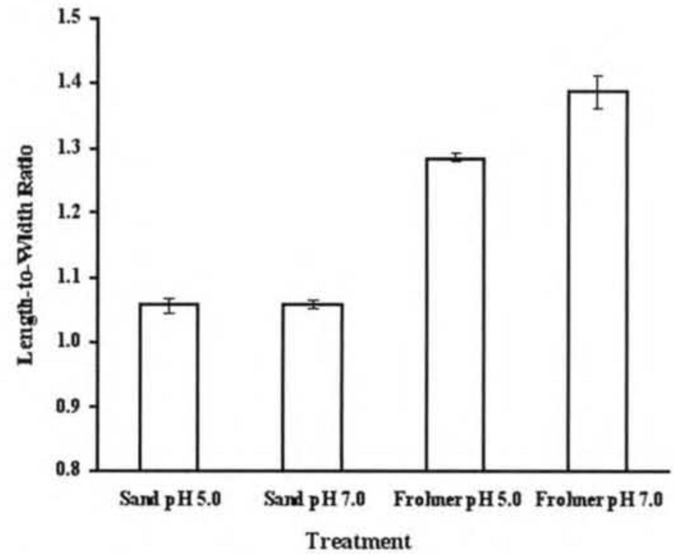

FIG. 1. The effects of substrate type (playground sand = sand; sediments from Frohner Meadows = Frohner) and pH on length-to-width ratios of nucleic DNA clusters. Clusters with the largest length-to-width ratios have the longest "comet" tails.

Our field and laboratory results suggest that mining effluent from the Nellie Grant Mine had both lethal and sub-lethal effects on Western Toad tadpoles. Tadpole survivorship and mass were lower when tadpoles were subjected to sediments from the site. Furthermore, our comet assay revealed a genotoxic effect for tadpoles exposed to the sediments. The length-to-width ratios of nucleic DNA clusters were larger for tadpoles exposed to the mining sediments than for tadpoles exposed to a control substrate, suggesting that DNA fragmentation was more severe for treatment tadpoles than for controls.

TABLE 1. The effects of substrate type and pH on the proportion of tadpoles surviving (survivorship), the average mass of surviving tadpoles (mass), and length-to-width ratios of DNA clusters (l/w ratio). (ANOVA).

Variable	Factor	Df	MS effect	F	p
Survivorship					
	Sediment	18	0.844	14.78	0.001
	pH	18	0.150	2.64	0.099
	Sediment x pH	18	0.084	1.47	0.257
Mass					
	Sediment	18	0.230	43.86	<0.001
	pH	18	0.006	1.08	0.361
	Sediment x pH	18	<0.001	0.14	0.867
L/W Ratio					
	Sediment	19	0.440	316.49	<0.001
	pH	19	0.016	11.33	0.003
	Sediment x pH	19	0.014	9.94	0.005

In the laboratory, pH had no significant effect on tadpole survivorship or mass. However, DNA fragmentation (indicated by larger length-to-width ratios) was higher at a pH of 7.0 than at 5.0 for tadpoles reared over sediment from Frohner Meadows. We do not know why DNA fragmentation was more severe at the higher pH. In laboratory conditions, heavy metals typically are more soluble in acidic conditions (Kotz and Treichel 1996) and should therefore have a more toxic effect at a lower pH. However, the composite nature of soil, with both organic and inorganic components, can create several buffering systems with complex ion formation and several equilibrium states (Harris 1999). Therefore, the unique composition of the effluent from the Nellie Grant Mine could cause some toxic elements to be more soluble at a higher pH.

Toxic sediments do not come solely from aban-

doned mine sites. In the Great Smoky Mountains National Park, runoff from roadsides and culverts contaminated streams and eliminated two stream breeding salamander species (Huckabee et al. 1975; Kucken et al. 1994). Two other amphibian species exhibited a 50% reduction in population size. Road construction had used fill from the Anakeestra rock formation containing significant levels of heavy metals.

Our results suggest that the comet assay is effective in assessing the toxicity of sediment effluent. As with organic pollutants (Clements et al. 1997; Ralph et al. 1996; Ralph and Petras 1997, 1998a,b), tadpoles *in situ* (caged for short time periods) or exposed to sediments in the laboratory could be used for bioassays. This technique would allow rapid assessment of contaminated sites and aid in reclamation decisions.

Acknowledgments.—We thank Mike Shevlin, Jon Griffin, Laura Peila, and Nichole Farr for helping with aquarium maintenance and other laboratory assistance. We also thank John Addis for his help with laboratory procedures. Our research was conducted with permission from authorities of the Helena National Forest and with appropriate federal and state collecting permits. Both laboratory and field experiments followed Carroll College and SSAR animal care guidelines. This project was funded with a Life Science Grant for Undergraduate Research from the Murdock Foundation.

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Artwork and Slides Wanted for *HR*

We are always interested in obtaining illustrations of herpetological subjects for publication in *Herpetological Review*. Generally, original drawings should be of a scale that would permit reduction to fit a 90-mm wide column. Original art, or high quality photocopies, should be packaged to ensure safe delivery and sent to the Editor. Alternatively, we would be pleased to receive material in electronic format; consult the Editor for appropriate file formats and sizes.

Also, we are interested in evaluating outstanding color slides of amphibians and reptiles for possible use on future *HR* covers. When reviewing material for submission, photographers should keep in mind the vertical format of our covers. In addition to highlighting outstanding photography, our cover subjects should lend themselves to communication of biologically interesting information through accompanying text. If you would like to have your work considered, please contact the Editor ***prior*** to sending any slides. We prefer to review images as JPEG or PDF files before requesting examination of original slides. Postal and e-mail addresses are listed on the inside front cover.

HERPETOLOGICAL HUSBANDRY

Herpetological Review, 2005, 36(2), 156–157.

Evidence of Sexual Dimorphism in Neonate Henkel's Leaf-tailed Gecko, *Uroplatus henkeli*

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Uroplatus henkeli is one of eleven recognized species of *Uroplatus* endemic to Madagascar. The sex of all species of *Uroplatus* can easily be determined by the presence of large hemipenial bulges in adult males. In addition, adult *U. henkeli* are sexually dimorphic by color (Glaw and Vences 1994; Henkel and Schmidt 1995). It has also been noted that some male *U. henkeli* exhibit a vertebral stripe as neonates; however, many juvenile males do not manifest this trait (Foley and McGinnity 1996). Other than the occasional presence of a vertebral stripe, sexual dimorphism in juvenile *U. henkeli* has yet to be described.

At Riverbanks Zoo and Gardens, two other traits have been consistently noted in neonates: parallel, longitudinally-oriented black striations on the dorsum and a transverse, bilaterally symmetrical black mark at the base of the skull. In a group of ca. 30 *U. henkeli* that were reared from hatching to sexual maturity, these two traits were never observed on the same neonate and seemed to correlate with the sex of the gecko. The presence of the markings was thought to represent a reliable method of determining the sex of neonate *U. henkeli*.

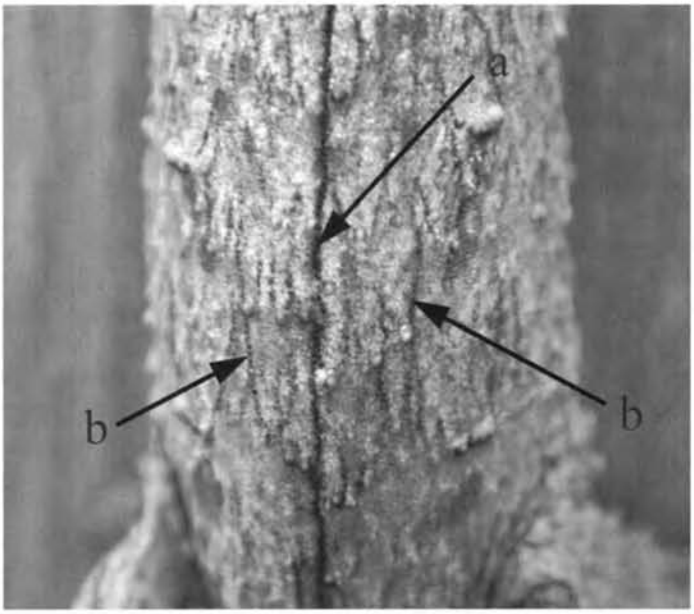

FIG. 1. Male neonate *Uroplatus henkeli* displaying the typical: (a) vertebral stripe and (b) dorsal striations.

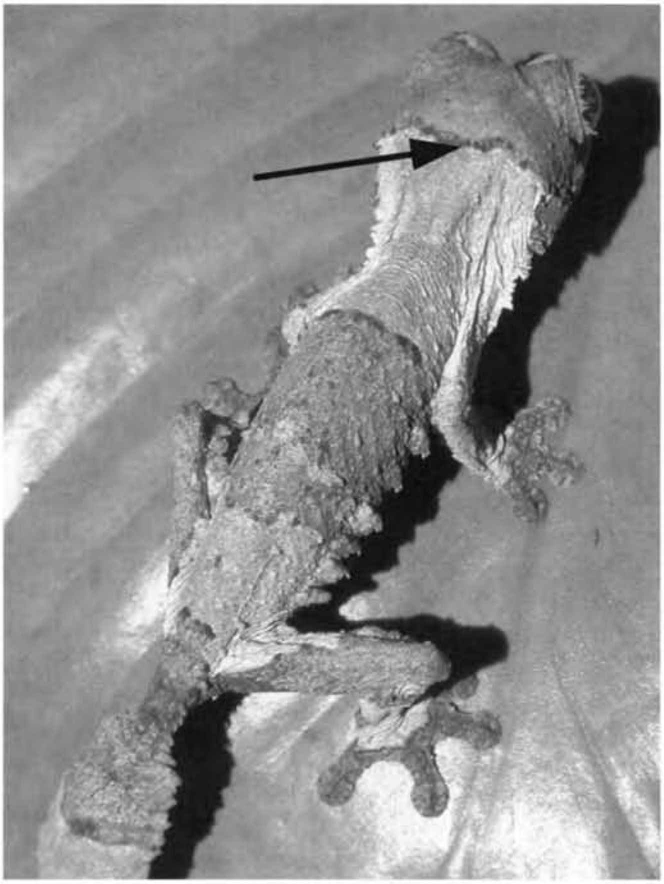

FIG. 2. Female neonate *Uroplatus henkeli* displaying the typical transverse, bilaterally symmetrical black marking at the base of the skull.

To test this hypothesis, 100 hatchling *U. henkeli*, from twelve different bloodlines, were selected for rearing. Of those, 50 exhibited the parallel black striations on the dorsum and were thought to be males, including two that also exhibited the cranial marking (Fig. 1). The other 50 did not exhibit the dorsal striations and were thought to be females. Forty-five of these females also exhibited the black cranial mark at the base of the skull (Fig. 2). All of the neonates were reared until adult external sexual characteristics began to appear (i.e., hemipenial bulges and larger spur size in males), which can take up to nine months to manifest.

The most accurate period to sex neonates was directly after they hatched. During this time the visual characteristics were very apparent. As the geckos grew, these traits often faded and in many cases disappeared altogether. The fading or disappearance of these traits was unique to each gecko and occurred in as little as three months while others retained the markings into adulthood. Also, because of *U. henkeli*'s ability to change color, the markings may not be easily distinguishable, especially during the daylight hours when the markings and ground color tend to lighten. At night, there is significantly more contrast between the markings and the ground color.

According to our observations, the only characteristic that was 100% effective in sexing neonate *U. henkeli* was the presence of the black striations on the dorsum of males. All males exhibited this trait while none of the females did. The presence of a vertebral stripe (Fig. 1) also suggested that an individual would be a male but was only present in 38% of males sampled (Table 1).

TABLE 1. Presence of physical characteristics in male and female *Uroplatus henkeli*.

Sex	N	Vertebral stripe	Dorsal striations	Cranial markings
Male	50	19 (38.0%)	50 (100%)	2 (4.0%)
Female	50	0	0	45 (90.0%)

The horizontal black marking on the cranium (Fig. 2) was observed in 90% of the females and 4% of the males (Table 1). Thus our data are strongly suggestive of juvenile sexual dimorphism in *Uroplatus henkeli*.

Acknowledgments.—We thank Keith Benson, Orinna Clark, and Jim Clark for their helpful comments with the text.

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NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 36, Number 1 (March 2005).

CAUDATA

ENSATINA ESCHSCHOLTZII OREGONENSIS* x *PICTA (Oregon x Painted Salamander Intergrade). **BEHAVIOR.** *Ensatina eschscholtzii* is the most widespread and common plethodontid salamander in western North America, with the range extending from southern British Columbia to northern Baja California (Stebbins 1985. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin Co., Boston, Massachusetts. 336 pp.). However, little is known about the climbing behavior of this salamander. In addition, little is known about the climbing behavior of *Batrachoseps attenuatus* or *Taricha granulosa* (Hayes and Hayes 2003. Herpetol. Rev. 34:45–46; Aubry 2000. J. Wildl. Mgmt. 64:1041–1052; Jones and Aubry 1985. Herpetol. Rev. 16:26; Stebbins 1954. Univ. California Publ. Zool. 54:47–124).

An extended period of observation of the climbing behavior of terrestrial salamanders and their use of stumps as habitat was performed from 23 Nov 2001 to 29 Mar 2003. The site is located within the coastal redwood region of Humboldt County, in a semi-rural area of Westhaven, California USA (T8N R1E SW1/4 Sec 31; elev. ca. 100 m) (Sundell and Norman 2003. Herpetol. Rev 33:4). The stumps were Redwood (*Sequoia sempervirens*) that were logged five decades ago. The forest canopy consisted of old-growth Sitka Spruce and second growth Redwood, with few Red Alder (*Alnus rubra*) and Cascara Buckthorn (*Rhamnus purshiana*) in the understory.

On 29 Jan 2001, two subadult female *E. eschscholtzii* intergrades were found on a Redwood stump (stump #1) covered with introduced English Ivy (*Hedera helix*) under a piece of Redwood bark in site 5. The stump was 6 m diam with Evergreen Huckleberry (*Vaccinium ovatum*) and spruce seedlings present on top of the stump ca. 1 m off the ground. The cover object measured 30 x 20 x 4 cm with a temperature of 11.4°C in the covered litter and English Ivy roots. The first female measured 7.3 cm TL and 3.6 cm SVL (measured to the anterior edge of cloaca), the other female measured 7.6 cm TL and 3.9 cm. SVL

On 16 Feb 2002, an *E. eschscholtzii* adult male intergrade (10.4 cm TL, 4.6 cm SVL) and a *B. attenuatus* were found 1.2 m off the ground on another redwood stump (stump #2), under litter, which was 8°C measured at a depth of 9 cm. The stump measured 5.2 m diam and was covered by False Lily-of-the-Valley (*Maianthemum dilatatum*) and two young spruce trees, which measured 4 cm in diameter.

On 2 Mar 2002, an adult male *E. eschscholtzii* intergrade (9.3 cm TL, 4.5 cm SVL) was found under litter on stump #2. This male was marked as LF2 RF2. The litter temperature was 7.3°C, which was measured at a depth of 9 cm. In addition, springtails, centipedes, and arachnids were located in the litter.

On 16 Mar 2002, an adult female, *E. eschscholtzii* (10.5 cm TL, 5.1 cm SVL) was found on another redwood stump (#3), 4.5 m diam. This salamander was wedged between pieces of outer bark, located 1.6 m off the ground.

The first stump was inspected again on 6 April 2002, and produced a female Rough Skinned-Newt (*Taricha granulosa*) (11.7 cm. TL, 4.7 cm SVL). The newt was found under the same piece of bark as the previous Ensatina salamanders found on top of stump #1. Also, present under the cover object with the newt was an adult *B. attenuatus*, which escaped capture.

On 16 Nov 2002, a subadult female *E. eschscholtzii* (7.6 cm TL, 4.1 cm SVL), was found under litter on stump #2, with a litter temperature of 10.8°C. Then again, on 25 Jan 2003, an adult male *E. eschscholtzii* (9.6 cm TL, 5.0 cm SVL), was found on the same stump, with a litter temp of 13.0°C. However, this was a recapture of the adult male (LF2RF2), first captured on 2 Mar 2002, on the same stump #2. Again, three more *B. attenuatus* juveniles were located under litter on top of the same stump. The litter had a temperature of 9.8°C at a depth of 9 cm.

On 15 Mar 2003, a subadult Wandering Salamander (*Aneides vagrans*) (7.4 cm TL, 4.1 cm SVL) was located on a Redwood stump (stump #4) with a subadult *B. attenuatus* (7.2 cm TL, 3.2 cm SVL), under a Redwood cover object 78 cm x 40 cm x 28 cm, which was located 1.5 m. above the forest floor. Stump #4 measured 3.1 m diam. The temperature in the interstitial space was 12.0°C.

Finally, on 29 Mar 2003, three more subadult *B. attenuatus* were located under litter on top of stump #2, which had a litter temperature of 11.7°C covering the coiled salamanders.

These observations emphasize the colonization of tree stumps

Herpetological Review

Volume 36, Number 2 — June 2005

Herpetological Review

The Quarterly News-Journal of the Society for the Study of Amphibians and Reptiles

Society for the Study of Amphibians and Reptiles

www.ssarherps.org

The Society for the Study of Amphibians and Reptiles, the largest international herpetological society, is a not-for-profit organization established to advance research, conservation, and education concerning amphibians and reptiles. Founded in 1958, SSAR is widely recognized today as having the most diverse society-sponsored program of services and publications for herpetologists. Membership is open to anyone with an interest in herpetology—professionals and serious amateurs alike—who wish to join with us to advance the goals of the Society.

All members of the SSAR are entitled to vote by mail ballot for Society officers, which allows overseas members to participate in determining the Society's activities; also, many international members attend the annual meetings and serve on editorial boards and committees.

Annual Dues and Subscriptions: Annual membership dues for the year 2005 in the Society for the Study of Amphibians and Reptiles are as follows: **REGULAR** membership US$60 (Student $30)—includes *Journal of Herpetology* and *Herpetological Review*; **PLENARY** membership US$80 (Student $45)—includes *JH*, *HR*, and annual subscription to the *Catalogue of American Amphibians and Reptiles*; **INSTITUTIONAL SUBSCRIPTION** $115—includes JH and HR. Additional fee for airmail postage outside USA $35 for one year. Additional membership categories available on the SSAR webpage: http://www.ssarherps.org/pages/membership.html.

All members and institutions receive the Society's primary technical publication, the *Journal of Herpetology*, and its news-journal, *Herpetological Review*; both are published four times per year. Members also receive pre-publication discounts on other Society publications, which are advertised in *Herpetological Review*.

Payment must be made in USA funds, payable to "SSAR," or by International Money Order, or with Visa or MasterCard (account number and expiration date must be provided). Payment should be sent to: Theodora Pinou, SSAR Treasurer, Department of Biological & Environmental Sciences, Western Connecticut State University, 181 White Street, Danbury, Connecticut 06810, USA. Fax: (203) 837-8769; e-mail: PinouT@wcsu.edu.

Future Annual Meetings

2005 — University of South Florida, Tampa, Florida, 6–11 July (with ASIH, HL)
2006 — New Orleans, Louisiana, 12–17 July (with ASIH, HL)

About Our Cover: *Siphlophis compressus*

Liana snakes are slender, usually under a meter in length and include six species: *Siphlophis cervinus*, *S. compressus*, *S. leucocephalus*, *S. longicaudatus*, *S. pulcher*, and *S. worontzowi* (Peters and Donoso-Barros 1970. Catalogue of the Neotropical Squamata. Part 1. Snakes. Washington, D.C., 347 pp.; Zaher and Prudente 1999. Journal of Herpetology 33:698–702). *Siphlophis compressus* was formerly placed in the monotypic genus *Tripanurgos*, but was reassigned to *Siphlophis* owing to its hemipenial morphology (Zaher and Prudente 1999, *op. cit.*; Zaher and Prudente 2003. Herpetological Review 34:304–307). The genus is distributed from Costa Rica and Trinidad south to Bolivia and tropical Brazil. Four species are Brazilian endemics, with *S. cervinus* and *S. compressus* ranging throughout the Amazon Basin and Trinidad northwest to Panama and Costa Rica, respectively.

Like its congeners, the Red-eyed Liana Snake, *S. compressus*, is nocturnal and arboreal. The preferred habitat is lowland rainforest, usually in humid locales, and often in flooded forest. Reaching at least 150 cm in length, *S. compressus* may be the largest member of the genus (Cunha and Nascimento 1978. Ofidíos da Amazônia 10. As cobras de região leste do Pará. Publicações Avulsas 31. Museu Paraense Emílio Goeldi, Belém, 218 pp.). This species has been known to consume small mammals (Q. Dwyer, personal communication), but it is primarily a lizard specialist, preying on everything from *Alopoglossus*, *Neusticurus*, *Norops*, and *Gonatodes* to larger species such as *Ameiva*, *Kentropyx*, *Enyalioides*, and even *Corytophanes* (crest and all!) (Cunha and Nascimento 1993. Boletim do Museu Paraense Emílio Goeldi 9:1–191; Martins and Oliveira 1998. Herpetological Natural History 6:78–150; Medem 1969 [dated 1968]. Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales 13:149–199). Prey is captured by active foraging, both in trees and on the ground. They are egg layers and the hatchlings bear a conspicuous cream-colored parietal ring, much like hatchlings of some *Leptodeira* species. The ring may be retained into adulthood, as is typical of northern populations, or obliterated by the reddish ground color.

The cover photo depicts an adult female *Siphlophis compressus*, 83.3 cm long. It was found at night while it climbed in a small tree about 3 m above the forest floor at Finca El Naranjal, Golfito, Puntarenas, Costa Rica. The site is near sea-level and about half a kilometer from the Pacific coast. The snake was captured in the month of January, the height of the dry season, and the usually humid forest was parched.


PHOTO BY ROB EAGLESTON

The photograph was taken by **Louis W. Porras**. He used a Canon AT-1 camera, Canon 100mm f/4 lens, and Fujichrome Velvia ISO 50 film exposed at f/11. Lighting was obtained using a Norman P400D power pack with 2 LH2 lamp heads and umbrellas.

Porras is proprietor of Eagle Mountain Publishing, LC, in Eagle Mountain, Utah. A veteran of numerous field trips to Mexico, the Caribbean, Central and South America, Louis now dedicates his efforts to studying the herpetofauna of the Neotropics and the Intermountain West and publishing.

SSAR BUSINESS

Announcing the 2005 Joint Meeting of Ichthyologists and Herpetologists 6–11 July 2005

The annual meeting of the Society for the Study of Amphibians and Reptiles, The Herpetologists' League, and the American Society of Ichthyologists and Herpetologists will be held 6–11 July 2005, hosted by the University of South Florida at the Marriott Tampa Waterside Hotel and Marina, Tampa, Florida. Please refer to the Joint Meeting website <http://www.dce.ksu.edu/jointmeeting/> for information on how to register for the meeting. All material typically included in the Call for Papers is now accessible on the website.

SSAR Election Results

Results of the 2004 SSAR election are as follows:

President-Elect: .... Roy McDiarmid

Secretary: .... Marion Preest

Treasurer: .... Theodora Pinou

Board Members (Class of 2008):

.... Rafe Brown, Meredith Mahoney

.... Jim McGuire, Richard Shine

Thanks to all of the nominees who agreed to stand for positions and to Maureen Kearney (Elector).

Kennedy Student Award Committee Annual Report, 2005

The Kennedy Award Committee (Craig Franklin, Mark Jordan, Terry Schwaner, Lynette Sievert, Robert Gatten, Jr., Chair) has completed its work for Volume 38 of the *Journal of Herpetology*. The Committee has selected "Using chorus-size ranks from call surveys to estimate reproductive activity of the wood frog (*Rana sylvatica*)" by **Cameron Stevens** (Cynthia Paszkowski, coauthor; Vol. 38:404–410). The Kennedy Award carries with it a cash prize of US $200 or the winner's selection of any SSAR publications valued at twice that amount. The Committee was impressed with the high quality of a number of eligible papers and would also like to acknowledge a runner up, **Caren Goldberg,** for her paper "Habitat use and spatial structure of a barking frog (*Eleutherodactylus augusti*) population in southeastern Arizona" (Cecil Schwalbe, coauthor; Vol. 38:305–312).

The committee invites all student members of the Society to submit their work to the *Journal*, and encourages regular members who supervise the work of students to draw this award to the attention of those students.

2005 Metter Award Winner

The Dean E. Metter Memorial Award was established to encourage students to pursue field research in herpetology and to facilitate field research by providing funds for related expenses. The Metter Award Committee is pleased to announce that this year's winner is Mr. Matthew W. H. Chatfield ("Hybrid zone dynamics between two species of salamanders in the genus *Plethodon*"). The committee (Joseph Beatty, Anne Maglia, and Brian Miller) was extremely impressed with all eight proposals but had to choose a single awardee.

Matthew Chatfield earned a B.A. in Biology from The University of Chicago and is now a Ph.D. student in the Department of Ecology and Evolutionary Biology at the University of Michigan working jointly with L. Lacey Knowles and Ronald A. Nussbaum. He has an impressive record working as a field biologist in a variety of ecological systems and with a broad spectrum of taxa. His PhD work is focusing on hybridization zones between *Plethodon jordani* and *P. metcalfi* and he is gathering data with the intent to understand more about the process of speciation as well as the maintenance of species boundaries between these two lungless salamanders.

NEWSNOTES

Kansas Herpetological Society Annual Meeting

The Kansas Herpetological Society held its 31st Annual Meeting at Kansas State University in Manhattan, Kansas, on November 6–7, 2004. Approximately 110 participants attended scientific paper sessions presented by scientists and students from across the nation. Featured speaker was Alicia Mathis, professor at Southwest Missouri State University in Springfield. Dr. Mathis spoke about salamander conservation.

Daphne Jones, a student at Emporia State University, received the 2004 Howard K. Gloyd/Edward H. Taylor Scholarship, honoring the memory of two great biologists with strong ties to Kansas. The 2004 Alan H. Kamb Grant for Research on Kansas Snakes were made to Erik Bartholomew, a student at Fort Hays State University. Dwight R. Platt, Bethel College, was recognized as the seventh recipient of "The Suzanne L. & Joseph T. Collins Award for Excellence in Kansas Herpetology."

In 2005, the Society will meet at Pittsburg State University in Pittsburg, Kansas.

Gopher Tortoise Council Grants

The J. Larry Landers Student Research Award is a Gopher Tortoise Council competitive grant program for undergraduate and graduate college students. Proposals can address research concerning gopher tortoise biology or any other relevant aspect of upland habitat conservation and management. The amount of the award is variable, but has averaged $1,000.00 over the last few years.

The proposal should be limited to four pages in length and should include a description of the project, a concise budget, and a brief resume of the student. Proposals should be submitted by 31 August 2005 to: Bob Herrington, Chair of Research Advisory Committee, Georgia Southwestern State University, Department of Biology, Americus, Georgia 31709, USA; e-mail: bherring@canes.gsw.edu.

Check List—A New Online Journal

Check List is a scientific journal devoted to publish species lists and geographic distribution maps of any taxa. We are all aware, these days, that the effort to preserve natural remnants of species ranges is fundamental for the perpetuation of life as it has evolved. The first step to accomplish this is to record species occurrences in those remnants and adjacent areas. This sort of study has been neglected for being considered "too basic" or "not directly applied." *Check List* was therefore created to fill this gap in publishing papers on such important inventories. *Check List* is available at: http://www.rc.unesp.br/ib/checklist/index.htm.

MEETINGS

Meetings Calendar

Meeting announcement information should be sent directly to the Editor (rwh13@csufresno.edu) well in advance of the event.

6–11 July 2005—48th Annual Meeting, Society for the Study of Amphibians and Reptiles, together with The Herpetologists' League and the American Society of Ichthyologists and Herpetologists. University of South Florida, Tampa (USA). Information: http://www.dce.ksu.edu/jointmeeting/.

27–30 July 2005—29th Annual International Herpetological Symposium, Scottsdale, Arizona (USA). Information: www.kingsnake.com/ihs.

15–19 August 2005—VII Latin American Congress of Herpetology, Universidad Autónoma del Estado de Morelos, Cuernavaca, Morelos, México. Information: http://www.ibiologia.unam.mx/barra/congresos/frame.htm.

21–23 October 2005—Snakebites Symposium, University of Nebraska Medical Center, Omaha, Nebraska, USA. Information: http://app1.unmc.edu/cce/snakebites/.

CURRENT RESEARCH

The purpose of **Current Research** is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure

that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, **María del Rosario Castañeda** or **Michele Johnson**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can be found at: http://www.herplit.com/contents.

First Plethodontid Salamander from Asia

The Plethodontids comprise almost 70% of the known salamander species, with nearly all of these confined to North and Middle America. A small number of species occur in southern Europe, and this enormous distributional gap has long vexed biogeographers. The exciting discovery of a plethodontid in southwestern Korea helps fill the gap, and suggests that the Plethodontidae was formerly more widespread in the Holartic region. A new genus (*Karsenia*) is erected to accommodate the new species (*K. koreana*), which is now known from 16 localities in three provinces. Bayesian analysis of 1503 base pairs of the nuclear gene *Rag-1* demonstrates that the new taxon is clearly a plethodontid, nested within a clade that includes the desmognathines and *Aneides*, but otherwise widely diverged from other members of this group. The authors propose that other species of plethodontids await discovery in the region between the Korean Peninsula and the southwestern Mediterranean.

Min, M. S., S. Y. Yang, R. M. Bonett, D. R. Vietes, R. A. Brandon, and D. B. Wake. 2005. Discovery of the first Asian plethodontid salamander. Nature 435:87–90.

Correspondence to: David B. Wake, Museum of Vertebrate Zoology, University of California, Berkeley, California 94720, USA; e-mail: wakelab@uclink.berkeley.edu.

Estimating Consistency In Fossil Calibration Points: Turtles As An Example

Heterogeneity in DNA substitution rates and inaccuracy in fossil age estimations have been two major problems when estimating clade divergence times. Additionally, the utilization of one fossil as a single calibration point has been highly criticized because it can increase potential bias when age estimation is not accurate. The authors propose a strategy to identify inconsistent fossil age estimations when multiple calibration points are available. The method measures consistency (or agreement) between fossil and molecular age estimates using each of the available fossil calibration points independently. The phylogeny of turtles was used as an example to test the method. Bayesian and Parsimony analyses were performed using cytochrome *b* (cyt*b*), nuclear recombination activating gene 1 (RAG-1) and R35 intron sequences of 23 species—representing all major lineages of living turtles. Seventeen available fossils were placed in the molecular phylogeny using a parsimony analysis of 115 morphological characters as a guide. Penalized likelihood was used to estimate divergence times in the molecular phylogeny. Results indicated that seven of the seventeen calibration points were inconsistent and were therefore eliminated from the analysis. The authors indicate that the magnitude of the effect of calibration inaccuracy depends on tree topology, inferred branch lengths and the proximity of the estimated node with the inconsistent fossils. This method promotes the removal of inaccurate calibration points to reduce the variance on time estimations.

Near, T. J., P. A. Meylan, and H. B. Shaffer. 2005. Assessing concordance of fossil calibration points in molecular clock studies: an example using turtles. The American Naturalist 165:137–146.

Correspondence to: Thomas J. Near, Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, Tennessee 37996-1610, USA; e-mail: tnear@utk.edu.

Historical Fragmentation Or Recent Population Decline In New Zealand Rare Skinks

To clarify whether the disjunct distribution and small population sizes of *Oligosoma grande* skinks in New Zealand are the result of a recent decline due to anthropogenic factors or to historical pre-human climatic changes, the authors sequenced the hypervariable region I (HVRI) of the mitochondrial control region and 12 nuclear microsatellites of 65 individuals, representing most known populations. Analyses included: 1) parsimony and maximum likelihood phylogenetic reconstructions, 2) calculation of F_{ST} for all pairwise population comparisons and 3) estimation of the effective population size through the genetic diversity parameter q. Results demonstrated that both Western and Eastern populations are highly structured genetically, indicating minor inter-population dispersal. Eastern populations showed high mitochondrial diversity despite their small sizes, which suggests that current populations are a fraction of their historical sizes, indicating a recent decline. On the contrary, Western populations had low levels of genetic diversity, evidence of a possible population bottleneck or a founding event. In conclusion, high levels of genetic structure more likely indicate that the distribution of *Oligosoma grande* skinks was discontinuous: Western and Eastern populations most probably have independent evolutionary histories that predate human arrival in New Zealand. However, small population sizes, additional population declines and evidence of the limited ability to recolonize new habitats indicate the necessity of prompt conservation strategies to prevent *O. grande* extinction.

Berry, O., and D. M. Gleeson. 2005. Distinguishing historical fragmentation from a recent population decline—shrinking or pre-shrunk skink from New Zealand? Biological Conservation 123:197–210.

Correspondence to: Oliver Berry, Applied Ecology Research Group, University of Canberra, ACT, Australia 2601; e-mail: oliver.berry@canberra.edu.au.

Bright Pattern, But Not Bright Color, As Requirement For Aposematism

Aposematism, the use of bright colors and patterns to advertise noxiousness, has been reported commonly in nature. However, bright coloration might also have costs, as it may act to warn specialized predators (that can handle noxious components) and alert potential prey. In theory, the use of patterns and colors that do not

interfere with crypsis, but provide a characteristic and recognizable signal, would be an alternative strategy to combine cryptic and aposematic signals. Many viperids are venomous, cryptic, sit-and-wait predators that show a very distinctive dorsal pattern. The authors used plastiline models with typical *Viper berus* zigzag patterns to test if the coloration pattern provides a dual function of crypsis and aposematism. To account for the effect of crypsis, models were placed against both white cards and natural backgrounds and to account for aposematic signals, half of the models had zigzag patterns and half lacked them. Marks of avian predators on the models and their relative location on the snakes' bodies were recorded. Binary logistic regression identified pattern and background as significant predictors of attack, showing that models with a zigzag pattern were attacked less frequently than models without it and models on the white board were attacked less frequently than models on a natural background. Models with zigzag patterns were attacked mainly in the anterior quarter of the body, while plain models attacks were scattered along the body, suggesting the recognition of a warning pattern by predators. Results support that zigzag patterns in *Viper berus* accomplish both the role of crypsis and warning coloration, evidencing that bright conspicuous coloration is not a prerequisite for predatory avoidance, a classic assumption in aposematic theory.

Wüster, W., C. S. E. Allum, I. B. Bjargardóttir, K. L. Bailey, K.J. Dawson, J. Gueniou1, J. Lewis, J. McGurk, A. G. Moore, M. Niskanen, and C. P. Pollard. 2004. Do aposematism and Batesian mimicry require bright colors? A test, using European viper markings. Proceedings of Royal Society of London: Biological Sciences 271:2495–2499.

Correspondence to: Wolfang Wüster, School of Biological Sciences, University of Wales, Bangor L57 2UW, United Kingdom; e-mail: w.wuster@bangor.ac.uk.

Disruption Of Endocrine Function Linked To Amphibian Population Declines

Population declines in amphibians have been detected worldwide, although for many species causes are still unclear. *Acris crepitans* is a native species of the northeastern half of the United States that has shown population declines in the past 25 years. Industrial compounds and their by-products have been associated with amphibian declines; polycyclic aromatic hydrocarbons (PAHs), polychlorinated byphenils (PCBs), polychlorinated dibenzofurans (PCDFs), and polychlorinated dibenzo-*p*-dioxins (PCDDs) have been linked with disruption in endocrine function, and DDT (p,p-dichlorophenyl trichloroethane) and the herbicide atrazine have been associated with biased functional sex ratios, reduced size at metamorphosis and delayed maturation among amphibians. To test the relationship between population declines and occurrence of intersexuality (hermaphrodism) of *Acris crepitans*, the authors examined museum specimens collected between 1852 and 2001 in Illinois, and determined proportions of male, female and intersex individuals. Three regions were delimited (northeast, central and southern), based on human population densities and agricultural intensity, and five time periods were considered based on industrial pollutants utilization. Results show that the proportion of intersex individuals was much larger and the proportion of females smaller in the northeast Chicago area, where the highest human population density and intensive industry occurs. The southern region, with the least intensive agriculture and industry, had the smallest proportion of intersex individuals. From 1930 to 1945 the percentage of intersex individuals increased until its peak in the 1946–1959 period, a rise accompanied by a reduction in female proportion, and a strong correlation with PCB's intensive use and the introduction of DDT. This study evidences a relation between endocrine disruption (intersexuality) and *Acris crepitans* population declines, suggesting the increase of PAHs, PCBs, PCDFs, PCDDs, and DDT usage as a contributing factor.

Reeder, A. L, M. O. Ruiz, A. Pessier, L. E. Brown, J. M. Levengood, C. A. Phillips, M. B. Wheeler, R. E. Warner, and V. R. Beasley. 2005. Intersexuality and the cricket frog decline: historic and geographic trends. Environmental Health Perspectives 113:261–265.

Correspondence to: Val R. Beasley, Department of Veterinary Biosciences, College of Veterinary Medicine, University of Illinois, 2001 S. Lincoln Avenue, Urbana, Illinois 61802, USA; e-mail: val@uiuc.edu.

Correlation Between Ontogenetic Changes In Coloration And Behavioral Changes

Color pattern is known to affect antipredatory behavior in snakes. In particular, disruptive patterns effectively conceal individuals when immobile, and striped, finely speckled and uniform patterns confound predators when the snake is in motion. Some species experience ontogenetic changes in their coloration patterns, but corresponding changes in behavior, although suspected, have not been investigated. The author studied behavioral responses to predator attacks in *Coluber constrictor* snakes, where juveniles have a blotched (disruptive) pattern and adults have a solid coloration. Results show that hatchlings were more prone to respond with an aggressive behavior when confronted by a predator, while adults where more likely to flee. Additionally, sprint speed was not significantly different between hatchlings and adults when accounting for the effects of size. However, sprint speed was correlated with body length, with adults faster than hatchlings on an absolute scale. In conclusion, this study supports the hypothesis that in *Coluber constrictor* there is a correlation between color pattern and antipredator behavior, which provides effective alternative defense strategies at different life stages.

Creer, D. A. 2005. Correlations between ontogenetic change in color pattern and antipredator behavior in the racer, *Coluber constrictor*. Ethology 111:287–300.

Correspondence to: Douglas A. Creer, Department of Biological Sciences, Florida International University, 11200 SW 8th Street, Miami, Florida 33199, USA; e-mail: creerd@fiu.edu.

Evolution Of Viviparity And The Cold-Climate Hypothesis

The cold-climate model states that viviparity evolved as an adaptation to cold climates, which are associated with high altitudes and latitudes. This hypothesis is supported by the characteristic lower temperatures in high altitudes and latitudes and, within

squamates, by 1) a large proportion of viviparous species living in high altitudes and latitudes, and 2) the association of recent origins of viviparity with recent invasions of higher altitudes and latitudes. The author tested, within a phylogenetic context, whether mode of reproduction was correlated with altitude and latitude in *Phrynosoma* lizards. Reproductive modes at minimum, midpoint, and maximum altitudes and latitudes were compiled for all species of *Phrynosoma* from literature, museum specimens, and field observations. Hodges and Zamudio's (2004) phylogeny, based on molecular and morphological characters, was used as the context for analyses. Results documented no correlation between latitude and reproductive mode; however, minimum and midpoint altitude were correlated with viviparity. This suggests that, in the cold-climate hypothesis context, altitude might be a better predictor of cold climates than latitude. Or, instead of an indicator of cold climate, altitude may incorporate other selective forces important for the evolution of viviparity, such as oxygen content, humidity conditions, daily temperature fluctuations, and growing season length.

HODGES, W. L. 2004. Evolution of viviparity in horned lizards (*Phrynosoma*): testing the cold-climate hypothesis. Journal of Evolutionary Biology 17:1230–1237.

Correspondence to: Wendy L. Hodges, Department of Biology, University of California, Riverside, California 92521, USA; e-mail: wendyh@ucr.edu.

Phylogeny And Colonization History Of Neartic *Bufo*

Three different colonization hypotheses have been proposed for the origin of the Neartic *Bufo*, suggesting the group is: 1) polyphyletic, resulting from different colonizations from Africa, 2) paraphyletic, resulting from a single colonization from South America and subsequent colonization into Eurasia, or 3) monophyletic, derived from the Neotropics. The authors sequenced ~ 2500 bp of the 12S, 16S, and intervening valine tRNA mitochondrial genes from 56 species, including South American, Eurasian, African, and most Neartic representatives. Parsimony, maximum likelihood and Bayesian analyses were performed to reconstruct phylogeny, and parametric bootstraping was used to test the different hypotheses for *Bufo* Neartic colonization. Although different optimality criteria rendered slightly different relationships within *Bufo*, all strongly supported the monophyly of the Neartic *Bufo* clade, with disagreements regarding its sister taxon (either a *Bufo marinus* clade or a Middle America *Bufo* clade). Furthermore, parametric bootstrap analyses rejected the polyphyly, paraphyly and non-monophyly hypotheses, strongly corroborating the monophyletic Neartic *Bufo* hypothesis. Results suggest that the Neartic *Bufo* evolved from a northward radiation from a South American ancestor, without any subsequent intercontinental dispersal into Eurasia. Additionally, the authors discuss evidence suggesting that North American *Bufo* colonization occurred prior to the development of a Central American Land Bridge, providing support for a transmarine dispersal hypothesis.

PAULY, G. B., D. M. HILLIS, AND D. C. CANNATELLA. 2005. The history of a Neartic colonization: molecular phylogenetics and biogeography of the Neartic toads (*Bufo*). Evolution 58:2517–2535.

Correspondence to: Gregory B. Pauly, Section of Integrative Biology and Texas Memorial Museum, University of Texas, Austin, Texas 78712, USA; e-mail: gbpauly@mail.utexas.edu.

Effects Of Destructive Collecting Practices On Reptile Abundance

Herpetofauna collection practices frequently result in permanent habitat damage; these consequences have increased in recent years, due to the rising demand for supplying the pet trade market. Practices include breaking apart and overturning rocks to expose hiding reptiles. The authors quantified the effects of destructive collecting techniques on reptiles by comparing abundance before and after disturbance on rock outcrops in Arizona. Additionally, in disturbed sites, individual location was quantified: whether reptiles were on an original rock surface, a freshly exposed surface, or a rock that was moved in the manipulations. Abundance of lizards increased in both control and treatment sites after the disturbance, with the increase larger in control sites. The effect of disturbance on abundance varied between seasons and species, and within species varied between seasons, sexes, and age-classes. Authors attributed interspecific variation to differences in reproductive ecology and habitat utilization. Results suggest that destructive collecting techniques led to a decrease in reptile abundance of diurnal lizards, and that portions of undisturbed rock outcrops were preferred. Based on the results, strict regulation of collecting methods is recommended, along with an increase in law enforcement to make restrictions effective.

GOODE, M. J., D. E. SWANN, C. R. SCHWALBE. 2004. Effects of destructive collecting practices on reptiles: a field experiment. Journal of Wildlife Management 68:427–432.

Correspondence to: Matthew J. Goode, Wildlife and Fisheries Sciences Program, School of Renewable Natural Resources, University of Arizona, Tucson, Arizona 85721, USA; e-mail: mgoode@ag.arizona.edu.

Effect Of Paedomorphic Characters in Salamander Phylogeny

The significance of developmental characters in phylogenetic reconstruction has been controversial for decades. In salamanders, several lineages show paedomorphic characters, and it has been suggested they all evolved independently. However, if similar, large-scale developmental changes are present in distantly related lineages, phylogenetic reconstruction based only on adult morphology can be misleading; paedomorphic species will group together, based on the shared presence of larval (paedomorphic) traits. The authors added new morphological and molecular data to previously published salamander analyses to test the confounding effects of paedomorphic characters in morphology-based phylogenetic reconstruction. Parsimony and Bayesian analyses were performed including thirty-two species, representing all ten living families. Analyzed matrices included: 1) morphological data only, including and excluding paedomorphic characters; 2) molecular data only, including ribosomal and nuclear sequences, and 3) morphological and molecular data combined, with and without cod-

ing morphological adult characters as missing data for paedomorphic taxa and/or including or excluding paedomorphic characters. Both parsimony and Bayesian analyses of the morphological-data matrices recovered three of the four paedomorphic families as monophyletic. These results are contradicted by the molecular and combined analyses, suggesting that the placement of the paedomorphic families as a single clade reflects the influence of paedomorphic characters and not phylogenetic history. The authors discuss different factors that could lead to an incorrect placement of paedomorphic taxa and propose a robust phylogenetic hypothesis for salamanders.

WIENS, J. J., R. M. BONETT, AND P. T. CHIPPINDALE. 2005. Ontogeny discombobulates phylogeny: paedomorphosis and higher-level salamander relationships. Systematic Biology 54:91–110.

Correspondence to: John J. Wiens, Department of Ecology and Evolution, Stony Brook University, Stony Brook, New York 11794-5245, USA; e-mail: wiensj@life.bio.sunysb.edu.

ZOO VIEW

Free Power Point Presentations

When I arrived in Washington, D.C. about a decade ago, one of the first things I did was to go to the Smithsonian Institution's National Museum of Natural History to examine the splendid collection of herpetological books and other printed materials. Of particular interest was the Joseph F. Cullman 3rd Library of Natural History (in SI Special Collections Department) which houses books written no later than 1840. As an example, in 1497 a woodcut showing a "gamaleon" was published in a body of works called "Hortus sanitatis" [Garden of Health]; the creature looks more like a canine with wings than a chameleon (Fig. 1). Librarians Leslie Overstreet and Daria Wingreen spent many hours finding historical illustrations of herps like these for me to covet. In addition, Kirsten van der Veen from the SI Dibner Library of the History of Science & Technology and National Zoological Park Librarian Alvin Hutchinson checked many sources for illustrations. Roy McDiarmid's personal library in the museum was also a treasure trove and he kindly let me scan many of his books.

FIG. 1. Gamaleon or chameleon from body of works called "Hortus sanitatis" [Garden of Health] in 1497. Quote is loose translation from text of early English version: "Chameleon is a beste with ii wynges and four fete havinge an hede lyke an adder and a longe wronge tayle lyke a dragon and bereth gere [hair?] on his backe lyke woll and the clothe that therof is made can nat burne." Credit: Courtesy of Smithsonian Institution Libraries, Washington, DC.

It occurred to me that seeing these original tomes was a unique opportunity, largely unavailable to other herpetologists. The Smithsonian's collection is unrivaled in breadth and depth. As a result, I asked Martin Kalfatovic, Permissions Coordinator from the SI Libraries, if it would be possible to duplicate these images to create a series of ***free*** power point presentations for zoo meetings, regional herp societies, natural history organizations, academics teaching herpetology, and others within the biological community and he assisted me in doing so. Here are the ones currently available, mostly using materials from the SI collection:

1) ***Herpetological Time Travel Through the Zoo and Aquarium World***
Divided into three parts—Deceased zoo herpetologists, historical vignettes, and tour of reptile buildings and aquaria throughout the world. Uses many historical illustrations and photos, often provided by zoo colleagues. Topics include first reptile building (Tower of London in 13th century), first zoo snakebite fatality, studies on brooding pythons in zoos beginning at Menagerie Jardin des Plantes in 1841, studies and experiments on fear of snakes at London Zoo by Charles Darwin, public outcry over feeding live food to snakes at London Zoo in 1860s (an issue so contentious that it was debated in Parliament), collection of Galapagos tortoises by Charles Townsend, final days of the Belle Vue herpetological collection, and others.

2) ***Are Komodo Dragons Really More Intelligent than Other Reptiles?***
Divided into four parts: historical studies on varanids, books on varanids, history of dragons in zoos, and play behaviors in a dragon at Smithsonian National Zoo. Produced with Trooper Walsh and Claudio Ciofi.

3) ***Chameleons: Biology and Captive Management***
Divided into four parts: biology, history of chameleon illustrations, captive history, and our research trip to Madagascar to study panther chameleons. Produced with Gary W. Ferguson.

4) ***How to Draw a Chameleon?***
Five centuries of chameleon illustrations showing evolution of this art and portraits of influential chameleon biologists. Produced with Gary W. Ferguson.

5) ***Zoo Herpetology. The Past to Now***
Suggestions for future herpetological research in zoos.

6) ***Betwixt Plated Decks. Five Centuries of Turtle Illustrations***
Five centuries of turtle illustrations and portraits of influential chelonian biologists.

7) ***The Art of Drawing Serpents***
Twelve centuries of snake illustrations from scientific and semi-popular works and portraits of influential snake biologists.

8) The Nature of Crocodilians Depicted Through Art and Literature
Twelve centuries of crocodilian illustrations showing examples from scientific and semi-popular works. Also includes books on crocodilians and portraits of influential crocodilian biologists.

9) Going, Going, Gone? The Case of Disappearing Frogs and Toads
Six centuries of frog and toad illustrations and a discussion of the role and mission of the Declining Amphibian Populations Task Force.

These CDs are available ***free*** for one-time use. Presentations last between 45–60 min, with accompanying background music. They cannot be duplicated or distributed and must be returned to me.

For additional information, contact me at <jbmurphy2@juno.com>. *Mailing Address*: 3100 Connecticut Ave., N. W., Apt. 431, Washington DC 20008, USA.

Kevin R Buley, Curator of Lower Vertebrates & Invertebrates at Chester Zoo, is editor of the new "Shellshocking News," official newsletter of the European Association of Zoos and Aquariums (EAZA). The newsletter details the activities of the organization's Turtle & Tortoise Campaign 2004/2005. The EAZA has 294 member zoos and aquaria; the mission of this campaign is to conserve chelonians through captive breeding initia-

tives and *in situ* conservation projects. Kevin is soliciting articles, photographs, ideas, and suggestions for the next issue. To send materials or be added to the electronic mailing list, contact him at Chester Zoo, Upton-by-Chester, Chester CH2 1LH, United Kingdom, (Direct Telephone Line: +44 1244 389402, Direct Fax: +44 1244 381352, e-mail: *k.buley@chesterzoo.org*, Website: *www.chesterzoo.org*).

Dr. Joseph Mendelson is the new herpetological curator at Zoo Atlanta. I first met him and his new boss, general curator Dr. Dwight Lawson, when they were lowly graduate students laboring under Jonathan Campbell at University of Texas at Arlington. Later, Joe received his PhD in Systematics and Ecology (Herpetology) at University of Kansas. After graduation, he was a professor of biology at Utah State University. Dwight and Joe will make a formidable team at Zoo Atlanta as both have a broad grasp of herpetology, have been involved in many field projects throughout the world, and have published extensively.

Clay Garrett from the Fort Worth Zoo analyzes the potential value of zoo collections for significant research in herpetology and opportunities for their caretakers by stressing the need for academic-zoo collaborations in the following article. Of particular interest are the new SSAR web pages being developed by the Relationships with Herpetologists at Zoological Parks Committee in 2005.

— *James B. Murphy, Section Editor*

Herpetological Review, 2005, 36(2), 103–106.

Herpetological Research in Zoos: A Contemporary Assessment

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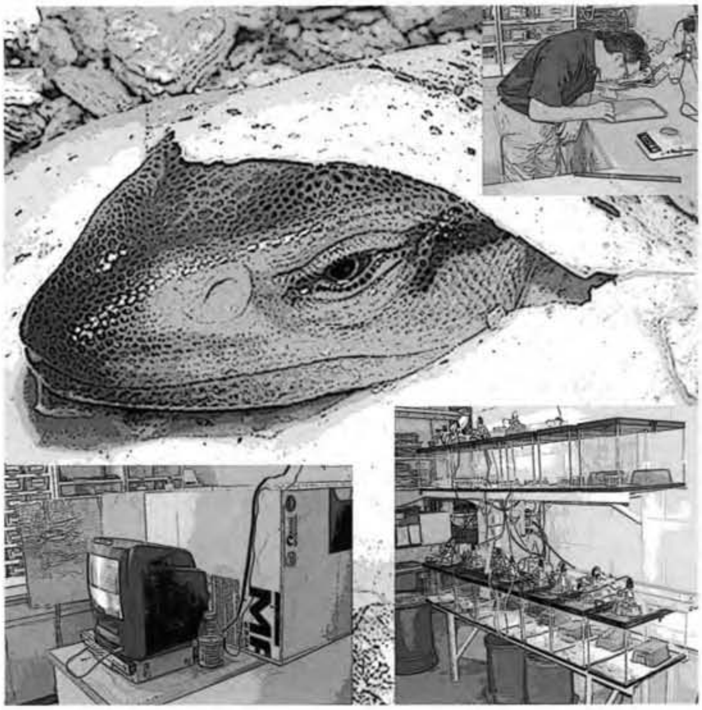
Over the last 15 years numerous authors have addressed the value of zoo-academic collaborations (Card et al. 1998; Chiszar et al. 1993a; 1993b; Cooper et al. 1996; Garrett and Chiszar 1996; Kreger 1993; Murphy and Chiszar 1989; Pough 1993). Consequently, many peer-reviewed papers have been published as a result of successful partnerships between zoo and academic colleagues. Although there are numerous zoo and academic herpetologists who work jointly on conservation projects, this paper addresses collaborative projects of a basic scientific nature.

Card et al. (1998) conducted a survey revealing 164 technical papers published during 1987–1997 contributed by zoo herpetologists, and determined that members from three institutions contributed 80% of those papers. In the eight years since the aforementioned review there has been a considerable decline in the number of manuscripts resulting from zoo-academic collaborations. Noteworthy exceptions include the following: Ferguson et al. (2003) investigated whether Panther Chameleons (*Furcifer pardalis*) bask to regulate endogenous vitamin D3 production; Hartdegen and Chiszar (2001) looked at prey chemical discrimination in Gila Monsters (*Heloderma suspectum*); Cooper and Hartdegen (1999) examined chemoresponse to plant and animal cues in *Scincella lateralis*; Cooper and Hartdegen (2000) explored lingual and biting responses to prey chemicals by ingestively naïve *S. lateralis*; Murphy et al. (2002) compiled various studies on Komodo Dragons (*Varanus komodoensis*) resulting in a book published by Smithsonian Institution Press; Aucone et al. (2003) conducted studies with Chuckwallas (*Sauromalus obesus*) to determine the levels of 25-hydroxyvitamin D following exposure to Westron® self-ballasted mercury vapor lamps; Ferguson et al. (2004) published a book on the natural history, conservation, and captive management of Panther Chameleons (*Furcifer pardalis*); and Ewert et al. (2004) documented temperature dependent sex determination and ontogeny in Pancake Tortoises (*Malacochersus tornieri*). Clearly, there are a handful of prolific collaborators, but overall there is a lack of breadth regarding experimental research among zoo herpetologists. Herein I identify some of the problems, and suggest how the occurrence of collaborations with academic colleagues might increase.



Savanna Monitors (*Varanus albigularis*): test subjects for collaborative experiments at Fort Worth and Dallas Zoos.

Some of the reasons for the paucity of collaborations include: lack of knowledge and/or inspiration on the part of zoo staff; perceived unimportance by management, both at the curatorial level and above; dwindling number of academic herpetologists who place emphasis on research in zoos due to de-emphasis of natural history and related fields in universities (as noted by Chiszar and Smith, 2005); and no convenient medium for broad-scale communication about ideas for interesting projects.

Most zoo herpetologists are really good at what they typically do, which is to care for and exhibit diverse living collections of amphibians and reptiles. It is also true that they tend to have a global knowledge of herpetofauna, and are generally well read. But the literature they consume is often descriptive in nature, thus formal papers pertaining to herpetological science are frequently unseen. This is an important detail, for without a basic knowledge of contemporary herpetological science, one would essentially speak a different language from those in mainstream academia. And unless we speak the same language there can be no meaningful relationships with those in academia. The best way to remedy this problem is for curators to encourage, if not require, their staff to stay abreast of current herpetological news. Further, the acqui-

sition of knowledge is intrinsically tied to the act of being inquisitive, so curators should always push their staff to explore the systematics, ecology, and physiology of amphibians and reptiles, and ensure that they have easy access to relevant scientific literature.

Likewise, academic herpetologists are really good at what they typically do. Often times, however, they have scant knowledge of the many resources zoos have to offer, and their ties with zoo herpetologists are weak or non-existent. The logical fix for this problem is to enhance communication between zoo and academic herpetologists and make the resources available at zoos more readily apparent and accessible to those in academia. See below for more on this topic.

Allow me to share a telling anecdotal experience. I was employed in the department of herpetology at the Dallas Zoo from 1985–1995. A ritual at the time was a morning meeting, lasting about an hour (a tradition that continues at Dallas today) that centered around the break table. These gatherings were an opportunity to discuss the day's agenda (medical procedures, new exhibits, research projects, animal transactions, etc.), and to talk about herpetology in general. There are several important points here: 1) everyone was equal at the break table so the curator could not or did not impose his ideas because of his position. If he pushed a particular idea for acceptance, it only was added to our program because his argument was sound; 2) there were ground rules—be courteous to one another and not try to intimidate with posturing, etc. Since we worked closely with each other, it was important to encourage a collegial interaction with a bunch of alpha types who, as a rule, were somewhat selfish; 3) there were limited resources so we had to make sure that what we did made sense and was a mutually acceptable course of action by the majority; 4) all of us needed to be able to defend our ideas and engage in a Socratic dialectic with the top professionals in our field.

Frequently we shared the company of prominent academic herpetologists (Walter Auffenberg, Roger Avery, Bayard Brattstrom, Bill Branch, Angus d'Bellairs, Daniel Bennett, Edmund Brodie, Jr., Jonathan Campbell, Charles Carpenter, Dave Chiszar, Joseph Collins, Roger Conant, William Cooper, Jr., David Crews, Ben Dial, James Dixon, Gary Ferguson, Neil Ford, Darrel Frost, Carl Gans, Bill Gehrmann, James Gillingham, Howard Gloyd, Harry Greene, David Hardy, Victor Hutchison, Frances Irish, Elliott Jacobson, Konrad Klemmer, Bill Lamar, Chris McAllister, Sherman and Madge Minton, M. Graham Netting, Eric Pianka, George Pisani, William Pyburn, Gerald Raun, Gordon Schuett, Edward Taylor, Donald Tinkle, Stanley Trauth, Paul Weldon, Martin Whiting, Wayne and Tom Van Devender, and others) who were passing through—stopping by to admire our collection and to harass curator James Murphy about all manner of things, not the least of which was his sartorial ineptitude. Humor aside, those of us in the department during those times had the good fortune of learning in this informal classroom with non-zoo colleagues who brought a suite of interesting ideas independent of zoo matters for us to consider. This was a place where all of us could test our wings with our peers, leading later to fruitful interactions. To his credit, James Murphy fostered this intellectual environment often at the frustration of the zoo director and fellow curators…as in…why are you guys still sitting around the break table drinking coffee…don't you have work to do? Of course, we always had plenty to do. We were encouraged to structure our days efficiently so that if an unexpected guest stopped by, there was time to visit. Accordingly, we generated project lists with agreed upon deadlines, and strived to complete routine duties as quickly as possible. Good time management also permitted us to work on other projects unrelated to collection maintenance. The benefits to this organizational strategy were that it built self-determination and good work habits, and negated the need for supervisors to micromanage staff—clearly a plus for both employee and employer!

It seems that the most important manifestation of these gatherings was the inspiration to think on a higher plane—to encourage inquisitiveness and develop independent lines of inquiry. And the effect of those morning meetings has been lasting, as evidenced by the number of us who have gone on to collaborate with many of the persons mentioned previously. When I think of factors that have led to successful partnerships, a scenario similar to that just described seems paramount. Further, I must emphasize how important those times were in influencing my overall philosophy of management and program building. Since the mid-1990s, several of us have moved into management positions in herp departments at other zoos, and we are working to establish a similar environment at our institutions.

The fact that experimental research is not on the "front burner" in more zoo herp programs is baffling. Murphy (2005) points out that zoo herpetologists devote considerable time to American Zoo & Aquarium Association (AZA) related activities, such as preparing studbooks and Taxon Management Accounts (TMAs), administering Taxon Advisory Groups (TAGs), etc., believing these activities are research, which they are not. This is not to say that these endeavors are unimportant, for they are. They should not, however, be confused with empirical research. Given the broad range of behaviors associated with amphibians and reptiles, there are myriad projects that can be implemented utilizing a diverse herpetological collection. Projects that explore basic organismal topics such as reproduction, behavior, and comparative physiology are important. Some specific reptilian psychobiological processes that are candidates for assessment include: activity cycles, cover-seeking behavior, anti-predator tactics, stress, foraging behavior, etc. (for more examples see Chiszar et al. 1993a; 1993b). Apart from experiments that have obvious applied value (see Ferguson et al. 1996; Burghardt et al. 1996), there are many opportunities to answer questions having theoretical relevance (see Kardong 1996; Garrett et al. 1996; Cooper et al. 1996). As Chiszar et al. (1993b) suggest "qualitative analysis of the presence or absence of suspected adaptive phenomena although useful in their own right, can easily give rise to theoretical insight and advanced understanding of phenomena that are incompletely known at present." Utilizing zoo herp collections to this end should be an integral component of progressive zoo herpetology. And the interest is there. In May of 2004, SSAR Zoo Liaison Committee member Brian Aucone (Curator of Herpetology – Oklahoma City Zoo) queried herpetologists at 46 US and European zoos as to whether they would be interested in collaborating with academic herpetologists for scientific research—100% indicated they would.

Non-invasive experimental research should be an easy sell to upper administration in zoos, as long as the primary facets of traditional operations (animal health, public display, education) are met. In-house research typically has negligible budget impact and can result in important contributions. And the experimental pro-

cess is, in and of itself, enriching. Apart from potentially answering interesting questions, the process often generates new questions, taking the investigators in completely new directions. Another fortuitous advantage of collaborative research is that it draws positive attention to the zoo—ever important in a time when zoos must constantly justify why they keep animals. Common sense would dictate that it is our responsibility to maximally utilize our collection.

There is little to be done about the falling number of herpetologists focusing on ecology in academia (which directly effects zoo collaborations), save for the constant bleating about its importance. What we can do is make it easier for the academic and zoo herpetologists to communicate. An historical problem has been the absence of a convenient medium for dialogue and the exchange of ideas. Accordingly, one of the goals for the SSAR Relationships with Herpetologists at Zoological Parks Committee for 2005 is to establish a web-based forum (as part of the SSAR website) to facilitate communication. As committee chair, I have volunteered to take on this task, both as developer and moderator. The forum will be accessible from the SSAR Homepage (Zoo Liaison button), and will be seamless, meaning it will link directly and have the same user interface as the main site. Herpetologists will also have the luxury of viewing threads and posts of all who participate, therefore augmenting dissemination of ideas. With this new tool at our disposal, communication should be considerably more efficient.

An artifact of communication through the web forum may be the increased desire of zoo herpetologists to attend professional meetings. While quite a few zoo peers do attend IHS, SWAN, SSAR/ASIH/HL meetings, it would certainly be conducive to collaborative relationships for more zoo herpetologists to attend academic symposia. These meetings, especially the larger ones, always engender excitement, and are the perfect venue for networking and exchange of ideas. Zoos are more likely to financially support registration fees and travel to AZA-sponsored events, so there exists the challenge of persuading zoo administrators to allocate a portion of their budget for academic herp meetings. Curators should certainly consider such meetings an important part of professional development for herp staff.

One of the most difficult aspects of implementing a research program in a zoo setting is getting projects off of the ground. While there will always be challenges with staff, administration, etc., the bottom-line is that curators just have to make it happen . . . no need to wait for planets to align. Collaboration with other individuals makes this considerably easier, as long as projects do not suffer scope creep (a corporate term for projects where focus is lost and deadlines are missed because too many people are allowed to have input and/or make decisions). A number of us at various zoos (all of whom were in the Dallas Zoo's herp department at some point) are working on what we hope will be a model program. We have formed a "consortium" of sorts where we view our inventories as a collective, thereby allowing us access to a greater diversity of species and increased sample sizes. We have identified numerous projects (some of which involve moving eggs and neonates between zoos), assigned principle investigators, and are presently carrying out experiments.

Every collaborative relationship is different. What works well for some, may not work well for others, thus investigators will tackle the issues of project planning and initiation in different ways. Chiszar and Smith (2005) offer some insightful comments on their experiences collaborating with zoo herpetologists, and they outline program attributes that have contributed to meaningful collaborations. Embracing those protocols can certainly facilitate new relationships. I should add that while Dave Chiszar and Hobart Smith humbly insist that their efforts have not been special in any way, I know first-hand that they have—namely their sharing of knowledge and willingness to encourage and support eager zoo herpetologists.

Pough (1993) suggests that involving students in zoo research projects is an excellent way to tap the resources of academic institutions, and notes that most colleges and universities offer academic credit for research projects supervised by a faculty member. In fact, many of these supervised projects result in peer-reviewed publications. Currently, numerous zoo herp departments offer intern programs where both undergraduate and graduate students work summer semesters for biology and/or research credit. Our experience at the Fort Worth Zoo has been that interns provide a great service while learning about animal behavior, husbandry, record keeping, etc. Many of these student employees will doubtless hold academic positions in the future, thereby paving the way for fruitful interactions. Zoo herpetologists should also become more involved in academic lab and field projects as research assistants, as academics with sizable grants may be interested in hiring temporary help from the non-student pool.

One more thing . . . it is rare for academic herpetologists to "drop the ball" when it comes to completion of collaborative projects. While I do not mean to suggest that indolence prevails among zoo herpetologists, we should make every effort to finish projects that are started. Nothing sours professional cooperation quicker than partners who do not follow through. Time is important for all of us, and mutual respect in this regard will serve everyone well.

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POINTS OF VIEW

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Did *Desmognathus* Salamanders Reinvent the Larval Stage?

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Until recently the plethodontid subfamily Desmognathinae, with 20 species, has been considered a monophyletic lineage of morphologically specialized salamanders, standing as the sister taxon of the 350-plus species of the subfamily Plethodontinae, the latter comprising the tribes Hemidactyliini, Plethodontini, and Bolitoglossini (Larson et al. 2003; Schwenk and Wake 1993; Wake 1966). The biphasic life cycle, featuring a free-living larval stage, has been hypothesized as the ancestral life-history mode of desmognathines; the three species having direct development have been viewed as specialized, derived forms (Hairston 1987; Wake 1966).

Recent studies of molecular systematics of desmognathines have shown that the direct-developing species, the large, elongate *Phaeognathus hubrichti* and the miniaturized *Desmognathus wrighti* and *D. aeneus*, occupy more basal positions in the taxon, leading to the hypothesis that direct development was ancestral in desmognathines (Rissler and Taylor 2003; Titus and Larson 1996).

Three newer studies have re-evaluated the relationships of plethodontids generally, and have supported Titus and Larson's (1996) and Rissler and Taylor's (2003) interpretation of desmognathine evolution. In an investigation of plethodontid mitochondrial genomes, Mueller et al. (2004) showed that desmognathines nest within a mix of direct-developing forms, including *Plethodon*, *Hydromantes*, and *Aneides*, and fall out as the sister taxon of *Ensatina* (Fig. 1). These authors (Mueller et al. 2004: Fig. 3) posited three equally parsimonious evolutionary scenarios to account for life-history diversification within the framework of their phylogeny. Although they left this as an unresolved problem, each of the three scenarios requires, for desmognathines, the evolution of biphasic life cycles in descendants from direct-developing ancestors, and thus the re-evolution of a free-living larval morph within this lineage. Second, Chippindale et al. (2004), using both morphological and molecular characters, found that desmognathines fall within the traditional plethodonine (tribal) clade, and stand as the sister taxon of *Aneides–Ensatina* (Fig. 2). They speculated that desmognathines re-evolved a biphasic life cycle under competitive pressures from other terrestrial plethodonines in species-rich Appalachian Mountain ecosystems. Finally, Macey (2005), in a reanalysis of the Mueller et al. (2004) mitochondrial genomic dataset, reported that desmognathines fall within a plethodonine–*Hydromantes* lineage, and recovered *Desmognathus–Phaeognathus* as the sister lineage of *Aneides–Ensatina–Hydromantes* (Fig. 3). This paper did not directly address life-history evolution. Chippindale et al. (2004) proposed a new taxonomy for plethodontids in which the traditional subfamily Desmognathinae is abolished, with the genera *Desmognathus* and *Phaeognathus* recognized as the supergenus *Desmognathus*. In the remainder of the present paper I use the term desmognathan for the monophyletic clade of *Phaeognathus* and *Desmognathus*, and will refer to plethodontid subfamilies by the new names suggested by Chippindale et al. (2004) and followed by Macey (2005) (see Figs. 2, 3).

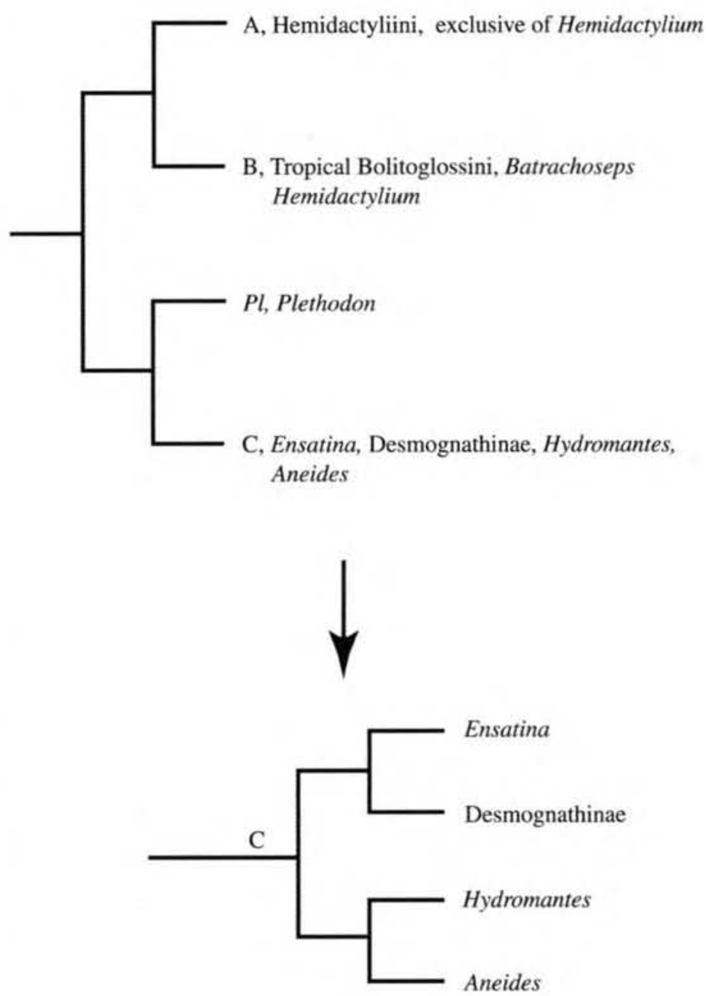

FIG. 1. Main features of the mitochondrial genomic phylogeny of Mueller et al. (2004: Fig. 2).

The Mueller et al. (2004), Chippindale et al. (2004), and Macey (2005) analyses raise numerous questions concerning the evolutionary history and relationships of desmognathans. I address the following: (1) What is the sister taxon of plethodontids, and how does resolution of this question inform understanding of life-history evolution in plethodontids generally and desmognathans specifically? (2) What is the likelihood that desmognathan morphology is a product of convergent evolution (homoplasy) for the three morphological character sets that Mueller et al. (2004) evaluated? (3) What other morphological characters contribute to the resolution of desmognathan relationships? (4) What is the status of the three direct-developing members of the clade in reference to their morphology, developmental biology, life history, and ecology? (5)

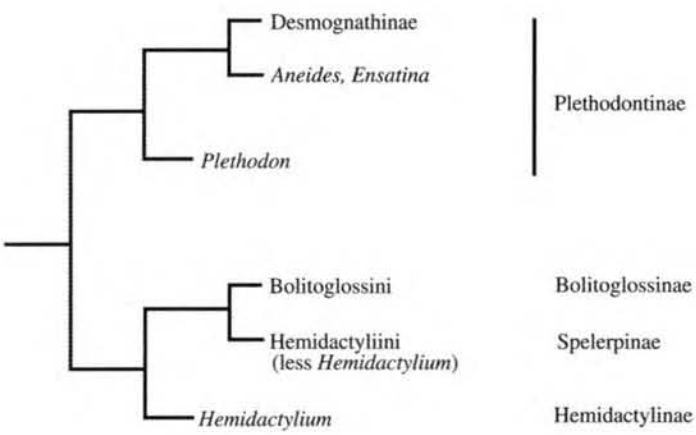

FIG. 2. Phylogeny of Chippindale et al. (2004: Fig. 4) based on combined data (molecular + morphology). Names in the right-hand column are the subfamily assignments proposed by the authors.

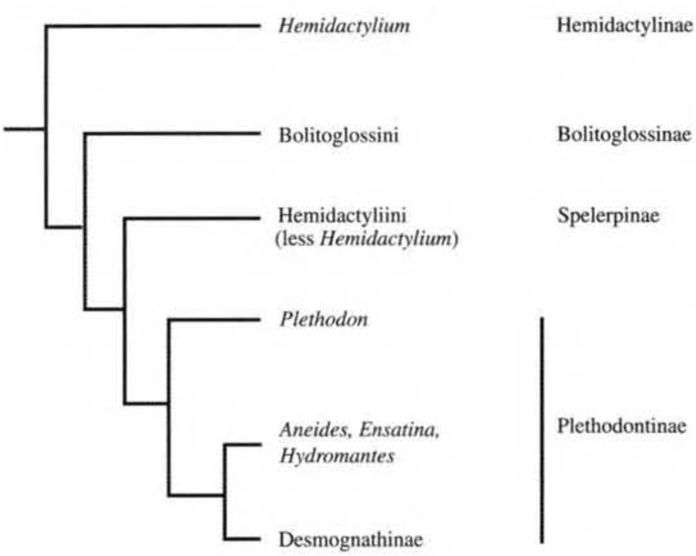

FIG. 3. Macey's (2005: Fig. 1A) most parsimonious tree based on the mt-DNA dataset. Subfamilies follow Chippindale et al. (2004).

How realistic is the ecological scenario posited by Chippindale et al. (2004) for the re-evolution of biphasic life cycles in desmognathans? (6) What weight should be assigned, in plethodontids, to an evolutionary transition from a biphasic life cycle to direct development, as opposed to the reverse?

In addressing these questions, my arguments are based on (1) application of outgroup comparison in phylogenetic inference, i.e., that the ancestral character state is most likely the one that is most widely distributed among taxa outside the group in question, and (2) Dollo's law of irreversibility, i.e., that complex characters, once lost in evolution, are unlikely to be regained (Dollo 1905; Gould 1970).

1. The sister family question

Whereas Larson and Dimmick (1993) assigned Amphiumidae as the sister family of Plethodontidae, Larson et al. (2003) noted the uncertainty of relationships among Amphiumidae, Plethodontidae, and Rhyacotritonidae. Chippindale et al. (2004) recovered Amphiumidae as the sister family of Plethodontidae, with Rhyacotritonidae as the sister lineage of this clade. The analyses of Mueller et al. (2004) and Macey (2005), both of which omitted Amphiumidae, supported a sister-group relationship between Rhyacotritonidae and Plethodontidae. Both Amphiumidae and Rhyacotritonidae are small families, each with a single genus, with three and four species, respectively. The species of *Amphiuma* are highly aquatic, specialized, partially paedomorphic salamanders; yet the gilled larval period is apparently brief and larvae may not feed in the larval stage (Gunzburger 2003; Ultsch and Arceneaux 1988). Thus—uniquely—life-history modes in *Amphiuma* approach direct development, even though metamorphosis is incomplete and adults retain some larval features. Rhyacotritonids resemble plethodontids in the reduction of lungs and absence of an ypsiloid cartilage (Good and Wake 1992), some aspects of cloacal anatomy (Sever et al. 2004a,b), and courtship behavior, which features a tail-straddling walk identical to that of plethodontids (Rudenko et al. 2003). The species of *Rhyacotriton* are mountain-stream salamanders; the biphasic life cycle involves a multi-year larval period (Nussbaum and Tait 1977), similar to that of many biphasic plethodontids (Bruce 2003). Thus, a sister-group relationship between rhyacotritonids and plethodontids infers a stream-dwelling common ancestor with a biphasic life cycle.

In their phylogenetic construct of developmental modes, Chippindale et al. (2004: Fig. 4) coded amphiumids as biphasic. They did cite evidence (Gunzberger 2003) that amphiumids could be considered direct developers. In any case, the early life histories of *Amphiuma means* (Gunzburger 2003) and *A. tridactylum* (Ultsch and Arceneaux 1988) are similar to those of *Phaeognathus hubrichti* (Means 2003) and *Desmognathus aeneus* (Harrison 1967; Valentine 1963), which Chippindale et al. (2004) considered direct developers. However, coding amphiumids as direct developers would require postulating a direct development–biphasic transition in the hemidactyline and spelerpine lineages, as well as in (most) desmognathans. This might be a difficult argument to sustain. Adding rhyacotritonids to the mix reinforces assignment of the ancestral life-history mode as biphasic.

2. Morphological homoplasy

Mueller et al. (2004) evaluated the following three morphological characters in reference to their mitochondrial genomic phylogeny: (1) hind-limb toe number, (2) tongue structure, and (3) tail autotomy. Toe number is uninformative for desmognathans; the ancestral number is five, and this state is retained in all members of their major *Pl*–C clade to which desmognathans belong. Reduction from five to four toes has occurred in several lineages within their major AB clade.

Three tongue types are found in plethodontids: protrusible, free, and attached projectile. The protrusible tongue is the simplest, and is least modified from the ancestral condition based on outgroup comparisons. It is retained in desmognathans and in the genera *Plethodon* and *Aneides*. However, in other members of the *Pl*–C clade, *Ensatina* (the putative sister group of desmognathans) has an attached projectile tongue, whereas *Hydromantes* has a free tongue.

The third character considered by Mueller et al. (2004) is tail

autotomy, with three states. The simplest is a thick-based tail with no specializations for autotomy and rapid wound healing. This condition is found in desmognathans and most spelerpines, as well as in close outgroups, and thus can be considered the ancestral state. The more specialized states are slender- and constricted-based tails, with various provisions for breakage and wound healing. Mueller et al. (2004) proposed that tail autotomy evolved in ancestral plethodontids, and that evolution of a thick-based tail occurred independently in aquatic and semi-aquatic spelerpines and desmognathans as an adaptation for aquatic locomotion. Based on outgroup analysis, such a scenario would represent a reversal. *Ensatina*, the putative sister taxon of desmognathans, has a constricted-based tail.

Based only on information provided by Mueller et al. (2004) on these three sets of morphological characters, it seems remarkable that desmognathans have retained character states for all three that can be inferred as ancestral vis-à-vis close outgroups, yet in the mitochondrial genomic phylogeny they nest deeply in a clade comprising members exhibiting derived morphological states. The sister-group relationship of *Ensatina* and desmognathans appears especially suspect, inasmuch as desmognathans otherwise share few traits with *Ensatina*, either in morphology, ecology, or life history.

3. Other morphological characters

The principal morphological characters that define desmognathans are nine skeleto-muscular features of the head, trunk, and limbs (Schwenk and Wake 1993). The latter authors interpreted these as conjoint adaptations for feeding and for burrowing by head wedging in streams. They argued that the traits reflect a secondary entry into streams by adult desmognathans. But, given that the traits are shared across the supergenus, such an evolutionary scenario would seemingly necessitate some degree of aquatic ancestry for the direct-developing species as well as for the biphasic members of the clade.

In comparing skull development in the biphasic *Desmognathus quadramaculatus* and direct-developing *D. aeneus*, Marks (2000), in assuming that the biphasic life cycle is the ancestral state in desmognathans, addressed the question of evolution of direct development by (1) recapitulation of the ancestral ontogeny, which is accelerated so that metamorphosis occurs before hatching, versus (2) ontogenetic repatterning, wherein the ancestral pattern is modified. One key element in her comparison was the palatopterygoid bone, absent in *D. aeneus* but present in *D. quadramaculatus* as well as in larvae of *Eurycea bislineata*. Parsimoniously, this requires that the evolution of direct development in desmognathans, as expressed in *D. aeneus*, involved ontogenetic repatterning. Conversely, if direct development represents the ancestral state in desmognathans, the palatopterygoid would have had to have been reinvented in biphasic desmognathans (if in fact it is also absent in *Phaeognathus* and *D. wrighti*). According to Marks (2000: p. 273), "... evolution of direct development via repatterning involves an alteration of the ancestral ontogeny. Thus, it may be difficult for larval forms to re-evolve from direct-developing ancestors." And later (Marks 2000: p. 275), "... evolution of direct development via ontogenetic repatterning may preclude subsequent re-evolution of species with larval development." Marks's (2000) argument is convincing insofar as the evidence allows, but what are needed to resolve the question are embryological data for the other two species (*D. wrighti* and *P. hubrichti*) of direct-developing desmognathans.

An additional set of characters bearing on desmognathan relationships is the hyobranchial skeleton, especially variation in morphogenesis of the epibranchial cartilages in embryos and larvae (Alberch 1987). Three epibranchial cartilages develop embryologically in most hemidactyline and spelerpine plethodontids, although two or three species, *Hemidactylium scutatum* and *Eurycea longicauda/guttolineata*, have either three or four epibranchials (Rose 1995a). Embryos of *Plethodon cinereus* develop three epibranchials (Dent 1942). In contrast, desmognathans, including *D. aeneus* and *D. quadramaculatus*, have four epibranchials (Marks 2000). Given that other families, Proteidae excepted, also develop four epibranchials, the desmognathan condition is most parsimoniously interpreted as ancestral for plethodontids.

In plethodontids, bolitoglossines excepted, the embryonic and larval first epibranchial undergoes replacement (versus remodeling) at metamorphosis by the single adult epibranchial that develops in its position (Alberch 1987; Alberch and Gale 1986; Rose 1995b). Alberch (1987) proposed that this feature, unique to plethodontids, was an adaptation of biphasic ancestral plethodontids that facilitated metamorphosis and allowed independent evolution of larval and adult morphology.

One feature of the sensory system of phylogenetic significance is the lateral line. Lateral line organs are found in larvae and aquatic adults in all urodelan families; thus the presence of the lateral line is postulated as the ancestral state. In plethodontids lateral line organs are found in spelerpines and in larvae and adults of aquatic and semiaquatic species of desmognathans; they are absent in direct-developing *D. aeneus* and *D. wrighti* and in direct-developing members of other lineages (Collazo and Marks 1994; Dent 1942). If desmognathans stem from a direct-developing ancestry, they have necessarily re-evolved the lateral line system.

4. Direct-developing desmognathans

The evolution of small body size in desmognathan salamanders is correlated with accelerated development to metamorphosis and sexual maturation (Beachy and Bruce 2003). *Desmognathus aeneus* and *D. wrighti* are among the world's smallest salamanders, similar to many species of *Thorius* (Bruce 2000: Table 4) in mean and maximum adult sizes (Harrison 1967; Hining and Bruce 2005; Organ 1961a,b). Given that no other members of the *Pl*–C clade of Mueller et al. (2004) exhibit such small sizes, miniaturization in these species is undoubtedly a derived trait. Miniaturization is correlated with a high rate of development to sexual maturation (Harrison 1967; Hining and Bruce 2005), inasmuch as age at maturation is lower in both species than in other, larger *Desmognathus* (Bruce et al. 2002; Castanet et al. 1996). Thus, I suggest that direct development in both *D. aeneus* and *D. wrighti* is an evolutionary consequence of heterochronic acceleration in developmental rate that eliminated the free-living larval stage, lowered age at sexual maturation, decreased generation time, and promoted small body size; i.e., a "matrix of acceleration" (Ryan and Bruce 2000). Possible ecological factors eliciting selection for these traits include competition and predation acting in diverse species assemblages along the rich resource gradient of southern Appalachian ecosystems (Bruce 1996; Hairston 1986, 1987).

The biology of the third direct-developing desmognathan, *Phaeognathus hubrichti*, is poorly known. It is a secretive burrower, highly derived in morphology (e.g., 21–23 trunk vertebrae vs. 15 in other desmognathans). Basic life-history data are sketchy. Whereas hatchlings emerge at a large size with well-developed gills, the larvae do not feed, and they metamorphose within a few days (Means 2003). Age at sexual maturation is estimated as 5–6 years in females and probably earlier in males, based on skeletochronological data of 11 individuals (Parham et al. 1996). Although these findings suggest acceleration in growth and developmental rates in comparison with the larger species of *Desmognathus* (Bruce et al. 2002; Castanet et al. 1996), verification awaits further data on growth and maturation in *Phaeognathus*.

5. The Ecological Scenario

Chippindale et al. (2004) proposed that selection favoring re-evolution of a biphasic life cycle in *Desmognathus* derived from competition with terrestrial plethodontines (e.g., *Plethodon*) in species-rich salamander assemblages of the Appalachian Mountains. They overlooked the likelihood that such assemblages contained semiaquatic and aquatic spelerpines of the genera *Eurycea*, *Gyrinophilus*, and *Pseudotriton*. Clade ages in the latter taxon are in fact greater than those of desmognathans (Larson et al. 2003). From an ecological perspective, the evolution of biphasic life cycles in amphibians is related to the causes and consequences of ontogenetic niche shifts in relation to differences in resources, competition, and predation in the aquatic and terrestrial habitats (Roff 2002; Rowe and Ludwig 1991). Extant species of biphasic desmognathans and spelerpines overlap considerably in body size, diet, and life history (Petranka 1998). Interactions among them are incompletely understood. Nevertheless, the ecological–evolutionary model of Chippindale et al. (2004) would seemingly have taken desmognathans "out of the frying pan into the fire" in the competitive milieu of Appalachian salamander assemblages.

Conversely, in assuming a biphasic ancestry of desmognathans, the same objection might be raised for the evolution of the direct-developing, terrestrial members of the lineage. However, *Desmognathus aeneus* and *D. wrighti* are miniaturized forms, smaller than any extant members of *Plethodon*, and they thereby occupy unique adaptive zones within the Appalachian plethodontid assemblage. Their evolutionary trajectories may have involved entry into unoccupied, resource-rich terrestrial niches, which served to reduce predation and competition from their more aquatic congeners (Bruce 1996; Hairston 1986, 1987). Similarly, as noted above, *Phaeognathus hubrichti* appears to occupy a unique niche, unlike that of other North American salamanders.

6. Evolutionary reversals

The acquisition in a descendant of a biphasic life cycle, with a free-living larval stage, from a direct-developing ancestor, which itself had evolved direct development from an earlier biphasic ancestor, might constitute an exception to Dollo's principle; i.e., an organism or a complex organ system never returns exactly to its former state (Dollo 1905). This postulate can be restated within the framework of probability theory: Reversal of a complex adaptation to its ancestral state involves so many independent steps that the laws of probability make re-evolution of the ancestral condition highly unlikely (Gould 1970). In the present case this generates the question whether the larval morph of plethodontid salamanders is sufficiently complex to make the probability of its re-evolution effectively nil. Resolution of the question requires evaluation of morphogenesis in the biphasic and direct-developing lineages within the framework of the phylogenetic hypotheses generated by the newer molecular techniques.

In plethodontid salamanders, the derivation of a descendant with a biphasic life cycle from a terrestrial ancestor with direct development would involve the re-evolution of a free-living larva adapted to respire with external gills and feed by suction feeding, and having an aquatic locomotor system, lateral line sensory organs, plus other morphological features associated with aquatic life. Moreover, such a scenario requires the re-evolution of a complex metamorphosis involving many organ systems, as well as the underlying physiological/endocrinological system that regulates the transformation. It is unlikely that an evolutionary change of this level of complexity (as expressed in the biphasic desmognathans) could be accomplished by simple heterochronic retardation of embryonic development starting with a direct-developing ancestor, given that in embryos of direct-developing plethodontids, including desmognathans, the requisites for a free-living existence in aquatic environments have been lost or have been obscured by ontogenetic repatterning (Collazo and Marks 1994; Marks and Collazo 1998; Wake and Hanken 1996).

In contrast, the evolution of direct development from a biphasic ancestry represents simplification of the ancestral life cycle that can be achieved through accelerated development, involving loss of ancestral larval characters and simplification of metamorphosis and its physiological controls. Thus, my response to the assertion of Mueller et al. (2004) that "Discrimination among these scenarios [of life history evolution] will require weighting either the loss or reevolution of larvae ..." is that the probability of evolving direct development from a biphasic ancestry far outweighs that of the reverse.

Chippindale et al. (2004) calculated probabilities that ancestral desmognathans were direct developing, over a range of hypothetical relative transition rates between alternative life-history modes. Their calculations generate probabilities below 50% only by assuming that the probability of the direct development to biphasic transition is several orders of magnitude lower than the reverse. However, this may not be an unreasonable assumption, given the morphogenetic constraints involved in re-evolving a larval stage.

Conclusions.—Contrary to the molecular evidence, data from morphology, embryology, and life history, in comparison with other urodelan families, all suggest that a biphasic life cycle is ancestral in plethodontids generally and in desmognathans specifically. In desmognathans the retention of ancestral states for an array of unrelated characters is difficult to account for on the basis of homoplasy. Moreover, the three direct-developing species of the subfamily are all specialized in body size and other characters, and they occupy unique adaptive zones. Direct development would appear to represent an evolutionary correlate of these derived traits.

The principal inconsistency in the Mueller et al. (2004) phylogeny is the putative sister-group relationship of desmognathans and *Ensatina*. This inconsistency is removed in Macey's (2005) re-evaluation of the mitochondrial genomic dataset, wherein the position of *Ensatina* shifts to a clade including *Aneides–Ensatina–Hydromantes*, forming the sister group of *Phaeognathus–*

Desmognathus. The Macey phylogeny requires no transitions from direct development to a biphasic life cycle. Although Chippindale et al. (2004) argued for a reversal from direct development to larval development in desmognathans, in their phylogeny retention of a biphasic life cycle in ancestral desmognathans, hemidactylines, and spelerpines would require the evolution of direct development in *Plethodon*, *Aneides* + *Ensatina*, and Bolitoglossini, as well as in three desmognathan lineages, but no reversals. Given the multiple derivations of direct development in anurans, caecilians, and tetrapods generally, this would appear to be a more likely scenario than the reinvention of biphasic life cycles by plethodontid salamanders.

From my perspective, the most compelling questions stemming from these surprising new phylogenies concern the ecological aspects of life-history evolution. I still maintain that streamside species with the brief larval periods and small metamorphic sizes represent valid models of the "ancestral" desmognathan (Bruce 1991). Nevertheless, it would be valuable to have more comprehensive, comparative data on embryogenesis and early life history in a variety of desmognathans, including *Phaeognathus hubrichti* and *Desmognathus wrighti*, and in their putative plethodontine relatives. Experimental studies on plasticity in ontogenetic niche shifts and its ecological and genetic basis in desmognathans should shed light on the evolutionary potential for transitions between life-history modes in this clade. Also needed are broader scale experimental studies than have heretofore been conducted on ecological interactions among spelerpines and desmognathans, in the aquatic phases especially, in species-rich communities in the Appalachians and elsewhere.

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Why Should Reaquisition of Larval Stages by Desmognathine Salamanders Surprise Us?

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It is understandable that Bruce (2005) questions interpretation of our independent studies concerning plethodontid life-history evolution. Larval development is found in all ten families of salamanders, and only members of Plethodontidae exhibit direct development from deposited eggs (Salthe 1969). Nevertheless, all analyses of mitochondrial DNA (Macey 2005; Mueller et al. 2004; Titus and Larson 1994), nuclear DNA (Chippindale et al. 2004), and even of the combined morphological and molecular data (Chippindale et al. 2004), indicate that desmognathine salamanders with larval development are deeply nested within direct-developing clades. Given the new and robust phylogenetic hypotheses, the most parsimonious interpretation of these results is that the free-living larval phase has re-evolved. We think that explorations such as those presented by Bruce (2005) are important contributions toward explaining these findings. However, invocation of generalizations such as Dollo's "Law" (which states that complex states cannot re-evolve once lost; Hall 1998) is not the most appropriate approach to the analysis of real data sets. Empirical analyses of Dollo's Law show that genes controlling developmental processes can indeed remain dormant for long time periods, up to 10 million years, and then be reactivated to express traits previously "lost" within clades (e.g., Marshall et al. 1994). Within salamanders there have been demonstrable reversals of other life-history traits, notably a return of metamorphosis in taxa deeply nested within otherwise permanently larval forms (Bruce 1976; Chippindale et al. 2000; Shaffer 1984; Sweet 1982). Also, there is surprising plasticity in life-history traits associated with metamorphosis and even egg retention and oviductal development (Lanza and Piero 2001; Wake 1989; Wake and Hanken 1996).

Perhaps, as Bruce (2005) argues, life history evolution has been highly non-parsimonious (i.e., direct development has independently evolved many times within Plethodontidae), and what has been called "direct development" is, instead, a heterogeneous set of non-homologous states. Labeling his argument as a "point of view" is appropriate. We think that his arguments contain elements of speculation, whereas ours are based on direct interpretations of the phylogenetic data. Refuting the possibility of a reversal from direct development to a free-living aquatic larval stage in desmognathines would require the acceptance of at least four or five independent origins of direct development. This would also imply that "direct development" is not one but many states (e.g., Wake and Hanken 1996); if so, there has been far more diversity of life-history modes in plethodontids than has been recognized previously. Our new phylogenetic hypotheses are based largely

on new molecular datasets; because they are hypotheses, we are actively engaged in gathering additional data to test them. We need to develop other datasets and integrate our studies in such a manner as to effectively test and reject alternative hypotheses of plethodontid relationships until such hypotheses can generally be viewed as robust, even if they conflict with more classical hypotheses for the evolution of morphology and life-history evolution in this group. The newly discovered Asian plethodontid salamander, *Karsenia koreana*, also appears to be a direct developer. Given its placement in the phylogeny (Min et al. 2005), the case for a reversal in *Desmognathus* is even stronger; argument against reversal now requires the independent evolution of direct development in at least six clades (*Plethodon*, *Hydromantes* + *Ensatina*, *Karsenia*, *Aneides*, *Phaeognathus*, and *Desmognathus wrighti*).

What has become clear in this developing debate is the absence of relevant comparative ontogenetic and developmental morphological data for salamanders. Relatively few species have been studied, and even such common species as members of *Amphiuma* are imperfectly known. Direct development is best known from studies of a species that is only a marginal direct developer, *Desmognathus aeneus* (Marks 2000), and very little is known about the early ontogeny of the 328+ species of direct developing plethodontids, many of which may prove to be relevant to this controversy.

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Re-evolution of the Larval Stage in the Plethodontid Salamander Genus *Desmognathus*

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Bruce (2005) presents provocative arguments in favor of an ancestral biphasic life-history mode for plethodontid salamanders, in particular for the genera formerly assigned to subfamily Desmognathinae Wake 1966: *Desmognathus* + *Phaeognathus*, the supergenus *Desmognathus* (sensu Chippindale et al. 2004). Bruce disputes the inferences of Chippindale et al. (2004) that a reversal from direct development to an aquatic larval stage occurred in *Desmognathus* (see also Bonett et al. 2005; Mueller et al. 2004). For decades, Bruce has played a leading role in studies of plethodontid life-history evolution (e.g., Bruce et al. 2000), and his disagreement with our conclusions is a cause for concern that must thoroughly be addressed.

The possibility that direct development is the ancestral state for supergenus *Desmognathus* (*Desmognathus* hereafter) has been discussed by several authors (e.g., Collazo and Marks 1994; Marks 2000; Titus and Larson 1996). The new and largely concordant phylogenetic hypotheses of Chippindale et al. (2004), Mueller et al. (2004), and Macey (2005) provide an opportunity to trace life-history evolution in plethodontids within a rigorous phylogenetic framework. Here, we address Bruce's arguments and show that the preponderance of evidence supports re-evolution of the aquatic larval stage in *Desmognathus*.

Bruce offers six key arguments in favor of biphasic development as the primitive condition for *Desmognathus*. We will address these in the order in which they appear in his paper. We

think that the issues can be distilled to four questions: (1) Is the family-level placement of plethodontids correct? (2) Is the phylogenetic position of supergenus *Desmognathus* within Plethodontidae correct? (3) Is the ancestral reconstruction for the evolution of direct development correct? (4) How strong is the evidence that competition in terrestrial environments drove the re-evolution of the larval stage?

1. The Sister Family Question: Amphiumidae or Rhyacotritonidae?

Bruce raises concerns about the phylogenetic position of Plethodontidae and the possible implications of its placement for the ancestral reconstruction of direct development in the family. Larson and Dimmick (1993) and Larson et al. (2003) showed relationships among amphiumids, plethodontids, and rhyacotritonids to be uncertain, and the analyses of Mueller et al. (2004) and Macey (2005) omitted amphiumids. However, the analysis of Chippindale et al. (2004) found strong support for the relationships (Rhyacotritonidae (Amphiumidae + Plethodontidae)). This result also has been strongly supported in a more recent analysis of higher-level salamander relationships based on molecular and morphological data (Wiens et al. 2005). We think that the phylogenetic position of plethodontids has now been resolved, and that Chippindale et al. (2004) used the appropriate outgroup relationships (based on inclusion of nearly all salamander families in their phylogenetic analyses) for their ancestral-state reconstructions.

Bruce favors biphasic development as the ancestral condition for plethodontids, based in part on a presumed close relationship between Plethodontidae and Rhyacotritonidae. The latter family occurs in mountain stream habitats in western North America, has aquatic larvae, and exhibits some other features similar to those in plethodontids (e.g., lung reduction). However, new molecular analyses and combined molecular and morphological analyses overwhelmingly support amphiumids as the sister group of plethodontids (Chippindale et al. 2004; Wiens et al. 2005).

In this section of his paper, Bruce also asserts that the ancestral state reconstructions of Chippindale et al. (2004) assume that Amphiumidae is biphasic. He states that "life-history modes in amphiumids approach direct development" (p. 108). This is a very reasonable view, especially given recent work by Gunzburger (2003). In fact, we presented and discussed ancestral state reconstructions in which amphiumids were treated alternately as biphasic and as direct developers. Both approaches yielded nearly identical results, with overwhelming support for a direct-developing ancestral *Desmognathus* using both maximum likelihood- and parsimony-based methods. In addition, treatment of amphiumids as direct developers supports the intriguing possibility (also suggested by analyses in which amphiumids were coded as biphasic) that direct development is the ancestral condition for Plethodontidae, and that there have been additional reversals to biphasic development in other lineages of plethodontids besides *Desmognathus*.

2 and 3. Morphological Homoplasy and Plethodontid Phylogeny: The Whole is Greater Than Some of the Parts

Bruce's sections 2 and 3 relate (directly or indirectly) to his concerns about the phylogenetic position of *Desmognathus* based on the incongruence of new molecular results with certain morphological characters. Bruce has informed us (pers. comm.) that he does not question our phylogenetic conclusions, and he does adopt our new taxonomy in his paper. However, his discussion of character evolution suggests that he questions our placement of *Desmognathus* within Plethodontidae, and we wish to clarify some of the issues that he raises.

A critical point is that simply discussing the evolution of selected morphological characters provides a very limited view of the implications of the morphological data for the phylogeny, at least relative to performing a full-scale phylogenetic analysis. Bruce fails to mention that Chippindale et al. (2004) performed a thorough phylogenetic analysis of the available morphological data for plethodontid phylogeny. This analysis included 123 morphological characters (including both original observations as well as characters based on data in the literature), encompassing nearly all of those discussed by Bruce (i.e., toe number, tongue structure, tail autotomy, and number of larval epibranchials, but not the presence or absence of lateral line organs). Rigorous analysis of the morphological data fails to support the traditional basal position for *Desmognathus* within Plethodontidae. Indeed, a basal position for *Desmognathus* was supported by only a single character (three larval epibranchials) in the widely used phylogenetic hypothesis of Lombard and Wake (1986). Furthermore, although the morphological analyses do not support the placement of *Desmognathus* within plethodontines as the molecular data do, they do not support monophyly of plethodontines either.

On the other hand, phylogenetic analyses of mitochondrial genome sequences (Macey 2005; Mueller et al. 2004), combined and separate analyses of nuclear and mitochondrial data (Chippindale et al. 2004), and combined molecular and morphological data (Chippindale et al. 2004) show that *Desmognathus* is nested within Plethodontinae (*Aneides* + *Ensatina* + *Plethodon* + supergenus *Desmognathus*, sensu Chippindale et al. 2004; Macey 2005 also included *Hydromantes* in this group). With the exception of the biphasic species of *Desmognathus*, all plethodontines are direct developers. At least two of the three direct-developing members of supergenus *Desmognathus* (*Phaeognathus hubrichti* and *D. wrighti*) appear to be basal to the remaining species; the third direct-developing species (*D. aeneus*) may be as well (Chippindale et al. 2004; Titus and Larson 1996; note that Mueller et al. 2004 and Macey 2005 did not include this species in their analyses). The data sets are not completely independent: Chippindale et al. (2004) included 1,473 mitochondrial characters in some of their analyses, overlapping with the 14,040 used by Mueller et al. (2004) and then reanalyzed by Macey (2005). However, it is noteworthy that none of the analyses support either a basal position for *Desmognathus* or monophyly of the former Plethodontini (*Plethodon*, *Ensatina*, and *Aneides*). Instead, the available data favor nesting of *Desmognathus* within an otherwise exclusively direct-developing clade of plethodontids.

4. Evolution of Direct-Developing *Desmognathus*: The Phylogeny Matters

In this section, Bruce discusses scenarios that might account for the evolution of direct development in genera *Phaeognathus* and *Desmognathus*. However, Bruce misses a key point. Given the overwhelming phylogenetic evidence that *Desmognathus* and

Phaeognathus are nested inside of plethodontines, any explanation for the evolution of direct development must also include *Plethodon*, *Aneides*, and *Ensatina* (and probably *Hydromantes* as well). Rather than making complex arguments to explain why direct development evolved convergently in these ecologically and morphologically diverse lineages, a simpler solution may be that this trait evolved in the common ancestor of all of these genera, and that there have been subsequent changes in body size, microhabitat specialization, and other traits among species sharing this developmental mode. This is what appears to have happened in the morphologically and ecologically diverse bolitoglossines, all of which are direct developers (Wake 1966). Thus, Bruce's comparison of miniaturization in the bolitoglossine genus *Thorius* to that in *Desmognathus aeneus* and *D. wrighti* merely highlights the repeated, extreme changes in body size in plethodontid lineages with direct development.

5. The Ecological Scenario: Out of the Frying Pan, into the Cool Mountain Stream

We speculated that competition with terrestrial plethodontids (likely *Plethodon*) drove the reinvasion of aquatic habitats and subsequent radiation of *Desmognathus* (note that in this section we refer only to members of the genus *Desmognathus*), whereas Bruce suggests that competition with aquatic salamanders may have led to repeated evolution of direct development. Our scenario is consistent with our likelihood-based analysis of divergence dates in plethodontids. Radiation of *Plethodon* in Appalachia appears to have predated or overlapped with the radiation of biphasic *Desmognathus*. Bruce counters with an "out of the frying pan, into the fire" argument, invoking possible competition with or predation by spelerpine (sensu Chippindale et al. 2004) plethodontids in Appalachian stream habitats. Spelerpinae is a subfamily corresponding to the tribe Hemidactyliini (Wake 1966), but excluding the phylogenetically distinct genus *Hemidactylium*.

Given that our hypothesis of competitive interactions was highly speculative, we do not have compelling evidence that competition with spelerpines may be less important to species of *Desmognathus* than competition with other plethodontines. However, some lines of evidence are suggestive of this idea. First, both spelerpines and *Desmognathus* seem to reach their maximum local species richness in streamside habitats (Petranka 1998), which is not the expected pattern if competition between them was substantial. Second, there is extensive microsympatry among many species of *Desmognathus* and spelerpines along streams in eastern North America (e.g., members of the *Eurycea bislineata* complex and *Gyrinophilus porphyriticus*), suggesting that these lineages can coexist without competitively excluding each other (Petranka 1998). In contrast, there is considerable evidence for competitive interactions among terrestrial plethodontines (e.g., Hairston 1996), and Hairston (1981) suggested that some stream-associated Appalachian plethodontids (including members of the genus *Desmognathus*) might escape competition for nesting sites with terrestrial *Plethodon* by breeding in or near aquatic habitats. Furthermore, recent evidence (Baldwin 2002, unpubl. data; Baldwin and Chippindale, unpubl. data) indicates that *Pseudotriton*, one of the spelerpine genera that is sympatric with *Desmognathus*, colonized the Appalachian highlands very recently, long after the radiation of biphasic *Desmognathus*.

6. Evolutionary Reversals and Breaking Dollo's Law: Crimes and Misdemeanors

Bruce rests much of his case on "Dollo's Law" (or "principle"), the assumption that complex characters, once lost, cannot re-evolve (or at least not in their original forms). However, there is abundant evidence that Dollo's Law has been broken repeatedly. One clear example is the re-evolution of teeth on the lower jaw of the hemiphractine treefrog *Gastrotheca guentheri* (Duellman and Trueb 1986). Other recent examples (while not without controversy) also show the loss and re-evolution of complex features, such as hind limbs in snakes (Tchernov et al. 2000), wings in stick insects (Whiting et al. 2003), and shell coiling in gastropod molluscs (Collin and Cipriani 2003). Given these challenges to the generality of Dollo's principle, we seriously question its applicability to plethodontid salamanders.

Recent advances in evolutionary developmental biology may explain why Dollo's Law may be broken so frequently. Numerous complex phenotypic traits appear to be controlled by regulatory or "master switch" genes (e.g., Carroll et al. 2001; Rogers et al. 2002; Wilkins 2001). These genetic control systems provide a potential mechanism by which expression of complex features may be turned off and then on again during development and over evolutionary time. Furthermore, based on analyses of mutation rates, Marshall et al. (1994) estimated that key genes controlling organismal structure and function can remain intact for millions of years, even if they are not expressed. It seems reasonable that gene reactivation or altered timing of regulatory gene expression could enable a return to a biphasic lifestyle in some plethodontids. We also question the extent to which invoking Dollo's Law is applicable in the case of *Desmognathus*, given that some larval traits may be expressed in the embryos of direct-developing plethodontids. For example, the embryonic hyobranchial apparatus of *Plethodon cinereus* retains key features associated with a larval lifestyle, albeit in a reduced form (Dent 1942). Thus, the reacquisition of the larval stage in *Desmognathus* may not require the re-evolution of all larval traits.

We agree with Bruce that more detailed study of development in plethodontids (using both embryological and molecular genetic approaches) would be valuable, given that most inferences about the morphology and development of embryos have been based on data from only a tiny fraction of the extant species, in the absence of a rigorous phylogenetic framework. However, we caution that the morphology of embryos and larvae may be subject to just as much homoplasy as the adult morphology, and may not be perfect indicators of the evolutionary history of traits or taxa (e.g., Wiens et al. 2005).

Bruce's Conclusions

Bruce concludes, in part, by stating that reconstruction of ancestral states on Macey's (2005) "total evidence" mitochondrial genome tree is consistent with a biphasic ancestral state for *Desmognathus*. However, we believe that his interpretation is in error with respect to simple parsimony. According to our calculations (using MacClade v. 4.02; Maddison and Maddison 2000), an ancestral *Desmognathus* with aquatic larvae requires a minimum of five steps on Macey's total-evidence tree (if all taxa are shown). If re-evolution of biphasic development within *Desmognathus* is allowed, then only three steps are required, mak-

ing this the more parsimonious hypothesis. We obtained an identical result using Macey's (2005) alternate, transversion-only parsimony tree. Furthermore, Mueller et al. (2004) and Macey (2005) examined only two of the three direct-developing species of *Desmognathus*, and excluded *D. aeneus*. This omission potentially biases their results against finding direct development to be ancestral within *Desmognathus*. Addition of *D. aeneus* to their analyses likely would require a sixth step for the ancestral *Desmognathus* to be biphasic, given the many other studies that indicate that this species is a basal member of the genus *Desmognathus* (e.g., Chippindale et al. 2004; Titus and Larson 1996). Thus, contrary to Bruce's conclusions, the most parsimonious explanation for the distribution of developmental modes in plethodontids requires a reversal to the aquatic larval stage in *Desmognathus* for all of the phylogenies discussed here.

Our Conclusions

Bruce (2005) has challenged our conclusions regarding the loss of direct development and re-acquisition of the larval stage in plethodontid salamanders. Specifically, he has raised doubts about (1) the phylogenetic placement of plethodontids within salamanders, (2) placement of the supergenus *Desmognathus* within plethodontids, (3) reconstruction of direct development as the ancestral state in *Desmognathus*, and (4) our ecological scenario for why this reversal has occurred. We have argued that the placements of plethodontids and the supergenus *Desmognathus* are very strongly supported by our analyses, and the contradictory morphological evidence mentioned by Bruce had already been taken into consideration. Furthermore, his argument against our ancestral reconstruction is based largely on a principle (Dollo's Law) that has been challenged both by new empirical evidence (e.g., Tchernov et al. 2000; Whiting et al. 2003) and a new understanding of the evolution and expression of regulatory genes (e.g., Carroll et al. 2001; Marshall et al. 1994). Our hypothesis that competitive interactions drove this evolutionary reversal is (admittedly) highly speculative, but no more so than the alternative hypothesis proposed by Bruce.

We conclude by posing the following question: what additional evidence would be required for Bruce to accept that there was re-acquisition of the larval stage in *Desmognathus*? Initially, we found this result hard to believe ourselves, and we even agree (in principle) that a few more independent origins of direct development might be more likely than a reversal. However, in the case of *Desmognathus*, the probability that repeated origins of direct development explains the phylogenetic pattern is extremely low. Given our maximum likelihood reconstructions on the tree based on combined nuclear DNA, mitochondrial DNA, and morphological data, multiple origins of direct development would have to be >77,000 times more likely than a single loss. We think that the available evidence points towards a loss of direct development and re-evolution of aquatic larvae as the more likely explanation. We invite Bruce (as one of the leading authorities on plethodontid life-history evolution) to identify what specific evidence could convince him of the veracity of our conclusion.

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Nomenclatural Notes on the Generic Nomen *Luperosaurus* Gray, 1845 (Squamata: Gekkonidae)

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Gray (1845) occupied the nomen *Lyperosaurus* (p. 145, and later, on p. 283, in the index) and subsequently *Luperosaurus* (p. 163) for a genus of Southeast Asian gekkonid lizards. The root 'Lyper,' Greek for 'difficult' or 'vexing,' is presumably for sharing characters of *Amydosaurus* Gray, 1845 (synonymous with *Lepidodactylus* Fitzinger, 1843 and *Ptychozoon* Kuhl and van Hasselt, 1822). The type species of the genus is *Luperosaurus cumingii* Gray, 1845, by monotypy. The content of *Luperosaurus* has been reviewed by Boulenger (1885), W. C. Brown and Alcala (1978), Russell (1979), and R. M. Brown and Diesmos (2000), and the latter nomen appears in checklists compiled by Kluge (1991, 1993, 2001), Rösler (2000), Welch (1994), Welch et al. (1990), and Wermuth (1966), but none of these reviews or lists give reference to the other original spelling (*Lyperosaurus*) of the generic nomen. In the most recent checklist of constituent species of the genus, Kluge (2001) recognized eight species within the genus, including *Luperosaurus browni* Russell, 1979 and *Luperosaurus yasumai* Ota, Sengoku, and Hikida, 1996, from the Sundas, *Luperosaurus iskandari* R. M. Brown et al., 2000, from Sulawesi, and *brooksii* Boulenger, 1920, *cumingii* Gray, 1845, *joloensis* Taylor, 1918, *macgregori* Stejneger, 1907 and *palawanensis* W. C. Brown and Alcala, 1978, from the Philippines (Brown and Alcala 1978).

Although the lack of citation of the nomen *Lyperosaurus* by Boulenger (1885:181), in the next monograph of the lizard collection of the British Museum (Natural History) can be interpreted that the name is a *lapsus calami*, argument against include its inclusion on p. 283 of the index of the work by Gray (1845), which notes its usage on p. 163 (where it is spelled *Luperosaurus*). The manuscript of the original work does not exist at The Natural History Museum, London, and Gray's annotated copy of the printed work (kindly examined by C. J. McCarthy at my request) has no corrections or remarks concerning these nomina.

Article 24.2.3 of the International Code of Zoological Nomenclature (International Commission of Zoological Nomenclature, 1999, hereafter, The Code) states that if more than a single original spelling for the same taxon exists, the first author to cite them together can select one spelling as correct (the First Reviser Principle), whereupon the other original spelling is incorrect and therefore unavailable. No such selection has ever been made. In accordance with Article 24.2.3 and Recommendation 24a of The Code, which states that the selection should be the one that "best serves stability and universality of nomenclature," I here select, as First Reviser, the nomen *Luperosaurus* Gray, 1845 as valid for the taxon, instead of *Lyperosaurus*. The spelling *Lyperosaurus*, with this action and in conformance with that article, has no nomenclatural status.

Acknowledgments.— I thank A. M. Bauer, P. David, C. J. McCarthy, R. Pethiyagoda, and H. M. Smith for comments.

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Herpetological Review, 2005, 36(2), 118–119.

Variation in and Natural History Notes on *Tropidophis fuscus* (Serpentes: Tropidophiidae) from Cuba

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The Cuban snake *Tropidophis fuscus* Hedges and Garrido, 1992 was described from two specimens from Minas Amores (Baracoa municipality) and Cruzata (Yateras municipality), both in Guantánamo Province, eastern Cuba (Hedges and Garrido 1992). Until now, this species has been included only in checklists (Powell et al. 1996; Estrada and Ruibal 1999; Fong and Navarro 2001) and in range extension notes (Fong 2000, 2002). Because of the rarity of this species, herein I report new data on the seven specimens included in those range extensions, all of which have been deposited in the herpetological collection of BIOECO in Santiago de Cuba (BSC.H) and "Carlos de la Torre" Natural History Museum in Holguín (MHNH). Data on localities, dates of collection, and collectors of these specimens have been published elsewhere (Fong 2000, 2002).

Specimens from El Toldo plateau, northeastern Cuba (Fong 2000), were collected by day, coiled under stones, where they were apparently inactive; one male (BSC.H 2026) was partially underground. This locality is a mixture of pine forest (*Pinus cubensis*) and broadleaf woods growing in a red lateritic soil, similar to the type locality (Hedges and Garrido 1992). The specimen from Sabana, Guantánamo Province (Fong 2002) was collected under a fallen tree trunk along the edge of a coffee plantation in a semideciduous woodland.

Two captive specimens underwent color changes similar to those observed in other species of the genus (Hedges et al. 1989; Rehák 1987). This was not observed in the type specimens, perhaps due to their brief time in captivity (Hedges and Garrido 1992). At night and with lights off, the two snakes were very light, almost gray, with very dark dorsal blotches. During the day or with lights on, the snakes had the dark coloration described for the type specimens (Hedges and Garrido 1992). When first captured, all individuals showed this dark pattern.

The new material of *T. fuscus* conforms well with the meristic and morphometric characteristics of the type specimens (Table 1), except that they expand the range of postocular scale numbers (from 3 to 2–4), subcaudal scale numbers (from 32 to 30–36), and dorsal rows of blotches (from 8 to 6–8, although only one specimen had six rows).

As in other species of *Tropidophis* (Schwartz and Marsh 1960), males of *T. fuscus* have one spur on each side of the vent. Females lack these spurs and tend to be larger than males. Except for MHNH w/n (original number AFG 369), the other two males have shorter snout-vent lengths than the two females (Table 1). The female holotype remains the largest known specimen. Males tend to have longer tails (14.5–17.8% of SVL) than females (11.2–11.6% of SVL), in contrast with the difference in SVL.

The female I collected was maintained in captivity and gave birth on 12 October 1996 to three neonates (BSC.H 750–752). The female weighed 7 g immediately after parturition, whereas the neonates weighed 0.75 g each. Measurements and counts of the young are given in Table 1. The only data about reproduction are those given by Hedges and Garrido (1992), who noted that the holotype (MNHNCU 2705) contained four or five well-developed young (they could not determine the exact number).

The neonates have a similar coloration pattern to that of the adults, except that the dorsal body blotches are surrounded by a few faint whitish scales (not present in adults), tail tips are bright yellow (no differently colored than body in adults), tops of the heads are brownish yellow (uniformly dark brown or black in

Table 1. Measurements (in mm), counts, and proportions of *Tropidophis fuscus*. Data for the holotype and paratype are from Hedges and Garrido (1992). All specimens with dorsal scales weakly keeled and parietal scales not in contact. F = female, M = male, J = juvenile, SVL = snout-vent length, TL = tail length, V = ventrals, S = subcaudals, SL = supralabials, IL = infralabials, P = preoculars, O = postoculars, DS = dorsal scales, DB = dorsal body blotches, LR = longitudinal rows at midbody, ED = eye diameter, HW = head width, NW = neck width.

	SVL	TL	V	S	SL	IL	P	O	DS	DB	LR	ED/HW	HW/NW
BSC.H 753 (F)	258	30	177	31	9	11	1:1	3:2	21-23-15	46	8	0.30	2.11
BSC.H 2026 (M)	223	36	169	36	10	11	1:1	3:3	24-23-17	48	6	0.26	1.80
MHNH w/n (M)	287	42	170	30	9	10	1:1	3:3	23-23-16	52	8	—	—
BSC.H 1730 (M)	247	44	181	34	10	11	1:1	3:4	23-23-18	52	8	0.32	1.99
BSC.H 751 (J)	110	11	175	30	10	10	1:1	2:3	22-23-15	—	—	—	—
BSC.H 752 (J)	113	8	178	32	10	10	1:1	3:3	23-23-17	—	—	—	—
MNHNCu 2705 (F)*	304	34	185	32	10	11	2:2	3:3	23-23-16	46	8	0.33	1.83
USNM 309777 (M)**	220	32	160	32	10	11	1:2	3:3	23-23-19	43	8	0.30	1.99

* Holotype, ** Paratype

adults), and two large white occipital spots fuse to form white collars, which are much more prominent and visible than those of adults. This pattern is similar to that seen in adult *T. pilsbryi*, suggesting affinities with that species. Schwartz and March (1960) recorded a radical ontogenetic change in the pattern of Bahamian *Tropidophis* (*canus, curtus, androsi,* and *barbouri*), from heavily spotted with dark blotches on a lighter ground color in juveniles to less prominent and faintly spotted in darker adults. A similar pattern apparently applies to *T. fuscus*.

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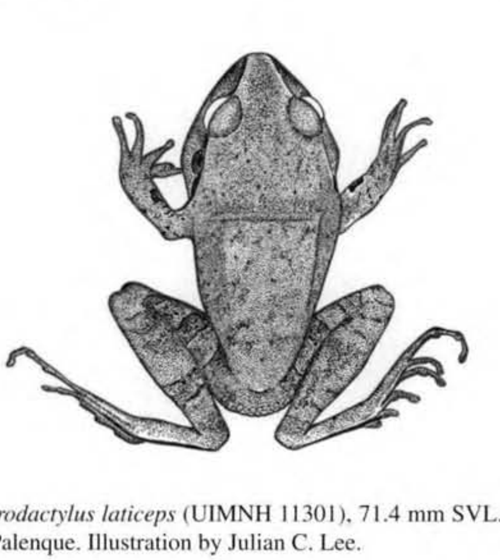

Eleutherodactylus laticeps (UIMNH 11301), 71.4 mm SVL. Mexico: Chiapas: Palenque. Illustration by Julian C. Lee.

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Common Names for the Frog Genus *Leptodactylus* (Amphibia, Anura, Leptodactylidae)

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Most species of the frog genus *Leptodactylus* lack common names. Common names are those names used by different human cultures and societies for the species of animals and plants where humans and biota reside together. Often times common names are lacking for Neotropical frogs or are broad in scope. For example, indigenous people may have a single name for frogs that occur on the ground and another name for frogs that occur in shrubs and trees, even though there are many species of ground frogs called by the same name as well as for the tree frogs. Sometimes colonists have used the same names as indigenous peoples, but often colonists use different names (usually imported from their own geographic origin), as they did not understand the indigenous word or words involved. Therefore, there may be different names used by humans for the same frogs at the same places—this is particularly true when more than one language or dialect is spoken in a given geographic area.

Why Use Common Names?

The simplest solution for what names to use for frogs would be for everyone to only use scientific names. In fact, this is the approach we have espoused and still recommend. However, it is clear that outside the systematic scientific community certain organizations only use or require common names for animals and plants; furthermore, they will continue to do so. For example, evaluation of the United States form 3-177 for importation of specimens into the US is based on common names, not scientific names, even though there is space for both kinds of names on the forms. Several ecotourism guidebooks only use common names. Many scientific journals only include common names in the titles of the articles. Common names are in use and will continue to be used.

Our purpose is to develop a standard set of common names (and their geographic synonyms) for the frog genus *Leptodactylus* for individuals who wish to use common names for *Leptodactylus* species.

Criteria for Evaluating Common Names

We find the literature on common names for *Leptodactylus*

species to be fragmentary, obscure, and/or inappropriate. For example, most of the names proposed by Frank and Ramus (1995) are inappropriate, inane, or both. As one example, they proposed Tropical Bullfrogs as the common name for the genus *Adenomera* and used Tropical Bullfrog in each of the common names for the recognized species in the genus. Members of the genus *Adenomera* are primarily tropical in distribution. However, none of the species is either large or has calls that sound like bulls (cattle). All but one species are less than 30 mm in snout–vent length; *Adenomera lutzi*, the largest species, only reaches 34 mm SVL. All species for which calls are known have different kinds of very short, high-pitched whistles.

The criteria we use for choosing the name to become the standard common name for each of the species of *Leptodactylus* are in priority order and are exclusive (that is if the first criterion can be used, it will be applied without consideration of the remaining criteria).

1. Any name that is in use and has been well established (i.e., most frequently used and appropriate) in publications. At times, the name that follows this criterion could be different than the name used locally.
2. The intent of the person who described the frog should be used, either explicitly or implicitly through use or translation of the scientific name.
3. Use of some distinctive aspect of the species including its distribution.

There are additional considerations for choosing among alternate names within the above criteria. These criteria are much more subjective and serve only as guidelines and can not be applied consistently.

- If a species occurs exclusively or primarily in Brazil, the Portuguese name is the name used to translate into English and Spanish. If the species occurs exclusively or primarily in Spanish-speaking countries, the Spanish name is the name used to translate into English and Portuguese.
- Common names should be distinguishable from all other common names at least in the Western Hemisphere and preferably worldwide. The proposed common name Chaco Frog for *Leptodactylus chaquensis* rather than Chaco Thin-toed Frog is preferred because the species involved has been called Rana Chaqueña in Argentina and will not be confused with any of the other species of frogs that occur in the Gran Chaco. On the other hand, the proposed name for the taxonomically unstable *Leptodactylus ocellatus* is Common Thin-toed Frog, rather than Common Frog, as the latter means the European *Rana temporaria* to many individuals.

How the List of Common Names Works

The list of common names is maintained on the web site http://learning.richmond.edu/Leptodactylus. Individuals are encouraged to participate in the process of determining the standard common names through sending comments and additions to us via the web site. We will use this information to update the site on a regular basis and acknowledge all individuals whose contributions are incorporated.

Each entry is headed by the scientific name. Only names currently recognized as valid are included. English, Portuguese, and Spanish names are listed for each species. If there is not a currently standardized common name in use, the title "Proposed (English, Portuguese, Spanish) name" is used. Once a consensus emerges, the word "proposed" will be dropped from the title.

As we have exercised our judgment on what common names should be considered as standard names for the first list, we also invite and welcome initial discussion on whether other names are more appropriate than those we have selected.

Each entry also has a list of other names that have been used in the literature or are used regionally for the species involved. We solicit additions to these entries as we have made no effort to extensively survey the literature for common names for *Leptodactylus* and are not aware of all names in local use.

When called for, comments are included for an entry.

The bibliographic citations are maintained in a separate file on the web site.

The Genus *Leptodactylus* as an Example

We find no published common name for *Leptodactylus* to be appropriate. Frank and Ramus (1995) used White-lipped Frogs as the common name for the genus. However, most species of *Leptodactylus* do not have white lips, making this name non-inclusive and misleading. Whistling Frogs is another name that has been used for the genus, but again, not all species of *Leptodactylus* have calls that sound like whistling. Fitzinger's name *Leptodactylus* is derived from the Greek words *leptos* (thin) and *daktylos* (finger or toe). This condition strictly applies to all but a few species of *Leptodactylus*. The few exceptions have small expanded disks at the tips of the toes, which are narrow or thin in comparison to most tree frog toes (e.g., Centrolenidae, Hylidae) or the expanded overall triangular disks found in most species of *Eleutherodactylus*. Therefore, we propose that the standard common name for the genus *Leptodactylus* should follow the second criterion and be known as Thin-toed Frogs.

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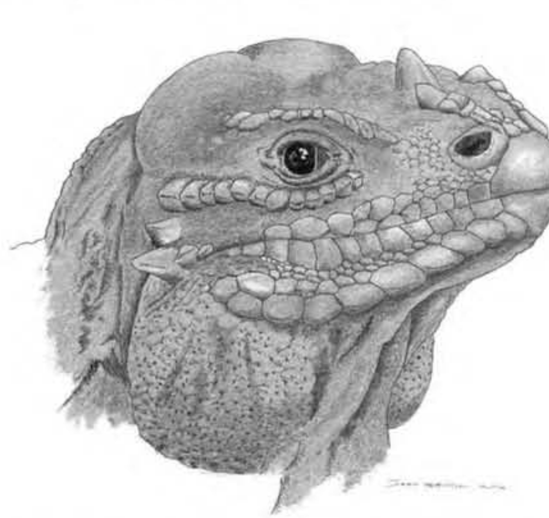

Cyclura cornuta stejnegeri (Mona Island Iguana). Adult female, wild but with radio collar, ca. 15 yrs old. Illustration by John Bendon (Lizardwizard@btinternet.com).

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Expansion and Natural History of a Successful Colonizing Gecko in Venezuela (Reptilia: Gekkonidae: *Hemidactylus mabouia*) and the Discovery of *H. frenatus* in Venezuela

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The family Gekkonidae is well known for having a number of highly effective colonizing species that have broadly expanded their distribution, invaded geographically distant places and have become human commensals, with or without deliberate human help (Lever 2003; Meshaka et al. 2004). Among the most accomplished invasive species are certain members of the genus *Hemidactylus*. This genus comprises around 80 recognized species (Bauer and Pauwels 2002), which are distributed throughout Africa, southern Europe, southern Asia, Polynesia, Oceania, and the Americas (Avila-Pires 1995; Lever 2003; Savage 2002). Although some of the nine New World taxa appear to be native to South America and the Caribbean (*H. agrius*, *H. haitianus*, *H. leightoni*, and *H. palaichthus*), the remainder (*H. brooki*, *H. frenatus*, *H. garnotii*, *H. turcicus*, and *H. mabouia*) are certainly present in the Americas due to accidental introductions from their native ranges in the Old World. Of these, the Tropical House Gecko, *H. mabouia* (Fig. 1–2) is the most broadly distributed, occurring in southeastern Florida, the West Indies, Trinidad and Tobago, the Gulf Coast of México (Veracruz), Honduras, and Panama (Köhler 2003; Powell et al. 1998). In South America, it ranges from Venezuela and the Guianas through coastal Brazil and into the Amazon basin in the latter country, Colombia, Ecuador, and Peru. It has also been recently reported in Argentina (Avila-Pires 1995; Federico and Cacivio 2000; Malhorta and Thorpe 1999; Powell et al. 1998; Rivas et al. 2001).

The known *Hemidactylus* fauna of Venezuela includes *H. palaichthus*, *H. leightoni*, and *H. mabouia* (Kluge 1969; La Marca 1997; Rivas et al. 2001; Rivas 2002; see Powell et al. 1996 and Rivas 2002 for remarks regarding the status of the taxa formerly regarded as subspecies of *H. brookii*). At present, the Tropical House Gecko (*H. mabouia*) is not only the sole introduced gecko recorded from Venezuela, but also the most common nocturnal lizard in many of the towns and cities in the northern portion of the country. The documentation of the expansion of *H. mabouia* is particularly important as this lizard has been shown to be an aggressive species (Zamprogno and Teixeira 1998) capable of displacing other geckos (Meshaka et al. 2004), and could very well cause the decline or even the disappearance of some native lizards, particularly other geckos. Until now, the distribution of *H. mabouia* in Venezuela has been limited to perianthropic situations, where it occurs with a wide variety of native species of lizards, including the geckos *Gonatodes albogularis*, *G. ceciliae*, *G. falconensis*, *G. vittatus*, two undescribed species of *Gonatodes*, *Hemidactylus palaichthus*, *Phyllodactylus rutteni*, *P. ventralis*, and *Thecadactylus rapicauda*. These taxa could be greatly affected by competition from the highly adaptable *H. mabouia*. We herein report a series of new localities for *H. mabouia* in northern Venezuela, documenting the expanding range of the taxon, and provide some data on the reproduction and habits of this gecko in the country, as well as some comments on the apparent impact this species has had on the populations of two other, native gecko species. We also document for the first time the occurrence in Venezuela of another introduced gecko, *Hemidactylus frenatus*.

In documenting the occurrence of introduced *Hemidactylus* in Venezuela, we have generally relied on voucher specimens (or occasionally voucher photographs) deposited in museums. Museum abbreviations used are as follows: EBRG – Museo de la Estación Biológica de Rancho Grande, Maracay, MBUCV – Museo de Biológia de la Universidad Central de Venezuela, Caracas, MCNC – Museo de Ciencias Naturales de Caracas, Caracas, MHNLS – Museo de Historia Natural La Salle, Caracas, and MBLUZ – Museo de Biologia de la Universidad del Zulia, Maracaibo. However, in certain cases, we have also accepted reliable sightings that have been verified by more than one source (Kaiser et al. 2002). Such records may be of particular importance, as common species, like *H. mabouia*, often are overlooked by scientists and, paradoxically, may not be collected because of their ubiquity and abundance. Therefore, such a species can be

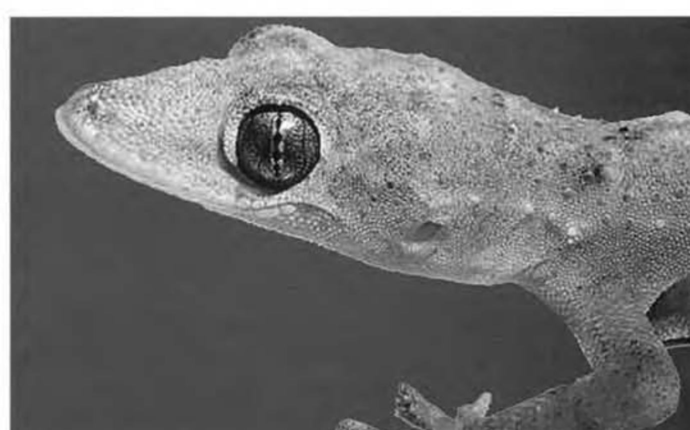

FIG. 1. *Hemidactylus mabouia*, adult female, MHNLS 15125. Specimen collected in a urban area of Porlamar, Margarita Island (photograph by Oswaldo Fuentes).

Table 1. Records of introduced *Hemidactylus* species in Venezuela.

Locality	Voucher	Reference
Hemidactylus mabouia		
Distrito Capital		
Caracas, 900 m	MBUCV 2156	Rivas 2001
Urb. Vista Alegre, 900 m	MHNLS 14188	Rivas 2001
Urb. Montalban, 900	MHNLS 11825	This paper
Anzoategui		
El Morro, Puerto La Cruz	Observed	This paper
Aragua		
Urb. Los Rauseos, El Limón, 520 m	EBRG 3722	This paper
Maracay, Facultad de Agronomía, UCV	EBRG 3889	This paper
Ocumare de La Costa	Observed	This paper
Carabobo		
Bahia de Patanemo, sector Los Caneyes	MHNLS 16678	This paper
Cojedes		
San Carlos, 148 m	Observed	This paper
Falcón		
Sanare, Municipio Silva, 40 m	EBRG 4209	This paper
La Vela de Coro	none	Mijares-Urrutia and Arends 2000
Lara		
Parque Zoologico Bararida, Barquisimeto	MHNLS 16318	This paper
Miranda		
Urbanización El Placer, Baruta	Observed	This paper
Los Naranjos-Guarenas	EBRG 3674	This paper
Nueva Esparta		
Porlamar, 10 m	MHNLS 15125	Rivas et al. 2001
Sucre		
La Viña, Carupano	MHNLS 13325, 28	This paper
Tunapuy	EBRG 960	Rivas and Oliveros 1997
Trujillo		
Urb. El Prado, municipio Pampanito	MHNLS 16682	This paper
Vargas		
Tanaguarenas, 10 m	MHNLS 1972	Rivas 2001
Yaracuy		
Marin, 120 m	EBRG 3200, 3214	This paper
Zulia		
Maracaibo	MBLUZ R-767	This paper
Hemidactylus frenatus		
Zulia		
La Universidad del Zulia, Maracaibo	MHNLS 16384-88	This paper
Sinamaica	MHNLS 15574, EBRG 3786	Rivas 2002

quite common in a locality for a long period without ever being reported, leaving considerable gaps in our knowledge of the expansion and total distribution of an exotic taxon.

Expansion in Venezuela—The known distribution of *H. mabouia* in Venezuela includes 13 states plus the Distrito Capital of Caracas and extends across almost all of the northern part of the country (Table 1). Despite this, only very recently has the extent of the species' distribution in the country been clarified and documented (Rivas et al. 2001). It was first reported from Venezuela by Burt and Burt (1931) and Parker (1936) from La Esmeralda and the upper Orinoco, respectively. These records (and Vanzolini's citation of them in 1968) actually represent *H. palaichthus,* a native species, which was not described until later (Vanzolini 1978). *Hemidactlyus mabouia* was next reported in northern Venezuela by Lancini (1962) from Isla de Patos, Sucre on the basis of a single, young individual. However this specimen (cited as MCNC 2330) is not present in the MCNC collection and the voucher number belongs to another species (L. F. Navarrete, pers. comm.). Years later, Donoso-Barros (1968) also reported this species for Venezuela, indicating localities in the state of Sucre, including one from Isla de Patos (based on Lancini's report). His records from Yacua, Puerto de Hierro, and Macuro were subsequently considered referable to *H. palaichthus* by Vanzolini (1978). We did not locate Donoso-Barros' vouchers, at least in any Venezuelan collections examined. Vanzolini (1978) mentioned some additional Venezuelan *Hemidactylus* records of undetermined specific identity, including one from the Andean slopes in Barinas. This record is almost certainly referable to *H. palaichthus*, which was subsequently verified for that region by Markezich (2002). However, another of his records, from the central coastal range (La Guaira, Vargas State), could very well be *H. mabouia*, whereas geckos from the eastern coastal range in the state of Sucre (Cumaná and

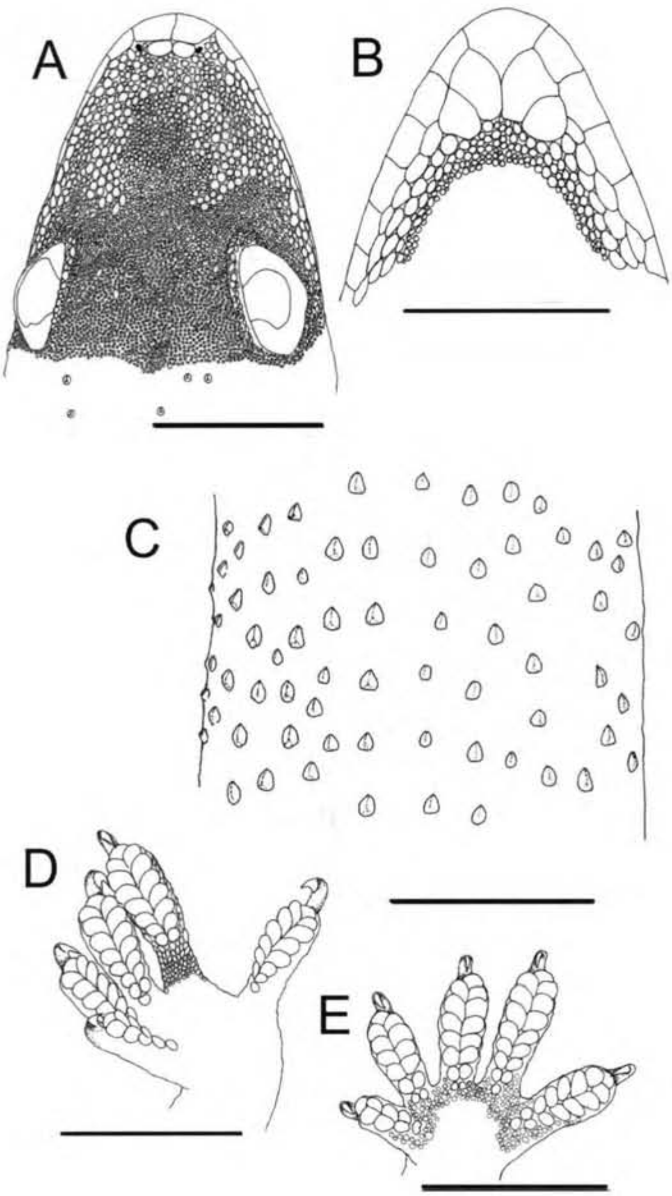

FIG. 2. *Hemidactylus mabouia*, MHNLS 15125. A, B: dorsal and ventral views of the head; C: tubercles on the back, approximately at mid-body; D: ventral view of the left foot (only fourth toe drawn in detail); E: ventral view of the left hand. Scale bars = 5 mm.

Cumanacoa) could be either *H. mabouia* or *H. palaichthus*, both of which are found in that state.

Rivas and Oliveros (1997) indicated the presence of *H. mabouia* for areas neighboring the city of Cumana, Sucre (Cerro Colorado and Cerro La Malagueña). However, their vouchers are actually misidentified individuals of *H. palaichthus,* as we suspect were those mentioned by Donoso-Barros (1968) and Oliveros et al. (2000). However, Rivas and Oliveros (1997) did correctly identify a specimen from Tunapuy, Sucre to *H. mabouia*, thereby providing the first reliable documentation of the species in Venezuela. Subsequently, Mijares-Urrutia and Arends (2000) reported the species from the northwestern portion of the country in Falcón State, and Rivas (2001) and Rivas et al. (2001) reported a few more verified localities. A record of this species exists for Guayacán, Peninsula de Araya, Sucre State (Cornejo and Prieto 2001), but we were unable to examine the single individual and therefore consider this record unverified.

Hemidactylus mabouia in Venezuela appears to have expanded from Caracas, where it has been present for at least ten years (Rivas 2001), both toward the east and the west. It has expanded throughout major cities and maritime ports in the country. So far, this gecko has only been found in perianthropic areas and does not appear to penetrate non-disturbed locations. Reasons for the failure of *H. mabouia* to proliferate away from edificarian situations in Venezuela are unknown, but the species appears to have the same problem expanding to undisturbed habitats throughout its range. To the present, *H. mabouia* has been recorded in Venezuela widely distributed among coastal cities and towns from Sucre to Zulia states (including Margarita Island). It is found on the central slopes of the Cordillera de La Costa, in the Cordillera del Interior, and in the mountainous system of the states of Lara and Falcón in the Andean foothills, but always in human habitations and below 1000 m asl (Fig. 3) (Rivas 2001; Rivas et al. 2001; this paper).

Natural History—In Venezuela, *Hemidactylus mabouia* is commonly found in buildings and houses at heights up to 10 m. At night, it is active on either external or internal walls, whereas during the day, it hides in wall crevices, holes, wall hangings, under roof tiles, or under other objects leaning against walls. Occasionally, it can also be observed at the base of palms or other trees, but always in or near to perianthropic areas. It is predominantly nocturnal; however, in El Placer, near Caracas, the second author observed several adults active during the morning hours on overcast days. Limited diurnal activity has also been observed in the introduced populations in Florida (Meshaka et al. 2004) and the Lesser Antiles (Malhotra and Thorpe 1999). Individuals are frequently observed in search of insects around artificial lighting. In Ocumare de la Costa, Aragua, as many as four individuals were seen by the second author around a single light engaging in strong antagonistic behavior. Opponents first slowly waved their tails and then quickly approached each other, biting each other on the neck or

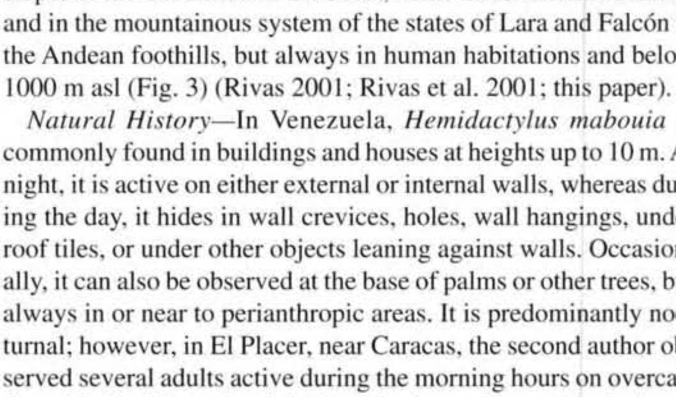

FIG. 3. Distribution of the introduced species of *Hemidactylus* (*H. frenatus* = asterisks, *H. mabouia* = solid dots) in Venezuela based on this study. Localities: 1) Sinamaica; 2) Maracaibo; 3) Urb. El Prado; 4) Barquisimeto; 5) La Vela de Coro; 6) Sanare; 7) Marín; 8) San Carlos; 9) Bahia de Patanemo; 10) Ocumare de la Costa; 11) El Limón-Maracay; 12) Tanaguarenas; 13) Distrito Capital records; 14) Urb. El Placer; 15) Los Naranjos-Guarenas; 16) El Morro, Puerto La Cruz; 17) Porlamar; 18) Tunapuy; 19) Carupano.

limbs, at times maintaining their grasp for more than a minute. Sometimes, a low, chirping sound was emitted by the bitten individual. When handled, some specimens produce a series of low, chirping sounds.

Hatchling and juvenile *H. mabouia* are strongly terrestrial when compared with adults. They are commonly found under rocks, rotten or fallen logs, piles of garbage, building materials, planks, and beneath the loose bark at the base of trees. Such sites conserve and radiate heat absorbed during the day (Howard et al. 2001) and may be thermally beneficial to young *H. mabouia*. Terrestrial retreats may also help juveniles to minimize the risk of predation by avoiding the climbing adults, which are known to be cannibalistic (Zamprogno and Texeira 1998), as well as other predatory lizards (Howard et al. 2001).

On 10 March 2001, the first and the fifth authors found five semi-spherical, calcareous eggs of *H. mabouia* inside tunnels dug by beetles in a rotten log in the areas surrounding the Instituto de Zoología Agrícola, Facultad de Agronomía de la Universidad Central de Venezuela, Maracay, estado Aragua (10°16'19"N, 67°36'34" W). The eggs, which measured 8.8–9.5 mm x 8.2–8.6 mm (N = 4), were incubated on parts of the log inside a clay vase. Two geckos hatched after 18 days at air temparatures of 27–32°C and were measured four days after eclosion (snout–vent length/tail length): 20.15 mm/19.02 mm (EBRG 3889); 19.52 mm/18.44 mm (released). These measurements are slightly smaller than those reported for African populations (Loveridge 1947), but similar to those from Colombia (Bock 1996), the West Indies (Malhotra and Thorpe 1999; Schwartz and Henderson 1991), and Florida (Meshaka et al. 2004). Communal egg sites have also been identified in buildings. On 15 October 2003, in the home of the first author (city of Caracas), 11 eggs and 30 empty shells of *H. mabouia* were found behind the cover of an electrical outlet. At least two females had been seen in that same area over the last four years.

Interspecific Interactions—The Tropical House Gecko has been introduced in areas with many species of native gekkonids in Venezuela. In the town of Ocumare de la Costa, Aragua, it is sympatric with *Gonatodes vittatus* and *Thecadactylus rapicauda*. The latter is a much larger, robust gecko, whereas the former is a smaller, diurnal sphaerodactyline gecko. The three species seem to be common in the area (at least when observed five years ago); however, all three taxa seemed to have well demarcated ecological niches. Adult *H. mabouia* were seen only on walls and other man-made structures, whereas *T. rapicauda* was mostly found in trees and on high roofs. In Ocumare de la Costa, Aragua, *T. rapicauda* appeared to be less common than *H. mabouia*, and competitive exclusion between these two species may occur. Competition between these two taxa was also suggested by Howard et al. (2001) on the West Indian island of Anguilla.

Many perianthropic situations in which *H. mabouia* is found in northern Venezuela are also occupied by *Gonatodes vittatus*. Although no quantitative data are available, the first two authors believe that *G. vittatus* has declined considerably in some areas of Caracas where it was very common several years ago, whereas the *H. mabouia* population has grown noticeably, indicating the possibility of predation of *G. vittatus* by *H. mabouia* or competition between the two species. The Tropical House Gecko is known to be cannibalistic (Zamprogno and Teixeira 1998), which could make it possible for this species to prey not only on their own young but on young or even adult individuals of the much smaller *G. vittatus*.

Hemidactylus frenatus—Rivas (2002) reported the first Venezuelan record of *Hemidactylus leightoni* based on material from Sinamaica, Zulia State (MHNLS 15574, EBRG 3786). A reevaluation of this material revealed that these specimens represent the Indo-Pacific House Gecko, *Hemidactylus frenatus*. Since its initial collection in 2000, this species has been found and observed to be common in urban areas throughout the northern half of the state of Zulia (Municipios Maracaibo, Mara, Paez, Almirante Padilla, among others; see Table 1). According to inhabitants of Maracaibo, this gecko has been present for at least 10 years, and local densities have increased dramatically during that time.

Venezuelan populations of *Hemidactylus frenatus* and their effects on native geckos are now being studied. Populations of native gekkonids, like *Gonatodes albogularis albogularis* and *Phyllodactylus ventralis*, apparently are declining in the presence of the invasive species. *Hemidactylus frenatus* also appears to be responsible for a decrease in cooccuring *H. mabouia*. Interestingly, in the Florida Keys, where both species occur, *H. mabouia* has proved to be the more successful, and populations of *H. frenatus* have diminished notably in the course of four years (Meshaka et al. 1994, 2004). The nature of the interactions between these two *Hemidactylus* are unknown, but *H. frenatus* has been known to competitively exclude a variety of other gecko species, chiefly parthenogenetic forms, in areas where it has been introduced (Bauer and Sadlier 2000; Petren and Case 1996; Petren et al. 1993), and in Veracruz, México it has been implicated in the displacement of *H. mabouia* (Powell et al. 1998).

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Predation on a Fanged Frog (*Limonectes kuhlii*) by a Freshwater Crab (*Candidiopotamon rathbuni*)

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Adult frogs are common prey for a great variety of predators, including mammals, birds, reptiles, fishes, insects, and spiders, because they are abundant at breeding sites, small in size, and have soft skin (Duellman and Trueb 1994). Freshwater crabs also seem to be important predators on small frogs (Duellman and Trueb 1994) because they often coexist in riparian environments. However, reports of the predation on frogs by crabs are scarce (Duellman and Trueb 1994; Murphy 1997), and there is little quantitative information on the interaction between frogs and predatory crabs.

Limonectes (*Rana*) *kuhlii*, one of the fanged frogs which are characterized by a suite of unusual sexually dimorphic traits (males have larger body, head, and fang sizes than females), is a common ranid small-sized frog, occurring widely throughout Southeast Asia (Emerson 2001; Inger 1966; Pope 1931). *Limonectes kuhlii* from Taiwan is found throughout the year in shallow, slowly flowing waters of small streams or creeks with overgrowing grass in mountain regions (Yang 1998). Although the frogs are capable of reproduction throughout most of the year (Yang 1998), breeding activity peaks in summer in subtropical northern Taiwan (unpubl. data). Both adult males and females of *L. kuhlii* frequently appear at breeding sites along creeks (Tsuji 2004; Tsuji and Lue 2000); therefore the frogs may be attractive prey for predators. However, there is no available information concerning predation on *L. kuhlii*. I here report predation by a freshwater crab (*Candidiopotamon rathbuni*) on *L. kuhlii* from Taiwan, based on field observations during a three-month period.

Study site.—This study was conducted at Hsingsien near Wulai (24°52'N, 121°33'E; 150 m elev.), ca. 25 km S of Taipei in northern Taiwan, Republic of China. The study site is a small creek below a forested cliff. This creek flows permanently, despite being only 30–50 cm wide and 0.5–2.0 cm deep. The creek bed consists of gravel and mud covered with fallen leaves, and it is mostly shaded by ferns. An 81-m long transect, marked every 1-m section, was laid out along this creek.

Methods.—Field observations were conducted along a study transect from 1900 h until 2400–0300 h each night, on 50 nights from 12 June to 31 August. Censuses, for identifying the position of individual frogs, were carried out along the study transect sev-

TABLE 1. Data on encounters between frogs (*Limnonectes kuhlii*) and predatory crab (*Candidiopotamon rathbuni*). All frogs were adults, except for F15. Parenthesis in "Status of frog" indicate the sex (F = female, M = male). SVL = snout–vent length. *Transect section with oviposition sites. See the text for the definition of "Behavior of crab."

Obs. no.	Date	Time	Section no.	Status of frog	ID no. of frogs (SVL, mm)	Behavior of crab	Remarks
1	6/28	01:25	13*	Pair	F3 (52.9), M?[a]	Approach	The crab approached the pair again at 01:40.
2	6/28	01:58	13*	Single	(F)F3	Capture	The crab seized the frog's leg.
3	7/1	22:34	33*	Pair	F8 (51.1), M2 (59.0	Approach	I moved the crab away from the pair.
4	7/2	00:55	7*	Pair	F1 (49.8), M12 (59.6)	Approach	
5	7/15	19:15	73*	Single	(M)M24 (57.4)	Attack	The crab attacked the frog twice in succession.
6	7/23	20:36	8*	Pair	F3, M25 (40.0)	Approach	
7	7/24	23:07	33*	Pair	F6 (57.9), M13 (59.6)	Approach	I moved the crab away from the pair.
8	7/25	22:39	3*	Single	(M)M2	Capture	The crab seized the frog's toe.
9	7/31	20:23	49	Single	(M)M8 (51.5)	Attack	
10	7/31	23:24	7*	Pair	F9 (50.0), M13	Approach	The crab approached the pair twice in succession.
11	8/14	20:50	75	Single	(F)F15[b] (48.0)	Capture	The crab was eating the frog's leg (see Fig. 1).

[a] ID no. of the male was unknown (apparently smaller than the amplectant female).

[b] The maturity of this female was unknown, because she never showed breeding behavior during the study period, although her SVL (48.0 mm) exceeded the minimum SVL (41.2 mm) of breeding females in this population (Tsuji and Lue 2000).

eral times each night. Observations were made using a 4.5-volt battery headlamp that did not seem to disturb the behavior of frogs and crabs.

In each encounter between frog(s) and crab, the time, the status of frog (single or amplectant pair), the identification number of the frog, its position along the transect (represented as section number), and the behaviors of frog and crab were recorded. The behaviors of crab were classified into three grades: "approach" (slowly walking toward a frog[s] at a distance of less than about 10 cm), "attack" (rushing at a frog[s] at a distance of less than about 5 cm), and "capture" (nipping a frog with a claw[s]). For several encounters in which an amplectant pair was targeted, I moved the crab away from the pair, in order to avoid disturbing the pair. When I found a frog captured by a crab, I released the frog from the crab after brief observation.

The body size (snout–vent length, SVL) of each frog was measured to the nearest 0.1 mm using slide calipers. The marking technique for permanent and temporary identifications and methods for checking the sex and sexual maturity of frogs are described elsewhere (Tsuji and Matsui 2002). Although I failed to measure the carapace width of *C. rathbuni* observed, it was about 4–5 cm.

Results.—A total of 11 encounters between *L. kuhlii* and *C. rathbuni* were observed during the 50 nights surveyed (Table 1). Frog-crab encounters occurred intensively in July (8 of 11 encounters; 72.7%). The number of encounters per survey night were 0.22 in June, 0.38 in July, and 0.05 in August (total = 0.22). Frog-crab encounters occurred in a wide range of the study transect (Table 1), but mostly in the sections with oviposition sites (81.8% of 11 encounters).

In 6 encounters (54.5% of 11), amplectant pairs were involved; in 4 pairs (66.7% of 6), the male was larger than the female (Table 1). Single males and females were involved three and two times, respectively. All targeted frogs were adult, except for female F15 (observation #11).

In the behavior of *C. rathbuni*, the frequencies of "approach," "attack," and "capture" were 6 times, 2 times, and 3 times, respectively (Table 1). When the frog(s) were approached or attacked by a crab, they jumped off, and the crab usually did not pursue them. In three encounters, however, the same frog(s) were targeted twice

FIG. 1. *Candidiopotamon rathbuni* eating the leg of a female *Limonectes kuhlii* (obs. no. 11 of Table 1).

during the same night (observations #1, #5, and #10).

I observed a crab capturing *L. kuhlii* 3 times (27.3% of 11 encounters), including 2 females and 1 male (Table 1). A female (F3) in observation #2 encountered a crab as amplectant pair (observation #1) at 0125 h and 0140 h, and she was observed being captured by her leg by a crab at 0158 h. A male (M2) in observation #8 was observed being captured his toe by a crab, emitting a distress call. A female (F15) in observation #11 was observed in the process of having her leg eaten by a crab (Fig. 1).

Snakes were observed 15 times at the study transect; they may have been predators of *L. kuhlii*. Fourteen of these observations involved the Red Banded Snake (*Dinodon rufozonatum*), and one snake could not be identified. However, I never observed a snake capturing a frog, or any type of frog-snake interactions.

Discussion.—These results suggest that crabs might be more important predators than snakes for *L. kuhlii*, because I observed crabs, but not snakes, attacking frogs. At present it is unknown whether the crabs kill the frogs in order to eat them, because I intervened and released the frogs captured by crabs in this study.

Predation by crabs on adult frogs may be common for small-sized frogs inhabiting the water's edge along small streams. A crab has been observed to be grasping the foreleg of *Colostethus ingunalis* in Panama, and many frogs of this genus that live along streams inhabited by crabs are missing limbs (Duellman and Trueb 1986). In Borneo, the frequency of the missing digits and limbs is significantly higher in *L. kuhlii* sitting closest to the water's edge than in any other species of frogs living along forest streams, presumably due to the predation by crabs (R. F. Inger, pers. comm.). Also in my study population, 4 (7.7%) of 52 adult frogs marked were missing a foot (unpubl. data).

The predation on adult *L. kuhlii* by *C. rathbuni* may be associated with the unique morphological features of this frog species. It may not be easy for a crab to capture an adult frog with its claw(s) because adult frogs usually exhibit good jumping performance. However, *L. kuhlii*, with its short hind legs, is not a strong jumper, even in adults. In addition, because the amplectant pairs (especially with the male being larger than the female) of *L. kuhlii* are more inactive (Tsuji and Lue 1998), they may be at greater risk of being attacked by crabs. Actually, in 6 (54.5%) of 11 frog-crab encounters, the amplectant pairs were targeted (Table 1); the pairs attacked by crabs accounted for 17.6% of the 34 pairs observed during the study period. Predation on amplectant pairs by crabs has been observed in *Physalaemus pustulosus* in Trinidad and Tobago (Murphy 1997).

The results of this study suggest several questions for the predator-prey interaction system of *L. kuhlii* and *C. rathbuni*: 1) what cues (visual, auditory, olfactory, or tactile) do *C. rathbuni* use for hunting *L. kuhlii*?; 2) what antipredatory mechanisms against the predatory crabs *L. kuhlii* have evolved?; and 3) how has the predatory behavior of *C. rathbuni* affected the life history and mating system of *L. kuhlii*? Because interactions between frogs and crabs are relatively easy to observe in the field, and because it should be possible to investigate experimentally crab-frog interactions in the laboratory, frogs and crabs might be ideal subjects for the study of predator-prey interaction.

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Lack of Parasitism on Diamondback Terrapins (*Malaclemys terrapin*)

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The Diamondback Terrapin (*Malaclemys terrapin*) is the only turtle in North America to spend its entire life in salt marshes. Diamondback Terrapins are found along the East Coast from Massachusetts to Florida and along the Gulf Coast of Florida to Texas. Seven subspecies of *M. terrapin* have been described: *M. t. terrapin* from Massachusetts to North Carolina; *M. t. centrata* from North Carolina to Florida; *M. t. tequestra* on the east coast of Florida; *M. t. rhizophorarum* in the Florida Keys; *M. t. macrospilota* from southern and western Florida; *M. t. pileata* in Mississippi; and *M. t. littoralis* in Louisiana and Texas (Ernst et al. 1994). In the early 1900s, *M. terrapin* was nearly hunted to extinction for food. Although it is still harvested today in some areas, the U. S. Fish and Wildlife Service has placed the Diamondback Terrapin on its Candidate Species List (Burger and Garber 1995). This designation calls for studies to determine whether or not *M. terrapin* is endangered or threatened. In recent years, a resurgence of turtle consumption (Garber 1990a; Orenstein 2001) combined with mortality due to crab traps (Garber 1990b), oil spills (Burger 1994),

Table 1. Distribution of sample populations, subspecies of *Malaclemys terrapin*, and samples.

Location	subspecies	Physical Exam	Fecal Flotation	Cloacal Flush	Blood Smear	Necropsy
Massachusetts (ca. 41.90°N, 70.03'W)	*terrapin*	45	2	45	45	
New Jersey (ca. 39.05°N, 74.80'W)	*terrapin*	21	13		14	2
North Carolina (ca. 34.71°N, 76.66'W)	*centrata*	16	6	13	14	
Florida (ca. 25.17°N, 81.10'W)	*macrospilota*		6			
Florida Keys (ca. 24.36°N, 81.28'W)	*rhizophorarum*	1		1	1	
Totals		83	27	59	74	2

automobiles (Wood and Herlands 1993; Orenstein 2001), predation (Feinberg and Burke 2003), and heavy metals (Burger 2002) have decimated various Diamondback Terrapin populations. Their future in some regions may be in jeopardy.

A thorough knowledge of the biology of a species is necessary if conservation efforts are to be successful. An important part of this knowledge is determining rates of parasitism. In one study to assess the health of captive raised and wild Diamondback Terrapins, parasitism was not obvious in over 300 individuals (Werner et al. 2002). An extensive review of the literature on parasitism in the Diamondback Terrapin uncovered only four species of endoparasites, the latest published in 1960 (Werner 2003). The parasites identified were: a monogene, *Neopolystoma orbiculare* (MacCallum 1918); two trematodes, *Telorchis corti* (Wharton 1940) and *Pleurogonius malaclemys* (Hunter 1961); and a nematode, *Camallanus microcephalus* (Leidy 1888). Ectoparasites, such as barnacles (*Balanus ebumeus, Balanus improvisus, Chelonibia manati, and Chelonibia testudinaria*) and oysters (*Crassostrea virginica*) have been reported but their status as true parasites remains controversial (Werner 2003). As a result of these findings, the present study was conducted to further elucidate the parasitic status of the Diamondback Terrapin.

Materials and Methods

From May 2002 to August 2002, Diamondback Terrapins were examined for evidence of parasites from the following areas: Beaufort, North Carolina; Big Sable Creek, Florida; Stone Harbor, New Jersey; Wellfleet (Cape Cod), Massachusetts. In addition, in January 2003, a single Diamondback Terrapin from Lois Key, Florida was examined. The methods utilized were:

Physical examination.—Each turtle was visually inspected for the presence of any external parasites. Oral cavities were examined for polystomes (such as those described by Leidy in his 1888 paper) with a speculum and binocular loupe or an otoscope. Cotton-tipped applicators were then used to swab the oral cavities. Swabs were placed in containers of Ringer's solution and later examined with a dissecting microscope at 15–20x.

Fecal examination.—A zinc sulfate solution (specific gravity 1.020) was used as a flotation medium. Fecal samples were suspended in this solution and centrifuged at 1000 RPM for 10 minutes. A drop of fluid from the surface was examined microscopically at 100x for a minimum of two minutes for protozoa and ova from trematodes, nematodes, and acanthocephalins.

Cloacal flush.—Cloacae were irrigated with 1.0 ml of Ringer's solution. The aspirate was centrifuged at 1000 RPM for 10 minutes. The sediment was drawn into a pipette, placed on a microscope slide, stained with a drop of Lugol's stain and examined at 100x (similar to the fecal examination).

Blood.—Blood was collected from the dorsal coccygeal vein and two blood smears were made immediately. Later, smears were stained with a commercial thiazine and eosin preparation and examined at 400x. At least 10 fields containing a minimum of 10 cells were searched on one of the two slides for hemogregarines or microfilaria.

Necropsy.—A thorough necropsy of all tissues was done on two turtles injured by vehicles. The two individuals were euthanized with an intraperitoneal injection of Beuthanasia-D, a pentobarbital sodium solution (Schering-Plough, Kenilworth, New Jersey). Since populations may be on the decline in many areas, it was deemed unjustifiable to sacrifice any healthy individuals for necropsy. Tissues were examined grossly, then with a dissecting microscope. The liver, lungs, and kidneys were macerated in a saline solution for examination while the digestive tract was sectioned, opened, and flushed. Both the lining and the flushed material were checked stereoscopically. The trachea and bladder were examined using a "squash" preparation between two microscope slides. The heart was flushed with saline and the resulting fluid was examined stereoscopically.

Results

Physical examinations were performed on 83 Diamondback Terrapins (Table 1). There was no evidence of parasites in any of the 83 oral cavities. The only sign of possible external parasitism was the observation of some small oyster shells (genus and spe-

cies not determined) on the carapace of one Cape Cod turtle. Blood smears collected from 74 terrapins were all negative for intracellular parasites and microfilaria (Table 1). None of 59 cloacal flushes were positive for parasitic ova. Four of the 27 fecal flotations were positive for parasitic ova but only one egg was found in each of the four positive samples. The eggs were tentatively identified by Thomas Nolan (School of Veterinary Medicine, University of Pennsylvania) as typical for an ascarid or a trematode. Two of the samples were from Stone Harbor, NJ, one was from Beaufort, NC, and one was from Big Sable Creek, FL. Several samples contained centric diatoms, which might be confused with parasite eggs.

The two necropsies did not reveal any parasites in the oral cavity, respiratory tract, heart, liver, gastrointestinal tract, or urinary tract.

Discussion

If the results of this study are combined with those of Werner (2002), it would appear that parasitism is rare or non-existent in the Diamondback Terrapin. No hemoparasites or filaria were identified in any of the blood smears from either study. Fecal samples and cloacal flushes from the present study yielded only a few possible parasitic ova. There was never more than one egg found in any of the positive samples. One would expect to find several eggs in a fecal sample from a parasitized animal. Because the Diamondback Terrapin is known to be a non-selective carnivore with a diet that can include crabs, periwinkles, mussels, snails, annelids, fish, and carrion (Ernst et al. 1994) it is possible that the few ova seen may have come from the terrapin's food sources rather than from the terrapin. The results for all of the geographic areas sampled were almost identical. Even though the sample sizes from any one area were not very large, it seems unlikely that every tested terrapin would be negative for parasites unless parasites were uncommon. Some authors suggest that virtually all wild reptiles have parasites (Lane and Mader 1996).

As with any negative data on rates of parasitism, there are a number of methodological reasons why parasites might have been missed, including: (1) parasites present but not shedding ova; (2) insufficient necropsies; and (3) sample collection at the wrong time of year. In addition, there are several biological reasons why *M. terrapin* may actually be parasite free, including: (4) natural resistance of the host; (5) lack of intermediate hosts to complete parasite life cycles; (6) ingestion of natural vermifuges. Further examination of other populations may eventually uncover parasites for *Malaclemys terrapin* but at the present time this turtle seems to be practically devoid of parasites.

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Condition and Immune Traits of Frogs from Ontario Baitshops: Risks of Practice not Ameliorated by Sale of Healthy Frogs

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A common practice in some of the Canadian provinces and many US states is the sale of live frogs and fish such as minnows, as well as leeches, earthworms and other organisms, for the recreational fishing industry. One such industry, the frog baitshop industry in Ontario, has recently come under scrutiny (Brousseau et al. 2003). Two main perceived risks of this industry include local overharvesting of frogs, and potential transmission of parasitic or pathogenic organisms to other populations (Brousseau et al. 2003). Given these risks, it is paramount to ensure both that benefits of the industry are large and that measures have ensured the sale of healthy frogs.

In this paper, our main objective is to determine whether Ontario baitshops are involved in the sale of healthy frogs, given the risks of this industry and small revenue generated. While the revenue generated by Ontario baitshops is estimated at $40–60 M yearly

by the Ontario Ministry of Natural Resources (OMNR), revenue from the sale of frogs is small: ca. $46,000 in 2002 (Brousseau et al. 2003). The main problem with stressful transport and housing of frogs is that this practice can result in die-offs of frogs in baitshops, making the net profit of the industry even smaller or putting further pressure on harvesting. Unhealthy frogs may also transmit bacterial infections to end users, and even results in the potential spread of disease to wild populations (a risk we entertain but do not address explicitly in this paper).

The risks perceived for the Ontario baitshop industry may be real. Commercial harvest has led to local population declines for other frog species elsewhere (reviewed by Blaustein et al. 1994). In 2001, the OMNR restricted capture and sale to only northern leopard frogs (*Rana pipiens*). There are, however, concerns about harvest of *R. pipiens*. This species is endangered in British Columbia, of special concern in the Prairie Provinces (Seburn and Seburn 1998) and potentially declining in southwestern Ontario (Hecnar 1997), and northern Ontario (Seburn and Seburn 2002). New regulations restrict the commercial harvest of frogs to eastern Ontario (Brousseau et al. 2003). Licensed dealers living outside the approved area can sell frogs, but the frogs must be harvested from inside the approved area. Abundance of *R. pipiens* at monitoring sites has suggested to some that the current restricted area can sustain a viable commercial *R. pipiens* harvest, whereas a region west of the harvest area cannot (Brousseau et al. 2003). Such population surveys may be of limited utility given that there is little information about normal population fluctuations for this species and other amphibians show marked short-term population fluctuations (Pechmann et al. 1991). There is also a question about the accuracy of records, e.g., annual returns from 2002 indicate that 27,000 more frogs were sold than were harvested (Brousseau et al. 2003). Such errors in assessing harvests can have strong implications for monitoring the impact of harvests on populations.

The risk of spread of parasites and pathogens from domestic or farmed animals back to natural populations of conspecifics or heterospecifics has been increasingly documented over the past decade (reviewed by Frölich et al. 2002; Mazzoni et al. 2003). Additionally, there has been a fear that such transmission back to the wild can occur from other practices. For example, increased susceptibility resulting from inbreeding, nutritional status, stress, or immunosuppression (all of which are often associated with high-density situations) may increase the efficiency of transmission to new hosts (Scott 1988). Thus, the risk of disease spread from baitshops may also be real, especially given the recent studies indicating ranaviral diseases in local areas in Ontario and current regulations about harvest areas, which encourage translocation of frogs (Brousseau et al. 2003).

Our main objective was to compare indices of health of juvenile *R. pipiens* captured and sold in baitshops to local frogs of the same age and size. If baitshops are typically not engaged in the sale of healthy frogs then revenues may not be increased much above current levels and may even be substantially reduced in some seasons due to die-offs in baitshops. Importantly, the loss of unhealthy frogs also could place more pressure on continued harvesting. It is likely that die-offs in baitshops, which have been observed (M.R. Forbes, pers. observ.), are episodic and thus not reported consistently. Further, frogs may be sold before they show outright symptoms of disease but can be assessed for general health (before being sold) using other metrics. As such, we were not addressing potential for disease spread to wild populations (although we believe this to be a risk) because such assessments would require more sophisticated approaches. Rather, we measured body mass, snout-to-vent lengths, leukocyte differentials (lymphocyte and neutrophile) and organ mass (spleen and liver) of juvenile *R. pipiens* as interrelated indices for assessing frog health.

We evaluated nutritional status using both body mass and liver mass, relative to body size. One of the primary roles of the liver is to store and process fats and proteins (Martini 1998). Individuals that are stressed, in ill health, or responding to an infectious disease also may have elevated leukocyte numbers (Bubenik and Brownlee 1987). Thus, we assessed amphibian leukocytes which consist mainly of neutrophils and lymphocytes, with eosinophils, basophils, and monocytes comprising the remainder of leukocyte cells. Neutrophils are phagocytic and mainly function in innate immune response, whereas lymphocytes function exclusively in acquired immune responses (Horton and Ratcliffe 1998). In most cases the increase in leukocyte numbers is caused by a rising number of neutrophils and lymphocytes in the peripheral blood (Rose et al. 1979). Conversely, individuals with lower lymphocyte numbers can be more susceptible to viral infections (Fitzgerald 1988; Siegel 1985). Examination of the spleen will help elucidate the frog's immune status. In amphibians, the spleen is a major peripheral lymphoid organ (Horton and Ratcliffe 1998), and splenomegaly has been shown in response to a naturally occurring infection in a frog species (Haynes et al. 1992).

Materials and Methods.—Eleven baitshops were chosen based on their close proximity to the Queens University Biological Station, Ontario, Canada (QUBS; 4534'N, 7613'W) where the wild-caught frogs were captured. Collection dates ranged between 30 July and 16 August 2000. In each baitshop, six juvenile frogs were selected by the baitshop owners for a total of 66 frogs from the 11 baitshops. Frogs were placed in a plastic bait bucket and then brought immediately back to QUBS. The maximum time any frog spent in transit was two hours, including frogs collected directly from the wild. Juvenile wild-caught frogs were collected in two fields that were situated next to ponds approximately ten kilometers west of QUBS. Collections were timed with baitshop visits to control for possible seasonal effects (two collection dates: 22 July and 13 August 2000).

Blood smears were made for baitshop and wild-caught frogs. In this procedure, 0.03 mL of blood was aseptically extracted via cardiac puncture, and spread on a new microscope slide using another new slide. The blood smear was air dried and placed into a slide storage container. Blood slides were sent to Vita-tech (Veterinary Laboratory Services in Markham, Ontario, Canada) for differential leukocyte analysis. For standard differential counts, 100 leukocytes were evaluated per smear and classified as neutrophils, lymphocytes, eosinophils, basophils, and monocytes. We excluded counts of eosinophils, basophils, and monocytes because counts of these cell types have been shown to have low repeatability (e.g., Pap 2002).

After withdrawing blood, frogs were placed separately in plastic containers and set in an ice bath for approximately one hour (or until their body temperature was lowered to). Frogs were removed from the ice bath, measured for snout-vent length (SVL), and double pithed. Each frog was dissected to determine its sex and its

liver, and spleen was removed. Wet mass for each organ was assessed with a Mettler AE 100 electronic balance scale accurate to 0.1 mg. Sex was determined by dissection.

Frogs with significantly higher SVL, microfilarial and protozoan parasites, and poor quality blood smears were excluded from subsequent analyses. The final dataset used in all analyses included 36 juvenile baitshop frogs (14 males and 22 females), and 36 juvenile wild-caught frogs (26 males and 10 females). All statistical analyses were performed using R (Ihaka and Gentleman 1996). Morphometric variables were natural-log transformed to meet the assumption of normality, and significance was assessed at P equals 0.05.

Results.—We did an analysis of co-variance (ANCOVA) to detect whether the relationships between SVL and body mass co-varied with treatment or sex nested within treatment. The interactions between SVL and treatment, and SVL and sex (nested within treatment) were non-significant and were dropped from the model. Body mass increased with SVL ($F = 739.82$, $P < 0.001$; Fig. 1A). Wild-caught frogs were heavier for their SVL than baitshop frogs ($F = 15.37$, $P < 0.001$; Fig. 1A). There was no significant difference between juvenile males and juvenile females in body mass ($F = 0.11$, $P = 0.89$).

We did an ANCOVA to detect whether the relationships between SVL and organ masses co-varied with treatment or sex (nested within treatment). Separate ANCOVAs were used for the spleen and liver. The interactions between SVL and treatment, and SVL and sex (nested within treatment), did not explain significant variation in organ masses. Both interaction terms were dropped from the models. Organ mass increased with SVL for the spleen ($F = 16.39$, $P < 0.001$; Fig. 1B), and liver ($F = 134.84$, $P < 0.001$; Fig. 1C).

Spleens from baitshop frogs were significantly larger than spleens from wild-caught frogs ($F = 6.09$, $P = 0.016$; Fig. 1B). In contrast, livers were significantly smaller in baitshop frogs compared to wild-caught frogs ($F = 18.53$, $P < 0.001$; Fig. 1C). There were no significant differences between juvenile males and juvenile females in mass of either of the organs (spleen: $F = 0.43$, $P = 0.65$; liver: $F = 0.062$, $P = 0.94$).

We tested whether the proportion of leukocytes that were lymphocytes or neutrophils was related to SVL, treatment, or sex (nested within treatment) using a logistic regression. We used quasibinomial errors because the data were overdispersed (McCullagh and Nelder 1989). Significance of the terms in the model was assessed with an F-test. Wild-caught frogs had a higher proportion of lymphocytes ($F = 11.52$, $P = 0.001$; Fig. 2). There was no relationship between SVL and lymphocyte proportion ($F = 0.13$, $P = 0.72$), and there was no difference between the sexes ($F = 1.18$, $P = 0.31$). Baitshop frogs had higher proportion of neutrophils ($F = 4.82$, $P = 0.03$; Fig. 2). There was no relationship between SVL and neutrophile proportion ($F = 0.32$, $P = 0.57$), and there was no difference between the sexes ($F = 0.81$, $P = 0.45$).

Discussion.—Our results suggest that juvenile baitshop *R. pipiens* frogs are not as healthy as juvenile wild-caught frogs. Baitshop frogs weighed less, and had lighter livers as compared to wild-caught frogs after correcting for body size. One of the primary roles of the liver is to store and process fats and proteins (Martini 1998). Because frogs are not fed in baitshops and can be housed for long periods (McRuer 2001), the natural metabolism

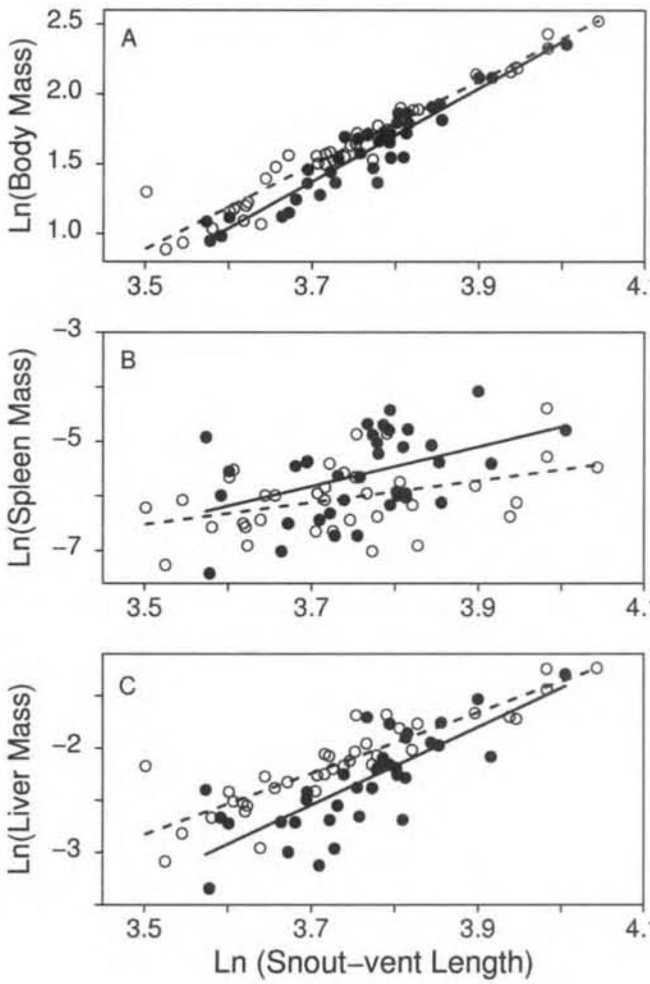

FIG. 1. Snout–vent length (mm) versus A) body mass (g), B) spleen mass (g), and C) liver mass (g) of juvenile *Rana pipiens* as found in baitshop (closed circles and solid line) versus wild-caught frogs (open circles and dashed line). All variables are natural-log transformed.

of the liver's stores of fat may account for its weight loss in baitshop frogs. Therefore, the relatively smaller livers and reduced body mass may be an indication of poor nutritional status in the baitshop frogs compared to their wild-caught counterparts.

In addition, relative spleen mass and leukocyte profiles were clearly different between the two groups of frogs. Baitshop frogs had heavier spleens (relative to body size) than wild-caught frogs. Splenomegaly has been shown in response to a naturally occurring infection in a frog species (Haynes et al. 1992). Baitshop frogs had a lower proportion of lymphocytes and a higher proportion of neutrophils compared to wild-caught frogs. The elevated neutrophil levels and diminished lymphocyte levels in the baitshop frogs are indicative of animals that are stressed, in ill health, or responding to an infectious disease (Bubenik and Brownlee 1987; Rose et al. 1979). For example, this same response has been shown in the newt *Notophthalmus viridscens* in response to a variety of stressors: hydrocortisone injection (Bennett et al. 1972), corticotrophin injection and osmotic stress (Bennett and Johnson 1973), continuous light (Bennett and Reap 1978), and constant high or low temperatures (Bennett and Daigle 1983).

The magnitude of the blood cell component changes we saw

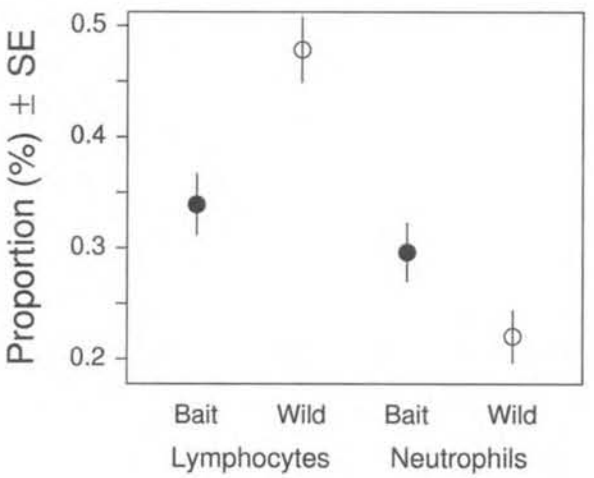

FIG. 2. Mean proportion (± SE) of leukocytes that are lymphocytes and neutrophils in juvenile *Rana pipiens* as found in baitshop (black) and wild-caught frogs (white). Proportions and SE are predicted values from a logistic regression with quasibinomial errors.

were consistent with amphibians given hydrocortisone injections (Bennett et al. 1972). The long-term consequences on the condition and viability of amphibians to changes of this magnitude are not known. Also, it is not known how long it would take to restore liver and spleen masses, and blood components back to 'normal' levels.

There are two main implications of baitshops housing and selling unhealthy frogs: local overharvesting of frogs, and potential transmission of parasitic or pathogenic organisms to other populations. Our data cannot identify if overharvesting of *R. pipiens* is occurring. Nonetheless, unhealthy baitshop frogs are likely to increase the number of episodic die-offs, which may lead to additional frog harvesting to replace these animals. Detailed data on the frequency of these die-offs and the number of 'replacement' frogs harvested would be required to identify if this is a real concern.

Our results also provide preliminary information about the potential for disease spread among baitshop frogs and from baitshop frogs to natural populations of conspecifics or heterospecifics. Baitshop frogs have lower lymphocyte proportions making them more susceptible to viral infections (Fitzgerald 1988; Siegel 1985). In addition, baitshop frogs have reduced nutritional status. A number of studies have shown that prolonged nutrient limitation can reduce immunocompetence (Apanius 1998). Our data do not identify the frequency and severity of disease transmission directly resulting from the use of frogs in the baitshop industry. We are able to show that baitshop frogs are not healthy and the risk of disease transmission is a valid concern that needs to be addressed. This is especially important given that current regulations encourage translocation of frogs (Brousseau et al. 2003).

It is evident that further research is needed to identify whether this (or any other) frog baitshop industry is sustainable. Certainly the risks need to be balanced against the benefits. Current data indicates that the frog baitshop industry in Ontario is not thriving and is engaged in the sale of unhealthy frogs. This increases the risk of die-offs and loss of profit to baitshop owners, and likely does not ameliorate the risk of disease transfers.

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West Africa, Madagascar, Central and South America: Main Origins of the CITES-listed Lizard Pet Market in France

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The increased availability of air transport around the world has greatly expanded the variety and numbers of wild species traded for use as pets (Roe et al. 2002). The European Union represents, along with the United States, one of the largest markets for the international pet trade. Reptiles especially have become very popular and wild populations have to sustain important off-takes to supply this market. According to Lawson (2002), nearly 210,000 live CITES-listed reptiles (excluding crocodilians and turtles/tortoises) and amphibians were legally imported into the EU in 1999, 30% of which were taken from the wild.

France is an important market for exotic reptile pets in Europe. For lizards and snakes (Squamata), the major European importers are Spain, Germany, the Netherlands, UK, Belgium, and France, respectively (Auliya and Berkhoudt, in prep.). The diversification in professional distribution channels for exotic pets in France (garden centers, do-it-yourself stores, franchise pet shops, agricultural self-service shops, etc.) illustrates the booming of this market and shows the confidence of French investors in this trade. Furthermore, it appears that local, regional and national commercial pet exhibitions have a great success and attract more and more people.

Recognizing the growing popularity of reptiles as pets in France, and the lack of data relative to French imports, TRAFFIC Europe-France sought to examine the imports in live CITES-listed reptiles —volumes, variety, dynamics, trends, and origins over a 10-year period, 1990–1999. This paper presents the main results for lizards.

Material and methods.—The main sources of data for the international wildlife trade estimations are the annual reports compiled by the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The data source consulted for this study was the annual CITES reports that are held in databases by the United Nations Environment Programme – World Conservation Monitoring Centre (UNEP – WCMC). The trade data presented in this study represent a compilation and analysis of the comparative tabulation UNEP-WCMC database. The analysis provides a detailed look at the data, and enables the comparison of reported exports with reported imports, by species, item (i.e., number of live animals), country of export/import, reported sources (e.g., wild, captive-bred, artificially propagated, etc.) and by purpose of trade (e.g., commercial, scientific, personal, etc.) (UNEP - WCMC 2003).

Often there are discrepancies between export and import figures in the comparative tabulation. On many occasions this was due to the item, the source, and/or the purpose of trade being reported differently by the importing and exporting countries.

- Item: if trade was reported differently by the importer and exporter the report used whichever figure was the greater, and if trade was reported only by one country the report kept the information to avoid underestimating the trade.
- Source and purpose: if trade was reported differently by the importer and by the exporter, the report used the exporter data, only using importer data if exporter data were unavailable.

Despite these limitations, these data still present a valuable and important source of information and provide a good indication on general trends in the trade.

Figures in this paper included just a part of the trade with the French dependent territories to which the Convention applies. This is because France usually does not specifically mention the name of its overseas departments, overseas territories, territorial communities or various islands in its annual reports (all transactions with dependent territories are usually mentioned as taking place with France instead of with French Guyana, Guadeloupe, Martinique, etc.). However, some information on trade in CITES-listed animals with French dependent territories is stored in the UNEP-WCMC CITES database, emanating only from the annual reports of the countries that were partners in the transactions. Furthermore, transactions with New Caledonia are specified as such since New Caledonia produces its own annual report independently from the annual report for France. These pieces of information with the French dependent territories are excluded from the analysis.

Overview of CITES-listed reptile trade.—According to the reported CITES trade data, 197,983 (96%) of the 206,563 live reptiles traded by France between 1990 and 1999 were imports. Furthermore, 90% of CITES-listed reptiles were imported into France for commercial purposes. Therefore, France can really be

considered as a consumer country of live CITES-listed reptiles, supplying a pet market.

Figure 1 shows that during the first half of the nineties, the number of CITES-listed reptiles imported was nearly constant (11,209 ± 1,925 specimens), whereas it shows a regular and drastic increase from 1994 to 1999 (+ 273%). The majority of imports concerned lizards (52%), which accounted for most of the increase in the total number of live reptiles, then snakes (27%), turtles and tortoises (20%), and crocodilians (1%).

Species of particular concern.– Iguanas, chameleons, geckos, agamids, and varanids were by far the most important CITES-listed lizard families imported and traded in French pet shops in the nineties, accounting for almost 99% of all recorded CITES-listed lizard trade from 1990 to 1999 (Table 1). The top five CITES-listed lizard species imported over this period were Green Iguana *Iguana iguana* (42,683 specimens, i.e. 41.1% of the total number of lizards imported between 1990 and 1999), Madagascar Day Gecko *Phelsuma madagascariensis* (5,921 specimens, 5.7%), Bell's Dabb Lizard *Uromastyx acanthinura* (5,202 specimens, 5.0%), Senegal Chameleon *Chamaeleo senegalensis* (5,123 specimens, 4.9%), and African Savanna Monitor *Varanus exanthematicus* (3,915 specimens, 3.7%).

Trends during the 1990s.– Evolution of imports: Table 2 shows the evolution of imports for the main CITES-listed lizard families in trade. The total number of specimens imported during the first half (1990–94) of the nineties was nearly constant (5,061 ± 860 specimens), whereas it shows a regular and drastic increase from 1994 to 1999 (+ 253%). Green iguanas accounted for a significant part of the increase in the total number of live lizards imported in the second half of the 1990s (apart from the decrease in 1996). Imports of chameleons, geckos, agamids and varanids also accounted for this increase but to a smaller extent.

Characteristics of the French market.– Figure 2 shows that the number of CITES-listed lizard species imported per year into France was quite stable (37,8 ± 4,6) and the number of new species appearing in trade was regular (5,1 ± 2,1). Furthermore, during the nineties, 62% of species were imported over a five year period or less, whereas only 16% were imported during a period of seven years or more. There are therefore some species that are imported on a regular basis to meet constant demand (e.g. *Iguana iguana, Phelsuma madagascariensis, Chamaeleo senegalensis, Varanus exanthematicus*), whilst other species are only in demand during a limited time period and appear only sporadically in the data depending on changing trends in purchaser demand (e.g., *Chamaeleo eisentrauti, Phelsuma cepediana, Phelsuma dubia, Bradypodion fischeri*).

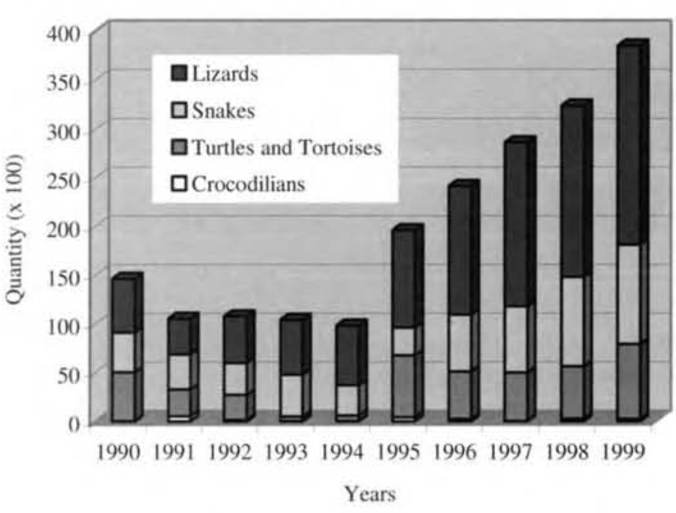

FIG. 1. Total number of live CITES-listed reptiles imported into France during the 1990s. Source: TRAFFIC analysis of UNEP-WCMC data, 2002.

TABLE 1. Taxonomic composition and quantity of CITES-listed lizard families imported into France (1990–1999). *Source*: TRAFFIC analysis of UNEP-WCMC data, 2002.

Taxon	No. Species Involved*	Quantity Imported
Agamidae		
Uromastyx spp.	5	9,699
Chamaeleonidae		
Bradypodion spp.	2	631
Calumma spp.	7	1,168
Chamaeleo spp.	18	13,808
Furcifer spp.	11	7,514
Cordylidae		
Cordylus spp.	5	570
Pseudocordylus sp.	1	5
Gekkonidae		
Phelsuma spp.	15	17,814
Iguanidae		
Iguana sp.	1	42,683
Scincidae		
Corucia sp.	1	52
Teiidae		
Dracaena sp.	1	6
Tupinambis spp.	3	176
Varanidae		
Varanus spp.	16	9,610
Xenosauridae		
Shinisaurus sp.	1	2
TOTAL	87	103,741

(*) Name of species when it is the sole representative of a genus: *Iguana iguana, Corucia zebrata, Dracaena guianensis, Pseudocordylus melanotus,* and *Shinisaurus crocodilurus.*

Origin of CITES-listed lizard species imported into France.– This trade targets only a few countries. A total of 40 countries have exported live CITES-listed lizards to France in the nineties, but twelve of them supplied nearly 90% of this trade. Figure 3 shows the main routes for this trade, according to the families concerned.

Green iguanas.– France has imported approximately 80% of specimens from the United States, 15% from Colombia and the remainder from Central and South American countries, appearing in the second half of the nineties: Nicaragua, Costa Rica, Bolivia and Chile. However, the United States is exclusively a re-exporting country because their specimens came from Colombia (52%), El Salvador (38%) or Suriname (10%). The vast majority of live CITES-listed Green iguanas imported for the French pet market were bred in captivity (86%), whilst other specimens were taken from the wild. For example 1,300 and 2,100 wild specimens were imported from Suriname respectively in 1998 and 1999.

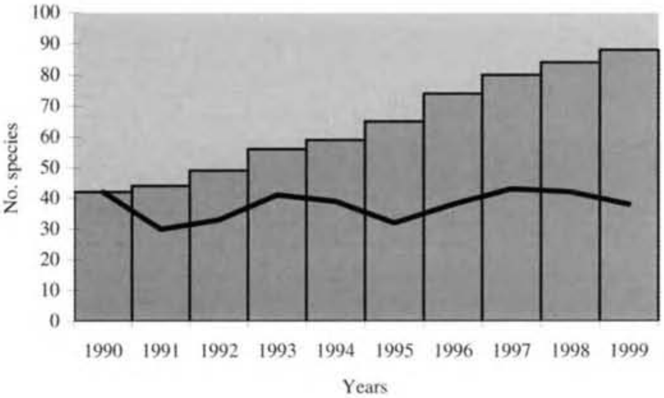

Fig. 2. Number of CITES-listed lizard species imported into France per year (line) and cumulative number of species imported (bars). Source: TRAFFIC analysis of UNEP-WCMC data, 2002.

Chameleons.– The status of chameleons within CITES has changed with the 12th meeting (Chile, 3–15 November 2002) of the Conference of the Parties to CITES. Indeed, all *Brookesia* species were included in Appendix II, except for *B. perarmata*, which was included in Appendix I (amendments to Appendices I and II of the Convention entered into force on 13 February 2003). The analysis for the present study covers the years 1990-1999, and therefore does not take *Brookesia* species into account. However, according to the Species Survival Network (2002), these species are in international trade, as Madagascar exported nearly 2,300 *Brookesia* specimens (excluding *B. perarmata*) in 2000 and 2001, mainly destined for pet markets in the United States and Europe. CITES-listed chameleons are principally imported from Madagascar (37%), Togo (20%), Burundi (14%), Tanzania (8%) and Benin (6%). Imports from Madagascar involved only specimens taken from the wild and concerned both the genera *Calumma* and *Furcifer*. *Calumma* exports from Madagascar stopped in 1995, whereas *Furcifer* exports (principally Carpet Chameleon *Furcifer lateralis* and Panther Chameleon *Furcifer pardalis*) increased in the second half of the nineties. Togo exported only two species: Senegal Chameleon *Chamaeleo senegalensis* (3,975 specimens) and Graceful Chameleon *Chamaeleo gracilis* (725). Specimens of Senegal Chameleon were exclusively taken from the wild and exports show an increase in exports during the second half of the nineties. Import of Graceful Chameleon began in 1996 and increased until 1999, with nearly 60% of specimens taken from the wild and 40% coming from ranching operations. In Togo, four farms raise reptiles for the export trade and are located in Lome (Toganim, Pajar, Fexas, and Mare). They share approximately 95% of the export quota between them while the other eight registered establishments share the remaining 5% of the quota (Harris 2002). Eighty percent of Burundi's exports (1990–1999) were realized in 1990, 1991, and 1992 and concerned only wild chameleons. From 1993 to 1999, Tanzania exported nine different species, exclusively taken from the wild, of which seven were from the genus *Chamaeleo* (*C. bitaeniatus, C. dilepis, C. fuelleborni, C. gracilis, C. jacksoni, C. melleri,* and *C. rudis*) and two from the genus *Bradypodion* (*B. fischeri* and *B. tavetanum*). Chameleon imports from Benin involved exclusively two species—Graceful Chameleon and Senegal Chameleon. From 1993 to 1995 Senegal Chameleons imported from Benin were taken from the wild, but since 1996 they have been derived from ranching operations. Graceful Chameleon imports began in 1996 and involved exclusively specimens from ranching operations.

Geckos.—During the 1990s, CITES-listed geckos were exclusively imported from Madagascar and taken from the wild. Figure 4 shows that in the first half of the nineties, France imported 15 gecko species whereas in the second half, imports focused on four species with a significant increase in their imports: the Gold-dust Day Gecko *Phelsuma laticauda* (+ 95%), the Madagascar Day Gecko *P. madagascariensis* (+ 82%), the Peacock Day Gecko *P. quadriocellata* (+ 83%), and the Lined Day Gecko *P. lineata* (+ 74%).

Agamids.—Ninety per cent of the CITES-listed agamids (*Uromastyx* spp.) were imported from Mali and involved only two species taken from the wild: Bell's Dabb Lizard *U. acanthinura* and *U. dispar*. Imports began in 1995 (1,000 specimens), increased in 1996 (4,866) then decreased until 1999 (no imports). Other agamids (10%) were occasionally imported from Egypt and Sudan: the Egyptian Dabb Lizard *U. aegyptia* and the Eyed Dabb Lizard

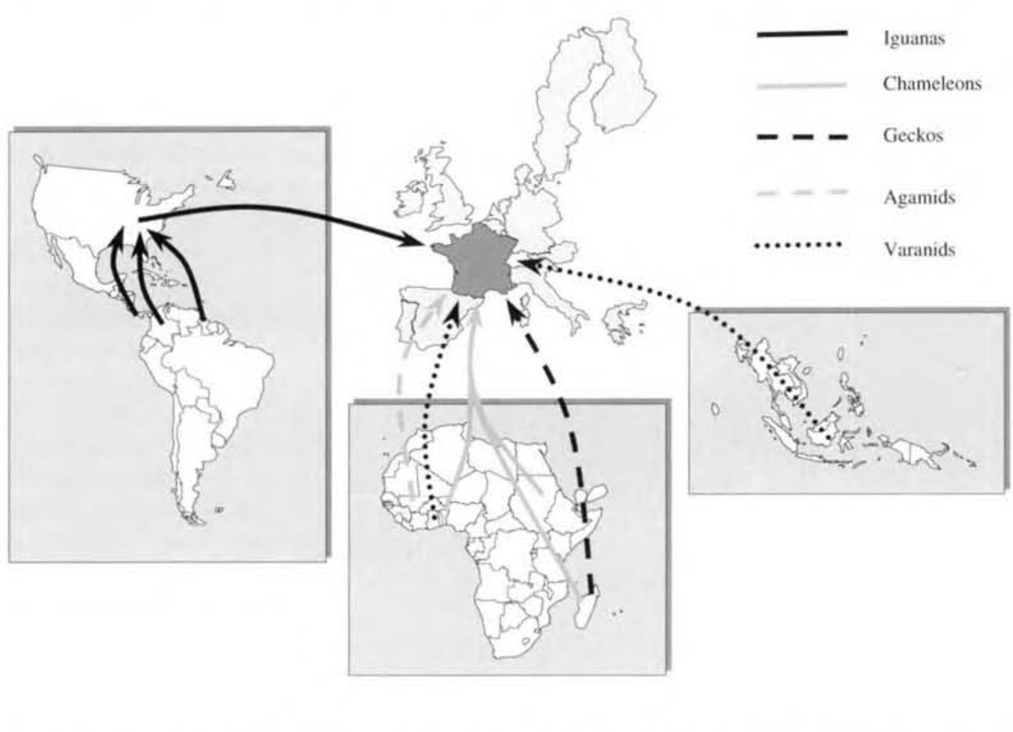

Fig. 3. Main routes for French CITES-listed lizard imports (1990–99). Source: TRAFFIC analysis of UNEP-WCMC data, 2002.

TABLE 2. Evolution of the French imports for the main CITES-listed lizard families (1990–1999). *Source:* TRAFFIC analysis of UNEP-WCMC data, 2002.

Family	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total
Iguanidae	1,012	50	1,095	2,100	1,801	5,351	2,754	6,163	8,353	14,004	42,683
Chamaeleonidae	1,939	1,630	1,946	1,595	1,441	1,003	1,576	3,272	4,272	4,447	23,121
Gekkonidae	1,538	1,376	1,274	1,590	1,647	1,348	2,215	4,050	2,280	496	17,814
Agamidae	15	100	0	0	150	1,276	5,316	1,875	967	0	9,699
Varanidae	980	515	478	311	721	947	1,342	1,247	1,663	1,406	9,610
TOTAL	5,484	3,671	4,793	5,596	5,760	9,925	13,203	16,607	17,535	20,353	102,927

U. ocellata.

Varanids.—Although 14 countries supplied the trade in varanids between 1990 and 1999, the majority of varanids were imported from Togo (47%), Ghana (16%), Benin (13%) and Indonesia (13%). Togo, Ghana, and Benin have exported both species present in their country: the Savannah Monitor *Varanus exanthematicus* and the Nile Monitor *V. niloticus* [note that *V. niloticus* is in fact composed of two species, one restricted to open savannas, the true *V. niloticus*, and another restricted to more closed forested areas, *V. ornatus* (Böhme and Ziegler 1997); both species are generally referred to as *V. niloticus* in CITES permits]. Table 3 shows that total imports of Savannah Monitor and Nile Monitor from these countries decreased between 1990 and 1992 then increased regularly until 1998/99. Imports from Togo, the main supplier, showed a sharp increase in the second half of the nineties, whereas imports from Ghana were more uneven (only six years of imports during the nineties) and imports from Benin showed a significant decrease in 1998 and 1999. From 1990 to 1994, specimens of both taxa were exclusively taken from the wild in those countries but since 1995 Togo and Benin have developed ranching operations. Therefore, since 1995, 41% and 88% of specimens imported from Togo and Benin respectively, issued from ranching operations. Varanid specimens imported from Indonesia were nearly four times more numerous from 1995 to 1999 (1,007 specimens) than from 1990 to 1994 (249). There are two reasons for this increase: five species (*V. dumerilii*, *V. indicus*, *V. rudicollis*, *V. salvadorii*, and *V. salvator*) which were occasionally imported from 1990 to 1994, were imported regularly and in larger numbers from 1995 to 1999. Furthermore, six additional Australasian species appeared in trade between 1995 and 1999 (*V. bogerti, doreanus, jobiensis, panoptes, prasinus,* and *timorensis*).

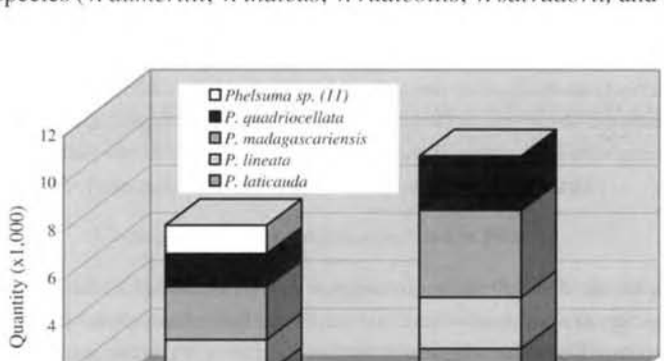

FIG. 4. Number and composition of CITES-listed geckos imported from Madagascar to France (1990–1999). Source: TRAFFIC analysis of UNEP-WCMC data, 2002.

Conclusions and discussion.—Hoover (1998) has shown that the international trade in live reptiles has grown dramatically in the last decade. Our data show that France followed this trend, but with a time delay, as French imports have only grown dramatically in the second half of the nineties. Our focus in the French trade CITES-listed lizards shows that:

Green iguanas, chameleons, geckos, agamids, and varanids were by far the most important CITES-listed lizard families imported and traded in French pet shops in the nineties, accounting for almost 99% of all recorded CITES-listed lizard trade between 1990 and 1999.

Green Iguanas *Iguana iguana* made up more than 40% of total French imports of CITES-listed lizards in the nineties. However, there are other species found in trade in substantial numbers, including Madagascar Day Gecko (*Phelsuma madagascariensis*), Bell's Dabb Lizard (*Uromastyx acanthinura*), Senegal Chameleon (*Chamaeleo senegalensis*), and African Savanna Monitor (*Varanus exanthematicus*).

Imports of iguanas first, then imports of chameleons, geckos, agamids, and varanids accounted for the dramatic increase in the total number of lizards imported between 1994 and 1999. Some species were imported on a regular basis to meet a constant demand (see previous section), while other species were in demand for a limited period and appeared only sporadically in the data depending on changing trends in purchaser demand (e.g., *Chamaeleo eisentrauti, Phelsuma cepediana, Phelsuma dubia, Bradypodion fischeri*).

West Africa, Madagascar, Central, and South America were the main regions supplying the CITES-listed lizard trade in France. Agamids, varanids, and a fraction of the chameleons were principally imported from West African French-speaking countries (Togo, Benin, Mali) and from Ghana, a West African English-speaking country. Another part of the chameleons (genera *Calumma* and *Furcifer*) and all CITES-geckos were imported from Madagascar. Iguanas originated from Central and South America (Colombia, Nicaragua, El Salvador), even if the United States played a significant role as a re-exporter. A reason why the United States plays a significant role in this trade is because of its relationship. For example, the single largest iguana producer in El

TABLE 3. The most important suppliers of the two main varanid species imported into France (1990-1999). *Source:* TRAFFIC analysis of UNEP-WCMC data, 2002.

Country of Origin/Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total
Togo											
V. exanthematicus	25	0	0	0	105	350	400	250	360	390	1,880
V. niloticus	292	280	45	0	180	330	255	215	440	560	2,597
Subtotal	317	280	45	0	285	680	655	465	800	950	4,477
Ghana											
V. exanthematicus	445	210	85	0	0	0	0	30	550	200	1,520
V. niloticus	0	0	0	0	0	0	0	0	0	0	0
Subtotal	445	210	85	0	0	0	0	30	550	200	1,520
Benin											
V. exanthematicus	0	0	90	0	50	50	0	100	0	20	310
V. niloticus	0	0	20	210	105	50	150	400	20	20	975
Subtotal	0	0	110	210	155	100	150	500	20	40	1,285
TOTAL	762	490	240	210	440	780	805	995	1,370	1,190	7,282

Salvador (and probably in the world) is an American-owned and operated business. The owner sends most of his iguanas to the United States, at least in part because he has a similar business in the U.S. and because he has long-standing relationships with several other reptile dealers in the United States (Hoover, pers. comm. 2002).

This paper shows that, since 1995, most CITES-listed lizards imported into France were bred in captivity or issued from so-called "ranching operations." The main reason is that the great majority of Green Iguanas (which account for nearly 40% of the total CITES-listed lizard imports to France) were bred in captivity. Captive breeding and ranching of reptiles may reduce overexploitation of some species in the wild. However, many of the captive breeding, farming and ranching operations that supply the global reptile market need wild-harvested animals to maintain their breeding stocks. Furthermore, the percentage of specimens taken from the wild is significantly higher for other groups of lizards imported for the French pet market: agamids (100%), geckos (91%), chameleons (77%), and varanids (64%).

Therefore, with the growing demand for CITES-listed live lizards as pets and the significant proportion of wild-caught specimens, it seems necessary to increase the monitoring of international trade and to encourage taxonomic studies. According to a Nomenclature Committee report prepared for the twelfth meeting of the Conference of the Parties, no standard references have been adopted yet for the frequently traded lizards of the genera *Phelsuma* and *Uromastyx* and several new species have recently been described in both genera. Therefore, the Nomenclature Committee proposed a budget of USD 18,000 for the period Cop12 and Cop13 to cover expenditures related to its activities concerning the nomenclature of the genera *Phelsuma* and *Uromastyx*.

Our data only concern CITES-listed lizards, but most of the imported lizard species are not listed on CITES appendices. Our lack of data concerning those species is a great problem because most of them are taken in the wild and we have no idea of pressure levels on their populations. There is (we hope only for the moment) no way to obtain such data! Some species of particular concern include several geckos (*Geckonia chazaliae*, *Hemitheconyx caudicinctus*, *Teratolepis* spp.), agamids (*Acanthosaura* spp., *Leiolepis* spp., *Physignathus* spp.), and iguanids (*Basiliscus* spp.).

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SPECIES SURVIVAL NETWORK, 2002. Analysis of proposals from Madagascar to be discussed at the 12th COP to CITES. Document prepared for the 12th COP to CITES and available from: www.speciessurvivalnetwork.org/documents/SSNanalysisMadagascarproposals.pdf.

UNEP-WCMC. A guide to interpreting outputs from the UNEP-WCMC CITES database. Version 5.0. United Nations Environment Programme - World Conservation Monitoring Centre, Cambridge, UK.

WIJNSTEKERS, W. 2001. The evolution of CITES: A reference to the Convention on International Trade in Endangered Species Of Wild Fauna and Flora. 6th edition. CITES Secretariat. Switzerland. 492 pp.

March 2004 at 1120 h, another *T. strigatus* (MCNR 988, 219 mm SVL) was captured on the edge of the same stream within 60 cm of two calling male *Crossodactylus* cf. *bokermanni* (SVL 23.8 and 22.0 mm). *Thamnodynastes* are primarily nocturnal, as are the majority of anurans that comprise their diet (Bernarde et al., *op. cit.*; Marques et al. 2001. Serpentes da Mata Atlântica. Guia Ilustrado para a Serra do Mar, Ribeirão Preto. Holos. 184 pp; Rufatto et al., *op. cit*). This is the first record *T. strigatus* preying on a diurnal anuran.

Submitted by **KATIA KOPP** (e-mail: kakopp@hotmail.com) and **MILENA WACHLEVSKI** (e-mail: milenawm@yahoo.com), Laboratório de Ecologia Evolutiva de Anfíbios e Répteis, Programa de Pós Graduação em Zoologia de Vertebrados, Pontifícia Universidade Católica de Minas Gerais, 30535-610, Belo Horizonte, Minas Gerais, Brazil.

TRIMERESURUS ALBOLABRIS (White-lipped Pitviper). **RESTING SITE**. Although *Trimeresurus albolabris* is occasionally found hunting on the ground at night, most accounts report that it is predominantly arboreal (Cox 1991. The Snakes of Thailand and their Husbandry. Krieger Publishing Company, Malabar. 526 pp.; Cox et al. 1998. A Photographic Guide to Snakes and other Reptiles of Thailand and Southeast Asia. Asia Books, Bangkok. 144 pp.; Das 2002. A Photographic Guide to Snakes and other Reptiles of India. New Holland Publishers, London. 144 pp.). Our own encounters have been primarily with individuals in trees and bushes, although several individuals were encountered moving on the ground at night (CAS 210108, 210665, 210690, 210691). Cox et al. (*op. cit.*) mention that during the day *T. albolabris* is typically found at rest in vegetation. On 13 April 2002 at 1609 h, one of us (HW) unearthed a male *T. albolabris* (625 mm SVL, 85 g; CAS 224646) near Nagmung Town, Kachin State, Myanmar (27°30'36.5"N, 97°49'50.4"E, WGS 84) at 613 m elev. The snake was inactive ca. 25 cm below ground level inside a termite mound located near a trail in an agricultural area in the midst of subtropical evergreen forest. This is the first record of any *Trimeresurus* using a termite mound as a retreat. We thank U Khin Maung Zaw, Alan Leviton, Jens Vindum, and the National Science Foundation (DEB-9971861).

Submitted by **GUINEVERE O. U. WOGAN**, Department of Herpetology, California Academy of Sciences, Golden Gate Park, San Francisco, California, USA 94118 (e-mail: gwogan@calacademy.org), and **HTUN WIN**, Nature and Wildlife Conservation Division, Forest Department, Ministry of Forestry, Bayintnaung Road, West Gyogone, Insein, Yangon, Myanmar.

GEOGRAPHIC DISTRIBUTION

Herpetological Review publishes brief notices of new geographic distribution records in order to make them available to the herpetological community in published form. Geographic distribution records are important to biologists in that they allow for a more precise determination of a species' range, and thereby permit a more significant interpretation of its biology.

These geographic distribution records will be accepted in a **standard format** only, and all authors *must* adhere to that format, as follows: SCIENTIFIC NAME, COMMON NAME (for the United States and Canada as it appears in Crother 2000. *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding*. SSAR Herpetol. Circ. 29:1–82, available online at <http://herplit.com/SSAR/circulars/HC29/Crother.html>; for Mexico as it appears in Liner 1994, *Scientific and Common Names for the Amphibians and Reptiles of Mexico in English and Spanish*. Herpetol. Circ. 23:1–113), LOCALITY (use metric for distances and give precise locality data), DATE (day-month-year), COLLECTOR, VERIFIED BY (*cannot* be verified by an author—curator at an institutional collection is preferred), PLACE OF DEPOSITION (where applicable, use standardized collection designations as they appear in Leviton et al. 1985. *Standard Symbolic Codes for Institutional Resource Collections in Herpetology and Ichthyology*, Copeia 1985[3]:802–832) and CATALOG NUMBER (required), COMMENTS (brief), CITATIONS (brief), SUBMITTED BY (give name and address in full—spell out state or province names—no abbreviations).

Some further comments. This geographic distribution section does not publish "observation" records. Records submitted should be based on preserved specimens which have been placed in a university or museum collection (private collection depository records are discouraged; institutional collection records will receive precedence in case of conflict). A good quality color slide or photograph may substitute for a preserved specimen *only* when the live specimen could not be collected for the following reasons: it was a protected species, it was found in a protected area, or the logistics of preservation were prohibitive (such as large turtles or crocodilians). Color slides and photographs *must* be deposited in a university or museum collection along with complete locality data, and the color slide catalog number(s) must be included in the same manner as a preserved record. Before you submit a manuscript to us, check Censky (1988, *Index to Geographic Distribution Records in Herpetological Review: 1967–1986*; available from the SSAR Publications Secretary) to make sure you are not duplicating a previously published record. The responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extensions unless a thorough literature review has been completed.

Please submit any geographic distribution records in the **standard format only** to one of the Section Co-editors: **Alan M. Richmond** (USA & Canadian records only); **Jerry D. Johnson** (Mexico and Central America, including the Caribbean islands); **Hidetoshi Ota** (all Old World records); or **Gustavo J. Scrocchi** (South American records). Short manuscripts are discouraged, and are only acceptable when data cannot be presented adequately in the standard format. **Electronic submission of manuscripts is required** (as Microsoft Word or Rich Text format [rtf] files, as e-mail attachments). Refer to inside front cover for e-mail addresses of section editors.

Recommended citation for new distribution records appearing in this section is: Schmitz, A., and T. Ziegler. 2003. Geographic distribution. *Sphenomorphus rufocaudatus*. Herpetol. Rev. 34:385.

CAUDATA

NOTOPHTHALMUS VIRIDESCENS LOUISIANENSIS (Central Newt). USA: INDIANA: Posey Co: Point Township: 14 km SSW Mount Vernon at Twin Swamps Nature Preserve. 16 June 2004. Zack Walker, Nathan Engbrecht, Andrew Berger, and Michael Lodato. University of Michigan Museum of Zoology (UMMZ 232002–06). Verified by Greg Schneider. New county record and first record for "pocket" of extreme SW Indiana. (Minton 2001. Amphibians and Reptiles of Indiana. 2nd ed., revised. Indiana Acad. Sci. 404 pp). Newts appear to be common at this locality with its bald cypress (*Taxodium distichum*) and overcup oak (*Quercus* lyrata) swamps surrounded by mature forest. Adults

were plentiful in aquatic situations while terrestrial juveniles were found in lesser numbers under cover. Its relative abundance at this site is in sharp contrast to the rest of SW Indiana where newts are generally unknown.

Submitted by **ZACKARY WALKER**, **NATHAN ENGBRECHT**, **ANDREW BERGER**, Indiana Department of Natural Resources – Wildlife Diversity/Herpetology, 533 East Miller Drive, Bloomington, Indiana 47401, USA (e-mail: Zwalker@dnr.IN.gov), and **MICHAEL J. LODATO**, 925 Park Plaza Drive, Evansville, Indiana 47715, USA (e-mail: mlodato229@aol.com).

PSEUDOTRITION RUBER (Red Salamander). USA: GEORGIA: Early Co: 85°0'43"W, 31°24'47"N.13 March 2002. T. Muenz and L. Smith, Joseph W. Jones Ecological Research Center. GMNH 49910. Verified by J. Jensen. Adults and larvae found at the edge of second-order, sandy-bottom streams, under wooden cover objects and leaf debris. This locality represents a new county record (Williamson and Moulis 1994. Distribution of Amphibians and Reptiles in Georgia. Savannah Sci. Mus. Spec. Publ. No. 3, 712 pp.).

Submitted by **TARA K. MUENZ** and **LORA L. SMITH**, Joseph W. Jones Ecological Research Center, Newton, Georgia 39870, USA; e-mail: tmuenz@jonesctr.org.

ANURA

ACRIS CREPITANS (Cricket Frog). USA: ARKANSAS: Lonoke Co: 2.2 km E. Ward (T5N, R9W, S25). 5 December 2004. Kelly E. McKenzie. Verified by Stanley E. Trauth. Arkansas State University Museum of Zoology Herpetological Collection (ASUMZ 28838). New county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **MICHAEL V. PLUMMER** (e-mail: plummer@harding.edu), Department of Biology, Box 12251, Harding University, Searcy, Arkansas 72149, USA (e-mail: plummer@harding.edu), and **DONALD F. McKENZIE,** Wildlife Management Institute, 2396 Cocklebur Road, Ward, Arkansas 72176, USA (e-mail: wmidm@ipa.net).

BUFO AMERICANUS CHARLESMITHI (Dwarf American Toad). USA: ARKANSAS: Carroll Co: County Road 527, Poddy Hollow (N36°29.563' W93°49.695'). 10 July 2004. Voucher specimen in Arkansas State University Museum of Zoology (ASUMZ 28718). Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **KORY ROBERTS**, Arkansas Herpetological Society, 8 Castle Acre Lane, Bella Vista, Arkansas 72714, USA; e-mail: webmaster@snakesofarkansas.com.

BUFO OLIVACEUS (Baluchestan Coastal Toad). IRAN: HORMOZGAN PROVINCE: Gheshm Island: 26°57'30"N, 56°16'45"E, 10 m asl. 20 December 2001. S. M. Dakhteh. Zoological Museum of Gorgan University (ZMGU) 636. First island record. Very common in various habitats on the island. HORMOZGAN PROVINCE: 20 km E of Jask City: 25°38'30"N, 58°27'57"E, 5 m asl. 19 July 1996. F. Oufi. ZMGU 186. Verified by S. C. Anderson. ZMGU 186 was collected from Gabrik River (30°C in water temperature) with salik net. Southernmost record of the species for Iran. This toad is known from Sistan and Baluchestan of Rask, Hormozgan Province, and Jiroft City of Kerman Province (0–914 m asl.: Baloutch and Kami 1995. Amphibians of Iran, p. 135. Tehran University Press, Tehran).

Submitted by **HAGI GHOLI KAMI,** Department of Biology, Faculty of Sciences, Agricultural Sciences, and Natural Resources, Gorgan University, Gorgan, Golestan Province, Iran; e-mail: hgkami2000@yahoo.com.

COCHRANELLA SUSATAMAI (Susatama´s Glass Frog). COLOMBIA: DEPARTAMENTO DE ANTIOQUIA: Municipio Anorí, vereda Cañadahonda, Quebrada La Soledad (07°00'22" N, 75°08'34"W) ca. 1530 m elev. 24 September 2003. Museo de Herpetología Universidad de Antioquia, Medellín, Colombia (MHUA 3262, male); 18 March 2004 (MHUA 3263, male), and 16 May 2004 (MHUA 3264, female). All collected by P. D. Gutiérrez-C. and J. C. Arredondo and verified by J. D. Lynch. Previously known only from Falán, Samaná, and Cocorná municipalities of Departamentos de Tolima, Caldas, and Antioquia, respectively, Colombia (Ruiz-Carranza and Lynch 1995. Lozania 62:1–24). These present records extend the known distribution ca. 210 km and 172.5 km NW from Falán and Samaná, respectively, and ca. 105 km N from Cocorná, toward the northern part of the Colombian Cordillera Central.

Submitted by **PAUL DAVID GUTIERREZ-C.**, Grupo Herpetológico de Antioquia (GHA), Instituto de Biología, Universidad de Antioquia, oficina 7-106, A.A. 1226, Medellín, Colombia; e-mail: pdgutierrez2@yahoo.com.

COLOSTETHUS TAMACUARENSIS (NCN). BRAZIL: AMAZONAS: Municipality of Barcelos, Serra do Tapirapecó, base camp at southern versant of Pico Tamacuari (1°12'26"N, 64°47'18"W, 350 m elev.). 29 April to 10 May 2004. U. Caramaschi and H. de Niemeyer. Museu Nacional, Rio de Janeiro, Brazil (MNRJ 38029–38049). Collected both day and night on forest floor bordering a river. Verified by C. A. G. Cruz. Previously known only from the type-locality, "from forested stream at north base of Pico Tamacuari, 1160–1200 m elevation, Sierra Tapirapecó, Amazonas, Venezuela (1°13'N, 64°42'W)" (Myers and Donnelly 1997. Amer. Mus. Nov. 3213:1–71; Frost 2004. Amphibian Species of the World: An online reference. Version 3.0. 22 August 2004. http://research.amnh.org./herpetology/amphibia/index.html). First documented record from Brazil.

Submitted by **ULISSES CARAMASCHI** and **HELIANNE DE NIEMEYER**, Departamento de Vertebrados, Museu Nacional/UFRJ, Quinta da Boa Vista, 20940-040 Rio de Janeiro, RJ, Brazil; e-mail: ulisses@acd.ufrj.br.

ELEUTHERODACTYLUS LYMANI (NCN). PERÚ: LAMBAYEQUE: CHONGOYAPE: Quebrada Chaparri (06°32'08.5"S, 79°28'25.2"W, 451 m elev.). 7 October 2002. P. Venegas. Museo de Historia Natural Universidad Nacional Mayor de San Marcos, Lima, Perú. (MHNSM 21905). In a rocky stream bed, during the night in tropical dry forest. Verified by W. E. Duellman. Previously known from southern Ecuador and

northwestern Perú, with the southernmost record for Perú in Canchaque and Palambla, Departamento de Piura (Duellman and Pramuk 1999. Sci. Pap. Nat. Hist. Mus. Kansas 13:1–78; Lynch and Duellman 1997. Spec. Publ, Nat, Hist, Mus. Kansas 23:1–236; Rodriguez et al. 1993. Publ. Mus. Hist. Nat. UNMSM [A] 45:1–22). First departmental and southernmost record for the species, extends known distribution ca. 125 km S from Palambla.

Submitted by **PABLO VENEGAS,** Facultad de Medicina Veterinaria de la Universidad Nacional Pedro Ruiz Gallo, Alfonso Uagarte 93, Pimentel, Chiclayo, Perú; e-mail: sancarranca@yahoo.es.

ELEUTHERODACTYLUS MALKINI (NCN). ECUADOR: PROVINCIA DE SUCUMBIOS: 5 km from "El Triunfo" [a town on the km 68 on the Lago Agrio - Puerto El Carmen road] (00º03'S, 76º24'W, 270 m). 16 July 2000. D. F. Cisneros-Heredia, M. Brandt, A. León, T. Suhagara, and C. Ponce. Universidad San Francisco de Quito, Ecuador (DFCH-USFQ 373–75). Verified by L. Coloma. *Eleutherodactylus malkini* occurs along the low elevation rainforests in the upper Amazon Basin in extreme southeastern Colombia (Leticia), Ecuador, Peru, and Brazil (Lynch 1980. Am. Mus. Novit. 2696; Frost 2004. Amphibian Species of the World. Ver. 3.0 [22 August, 2004]. http://research.amnh.org/herpetology/amphibia/index.html. American Museum of Natural History, New York). This record represents the northernmost locality in the distribution of the species, extending its range ca. 60 km N from the nearest locality at the Tiputini Biodioversity Station (Cisneros-Heredia 2003. Herpetofauna de la Estación de Biodiversidad Tiputini, Amazonía Ecuatoriana. *In* De la Torre and Reck [eds], Ecología y Ambiente en el Ecuador, pp. 1–21. Mem. I Congreso de Ecología y Ambiente, Ecuador país megadiverso. CD. Universidad San Francisco de Quito).

Submitted by **DIEGO F. CISNEROS-HEREDIA**, College of Biological and Environmental Sciences, Universidad San Francisco de Quito, Ave. Interoceánica y calle Diego de Robles, Campus Cumbayá, Edif. Maxwell. Casilla Postal 17-12-841, Quito, Ecuador; e-mail: diegofrancisco_cisneros@yahoo.com.

ELEUTHERODACTYLUS MEMORANS (NCN). BRAZIL: AMAZONAS: Municipality of Barcelos, Serra do Tapirapecó, base camp at southern versant of Pico Tamacuari (1°12'26"N, 64°47'18"W, 350 m elev.). 29 April to 10 May 2004. U. Caramaschi and H. de Niemeyer. Museu Nacional, Rio de Janeiro, Brazil (MNRJ 37382–37439). Collected by night on the ground of forest bordering a river. Verified by C. A. G. Cruz. Previously known only from the type-locality, in the "camp on ridge N Pico Tamacuari, 1270 m elevation, Sierra Tapirapecó, Amazonas, Venezuela (1°13'N, 64°42'W)" (Myers and Donnelly 1997. Amer. Mus. Nov. 3213: 1–71; Frost 2004. Amphibian Species of the World: An online reference. Version 3.0. 22 August 2004. http://research.amnh.org./herpetology/amphibia/index.html). First documented record for Brazil.

Submitted by **ULISSES CARAMASCHI** and **HELIANNE DE NIEMEYER**, Departamento de Vertebrados, Museu Nacional/UFRJ, Quinta da Boa Vista, 20940-040 Rio de Janeiro, RJ, Brazil; e-mail: ulisses@acd.ufrj.br.

GASTROPHRYNE CAROLINENSIS (Eastern Narrow-mouthed Toad). USA: ARKANSAS: MADISON Co: Madison County Wildlife Management Area. 15 June 2002. Photo voucher in Arkansas State University Museum of Zoology (ASUMZ 28648). Additional specimen located in field on County Road 6060 near Huntsville (N36°4.030' W93°44.382'). 22 May 2004. ASUMZ 28716. Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **JASON GUNTER**, **KORY ROBERTS**, Arkansas Herpetological Society, 8 Castle Acre Lane, Bella Vista, Arkansas 72714, USA; **CHAD E. MONTGOMERY** (e-mail: chad_mont@yahoo.com) and **STEVEN J. BEAUPRE**, University of Arkansas, Department of Biological Sciences, Fayetteville, Arkansas 72701, USA.

GASTROPHRYNE CAROLINENSIS (Eastern Narrow-mouthed Toad). USA: ARKANSAS: PIKE Co: Langley, at jct. St. Hwys 84 and 369. 23 October 2004. S. F. Barclay and M. L. Cameron. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28774). Verified by Stanley E. Trauth. New county record completely filling small distributional gap in southwestern Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville. 421 pp.) Except for Perry County in the central part of the state, *G. carolinensis* has now been reported from every county south of the Arkansas River Valley.

Submitted by **STEPHANIE F. BARCLAY, MICHELLE L. CAMERON** and **CHRIS T. McALLISTER,** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA; e-mail: chris.mcallister@tamut.edu.

HYLA CHRYSOSCELIS (Cope's Gray Treefrog). USA: GEORGIA: EARLY Co: 85°0'43"W, 31°24'47"N. 17 June 2002. T. Muenz and L. Smith, Joseph W. Jones Ecological Research Center. GMNH 49908. Verified by J. Jensen. Individuals found within PVC pipe traps hung on trees at the edge of second-order streams. This locality represents a new county record (Williamson and Moulis 1994. Distribution of Amphibians and Reptiles in Georgia. Savannah Sci. Mus. Spec. Publ. No. 3, 712 pp.).

Submitted by **TARA K. MUENZ** and **LORA L. SMITH,** Joseph W. Jones Ecological Research Center, Newton, Georgia 39870, USA; e-mail: tmuenz@jonesctr.org.

HYLA EXIMIA (Mountain Treefrog). USA: NEW MEXICO: CIBOLA Co.: El Malpais National Monument: Temporary roadside pool along CR 42, ca. 2.7 rd. mi. S of SR 53, just E of the Continental Divide, UTM (NAD27) 12S, 763413 E, 3875108 N, ca. 2356 m. elev. 10 August 2003. A. J. Monatesti. MSB/USGS Biological Survey Collection, BS/FC 7818–20. Verified by Cindy Ramotnik. First record for Cibola County, and first verified record in New Mexico away from the Gila River basin. Extends range ca. 143 km NNE of closest records in the San Francisco Mountains region near Reserve, Catron County, New Mexico (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. University of New Mexico Press, Albuquerque, 431 pp.; Stebbins 2003. A Field Guide to Western Reptiles and Amphibians, Third Edition. Houghton Mifflin Co., Boston, Massachuseets, 533 pp.). This record lends credence to 19th century specimens collected at Nutria,

McKinley County (Gehlbach 1965. Proc. U.S. Nat. Mus. 116 [3505]:243–332), the surviving specimen of which was poorly preserved and unidentifiable by Gehlbach (*op. cit.*). This new Cibola County locality is ca. 56 km SE of Nutria, and more or less contiguous upper elevation forested habitats associated with the Zuni Mountains connect them, suggesting the species may be more widespread in the region. However, this northern region is separated from populations to the south by large areas of lower elevation woodland, savanna, and grassland habitats (Dick-Peddie 1993. New Mexico Vegetation, Past Present, and Future. University of New Mexico Press, Albuquerque. 244 pp.).

Submitted by **A. J. MONATESTI** (e-mail: ajmonatesti@yahoo.com), **TREVOR B. PERSONS** (e-mail: Trevor.Persons@nau.edu), and **ERIKA M. NOWAK**, USGS Southwest Biological Science Center, Colorado Plateau Research Station, Box 5614, Northern Arizona University, Flagstaff, Arizona 86011-5614, USA (e- mail: Erika.Nowak@nau.edu).

HYLA ROSENBERGI (Rosenberg's Gladiator Treefrog). COLOMBIA: DEPARTAMENTO DE ANTIOQUIA: Municipio Maceo, vereda Las Brisas, Quebrada Santa Barbara (06°32'38.8"N, 74°38'24.8"W, ca. 500 m elev.). 28 July 2003. Museo de Herpetología Universidad de Antioquia, Medellín, Colombia (MHUA 2676, male) and 20 March 2004 (MHUA 3233, male). All collected by J. C. Arredondo and M. Rivera-C. and verified by J. D. Lynch. Adults were found on leaf litter at the edge of a stream in secondary forest. This species is distributed disjuntly in western Panamá and in Colombia (Kluge 1979. Occas. Pap. Mus. Zool. Univ. Michigan 688:1–23). Previously known only from the following localities in Colombia: Socorro, upper Río Sinu (Cordoba Department); Lower Río Calima and vereda El Danubio (Valle del Cauca Department); and La Guayacana (Nariño Department) (Kluge, *op.cit.*; Vargas-S. and Castro-H. 1999. Caldasia 21:95–109). First records from Antioquia Department and Colombian Cordillera Central, extend the distribution toward the eastern region of Colombia and fill a hiatus between its nearest known localities (ca. 215 km SE from Cordoba Department and ca. 263 km NE from Valle del Cauca Department).

Submitted by **MAURICIO RIVERA-C.** and **PAUL D. A. GUTIÉRREZ-C.**, Grupo Herpetológico de Antioquia (GHA), Instituto de Biología, Universidad de Antioquia, oficina 7-106, A.A. 1226, Medellín, Colombia; e-mail: mauriciorivera79@yahoo.com.ar.

HYLA SAVIGNYI (Savigny's Tree Frog). IRAN: GOLESTAN PROVINCE: MINOUDASHT CITY, Safi Abad Village: 37°10'08"N, 55°33'12"E, 1200 m asl. 3 March 2004. T. Taymouri. Zoological Museum of Gorgan University (ZMGU) 831. Verified by S. C. Anderson. Found in active posture near the base of a tree, ca. 20 m away from nearest water. First provincial record, and eastward range extension by almost 220 km (Baloutch and Kami 1995. Amphibians of Iran, p. 148. Tehran University Press, Tehran).

Submitted by **HAGI GHOLI KAMI,** Department of Biology, Faculty of Sciences, Agricultural Sciences, and Natural Resources, Gorgan University, Gorgan, Golestan Province, Iran; e-mail: hgkami2000@yahoo.com.

HYLA SMITHI (Dwarf Mexican Treefrog). MÉXICO: CHIHUAHUA: Ejido Gorogachi, Chínipas (27°16'21.1"N, 108°32'7.2"W), 700 m elev. 29 July 2004. Martin Velducea Aveldano and Julio A. Lemos-Espinal. Herpetological Collection of Unidad de Biología, Tecnología y Prototipos (UBIPRO 13037, 13084). Verified by Richard L. Holland. First record for the state of Chihuahua, extending its known range ca. 257 km NW of 13.6 km NW of Culiacán, Sinaloa (Duellman 2001. Hylid Frogs of Middle America. Contr. Herpetol. Vol. 18, SSAR. 1159 pp.).

Submitted by **HOBART M. SMITH** (e-mail: hsmith@colorado.edu) and **DAVID CHISZAR**, University of Colorado Museum, Boulder, Colorado 80309-0334, USA; and **JULIO A. LEMOS-ESPINAL** (under CONABIO projects BE002, CE001-002), Laboratorio de Ecología, UBIPRO, Facultad de Estudios Superiores Iztacala, UNAM, A.P. 314, Avenida de los Barrios No. 1, Los Reyes Iztacala, Tlalnepantla, Estado de México, C.P. 54090 México (e-mail: lemos@servidor.unam.mx).

HYLA SQUIRELLA (Squirrel Treefrog). USA: GEORGIA: EARLY Co: 85°0'43"W, 31°24'47"N. 13 June 2002. T. Muenz and L. Smith, Joseph W. Jones Ecological Research Center. GMNH 49909. Verified by J. Jensen. Individuals found within PVC pipe traps hung on trees at the edge of second-order streams. This locality represents a new county record (Williamson and Moulis 1994. Distribution of Amphibians and Reptiles in Georgia. Savannah Sci. Mus. Spec. Publ. No. 3, 712 pp.).

Submitted by **TARA K. MUENZ** and **LORA L. SMITH,** Joseph W. Jones Ecological Research Center, Newton, Georgia 39870, USA; e-mail: tmuenz@jonesctr.org.

HYLA VERSICOLOR (Gray Treefrog). USA: ARKANSAS: BOONE Co: E. Black Ranch Rd. (N36°24.902' W92°59.571'). 10 July 2004. Voucher specimen in Arkansas State University Museum of Zoology (28720). Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **KORY ROBERTS**, Arkansas Herpetological Society, 8 Castle Acre Lane, Bella Vista, Arkansas 72714, USA; e-mail: webmaster@snakesofarkansas.com.

HYPOPACHUS VARIOLOSUS (Sheep Frog). MÉXICO: CHIHUAHUA: Chínipas (27°23'39.9"N, 108°32'36.0"W), 469 m elev. 19 July 2004. Julio A. Lemos-Espinal. Herpetological Collection of Unidad de Biología, Tecnología y Prototipos (UBIPRO 13047-8). Verified by Richard L. Holland. First record for Chihuahua, although the species is recorded 75 km W, in southern Sonora (Wiewandt et al. 1972. Herpetologica 28:162–164).

Submitted by **HOBART M. SMITH**, Department of EE Biology, University of Colorado, Boulder, Colorado 80309-0334, USA (e-mail: hsmith@colorado.edu); **JULIO A. LEMOS-ESPINAL** (under DGAPA-PASPA, and CONABIO projects BE002, CE001-002), Laboratorio de Ecología, UBIPRO, Facultad de Estudios Superiores Iztacala, UNAM, A.P. 314, Avenida de los Barrios 1, Los Reyes Iztacala, Tlalnepantla, Estado de México, 54090 México (e-mail: lemos@servidor.unam.mx); and **DAVID CHISZAR**, Department of Psychology, University of Colorado, Boulder, Colorado 80309-0345, USA; e-mail: chiszar@clipr.colorado.edu.

LEPTODACTYLUS LABYRINTHICUS (South American Pepper Frog). BRAZIL: RONDÔNIA: Municipality of Pimenta Bueno (11°40'S, 61°37'W). 01 February 2003. M. N. C. Kokubum. Verified by A. A. Giaretta. Coleção Zoológica da Universidade Federal de Uberlândia (Anura), Uberlândia, Minas Gerais, Brazil (AAG-UFU: 2434). Immature female (116 mm SVL), collected at night in a pasture landscape besides wood vegetation (Cerrado). First state record, extends the known distribution about 110 km W from the frontier of Mato Grosso State (Heyer 1979. Smithson. Contrib. Zool. 301:1–43). *Leptodactylus labyrinthicus* was known from northern (Roraima), central, northeastern, and southeastern Brazil, Venezuela, Paraguay, Bolivia, and northeastern Argentina (Lavilla, Richard, and Schrocchi [eds.] 2000. Categorización de los Anfíbios y Reptiles de la República Argentina. Asociación Herpetológica Argentina, Tucumán, Argentina. 97 pp.; Frost 2004. Amphibian Species of the World: an online reference. Amer. Mus. Nat. Hist., New York, USA [http://research.amnh.org/herpetology/amphibia/index.php]).

Submitted by **MARCELO N. DE C. KOKUBUM** (e-mail: mnckokubum@unb.br) and **WAGNER RODRIGUES SILVA**, Laboratório de Ecologia e Sistemática de Anuros Neotropicais, Instituto de Biologia, Universidade Federal de Uberlândia, CEP 38400-902, Uberlândia, Minas Gerais, Brazil (e-mail: wagnerdrigues@yahoo.com.br).

OSTEOPILUS SEPTENTRIONALIS (Cuban Tree Frog). BRITISH VIRGIN ISLANDS: TORTOLA: Road Town Dock (18°25.8'N, 64°36.8'W). Fall 1990. Everton Henry. MCZ A-135386. First island record. NECKER ISLAND (18°31.6'N, 64°21.6'W). 19 October 1993. A. Miller. MCZ A-119258. First island record. BEEF ISLAND: Trellis Bay (18°26.44'N, 64°32.08'W). 15 October 2002. Gad Perry and Kate LeVering. MCZ A-136611. First island record. VIRGIN GORDA: Spanish Town (18°26.6'N, 64°26.2'W). 27 October 2003.J im Egelhoff. MCZ A-136432. First island record. All verified by Jose Rosado and deposited at the Museum of Comparative Zoology, Harvard University.

Native to Cuba, the Cayman Islands, and Bahamas, the Cuban Tree Frog (CTF), is recorded as introduced in Florida, Puerto Rico, Hawaii, Costa Rica, and several Caribbean islands including Anguilla and the US Virgin Islands (Lever 2003. Naturalized Reptiles and Amphibians of the World. Oxford University Press, New York. 318 pp; reviewed in Somma at http://nas.er.usgs.gov/queries/SpFactSheet.asp?speciesID=57, accessed 20 August 2004). It has also been collected at multiple North American sites where populations have not been established (Somma, *op. cit.*). The CTF has not previously been formally reported as present in the British Virgin Islands (BVI). However, the Necker specimen has formerly been mentioned by Meshaka (2001. The Cuban Tree Frog in Florida: Life History of a Successful Colonizing Species. Univ. Press of Florida, Gainesville, Florida. 191 pp.) and the presence on Tortola has previously been cited on the internet (G. Perry in Somma, *op. cit.*).

The first collection of the CTF in the BVI was on Tortola in 1990 (MCZ A-135386), and multiple specimens have been collected thereafter. A single specimen was collected on Necker Island in 1993 (MCZ A-119258). However, no viable population was established (Meshaka, *op. cit.*). The CTF appears to continue spreading in the BVI. Breeding populations were recently recorded on Beef Island (2002, beginning with MCZ A-136611) and Virgin Gorda (first collection in 2003, MCZ A-136432). Surveys continue on other islands where it might establish.

The CTF is usually introduced through importation of horticultural or building supplies (Somma, *op. cit.*). BVI resident Elvet Meyers noted (pers. comm.) that CTFs were found in concrete block pallets arriving from Florida directly to Cane Garden Bay, Tortola in April 2000, long after the species was first documented on the island. According to Meyers, local populations then rapidly irrupted, having bred in ghut puddles and a beach lagoon that sometimes contains fresh water. Thus, at least some populations are the result of multiple introduction events, potentially from different sources. The ecological impacts of the CTF remain to be established (Somma, *op. cit.*). However, interviews with BVI residents indicate a decline in native frog populations as the CTF increases in numbers. Concerns thus continue to arise as the CTF expands its range throughout the BVI and the Caribbean.

Support for this project was provided by The Conservation Agency, The Texas Herpetological Society, H. Lavity Stoutt Community College and Texas Tech University. This is manuscript T-9-1027 of the College of Agricultural Sciences and Natural Resources, Texas Tech University.

Submitted by **JENNIFER OWEN** and **GAD PERRY,** Department of Range, Wildlife, & Fisheries Management, Texas Tech University, Box 42125, Lubbock, Texas 79409-2125, USA (e-mail: gad.perry@ttu.edu); **JAMES LAZELL,** The Conservation Agency, 6 Swinburne Street, Jamestown, Rhode Island 02835, USA; **CLIVE PETROVIC**, H. Lavity Stoutt Community College, P.O. Box 3097, Road Town, Tortola, BVI; and **JIM EGELHOFF,** BVI Pest Control, P.O. Box 1109, Virgin Gorda, BVI.

PHRYNOPUS CARPISH. PERÚ: SAN MARTÍN: HUALLAGA: Juanjui: Laguna de los Cóndores (6°50'49"S, 77°41'40"W, 2870 m elev.). 28 November 2003. P. Venegas. Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Perú (MHNSM 19471). Found below a terrestrial bromeliad, during the day in humid montane forest near the lake. Verified by E. Lehr. Previously known only from type locality, Departamento de Húanuco, Perú (Lehr et al. 2002. Zool. Abh. 52:65–70). First departament and northernmost record for the species, extends known distribution ca. 364 km N from type locality.

Submitted by **PABLO VENEGAS** Facultad de Medicina Veterinaria de la Universidad Nacional Pedro Ruiz Gallo, Alfonso Ugarte 93, Pimentel, Chiclayo, Perú; e-mail: sancarranca@yahoo.es.

PSEUDACRIS CRUCIFER (Spring Peeper). USA: ARKANSAS: LONOKE CO: 2.2 km E. Ward (T5N, R9W, S25). 5 December 2004. Patrick F. McKenzie. Verified by Stanley E. Trauth. Arkansas State University Museum of Zoology Herpetological Collection (ASUMZ 28839). New county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **MICHAEL V. PLUMMER** (e-mail: plummer@harding.edu), Department of Biology, Box 12251, Harding University, Searcy, Arkansas 72149, USA; and **DONALD F. McKENZIE,** Wildlife Management Institute, 2396 Cocklebur

Road, Ward, Arkansas 72176, USA (e-mail: wmidm@ipa.net).

SCINAX AGILIS. BRAZIL: ALAGOAS: Municipality of Barra de Camarajibe (09°18'52"S, 47°26'20"W; sea level). June 2004. L. F. Toledo. Célio F. B. Haddad anuran collection, Departamento de Zoologia, Universidade Estadual Paulista, Rio Claro, São Paulo, Brazil (CFBH 7358–61). Verified by U. Caramaschi, J. P. Pombal Jr., and C. F. B. Haddad. Males were calling from leaf axils of bromeliads in a restinga remnant, ca. 200 m from the sea. Previously known from few municipalities in the states of Espírito Santo (Cruz and Peixoto 1982. R. Bras. Biol. 42[4]:721–724), and Bahia (Peixoto et al. 2003. Herpetol. Rev. 34:163; Rocha et al. 2003. A biodiversidade nos grandes remanescentes florestais do Estado do Rio de Janeiro e nas restingas da Mata Atlântica. p. 90). First state record extends the known distribution ca. 1260 km N from municipality of Prado, Bahia, Brazil (Peixoto et al. 2003, *op. cit.*). This species might occur in remnants of the restinga physiognomy that provides suitable breeding sites, such as bromeliads and/or swamps.

Submitted by **LUÍS FELIPE TOLEDO**, Laboratório de Herpetologia, Departamento de Zoologia, Instituto de Biociências, Universidade Estadual Paulista, Rio Claro, Caixa Postal 199, CEP 13506-970, São Paulo, Brazil; e-mail: toledo@rc.unesp.br.

***STEFANIA TAMACUARINA* (NCN).** BRAZIL: AMAZONAS: Municipality of Barcelos, Serra do Tapirapecó, base camp at southern side of Pico Tamacuari (1°12'26"N, 64°47'18"W, 350 m elev.). 29 April to 10 May 2004. U. Caramaschi and H. de Niemeyer. Museu Nacional, Rio de Janeiro, Brazil (MNRJ 37143–37169). Collected at night on the ground of the forest bordering a river. Verified by C. A. G. Cruz. Previously known only from the type-locality, in the "camp on ridge N Pico Tamacuari, 1270 m elevation, Sierra Tapirapecó, Amazonas, Venezuela (1°13'N, 64°42'W)" (Myers and Donnelly 1997. Amer. Mus. Nov. 3213: 1–71; Frost 2004. Amphibian Species of the World: An online reference. Version 3.0. 22 August 2004. http://research.amnh.org./herpetology/amphibia/index.html). First documented record for the genus and species for Brazil.

Submitted by **ULISSES CARAMASCHI** and **HELIANNE DE NIEMEYER**, Departamento de Vertebrados, Museu Nacional/UFRJ, Quinta da Boa Vista, 20940-040 Rio de Janeiro, RJ, Brazil; e-mail: ulisses@acd.ufrj.br.

TELMATOBUFO BULLOCKI (Bullock's Frog). CHILE: VIII REGION DEL BIO-BIO: 12 km W of Quirihue (36°15'S, 72°31'W). 16 July 2003. M. Escobar. Herpetological Collection Fundación Miguel Lillo, Tucumán, Argentina (FML 15880). On ground in an exotic Monterey Pine (*Pinus radiata*) plantation, ca. 90 m from native vegetation. Photograph verified by H. Núñez. Species is rare (Glade 1988. Libro rojo de los Vertebrados terrestres Chilenos. Corporación Nacional Forestal, Impresiones Comerciales S.A., Santiago, Chile.) with a restricted geographic range (Ortiz et al. 1994. Vertebrados Terrestres con Problemas de Conservación en la Cuenca del Biobío y mar adyacente. Ed. Universidad de Concepción, Concepción, Chile. 151 pp.). Previously known in Chile only from Cordillera de Nahuelbuta (Formas et. al. 2001. Revista Chilena de Historia Natural. Santiago. Chile. 74:365–387). First observation of this species north of Biobio River, extends the range ca. 150 km N from Lota (37°05'S, 73°10'W; Formas et. al. 2001, *op cit.*).

Submitted by **MARTÍN A. H. ESCOBAR, CRISTIÁN F. ESTADES, MATHEW FALCY,** and **M. ANGÉLICA VUKASOVIC**, Laboratorio de Ecología de Vida Silvestre, Departamento de Manejo de Recursos Forestales, Universidad de Chile, Casilla 9206, Santiago, Chile; e-mail: marescob@uchile.cl.

TESTUDINES

AGRIONEMYS HORSFIELDI (Afghan Tortoise, Four-clawed Tortoise, or Steppe Tortoise). IRAN: GOLESTAN PROVINCE: Miankaleh Peninsula 12 km W of Bandar-e-Turkmen: ca. 36°54'N, 54°02'E, -20 m asl. 17 May 2004. K. Samimi and M. Safikhani. Zoological Museum of Gorgan University (ZMGU 986–988; three females). Verified by S. C. Anderson. Westernmost record of the species in Golestan Province and first record from the coastal area of Caspian Sea (Anderson 1979. Proc. California Acad. Sci. Ser. 4, 41:501–528; Kami 1999. Zool. Middle East 19:43–54; Kami *in press*, Colour Atlas of Iranian Turtles. Dept. Environment, Mus. Pardisan, Tehran).

Submitted by **HAGI GHOLI KAMI,** Department of Biology, Faculty of Sciences, Agricultural Sciences, and Natural Resources, Gorgan University, Gorgan, Golestan Province, Iran; e-mail: hgkami2000@yahoo.com.

DEIROCHELYS RETICULARIA RETICULARIA (Eastern Chicken Turtle). USA: SOUTH CAROLINA: Lee Co: Long Leaf Pine Heritage Preserve, (UTM: 0581188 E, 3762602 N). 24 April 2004. Charleston Museum color slide and North Carolina State Museum of Natural Sciences (NCSM 11678.1). Verified by P. D. King. Adult female caught in a seine. New county record.

Submitted by **JEFFREY D. CAMPER**, Department of Biology, Francis Marion University, Florence, South Carolina 29506, USA (e-mail: jcamper@fmarion.edu); and **PATRICK L. CLONINGER**, 1529 Strathmore Lane, Mt. Pleasant, South Carolina 29464, USA.

GLYPTEMYS (= CLEMMYS) MUHLENBERGII (Bog Turtle). USA: NORTH CAROLINA: Caldwell Co: Male found crossing driveway 9.6 km airline SSW Lenoir. 21 May 2004. Larry Pennington. N.C. State Museum photo vouchers (PBT – CAL01.01–03). Verified by Jeffrey C. Beane. First county record. Fills the gap in the distribution 6.7 km airline NE nearest Piedmont Province records in Burke Co. (Herman et al. 2003. Herpetol. Rev. 34:260; Project Bog Turtle database) and 47.5 km airline WSW Alexander Co. record (Herman and Weakley 1986. Herpetol. Rev. 17:50; Project Bog Turtle database; and 31.6 km airline SE nearest Blue Ridge Mountain Province record in Avery Co. (Palmer and Braswell 1995. Reptiles of North Carolina. UNC Press, Chapel Hill; Project Bog Turtle database).

Submitted by **DENNIS W. HERMAN**, Project Bog Turtle, 105 Heidinger Drive, Cary, North Carolina 27511, USA; **TONYA WARD**, Gamewell Elementary School, 2904 Morganton Blvd., Lenoir, North Carolina 28645, USA; and **LORI A. WILLIAMS**, North Carolina Wildlife Resources Commission, 36 Pearl Street, Black Mountain, North Carolina 28711, USA.

PSEUDEMYS CONCINNA (River Cooter). USA: INDIANA: MARTIN CO: East Fork of the White River: 4.4 km NE of Shoals (38.6992, 86.7703). 27 September 2004. Brant Fisher. Verified by Chris Phillips. Photovoucher in Illinois Natural History Survey (INHS 2004e). New county record for this state endangered species. (Minton 2001. Amphibians and Reptiles of Indiana. 2nd ed., revised. Indiana Acad. Sci. 404 pp). This sighting is outside of Indiana's current proposed range, and suggests an extension eastward along the White River. The turtle was captured in a trammel net in approximately 20 feet of water.

Submitted by **ZACK WALKER,** Indiana Department of Natural Resources, Division of Fish and Wildlife, 553 E. Miller Drive, Bloomington, Indiana 47401, USA (email: zwalker@dnr.IN.gov); and **BRANT FISHER,** Indiana Department of Natural Resources, Division of Fish and Wildlife, 7970 S Rowe St., PO Box 3000, Edinburgh, Indiana 46124, USA (e-mail: bfisher@dnr.IN.gov).

RAFETUS EUPHRATICUS (Mesopotamian Soft-shell Turtle). IRAN: KHUZESTAN PROVINCE: Dezfoul City, Zavieh-e-Hamoudi Village: ca. 32°18'N, 48°21'E, 140 m elev. July 1997. M. Rashkan. Verified by S. C. Anderson. Zoological Museum of Gorgan University (ZMGU 254). Died in Zoology Laboratory, Gorgan University, on 7 April 1998, and then fixed. Northernmost record of the species in Iran. This species is not recorded from Dezfoul City (Anderson 1979. Proc. California Acad. Sci. Ser. 4, 41:501–528; Kami, *in press*, Colour Atlas of Iranian Turtles. Dept. Environment, Mus. Pardisan, Tehran).

Submitted by **HAGI GHOLI KAMI,** Department of Biology, Faculty of Sciences, Agricultural Sciences, and Natural Resources, Gorgan University, Gorgan, Golestan Province, Iran; e-mail: hgkami2000@yahoo.com.

STERNOTHERUS ODORATUS (Stinkpot). USA: ARKANSAS: POLK CO: Ouachita River at U.S. Hwy. 71 at Acorn. 1 October 2004. Daniel C. Allen. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28772). Verified by Stanley E.Trauth. New county record in western Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **DANIEL C. ALLEN, HENRY W. ROBISON, JANET RADER,** and **TESS RADER,** Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA; e-mail (HWR): hwrobison@saumag.edu.

TRACHEMYS SCRIPTA ELEGANS (Red-eared Slider). USA: FLORIDA: ST. JOHNS CO: 6.4 km S of the intersection of A1A South and State Road 206 (29°43'N, 81°13'W) Fort Matanzas National Monument (FOMA). 23 August 2004. Dana J. Ehret and David Parker. Florida Museum of Natural History (UF 142391). Verified by Kenneth L. Krysko. Juvenile, straight carapace length 150 mm. Individual was collected dead on AIA South in front of Ft. Matanzas National Monument, which is located on Anastasia Island. This species is invasive in Florida, but has been documented in a few counties as early as 1958 (Ashton and Aston 1991. Handbook of Reptiles and Amphibians of Florida, Part 2: Lizards, Turtles, and Crocodilians 2nd Edition. Windward Publishing, Inc. Miami, Florida, 191 pp.). This new county record should serve as a reminder to document the spread of introduced species.

Submitted by **DANA J. EHRET**, Florida Museum of Natural History, Dickinson Hall, Museum Road & Newell Drive, PO Box 117800, University of Florida, Gainesville, Florida 32611-7800, USA; and **DAVID PARKER**, Fort Matanzas National Monument, 8635 A1A South St. Augustine, Florida 32080, USA; e-mail dehret@flmnh.ufl.edu.

LACERTILIA

ANOLIS MACULIGULA. COLOMBIA, DEPARTAMENTO DE ANTIOQUIA. Municipio Valdivia, Corregimiento Puerto Valdivia, Vereda La China (7°16'30"N, 75°20'58"W) ca. 600 m elev. 09 May 1997. Museo de Herpetología Universidad de Antioquia, Medellín, Colombia (MHUA 10041, adult male). Captured in gallery forest on rock by a stream. J. M. Daza-R. Verified by F. Castro. This species has been considered endemic to northern Chocoan lowland rainforest in Cordillera Occidental (Williams 1984. Breviora 478:1–22; Uetz 2004. www.embl-heidelberg.de/~uetz/LivingReptiles.html). The present record extends the distribution to the northern part of Cordillera Central almost 190 km NE from its type locality.

Submitted by **JUAN MANUEL DAZA-R.** Grupo Herpetológico de Antioquia, Instituto de Biología, Bloque 7-121, Universidad de Antioquia, A.A. 1226, Medellín, Colombia; e-mail: juandaza35@hotmail.com.

BACHIA BRESSLAUI (Bresslau's Bachia). BRAZIL: MATO GROSSO DO SUL: MUNICIPALITY OF AQUIDAUANA: Dois Irmãos do Buriti district: Santa Helena farm (20°31'00"S; 55°20'15"W) a Cerrado fragment of about 200 ha. 24 November 2003 and 08 February 2004. Zoology Collection, Laboratório de Zoologia, Campus de Corumbá, Universidade Federal de Mato Grosso do Sul, Corumbá, Mato Grosso do Sul, Brazil (CEUCH 2998, CEUCH 3270). Both captured in pitfall traps with drift fence. N.C. Cáceres and collaborators. Verified by R. W. Avila. *Bachia bresslaui* is a rare gymnophthalmid known only from Cerrado of central-west Brazil (Chapada dos Guimarães, MT, Brasília, DF), NE Bahia (Correntina), and possibly SE (São Paulo) by Colli et al. (1998. Herpetologica 54:169–174). This first state record for the genus extends the known distribution ca. 540 km S from Chapada dos Guimarães, Mato Grosso state and 870 km SW from Brasília, Distrito Federal.

Submitted by **VANDA LÚCIA FERREIRA**, **DENISE MIGUEL PETRONI,** Lab. de Zoologia, Campus de Corumbá, Universidade Federal de Mato Grosso do Sul, Caixa Postal 252, CEP 79301-970, Corumbá, MS, Brazil (e-mail: vandaf@ceuc.ufms.br; depetroni@bol.com.br); and **NILTON CARLOS CÁCERES,** Depto. Biociências, Campus de Aquidauana, Universidade Federal de Mato Grosso do Sul, Caixa Postal 51, CEP 79200-000, Aquidauana, MS, Brazil (e-mail: nc_caceres@hotmail.com).

CROTAPHYTUS COLLARIS (Eastern Collared Lizard). USA: ARKANSAS: SCOTT CO: S-facing talus slope N of Hwy 270, 1.0 mi. E of Hwy 71, Near "Y" City (N34°44.091', W94°2.448'). 04 May 2002. Photo voucher in Arkansas State University Museum of Zoology (28714). Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of

Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **KORY ROBERTS** and **ROBERT PULAY**, Arkansas Herpetological Society, 8 Castle Acre Lane, Bella Vista, Arkansas 72714, USA; e-mail: webmaster@snakesofarkansas.com.

CYRTOPODION CASPIUM CASPIUM (Caspian Bent-toed Gecko, or Caspian Thin-toed Gecko). IRAN: MAZANDARAN PROVINCE: Ghaemshahr City: ca. 36°28'00"N, 52°51'45"E, 40 m elev. 1994 (exact date unknown). S. Mirzanejad. Zoological Museum of Gorgan University (ZMGU 71). Same locality. 31 March 2004. E.Samadian. ZMGU 836. Feridounkenar City, ca. 36°41'N, 52°31'E, 24 and 30 October 2003. A. Pourmomeni. ZMGU 751–758. Collected at night on the walls of buildings. Verified by S. C. Anderson. First provincial records and westernmost records of the species in Iran. This gecko is very common in Bandar-e-Turkmen. In Iran it is known from the Gorgan region of Golestan Province, from the northern part and Khorasan, extending southward to Sistan. The historical altitudinal distribution of this species in Iran was from sea level to 1700 m (Anderson 1999. The Lizards of Iran, p. 156. SSAR, St. Louis). Specimens from Feridounkenar City were found at -20 m asl., extending the lower altitudinal limit by 20 m.

Submitted by **HAGI GHOLI KAMI,** Department of Biology, Faculty of Sciences, Agricultural Sciences, and Natural Resources, Gorgan University, Gorgan, Golestan Province, Iran; e-mail: hgkami2000@yahoo.com.

EUMECES LATICEPS (Broad-headed Skink). USA: ARKANSAS: Madison Co: Madison County Wildlife Management Area. 15 June 2001. Voucher specimen in Arkansas State University Museum of Zoology (28590). Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **CHAD E. MONTGOMERY** and **STEVEN J. BEAUPRE**, University of Arkansas, Department of Biological Sciences, Fayetteville, Arkansas 72701, USA; e-mail: chad_mont@yahoo.com.

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). USA: CALIFORNIA (as listed below). In California, *Hemidactylus turcicus* was first reported from Ocotillo in Imperial County (Porter 1988. San Diego Herpetol. Soc. Newsl. 10:5; LACM 137493–95). Sight records were reported from Cathedral City and Palm Springs, Riverside Co. (Cornett 1997. The Desert Sun, January 5, 1997) and the species was included in a checklist of the amphibians and reptiles of California based on records from El Centro, Imperial County (Laudenslayer et al. 1991. California Fish and Game 77[3]:109–141 [see Saethre and Medica 1993. Herpetol. Rev. 24:154–155]). Voucher specimens for El Centro and Palm Springs were obtained, herein reported as LACM 153060 and LACM 147938, respectively.

The following records are new for California: Imperial Co: Brawley (LACM 155072); Riverside Co.: Blythe (LACM 146690), Desert Hot Springs (LACM 146693), Indio (LACM 155073), Palm Desert (LACM PC 1386), and Rancho Mirage (LACM 152669); San Bernardino Co: Earp (LACM 146691) and Needles (LACM 155124); and San Diego Co: El Cajon (LACM-PC 1363). Verified by Andrew G. Gluesenkamp. Searches of residential and commercial areas in Coachella, Holtville, La Quinta, Mecca, and Thermal were unsuccessful. Our records suggest a very localized distribution. Mediterranean House Geckos have been observed at Moorten Botanical Gardens in Palm Springs for approximately 25 years (J. Moorten, pers. comm.). The species also occurs in nearby neighborhoods, but is apparently absent from other suitable areas. Probable dispersal mechanisms for this species in California include transportation of nursery stock, transport via recreational vehicles and associated equipment (e.g., a specimen was found in the folds of a canvas picnic umbrella) and the use of railroad ties for landscaping (e.g., specimens were found in the crevices of railroad ties at two localities).

The Mediterranean House Gecko is one of two introduced species of gecko that have become established in California. A population of the Common Wall Gecko (*Tarentola mauritanica*) has been reported from San Diego County (Mahrdt 1998. Herpetol. Rev. 29:52). The impact of *H. turcicus* on native gecko populations (e.g., *Coleonyx* and *Phyllodactylus*) is unknown.

Submitted by **KENT R. BEAMAN**, Section of Herpetology, Natural History Museum of Los Angeles County, 900 Exposition Blvd., Los Angeles, California 90007, USA (e-mail: heloderma@adelphia.net); **DAVID M. GOODWARD**, 22430 Pico Street, Grand Terrace, California 92313, USA; **NATHAN T. MOORHATCH**, AMEC, 3120 Chicago Ave., Suite 180, Riverside, California 92507, USA; and **CHRIS W. BROWN**, U.S. Geological Survey, 5745 Kearny Villa Road, Suite M, San Diego, California 92123, USA.

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). USA: TEXAS: Orange Co: Admiral Street in the city of West Orange (30°05'07.2"N, 93°45'46.3"W). 10 July 2004. TCWC 87878. Verified by R. Kathryn Vaughan. New county record. (Dixon 2000. Amphibians and Reptiles of Texas, Second edition, Texas A&M Univ. Press, College Station. 421 pp.) Partially fills in the hiatus in southeast Texas. Specimen collected at a residence.

Submitted by **KJ LODRIGUE, JR.**, Texas Parks and Wildlife Department, 1201 Childers Road, Orange, Texas 77630, USA; and **KASI RUSSELL-LODRIGUE**, Texas A&M University, Department of Veterinary Pathobiology, College Station, Texas 77843-4467, USA.

HOLBROOKIA APPROXIMANS (Dickerson's Earless Lizard). MÉXICO: SONORA: Sierra de San Luis, near Hwy 2, ca. 1–2 km from the U.S. border, and 1.5 km from the Chihuahua border (31°19'12.0"N, 198°45'42.0"W), 1417 m elev. 10 July 2004. Julio A. Lemos-Espinal. Herpetological collection of Unidad de Biología, Tecnología y Prototipos (UBIPRO 12326). Verified by Richard L. Holland. First record for Sonora, extending its range 2–3 airline km westward from the nearest locality of record in Chihuahua (Cañón de la Madera, 31°13'41.1"N, 108°44'5.6"W, 1638 m elev. (Lemos-Espinal et al. 2004. Bull. Chicago Herpetol. Soc. 39:1–7).

Submitted by **HOBART M. SMITH**, Department of EE Biology, University of Colorado, Boulder, Colorado 80309-0334, USA (e-mail: hsmith@colorado.edu); **JULIO A. LEMOS-ESPINAL** (under DGAPA-PASPA and CONABIO projects BE002, CE001–002), Laboratorio de Ecología, UBIPRO, Facultad

de Estudios Superiores Iztacala, UNAM, Apartado Postal 314, Avenida de los Barrios 1, Los Reyes Iztacala, Tlalnepantla, Estado de México, 54090 México (e-mail: lemos@servidor.unam.mx); and **DAVID CHISZAR**, Department of Psychology, University of Colorado, Boulder, Colorado 80308-0345 (e-mail: chiszar@clipr.colorado.edu).

KENTROPYX PAULENSIS. BOLIVIA: Departamento SANTA CRUZ: CHIQUITOS: San Rafael, El Tuna, Laguna la Selva: 59°31'W, 16°34'S, 350 m elev. 17 December 2000. L. Gonzales. Museo Historia Natural Noel Kempff Mercado, Santa Cruz de la Sierra, Bolivia (MNKR 2264). Verified by S. Reichle. *Kentropyx paulensis* is a medium to small teiid distributed mainly in Matto Grosso, Brazil (Gallagher and Dixon 1992. Boll. Mus. Reg. Sci. nat. Torino 10[1]:125–171). This specimen is the first record for Bolivia and represents a western range extension of over 500 km from the former westernmost locality in central western Brazil (Gallagher and Dixon, *op. cit*).

Submitted by **DIRK EMBERT**, Zoologisches Forschungsinstitut und Museum Alexander Koenig, Adenauerallee 150-164, 53113 Bonn, Germany; e-mail: dirkembert@hotmail.com.

LIOLAEMUS NIGROVIRIDIS (Black-green Tree Iguana). CHILE: V REGION DE VALPARAÍSO: Los Andes Province, Valle El Arpa (32°39'12"S, 70°28'30.4"W), 2740 m elev in high Andean steppe. 10 September 2003. F. Torres-Pérez and D. Gomez-Lobo. Colección de Flora y Fauna "Patricio Sánchez Reyes," Pontificia Universidad Católica de Chile (SSUC-Re 00001–00006). Verified by H. Núñez. The species was previously known from Metropolitana and O'Higgins regions in Andean ranges above 1400 m, and in the tops of central Coastal ranges (La Campana, El Roble and Cantillana) (Nuñez 1992. Smithson. Herpetol. Info. Serv. 91:1–29). First record from the Andes of Región de Valparaiso and northernmost record for the species, extending the distribution ca. 76 km N from Valle del Río San Francisco (33°20'S; 70°22'W), the previous northernmost Andean locality (Donoso-Barros 1966. Reptiles de Chile. Ed. Universidad de Chile, Santiago, Chile. 458 pp.).

Submitted by **FERNANDO TORRES-PÉREZ** and **DANIEL GOMEZ-LOBO F.**, Centro de Estudios Avanzados en Ecología y Biodiversidad, y Departamento de Ecología, Pontificia Universidad Católica de Chile, Casilla 114-D, Santiago Chile; and **CARLOS GARIN**, Museo Nacional de Historia Natural, Casilla 787, Santiago, Chile.

PHRYNOSOMA MODESTUM (Round-tailed Horned Lizard). USA: NEW MEXICO: TORRENCE Co.: Abo ruins unit, Salinas Pueblo Missions National Monument, UTM (NAD27) 13S, 373489 E, 3812739 N, ca. 1838 m. elev. 18 May 2001. Shawn C. Knox and Trevor B. Persons. MSB/USGS Biological Survey Collection, BS/FC 7857. Verified by Cindy Ramotnik. New county record (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. University of New Mexico Press, Albuquerque, 431 pp.).

Submitted by **TREVOR B. PERSONS** (e-mail: Trevor.Persons@nau.edu) and **ERIKA M. NOWAK**, USGS Southwest Biological Science Center, Colorado Plateau Research Station, Box 5614, Northern Arizona University, Flagstaff, Arizona 86011-5614, USA (e-mail: Erika.Nowak@nau.edu).

SCELOPORUS UNDULATUS (Eastern Fence Lizard). USA: ARKANSAS: PHILLIPS Co: 4.8 km NE West Helena. 12 August 2004. H. W. Robison. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28750). ST. FRANCIS Co: 1.6 km E Forrest City. 17 September 2004. H. W. Robison. ASUMZ 28751. Both verified by Stanley E. Trauth. New county records in eastern Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **HENRY W. ROBISON** and **JANET RADER**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA; e-mail (HWR): hwrobison@saumag.edu.

SCINCELLA MODESTA (Slender Forest Skink). CHINA: GUANGDONG PROVINCE: HUADU Co: Wang Zi Feng (Princess Peak). 19 July 2004. Wenhua Lu. Verified by Zhen-chang Li, South China Normal University (SCNU), Guangzhou, Guangdong, China. SCNU 4070. Young of the year. New county record. "Has a puzzling distribution in central and southern China that is rather discontinuous" (Karsen et al. 1998. Hong Kong Amphibians and Reptiles. Second edition. Provisional Urban Council, Hong Kong, China, 186 pp.). Zhou and Adler (1993. Hepetology of China. SSAR, Oxford, Ohio, 522 pp.) did not list this species for either Guangdong Province or Hong Kong. However, *S. modesta* has long been known from the mainland New Territories of Hong Kong and the large islands of Hong Kong and Lantau (Karsen et al. 1986. Hong Kong Amphibians and Reptiles. Urban Council, Hong Kong, 136 pp.). Lazell et al. (1997. Asiatic Herpetol. Res. 7:80–84) recorded *S. modesta* on Wai Ling Ding in the Wanshan Archipelago of Guangdong. This little-known and uncommon skink is of considerable biogeographic interest because of its close resemblance to *S. laterale* of southeastern North America (Lazell and Lu 2003. *In* X. Pang [ed.], Studies on Biodiversity of the Guangdong Nanling National Nature Reserve, pp. 65–88. Guangdong Science and Technology Press, Guangzhou, China).

Submitted by **WENHUA LU** and **JAMES LAZELL,** The Conservation Agency, 6 Swinburne Street, Jamestown, Rhode Island 02835, USA; e-mail: hq@theconservationagency.org.

THECADACTYLUS RAPICAUDUS (Turniptail Gecko). MEXICO: QUINTANA ROO: Campamento de Fauna, Ejido Tres Garantías (18°11'26.2"N, 89°05'36"W). 23 April 2003. Rogelio Cedeño. Colección Herpetológica, Museo de Zoología, El Colegio de la Frontera Sur, Chetumal, Quintana Roo (ECO-CH-H-226) Nueva España Lagoon, 23 km south Ejido Caobas (18°14'57"N, 89°03'06"W). 27 March 2004. Victor H. Luja. ECO-CH-H-2583. Both specimens verified by Oscar Flores-Villela. Southernmost records for the species in Quintana Roo, extending the range more than 100 km N from the closest records in Belize and Campeche, and closes the gap between the northern and southern populations on the Yucatan Peninsula (Lee 1996. The Amphibians and Reptiles of the Yucatán Peninsula. Comstock Publ. Assoc., Cornell Univ. Press, Ithaca, New York, 500 pp.; Calderón et al. 2003. Herpetol. Rev. 34:269–272). The specimens were found in an area containing tropical deciduous forest.

Submitted by **VÍCTOR H. LUJA** and **RENE CALDERON-MANDUJANO,** El Colegio de la Frontera Sur (ECOSUR), Unidad Chetumal. Av. Centenario km 5.5, A. P. 424, C.P. 77000, Chetumal Quintana Roo, México; e-mail (VHL): lujastro@yahoo.com.

VARANUS GRISEUS CASPIUS (Transcaspian Desert Monitor). IRAN: GOLESTAN PROVINCE: 60 km NE of Gorgan City, in the vicinity of Alagol Lake: ca. 37°20'N, 54°35'E, -6 m elev. November 1997. R. Ghaemi. Zoological Museum of Gorgan University (ZMGU) 414. Collected DOR. 3 May 2002. M. Ebrahimi. ZMGU 646. Verified by S. C. Anderson. First provincial record and the northernmost and lowest records of the species in Iran (Anderson 1999. The Lizards of Iran, p. 298. SSAR, St. Louis). In the spring, five other live individuals and several DORs were observed in this locality indicating this species might be common the Alagol Lake area.

Submitted by **HAGI GHOLI KAMI,** Department of Biology, Faculty of Sciences, Agricultural Sciences, and Natural Resources, Gorgan University, Gorgan, Golestan Province, Iran; e-mail: hgkami2000@yahoo.com.

SERPENTES

AGKISTRODON CONTORTRIX CONTORTRIX (Southern Copperhead). USA: ARKANSAS: Boone Co: N. Dubuque Rd. (N36°25.543' W93°6.086'). 10 July 2004. Voucher specimen in Arkansas State University Museum of Zoology (28719). Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **KORY ROBERTS** and **ROBERT PULAY**, Arkansas Herpetological Society, 8 Castle Acre Lane, Bella Vista, Arkansas 72714, USA; e-mail: webmaster@snakesofarkansas.com.

AGKISTRODON PISCIVORUS LEUCOSTOMA (Western Cottonmouth). USA: ARKANSAS: Madison Co: On Felkin's Creek at Jct of Robert Creek and Valerie Creek in Rocky Grove. 23 May 2000). Voucher specimen in Arkansas State University Museum of Zoology (28592). Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **JACQUES G. HILL**, **FREDERIC ZAIDAN III**, **STEVEN J. BEAUPRE**, and **CHAD E. MONTGOMERY**, University of Arkansas, Department of Biological Sciences, Fayetteville, Arkansas 72701, USA; e-mail: chad_mont@yahoo.com.

CROTALUS HORRIDUS (Timber Rattlesnake). USA: TEXAS: Montgomery Co: 0.35 mi. E of Osburn Road (30°30'05N, 95°41'17W), 289 ft elev. 12 July 2004. Farm Road 149, 4.3 mi. N of Texas State Highway 105 (30°26'49N, 95°41'50W), 205 ft elev. 20 August 2004. Thomas A. Sinclair. Verified by Travis J. LaDuc. Texas Natural History Collections-Texas Memorial Museum-University of Texas (TNHC 63003, 63071). New county record. (Dixon 2000. Amphibians and Reptiles of Texas. Second Edition. Texas A&M University Press, College Station, Texas, 421 pp.). The first specimen was captured AOR crossing an unpaved road in an area of pine trees with heavy undergrowth. It now resides alive at the TNHC. The second specimen was found DOR on a paved road precisely on the bridge of Little Lake Creek in an area of mixed pine and hardwood with heavy undergrowth. Tissue samples and a digital photo were taken.

Submitted by **THOMAS A. SINCLAIR**, 12903 Cloverwood Drive, Cypress, Texas 77429-2028, USA (e-mail: tsinclair2@houston.rr.com); and **BOB L. TIPTON**, 15622 Ten Oaks, Tomball, Texas 77377, USA (e-mail: btipton@ghg.net).

CYLINDROPHIS RUFFUS (Red-tailed Pipe Snake). VIETNAM: QUANG BINH PROVINCE: Vicinity of Dong Hoi. July 2004. Collected by local people. Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany (ZFMK 82922). Verified by Wolfgang Böhme. *Cylindrophis ruffus* was previously only known from a few provinces in central and southern Vietnam, northwards up to Quang Tri (Nguyen Van Sang and Ho Thu Cuc 1996. Danh luc bo sat va ech nhai Viet Nam. Nha xuat ban khoa hoc va ky thuat, Ha Noi), as well as from Tam Dao mountain ridge in the northern part of the country (Orlov et al. 2000. Russ. J. Herpetol. 7:69–80). This specimen represents the first record for the Quang Binh Province, which borders Quang Tri Province in the south. The specimen (SVL 670 mm; TL 13 mm) exhibits coloration, patterning and scale counts diagnostic for the species. It was caught in a rice paddy near the sea.

Submitted by **THOMAS ZIEGLER,** Zoologischer Garten Köln, Riehler Str. 173, D-50735 Köln, Germany (e-mail: tziegler@zoo-koeln.de); and **VO BA PHONG,** Phong Nha – Ke Bang National Park, Phong Nha – Son Trach Commune, Bo Trach District, Quang Binh Province, Vietnam (e-mail: phongnhanp@dng.vnn.vn).

DENDRELAPHIS CYANOCHLORIS (Wall's Bronzeback). SINGAPORE: Pulau Ubin, (1°12'N, 103°43'E). 25 February 1921. Collector unknown. Raffles Museum of Biodiversity Research: Zoological Reference Collection (ZRC.2.3757; total length 112.5 cm, tail length 23.0 cm). Mandai Track 15 (roadkill). 2 October 2002. Thomas Leong. ZRC.2.5534; total length 136.5 cm, tail length 43.0 cm). Verified by Kelvin K. P. Lim. Previously misidentified as *D. formosus*, from which it differs in having more extensive portions in blue between neck scales, more lengthy black face mask reaching onto midbody, and having a white lateral stripe along hind part of body. New country record and fourth representative of the genus *Dendrelaphis* for Singapore (Lim and Lim 1992. A Guide to the Amphibians and Reptiles of Singapore, Singapore Science Centre. 160 pp.).

Submitted by **TZI MING LEONG,** Department of Biological Sciences, National University of Singapore, Singapore 119260; e-mail: scip0132@nus.edu.sg.

ELAPHE OBSOLETA (Texas Ratsnake). USA: ARKANSAS: Franklin Co: Devils Canyon (N35°38.316', W94°2.001'). 03 July 2004. Voucher specimen in Arkansas State University Museum of Zoology (28717). Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **KORY ROBERTS**, Arkansas Herpetological Society, 8 Castle Acre Lane, Bella Vista, Arkansas 72714, USA; e-mail: webmaster@snakesofarkansas.com.

ELAPHE EMORYI (Great Plains Ratsnake). USA: ARKANSAS: YELL Co: base of Mount Magazine (N35°8.599' W93°34.077'). 31 March 2003. Photo voucher in Arkansas State University Museum of Zoology (28706). Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp).

Submitted by **KORY ROBERTS**, Arkansas Herpetological Society, 8 Castle Acre Lane, Bella Vista, Arkansas 72714, USA; e-mail: webmaster@snakesofarkansas.com.

GEOPHIS BLANCHARDI (Blanchard's Earth Snake). MÉXICO: PUEBLA: 1.5 mi. S Puerto del Aire. 14 August 1971. John P. O'Neill and W. Gary Eberle. LSUMZ 28708. Verified by Jeff Boundy. First record for Puebla and extends its range ca. 9 km (airline) SW of the Cumbres de Acultzingo, Veracruz (Downs 1967. Misc. Publ. Mus. Zool., University of Michigan 131:1–193) and ca. 79 km (airline) NW of Puerto Soledad, Oaxaca (Canseco-Márquez et al. 2004. Herpetol. Rev. 35:191–192). This locality is near the border with Veracruz. Smith and Taylor (1945. Smithson. Inst., U.S. Natl. Mus. Bull. 187:1–239) indicated that the species was only known from the type locality in Puebla and Veracruz, but no verified record of its occurrence in Puebla could be found.

Submitted by **LUIS CANSECO MÁRQUEZ,** Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, A.P. 70-399, México, D.F., 04510 (e-mail: lcm@correo.unam.mx); and **CHRISTOPHER C. AUSTIN**, Museum of Natural Science, Lousiana State University, Baton Rouge, Louisiana 70803, USA (e-mail: ccaustin@lsu.edu).

HETERODON PLATIRHINOS (Eastern Hog-nosed Snake). USA: ARKANSAS: CARROLL Co: cedar glade in Lake Leatherwood City Park near Eureka Springs (N36°25.994' W93°45.425'). 20 April 2002. Photo voucher in Arkansas State University Museum of Zoology (28713). Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **KORY ROBERTS**, Arkansas Herpetological Society, 8 Castle Acre Lane, Bella Vista, Arkansas 72714, USA; e-mail: webmaster@snakesofarkansas.com.

HYPSIGLENA TORQUATA (Nightsnake). USA: COLORADO: LA PLATA Co: 4.8 km SE Marvel, 0.4 km S of the north line between S20-30, T33N, R11W, 1950 m. 24 September 2004. B. Parker. UCM Herpetol. Photo. Coll. 155. Verified by Geoffrey A. Hammerson and Hobart M. Smith. First county record (Hammerson 1999. Amphibians and Reptiles in Colorado. Second Ed. Univ. Press of Colorado. xxviii + 484 pp.).

Submitted by **BRIAN PARKER**, U.S. Forest Service and Bureau of Land Management, San Juan Public Lands Center, 15 Burnett Court, Durango, Colorado 81301, USA; e-mail: bparker02@fs.fed.us.

HYPSIGLENA TORQUATA (Nightsnake). USA: NEW MEXICO: CIBOLA Co: El Morro National Monument campground, NW/4 SE/4 Sec. 5, T9N R14W, ca. 2194 m elev. 8 September 2002. Eric Zepnewski. MSB/USGS Biological Survey Collection, BS/FC 7841. Verified by Cindy Ramotnik. New county record (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. University of New Mexico Press, Albuquerque, 431 pp.).

Submitted by **TREVOR B. PERSONS** (e-mail: Trevor.Persons@nau.edu) and **ERIKA M. NOWAK** (e-mail: Erika.Nowak@nau.edu), USGS Southwest Biological Science Center, Colorado Plateau Research Station, Box 5614, Northern Arizona University, Flagstaff, Arizona 86011-5614, USA.

LAMPROPELTIS CALLIGASTER CALLIGASTER (Prairie Kingsnake). USA: ARKANSAS: CARROLL Co: DOR on Hwy 412, 0.9 mi. E of Hwy 103 South. 14 June 2004. Voucher specimen in Arkansas State University Museum (28666). Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **CHAD E. MONTGOMERY** and **STEVEN J. BEAUPRE**, University of Arkansas, Department of Biological Sciences, Fayetteville, Arkansas 72701, USA; e-mail (CEM): chad_mont@yahoo.com.

LAMPROPELTIS CALLIGASTER CALLIGASTER (Prairie Kingsnake). USA: ARKANSAS: MADISON Co: juvenile found in a residential pool on County Road 6060 near Huntsville (N36°4.053' W93°44.272'). 22 September 2001. Photo voucher in Arkansas State University Museum of Zoology (28707). Additional record DOR on Hwy 23, 2.9 mi. S of jct Hwy 12. 13 May 2003. Arkansas State University Museum of Zoology (28595). Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **KORY ROBERTS**, Arkansas Herpetological Society, 8 Castle Acre Lane, Bella Vista, Arkansas 72714, USA; **CHAD E. MONTGOMERY** (e-mail: chad_mont@yahoo.com), and **STEVEN J. BEAUPRE**, University of Arkansas, Department of Biological Sciences, Fayetteville, Arkansas 72701, USA.

LAMPROPELTIS TRIANGULUM SYSPILA (Red Milksnake). USA: ARKANSAS: MADISON Co: near pond on County Road 6060 near Huntsville, AR (N36°4.043' W93°44.282' and N36°4.043' W93°44.318'). 24 September 2001 and 28 April 2002. Photo vouchers in Arkansas State University Museum of Zoology (28709, 28708). Additional specimens located in Madison County Wildlife Management Area. 15 June 2002. ASUMZ photo voucher 28646. Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **JASON GUNTER**, **KORY ROBERTS**, Arkansas Herpetological Society, 8 Castle Acre Lane, Bella Vista, Arkansas 72714, USA; **CHAD E. MONTGOMERY** (e-mail: chad_mont@yahoo.com), and **STEVEN J. BEAUPRE**, University of Arkansas, Department of Biological Sciences, Fayetteville, Arkansas 72701, USA.

MASTICOPHIS FLAGELLUM CINGULUM (Sonoran Coachwhip). MÉXICO: CHIHUAHUA: Chínipas (27°23'39.9"N, 108°32'9.7"W), 469 m elev. 10 August 2004. Julio A. Lemos-Espinal. Herpetological Collection of Unidad de Biología, Tecnología y Prototipos (UBIPRO 13091). Verified by Richard L.

Holland. First record for Chihuahua, extending the known range ca. 50 km W of the vicinity of Alamos and Guirocoba, Sonora (Bogert and Oliver 1945. Bull. Am. Mus. Nat. Hist. 83:297–426; Wilson 1973. Cat. Am. Amph. Rept. [145]:1–4).

Submitted by **HOBART M. SMITH** (e-mail: hsmith@colorado.edu) and **DAVID CHISZAR** (e-mail: chiszar@clipr.colorado.edu), University of Colorado Museum, Boulder, Colorado 80309-0334, USA; and **JULIO A. LEMOS-ESPINAL** (under CONABIO projects BE002, CE001-002, with support from DGAPA-PASPA), Laboratorio de Ecología, UBIPRO, Facultad de Estudios Superiores Iztacala, UNAM, Apartado Postal 314, Avenida de los Barrios No. 1, Los Reyes Iztacala, Tlalnepantla, Estado de México, 54090 México (e-mail: lemos@servidor.unam.mx).

MASTICOPHIS FLAGELLUM FLAGELLUM (Eastern Coachwhip). USA: ARKANSAS: Franklin Co: juvenile located in Devils Canyon (N35°38.483' W94°3.474'). 17 October 2003. Photo voucher in Arkansas State University Museum of Zoology (28710). Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **KORY ROBERTS**, Arkansas Herpetological Society, 8 Castle Acre Lane, Bella Vista, Arkansas 72714, USA; e-mail: webmaster@snakesofarkansas.com.

MASTICOPHIS FLAGELLUM FLAGELLUM (Eastern Coachwhip). USA: ARKANSAS: Madison Co: DOR on Hwy 23, 0.9 mi. S jct. Hwy 12. 28 September 2003. Voucher specimen in Arkansas State University Museum of Zoology (28597). Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **CHAD E. MONTGOMERY** (e-mail: chad_mont@yahoo.com) and **STEVEN J. BEAUPRE**, University of Arkansas, Department of Biological Sciences, Fayetteville, Arkansas 72701, USA.

MASTICOPHIS FLAGELLUM FLAGELLUM (Eastern Coachwhip). USA: SOUTH CAROLINA: Florence Co: Lynches River County Park, 11.5 km S Florence. 31 March 2004. Charleston Museum color slide and North Carolina State Museum of Natural Sciences (NCSM 11678.2). Verified by P. D. King. New county record. Fills a gap between extreme northern Darlington Co. and the southern tip of Marion Co. (Leiden et al. 1999. J. Elisha Mitchell Sci. Soc. 115:270–280).

Submitted by **JEFFREY D. CAMPER**, Department of Biology, Francis Marion University, Florence, South Carolina 29506, USA (e-mail: jcamper@fmarion.edu); and **RYAN J. BROOKS,** 4554 Lightwood Road, Bennettsville, South Carolina 29512, USA.

OPHEODRYS AESTIVUS (Rough Greensnake). USA: ARKANSAS: Franklin Co: juvenile located on cedar glade in Devils Canyon (N35°38.308' W94°2.265'). 03 July 2004. Photo voucher in Arkansas State University Museum of Zoology (28715). Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **KORY ROBERTS**, Arkansas Herpetological Society, 8 Castle Acre Lane, Bella Vista, Arkansas 72714, USA; e-mail: webmaster@snakesofarkansas.com.

OPHEODRYS AESTIVUS (Rough Greensnake). USA: ARKANSAS: Madison Co: Ozark Natural Science Center (ONSC), Madison County Wildlife Management Area (MCWMA). 15 May 2002. Captured by staff at ONSC. Photo voucher in Arkansas State University Museum of Zoology (28647). Additional specimen located in MCWMA on cedar glade (N36°12.169' W93° 39.713'). 20 September 2003. ASUMZ photo voucher 28711. Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **KORY ROBERTS**, Arkansas Herpetological Society, 8 Castle Acre Lane, Bella Vista, Arkansas 72714, USA; **JASON GUNTER**, **CHAD E. MONTGOMERY** (e-mail: chad_mont@yahoo.com), and **STEVEN J. BEAUPRE**, University of Arkansas, Department of Biological Sciences, Fayetteville, Arkansas 72701, USA.

PHALOTRIS LABIOMACULATUS (Falsa Coral). BRAZIL: TOCANTINS: Mateiros Municipality: Parque Estadual do Jalapão (10°16'S, 46°50'W). 06 March 2002. F. G. R. França and D. O. Mesquita. Coleção Herpetológica da Universidade de Brasília (CHUNB 29826). Verified by G. Colli. Adult female collected from a campo sujo area of Cerrado biome. Second record for the species, previously know only from type-locality: Serra da Desordem, Maranhão (Lema 2002. Comun. Mus. Ciênc. Tecnol. PUCRS, Ser. Zool. 15[2]:201–214). Present record extends known distribution 585 km S.

Submitted by **FREDERICO G. R. FRANÇA**, Departamento de Ecologia, Universidade de Brasília, 70910-970, Brasília, Brazil (e-mail: fredgrf@terra.com.br); **DANIEL O. MESQUITA**, Departamento de Zoologia, Universidade de Brasília, 70910-900, Brasília, Brazil (e-mail: danmesq@unb.br); and **ADRIAN A. GARDA**, Department of Zoology, University of Oklahoma, Norman, Oklahoma 73072, USA (e-mail: garda@ou.edu).

PITUOPHIS DEPPEI DEPPEI (Deppe's Gophersnake). MÉXICO: SONORA: In front of restaurante "Los Parajes," km 269.5, Méx. Hwy. 16 (Hermosillo-Cd. Chihuahua) (28°21'19.6"N, 109°0'14.1"W), 1829 m elev. 21 July 2004. Julio A. Lemos-Espinal. Herpetological Collection of Unidad de Biología, Tecnología y Prototipos (UBIPRO 12593). Verified by Richard L. Holland. First record for Sonora, extending its known range NW ca. 112 km from the vicinity of Maguarichi, Chihuahua (Lemos-Espinal et al. 2004. Introducción a los Anfibios y Reptiles del Estado de Chihuahua. CONABIO, México. 128 pp.).

Submitted by **HOBART M. SMITH** (e-mail hsmith@colorado.edu) and **DAVID CHISZAR** (e-mail: chiszar@clipr.colorado.edu), University of Colorado Museum, Boulder, Colorado 80309-0334, USA ; and **JULIO A. LEMOS-ESPINAL** (under CONABIO projects BE002, CE001-002), Laboratorio de Ecología, UBIPRO, Facultad de Estudios Superiores Iztacala, UNAM, Apartado Postal 314, Avenida de los Barrios 1, Los Reyes Iztacala, Tlalnepantla, Estado de México, 54090 México (e-mail: lemos@servidor.unam.mx).

SINONATRIX AEQUIFASCIATA (Equal-banded Watersnake). VIETNAM: NGHE AN PROVINCE: Vicinity of Ky Son. November 1986. Hoang Xuan Quang and students. Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany (ZFMK 82923). Verified by Wolfgang Böhme. *Sinonatrix aequifasciata* had long been known only from southern China (Zhao and Adler 1993. Herpetology of China. SSAR, Oxford, Ohio). Recently, Orlov et al. (2000. Russ. J. Herpetol. 7:69–80) recorded the species from Tam Dao Mountain Ridge for the first time for Vietnam, and stated that it occurs in central and northern Vietnam but without referring to any concrete evidence. This specimen represents the first voucher for the Nghe An Province. This juvenile (SVL 170 mm; tail 54 mm) exhibits coloration, pattern (23 dark dorsal bands on body, 13 on tail), and scale counts characteristic of *S. aequifasciata*.

Submitted by **THOMAS ZIEGLER**, Zoologischer Garten Köln, Riehler Str. 173, D-50735 Köln, Germany (e-mail: tziegler@zoo-koeln.de); and **HOANG XUAN QUANG**, University of Vinh, Nguyen Du Str., Vinh - Nghe An, S. R. Vietnam.

SISTRURUS MILIARIUS STRECKERI (Western Pigmy Rattlesnake). USA: ARKANSAS: MADISON CO: Madison County Wildlife Management Area. 26 August 2003. Voucher specimen in Arkansas State University Museum of Zoology (28593). Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **CHAD E. MONTGOMERY** (e-mail: chad_mont@yahoo.com) and **STEVEN J. BEAUPRE**, University of Arkansas, Department of Biological Sciences, Fayetteville, Arkansas 72701, USA.

STORERIA DEKAYI TEXANA (Texas Brownsnake). USA: TEXAS: LEE CO: Road FM 1624, 1.1 rd mi SW of Lee Co. Road 323 (ca. 3 mi SW of Lexington). 14 September 2003. 190 + 30 mm, 2.8 g. Male collected DOR. TNHC 63074 (GBP 327). Verified by Travis J. LaDuc. New county record and fills a gap within the known distribution (Dixon 2000. Amphibians and Reptiles of Texas, 2nd edition, Texas A&M University Press, 421 pp.).

Submitted by **GREGORY B. PAULY,** Section of Integrative Biology and Texas Memorial Museum, One University Station (C0930), University of Texas, Austin, Texas 78712, USA; and **JEREMY M. BROWN,** Section of Integrative Biology, One University Station (C0930), University of Texas, Austin, Texas 78712, USA.

STORERIA DEKAYI WRIGHTORUM (Midland Brownsnake). USA: ARKANSAS: LOGAN CO: 10.4 km SW Booneville on St. Hwy 23 (Sec. 30, T5N, R28W). 20 November 2004. H. W. Robison and Janet Rader. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28814). Verified by Stanley E.Trauth. New county record in western Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville, 421 pp).

Submitted by **HENRY W. ROBISON** (e-mail: hwrobison@saumag.edu) and **JANET RADER**, Department of Biological Sciences, Southern Arkansas University, Magnolia, Arkansas 71754-9354, USA.

STORERIA OCCIPITOMACULATA (Red-bellied Snake). USA: GEORGIA: EARLY CO: 85°0'43"W, 31°24'47"N. 13 March 2002. T. Muenz and L. Smith, Joseph W. Jones Ecological Research Center. GMNH 49907. Verified by J. Jensen. Individual found under log within the riparian area of a second-order stream. This locality represents a new county record (Williamson and Moulis 1994. Distribution of Amphibians and Reptiles in Georgia. Savannah Sci. Mus. Spec. Publ. No.3, 712 pp.).

Submitted by **TARA K. MUENZ** and **LORA L. SMITH,** Joseph W. Jones Ecological Research Center, Newton, Georgia 39870, USA; e-mail (TKM): tmuenz@jonesctr.org.

THAMNOPHIS PROXIMUS (Western Ribbon Snake). USA: TEXAS: JIM HOGG CO: Agua Nueva: Farm Road 1017, 28.8 mi. S jct Hwy 285. 5 June 2004. Thomas A. Sinclair. Verified by James R. Dixon. Texas Cooperative Wildlife Collection-Texas A&M University and Travis J. LaDuc. Texas Natural History Collections-Texas Memorial Museum-University of Texas (TNHC 63006) digital photo. New county record (Dixon 2000. Amphibians and Reptiles of Texas. Second Edition. Texas A&M University Press, College Station, Texas, 421 pp.). This individual fills a gap in the distribution as all counties surrounding Jim Hogg have multiple records from them.

Submitted by **THOMAS A. SINCLAIR**, 12903 Cloverwood Drive, Cypress, Texas 77429-2028, USA (e-mail: tsinclair2@houston.rr.com); and **BOB L. TIPTON**, 15622 Ten Oaks, Tomball, Texas 77377, USA (e-mail: btipton@ghg.net).

THAMNOPHIS SIRTALIS SIRTALIS (Eastern Gartersnake). USA: ARKANSAS: MADISON CO: DOR on Madison County Wildlife Management Area. 7 May 2000. Voucher specimen in Arkansas State University Museum (28596). Additional specimen located near pond on County Road 6060 near Huntsville (N36°4.035', W93°44.189'). 25 April 2004. ASUMZ photo voucher 28712. Verified by Stanley E. Trauth. First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **STEVEN J. BEAUPRE**, University of Arkansas, Department of Biological Sciences, Fayetteville, Arkansas 72701, USA; **KORY ROBERTS**, Arkansas Herpetological Society, 8 Castle Acre Lane, Bella Vista, Arkansas 72714, USA; and **CHAD E. MONTGOMERY**, University of Arkansas, Department of Biological Sciences, Fayetteville, Arkansas 72701, USA (e-mail: chad_mont@yahoo.com).

TROPIDOCLONION LINEATUM (Lined Snake). USA: NEW MEXICO: CURRY CO: DOR on Curry Co. Hwy 17, 3.2 rd km E NM Hwy 209; ca. 11.3 air km N of Clovis; 1305 m elev. 34°30.24'N, 103°4.40'W. 27 October 2004. James D. Jones.University of New Mexico Museum of Southwestern Biology (MSB 71665).Verified by J. Tomasz Giermakowski. New county record (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque, xix + 431 pp.).

Submitted by **JAMES D. JONES**, 117 East Christopher, Clovis, New Mexico 88101,USA; and **CHARLES W. PAINTER**, New Mexico Department Game and Fish, 1 Wildlife Way,Santa Fe, New Mexico, USA (e-mail: cpainter@state.nm.us).

VIRGINIA VALERIAE ELEGANS (Western Smooth Earthsnake). USA: TEXAS: CASS CO: off St. Hwy 43 in Atlanta, Atlanta City Park. 31 October 2004. J. Caldwell. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28777). Verified by Stanley E. Trauth. First record for county and extends range north and northeast from previous records in Gregg, Harrison, and Rains counties (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station. 421 pp.; Werler and Dixon 2000. Texas Snakes: Identification, Distribution, and Natural History. Univ. of Texas Press, Austin, 437 pp.). Although this site is the northeasternmost locality noted for the species in Texas, a single record was reported due east in adjacent Miller County, Arkansas (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville, 421 pp.). Locality records within its projected range in Texas are relatively uncommon (see Dixon 2000, *op. cit.*) as evidenced by this snake now being reported from only 30 counties.

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New County Records of Amphibians and Reptiles from Florida

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Florida has a well-documented herpetofauna, and its exotic herpetofauna has grown considerably over the last few decades since the classic reviews by King and Krakauer (1966) and Wilson and Porras (1983). Florida's diverse habitats, warm climate, and thriving pet trade have facilitated the establishment and subsequent range expansion of many exotic herpetofaunal species. While conducting surveys throughout Florida from May 2000 through October 2003, we documented new county records for both native and exotic species. Additional new county records were obtained from specimens collected or photographed by others and deposited in the Florida Museum of Natural History (FLMNH, UF collection), Louisiana State University Museum of Natural Science (LSUMZ), and Texas Cooperative Wildlife Collection (TCWC). Identification of all UF specimens was verified by K. L. Krysko, unless otherwise noted. Common names follow Crother (2000).

Anura

Bufo marinus (Cane Toad). OKEECHOBEE CO: Okeechobee, Flamingo Motel, 4101 U.S. Hwy. 441 S (27°12.47'N, 80°49.78'W). 30 May 2002. K. L. Krysko and K. M. Enge. UF 132733–34. New county record. Along building at 2030 h.

Hyla gratiosa (Barking Treefrog). GADSDEN CO: Frank Smith Rd. 0.2 km NE of jct. Co. Rd. 159 (30°40.15'N, 84°28.59'W). 4 June 2003. K. M. Enge. UF 137127. New county record. On road at 2200 h.

Osteopilus septentrionalis (Cuban Treefrog). ALACHUA CO: Gainesville, near 4455 SW 34th St. (29°36.80'N, 82°22.32'W). 2 October 2002. J. H. Townsend and D. T. Vergara. UF 134294. New county record. On gutter drain at 2045 h. BAY CO: Lynn Haven, Aberdeen Loop (30°13.71'N, 85°37.17'W). 2 December 2004. S. Wilson. UF 142698. New county record. COLUMBIA CO: O'Leno State Park. May 2001. G. Davidson. UF 122901. New county record. Near bath house in Magnolia area. DUVAL CO: Jacksonville, Mandarin, 10767 Orchard Walk Place West near San Jose Blvd. and I-295 (30°10.84'N, 81°37.34'W). 11 May 2002. D. Burger. UF 137173 (photographic voucher). Jacksonville, 7120 Pottsburg Dr. (30°17.56'N, 81°35.15'W). 17 June 2002. L. Jacobson. UF 133206 (photographic voucher). In koi pond. New county records. FLAGLER CO: Palm Coast, 17 Blaketown Place. 2 November 2004. J. Kuypers. UF 142584 (photographic voucher). New county record. Under the cover of grill on backyard deck at 1700 h. Two others found 16 November 2004.

Rana capito aesopus (Florida Gopher Frog). GLADES CO: ca. 12.5 km WNW of Palmdale (26°59.66'N, 81°26.20'W). 9 May 2000. K. M. Enge and R. T. Felix. UF 137113 (photographic voucher). New county record. In mouth of active gopher tortoise (*Gopherus polyphemus*) burrow in scrubby flatwoods.

Caudata

Notophthalmus perstriatus (Striped Newt). LAKE CO: Ocala National Forest, ca. 3 km SW of Alexander Springs. 17 January 2003. S. A. Johnson and C. Sekerak. UF 135125. New county record. In isolated wetland pond in longleaf pine (*Pinus palustris*) sandhill habitat.

Siren intermedia (Lesser Siren). SUWANNEE CO: Ichetucknee River, just downstream from Devil's Eye Spring mouth (29°58.42'N, 82°45.58'W). 11 December 2001. S. J. Walsh, J. D. Williams, R. J. Lewis, and S. Cole. Verified by P. E. Moler. UF 133883. New county record.

Lacertilia

Agama agama (African Rainbow Lizard). CHARLOTTE CO: Punta Gorda, State Rd. 17 ca. 1.3 km W of I-75 (26°56.46'N,

82°01.89'W). 3 June 2003. K. L. Krysko, C. S. Samuelson, B. L. Talley, K. L. Bell, and F. W. King. UF 137017. Adult female on wall of Circle K store; two other adults observed here, and six adults observed at another site in the area. Punta Gorda, Lavilla Rd. under State Rd. 17 (26°56.37'N, 82°01.64'W). 4 June 2003. UF 137043–55. Ten adults and two hatchlings collected, and ≥ 13 more adults observed. Thirteen adults and one hatchling observed at two other nearby sites, indicating a well-established population. New county records. MIAMI-DADE Co: Homestead, Redland Middle School, Coconut Palm Dr. (SW 248 St.) and SW 162 Ave. (25°32.17'N, 80°27.13'W). 28 March, 29 May, 19 September 2002. K. L. Krysko, K. M. Enge, F. W. King, and W. B. Love. UF 131521, 132696–700, 134222. First records of an undocumented population in Miami-Dade County, although an extirpated population has been reported (Wilson and Porras, *op cit.*; LSUMZ 36647, UF 43490). Numerous individuals observed one to three blocks in each direction. SEMINOLE Co: Sanford, 3000 S Orlando Dr. (28°46.18'N, 81°16.84'W). 26 May 2003. K. L. Krysko and K. M. Enge. UF 136983–88. New county record. Nineteen individuals of both sexes observed in the area.

Ameiva ameiva (Giant Ameiva). BROWARD Co: Deerfield Beach, 90 SE 3rd Ct., just N of SE 4th St. (26°18.75'N, 80°6.177'W). 25 May 2004. K. L. Krysko and K. M. Enge. New county record. Several individuals observed along RR track at 0945 h; population present at least 6 yr.

Anolis cybotes (Large-headed Anole). MARTIN Co: Port Mayaca (26°58.43'N, 80°36.76'W). 25, 28 March 2002. K. L. Krysko, K. M. Enge, F. W. King, and W. B. Love. UF 131446–48, 131527–29. New county record. On fig (*Ficus* sp.) trees.

Anolis equestris (Knight Anole). MARTIN Co: Port Mayaca (26°58.43'N, 80°36.76'W). 25, 28 March 2002. K. L. Krysko, K. M. Enge, F. W. King, and W. B. Love. UF 131449, 131530. New county record. On cypress (*Taxodium* sp.) trees. PALM BEACH Co: Boca Raton, near jct. NE Spanish River Blvd. and State Rd. A1A (26°23.13'N, 80°04.02'W). 2 August 1997. L. Monroe. Verified by R. K. Vaughan. TCWC 80508. New county record. In bush near beach. Documented also in West Palm Beach in January 2003 (UF 137015, photographic voucher). ST. LUCIE Co: E of Carlton Rd. ca. 1.6 km N of Glades Cutoff Rd. (27°16.72'N, 80°32.29'W). 18 August 2003. G. J. Ward and M. A. Flowers. UF 137459. New county record. Seven additional juveniles and adults observed in Brazilian pepper (*Schinus terebinthifolius*) and slash pine (*Pinus elliottii*) trees.

Basiliscus vittatus (Brown Basilisk). COLLIER Co: Naples, Vanderbilt Beach Park (26°15.20'N, 81°49.31'W). 27 July 2002. Jason C. Seitz. UF 137035. 1 September 2002. Jason C. Seitz. UF 137036. 4 June 2003. K. L. Krysko, F. W. King, C. S. Samuelson, B. L. Talley, and K. L. Bell. UF 137034. All specimens collected on mangrove trees and edge of canal along parking lot; numerous other individuals (neonates to large adults) observed during these and other dates. Golden Gate, jct. SW 17th St. and 16th Ave. (26°11.91'N, 81°38.44'W). 23 May 2004. S. Chrzanowski. UF 141603. Numerous other individuals observed along banks of canal. New county records. PALM BEACH Co: Loxahatchee, 16700 W Jenny Ln. (26°42.30'N, 80°18.63'W). 4 July 2003. J. H. Altman. UF 137179–80 (photographic vouchers). New county record. Male and female in backyard. ST. LUCIE Co: N end of Co. Rd. 609 (Header Canal Rd.; 27°28.22'N, 80°29.85'W). 19 August 2003. G. J. Ward, M. A. Flowers, K. L. Krysko, and K. M. Enge. UF 137407, 137447. New county record. Four juveniles and adults observed at 2100 h.

Gekko gecko (Tokay Gecko). LEE Co: Fort Myers (26°40.96'N, 81°48.13'W). 25 June 2002. K. L. Krysko, K. M. Enge, F. W. King, and W. B. Love. UF 133237–39. New county record. MONROE Co: Key Largo, near John Pennekamp Coral Reef State Park (25°07.35'N, 80°24.54'W). April 2002. J. Duquesnel. UF 132435–36. Little Torch Key (24°39.94'N, 81°23.41'W). 3 May 2002. K. L. Krysko and A. N. Hooper. UF 132446. Plantation Key, on Sioux St. E of Indian Mound Trail (24°59.12'N, 80°32.88'W). 3 January 2003. K. L. Krysko. UF 135122–23. New county records.

Hemidactylus frenatus (House Gecko). BROWARD Co: Hollywood, S side of Stirling Rd. just E of jct. NW 65th Ave. (26°02.76'N, 80°13.15'W). 22 August 2003. K. M. Enge and K. L. Krysko. UF 137408. New county record. At least 24 other individuals observed on walls.

Hemidactylus garnotii (Indo-Pacific Gecko). LAKE Co: Leesburg, 6510 Tuscawilla Drive (28°48.042'N, 81°50.938'W). 6 October 2004. K. L. Krysko. UF 142048. New county record (see Townsend and Krysko 2003). On wall at 2230 h; at least 20 more individuals observed in neighborhood.

Hemidactylus mabouia (Amerafrican House Gecko). COLLIER Co: Marco Island, Marco Island Chamber of Commerce office complex at jct. of North Collier Blvd. and Rose Ave. (25°57.30'N, 82°43.03'W). 14 July 2003. T. S. Campbell. UF 137277–85. Island range extension (see Klowden 2002). HENDRY Co: E side of Co. Rd. 832 (Evercane Rd.) at RR tracks (26°42.64'N, 80°54.09'W). 11 March 2003. K. L. Krysko. UF 136077. New county record. Under bark of Australian pine tree (*Casuarina equisetifolia*). MARTIN Co: Tequesta, N side of Loxahatchee River (26°58.48'N, 80°5.31'W). 25 March 2002. K. L. Krysko, K. M. Enge, and F. W. King. UF 131455–56. New county record. OSCEOLA Co: Canoe Creek Service Plaza, Florida Turnpike (28°05.81'N, 81°16.62'W). 22 August 2003. K. L. Krysko and K. M. Enge. UF 137421–24. New county record. PALM BEACH Co: Jupiter, ca. 1.6 km W of U.S. Hwy. 1, 4.8 km S of Martin Co. line (26°55.64'N, 80°5.62'W). 6 April 2001. C. Roelke. UF 122899–900. New county record.

Hemidactylus turcicus (Mediterranean Gecko). BAKER Co: Macclenny, 682 W Ohio Ave. (30°17.08'N, 82°07.10'W). 3 October 2003. D. Davis. UF 138388. New county record (see Townsend and Krysko, *op cit.*). Inside house; two other adults seen on outside wall at night. PASCO Co: Dade City, 37715 Farr Rd. (28°56.63'N, 82°11.50'W). 9 November 2004. C. Henderson. UF 142582 (photographic voucher). New county record (see Townsend and Krysko, *op cit.*). Found underneath wooden pallets in yard. VOLUSIA Co: Daytona Beach, W side of State Rd. A1A (N Atlantic Ave.) N of jct. Earl St. (29°13.81'N, 81°00.62'W). 15 August 2003. K. L. Krysko, K. M. Enge, and A. N. Hooper. UF 137426–7. New county record (see Townsend and Krysko, *op cit.*).

Iguana iguana (Common Green Iguana). COLLIER Co: Golden Gate, 1716 SW 46th St. SW (26°11.74'N, 81°42.04'W). 1998. S. Chrzanowski. UF 141486 (photographic voucher). New county record. In cypress tree; a few other individuals observed along canal. LEE Co: Cape Coral (26°33.75'N, 81°57.81'W). February

2000. J. Hollister and L. Hollister. UF 133209 (photographic voucher). New county record. Monroe Co: Upper Sugarloaf Key, 940 Loggerhead Lane (24°40.33'N, 81°32.15'W). 29 December 2001. K. L. Krysko and S. W. Morey. UF 131549 (photographic voucher). Four individuals observed feeding on a dock along a canal. 2 January 2002. UF 134836. Subsequent specimen collected. Stock Island, Key West Botanical Garden (24°34.41'N, 81°44.99'W). 7 August 2002. K. L. Krysko and A. N. Hooper. UF 133862 (photographic voucher). On buttonwood (*Conocarpus erectus*) tree. Little Torch Key (24°40.39'N, 81°23.41'W). 5 July 2003. K. L. Krysko. UF 137214. Hatchling on grass at base of *Conocarpus erectus*. Two other hatchlings and six adults observed within 100 m along canal. New county records. Palm Beach Co: Palm Beach Gardens, 2427 Marseilles Dr. (26°52.73'N, 80°04.38'W). March 2003. G. Ramseier. UF 137086 (photographic voucher). Female on floating platform in water. Documented also in Loxahatchee in July 2003 (UF 137181, photographic voucher). New county records.

Leiocephalus carinatus (Northern Curly-tailed Lizard). Monroe Co: Key Largo, Buttonwood Bay, 96000 Overseas Hwy (25°03.93'N, 80°28.46'W). 21 August 2003. K. L. Krysko, K. M. Enge, D. Giardina, and J. G. Duquesnel. UF 137527–28. New county record. Palm Beach Co: Belle Glade, 324 State Rd. 715 ca. 100 m N of Florida East Coast RR tracks (26°41.51'N, 80°41.05'W). 15 August 2002. T. S. Campbell. UF 134110–11. Represents an independent introduction ca. 65 km W of the Palm Beach population along the Atlantic Coast (King and Krakauer 1966; Wilson and Porras, *op cit.*). Numerous individuals of all size classes were observed on sidewalks, landscaping, and vegetation around the main entrance to the building and along the fence line N of the RR tracks.

Leiocephalus schreibersii (Red-sided Curly-tailed Lizard). Charlotte Co: Punta Gorda, State Rd. 17 ca. 1.3 km W of I-75 along N edge of right-of-way at S end of Solona Loop W (26°56.48'N, 82°01.87'W). 19 June 2003. T. S. Campbell. UF 137133–34. New county record; this locality is ca. 210 air km NW of the nearest reported population in Broward County (Townsend et al. 2002). Three adults and numerous hatchlings observed in sandy areas along fence line and on Solona Loop W.

Serpentes

Heterodon platirhinos (Eastern Hog-nosed Snake). Hernando Co: Croom Wildlife Management Area (28°33.19'N, 82°15.89'W). 29 March 2004. D. Smith. UF 141651 (photographic voucher). New county record. In former sandhill habitat among planted longleaf pine seedlings.

Ramphotyphlops braminus (Brahminy Blind Snake). Brevard Co: Eau Gallie, 4326 Sherwood Blvd. (28°10.63'N, 80°39.65'W). 15 October 2004. K. Pennick. UF 142697 (photographic voucher). New county record. Between the drywall and concrete block of a house. Citrus Co: Inverness, 804 Windy Avenue (28°49.29'N, 82°20.02'W). 29 August 2003. C. Fitzgerrell. UF 137720. New county record. Found inside house along with two other specimens. Collier Co: Marco Island, Hideaway Beach (25°57.53'N, 81°44.82'W). 21 November 2002. J. C. Seitz. UF 137071. New county record. Leon Co.: Tallahassee, Killearn Estates, Arklow Dr. near Tralee Rd. (30°31.25'N, 84°11.94'W). 29 March 2001. D. G. Cook. UF 140540. DOR. Tallahassee, Killearn Estates, 4130 Arklow Dr. (30°31.29'N, 84°11.98'W). 6 July 2002. D. G. Cook. UF 140541. DOR. New county records.

Seminatrix pygaea (Swamp Snake). Washington Co: State Rd. 90, 0.2 km W Holmes Co. line (3°47.32'N, 85°45.38'W). 27 April 2001. P. E. Moler. UF 123185. New county record.

Storeria victa (Florida Brownsnake). Manatee Co: Buckeye Road (27°37.41'N, 82°31.98'W). October 2002. L. Pike. UF 141264. New county record.

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Plethodon cylindraceus (White-spotted Slimy Salamander). USA: Virginia: Greene County. Photographic illustration by Will Brown (www.blueridgebiological.com).

Herpetological Review, 2005, 36(1), 88.

New Distributional Records of *Ambystoma talpoideum* (Caudata: Ambystomatidae) in Southwestern Arkansas

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Populations of *Ambystoma talpoideum* in southwestern Arkansas appear to be isolated or disjunct from populations in northern Louisiana, northeastern Texas, and eastern Oklahoma (Conant and Collins 1998; Petranka 1998; Trauth et al. 1993), and available information seldom defines whether populations are metamorphic or paedomorphic. Recent records (Caldwell and Tumlison 2003; Tumlison and Campbell 2002) prompted a survey for *A. talpoideum* in southwestern Arkansas, outside of its previously known range. Using dipnets and seines, we sampled aquatic habitats because aquatic *A. talpoideum* are more easily captured than the burrowing terrestrial adults (Bishop 1947).

Habitat descriptions (Bishop 1947; Dundee 1989; Petranka 1998) directed us to suitable sampling sites. Topographic and county maps were used to locate wooded, swampy, and lowland areas, then roads were cruised in those areas to identify specific sampling sites. At each site, several net drags were used to sample the pool.

Sampling from April 2002 to May 2004 produced several new records of *Ambystoma talpoideum* from the southwestern Arkansas region. Voucher specimens are housed in the Henderson State University (HSU) Vertebrate Collections in Arkadelphia, Arkansas. Identification of metamorphic and paedomorphic forms was aided by the photographs in Trauth et al. (2004), and verified by Stan Trauth. Metamorphic salamanders were collected from temporary pools. Paedomorphic forms were collected in small, permanent, fishless ponds.

CLARK Co., 8 km NW Gurdon (S27 T9S R21W), 23 February 2002 and 15 March 2002, Renn Tumlison, HSU 903–906, 1281. Only paedomorphic larvae (numerous) were found in one pond, and a single metamorphic form (1281) was taken from another pond located about 1 km distant. Center Grove Church Road, 0.8 km E Hwy 182 (S1 T9S R22W), 24 March 2002, Tobin Fulmer, HSU 1041, paedomorphic larvae. 10 km W Hollywood, Hwy 26 (S3 T8S R22W), 15 May 2002 and 26 April 2003, Brian Caldwell, HSU 1278, 1299, metamorphic larvae.

COLUMBIA Co., 3 km E McNeil (S16 T16S R20W), 25 April 1992, Renn Tumlison, HSU 1282, metamorphic larvae.

DALLAS Co., jct. Co. Rds. 245 and 247 (S6 T9S R17W), 22 April 2003, Brian Caldwell and Tobin Fulmer, HSU 1293, metamorphic larvae; 3.7 km S Ouachita, Hwy 7 (S34 T10S R17W), 22 April 2003, Brian Caldwell and Tobin Fulmer, HSU 1294, metamorphic larvae.

HEMPSTEAD Co., Co. Rd. 32, 0.6 km from jct. with Co. Rd. 27 (S9 T9S R26W), 26 April 2003, Brian Caldwell, HSU 1295, metamorphic larvae.

HOWARD Co., 5 km W jct. Hwys 26 and 369, (S30 T8S R27W), 27 and 28 April 2003, Brian Caldwell, HSU 1297, 1302, metamorphic larvae.

PIKE Co., 3 km SW of Murfreesboro, off Hwy 27 (S14 T8S R26W), 27 April 2002 and 26 April 2003, Brian Caldwell and Tobin Fulmer, HSU 1274, 1300, metamorphic larvae; NW of Murfreesboro (S3 T8S R26W), 4 May 2002, Brian Caldwell, HSU 1275, metamorphic larvae; 6 km SE of Murfreesboro, Hwy 301 (S6 T9S R24W), 5 May 2002, Brian Caldwell, HSU 1276, metamorphic larvae; 11 km SE of Murfreesboro, Hwy 301 (S15 T9S R24W), 15 May 2002, Brian Caldwell, HSU 1277, metamorphic larvae; 5 km SW of Murfreesboro, Hwy 27 (S23 T8S R26W), 15 May 2002, Brian Caldwell, HSU 1279, metamorphic larvae; 2.9 km SW Nathan, Co. Rd. 7 (S6 T8S R26W), 26 April 2003, Brian Caldwell, HSU 1296, metamorphic larvae; 1 km E jct. Hwys 29 and 301 (S35 T8S R23W), 9 May 2003, Brian Caldwell, HSU 1305, metamorphic larvae.

Acknowledgments.—We thank Stan Trauth for verifying identification of specimens, Fred Kizzia for permission to collect on his land, and Tobin Fulmer for field assistance.

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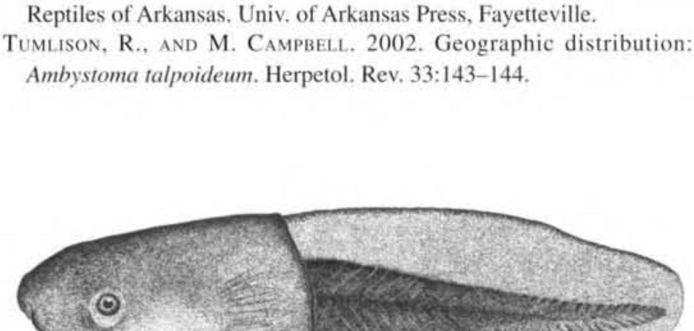

Gastrophryne elegans tadpole (KU 145983), 25 mm TL. Mexico: Veracruz: 2.6 im E Tolome. Illustration by Julian C. Lee.

BOOK REVIEWS

Herpetological Review, 2005, 36(1), 89.

The Exotic Amphibians and Reptiles of Florida, by Walter E. Meshaka, Jr., Brian P. Butterfield, and J. Brian Hauge, 2004. Krieger Publishing Co., P.O. Box 9542, Melbourne, Florida 32902-9542, USA (www.krieger-publishing.com). x + 155 pp. Hardcover. US $34.50. ISBN 1-57524-042-4.

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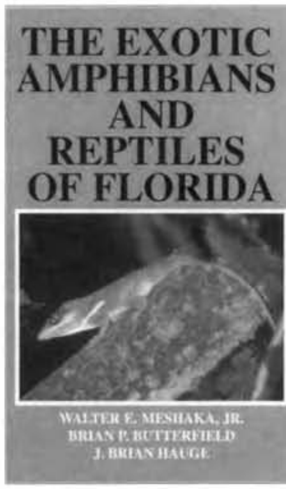

The presence of invasive species can potentially pose a severe threat to a region's biodiversity by altering natural landscapes and affecting its native biota. As an example, with just a quick trip through southern Florida, one can appreciate the dramatic environmental damages from invasive plant species. The impacts of introduced animals are often less visible, except when they become agricultural pests or nuisances. Although exotic amphibians and reptiles have been present in Florida since at least the mid 19th century, they have rarely drawn attention except from the occasional inquisitive citizen, curious about some unrecognized species in his yard.

This book includes an introduction, 40 full accounts of established species, 19 abbreviated accounts of species with uncertain status, an afterword, a glossary, two appendices, and references. The full accounts cover four frog species in three families, one turtle, 32 lizards in five families, two snakes in two families, and a crocodilian. These accounts include a description, information on body size, history of the introduction, current distribution, habitat, habits, reproduction, diet, and potential predators. A section in the full accounts on similar-appearing taxa is meant to separate more difficult species. Color plates and range maps are provided for the established species. The 19 abbreviated accounts provide information on occurrences of species not known to be established and breeding in Florida. A six-page Afterword by Walter Meshaka, entitled "The human role in the colonization of species in Florida," discusses the attributes of a successful colonizing amphibian or reptile species in Florida, the role the exotic plays "in the context of conservation," and recommendations for lessening the impacts of introductions on native species and habitats. Sadly, this section suffers from academic tedium that could have been written in a more inviting style to ensure the readership of the intended audience.

Guides such as this book will always represent a work-in-progress since there is no end in sight to the introduction of novel amphibians and reptiles to Florida. For example, between 2002–2004, more than 35 papers appeared in the literature that reported range extensions, possible extirpations, taxonomic clarifications, and new additions for Florida's exotic herpetofauna. These more recent citations can be found in the online bibliography maintained by the Florida Fish and Wildlife Conservation Commission (www.wildflorida.org/ herpbibl/default.asp). One thing for certain, Florida's list of exotic amphibians and reptiles will continue to expand as more and more species are incidentally or deliberately released in the state, despite state laws that prohibit such activities. As a result, investigating Florida's exotic amphibians and reptiles will remain a fertile field for research for years to come.

For the most part, the book is generally well constructed, easy to read, and contains interesting information. The accounts include numerous literature citations that allow readers to track information. Many of the accounts have tables that provide information on body sizes, activity patterns, reproduction, diet, and perch heights, which in my opinion adds little to the book's overall usefulness. The range maps are well constructed with symbols representing records without voucher specimens or photographs, general distributions, literature records, and unpublished records supported by museum specimens or photographs. The photographs are of mixed quality, although the blame may lie with the printing process rather than with the original photographs taken by many well-known herpetological photographers. One important drawback to the book is the lack of descriptive materials or photographs for reptiles in the abbreviated accounts. It seems to me that this was a missed opportunity to draw attention to species that lack confirmation in the state. The appendices add little to the usefulness of the book. The authors could have used common names throughout the text to improve general readership and depended on Appendix B to convert common and scientific names. A minor irritation…they misspelled *Heterodon platirhinos* in Appendix B.

The book by Meshaka, Butterfield, and Hauge belongs to the genre of the ever-growing field guides that market Florida's rich biota. *The Exotic Amphibians and Reptiles of Florida* will be of interest to those naturalists, particularly in southern Florida, who want to know more about the strange frogs, lizards, and other non-native herpetological species that appear in their neighborhoods. This book can provide them with a wealth of information on the histories that surround the introductions and how the animals came to reside in their backyards. The slim, hardback volume is overpriced, which probably will influence its availability for the people who would be best served by it.

Erratum

In Ken Kawata's article in the last issue of *HR* (vol. 35, number 4, page 317), Charles Shaw was mistakenly credited with bringing the San Diego Zoo's herpetological collection to prominence by 1930. However, the credit should have been given to C. B. "Si" Perkins. Shaw's tenure at the Zoo came much later, serving as Curator of Reptiles from 1954 until his death in 1971.

Herpetological Review, 2005, 36(1), 90–91.

The Amphibians and Reptiles of Arkansas, by Stanley E. Trauth, Henry W. Robison, and Michael V. Plummer. 2004. University of Arkansas Press, McIlroy House, 201 Ozark Avenue, Fayetteville, Arkansas 72701, USA (www.uapress.com). xviii + 421 pp. Hardcover. US $45.00. ISBN 1-55728-737-6.

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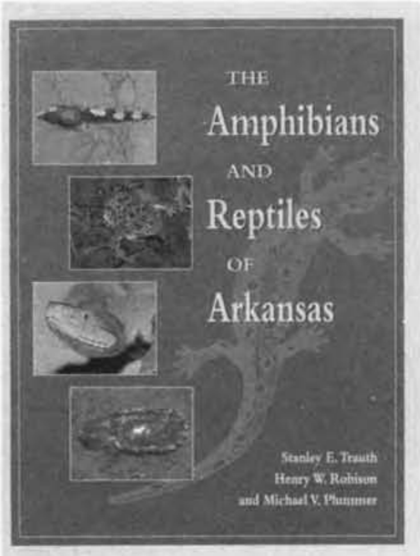

Arkansas is a state with a large and diverse herpetofauna with over 136 species and subspecies and, until now, it was a state without a field guide to amphibians and reptiles. *The Amphibians and Reptiles of Arkansas* is actually much more than a field guide in respect to both depth of material and size of the book. This book has been in the works for over two decades by the senior author and his efforts show.

The introductory sections of the book include a detailed history of herpetological studies in Arkansas stretching back over 100 years, starting with John Strecker and Julius Hurter in the early 1900s. The section is broken down by decade with each period, especially from 1970s on, showing increased herpetological activity compared to the previous decade. The high level of activity in the last 25 years is largely the result of the work of the authors and their students throughout the state.

"Classification and Species Checklist" shows what happens when multiple names lists are merged. The authors state that they use the scientific names from Crother (2000) and the common names of Conant and Collins (1998) and Collins (1997). They then recognize subspecies in Conant and Collins (1998), which differ from Crother (2000) and use common names found in Crother (2000), but not Collins (1997). I would have liked to see one name list used, preferably the officially recognized list (Crother 2000), since mixing of differing lists may confuse users of the book. Where names differ from the base list, such as competing lists or local names, relevant remarks can be included in the species accounts.

The "Ecoregions of Arkansas" section highlights the diversity of the state, with areas as disparate as the Ozark Highlands and the Mississippi Bottomlands. Topographic relief varies by region with as little as 50 m in the Mississippi Alluvial Plain to almost 800 m in the Arkansas Valley. The six different regions and twelve subdivisions in the state contribute to the high diversity of amphibians and reptiles. The authors do a good job describing the different habitats. This section is illustrated with representative photos of the major ecoregions.

The "Searching for and Observing" section provides good general insights into locating Arkansas herps. The variety of techniques covered goes from the mundane—dipnetting tadpoles from roadside ditches, to the exhilarating—rapids diving for Hellbenders. There are bolded passages throughout the section highlighting the ethical points of collecting. Other authors should highlight these points more often. The Conservation section carries on the theme of ethics. It also shows the authors' concerns about state agency practices that are detrimental to reptiles. These range from cold water discharges from dams to improve trout habitat, which negatively impacts turtles, to the limited regulations on the harvest of amphibians and reptiles, which leaves most of Arkansas' species open for commercial exploitation.

The species accounts constitute the majority of the book. The major groupings are preceded by illustrated keys and followed by keys to the larval forms. The adult keys work well and the line drawings by Renn Tumlison are very well done. The larval keys are the highlight of the book. The keys are illustrated with excellent photos of each species at different stages of development. This is something that is missing in most state amphibian books. The one species with "wow" factor is the gorgeous black-and-orange Bird-voiced Treefrog tadpoles. These are not your grandma's hylid tadpoles!

The accounts are broken down into description, Arkansas distribution, habitat and habits, conservation status and Arkansas literature and remarks. Each account also includes a detailed state distribution map and a generalized map of the national distribution. Multiple color photos accompany each account. Besides having a portrait of the species, the photos show interesting natural history and habitat information. The photos are well composed and large enough to show details. Having color photos throughout the books adds greatly to the user friendliness.

The accounts are complete with much Arkansas-specific data. The one disappointing species account is the Gray Treefrog (*Hyla chrysoscelis/Hyla versicolor*) "sibling species complex." These two species are treated as one, even though they have been known to be separate species, with different calls and habitats, for over 40 years. Several other authors (Collins 1993; Harding 1997; Johnson 2000) have also taken this route, but it is more noticeable here given the separate accounts for the four species in the "*Plethodon albagula* complex." Hopefully, when the authors are ready to do a revision, they will split the Gray Treefrog account.

The closing sections of the book include the most complete Glossary I have seen in a state work and a 28-page Literature Cited with close to 1000 citations. The book also has a large full-page map of the state with county names and major waterways.

The Amphibians and Reptiles of Arkansas has raised the bar for other state amphibian and reptile books. The authors did an excellent job and the book will be indispensable to all herpetologists and conservationists, especially those in Arkansas and surrounding states. I would also strongly recommend it to anyone thinking about writing a book about the amphibians and reptiles of their state or province. This is the new benchmark.

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Herpetological Review, 2005, 36(1), 91–92.

A Field Guide to the Herpetofauna of Fiji, by Clare Morrison. 2003. Institute of Applied Sciences, The University of the South Pacific, Suva, Fiji. 121 pp. Softcover. US $20.00. ISBN 982-01-0557-9.

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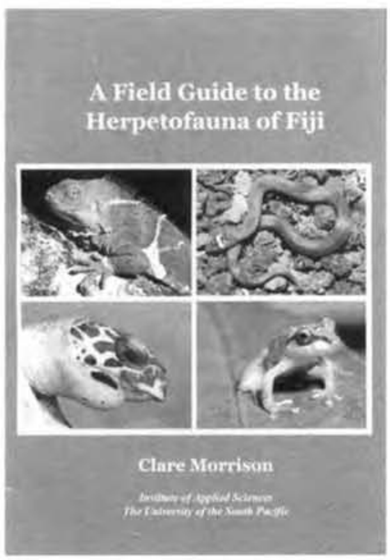

The Fijian herpetofauna comprises an interesting mix of endemics (including the Fijian iguanas — *Brachylophis*, the elapid *Ogmodon vitianus*, the skink "*Leiolopisma*" *alazon*, and the gecko *Lepidodactylus manni*) and a number of widespread species, both terrestrial and marine. Until now the only major modern work devoted specifically to the herpetofauna of the archipelago has been a technical monograph on the lizards by Zug (1991). Information on other groups (none of which are particularly diverse) may be found in more general works on the amphibians and reptiles of the Pacific or in more narrowly focused papers scattered through the herpetological literature. Thus, *A Field Guide to the Herpetofauna of Fiji* is a book with a niche to fill.

The book begins with a general section on reptiles and amphibians, a brief summary of the Fijian herpetofauna, and a short introduction to the geology, climate and vegetation of the island group. An accompanying reference map for Fiji labels the islands mentioned in the text, but is not particularly well reproduced. This will be sufficient to orient unfamiliar readers, but just barely. The remainder of the book consists of keys (frogs, lizards, snakes, and turtles), each followed by the relevant species accounts, organized alphabetically by genus and species regardless of family. Thirty terrestrial and nine marine species recorded from Fiji are treated, including introduced species, such as *Bufo marinus*, and apparent vagrants, such as *Lepidochelys olivacea*, which has been reported from only a single locality. The only omission appears to be *Crocodylus porosus*, which has been recorded as a stray stranding on Rotuma at least once in historical times (Gardiner 1919). Each account provides Latin, English, and Fijian names, a statement of status (native, endemic, or introduced), and brief sections on distribution, description, habitat, reproduction, behavior, threats (cats and mongoose as well as deforestation), and similar species. All accounts are accompanied by a point locality map of Fiji and one or more color photos (as well as line drawings of subdigital features for all geckos and all but one skink). The book closes with a glossary with 89 entries, a reference list, an index to species and genera, and a short appendix on finding, collecting, transporting, killing, and preserving specimens.

For amateur naturalists or visitors to Fiji, this concise book will certainly be an adequate guide to the fauna, although its binding does not appear to be up to the rigors of the field. The photographs are mostly of good quality, though sometimes too small, and the maps and habitat descriptions will help to narrow down the species likely to occur in particular areas. In some cases, however, use of the guide is likely to require having the specimen in hand, as some geckos (e.g., *Hemidactylus frenatus* and *H. garnotii*) and skinks (e.g., *Emoia cyanura* and *E. impar*) may require detailed observation of scalation and/or color pattern to permit unambiguous identification by the uninitiated.

Despite its general utility, herpetologists may be disappointed in some aspects of the book. Although typographical errors are few and inconsequential, there are enough misstatements or inaccuracies to be irksome. These include a statement that implies that salamanders and caecilians all have aquatic larvae and the contention that all reptiles posses a three-chambered heart. In the species accounts original tail length is reported as less than SVL in *Hemidactylus frenatus* (it is typically 100–110% of SVL; Bauer and Sadlier 2000) and a maximum size of 3 m is reported for *Candoia bibroni* (the actual maximum is under 1.5 m; Harlow and Shine 1992). Names and terms are also problematic: *Hemidactylus garnotii* is consistently misspelled as *H. garnotti*, the names Crocodilia and Testudinae or Testudinata are used rather than Crocodylia and Testudines, and the terms parotid (or paratoid) and oviducal are employed rather than the correct parotoid (Tyler et al. 2001) and oviductal (Smith et al. 1989).

More central to the goals of the book are difficulties associated with distributional data. To begin with, the source of the localities plotted is unclear, except that some are derived from the records of the United States National Museum. At least some of the island records appear to be previously unpublished, but their basis is not mentioned. In some cases there are significant mismatches between the localities mapped and the distributional text. For example, *Platymantis vitianus* has been recorded from Koro and Kadavu, points not plotted on the map, while the islands of Beqa and Ovalau, which are shown with localities plotted, are not mentioned as among the areas harboring the species. At least some of these inconsistencies seem to have a common source. For example *Gehyra mutilata* has been mapped on Taveuni and *G. vorax* on Kadavu, but these islands are not included in the distributional statements of the respective accounts. These appear to represent

localities reported by Zug (1991) based on sight or photographic records, which have here been excluded from the distributional statements but mapped identically to localities represented by voucher specimens. Other problems include omissions in the extralimital ranges of widespread taxa: the Loyalty Islands have been omitted from the stated distributions of *G. vorax* and *Candoia bibroni*, *Hydrophis coggeri* has not been mentioned for New Caledonian waters (see Bauer and Sadlier 2000; Ineich and Laboute 2002), and the occurrence of *Brachylophus fasciatus* in the French territory of Wallis et Futuna (Etheridge 1981) has not been noted. A final criticism is that references are not cited in the text, making it difficult to track primary sources of interest. Many of these are included, however, in the list of 36 references provided at the end of the book. But while this bibliography includes the majority of important references for Fijian amphibians and reptiles, including several published locally in *Domodomo*, the journal of the Fiji Museum, at least a few important references have been omitted including Brown and Myers (1949), Brown (1991), Bauer and Henle (1994), and Shea (1995).

Regardless of any faults, the paucity of literature on the herpetofauna of the Southwest Pacific dictates that *A Field Guide to the Herpetofauna of Fiji* will be a useful addition to the libraries of herpetologists with an interest in the region. It will also be a great help to local naturalists and ecotourists for whom access to (or interest in) the primary literature is likely to be limited. Thus, the book will undoubtedly "stimulate interest, understanding and appreciation for" the amphibians and reptiles of Fiji, and thereby achieve the most important of its author's stated goals.

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Herpetological Review, 2005, 36(1), 92–93.

Chameleons, Nature's Hidden Jewels, 2[nd] edition, by Petr Neças. 2004. Edition Chimaira, Frankfurt am Main (distributed in the USA by Zoo Book Sales, P.O. Box 405, Lanesboro, MN 55949-0405; www.zoobooksales.com). 380 pp. Hardcover. US $65.00. ISBN 3-930612-49-6.

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The original 1995 German edition of this book on chameleons was favorably reviewed by Bauer (1997a). Since then, a second German edition has appeared (1999) and a third German edition is being published concurrently with this second English edition. The current version is more than 100 pages longer than the first edition, despite being more restricted in its content (the genera *Brookesia* and *Rhampholeon* are to be dealt with in a forthcoming companion volume). Like the original version, the book is divided into a "general" section dealing with chameleon systematics and biology, as well as chameleons and human culture and chameleon keeping. This is followed by a longer "special" section with detailed species accounts covering 51 species (including eleven taxa added since the previous edition) of *Chamaeleo*, *Bradypodion*, *Furcifer*, and *Calumma*. The general section is aimed at a non-specialist audience, but provides much information and is fully referenced. Major topics include morphology, tongue projection, color change, reproduction, and behavior. The section on care in captivity emphasizes that different species require quite different conditions and includes sections on housing, feeding, health, and husbandry. Species accounts in the special section provide Latin and vernacular names in English, German, and French, as well as information on identification (characteristics), systematics and zoogeography (subspecies and distribution), and habitat. Each account closes with details of biology and captive care interwoven and a list of suggested literature sources. Accounts range from one to seven pages, reflecting the varying amount of information known about the species. All species treated are illustrated by a minimum of two color photos and many have eight or more. In many cases both sexes, as well as hatchlings or juveniles, are depicted, as are different color patterns.

In my previous review (Bauer 1997a) I complained about the quality of illustrations. In contrast, they are a real strength of the current edition, having expanded from 250 color photos to more than 450 with notable improvement in both quality and size (although in some cases the additional images are gratuitous). In addition the photos appear with their respective accounts (vs. grouped

in plates in the first German edition) and even a subpar computer-generated distribution map in the earlier edition has been scrapped in favor of a more informative and attractive color replacement. In all, at least 90 species, including several as yet undescribed, are figured.

The book ends with a series of useful appendices. One is a table of living species summarizing habitat and vegetation type, reproductive mode, and size. The others are more taxonomically relevant: an up-to-date list of living and fossil forms of chameleons with author, type locality (unfortunately not verbatim), and distribution, a chronological list of names of chameleons as originally described, with comments on the status of each name, and a list of chameleon generic names (both intentional and erroneously applied). These appear to be comprehensive except for two obscure synonyms, too recently "rediscoved" to be included (Böhme and Das 2002; Bauer and Petit 2004). A bibliography of nearly 2000 references, about twice the size of that in the original, provides a superb entree into the ever-expanding chameleon literature. The glossary of the original is again present, and again there is no index, except to figures.

I found relatively few minor misstatements or inconsistencies in the text (e.g., the pre-1994 names for South African provinces are still employed; Karachi—rather than Islamabad—is referred to as the capital of Pakistan). My main disappointment in this otherwise highly useful book is that it lacks a real review of chameleon phylogenetics. While this may be beyond the scope of a book mostly aimed at chameleon enthusiasts rather than professional herpetologists, at least a brief summary would have been appreciated. It also would have had practical relevance for the organization and application of names in the book. For example, both morphological (Bauer 1997b) and molecular data (Townsend and Larson 2002) have demonstrated that East African *Bradypodion* are not members of same clade as the southern African forms to which that name is correctly applied.

Although the primary audience for this book is likely to be the many keepers and breeders of chameleons, others will also find it a valuable resource. My copies of the earlier editions have been well-used and I suspect that I will turn to this new version in the future for its photos and bibliography in particular. No one has yet written the ultimate chameleon book, but with this volume Petr Neças and Edition Chimaira have produced an attractive and authoritative work that will be a valuable addition to the libraries of both amateur and professional herpetologists.

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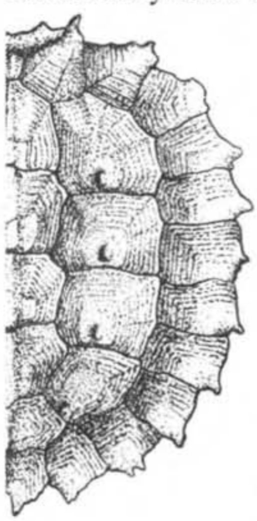
A New Facsimile Reprint from the Society for the Study of Amphibians and Reptiles

LES TORTUES DE L'INDOCHINE

by René Leon Bourret

Bourret's *Les Tortues de l'Indochine*, published in Vietnam in 1941, was the first complete and detailed monograph to deal with the turtles and tortoises of Southeast Asia. Although focused on French Indochina (Vietnam, Laos, Cambodia), the book treats the chelonian fauna of a larger area, extending from northeastern India to southern China to the Malay Peninsula. The book was based on work conducted during Bourret's decades of study in Vietnam and forms part of a series of his major publications on the herpetofauna of the region. More than 60 years after its original publication, *Les Tortues* remains an essential work in chelonian systematics and Southeast Asian herpetology. Published at the outset of more than 30 years of turmoil in the region, the book has long been a rarity and is among the most desirable of 20th century turtle books.



Detailed accounts are provided for 44 species of chelonians in 25 genera. Because of taxonomic changes these correspond to 56 currently recognized species in 34 genera. Species accounts are illustrated by more than 100 drawings and photos of whole turtles, skulls, carapaces and plastra. Six species are illustrated in color. In addition, the book provides a series of keys based on both skeletal and external characters, as well as chapters dealing with turtle morphology, the history of chelonian research in Indochina, and the faunal composition of the Indochinese region. An appendix on marine turtles and the turtle fishery in the Gulf of Siam by F. Le Poulain rounds out the volume, which also includes a 26-page bibliography.

Les Tortues de l'Indochine, originally published in the Notes de l'Institut Océanographique de l'Indochine, has long been out of print. With the publication of the new SSAR facsimile edition this classic book is again available to herpetologists with interests in turtles and tortoises or in the herpetofauna of Southeast Asia. The original French text is reproduced and a new English introduction by Indraneil Das of the Universiti Malaysia Sarawak places *Les Tortues de l'Indochine* in its historical context and provides an annotated correspondence between Bourret's nomenclature and that in current usage.

SPECIFICATIONS: 264 pages, 7 x 10 inches, 48 black and white and 6 color plates, clothbound. ISBN 0–916984–64–8. To be published April 2005.

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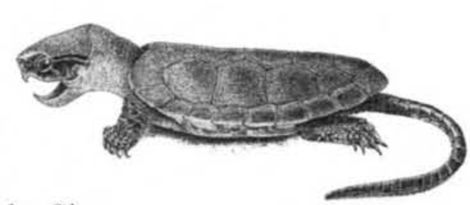

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TECHNIQUES

Herpetological Review, 2005, 36(1), 33–36.

In Situ Prevention of Anuran Fertilization: A Simple Method for the Detection of Sperm Competition with Potential for Other Applications

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Sperm competition is recognized as an integral component of sexual selection, shaping life-history characteristics such as body size, morphology, physiology and behavior (Birkhead and Parker 1997). Sperm competition occurs when there is competition between the ejaculates of different males for the fertilization of a given set of ova (Parker 1970). Therefore sperm competition can be shown by detecting mixed paternity using molecular methods (Queller et al. 1993; Roberts et al. 1999), by direct observation of multiple male - single female copulations (Birkhead and Parker 1997; Jennions and Passmore 1993) and by comparing relative testis sizes and sperm traits among and within species based on sperm competition theory (Byrne et al. 2002; Harcourt et al. 1981). However, despite the relatively high number of proposed methods it remains difficult to assess sperm competition in external fertilizers, and our knowledge of the occurrence of sperm competition in externally fertilizing anuran taxa has remained scarce (Halliday 1998).

In the externally fertilizing anurans, the production of offspring often numbering in the hundreds or thousands may render molecular paternity analyses uneconomical. Similarly, comparative methods using testis sizes and sperm traits require large sample sizes (sometimes more than a hundred) of sacrificed animals (Jennions and Passmore 1993; Kusano et al. 1991). This method is also problematic because it does not provide direct evidence for sperm competition (Birkhead and Parker 1997). Behavioral observations (e.g., Fukuyama 1991; Kaminsky 1997; Kusano et al. 1991) also share the latter burden.

In order to demonstrate the occurrence of sperm competition in a rhacophorid frog, Jennions and Passmore (1993) proposed a simple method for the documentation of sperm release by peripheral males in multiple male amplexes. Before oviposition, they placed the amplexed male's lower body in a plastic bag (20 x 20 cm) and let the pair spawn in the presence of peripheral males. After embryonic development they counted hatching larvae and unfertilized eggs. In control treatments, where peripheral males were excluded, fertilization success was zero, whereas in the experimental trial, where peripheral males were present, hatching success was nearly 37%. They concluded that plastic bags act as effective condoms, and that peripheral males sired the tadpoles in experimental treatments. Their method, however, has some substantial weaknesses: Jennions and Passmore only performed

two controls and one experimental trial, thus they did not test their method thoroughly for repeatability. They also noted that the plastic bag might have affected the rate at which peripheral males came into close contact with the female's cloaca, possibly reducing fertilization success. Furthermore, it is inevitable that the primary male would be hampered with its lower body completely wrapped in a 20 x 20 cm plastic bag, presumably leading to altered behavior and a strongly decreased ability to keep peripheral males away from the female.

We propose here an alternative technique that overcomes these problems by using condoms instead of plastic bags. Condoms were washed with soap before use to remove the lubricating gel, which could adversely affect study animals. After rinsing soap residue off with water, two holes were cut opposing each other in the condom. The size of the hole depended on the thickness of the proximal end of thighs of males, as it must prevent sperm leakage but not compress the blood vessels of the legs. Handling and fixing of the condom was easier when the condom was not unrolled completely. Once these preparations were completed, one person held the condom and stretched it open so that the holes for the legs became wide and the other person could easily pull the hind legs of the male one by one through the holes and smooth out the condom on the abdomen. The condom was fastened with two 20 cm long pieces of yarn bound as slings around the abdomen covered by the condom, one just under the fore-limbs and another above the hind-limbs and the cloaca (Fig. 1). The slings were tightened enough to prevent the condom from slipping down the body.

Amplexed pairs of *Bufo bufo* were hand-collected from a breeding-site in the Pilis Mountains (47°42'N, 19°01'E) 25 km N of Budapest, Hungary on five occasions in mid-April 2002. Pairs were transported in covered plastic boxes to the Ecology Laboratory at Eötvös Loránd University, Budapest, where trials were conducted within 24 hours of capture. Two inflatable plastic wading pools (120 cm x 120 cm, 60 cm deep) filled to a depth of 25 cm with aged tapwater were used as artificial egg-deposition sites.

We ran one control (no condom) and one experimental trial (with condom) at a time. Treatments were assigned randomly to wading pools. A total of five replicates were performed for each treatment. Pools were washed thoroughly with aged tapwater between successive trials. Treatments were terminated following egg deposition, which occurred within 16 hours in all cases. Animals were then removed and returned to the site of their collection, and egg strings were placed into uncovered boxes (55 cm x 35 cm, 30 cm deep) filled to a depth of 3 cm with aged tapwater. Eggs were stored for approximately three days at room temperature, so that embryonic development advanced to Gosner stage 18 (Gosner 1960). After this time fertilized and unfertilized eggs could be readily distinguished. In clutches taken from experimental trials we counted all eggs, but estimated egg number in the controls only to the nearest 100, as control treatments were only applied to test whether the experimental design grossly modified reproductive behavior and/or fertilization success. Embryos were reared until hatching and were then released at the site of their parents' collection. Experimental trials were video recorded to survey if the condom affected the behavior of the amplexed pair and whether it remained set in its place.

Bufo bufo females (N = 5) deposited on average 5305 eggs in

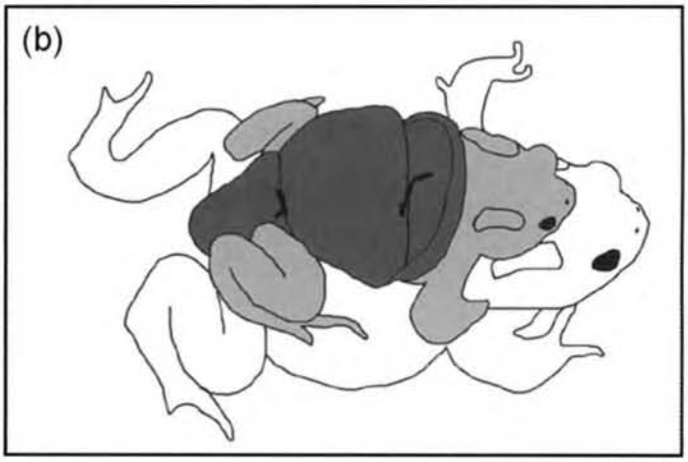

FIG. 1. (a) Photograph of an amplexed *Bufo bufo* male equipped with condom. (b) Diagrammatic interpretation of photograph in (a): Female: white, male: light grey, condom: dark grey.

experimental trials (N = 5; SD = 1121) and 5360 eggs in control treatments (N = 5; SD = 1064). We found no difference in number of eggs deposited between experimental trials and control treatments (Student *t*-test, $t_8 = 0.08$; $P = 0.938$). Average fertilization success was 0.303% (SD = 0.293) in experimental trials and 93.2% (SD = 8.55) in control treatments, and this difference was strongly significant (Mann-Whitney $U = 0.00$; $P<0.01$). In two cases the pair in the experimental trial started egg laying first, in three cases it was the pair in the control. There was no observable change in the position of condoms in any of our experimental replicates. Video records confirmed that the males did not try to remove the condoms, that the condoms remained in their position and that the males remained in amplexus until egg deposition was complete. After treatments, condoms contained an opaque fluid that we checked for spermatozoa under a light microscope, at 800x magnification. We found actively swimming spermatozoa in high numbers in the condoms of all experimental replicates.

Birkhead and Parker (1997) suggested two ways to detect sperm competition in internally fertilizing species: 1) by direct observation of multiple male mating assemblages, and 2) by detecting mixed paternity. However, it is important to note that both methods have limitations. In the first, copulation does not always result in insemination. In the second, it is possible that secondary males do not sire any progeny. Birkhead and Parker (1997) con-

cluded the combined use of both methods is desirable despite the difficulties in carrying out such studies. The same requirements should also apply to externally fertilizing species with the modification that, instead of multiple copulations, sperm release by multiple males targeting the same set of eggs must be detected. With our method it is possible to satisfy both of Birkhead and Parker's (1997) requirements without the use of molecular markers. If the focal male of a pair is equipped with a condom and the resulting clutch contains a high ratio of fertilized eggs, sperm competition can be assumed to occur under natural conditions as sperm from males other than the focal male must have achieved those fertilizations.

The testing of our method showed the following: 1) Fertilization success was negligible in all experimental trials, indicating that our method is effective in the retention of sperm of the amplexed male; 2) Among experimental trials we found low variance in fertilization success, showing our method to be highly repeatable; 3) Low fertilization success was due solely to the inhibition of fertilization by condoms, as average fertilization success in control treatments was comparable to that found in natural populations (A. Hettyey, pers. obs.) 4) Video records showed that the condoms applied as described stayed in position throughout the trials, allowing males to use their hind-legs without any difficulty. The condoms fitted *Bufo bufo* males tightly, clinging onto the males' abdomen and clearly not hanging over the females' cloaca. Thus they would not have prevented the sperm of other males from fertilizing emerging eggs; 5) High numbers of live spermatozoa were found in the condoms after termination of experimental trials, again documenting the efficacy of condoms in retaining the ejaculate. We note, however, that condoms appropriate for use in *Bufo bufo* and other large and medium-sized species may not be applicable for small frogs and toads. In this case pharmaceutical finger cots can be used instead of condoms (A. Hettyey, unpubl. data).

The fact that our method enabled the collection of ejaculates suggests other applications of this technique. For instance, artificial fertilization is a widely used method in a variety of studies (e.g., Berger and Rybacki 1992; Rakitin et al. 1999; Semlitsch 1994). In anurans the traditional method of obtaining sperm for artificial fertilization is to sacrifice and dissect the males, squash their testes, and then prepare sperm-suspensions (Berger et al. 1994). Such sacrifice may bring up ethical and conservation problems, possibly constraining the researcher's ability to obtain sperm from some populations or species. Gutleb et al. (2001) have shown that water that came into intensive contact with latex gloves can damage amphibian larvae. However, in our experiments, animals did not seem to be harmed by the condoms and the condoms contained live, actively swimming spermatozoa after trials. Consequently, we conclude that our technique allows the collection of sperm without killing or damaging males and allows the use of ejaculated sperm (which is superior in many aspects to sperm from dissected testes (Wilson et al. 1998). Another possible application is the testing of sperm competition theory suggesting differences among and within males in quality and quantity of sperm spent on distinct ejaculates (for a review, see Parker 1998). Predictions offered by theory have not been tested in anurans so far, probably due to the lack of an appropriate method of ejaculate sampling. As our technique retains almost the entire ejaculate, it offers the possibility to examine actual ejaculates and to compare them among or within individuals. Potential applications of our method are the detection of mating preferences at the level of ejaculate expenditure and toward male quality estimation based on sperm characteristics. Although this might be accomplished using the traditional dissection approach, our method collects only ejaculated sperm and avoids collecting samples contaminated with cells not directly involved with fertilization.

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"Shark Fishing": A Method for Determining the Abundance and Distribution of Sea Turtles at Shallow Reef Habitats

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The size and distribution of local marine turtle populations is critical for managers who need to know where and when the turtles congregate, what resources attract turtles to a given location, and how both the turtles and those requisite resources can be managed and protected. But obtaining this information is often difficult. Home ranges may be large, water clarity can be limited, and the turtles may avoid observers by fleeing or hiding before they can be detected.

The Palm Beach County, Florida (USA) Department of Environmental Resource Management has been aware that juvenile Green Turtles (*Chelonia mydas*) often were observed by local swimmers and divers near shallow water (1–5 m deep) reefs (Fig. 1). These reefs are long (up to 0.5 km), narrow (≤ 12 m wide), hard-bottom formations that parallel the shore along the Atlantic coast of southeastern Florida. In parts, the hardbottom is colonized by living worm reef, structures formed by the secretions of a colonial sabellariid polychaete (*Phragmatopoma lapidosa*). Throughout these reefs, sponges, soft and hard corals, and algae adhere to the hardbottom surface. Turtles feed on the macro-algae and seek shelter under ledges and within reef crevasses when inactive (especially at night; Wershoven and Wershoven 1988). Because the reefs provide food and shelter, they may constitute an important "developmental" (age-specific, temporarily utilized) habitat (Musick and Limpus 1997) for the turtles.

The reefs are popular boating and snorkeling sites. For that reason, we suspected that in-water observers towed behind a slowly moving, small boat would be an effective census method because the animals should be acclimated to both boat traffic and swimmers. This surveying method, colloquially referred to as "shark fishing" (derived from the towing of large "baits" [observers] through the water) is used in Hawaii by trap and spear fishers to locate prey. To our knowledge, no published studies have reported the use of this technique for estimating turtle abundance. We estimated the density of turtles in the shallowest of these discontinuous reef formations, and determined whether turtles were more abundant over the reefs than over the sandy areas separating reefs. Our results indicate that the method works in clear water and might be useful at other subtropical and tropical reef locations worldwide. We also describe its limitations.

Methods.—In-water surveys were performed by two observers wearing a mask and snorkel, each holding one end of a 5-m long tagline. The other end of each line was attached to each side of a slowly (2–3 nautical miles/h) moving small (~ 6 m long) powerboat, traveling directly over the reef axis parallel to shore. Observers visually scanned the bottom directly below and to the left (port observer) or right (starboard observer), as far as water clarity permitted (typically, 8–12 m to each side). When a turtle was seen, the boat operator was informed and stopped the boat to record the time, water depth, and the turtle's geographic position (using a GPS and depth sounder).

We surveyed the county's three primary shallow reefs (north, south, and middle reef), as well as three sand bottom areas at similar depth between the reefs (Fig. 1). The total length of the reef (12.1 km) and sand (10.0 km) surveys accounted for ca. 30% of the county's shoreline. Surveys were carried out in July–August 2001 (over 9 days), and in July–September 2002 (over 5 days).

The short north and south reefs were surveyed in a single day; the longer middle reef required several transects done over a 2–4 day survey period, with each sequential transect beginning where the previous transect ended. Longitude and latitude were noted at the start and end of each transect, as well as at five min intervals during each survey so that both transect paths and turtle sightings could be accurately depicted on nearshore maps. Surveys were usually made between 0800 and 1200 h to avoid afternoon thunderstorms.

Results.—We observed 62 turtles over the reefs during the 2001 survey, and 79 turtles during the 2002 survey; none was seen over open sand (2001 survey). Turtles either were resting on the bottom, swimming over the reef, or feeding (apparently, on benthic macro-algae). As we passed them, most turtles within 5 m swam away slowly to one or the other side of the boat's path. Turtles observed at greater distance ignored us.

During the 2001 survey, 68% (42 of 62) of the turtles were separated by short distances (≤ 40 m) from one another (Fig. 2). This pattern did not change during the 2002 survey.

Discussion.—Our shore-parallel surveys assume that all of the turtles can be sighted because the animals confine their movements to a certain (in this case, elongated reef) area (Gerrodette and Taylor 1999). Support for this assumption is provided by studies in progress. One of us (CM) recently attached sonic tags to six turtles from the middle reef; each has confined its movements entirely to a discrete home range located directly over the reef. These results provide further support for the hypothesis that juvenile Green Turtles establish home ranges over reef substrates

(Balazs et al. 1987; Brill et al. 1995, for Hawaiian turtles; Guseman and Ehrhart 1990; Wershoven and Wershoven 1988, for Florida turtles; Seminoff et al., *in press*, for Baja California turtles).

"Shark Fishing" as a survey technique has several advantages. It is (i) technically simple, (ii) time-efficient (5–9 d required to survey 12 km of reef), (iii) requires no permit (and lengthy review process), and (iv) does not appear to disturb the turtles. But the method also has limitations. Good visibility (≥ 7 m) is required. Because turtles are not individually identified they may be counted more than once, especially when reef tracts are long and require several days to survey. The method assumes that the population is static (no immigration or emigration) during the survey period. At our site that assumption is probably correct during the summer when the turtles occupy fixed home ranges, but not during the spring and fall when juvenile Green Turtles are known to seasonally migrate (Bresette et al. 1998). Because size is estimated (rather than precisely measured), information on size class distribution is limited.

In Palm Beach County and elsewhere in South Florida, similar reef formations are also located in deeper water, and Green Turtles are routinely observed there (J. Abernathy, SCUBA adventures, pers. comm.; Ben Harkanson, Palm Beach County Reef Research Team, pers. comm.). Thus, our survey is an incomplete assessment of reef-dwelling population density; counts made by divers (using SCUBA) over the deep reefs are also required.

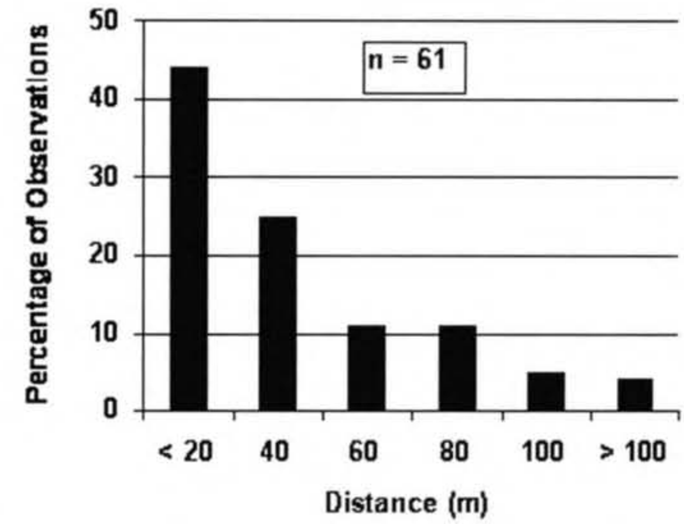

FIG. 2. Distribution of distances between turtles observed over the reef, 2001 field season. N = number of intervals.

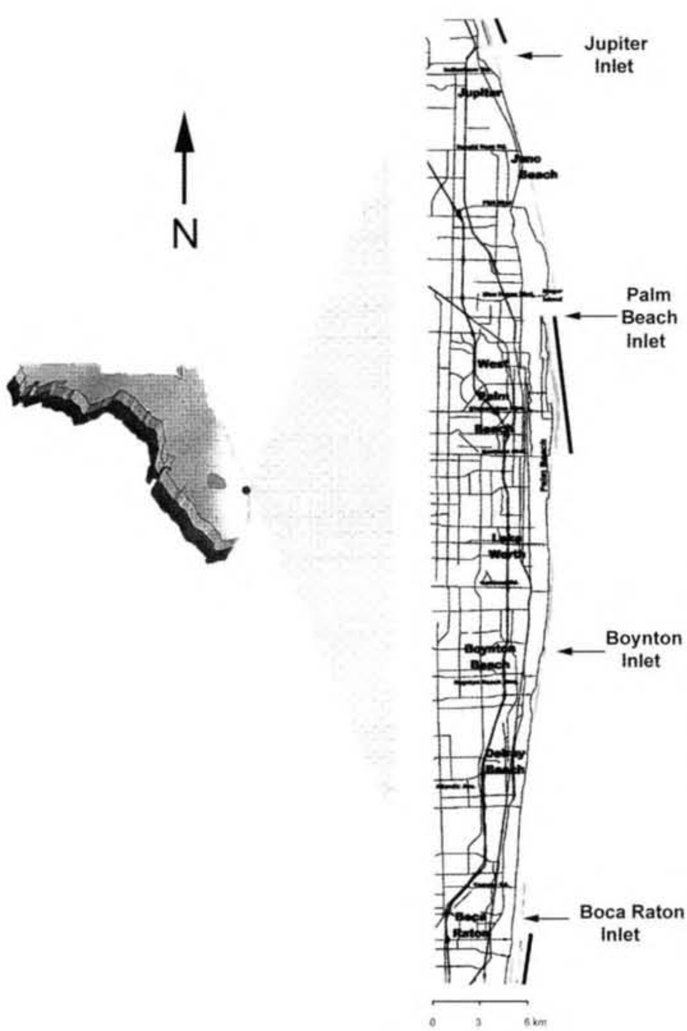

FIG. 1. Coastal shoreline of Palm Beach County, showing the major inlets and the approximate location of the north, middle, and south inshore reefs (dotted lines).

At other developmental habitats in Florida, different methods are used. One procedure is to count the number of turtles seen surfacing to breathe as a boat and its operator travel along a transect line. This method is useful where water clarity is limited, but is compromised when the water surface is disturbed (by waves or rain) or the turtles occur at low densities (reducing the probability of detection; Gerrodette and Taylor 1999). We observed only five turtles breathing at the surface during our 2001 survey. Additionally, surface counts must be corrected for turtles that are submerged at the time of the survey and, because individuals are not identified, some turtles may be counted more than once. Thus, headcount surveys (including those obtained by shark fishing) can be used to estimate densities of turtles, but not their absolute population sizes.

Another procedure, useful in shallow lagoons and tidal channels where visibility is limited, involves the use of tangle nets (Ehrhart and Ogren 1999). Captured turtles are marked using flipper tags. Their recapture probabilities are determined over repeated net sets. The procedure is labor intensive, but it is effective for estimating relative abundance if continued over several months or years. Population estimates based upon mark and recapture techniques, however, also carry assumptions (e.g., there are no deaths, immigration and emigration rates are constant, tags are not lost, tagging does not affect recapture probability, etc.). Nonetheless, this is the preferred method at some habitats, such as the Indian River Lagoon (Ehrhart and Ogren 1999; Mendonça 1983; Mendonça and Ehrhart 1982). Netting is difficult at oceanic nearshore reefs where tidal flow and surge can cause the net to be caught on, and damaged by, the reef. However, it has been successfully employed to estimate Green Turtle relative abundance and seasonal occupancy at habitats where water clarity precludes direct observation (Guseman and Ehrhart 1990).

In-water "Shark Fishing" surveys are an effective procedure for estimating Green Turtle population densities in clear water habitats. These observations can be enhanced by using sonic and/or satellite telemetry to pinpoint daily and seasonal movements. This information is essential for specifying home range characteristics, and for insights into both ecological requirements as well as for effective management and protection strategies (Mendonça 1983; Musick and Limpus 1997). Our two-year study, for example, provided important baseline information to Palm Beach County personnel. A beach restoration project is planned for the coastline adjacent to the middle reef where the Green Turtles are most concentrated. Pumping sand to the beach can have consequences that seriously compromise the integrity of near-shore reef habitats (Crain et al. 1995). Our data will make it possible for the County to assess these effects on Green Turtles, which are currently listed as endangered under the authority of the Endangered Species Act (National Marine Fisheries Service and U.S. Fish and Wildlife Service 2002).

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Mechanical Excavation of Gopher Tortoises for Translocation Using Heavy Equipment

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As human encroachment into upland areas inhabited by Gopher Tortoises (*Gopherus polyphemus*) has accelerated, the need to protect tortoises during construction activities has increased. Commonly, tortoises at construction sites are captured and relocated or temporarily displaced until construction is complete (Wester 1995). Various methods of capture are employed; including opportunistic capture by hand, live trapping, and excavation. Capturing tortoises by hand depends on finding them out of their burrows. If the capture is made while the tortoise is within the burrow, it can be injured in its retrieval. Live trapping often takes many days to accomplish. Increasingly, excavation has become the method of choice for the capture and translocation of Gopher Tortoises. Excavation involves digging tortoises out of their burrows either with a hand shovel or by mechanical means. Although we do not advocate one method of capture over another, here we report on an effective method for mechanical excavation of Gopher Tortoises.

Currently, no uniformly recognized standards exist for mechanical excavation of Gopher Tortoises or their commensals. We have used the technique described here since 1994 to excavate Gopher Tortoises in Mississippi, Alabama, and Florida. The method is not complicated, but involves expensive equipment and skilled personnel. We present our findings so that the process of mechanical excavation can be standardized and made safer for tortoises, burrow commensals, and personnel involved in the procedure.

The equipment necessary to successfully excavate a tortoise burrow with the methodology described here is listed in Table 1.

Biological Considerations.—The presence and location of tortoises and commensals should be determined before digging to

help ensure capture without injury. A burrow camera can be used to survey the length of the burrow for occupancy. The usefulness of these devices is highly dependent on equipment design, field conditions, and the skill of the user. If burrow occupants can be seen with a camera, it may be possible to determine the species present, number of individuals, and location within the burrow. Knowing the relative position of the burrow occupants will help avoid injury during excavation. Knowing the species present also may influence the process (e.g., some vertebrate species may leave voluntarily overnight once disturbed).

Most mammal and bird species tend to leave tortoise burrows voluntarily given the opportunity. We recommend that commensals that do not leave the burrow voluntarily be translocated along with tortoises. Commensals may include vertebrate as well as invertebrate species (Franz 1986; Jackson and Milstrey 1989; Speake 1981; Young and Goff 1939). Certain species, such as Gopher Frogs (*Rana capito*), over-wintering snakes, and Florida Mice (*Peromyscus floridana*) may require relocation via excavation.

It is important to keep in mind certain other circumstances when determining burrow occupancy. Multiple occupants in a burrow, although not common, may occur at any time of the year, especially during the breeding season, April to June. In addition, flooded burrows are not necessarily unoccupied. We excavated two tortoises from the same burrow after a burrow camera revealed the burrow to be flooded and no tortoises were observed above the water line. Even though burrow cameras can be quite useful, they cannot be relied upon to determine if a burrow is unoccupied. All burrows should be considered occupied until proven otherwise.

Preparing the Burrow for Excavation.—Prior to disturbing the burrow, measurements, photos, and other descriptive data should be recorded. The burrow apron then should be thoroughly excavated by hand to find and protect any unhatched reptile eggs.

Gopher Tortoise eggs, which are hard-shelled and brittle, will generally be found 10–26 cm deep (Diemer and Moore 1994; Hallinan 1923; Landers et al. 1980) between April and September (Brode 1959; Mount 1975). Because the nesting season for Gopher Tortoises varies so widely across the range, we recommend excavation of the apron at any time of the year. Eggs should be marked on top with a pen or pencil; gently transferred to an insulated, padded container without altering orientation; immediately translocated to an area with similar ground quality and canopy cover, such as another burrow apron; protected from ground traffic; and buried at the same depth as found. To deter predators, wire fencing or other protection of sufficient mesh size to allow hatchlings to escape should be placed over the new nest site (Butler and Sowell 1996; Landers et al. 1980; Wilson 1991).

Plastic conduit tubing, such as 1.9 cm (3/4 inch) outside diameter PEX tubing, with graduation markings along the length, and with an attached blunt end fitting should be inserted to the end of the burrow and left in place. An empty, single-serving plastic soda bottle taped to the tubing works well for this purpose. This serves as a guide to determine the location of the burrow channel during excavation. The blunt end allows the tube to be inserted without embedding itself in the wall of the burrow. Mechanical excavation can begin once the plastic conduit is fully inserted into the burrow.

Excavation.—Utilization of heavy equipment is inherently dangerous. Skilled, properly licensed backhoe operators and trained biologists should be involved. Local and federal authorities governing the disposition of tortoises or their commensals should also be involved in the process. This includes procurement of proper permits and licenses. In addition, guidelines for safe operation of heavy equipment and excavating procedures as put forth by the Occupational Safety and Health Administration (OSHA) should be followed.

The backhoe is positioned ca. 4–6 m (depending on the length of the excavating arm) behind the burrow entrance (opposite the apron) and over the burrow tunnel, with the excavating bucket extending toward the burrow entrance. One or more ground personnel direct the backhoe operator during the entire excavating process. Burrow tunnel direction can be communicated to the operator by placing a shovel handle in the burrow showing the long axis of the tunnel. The skill of the backhoe operator is essential to safe excavation. The flat leading edge of the bucket is used to scrape away earth over the top of the burrow in a horizontal pulling or "sweeping" motion. It is important that the bucket be pulled horizontally toward the backhoe and not allowed to dip or arc into the tunnel. The depth of each pass of the bucket into the ground should increase only by centimeters with each pass. Done properly, the backhoe bucket should never enter the lumen of the tunnel. Ground personnel should remove the layer of earth comprising the top of the burrow with hand tools and determine the direction of the tunnel. Often, the tunnel will change direction and the backhoe must be repositioned to orient the pull of the bucket parallel to the direction of the tunnel. The guide tube should be checked frequently for proper insertion and advanced as far toward the end

TABLE 1. Necessary equipment for Gopher Tortoise burrow excavation.

Equipment	Approximate Cost (US $)
Backhoe Loader (416 or 420 Caterpillar or equivalent), equipped with 0.61-m wide bucket with a smooth cutting edge (i.e., no digging teeth)	$300/hr with operator
Closed-circuit burrow camera (see Kent et al. 1997)	$2,500
Portable drill	$100
Calipers	$41
Scales	$35-$75
35-mm Camera	$5-$500
Tape measure	$10
Pump sprayer (4-12 liter garden sprayer)	$20
10% Chlorine bleach (sodium hypochlorite)	$1
Shovel	$20
Flexible plastic conduit (6.7 m length, 1.9 cm diameter)	$5
19-Liter bucket	$10
Latex gloves	$17

of the burrow as possible. If a burrow camera could not initially visualize the entire length of the burrow, the camera should be used to recheck the burrow frequently during the excavation process. The burrow should be carefully excavated until the guide tube shows at least 1.25 m or more of burrow tunnel remaining. At this point, only shovel and hand excavation by ground personnel should be used to avoid injury to the occupant(s). Frequent visualization of the burrow and probing by hand should help avoid inadvertent injuries.

Tortoises and commensals should be removed when sufficiently exposed. Although burrow occupants normally retreat to the end of the burrow, we have not found a definitive means for determining if the end of the burrow has been reached. Tortoise burrows do not typically terminate in a "chamber" or other readily identifiable configuration. The following criteria, however, can be helpful in determining when a burrow has been completely excavated:
1. Soil may be more compact at the end of the burrow;
2. There may be a change in soil color and/or texture;
3. There may be a buildup of tortoise fecal material;
4. Often there is a collection of invertebrates (e.g., camel crickets, *Ceuthophilus* spp.) and/or surface vegetation at the end of the burrow; and
5. The insertion length achieved by the burrow camera and guide tube should correlate with the actual burrow length.

The burrow terminus should be carefully and thoroughly examined for additional tunnel branches (uncommon), commensals, and tortoises. Hand excavation is complete when one is convinced the entire burrow has been excavated. The vertical depth of the excavated trench should be measured prior to backfilling to determine the depth of the burrow. Burrow depth should be recorded along with other relevant burrow data, such as height and width of burrow opening and length of burrow. For an average burrow, the entire excavation process usually can be completed in less than an hour.

All materials used in excavation, data collection, and relocation, including the backhoe bucket, should be disinfected after each excavation/relocation. We used a hand held pump sprayer containing a 10% solution of sodium hypochlorite in water (bleach) (Smith et. al. 1998). The disinfectant should be allowed to dry or rinsed from the equipment and not contact live animals.

Data Collection and Relocation.—Biological information may be gathered on tortoises and commensals prior to relocation. To prevent the potential spread of diseases, a clean pair of disposable latex gloves should be worn when handling each animal. We recommend marking (Cagle 1939) and photographing tortoises for future identification. All animals to be relocated should be placed in their own appropriate holding container, protected from sunlight, temperature and humidity extremes, and relocated as soon as possible.

Wester and Kolb (1997) and Thomas (2002) have shown evidence that Gopher Tortoises displaced from their burrows but not released beyond major barriers such as streams or wetlands tend to remain in the vicinity of their release. We have noted tortoises attempting to re-excavate their original burrows within hours after being displaced. It is therefore important to re-check areas where tortoises have been excavated in order to avoid re-colonization of the site.

Historical Success Rates.—The capture and relocation of Gopher Tortoises by any means can cause stress, and all methods have some risk of injury. Excavation of burrows by mechanical means is a fast and effective method of displacing tortoises from construction areas, and if done correctly, presents minimal risk to the animal. Wester (1995) utilized a variety of methods to displace Gopher Tortoises along a pipeline corridor. Of 1514 tortoises displaced using a method of mechanical excavation similar to that described here, 15 (0.99%) suffered relatively minor injuries and were subsequently released, nine died (0.59%) or were euthanized as a result of injuries, and nine burrows collapsed during excavation and could not be reopened. Occupancy was in doubt for some of the collapsed burrows, but assuming a single tortoise occupied each, total mortality was 1.19%. Of the nine confirmed mortalities, at least one tortoise ascended the burrow during excavation, resulting in the operator and ground crew being unaware of its location. In another case, the burrow ascended toward its end, leaving the occupant at a shallower depth than anticipated. Other possible causes of mortality may have resulted from either operator error (allowing the backhoe bucket to go too deep and therefore invade the burrow cavity) or ground crew error (not using hand excavation soon enough near the burrow terminus). The nine burrow channels lost during excavation resulted from inadvertent removal of the guide tube during excavation or inadequate placement of the tube (end of the tube did not reach the end of the burrow) prior to digging.

We have successfully displaced several hundred Gopher Tortoises using the technique described without injury/mortality to burrow occupants. Utilizing data from several relocation projects with which we have had personal experience, including Wester's (1995) study, we estimate that a mortality rate of less than 2% for mechanical excavation with experienced personnel can be expected.

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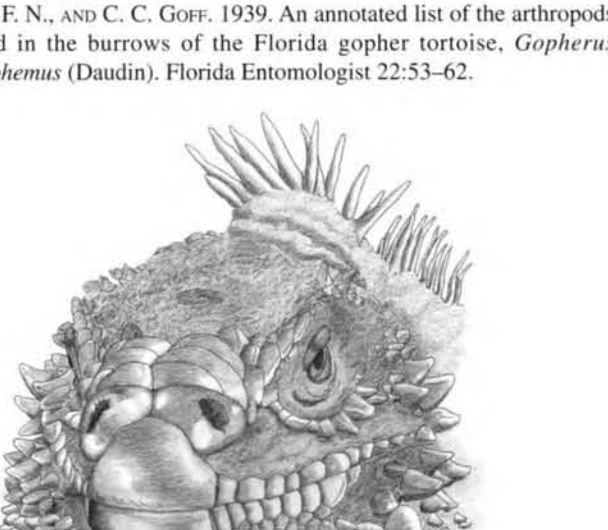

Cyclura lewisi (Grand Cayman Blue Iguana). Adult male, well over 30 yrs old, held at Queen Elizabeth Botanical Gardens, Grand Cayman. Largest known example of this species. Illustration by John Bendon (Lizardwizard@btinternet.com).

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A Technique for Sampling Lizards in Rocky Habitats

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Many techniques exist for sampling a vast array of lizard species, including noosing poles, grab sticks, scoop buckets, sticky sticks, rubber bands, sticky traps, and habitat traps (Bauer and Sadlier 1992; Bertram and Cogger 1971; Brattstrom 1996; Downes and Porges 1998; Durtsche 1996; Simmons 1987; Whiting 1998; Witz 1996). However, many lizard species live in habitats where sampling is inherently difficult. In particular, open rocky areas make sampling lizard populations difficult. This may be because lizard species inhabiting open rocky habitats often exhibit behaviors (e.g., increased wariness and/or flight distance), morphologies (e.g., increased relative limb length), and performance abilities (Bauwens et al. 1995; Melville and Swain 2000; Vanhooydonck and Van Damme 2003) that can make their collection both time consuming and labor intensive. Collecting is further compounded by the large number of potential refugia that are typically available within rocky habitats, resulting in lizards usually being close to suitable cover (Ingram and Covacevich 1978).

In an attempt to sample several skink species from rocky habitats in eastern Australia we searched for published reports of techniques that could be extended to collecting saxicolous species. In our experience we found most species to be too wary for capture by noosing, grab sticks, or sticky sticks. In an effort to increase capture success we used sticky traps (Zoro Zoro® cockroach traps, Japan Food Corp., Sydney, N.S.W.) baited with *Tenebrio* larvae or adult crickets (*Acheta*). Although this technique was an improvement on the former methods, it was also labor intensive, time consuming, and relatively ineffective in rocky habitats. For example, capture rates were relatively low (0.76 animals/hr), even with two persons each operating two traps. An additional problem with the collection of lizards with sticky traps is that captured individuals would occasionally autotomize their tail while struggling to free themselves from the trap. Because we were specifically interested in the locomotor performance of individuals with complete tails, this technique rendered such individuals inappropriate for study (e.g., Garland and Losos 1994; Melville and Swain 2000). More importantly, because a number of the species we intended to investigate are classified as threatened or rare, we were also concerned about the possibility of mortality following capture using sticky traps (Vargas et al. 2000).

Here we describe a simple and effective method for the collection of actively foraging lizards occupying rocky habitats. This technique may also be used to provide estimates of abundances within these habitats. The technique is a pitfall-style trap consist-

TABLE. 1. Capture-success rates using this technique and two other collection methods for five species of rock-dwelling skinks from eastern Australia. Numbers in parentheses indicate the total number of hours that each technique was used.

TAXON	HABITAT TYPE	BAITED BUCKET TRAPS (captures/trap hr)	BAITED STICKY TRAPS (captures/trap hr)	HAND CAPTURE (captures/person hr)
Carlia scirtetis	Granite boulders	2.1 (18)	1.1 (25)	0.3 (21)
Cryptoblepharus litoralis	Rocky coastal zones	3.4 (22)	—	1.8 (32)
Eulamprus brachysoma	Rock outcrops, boulders	3.1 (11)	—	2.6 (13)
E. tympanum marniae	Basaltic flows	2.25 (89)	2.1 (83)	—
Lampropholis mirabilis	Small river boulders	3.8 (38)	2.4 (24)	1.9 (64)

ing of a bucket and a tray of live food (*Tenebrio* larvae, or adult crickets, *Acheta*, with their hind legs completely removed). A circular tray (10 x 2 cm) containing live prey is positioned centrally at the same level as the mouth of the bucket or pitfall container (Fig. 1). The trap is then positioned between adjacent rocks or placed in a suitably sized vertical crevice so that the mouth of the trap is level with the rocks. We used traps with a 30–40 cm depth and a 40–50 cm mouth diameter. For traps of this size the distance

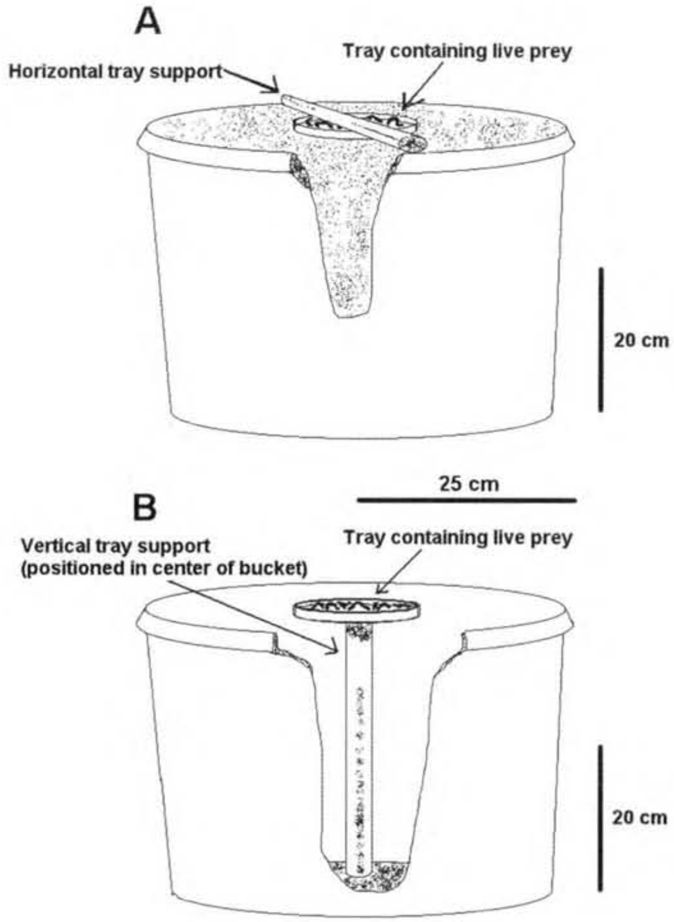

FIG. 1. Two variations of the baited-bucket trap that can be used to collect saxicolous lizards. The food tray can either be attached to the underside of a dowel spanning the mouth of the bucket (Fig. 1A), or mounted on top of a dowel that is fixed vertically to the center of the bucket (Fig. 1B).

from the edge of the prey tray to the edge of the bucket is 15–20 cm. As both trap diameter and depth may influence the size and composition of lizards species collected (Blomberg and Shine 1996), some experimentation with the design may be necessary. In addition, it may be necessary to secure traps into the desired position using supports or adhesive tape. Lizards are attracted to the trap by the movement of live food within the food tray.

Depending on the target species, we use one of two variations of our general trap design. The food tray can either be (1) attached to the underside of a dowel (1–2 cm diameter) that spans the mouth of the bucket (Fig. 1A), or (2) mounted on top of a vertical dowel that is fixed centrally to the base inside the bucket, such that the food tray is level with the mouth of the bucket (Fig. 1B). In the former design lizards are trapped in either of two ways: the lizard falls into the bucket while negotiating the dowel in an attempt to reach the food tray or, because the food tray is fixed to a dowel that is free to move, once on the tray the mass of the lizard causes the dowel and food tray to rotate causing the lizard to fall into the bucket. In the latter design, lizards fall into the bucket when they attempt to jump onto or from the food tray. We achieved the highest success (2.1–3.8 lizards/trap hr; depending on species) when we placed the trap in highly visible areas where live prey is more likely to be seen by active lizards from perching or basking sites. In hot environments, traps should be placed in shaded areas to avoid exposing the prey and captured animals to lethal temperatures, or refugia (e.g., leaf litter) could be placed in the buckets.

This collection technique allows a single researcher to set out and monitor a large number of traps. We have used this technique to collect small (SVL 30–100 mm; 1.3–25.0 g) saxicolous skinks that occur in several types of rocky habitat (Table 1). Overall, the baited bucket method provided marginal to substantial improvement in capture success for these lizards relative to other widely used collection techniques (Table 1). The technique is nondestructive and traps are quick to set-up and can be adapted to suit most types of rocky habitats. Further, because it is usually possible to position traps in a predetermined grid pattern within a rocky habitat, this technique may also be used to estimate lizard abundance. Although we have specified the use of this technique in rocky habitats, it might also be adaptable and effective in other habitats (e.g., arboreal rainforest species) where traditional collection techniques (e.g., pitfall trapping) are problematic.

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Using Alpha Numeric Fluorescent Tags for Individual Identification of Amphibians

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Drawbacks of various marking techniques for amphibians include potential harmful effects (toe-clipping; Brown 1997), mark longevity (toe-clipping, ink Panjet marking; Brown 1997), and cost (PIT tags; Brown 1997; Ireland et al. 2003). Recent techniques also can have varying negative effects such as length of handling time and invasiveness (e.g., pressurized fluorescent marking, coded wire tags, visible implant elastomers; see Nauwelaerts 2000 and Ralston Marold 2001 for review). Prefabricated biocompatible fluorescent tags (Soft VIAlpha Numeric Tags; Northwest Marine Technology Inc., Shaw Island, Washington) have been used extensively on fish (Frenette and Bryant 1996) but have not been tested on amphibians. Each tag is imprinted with a letter (A–Z) followed by a number (00–99) available with various color schemes (e.g., black letters on a red, orange, or yellow fluorescent background or the reverse). We conducted experiments to assess ease of application, readability, and tag retention on a variety of amphibians including 376 *Pseudacris regilla* (Fig. 1), and 1–3 *Taricha granulosa*, *Bufo boreas*, *Rana cascadae*, *Spea intermontana*, and *Rana luteiventris*.

Animals were tagged by making an incision using a sterile standard-size blood lancet and then inserting the tag using forceps or an injector (provided by Northwest Marine Technology). Individuals were physically restrained by hand with no anesthesia used during the procedure. Depending on the species, the tags were placed in the subcutaneous layer near the sartorius muscle on the ventral side (*Pseudacris, Rana, Spea, Bufo*), or into the tissue near the base of the tail on the dorsal side (*Taricha*). Post-injection sterilization consisted of cleaning forceps or injector with alcohol. Juveniles and smaller-sized amphibians such as *P. regilla* (size 15–45 mm) and *T. granulosa* (juvenile) were tagged with the smaller (1.0 x 2.5 mm) tags, and all other amphibians were tagged with the large (1.5 x 3.5 mm) tags. Retention rate, readability, and survival were monitored in the laboratory for 10–120 days depending on species studied. Further, a field test of tag efficacy was conducted with *P. regilla*.

Pseudacris regilla were tested on three occasions. First, tags were forceps-inserted in 10 individuals. The procedure was tedious requiring at least one minute per individual. Animals were monitored in the lab for 120 days; tag retention was 80% (2 tags slipped out the original incision), all tags could be read without ambiguity, and all animals survived. Second, 23 individuals were injector-tagged (using a blood lancet to make the incision) with tags of different color schemes (orange, red, and green tags with black lettering, and black tags with orange, red and green lettering) to compare readability. Injections took less than 15 sec per

FIG. 1. The alpha numeric tag for individual identification of amphibians.

animal, and animals were housed in the lab for 90 days; all tags were retained and readable without ambiguity. Survival of marked animals was 96%. One animal died because it became trapped between the cage and its lid. Third, 468 *P. regilla* were tagged and released into their natural habitats, of which 59 individuals were recaptured up to 210 days after tagging, with no apparent inflammation or swelling of insertion area, or deterioration of tags.

One *T. granulosa* was injector-tagged into tissue. The procedure took about 30 sec, the animal was housed for 60 days, during which time the tag was retained and was readable without ambiguity. Similarly, *B. boreas* (N = 1), *R. cascadae* (N = 1), *R. luteiventris* (N = 1), and *S. intermontana* (N = 3) were injector-tagged. The procedure took less than 30 sec, individuals were housed for 10 days, during which time all survived and retained their tags which were readable without ambiguity.

We found VIAlpha tags were efficiently applied when the tag injector was used in combination with a blood lancet. Survivability of animals and retention of tags was high. Further, tags were readable with no deterioration after 210 days. Tags cost approximately US $1.00 per tag, and the injector is approximately US $120.00. This appears to be an effective and low cost method for individually marking and identifying amphibians.

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An Improved Method for Karyotyping Anuran Chromosomes

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Karyotyping is an effective and simple tool for analyzing basic genetic characteristics of organisms. This method is especially useful when assessing the presence in a given area of the morphologically indistinguishable species of the Gray Treefrog complex, *Hyla chrysoscelis* and *H. versicolor* (Wasserman 1970), found in the eastern United States because these species can be identified by chromosome number. Here we elaborate and improve upon previously published methods (Bogart 1967; Kligerman and Bloom 1977) for the extraction and acquisition of chromosome spreads for anuran DNA. Our method focuses on the attainment of spreads where the chromosomes are spaced relatively far apart so that each chromosome can be identified and studied. We found that karyotyping methods published by Bogart (1967) and Kligerman and Bloom (1977) resulted in mostly layered chromosomes, which made individual recognition and quantification difficult. Moreover, these other methods have either focused on fish as the model system for karyotyping or, if they are anuran specific, are not described in sufficient detail, which made replication in the lab difficult.

We used Cope's Gray Treefrog, *Hyla chrysoscelis*, as the model system for this technique. In July and August 2002 twenty individuals (12 larvae and 8 adults) were captured from Green Wing Environmental Laboratory, a biological field station located in north-central Illinois. All individuals were transported alive to the laboratory where karyotyping methods were completed. After each individual was sacrificed and the necessary tissue extracted for karyotyping, the rest of the body was immediately fixed in 10% neutral buffered formalin, and each is currently stored in 70% EtOH in the Vertebrate Zoology Collection at Augustana College.

Procedure.—Tadpoles in late larval stages, i.e., late 30s or early 40s based on Gosner (1960), or adult frogs can be used for this procedure. If using tadpoles, allow them to swim in 0.01% colchi-

cine solution for 12–24 h (Kligerman and Bloom 1977). Adult frogs, on the other hand, will need to be injected with a small amount of colchicine (1 mg/ml deionized water) using a 23-gauge needle (1.9 cm in length). To ensure circulation throughout the torso the colchicine solution should be injected through the skin of the dorsum and into the abdomen at a depth of ca. 3 mm. A frog 5 cm in length, such as Gray Treefrogs, should be injected with ca. 0.5 cc of the solution. Frogs of larger or smaller size should be injected with amounts scaled up or down relative to the amount used for adult Gray Treefrogs. Once injected, adult frogs should be placed into a container with a moist paper towel at 30°C for 10–12 h (Bogart 1967).

Once the specimens (either tadpole or adult frog) have been subjected to the colchicine solution for the correct time, they should be sacrificed by the application of Orajel® to the top of the head (Altig 1980). Once sacrificed, the specimens can be dissected and tissue samples may be taken from various locations on the specimen. Leg buds, gills, and intestinal tissue samples were the most successful from tadpoles and intestinal tissue worked best for adult frogs. The tissue sample should be no longer than 0.5 cm in length and should be placed in a small vial containing about 10 times their volume of 0.4% KCl hypotonic solution and should be allowed to sit for 20–30 min (Kligerman and Bloom 1977). Transfer the tissue into 2–3 changes of fixative (3:1 ethanol:acetic acid solution) for ca. 30 min each time (Kligerman and Bloom 1977).

Mount chromosomes on slides using heat fixation. This can be accomplished by heating blank slides 46–48°C. The tissue sample should then be placed into a separate vial containing 100 µl 50% acetic acid (Kligerman and Bloom 1977). Tap the vial for 60–90 sec to break apart the tissue and form a cell suspension. Using a pipetman, draw the cell suspension into the tip and expel it onto the slide. Quickly withdraw the suspension back into the pipet tip, leaving as little liquid on the slide as possible.

Stain chromosomes with 4% Geimsa made up in 0.01 M phosphate buffer at pH 7 for 10 min. Air-dry the slides and place in xylene for 10 min to remove excess water. Once dried, the slides can be completed by using Permount and a cover slip over the fixed sample.

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PIT Tag Retention in *Trachemys* and *Pseudemys*

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Passive integrated transponders are small microprocessors encased in glass that transmit a unique identification number to an electronic reader when the tag is activated by the reader with a low frequency radio signal at close range (Balazs 1999). PIT tags were originally developed to census fish populations (Boarman et al. 1998) and to track fish migration (Prentice et al. 1987). However, their use has become widespread in the identification and monitoring of individuals of other vertebrate groups. PIT tags have been successfully used in studies of mammals, such as otters, rats, bats, mice, ferrets (Elbin and Burger 1994), and voles (Harper and Batzli 1996). PIT tagging has been used on a variety of amphibians and reptiles, including lizards, alligators, frogs, and toads (Elbin and Burger 1994), neonatal snakes (Keck 1994), caiman hatchlings (Dixon and Yanosky 1993), and rattlesnakes (MacGregor and Reinert 2001). In freshwater turtles (Elbin and Burger 1994; Buhlmann and Tuberville 1998), and sea turtles (Balazs 1999; McDonald and Dutton 1996), PIT tags have also been proven successful. In a study of PIT tag utility, Camper and Dixon (1988) tagged 24 individuals of eight different species of freshwater turtles, including eight *Trachemys scripta elegans*.

PIT tag effectiveness has been discussed in a number of different studies, including one on the Pine Snake (Elbin and Burger 1994), and another on a large group of Desert Tortoises (Boarman et al. 1998). Both of these studies came to the conclusion that PIT tags were an efficient and reliable method of marking and tracking their respective subjects. There have been relatively few reports on tag retention in freshwater turtles, Buhlmann and Tuberville (1998) being the only one with large sample sizes known to us. Balazs (1999) discussed some of the advantages and disadvantages of tagging sea turtles with PIT tags. Advantages of the tags include virtually no loss or damage over time from breakage or corrosion, which offers the possibility of long-term reliable retention in sea turtles. Disadvantages include migration within body tissue, inability to detect a tag without a reader, and overall higher cost for the PIT tags (US $6.00 each) and reader (~ US $400) as compared to external tags. PIT tags appear to have no adverse effects upon the freshwater turtles into which they are injected (Buhlmann and Tuberville 1998).

During the course of a study of the impact of the invasive turtle *Trachemys scripta elegans* on native *Pseudemys floridana* and *P. nelsoni* populations in St. Petersburg, Florida, PIT tags were injected into each captured turtle in order to recognize individuals of all three species. Our goal here is to examine tag retention and tag movement in the turtles marked for that study and to report on the utility of a specific injection site between the pelvis and plastron. Furthermore, we assess the impact of PIT tags on reproduction in female turtles.

Since April of 1998, retention and movement of PIT tags from the site of implantation in turtles of three species were studied using x-rays. Throughout the study, x-rays were taken to determine if captured females were carrying eggs (Gibbons and Greene 1979). This also allowed the presence and movement of PIT tags to be observed. Most of our data are from adult female *T. scripta elegans*; however, small samples of female *Pseudemys floridana* and *P. nelsoni* were also tagged, recaptured, and x-rayed, as were small samples of males of all three species. Females were kept overnight to be x-rayed at a veterinarian's office. Three males, two *P. floridana* and one *T. s. elegans*, were x-rayed to confirm the location of the PIT tag after a number of years. Turtles were released into the ponds from which they were captured.

Turtles were captured using hoop traps (Nylon Net Co.) in six ponds on the Eckerd College campus, St. Petersburg, Florida (Emer 2004; Hutchinson 1992). Upon first capture, each turtle was given a unique three-letter code that was drilled into their marginal scutes (Gibbons and Greene 1979), which was used to identify turtles in case of PIT tag loss. Beginning in April 1998, PIT tags were used along with scute drilling. Prior to injection, the turtle was placed on its carapace. The tag was injected with a 13-gauge needle into muscles and connective tissue between the pelvis and plastron just lateral to the midline. This location was chosen because it is between two plates of bone that move little relative to one another, subjecting the tag to the least disturbance possible. The needle was inserted just through the skin into the tissue dorsal to the xiphiplastron and ventral to the ischium, lateral to the cloaca. The tag was delivered into connective tissue and muscle by a plunger built into the syringe. Care was taken to avoid any inadvertent lateral tail movement during insertion of the needle. When turtles were recaptured, PIT tags were read using an AVID, Inc. scanner by placing the scanner along the interanal seam of the plastron.

The locations of the PIT tags were followed using x-rays in a total of eleven female *T. s. elegans*. In these turtles, the PIT tags stayed in essentially the same location into which they were injected. These eleven females had been PIT tagged over a period of five months (April–June 1998). They were found to have retained the tags at subsequent captures, ranging from 30 days to 48 months later. In two females, the PIT tags moved from one side of the midline to the other over a period of 16 days to 16 months, respectively. Another female died during the course of the study of causes not related to the tag implant; this female had lost a PIT tag and had a second one injected. It is believed that this turtle lost the first tag because it was placed too far posterior of the ideal injection site and was lost through the injection site. The second tag was placed in the proper position and was retained for 45 months until her death. At least two females developed, carried, and laid clutches of eggs without affecting the position of the PIT tag, nor did the tag appear to interfere with the normal reproductive process. One male *T.s. elegans* was x-rayed 50 months after implantation of the PIT, and the tag was found to be in the same location into which it was injected originally. Seventeen other males were tagged, and retained their PIT tags without loss between captures spanning from 73 days to 35 months. All tags were readable at each recapture.

PIT tags in a total of eight *Pseudemys floridana* and three *P. nelsoni* were also monitored. Two female and six male *P. floridana* were tagged, but only one female and two males were subsequently x-rayed. Two males were x-rayed at recapture; one had retained the PIT for 36 months, and the other for 14 months between captures (Fig. 1). The female was tagged and x-rayed on first capture, but was not recaptured. In the turtles that were checked with the scanner but not x-rayed, tags could be read at subsequent recaptures, spanning periods of 20–30 months. Only one of three *P. nelsoni* has been tagged and subsequently recaptured. This adult female had retained the PIT tag for 32 months.

FIG. 1. X-ray of male *Pseudemys floridana* showing the location of the PIT tag; located laterally and to the right of the midline.

It appears that PIT tags are reliable if properly injected into the location described above, and the tags do not get lost when placed in connective tissue where very little movement occurs. In this study, the tags did not appear to be more effective than carapacial drilling. However, if tracking of large numbers of turtles were necessary (Boarman et al. 1998), or for tagging of softshell turtles, PIT tags would be more efficient. Another consideration with the use of the PIT tag system is that while electronic readers cost on average US $400, PIT tags remain expensive at US $6 per tag. This may affect the use of PIT tags in a study that monitors large numbers of animals. The tags are an easier and quicker method of marking turtles than scute drilling, and while carapacial scute markings may grow back after one to two years in juvenile *Pseudemys* (Meylan, unpubl.), the PIT tags remain in place and are readable for at least 50 months after implantation. The lifespan

of a PIT tag is theoretically the lifetime of the animal; because a PIT tag is a passive marking system, as long as it remains inside the animal, it should be readable. The first successful PIT tag was made in the early 1990s, and is still working today, so the lifetime is at least 14–15 yrs (AVID, Inc., pers. comm., 16 January 2004). PIT tags are easier to read and provide a means of confirming drilling or notching, thus leading to fewer errors when large numbers of collaborators collect data, or when large numbers of animals are used in a study.

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HERPETOLOGICAL HUSBANDRY

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Despite being such a large, conspicuous snake, the King Cobra (*Ophiophagus hannah*) was not described until 1836 (Cantor 1836). To date, little is known regarding its natural history and reproductive biology. For a summary of field observations of reproductive behavior see Table 1.

Examination of reproductive data reveals some interesting trends. In general, mating occurs in the post-winter warming period, egg development within the female occurs in the tropical summer, nesting and egg laying coincide with pre-monsoon showers, and hatching occurs at the peak of the monsoon. Captive snakes in locales far removed from monsoon seasons remain faithful to this breeding cycle. While the monsoon in Chennai (where no King Cobras occur) is in the winter, reproductive behavior in our captive King Cobras followed the southwest monsoon cycle of southwestern and northeastern India.

In 1996, we established a conservation-oriented captive-breeding program for King Cobras at the Madras Crocodile Bank/Centre for Herpetology (MCB/CFH). The objectives were to (a) develop methods and a protocol for the breeding of King Cobras in India, and (b) to offer captive bred King Cobras to zoos in order to discourage the taking of animals from the wild. Herein, we report husbandry and captive breeding information along with previously published data.

Husbandry.—In 1996, MCB/CFH received seven (three males and four females) adult King Cobras; four of these were on breeding loan from Indian zoos and three had been seized by the Wildlife Department from snake collectors.

A block of eight rooms was constructed of brick and mortar with light roofing. Each room measured 3.5 x 1.5 x 2 m (L x W x H). At the rear of each room (opposite the door) is a 100-mm air duct connected to an air conditioner, which from April to September (1000–1600 h) creates a temperature gradient of about 6°C, increasing to 30°C towards the door. Outside the rooms, the ambient temperature may reach 40°C + during this period. Throughout the rest of the year (cooler months with lows of 18– 20°C), a heating pot containing a 25-watt bulb placed in an upturned mud pot is situated in the rear corner of each room. The surface temperature

TABLE 1. A summary of *Ophiophagus hannah* breeding data. Incubation period is recorded from oviposition to first hatching.

Mating	Nesting/laying	Gestation (days)	Hatching	Incubation (days)	Captive/wild	Source
	Apr, May, Jul				Wild, Burma	Evans 1902
	Jul 1927				Wild, Burma	Mustill 1936
	Jun 1936				Wild, Burma	Mustill 1936
Jan 1955	Apr 1955	94	Jul 1955	75	Captive	Oliver 1956
Mar 1956	Apr 1956	42			Captive	Oliver 1956
Mar 1957	May 1957	45			Captive	Oliver 1957
	May 1966		May–Jul 1966		Wild, Thailand (N = 16 nests)	Leakey 1969
Mar 1974	Jun 1974	112	Sep 1974	74	Captive	Burchfield 1977
Apr 1975	Jun 1975	52			Captive	
Mar 1976	May 1976	68			Captive	
	Jun 1976		Jul 1976		Wild, Andamans	R. Whitaker 1977
	Jun 1977				Wild, Andamans	R. Whitaker 1984
Feb 1984	Apr 1984	68	Jun 1984	70	Captive	Dattatri 1987
Mar 1996	May 1996	44	Jul 1996	58	Captive	R.Whitaker and Naseer 1997
Mar 1996	May 1996	47	Jul 1996	57	Captive	R.Whitaker and Naseer 1997
Mar 1996	May 1996	43	Jul 1996	58	Captive	R.Whitaker and Naseer 1997
Mar 1996	May 1996	46			Captive	R.Whitaker and Naseer 1997

of the exposed section of the pot averages 31°C. Each room has a large wooden hide box measuring 60 x 60 x 30 cm with a lid and a small sliding entry door (12 x 20 cm).

Reproduction.—After laying eggs on the open pile of leaves, the females gathered more leaves and covered the eggs with a thick layer. They then crawled on top of the nest and burrowed into the leaves. These two cavities (one for the eggs and another for the female) are probably the "two chambers" described by Mustill (1936). In the wild, rain and the weight of the female compacts the nest, and towards the end of incubation the female often lies exposed on top of the nest (as observed by Leakey 1969 and Whitaker 1977). See Table 2 for summary of nest data.

A relationship between female length and clutch size in *Ophiophagus hannah* has been postulated (Leakey 1969). Correlation between both brood size and clutch size in oviparous elapids from Australia is known (Greer 1997). Using linear regression analysis we observed a linear relationship between female total length and clutch size. Localities for specimens examined are northeastern and southwestern India, Thailand, Burma, and Malaysia. From this relationship, we developed equations for predicting female total length from clutch size (formula 1) and clutch size from female size (formula 2, SEE = standard error of the estimate).

(1) Female total length = 126.457 + 5.244 x clutch size (r^2 = 0.79; N = 23; SEE = 21.8);

(2) Clutch size = -13.121 + 0.151 x female total length (r^2 = 0.79; N = 23; SEE = 3.69).

The 23 samples used were derived from a larger population. Hence samples from the same population would yield different SEEs. In order to apply the SEE to the population and derive estimates of total length from clutch size (formula 1), and clutch size from total length (formula 2), a Students t-distribution was used. The 95% confidence limit (t = 2.080; df = 21) would for equation 1 be ± 45.35 cm, while it would be ± 7.68 eggs for equation 2. Hence, using equation 1 and assuming a clutch size of 22 eggs, predicted total length can be calculated as female total length = 126.457 cm + 5.244 cm x 22 = 241.83 cm. Calculating SEE ($t_{.05}$) results in 21.8 cm(2.08) = ± 45.34 cm. Therefore, a clutch size of 22 eggs has a 95 % confidence limit that a female would be 241.83 cm long (± 45.34 cm).

Both equations have management implications. In such cases where females are often not observed at nest locations, one may utilize formula 1. If a mature female is captured, her probable clutch size may be predicted from her

TABLE 2. Nesting data for *Ophiophagus hannah* from the Madras Crocodile Bank (CS = clutch size; and nest temperature in °C).

CS	No. viable (% of CS)	No. hatched (% of viable eggs)	Incubation periods (days)	Oviposition time (h:min)	Nest temperature
18	18 (100)	11 (61.1)	57–61		
37	34 (92.0)	14 (41.1)	58–63	4:35	31.2–32.3
16	12 (75)	5 (41.7)	57–59	3:45	29.8–33.1
18	0 (0)	0 (0)		4:03	29.2–32.8

dimensions by formula 2. The r^2 value (0.79) is high, and this can be interpreted by stating that 79% of variation in clutch size/female total body length was explained by the other factor. Additional factors that might account for the residual 21% are female body condition and environmental effects. Regression equations were significant in both cases (ANOVA; F = 78.92, N = 23 for equation 1, and F = 79.89, N = 23 for equation 2). The relationship between female total body length and clutch size is illustrated in Fig. 1.

TABLE 3. *Ophiophagus hannah* growth rate summary based on snakes hatched at Madras Crocodile Bank. Age in months, followed by number of males, females, and unsexed. TL = mean total length in centimeters.

Age		Male TL (± SD)	Wt (grams)	Females TL (± SD)	Wt (grams)
6	(0.0.30)	~80		~80	
12	(0.0.26)	~150		~150	
55	(4.11.0)	234 (37)	1587 (916)	210 (25.6)	1036 (225)
62	(3.7.0)	239 (47)	1800 (1562)	216 (25.23)	1000 (200)

The eggs were elongate and leathery, 3–5 cm in length, and 2–3 cm in width. As many as 51 eggs have been reported in a clutch (Oliver 1956). Our snakes produced 16–37 eggs. Each egg was set up individually. Eggs were kept on a vermiculite and water mixture, 1:0.8 by weight. Incubation temperatures ranged from 27.5°C to 33.0°C with a humidity of 85–90%. Each jar was opened daily to allow fresh air exchange.

Eggs hatched in 57–63 days, a shorter incubation period than reported for other captive breedings (70–75 days; Burchfield 1977; Dattatri 1987; Oliver 1956). We attribute shorter incubation time to higher incubation temperatures.

Neonate Care.—Upon hatching, animals were housed according to standard setups for most neonate snakes. This included individually housing animals in small plastic boxes with newspaper substrate and cage furniture. The only exception was lack of a water bowl (neonates were soaked separately).

Because many captive King Cobras hatchlings initially refuse to feed (Burchfield 1977; Dattatri 1987; Leakey 1969), we found it necessary to assist-feed our animals with pinkies (*Mus boodaga*) and small skinks (*Riopa punctata*).

Long-term successful maintenance of hatchling King Cobras requires a clean, humid environment with optimal temperature range of ca. 25–33°C. These conditions facilitated rapid growth (Table 3).

As of July 2003, ten of the offspring have been sent to five zoos in India, and a pair to the National Zoological Gardens, Sri Lanka. King Cobras have also been bred at several US zoos (Gladys Porter Zoo, Riverbanks Zoological Park, Toledo Zoo, and Black Hills Reptile Gardens). Apart from data gleaned from captive animals, the reproductive biology and status of this species in the wild remains poorly known

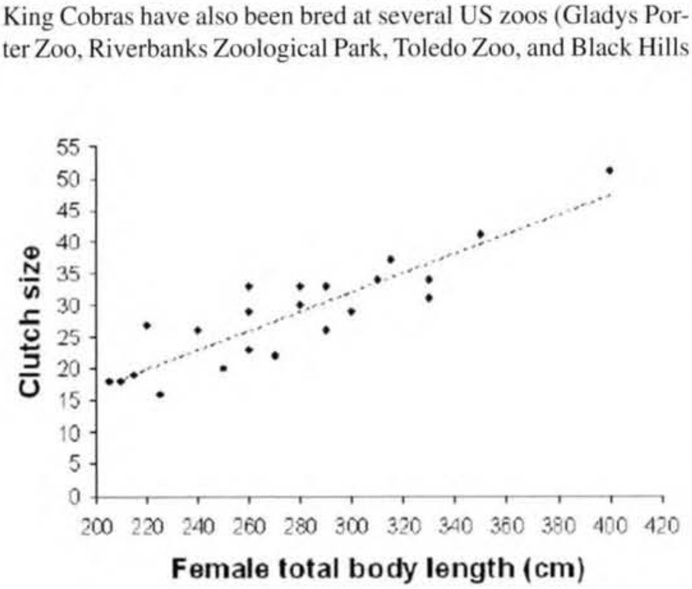

FIG. 1. Relationship between female total body length and clutch size in *Ophiophagus hannah* (N = 23).

Acknowledgments.—We thank the following people and organizations for their contributions, making this work possible. The Central Zoo Authority, Ministry of Environment and Forests (Govt. of India), the Wildlife and Forest Departments of Pondicherry, Tamil Nadu, Kerala, Gujarat and Karnataka provided permits for transferring king cobras to the MCB/CFH. The Ahmedabad Zoo, Sundervan Nature Park, Malampuzha Snake Park, and Mysore Zoo provided snakes for this project. Thanks to Harry V. Andrews, Rupali Ghosh, Gowrishankar, P. O. Naseer, Samir Whitaker, Colette Adams, Scott Pfaff, and National Geographic Television for assisting in a variety of ways. Special thanks to K. Munusamy (Sr.) for the supervision of construction of breeding enclosures, and to snake handlers S. Sampath and V. Mari. Brian Stacy provided valuable medical advice, while Matthew C. John provided veterinary services. We are grateful to the Trustees of the Centre for Herpetology.

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NATURAL HISTORY NOTES

The Natural History Notes section is analogous to Geographic Distribution. Preferred notes should 1) focus on observations with little human intrusion; 2) represent more than the isolated documentation of developmental aberrations; and 3) possess a natural history perspective. Individual notes should, with few exceptions, concern only one species, and authors are requested to choose a keyword or short phrase which best describes the nature of their note (e.g., Reproduction, Morphology, Habitat, etc.). Use of figures to illustrate any data is encouraged, but should replace words rather than embellish them. The section's intent is to convey information rather than demonstrate prose. Articles submitted to this section will be reviewed and edited prior to acceptance.

Electronic submission of manuscripts is requested (as Microsoft Word or Rich Text format [rtf] files, as e-mail attachments). Authors without the ability to send manuscripts electronically may supply hard copy instead. Figures can be submitted electronically as JPG files, although higher resolution TIFF or BMP files will be requested for publication. If figures cannot be provided in this format, you may send them to the section editor for scanning. Additional information concerning preparation and submission of graphics files is available on the SSAR web site at: http://www.ssarherps.org/HRinfo.html. Manuscripts should be sent to the appropriate section editor: **Marc P. Hayes** (amphisbaenids, crocodilians, lizards, and *Sphenodon*; mhayesrana@aol.com); **Charles W. Painter** (amphibians; cpainter@state.nm.us); **Andrew T. Holycross** (snakes; holycross@asu.edu); and **James Harding** (turtles; hardingj@pilot.msu.edu).

Standard format for this section is as follows: SCIENTIFIC NAME, COMMON NAME (for the United States and Canada as it appears in Crother [2000. *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding*. Herpetol. Circ. 29:1–82; available online at <http://herplit.com/SSAR/circulars/HC29/Crother.html>]; for Mexico as it appears in Liner [1994, *Scientific and Common Names for the Amphibians and Reptiles of Mexico in English and Spanish*, Herpetol. Circ. 23:1–113]), KEYWORD. DATA on the animal. Place of deposition or intended deposition of specimen(s), and catalog number(s). Then skip a line and close with SUBMITTED BY (give name and address in full—spell out state names—no abbreviations). (NCN) should be used for common name where none is recognized. References may be briefly cited in text (refer to this issue for citation format).

Recommended citation for notes appearing in this section is: Lemos-Espinal, J., and R. E. Ballinger. 1994. *Rhyacosiredon leorae*. Size. Herpetol. Rev. 25:22.

CAUDATA

AMBYSTOMA CALIFORNIENSE (California Tiger Salamander). **PREDATION.** Although a variety of predators likely feed on *A. californiense* larvae, few have been reported (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Inst. Press, Washington D.C., 586 pp.; Balfour and Stitt 2003. Herpetol. Rev. 34:1). On 12 April 2002, at 1230 h, we observed a pair of adult American Avocets (*Recurvirostra americana*) land at a shallow (ca. 20 cm), 0.011-ha, seasonal pool situated in non-native annual grassland near Brentwood, Contra Costa County, California, USA (37°55'18.5"N, 121°45'28.7"W). Both birds immediately began feeding by aggressively sweeping their bill side to side in shallow water. Within 2 min, one American Avocet moved quickly out of the pool with an *A. californiense* larva in its bill. To confirm our observation, we immediately flushed the birds and the larva was dropped ca. 30 m away. We recovered the late-stage larva (98 mm TL; 52 mm SVL), took photographs, and returned it to the pool, although a small laceration near the left gill may have been fatal. A digital photograph of the larva was deposited in the Natural History Museum of Los Angeles County (LACM PC 1389).

On 31 March 1998, at 0830 h, we observed a Forster's Tern (*Sterna forsteri*) take a small *A. californiense* larva from a deep (ca 1.7 m), ca. 0.28-ha, seasonal stockpond situated in non-native annual grassland and salt grass (*Distichlis spicata*) near Byron Airport in southeastern Contra Costa County, California, USA (37°49'13"N; 121°37'42"W). The Forster's Tern captured the larva by plunging from a height of ca. 10 m. Ten minutes later, after preening on the ground during a light rain, another *A. californiense* larva was caught in the same way. Binoculars (10 power) were used to identify both larvae, which were briefly held in the bill before being consumed. On 17 March 1998, aquatic sampling of the stockpond with a seine detected only larval *A. californiense* that averaged 18.2 mm SVL (range: 8–30 mm SVL; N = 20).

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AMBYSTOMA CALIFORNIENSE (California Tiger Salamander). **FUNGAL INFECTION**. First described as a new species in 1999 (Longcore et al. 1999. Mycologia 91:219–227), *Batrachochytrium dendrobatidis* is a recently emerged chytrid fungus that has been identified as a causative agent in selected amphibian declines around the world (Berger et al. 1998. Proc. Nat. Acad. Sci. USA 95:9031–9036; Daszak et al. 1999. Emerg. Infect. Diseases 5:735–748; Bosch et al. 2001. Biol. Cons. 97:331–337). To date, this pathogen has been reported in the wild from 8 anuran species and the Santa Cruz Long-toed Salamander (*Ambystoma macrodactylum croceum*) in California (Speare and Berger 2000. Global distribution of chytridiomycosis in amphibians [11 November]. (http://www.jcu.edu.au/school/phtm/PHTM/frogs/chyglob.htm); Vredenburg and Summers 2001. Herpetol. Rev. 32:151–152). It has also been reported in Sonoran Tiger Salamanders (*A. tigrinum stebbinsi*) in Arizona (Davidson et al. 2003. Copeia 2003:601–607). Herein, we report the first case of *B. dendrobatidis* in California Tiger Salamanders (CTS; *A. californiense*), a urodele currently federally listed as Endangered in parts of California (Anonymous 2000. CFR 65:7241–57264; Anonymous 2002. CFR. 67:47726–47740).

A total of 11 larval CTS from five different ponds in Joseph D. Grant County Park, Santa Clara County, California, USA (37°20'29"N, 121°42'17"W; elev. 650 m) were collected, preserved in alcohol, and later examined. We removed small pieces of toe skin from each specimen and microscopically examined unstained tissue for *B. dendrobatidis* zoosporangia. Two specimens from two different ponds were positive for the pathogen, as indicated by the presence of non-hyphal spherical zoosporangia with one or more inoperculate discharge papillae (Longcore et al. 1999. Mycologia 91:219–227) (Fig. 1). These data demonstrate that the potentially harmful pathogen is present in wild populations of CTS. Thus, translocating CTS to areas containing amphibian species that are mortally affected by *B. dendrobatidis* could have profound negative effects on our endemic herpetofauna. As translocation is often encouraged by state and federal agencies as part of rescue efforts (Dodd and Seigel 1991. Herpetologica 47:336–350), testing for this pathogen should be a routine part of the protocol prior to any CTS relocation attempts.

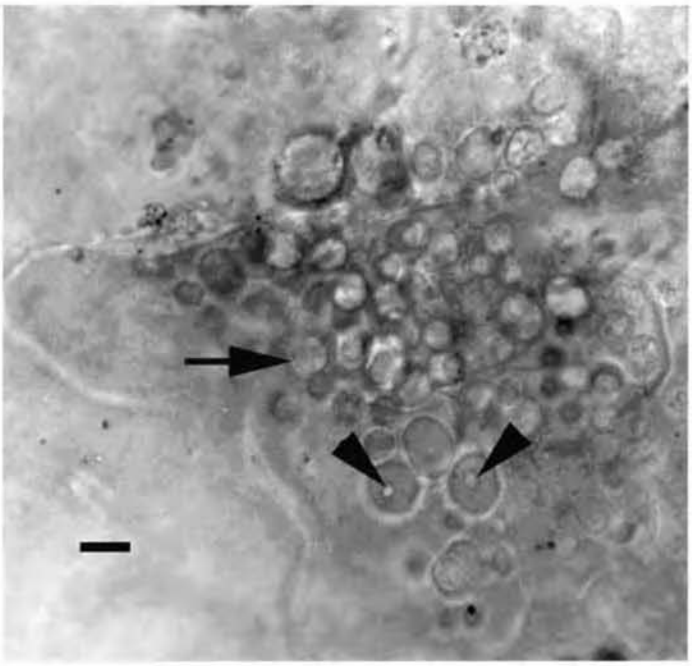

FIG. 1. Unstained toe skin from *Ambystoma californiense*; arrow indicates thin wall within thallus of *Batrachochytrium dendrobatidis*; arrowheads indicate open discharge papillae (*fide* Longcore, *op. cit.*). Size bar = 10 µm.

Permission to collect CTS specimens was authorized by permits issued by the California Department of Fish and Game (801160-02) and the County of Santa Clara Parks and Recreation Department to Gretchen E. Padgett-Flohr. Specimens (CAS GEF101-GEF112) are deposited at California Academy of Sciences, San Francisco, California. We thank Daniel Clark, Karen Coffer, Molly Goble, Mark Jennings, Maya Khosla, Don Rocha, and Jeffrey Wilcox for assistance in the field, and Mark Jennings for suggestions on the manuscript.

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DESMOGNATHUS AENEUS (Seepage Salamander). **MAXIMUM SIZE**. *Desmognathus aeneus* is one of the smallest salamanders native to North America, reaching a previously documented maximum SVL (measured to anterior end of vent) of 29 mm (Harrison. 1967. Amer. Midl. Nat. 77:356–370).

On 28 October 2003, we collected an adult male *D. aeneus* (deposited at the Georgia Museum on Natural History, GMNH 49482) near Stanley Creek at Rock Creek Road, Gilmer County, Georgia (within the Rich Mountain Wilderness Area) that surpassed the previous record length. Following preservation, this specimen measured 31.20 mm SVL (measured to anterior vent; 33.48 mm to posterior vent) and 64.50 mm TL; however discoloration of the posterior end of the tail revealed regeneration. Additionally, the specimen has three testicular lobes on each side, which is indicative of a very old individual (Harrison, *op. cit.*).

We thank Thomas Floyd and Elizabeth McGhee for verifying measurements.

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HEMIDACTYLIUM SCUTATUM (Four-toed Salamander). **NESTS.** *Hemidactylium scutatum* is a small secretive salamander associated with bogs and mossy forests. Communal nesting has been reported in that species, in which nests are highly associated with Sphagnum moss. Nevertheless, despite the numerous notes about new localities for that species in Québec, Canada, at its northeastern range limit, no data about the ecology of this salamander are available. Here we report the nests of the species at four different localities in Québec, with inferences about the occurrence of communal nesting, based on the number of females and eggs at nest, and the characteristics of the nests (height, water depth, and substrate).

The sites were located on the Canadian Shield, north of St. Lawrence River (45°39'N, 75°03'W; 46°36'N, 72°36'W; 46°33'N, 72°24'W; 46°45'N, 71°19'W; NAD83 map datum). They were visited in May 2002 and 2003. Nests were sought by turning over mats of mosses, Sphagnum, and grass adjacent to stagnant water, in habitats where we previously found *Hemidactylium*. Every time a nest was found, the eggs were counted, if possible without touching the females, though most females were put in a small plastic bag with Sphagnum during the count of eggs. This did not seem to disturb females, and only one lost its tail during the procedure. The height of the nests above water and the water depth were measured using a metric plastic rule.

A total of 107 nests of *H. scutatum* were found during May in small pools where Sphagnum occurs, bordered by mixed woods. The average number of eggs in a nest was 28.1 (range 4–114) and in only 4.7% of nests did we observe two females. Considering an average clutch of 40 eggs per female (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington and London, p. 293), only 12.2% of the nests were communal. Nevertheless, if we consider the maximal possible known number of 80 eggs/female (Wood 1953. Amer. Nat. 87:77–86) only 2.8% of all nests are certainly not from a single female. Sphagnum is the most often used substrate for deposition of eggs, occurring in 95.3% of all nests and the only substrate in 88.8% of cases. Only five nests were found without any Sphagnum—four in mosses and one in grass. The height of nests from water varied from 4.5 to 18 cm (average 11.2 cm) and the depth of water under nests varied from 2.3 to 19 cm (average 9.1 cm).

These data help in understanding the ecology of *H. scutatum* at its northeastern range limit. Although commonly described as a communally nesting species, this seems not to be the standard rule in Québec. Maybe this is a consequence of smaller populations, near their range limit, allowing many potential nesting sites for each female.

We thank F. W. Schueler for useful comments on the first draft of this note.

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PSEUDOTRITON RUBER RUBER (Northern Red Salamander). **TREE CLIMBING.** On 10 June 2003 at 1830 h in a second growth forested stream/seep area 1.5 km WSW of Ward Chapel, Tennessee (Coffee Co., 35°28'07"N, 86°11'32"W), a recently metamorphosed *Pseudotriton ruber ruber* (42 mm SVL, 68 mm TL) was observed 90 cm above ground on a 20 cm diameter *Carya* sp. (hickory). The salamander was oriented perpendicular to the vertical axis of the tree and remained motionless for 10 min after which time measurements were taken. The forest floor and tree were wet following the passage of a thunderstorm that moved through the area 30 minutes before the observation producing rainfall in excess of 1 in (2.54 cm). Air temperature was 23°C and a light rainfall was detected at the time of observation.

A few ground-dwelling plethodontids are known to be effective foragers utilizing vegetation. Jaeger (Copeia 1978:686–691) reported *Plethodon cinereus* climbing plant stems to forage but only during periods of high humidity on rainy nights due to risk of desiccation. Recently, *Plethodon glutinosus* was reported climbing a pine tree during a rainy night from Coffee Co., Tennessee by Regester and Samoray (2002. Herpetol. Rev. 33:45). This observation is believed to be the first report of tree climbing by *P. ruber ruber*.

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ANURA

BUFO BOREAS (Western Toad). **SEED DISPERSAL.** On 22 Aug 2003, during surveys as part of an amphibian monitoring program in Elk Island National Park, Alberta, Canada (53°36'N, 112°53'W) we captured two young-of-the-year *Bufo boreas* with seeds attached to their heads. Both individuals had a single achene of the nodding beggartick (*Bidens cernua*; Asteraceae) embedded in the sphenethmoid and frontoparietal regions of the head between the eyes. The beggartick is a native annual common on muddy shores of lakes and ponds in Elk Island (Griffiths and Cotterill 2002. Vascular Plant Species List: Elk Island National Park. Unpubl. report). Its seeds are 5–7 mm long and bear 2–4 barbed awns used in a "stick-tight" dispersal strategy in late summer (Johnson et al. 1995. Plants of the Western Boreal Forest and Aspen Parkland. Edmonton). Initially we did not recognize the seed and pulled the achene from the head of one of the toads, which was then released at the capture site. The spines at the base of the achene were bloody after removal. We were unable to remove the achene from the second animal (Fig. 1), and retained this individual in captivity for observation. It died on 7 Sept 2003. The mean length of 30 individuals measured at the same site was 18.7 mm (range: 15.5–21 mm); the individual with the seed in its head measured 13.0 mm in length (measured after preservation in 70% ethanol). The animal did not appear emaciated or stressed when it was captured, and was observed attempting to eat small crickets we provided in captivity. The toad did not exhibit any obvious signs of distress, and was never observed trying to remove the seed.

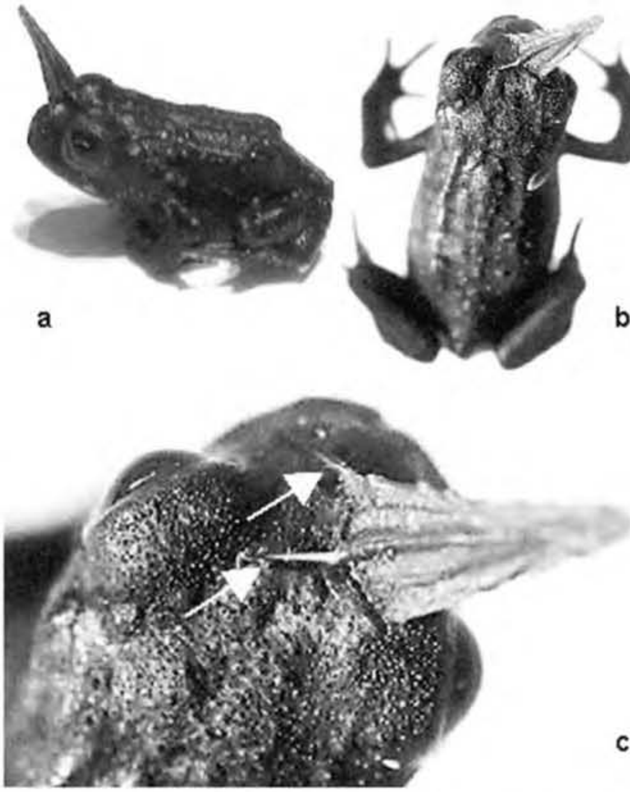

FIG. 1. Living young-of-the-year *Bufo boreas* with achene of nodding beggartick attached to head. (a) Lateral view; (b) dorsal view; (c) close-up of seed insertion point on head, with two of the barbed awns of the seed visible (arrows). The animal was captured 3 days prior to the photographic session.

We examined a total of 293 Western Toads, 755 Wood Frogs (*Rana sylvatica*), and 408 Boreal Chorus Frogs (*Pseudacris triseriata*) during the summer of 2003 in and around Elk Island National Park; 87 of these were YOY Western Toads from the same pond as the seed-bearing individuals. None of the other anurans examined bore seeds. Although seed dispersal by vertebrates is a well-known and important process in many ecosystems, seed dispersal by amphibians seems rare. This is the first report of an anuran passively transporting plant seeds. Presumably the toads pick up the adhesive achenes as they move through plants growing on the shores of ponds and lakes.

Thanks to R. Mandryk for photographing the specimen. Parks Canada allowed access to the study site. Ducks Unlimited Canada, Friends of Elk Island, and the Parks Canada Species at Risk Recovery Action and Education Fund provided support for amphibian sampling at Elk Island.

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BUFO BOREAS HALOPHILUS (California Toad) and ***RANA CATESBEIANA*** (American Bullfrog). **AMPLEXUS.** Attempted mating between native and introduced anurans has been documented for a number of species. For example, North American anurans such as *Rana aurora* have been observed in amplexus with introduced *R. catesbeiana* (Storm 1952. Herpetologica 8:108). We here provide the first documentation of *Bufo boreas halophilus* in amplexus with *R. catesbeiana*.

On 21 June 1997 while conducting a herpetological survey of Cache Creek in the vicinity of Rumsey, Yolo County, California (USA), we observed three instances of male *B. b. boreas* attempting to mate with juvenile *R. catesbeiana*. Male *Bufo* were calling in a number of ponds and oxbows along Cache Creek in the evening after 0015 h. *Rana catesbeiana*, which are introduced to California, are common in this part of the creek. Upon careful examination of several clumps of salt-cedar (*Tamarix* sp.) along the stream, we observed three separate instances of adult male *B. b. halophilus* in amplexus with *R. catesbeiana*. Two of these amplexing pairs were captured intact (pair #1: *Bufo* 91.0 mm SUL, 59.0 g/*Rana* 88.0 mm SUL, 54.6 g; pair #2: *Bufo* 98 mm SUL, 86.8 g/*Rana* 84 mm SUL, 51.2 g), while the third pair separated and escaped. These four specimens (CAS 203248–9, 203160–1) were all healthy individuals, although the male *Bufo* had rubbed the undersides of the *Rana* raw where they had amplexed with their thumbs and forelimbs. The repeated observations of *B. b. halophilus* in amplexus with *R. catesbeiana* indicate that this is not an isolated incident during the breeding season and further show that *R. catesbeiana* can have a negative effect on native anurans by interfering with reproduction. This is significant as most detrimental effects of introduced bullfrog populations center on their voracious predatory habits (Cook and Jennings 2001. Herpetol. Rev. 32:182–183), their ability to displace other anurans from suitable aquatic habitats (Kiesecker and Blaustein 1997. Ecology 78:1752–1760), and their effects on native gartersnakes (*Thamnophis* spp.) as potential food items (Kupferberg 1994. Herpetol. Rev. 25:95–97).

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ELEUTHERODACTYLUS RANOIDES (NCN). **DRY FOREST POPULATION, REFUGE FROM DECLINE?** Amphibian declines in pristine and apparently undisturbed habitats have occurred in many highland areas in tropical Latin America (Young et al. 2001. Cons. Biol. 15:1213–1223). One member of the *Eleutherodactylus* "*rugulosus* group" is *E. ranoides*. Known from lowlands and premontane slopes from eastern Nicaragua to extreme western Panama, it was previously common in the Área de Conservación Guanacaste in northwestern Costa Rica. In at least two herpetological surveys of the same area in 2001 and 2003 no *E. ranoides* were found, even though suitable habitat was explicitly examined in several occasions (D. Laurencio, pers. comm; RP, pers. obs.). Because it had not been recorded since 1987, this species has been listed by the IUCN as Endangered (InfoNatura: Birds, mammals, and amphibians of Latin America [web application]. 2004. V. 3.1. Arlington, Virginia: NatureServe. Available: http://www.natureserve.org/infonatura. Accessed: 23 April 2004). However, Sasa and Solórzano (1995. Herpetol. Nat. Hist. 3:113–126) and Sasa (pers. comm.) reported finding *E. "rugulosus"* in 1994 and 1995 at the lowland (5–20 m elev.) Río Murciélago site in the ACG in Sector Murciélago at the northern base of the Península Santa Elena in the Dry Tropical Forest life zone of Holdrige (Tosi, 1969), though no voucher specimens were collected.

We returned to the Río Murciélago site in May 2003 to confirm these earlier observations. On 24 May 2003 we surveyed ca. 2 km of the banks of the Río Murciélago. This was the end of the dry season, and the habitat was extremely dry but the river was flowing from springs. The temperature of the water in the stream was 28°C. No frogs were found between 1700 and 1800 h, however on our return soon after dusk, we collected eight specimens of *E. ranoides* on rocks and under boulders in the stream in ca. 1 h of search. Specimens were deposited at the Museum of Zoology, University of Costa Rica.

Our findings confirm the observations of Sasa and Solórzano (*op. cit.*) and demonstrate the continued survival of at least one of the five *rugulosus* group species in Costa Rica. We emphasize that the lowland Río Murciélago site is 24 km due W of Volcán Cacao and central to the 80,000 ha of coastal lowland regenerating dry forest that separates the Cordillera Guanacaste from the Pacific Ocean. However, this portion of the Río Murciélago is exceptional for dry forest in having year-round flowing water in a least some portions, though the water temperature in the Río Murciélago is quite high. Historical collections of *E. ranoides* at Volcán Cacao are from sites of much lower water temperatures and much wetter. We hypothesize that the high temperature and six-month dry season at the Río Murciélago site protect the frogs from whatever made their populations decline at Volcán Cacao.

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HYLA CHRYSOSCELIS (Cope's Gray Treefrog). **TADPOLE OVER-WINTERING.** Relatively little is known about larval ecology of anurans from northwestern Louisiana. On 10 Nov 2003 we observed 10–12 *Hyla chrysoscelis* tadpoles living in a 30 cm deep, 3-m diam unheated pond with a running fountain and concrete basin located on the grounds of Holy Angel's Residential Facility, about 15 km S. of Hwy 3132 on Ellerbe Rd. in Shreveport, Louisiana (Caddo Parish). Unidentified odonates and bellostomatids were present in the pond. Vegetation included emergent *Equisetum* sp., *Typha* sp., and *Nymphaea* sp. Fallen oak (*Quercus* sp.) leaves and pine (*Pinus* sp.) needles covered the pond's substrate. Two of the tadpoles had fully emerged rear legs. Upon returning to the site 1 Jan 2004, two *H. chrysoscelis* tadpoles with early developing hind limbs were observed actively foraging on the substrate. A third tadpole was observed secluded among pine needles and was lethargic. The calling season for this species continues into late summer and early fall (Dundee and Rossman 1996. The Amphibians and Reptiles of Louisiana, Louisiana State University Press, Baton Rouge, Louisiana). Our observations provide some evidence that this species can facultatively overwinter as a tadpole if needed. This anecdote also represents the first known observation of overwintering in this species. All larvae were returned to the pond after observations. We thank Holy Angel's Residential Facility for access to the pond.

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PHYLLOMEDUSA ROHDEI (Leaf-tree Frog). **FIGHT INJURIES?** A population of *P. rohdei* was observed for 84 nights (411 h), during July 1999–July 2000, in a temporary pond ca. 170 m², located in the edge of a forest at Palmital (22°50'S; 42°27'W), Municipality of Saquarema, State of Rio de Janeiro, southeastern Brazil. During breeding activities, agonistic interactions, including escalated aggressive behavior from non-physical to physical encounters (Wogel et al. 2004. Herpetol. Rev. 35:239–243), were common between males in courtship sites. Although males of *P. rohdei* do not have any anatomical weapons that could cause injuries in a fight, several males' backs were covered with scratches. Less severe scratches were observed in only three females (ca. 4%). Similar scratches also were observed in males of *Phyllomedusa burmeisteri* (Abrunhosa and Wogel, *in press*. Amphibia-Reptilia) that engaged in physical combats. At least two hypotheses might explain these observations: 1) the injuries were caused directly by males using their nuptial excrescences during fights, or 2) the injuries were caused indirectly by the surrounding vegetation at the combat site or when males fell down, a common observation when males were fighting.

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PHYSALAEMUS SIGNIFER (Girard's Dwarf Frog). **COMMUNAL OVIPOSITION.** Communal oviposition is known in several explosive-breeding anurans (Wells 1977. Anim. Behav. 25:666–693). Here, we describe communal egg laying in *Physalaemus signifer* from Reserva Biológica União, Municipality of Rio das Ostras, State of Rio de Janeiro, southeastern Brazil.

A temporary pond ca. 800 m², located in an open area at the edge of the forest (22°25'03"S, 42°02'10"W), was filled with water from November 2002 to the beginning of March 2003 during one year of study (Sept 2002–Aug 2003). After a dry month at the end of the summer 2003, the rain regressed on 17 March, and the pond became a muddy area. On the following night, 10 *P. signifer* formed a chorus at the pond with activity, beginning at 1800 h and lasting until 200 h. Flooded footprints along the edge of the pond had become suitable oviposition sites, and several amplectant pairs were observed using the footprints to spawn. At about 2145 h we observed communal oviposition in *P. signifer*, consisting of five amplectant pairs (mean SVL and mass as follows: males 27.7 ± 1.2 mm SVL, 1.6 ± 0.2 g mass, N = 5; females: 31.0 ± 1.0 mm SVL, 2.2 ± 0.2 g mass, N = 5) spawning inside a footprint 29 x 12 cm, 15 cm depth, and 5 cm of water retention. Wogel et al. (2001. Iheringia 92:57–70) and Weber and Carvalho e Silva (2001. Bol. Mus. Nac. 462:1–6) reported the preference of *P. signifier* for calling and spawning in shallow areas, such as along the margins of a pond. As suggested for *P. ephippifer* (Hödl 1990. Copeia 1990:547–554), the observed communal oviposition in *P. signifer* could result from a shortage of suitable sites for nests.

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PSEUDACRIS CRUCIFER CRUCIFER (Northern Spring Peeper). **AGGRESSIVE BEHAVIOR.** In natural populations males may compete for a limited resource and in pond-breeding anurans, this resource is usually receptive females. Because of direct competition, aggressive bouts between males occur (Duellman 1966. Herpetologica 22:217–221). There have been several reports of aggressive behavior in *Pseudacris crucifer* ranging from territoriality calling (Rosen and Lemon 1974. Copeia 1974:940–950) to grappling events. However, previous reports have documented grappling events and aggressive encounters lasting only a few seconds.

On 8 March 2002, at one of our (JMM) research ponds in Kickapoo State Park, Vermilion County, Illinois (USA), we heard a large intermittently calling chorus of *P. c. crucifer*. Males were calling from perches of emergent vegetation or from low in the water. In some areas where the vegetation was more abundant, males were clustered close together (< 2 m). At ca. 2200 h, we

heard quick trills indicative of *P. crucifer* territoriality calls. After ca. 5 min of searching, we located two males in close proximity (< 0.2 m). They began exchanging territoriality calls in rapid succession. When male one approached male two, the intensity of calling from both males increased. The males oriented toward each other and continued to rapidly call. Male two approached male one and the frogs locked their forearms. At this time, the calling had nearly ceased. Both frogs began pushing each other and in some instances rose slightly up on their hind legs. Wrestling continued for a minute, then male one broke free and turned away. Male two hopped onto his back and they began to jostle for the top position. The jostling continued for ca. 2 min until male one retreated ca. 0.5 m away and held a low posture in the water. Male two returned to the original perch and commenced advertisement calling. After another two to three minutes, male one moved within ca. 0.2 m of male two but remained postured low in the water. Male one remained in this position for about three minutes then swam away.

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PSEUDACRIS TRISERIATA (Western Chorus Frog). **REPRODUCTION**. *Pseudacris triseriata* is widespread throughout the upper Yampa River Valley (ca. 2100 m) in northwestern Colorado (Hammerson 1999. Amphibians and Reptiles in Colorado. 2nd Edition. Univ. Press of Colorado and Colorado Division of Wildlife. 484 pp.). After most natural temporary breeding habitats (snowmelt ponds and wet meadows) dry, *P. triseriata* often reproduces in available irrigated meadows. Irrigated meadows have variable and unpredictable hydroperiods, so they may represent risky reproductive sites. Although *P. triseriata* can lay eggs in areas that dry before metamorphosis (Hammerson, *op. cit.*), their success in irrigated meadows is undocumented. Here, I provide preliminary data on *P. triseriata* survivorship in irrigated meadows.

In mid-June 1999, I located nine irrigated meadows that *P. triseriata* were using by following their breeding calls. I monitored sites only if they were currently irrigated or had been within the past week, determined by asking local ranchers. Meadows irrigated by the same ditch were considered independent only if a barrier, such as a flowing irrigation ditch separated them. I searched each site until 2–5 *P. triseriata* egg clusters were found. I flagged each cluster to enable relocation and measured water depth and water temperature at subsequent visits. Sites were visited during early morning, mid-afternoon, or early evening to encompass daytime temperature variation. Dating the initiation of hatching in each egg cluster allowed me to estimate the minimum period from oviposition by counting back 2 days (i.e., the minimum period from oviposition to hatching [Pettus and Angleton 1967. Evolution 21:500–507]). I revisited the meadows every 3–5 days until they dried.

In five (56%) meadows, the water level dropped steadily over the monitoring period and the pools within dried completely. In the remaining four meadows, water depth fluctuated as irrigation water was increased or cut off. Maximum pool temperature ranged from 24–35°C; less than the critical thermal maxima for both piedmont and montane *P. triseriata* tadpoles (Hoppe 1978. Herpetologica 34: 318–321). Although all monitored egg clusters hatched tadpoles, the longest hydroperiod for any of the meadows was 51 days.

As a minimum hydroperiod of ca. 65 days is required from oviposition to metamorphosis (Smith 1983. Ecology 64:501–510), 100% mortality is implied. Because *P. triseriata* began calling at least 30 days prior to initiation of my study (Anne Davis, pers. comm.), substantial breeding had likely already taken place. Therefore, irrigated meadows may have acted as mortality sinks only to late-season breeders. Because *P. triseriata* may lay two clutches per season (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque. 431 pp.), it is possible that the unsuccessful eggs could have been second attempts or that many of the clusters within individual pools were from a single female. These alternatives notwithstanding, these data imply that further investigation of irrigated pastures as mortality sinks is warranted.

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RANA PALUSTRIS (Pickerel Frog) and ***AMBYSTOMA MACULATUM*** (Spotted Salamander). **REPRODUCTIVE BEHAVIOR.** Pickerel Frogs and Spotted Salamanders are early spring breeders (Johnson 1997. The Amphibians and Reptiles of Missouri. Missouri Department of Conservation). Although both species may breed in the same pond, the potential for interspecific interference seems small, as both species have widely different reproductive behavior. The salamander mating system is based on olfactory communication, whereas the frog attracts mates via acoustic/vibrational communication. Nevertheless, here I report several instances of inter-species amplexus.

On the night of 7 March 2004, I visited a pond at Three Creeks CA (Boone Co., Missouri, USA). While there were many salamanders in the pond, I found very few *Rana palustris* and did not observe any signs of reproduction (e.g., calling activity or pairs). However, I encountered two different cases in which a male *R.*

FIG. 1. A male *Rana palustris* in amplexus with an *Ambystoma maculatum* of unknown sex, found in central Missouri on 7 March 2004.

palustris had amplexed an *Ambystoma maculatum*. Both pairs were found on the bottom of the pond, in 0.3–0.6 m of water. Although I caught the pairs to examine them and take photographs, the frog maintained the amplexus. Between-species amplexus may incur several costs for both participants. Besides lost feeding opportunity and increased risk for predation there is also the cost of lost mating opportunity.

Two weeks later I visited the site again. This time I found several dozen *R. palustris*, heard males call, and found many egg clutches. I also observed another between-species interaction: as a salamander swam by a male *R. palustris*, the frog turned and amplexed the salamander. The frog quickly released the salamander, however. Further observations are needed to verify whether males are less prone to mating mistakes when conspecific mating opportunities are available.

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RANA RUGOSA (Wrinkled Frog). **ENDOPARASITES.** *Rana rugosa* is endemic to Japan, Korea, and northeastern China (Frost [ed.]. 1985. Amphibian Species of the World: A Taxonomic and Geographical Reference. Allen Press, Inc. and The Association of Systematics Collections, Lawrence, Kansas. 732 pp.). It was introduced to Hawaii from Japan in 1895 or 1896 (Bryan 1931. Mid-Pacific Magazine 43:61–64; Oliver and Shaw 1953. Zoologica 38:65–95). The purpose of this note is to report the acanthocephalan *Acanthocephalus bufonis* in *R. rugosa* from Oahu, Hawaii.

One *R. rugosa* (52 mm SVL) was collected 2 May 2000 at Honolulu, Hawaii. It was deposited in the herpetology collection of the University of Michigan, Ann Arbor, Michigan as UMMZ 227582. The esophagus, stomach, small intestine, large intestine, lungs, and urinary bladder were opened and examined separately for helminths under a dissecting microscope. The body cavity was also searched. Two adult acanthocephalans were found in the small intestines. They were each cleared in a drop of concentrated glycerol, identified as *Acanthocephalus bufonis* and subsequently deposited in the United States Parasite Collection, USNPC, Beltsville, Maryland as USNPC 94316.

Acanthocephalus bufonis has an oriental distribution (Kennedy 1982. Can. J. Zool. 60:356–360). It has been reported in *Bufo marinus* from Honolulu, Hawaii by Barton and Pichelin (1999. Parasite 6:269–272). Whether *A. bufonis* reached Hawaii in *B. marinus*, *R. rugosa* or in an intermediate host is not known. *Acanthocephalus bufonis* in *R. rugosa* is a new host record.

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TESTUDINES

ACTINEMYS MARMORATA (Pacific Pond Turtle). **DIET.** The diet of *Actinemys marmorata* is known to include a wide variety of items from benthic invertebrates, to plant materials, to carrion (Bury 1986. J. Herpetol. 20:515–521). An opportunistic forager, they often eat the most abundant food resource available (Holland 1985. Herpetol. Rev. 16:112–113). In this note, we provide the first observation of a Pacific Pond Turtle consuming fish eggs.

On 14 May 1997 while conducting a herpetological survey of the Cache Creek drainage in Wolf Creek at the mouth of Quartz Canyon in Lake County, California (USA), one of us (MRJ) observed a spawning aggregation of ca. 100 California Roach (*Lavinia symmetricus*). The fish had schooled into a tight ball ca. 40 cm diam and were spawning over a cobble substrate in 50 cm of water. Closer examination revealed the presence of a Pacific Pond Turtle under this spawning aggregation. The turtle was resting on the cobble substrate and remained motionless except for occasionally retracting its head to avoid being hit by swimming and darting fish. I carefully watched the turtle between 1550–1615 h and soon observed that it was foraging for fish eggs being deposited in the cracks of the substrate. There was no attempt to catch swimming fish as they moved by the turtle's head or bounced off the turtle's head, neck, and front legs. After my observations were completed, I removed the turtle from the spawning aggregation and found that it was an adult female, 145 mm straight-line carapace length.

This record provides another observation of an opportunistic feeding event by a Pacific Pond Turtle; the consumption of fish eggs may also benefit female turtle fitness by providing a rich source of nutrients for their own egg development.

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CHELONIIDAE (Marine Turtle). **NEST PREDATION BY BOBCATS**. A variety of mammal species are known as primary predators (initial excavators) of marine turtle nests in Florida (e.g., Stancyk 1982, *In* Bjorndal (ed), Biology and Conservation of Sea Turtles, pp. 139–152. Smithsonian Institution Press, Washington, D.C.). Raccoons (*Procyon lotor*) are probably the most widespread and destructive nest predator (Stancyk, *op. cit.*), depredating up to 95% of nests in some areas, unless control measures are implemented (Bain et al. 1997. Sea turtle nesting and reproductive success at the Hobe Sound National Wildlife Refuge (Florida), 1972-1995. Report to U.S. Fish and Wildlife Service, ARM Loxahatchee NWR). Spotted Skunks (*Spilogale putorius*), Gray Foxes (*Urocyon cinereoargenteus*), Opossums (*Didelphis virginiana*), and Red Wolves (*Canis rufus*) are other native species that depredate nests, while Nine-banded Armadillos (*Dasypus novemcinctus*), Coyotes (*Canis latrans*), feral swine (*Sus scrofa*), and Red Foxes (*Vulpes vulpes*) are destructive exotic mammal species (Atencio 1994. Proc. Sea Turtle Symp. 13:201–204; Bain et al., *op. cit.*; Drennen et al.

1989. Mar. Turt. Newsl. 1989:7–8; Engeman et al. 2003. Biol. Cons. 113:171–178; Foote et al. 2000. Proc. Sea Turtle Symp. 18:189–190; Helmstetter and Atencio 1997. Endangered Species Update 14:3–5; Lewis *et al.* 1996. Proc. Sea Turtle Symp. 15:162–164; Mroziak et al. 2000. Chel. Cons. Biol. 3:693–698; Rusenko et al. 2000. Proc. Sea Turtle Symp. 18:209–211; Woolard et al. Herpetol. Rev. *in press*; Wright et al. 2000. Proc. Sea Turtle Symp. 12:210–212). Here we provide the first observations of Bobcat (*Felis rufus*) acting as a primary predator (excavator) of marine turtle nests.

We have made observations since 1997 on the beach at Hobe Sound National Wildlife Refuge (HSNWR), Jupiter Island, Florida. HSNWR offers undeveloped and protected beach habitat for nesting by loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*), and green (*Chelonia mydas*) turtles, each of which is listed as threatened or endangered. Our first observation of bobcat excavation and predation of a turtle nest occurred in 2001. In that year 251 of the 1259 loggerhead nests, all 16 green turtle nests, and all 58 leatherback nests were marked for observation, for a total of 325 marked nests. On 10 September, a loggerhead nest was depredated by a bobcat. This was the only bobcat-predated nest during the 2001 nesting season, and it is the first observation of which we are aware where a bobcat excavated and predated the eggs of a marine turtle nest. The destruction of a single nest represented 0.4% of marked loggerhead nests and 0.3% of total marked nests for all marine turtle species.

In 2002, a total of 307 turtle nests were marked for observation; 132 of the 1062 loggerhead nests, all 142 green turtle nests, and all 33 leatherback nests. Two of the marked loggerhead nests were excavated and depredated by bobcats. This represented 1.5% of loggerhead nests and 0.7% of total marked nests on the refuge. Bobcat predation occurred on 29 and 30 July, which is when the maximal number of nests would be expected to be in this beach (e.g., Engeman et al., *op. cit.*).

Raccoons and armadillos are removed at HSNWR in an ongoing effort to protect turtle nests from these most destructive nest predators (Engeman et al., *op. cit.*). A predation rate around 1% by bobcats is negligible, especially when compared to depredation by raccoons and armadillos. While bobcat predation on turtle nests at its current level does not merit remediation, their populations and predation should be simultaneously monitored each year along with those for raccoons and armadillos in case their predation increases (for methodology see Engeman et al., *op. cit.*). On the other hand, if bobcat depredation remains at very low levels, then their presence on the beach may have the beneficial effect of deterring other, potentially more destructive, nest predators.

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GOPHERUS POLYPHEMUS (Gopher Tortoise). **PREDATION.** *Gopherus polyphemus* is eaten by numerous native predators throughout its range (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington. 578 pp.). Here, we document a non-native reptile species, the Savannah Monitor (*Varanus exanthematicus*), preying upon a juvenile *G. polyphemus* in Florida.

On 22 September 2002, an adult male (37.3 cm SVL, 1.2 kg) *V. exanthematicus* was collected by residents at 1212 Alhambra Way S., St. Petersburg, Pinellas Co., Florida (27°43.39'N, 82°39.10'W), and brought to a staff member at nearby Boyd Hill Nature Park. On 24 September 2002, this *V. exanthematicus* defecated scutes and all four legs of a juvenile *G. polyphemus* (ca. 50 mm CL), as well as body parts of two adult ox beetles (*Strategus antaeus*). The *V. exanthematicus* and prey items were deposited in the Florida Museum of Natural History (UF 135537).

This *V. exanthematicus* was collected in a residential area ca. 335 m SSE of the largest remaining *G. polyphemus* population on the southern Pinellas County peninsula (pers. obs.). *Gopherus polyphemus* is a protected species throughout its range and is listed as a species of special concern in Florida (Moler 1992. Rare and Endangered Biota of Florida, Vol. III. Amphibians and Reptiles, Univ. Press of Florida, Gainesville, 291 pp.). Major threats to the Gopher Tortoise include habitat loss and degradation (Diemer 1986. Herpetologica 42:125–133), but heavy predation on *G. polyphemus* nests and juveniles is also a threat, due to the species' deferred sexual maturity and low fecundity (Diemer 1992. *In* Moler [ed.], Rare and Endangered Biota of Florida, Vol. III. Amphibians and Reptiles, Univ. Press of Florida, Gainesville, pp. 123–127).

Presently, more than 40 non-native herpetofaunal species are reported to be established in Florida (Townsend et al. 2003. Iguana 10:111–118), including three large lizards, the Mexican Black Spiny-tailed Iguana (*Ctenosaura pectinata*), Black Spiny-tailed Iguana (*C. similis*), and Nile Monitor (*Varanus niloticus*) (Campbell 2003. Iguana 10:119–120; Enge et al. 2004, unpubl.; Krysko et al. 2003. Florida Sci. 66:74–79; Townsend et al. 2003. Herpetozoa 16:67–72) that can potentially prey on *G. polyphemus*. Although there is presently no evidence that *V. exanthematicus* has established itself in Florida, this note documents the first predation of a protected reptile species in Florida by a non-native reptile species. Although it is illegal to release nonindigenous animals without a permit from the Florida Fish and Wildlife Conservation Commission (FWC), enforcement difficulties and inadequate regulatory control suggest that the release of non-native fauna will continue to be a major contributor to the state's battle with invasive non-native species.

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GOPHERUS POLYPHEMUS (Gopher Tortoise). **JUVENILE BURROW COHABITATION.** Hatchling and neonate chelonians have received little attention from field biologists (Morafka et al. 2000. Herpetol. Monogr. 14:353–370); thus most aspects of their ecology, including social behavior, are not well understood. In *Gopherus polyphemus*, adults often cohabit burrows with other conspecifics (see review in Smith et al. 1997. Chel. Cons. Biol. 2:358–362), or may usurp and enlarge burrows formerly inhabited by juveniles (Diemer 1992. J. Herpetol. 26:158–165); and juvenile tortoises occasionally occupy adult burrows (Douglass 1978. J. Herpetol. 12:413–415; Smith et al., *op. cit.*). Burrow sharing by juveniles has been previously reported (McRae et al. 1981. Am. Midl. Nat. 106:165–179; Diemer, *op cit.*); however, the authors make no reference to the sizes of the animals nor do they provide descriptions of the sharing events. Herein we provide the first descriptive documentation of burrow cohabitation involving two juveniles, as well as another event involving two sibling hatchlings at the Kennedy Space Center, Brevard County, Florida.

From 9 July–10 August 2003 a juvenile tortoise (Juvenile 1; carapace length = 9.8 cm) was monitored at a burrow (burrow width = 13.1 cm) using a motion-triggered digital camera. On 1 August 2003 at 1023 h a Peeper video camera system (Sandpiper Technologies, Manteca, California, USA) was also placed outside of the same burrow. Analysis of the videotape revealed another juvenile using the same burrow. The following is a description of the events recorded on the videotape. (Prior to this, Juvenile 1 was recorded entering the burrow on 30 July at 1431 h).

At 1053 h a juvenile tortoise (Juvenile 2; approximately the same CL as Juvenile 1, inferred from the videotape) walked directly up to the burrow and began digging at the entrance until it entered the burrow at 1054 h. At three separate times (from 1147–1150 h, 1154–1155 h, and 1255–1259 h) Juvenile 2 emerged from the burrow headfirst, turned around to face the entrance, and worked at enlarging it. Between these events it was inside the burrow. At 1504 h Juvenile 2 exited the burrow and was not seen again on the videotape.

At 1519 h on the same day an adult tortoise (> 25 cm CL) approached and attempted to force itself into the juvenile burrow. When the adult was unsuccessful, it turned around, briefly pulled inside its shell as if disturbed by an unknown source, and left the area at 1521 h.

At 1706 h a sand-covered Juvenile 1 emerged from the burrow, bit at some vegetation, began digging in the burrow entrance, and reentered the burrow at 1709 h. No further tortoise activity was observed on the videotape, which ended at 1833 h. Logistical constraints did not allow further videotaping of this burrow, and digital camera data did not reveal further co-occupation of juveniles within the burrow. Juvenile 1 left the burrow on 10 August 2003 and no tortoises have used it since.

At the same site, the burrow cohabitation of two hatchling tortoises hatched from the same nest (on 9 October 2003) was also observed. Both animals were given a unique mark and Hatchling 1 was outfitted with a radiotransmitter. Hatchling 1 was tracked daily from release until the present observation took place. During this time Hatchling 1 never dug a burrow, but instead used multiple short pallets. Hatchling 2 was recaptured on 8 March 2004 outside of its burrow (6.5 cm wide), fitted with a radiotransmitter, and released in the same location on 9 March. At the time we recaptured Hatchling 2 the tortoises were within 1.0 m of each other and both had dispersed 9.0 m from the nest since hatching.

After 9 March, Hatchling 2 was always in its burrow and Hatchling 1 was located 1.6 m away in its pallet. On 29 March Hatchling 1 was seen walking 1.8 m from the burrow of Hatchling 2. On 30 March both animals were found inside the burrow of Hatchling 2. Hatchling 2 was deeper inside the burrow and Hatchling 1 had about 20% of its body sticking out of the burrow. Over the next several days the tortoises remained in the same relative positions, but by 5 April both were completely inside the burrow. By 14 April Hatchling 2 had moved from the original burrow and dug another burrow 2.3 m away. Hatchling 1 was still using the original burrow.

Burrow takeover by tortoises has been reported elsewhere (Diemer, *op cit.*). Little is known about the significance of social interactions between immature turtles and tortoises and even less is known about sibling interactions. Research into the behavioral interactions of Gopher Tortoises and other species, especially juveniles and siblings, should be a focus of future research.

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LEPIDOCHELYS KEMPII (Kemp's Ridley Seaturtle). **DIET.** Dietary studies on post-pelagic *Lepidochelys kempii* document that crabs are a primary food source (Bjorndal 1997. *In* Lutz and Musik [eds.], The Biology of Sea Turtles, pp. 206–207. CRC Press, Boca Raton, Florida). Trawl fishery discards (fish or shrimp) may also be a supplemental food source in some regions. Portunid crabs are emphasized as a predominate prey item, but spider crabs, rock crabs, and lady crabs are also common in gut contents of live and stranded turtles. Here we report an attempted ingestion of a *Limulus polyphemus* (Horseshoe Crab) by a *L. kempii* in the Gulf of Mexico.

In September 2003, line transect surveys were conducted by the Sarasota Dolphin Research Program throughout Charlotte Harbor National Estuary along Florida's southwest coast. A survey on 8 Sept. encountered a *L. kempii* at 1329 h near the mouth of Alligator Creek (26.86555°N, -82.06394°W; depth 2.5 m, sandy-mud bottom adjacent to seagrasses composed of *Halodule*, *Syringodium*, and sparse *Thalassia*). The turtle swam at the surface with its head

elevated while holding a *Limulus polyphemus* in its jaws, grasped by the posterior margin, presumably to avoid the telson. A photo sequence recorded with a Nikon D100 6.1 MP digital camera illustrated lateral, frontal, and dorsal views while the turtle swam at the surface. The extreme dorsal flexion of the crab indicated that the crab was alive, verifying that the turtle was not scavenging a dead crab from the bottom. The turtle submerged briefly, lost its grip on the crab and when it resurfaced, shifted its mouth grasp of the prey item. It was impossible to follow the turtle or its prey to confirm ingestion of the crab. Estimates based on photo dimensions suggest that the ridley was a large subadult or adult, and the crab was of adult size (AAB, pers. obs.).

Limulus polyphemus is a common prey item of Loggerhead Turtles (*Caretta caretta*) in Virginia (Lutcavage and Musik 1985. Copeia 1985:449–456) but has been mentioned rarely in the diets of ridleys (Seney 2003. Master's thesis, College of William and Mary). *Limulus* is distributed geographically from the Yucatan peninsula to northern Maine with peak abundance in Delaware Bay (Botton and Ropes 1987. Fish. Bull. 84[4]:805–812).

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LEPIDOCHELYS KEMPII (Kemp's Ridley Seaturtle). **NEST ARCHITECTURE**. Studies describing sea turtle nest architecture have been largely limited to the Loggerhead Seaturtle (Carthy 1996. The Role of the Egg Shell and Nest Chamber in Loggerhead Turtles [*Caretta caretta*] Egg Incubation. Ph.D. dissertation. Univ. Florida, Gainesville. 123 pp.; Tiwari et al. 2003. Herpetol. Rev. 34:138–139). Here we report nest architecture data for the highly endangered Kemp's Ridley.

Data were collected from five nesting Kemp's Ridley seaturtles during the 2001 nesting season at Rancho Nuevo, Tamaulipas, Mexico. After recording standard size and clutch data, each turtle was removed from the nest after oviposition but prior to refilling. The eggs were removed, and the egg chamber cleaned of any loose sand and debris. A cast was made by filling the entire nest cavity with minimally expanding polyurethane construction foam and allowed to cure. Excess foam was cut off at the top of the nest structure flush with the surface of the sand and the cast excavated. A typical sea turtle nest is roughly urn-shaped, consisting of a narrow neck with a larger egg chamber at the bottom. The maximum diameters of the neck and egg chamber were measured as well as the distance from the top of the sand to the top and bottom of the egg chamber. Nest volumes were determined by measuring the amount of water displaced when the cast was submerged.

Mean carapace lengths (CCL) and weights of the five turtles were 69.8 cm (± 3.2) and 38.0 kg (± 2.9), and all five turtles were observed to have normal rear flippers. The mean number of eggs per nest was 96.4 (± 16.1). The mean depths from the top to the bottom of the nests were 21.6 cm (± 2.6) and 39.6 cm (± 3.6), and the mean diameters of the neck and egg chamber were 13.6 cm (± 1.7) and 28.0 cm (± 2.0), respectively. The mean nest volume was 6620 ml (± 2510).

FIG. 1. Polyurethane nest molds of the five Kemp's Ridley Seaturtles showing differences in size and shape.

The shapes and sizes of these nests varied considerably (Fig. 1). The shapes were probably influenced by the substrate in which the nests were constructed and the location on the beach. Substrate materials ranged from moist broken shell to dry rocky sand/soil. Variation in the dimensions of the nests, and resultant volumes, could also be attributed to the type of substrate, turtle size, and possibly the number of eggs deposited. There was a positive, but weak, correlation between the number of eggs per nest and nest volume ($r = 0.422$), while better relationships were found for turtle length and nest volume ($r = 0.835$), and turtle weight and nest volume ($r = 0.932$). Consequently, Kemp's Ridley nest sizes appear to be more of a function of turtle size and not clutch size, although a larger sample size would increase confidence in statistical analyses.

It is difficult to compare nest cast sizes with those previously done for Loggerheads because of different measuring techniques. However nest volumes for the Kemp's Ridleys and the Florida and Brazilian Loggerheads (Tiwari et al., *op. cit.*) averaged 6620 ml, 11030 ml, and 11757 ml, respectively. The much larger Loggerhead nest size undoubtedly reflects the equally large difference in mature sizes between Kemp's Ridleys (65 cm) and Loggerheads (90 cm), respectively (Marquez 1994. NOAA Tech. Memo. NMFS-SEFSC-343, 91 pp.; Dodd 1988. U.S. Fish Wildl. Serv. Biol. Rep. 88[14], 110 pp).

Conservation biologists at Rancho Nuevo currently relocate almost all nests to protected corrals, using a manual post-hole digger to excavate the main part of the nest. The egg chamber is then hand sculpted at the bottom of the hole and the eggs are then deposited and covered with sand. The depth of the relocated nests is currently 45 cm and the dimensions of the egg chambers are at the discretion of the individuals transplanting that particular nest. The five nests observed in this study ranged in depth from 38–45 cm (mean = 39.6). This is shallower than the standard 45 cm currently used in the corrals. Also, when hundreds of nests are being transplanted in a single day, the sizes of the egg chambers tend to be smaller than naturally occurs (pers. obs.). Perhaps the percent hatching success rate might increase from the present 55–65% by making the nest hole shallower and the egg chamber larger. However, a follow up study using a larger sample size should be undertaken before changes in the current conservation techniques are considered.

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PHRYNOPS GEOFFROANUS (Geoffroy's Side-necked Turtle). **DIET.** *Phrynops geoffroanus* has the widest geographical distribution among the South American freshwater turtle fauna, ranging from the Colombian Amazon to southern Brazil, Uruguay, and northern Argentina. This species occurs primarily in large streams and lakes, and appears to be tolerant of polluted waters (Vanzolini 1994. Smithson. Herpetol. Inf. Serv. 97:1–10). Despite this turtle's broad range, information on its natural diet is quite scarce. Some published data suggest that habitat characteristics might influence diet (Fachin-Teran et al. 1995. J. Herpetol. 29:536–547; Souza and Abe 2000. J. Zool. 252:437–446). We examined digestive tract contents (stomach flushing and feces) of 28 *P. geoffroanus* captured June–September 2003 in a dam reservoir at the upper Paraná River, bordering Mato Grosso do Sul and São Paulo States, Brazil (20°49'15"S, 51°39'31"W). Diet analyses are summarized in Table 1. *P. geoffroanus* from the sampled region exhibits predominantly carnivorous feeding habits, consuming fishes, crustaceans, mollusks, and insects. The presence of plant material in three stomachs (10.7%) may represent incidental ingestion.

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TABLE 1. Diet of *Phrynops geoffroanus* (N = 28) from a dam in upper Paraná River, Brazil. Data are expressed as occurrence frequency.

Prey categories	f	f%
Fish*	4	14.3
Crustacea (Decapoda)	3	10.7
Crustacea (Trichodactylidae)	2	7.1
Insecta (Coleoptera)	5	17.9
Insecta (Formicidae)	1	3.6
Insecta (Chironomidae)	1	3.6
Insecta (Odonata - Larvae)	2	7.1
Gastropoda (*Pomacea* sp.)	4	14.3
Gastropoda (unidentified snail)	1	3.6
Bivalvia	2	7.1
Hirudinea	1	3.6
Unidentified animal material	12	42.9

* Includes bones and scales from Characiiformes and Perciformes.

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PODOCNEMIS UNIFILIS (Yellow-spotted River Turtle). **NESTS** and **NESTING**. *Podocnemis unifilis* is widely distributed along the Amazon and Orinoco Basins in South America (Pritchard and Trebbau 1984. The Turtles of Venezuela. Society for the Study of Amphibians and Reptiles, Athens, Ohio, pp. 33–73). Like other species of *Podocnemis, P. unifilis* is of economic importance to the people who live in the region, due the high quality of its meat and eggs (Smith 1979. Acta Amazônica 9:87–97). Studies on this turtle's breeding biology were carried out in Colombia (Foote 1978. Herpetologica 34:333–339), Venezuela (Thorbjarnarson et al. 1993. J. Herpetol. 27:344–347; Escalona and Fa 1998. J. Zool. 244:303–312), but data are almost inexistent for Brazil (Thorbjarnarson and Silveira 1996. Herpetol. Rev. 27:77–78). From September to November 2000/2001 we collected data on nests of *P. unifilis* in Reserva Biológica do Rio Trombetas. The reserve has an area of 385,000 ha and is located in the northwest part of state of Pará, municipality of Oriximiná, on the northeast bank of Rio Trombetas (1°46'S, 55°52'W), Brazil. Nesting took place in the sandbanks (tabuleiros) formed by the dropping water levels and on lakeshore beaches. Observations and data were collected at Tabuleiro do Farias, Tabuleiro do Jacaré, and Lago do Jacaré.

Nests were excavated and the nest depth (measured vertically between surface and incubation chamber) and the distance between the entrance of the nest and the incubation chamber were measured with a metric tape. Eggs were measured in the early morning immediately after nesting using a caliper with precision of 0.05 mm and weighed to the nearest 1 g with Pesola spring scales. To avoid natural and human predation, eggs were transferred to permanently monitored areas in the same sandbank. Original position of eggs was established with a pencil mark on top of each egg.

Most nests were found at a distance of 3–780 m from the water on lake beaches; some were on sandbanks near or covered by vegetation, rarely in places totally exposed to the sun. The following data are based on 30 nests: mean total nest depth: 17.7 ± 2.7 cm; depth of the first egg in relation to the surface: 9.0 ± 3.3 cm; mean length of the incubation chamber: 18.4 ± 3.4 cm; width of the incubation chamber: 16.3 ± 2.3 cm; and diameter of nest mouth: 9.4 ± 1.3 cm. Clutch size (N = 37) varied from 7 to 27 eggs (mean = 19) in both years. Mean egg length was 4.4 cm (3.8–5.1 cm), mean egg width was 2.9 cm (2.4–3.2 cm), and mean egg mass, 22.5 g (15.0–30.0 g). Incubation periods varied from 58 to 66 days (mean = 61). In these two years of study, hatching was completed about one month before the beginning of the rainy season.

IBAMA provided the permit to work with *Podocnemis unifilis* at Reserva Biológica do Rio Trombetas - Brazil (IBAMA 02010.003215/00-44). This study was supported by FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo), CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) and Conservation International. Thanks to IBAMA (Rio Trombetas) for logistic support and to the following people for help in the field or laboratory: Flávio de Barros Molina, Márcio Martins, Alberto Guerreiro, and Renata Moretti.

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PSAMMOBATES GEOMETRICUS (Geometric Tortoise). **DIET**. *Psammobates geometricus* is an endangered tortoise restricted to

renosterveld in the southwestern corner of South Africa. Twenty-four genera or species of plants have been reported as food for these tortoises, either by visual observation or fecal analysis (Baard 1990. Ph.D. dissertation, University of Stellenbosch, South Africa, 208 pp.). In one study, 40% of the plant epidermi examined in feces were unidentifiable (Baard, *op. cit.*), suggesting that many food plant species have yet to be catalogued.

On three consecutive days (13–15 October 2002), while researching *P. geometricus* at the Elandsberg Private Nature Reserve (Hermon, Western Cape Province, South Africa 33°24'S; 19°01'E), we observed three adult Geometric Tortoises feeding. A male tortoise fed on the leaves of *Cyanella hyacinthoides* (lady's hand), a monocotyledonous geophyte that has not been reported earlier as a food plant for *P. geometricus*. A female tortoise ate the leaves of another monocotyledonous geophyte, *Lachenalia contaminata* Aiton (wild hyacinth), also a new species for the *P. geometricus* diet list. This tortoise also ate leaves of *Cynodon dactylon* (quick grass), a low-lying grass previously reported as a food plant by Baard (*op. cit.*). Another female tortoise fed on leaves of *Cynodon dactylon* and the leaves and inflorescence of *Briza maxima* (quaking grass, 10–40 cm tall), a grass reported as food plants (Baard, *op. cit.*; Engelbrecht 1995. Ph.D. dissertation, University of Stellenbosch, South Africa. 176 pp.).

Renosterveld, a habitat once widespread in western South Africa, has been reduced by over 90% due to farming, development, and an altered fire regime (Parker 1982. Veld and Flora 68:98–101). These factors, as well as invasive plants and animals, continue to threaten the remaining renosterveld. Thus, to conserve *P. geometricus*, it is imperative that we identify and conserve their food plants. Our observations confirm previous reports that low-lying grasses are a component of the diet of this tortoise and also expand the *P. geometricus* database of native food plants by two species of monocotyledonous geophytes.

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CROCODYLIA

ALLIGATOR MISSISSIPPIENSIS (American Alligator). **MORTALITY.** Alligators are large, long-lived carnivores (Campbell 2003. Appl. Herpetol. 1:45–163) and non-human causes of mortality (besides cannibalism; Rootes and Chabreck 1993. Herpetologica 49:99–107) are rarely reported. Anthropogenic factors are more commonly reported as causes of alligator deaths, which include direct take (Mazzotti and Brandt 1994. *In* Davis and Ogden [eds.], Everglades: The Ecosystem and its Restoration, pp. 485–505. St. Lucie Press, Delray Beach, Florida), road mortality (Smith and Dodd 2003. Florida Sci. 66:128–140), toxicants caused by pollution (Schoeb et al. 2002. J. Wildl. Dis. 38:320–337), or bacterial infections that a variety of human-influenced or environmental factors may aggravate (Clippinger et al. 2000. J. Zoo Wildl. Med. 31:303–314). Besides road mortality (Smith and Dodd, *op cit.*) and cannibalism (Rootes and Chabreck, *op cit.*), this report is the first documentation of an American Alligator dying because of presumptive behavioral error.

On 31 July 2003, we observed a large (3.6 m) dead American Alligator of undetermined sex on the bank of the Banana River at the Merritt Island National Wildlife Refuge, Brevard County, Florida (28°34'56"N, 80°36'45"W; elev. 1 m; Fig. 1). The alligator was facing away from water lying perpendicular to the bank on a 45° slope and a well-used emergence trail was located ca. 1 m W of the animal. The alligator was pinned between 4 large limestone rocks (Fig. 1). The forelimbs were outstretched with the anterior rocks extending from the axial region down to mid-body. Each hind leg was also hemmed in by a rock on either side of the pelvic region. The rocks were all sufficiently large (the smallest next to the left leg measured 40 x 52 x 33 cm) and heavy that an adult human could not move them without difficulty.

At the time of discovery scavengers had chewed off the hands and feet and the skin had begun to crack open in several places, exposing the flesh, implying the carcass was several days old. Examination of the cracked skin showed no indication that these lesions represented human-inflicted wounds (including gunshot) and later re-examination of the skull failed to show evidence of trauma. The location of this find is within a secure, remote area of the Kennedy Space Center (where weapons are not permitted) with restricted access.

FIG. 1. American Alligator (*Alligator mississippiensis*) found stuck between rocks along the Banana River, Brevard County, Florida.

We believe that the alligator became inextricably trapped between these rocks while climbing up the steep bank and could not escape due to the bank angle and the awkward positioning of the alligator. Alligators normally use an upright high-walk posture when moving overland, where the limbs are erect underneath the body and move parallel to the body axis (Pough et al. 2001. Herpetology. Prentice Hall, New Jersey. 612 pp.). Rocks enclosing the axial region of the body causing the headward extension of the forelimbs may have prevented the alligator from effectively positioning the limbs underneath the body. Crocodilians can also use a sprawling posture during locomotion to travel short distances or to make the transition from a resting position to a high-walk (Reilly and Elias 1998. J. Exp. Biol. 201:2559–2574), but this type of locomotion requires the limbs to be outstretched perpendicular to the body, an option that may not have been possible here.

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LACERTILIA

AMEIVA AMEIVA (Calango Verde). **COURTSHIP BEHAVIOR.** *Ameiva ameiva*, a heliothermic teiid widely distributed in Central and South America, is abundant in ecotonal areas and typically active during prolonged sunlight intervals (Colli 1991. Copeia 1991:1002–1012; Sartorius et al. 1999. Biol. Cons. 1999:91–101; Zaluar and Rocha 2000. Ciência e Cultura 52:101–107). Despite this abundance and broad distribution, most aspects of courtship and reproduction remain unknown for most populations of this species. Herein, we describe courtship behavior in *A. ameiva* from southeastern Brazil.

Our observations were made on a lawn on the grounds of the Serra do Cipó National Park headquarters (19°00'S, 43°40'W; elev. 515 m) on 22 October 2001 at 1500 h. We encountered an adult male *A. ameiva* following an adult female and making ca. 80-cm diam circles around her while she kept moving forwards. After at least three attempts to intercept her over a one-minute period, the female stopped and the male clasped her by mounting her back, and wrapping his tail around hers on her left side. The male seized the female by her hind legs using his forelimbs and kept making circular movements with his tail. Copulation could not be directly observed from our position, but the pair remained in the same position for 30 sec; during that time, the female was passive and the male's tail kept moving. Subsequently, the female broke free from the male, and moved away. When she had move away a distance of ca. 0.5 m, the female encountered an adult treefrog, *Scinax fuscovarius*, in the shade. After three attempts to capture it, the female caught the frog by its hind limbs as it tried to escape. The treefrog vocalized twice, emitting a scream before being killed by head shaking. During this time, the male *A. ameiva* had remained behind the female. The male continued to follow the female with the treefrog in her mouth. When the male got too close, the female tried to flee, alternatively running and walking away. We saw the female enter and exit a drainpipe several times. When the male arrived, the female emerged. Sometimes, the female would briefly deposit the treefrog on the ground but as the male approached, the female would retrieve it and run away. We discontinued observations after 25–30 min as no obvious changes had occurred in the pair's behavior.

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EUPREPIS ATLANTICUS (Noronha Skink). **PREDATION.** This lizard, formerly known as *Mabuya maculata* or *M. punctata*, is endemic to the Fernando de Noronha Archipelago off NE Brazil (Mausfeld and Vrcibradic 2002. J. Herpetol. 36:292–295; Mausfeld et al. 2002. Zool. Anz. 241:281–293). It occurs across habitats from rocky seashore to insular forest, and thrives on a broad range of foods ranging flower nectar to human leftovers (IS, pers. obs.). No snakes or raptorial birds exist on the archipelago; thus, the Noronha Skink likely evolved without native predators. Humans tolerate the skink as well; all houses harbor sizeable populations (up to 29 animals have been counted in a six-room dwelling; IS, pers. obs.). However, human colonization of the archipelago has brought three rodent pests—Brown Rats (*Rattus rattus*), Norway Rats (*Rattus norvegicus*), and House Mice (*Mus musculus*)—as well as Domestic Cats (*Felis catus*) and Domestic Dogs (*Canis domesticus*). A few pairs of the giant tegu (*Tupinambis merianae*) were introduced in the 1950s for the alleged purpose of controlling rats and giant toads (*Bufo paracnemis*), the latter of which also represents an introduction. Additionally, the Cattle Egret, already present in the 1980s, established breeding colonies in the archipelago by the year 2000 (JSM, pers. obs.). Herein, we report on predators of the Noronha skink as well as record cannibalism by this lizard (Table 1).

Except for the predation records by tegus, which we obtained from examination of gut contents, most records were direct visual observations. We obtained visual records opportunistically from June 2000 to January 2003, whereas tegu diet was studied from March 2000 to October 2001. Cats and egrets always stalked the skinks, whereas the tegu chased its prey—a hunting tactic it employs for smaller lizards (Sazima and Haddad 1992. *In* Morellato [ed.], História Natural da Serra do Japi, pp. 221–236. Edunicamp, Campinas). In the cannibalistic encounters, *E. atlanticus* adults robbed eggs from within shallow oviposition burrows of conspe-

TABLE 1. Predation records on the Noronha Skink (*Euprepis atlanticus*).

Predators	N	Comments
Felis catus	23	Kittens killed, but did not eat 2 skinks
Mus musculus	1	Potential scavenging
Rattus norvegicus	2	
Rattus rattus	1	
Bubulcus ibis	11	
Tupinambis merianae	5	Actual predation event recorded once
Euprepis atlanticus	5	Eggs (2); juveniles (2); adult tail (1)

cifics, or chased smaller individuals often consuming their tail after a brief aggressive encounter. Cannibalism is recorded for the continental skink *Mabuya frenata* (Vrcibradic and Rocha 1996. Herpetol. Rev. 27:201–202) and occurrence of this habit in *E. atlanticus* may be related both to its well-developed opportunistic foraging behavior and high population densities (pers. obs.). One rat was found eating its prey during the day, but most probably took *E. atlanticus* in its nocturnal retreats. In all instances of consumption by rodents, the skink was already dead when the event was recorded, so it is unclear how frequently scavenging rather than actual predation occurs. As the House Mouse was similar in size to the skink, a greater likelihood exists that consumption by mice involves scavenging. We lack definitive data to support the view that any of the predators may be causing skink populations to decline on the archipelago. However, we noted that houses with resident cats have few or no skinks in their neighborhoods. A cat which gave birth to four kittens weaned them with skinks, and we recorded eight skinks preyed on by this adult and seven others by its kittens. Additionally, the toll taken by Cattle Egrets also may be high, as we recorded a single egret catching three skinks in a row during a foraging bout of about 10 min.

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MICROLOPHUS PERUVIANUS (NCN). **CANNIBALISM**. Cannibalism is common among reptiles, with many cases reported among lizards (Polis and Myers 1985. J. Herpetol. 19:99–107; Mitchell 1986. SSAR Herpetol. Circ. 15:1–37). Two cases involve species of *Microlophus* (formerly included in *Tropidurus*; Mitchell, *op. cit.*), but *M. peruvianus* is not among them. Here, I report an observation of cannibalism in *M. peruvianus* from northern Peru.

On 25 July 1997, I observed an adult male *M. peruvianus* ingesting a live conspecific juvenile in Lobos de Tierra Island, Departamento de Lambayeque (06°28´S, 80°50´W; elev. 15 m). The adult was moving while carrying the juvenile in its mouth. After 2 min, the adult stopped and ingested the juvenile using lateral movements of its head. I could only see the dorsum, posterior limbs and tail of the juvenile. I was unable to capture the adult male, but I could identify the juvenile because of its characteristic yellow-orange inguinal markings (Dixon and Wright 1975. Nat. Hist. Mus. Los Angeles Co. Contrib. Sci. 271:1–39) which are not present in conspecific adults nor in any other sympatric lizards species.

Microlophus peruvianus was introduced to Lobos de Tierra Island to control ectoparasites that affect guano bird populations (Vogt 1942. Bol. Cia. Admora. Guano 18:1–132). Whether it exerts such an effect is unconfirmed, but *M. peruvianus* is the only known tick consumer at this locality and in similar habitat on other islands (Perez and Jahncke 1998. Bol. Inst. Mar del Peru 17:81–86; Duffy 1983. Ecology 64:110–119). *Microlophus peruvianus* and *Phyllodactylus microphylus* are the only lizards known from Lobos de Tierra Island, and appear to have densities that are higher than those observed on the mainland. This condition may increase the likelihood of cannibalism (Polis and Meyers, *op. cit.*).

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MICROLOPHUS THERESIAE (NCN). **SAUROPHAGY**. Members of the lizard genus *Microlophus* are mostly insectivores (Dixon and Wright 1975. Contrib. Sci. Nat. Hist. Mus. Los Angeles Co. 271:1–39). Predation by Peruvian desert *Microlophus* on other sympatric lizards is unreported. Here, we report saurophagy by *M. theresiae* from central Peru.

At 1230 h on 10 April 2001, we captured an active adult male *M. theresiae* (65.8 mm SVL, 8.0 g., MHNSM 18600) in the Reserva Nacional de Lachay, Departamento de Lima (11°20'48"S, 77°19'45"W; elev. 180 m). The stomach of the *M. theresiae* contained two juveniles of *M. thoracicus* (ca. 22 mm SVL, 0.4 g, MHNSM 18601; ca. 27 mm SVL, 0.8 g, MHNSM 18602), which were the only foods items in the stomach. Given the parallel degree of digestion, both lizards were probably eaten in the same day. The three individuals were deposited in the Herpetology Collection of the Department of the Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos, Lima, Peru.

The site of this observation is part of the Peruvian desert, characterized by sandy substrate, few rocks of different sizes, and little vegetation. This habitat is typical for adults of *M. theresiae* and juveniles of *M. thoracicus*. Overlap in microhabitat use and activity (both species are diurnal) increases their likelihood of encounter despite their apparently relatively low densities. Moreover, our observation of saurophagy coincided with the dry season when the availability of arthropods is low.

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PEDIOPLANIS LINEOOCELLATA (Spotted Sand Lizard). **ENDOPARASITES.** *Pedioplanis lineocellata* is a lacertid lizard that occurs in the western half of the African subcontinent but is absent from regions of deep sand, e.g., Namib desert and central Kalahari (Branch 1998. Field Guide to Snakes and other Reptiles of Southern Africa. Ralph Curtis Books, Sanibel Island, Florida. 399 pp.). Goldberg and Bursey (2002. Afr. Zool. 37:159–164) reported one species of Cestoda (*Oochoristica ubelakeri*) and four species of Nematoda (*Maxvachonia dimorpha, Spauligodon smithi, Thubunaea fitzsimonsi,* as well as ascarid larvae) in *P. lineoocellata* from Botswana. The purpose of this note is to report a second species of Cestoda in *P. lineoocellata.*

During an examination of coelomic cavities of 535 *P. lineoocellata* from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California, USA, three adult cestodes were found in LACM 79142 (60 mm SVL); two adult cestodes were found in LACM 84087 (64 mm SVL). These cestodes were regressively stained in hematoxylin, mounted in Canada balsam on glass slides and identified as *Oochoristica truncata.* Voucher cestodes were deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland as USNPC 94424.

Four species of *Oochoristica*, namely, *O. theileri, O. truncata, O. ubelakeri,* and *O. zonuri*, have been reported in South African lizards (Bursey et al. 1994. Trans. Am. Microsc. Soc. 113:400–405). These species exhibit little host specificity. *Oochoristica truncata*, the most frequently reported taxon, is known from the lizard families Agamidae, Chamaeleonidae, Cordylidae, Gekkonidae, Scincidae as well as the snake families Boidae and Colubridae (Goldberg and Bursey 2004. Afr. Zool. 39:111–114). *Pedioplanis lineoocellata* is the second South African lizard reported to harbor two species of *Oochoristica. Agama hispida* has been previously reported to harbor both *O. theileri* and *O. truncata* (Malan 1939. Onderstepoort J. Vet. Sci. An. Husb. 12:21–74; Simbotwe 1979. Afr. J. Ecol. 17:177–180). *Oochoristica truncata* in *P. lineoocellata* is a new host record.

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PHRYNOSOMA ASIO (Giant Horned Lizard). **COPULATION POSITION**. Lizards in the genus *Phrynosoma* normally copulate following sometimes extensive visual and olfactory displays when a male assumes a position on the female's back (Baur and Montanucci 1998. Krötenechsen, Herpeton, Verlag Elke Köhler, Offenbach, 158 pp.; Sherbrooke 2003. Introduction to Horned Lizards of North America, University of California Press, Berkeley. 176 pp.). The male maintains this position by using his jaws to bite and grip skin on the female's neck or nuchal fold, or by biting her occipital or temporal horns. The place used by the male to secure his jaw hold varies within and between species, with short-horned species preferring a neck skin hold (Baur and Montanucci, *op. cit.*). The male uses all four legs to assist in maintaining his straddle position. Thus situated, the male wraps his tail to the side of the female's tail and endeavors to bring his cloaca into contact with the female's cloaca, ideally with her cooperation in positioning, prior to the male inserting one of his hemipenes into the female's cloaca for insemination. In the coast horned lizard, *P. coronatum*, the male has been reported to utilize a dramatically different position for copulation, one possibly unique to amniotes except humans (Wood 1936. Copeia 3:177; Lynn 1963. Ph.D. dissertation, University of Oklahoma, Norman. 75 pp.; Montanucci 1968. Herpetologica 24:316-320; Tollestrup 1981. Herpetologica 37:130–141; Montanucci and O'Brien 1991. Vivarium 3:27–28). The male grasps the female in his jaws by her neck or gular skin and, with a quick jerk, flips the female onto her back. Then he secures a position on top of the female that brings them into belly-to-belly contact (see photographs in Montanucci and O'Brien, *op. cit.*; Baur and Montanucci, *op. cit.*). The male retains his jaw hold on the female's gular skin and spreads his legs to maintain an upright position on top of the inverted female. He then positions his lower abdomen and tail to bring their cloacas into contact and inserts a hemipenis for copulation. Although this position has been observed numerous times it is not always used, with males of this species being seen to mount females for copulation in the male-on-female's back position (Tollesrup, *op. cit.*; Baur and Montanucci, *op. cit.*) more widespread among horned lizards. Males of the giant horned lizard, *P. asio*, are also reported to use the typical male-on-female's back copulatory position, holding the female's neck skin in their jaws (see photographs in Baur 1979. Salamandra 15:1–12; Baur and Montanucci, *op. cit.*). Davis and Dixon (1961. Proc. Biol. Soc. Washington 74:37–56) reported observing a mating sequence in the field but did not comment on copulatory position, suggesting that it was not unusual (i.e., belly-to-belly). Here, we report four field observations of mating position in *P. asio* in which the male was positioned over the inverted female with his belly oppressed to her belly while holding her gular skin in his jaws. These represent the first observations of this unique belly-to-belly mating position being used by any species of lizard other than *P. coronatum*.

Between 1998 and 2003, one of us (EBS) and students from the Universidad Autónoma de Guerrero conducted field investigations on *P. asio* and *P. taurus* at Cerro Tepetlayo (17°83'09"N, 99°31'31"W; elev. 1280 m), Zumpango del Río, Municipio de Eduardo Neri, Guerrero, México. The following observations were made on four mating pairs of *P. asio*, all utilizing the belly-to-belly copulatory position for mating. On 1 June 1999, a 50-g female (95 mm SVL, 49 mm tail) was found copulating with a 56-g male (100 mm SVL, 71 mm tail; Fig. 1). The mating was observed for ca. 15 min before the two animals separated and departed. On 9 June 1999, a male and female were seen to approach each other with the female raising her tail and wagging it from side to side. No vent licking (Sherbrooke 1988. Ph.D. dissertation, University of Arizona, Tucson, 202 pp.) was observed. The male grabbed the female by the neck skin in his jaws, threw her onto her back, and then moved over her so that they were in a belly-to-belly position. He held her for 6 min before she escaped his hold. He followed her, but then seemed to lose interest and walked away. Copulation was not observed. A third pair was observed on 6 June 2001. When encountered at 1030 h the male was following the female. Observations lasted 1.5 h. The male turned the female over onto her back after securing a jaw hold on her

FIG. 1. Male and female *Phrynosoma asio* in belly-to-belly copulatory position.

under the neck and assumed a belly-to-belly position on top of her. He wrapped his tail around her tail before introducing his hemipenis for copulation. A fourth pair of giant horned lizards were found copulating about 15 days later in June 2001. The pair was mating in a belly-to-belly position when encountered, and the male's everted hemipenis was seen as the pair separated. In three of the four field observations of belly-to-belly mating behavior, copulation was observed. The absence of the typical *Phrynosoma* mating posture (except in *P. coronatum*) during these field observations of *P. asio* is noteworthy. Also of interest, all matings occurred in June, a timing parallel to the 26 June field observation near Chilpancingo (Davis and Dixon, *op. cit.*), and to a captive mating on 24 June (Baur, *op. cit.*). The mating dates recorded here agree with the typical time for oviparous species of horned lizards, May-July (Zamudio and Parra-Olea 2000. Copeia 2000:222–229).

Observations of a belly-to-belly copulatory position in *P. asio* bring to two the number of species in the genus exhibiting this mating posture. Whether these positional differences within species are attributable to pairs in particular encounters, individual behaviors, or population characteristics is unknown. Both *P. asio* and *P. coronatum* potentially represent the least derived taxa in the two evolutionary branches of the genus, the northern and southern radiations (Montanucci 1987. Contri. Sci. Nat. Hist. Mus. Los Angeles Co. 390:1–36; Zamudio et al. 1997. Syst. Biol. 46:284–305). Thus, whether lack of reports of this mating behavior in other species is due to its evolutionary loss, insufficient observations of matings, or other factors is unclear. Functional aspects of this unusual lizard mating posture remain elusive, but are intriguing. The position may aid the male in his attempts at maintaining a firm grip on the female, whose locomotion is severely restricted while inverted. In this position, the male is not subject to injury from the female's horns during copulations, which might not always involve the full cooperation of the female. In *P. asio*, the occipital horns are notably erect and positioned adjacent to particularly long, and posteriorly-projecting, supraocular spines. In *P. solare*, a well-armored species with extra cranial horns, males apparently avoid the bite-holding of horns or neck skin during copulation, maintaining position solely with their legs (Baur and Montanucci, *op. cit.*). Cranial horn thrusts are known to be capable of inflicting serious wounds in male-to-male combat (Whitford and Whitford 1973. Herpetologica 29:191–192). *Phrynosoma asio* also has the longest, most erect, and most impressive array of dorsal spines on its back of any species of horned lizard; these structures may impose additional obstacles to a male attempting to mount and copulate successfully with a female that is typically larger in size than the male (Zamudio 1998. Evolution 52:1821–1833). Compared to females that mate with males who secure horns during copulation (Lynn, *op. cit.*), females in belly-to-belly copulations may experience reduced horn breakage.

Among horned lizards, social signals involving head bobbing, push-ups, vent flashing, vent licking, and attempted mounting provide individuals with opportunities to visually and chemically assess species identity, sex, reproductive status, and receptivity of other congeners (Tollestrup, op. cit.; Montanucci and Baur 1982, Copeia 1982:971–974; Sherbrooke 1988, 2003, *op. cit.*). A male's attempt to mount a female is near the terminal end of this sequence. In non-territorial horned lizards (Stamps 1977. *In* Gans and Tinkle [eds.], Vol. 7, Biology of the Reptilia, pp. 265–333. Academic Press, London.; Munger 1984. Oecologia 62:351–360), males can have difficulties encountering suitable sexual partners due to low population densities, restricted visual landscapes (Stamps, *op. cit.*; Sherbrooke 2002. Herpetol. Rev. 33:21–24), or brief seasonal sexual receptivity of females (Munger 1984, *op. cit*; Sherbrooke 2002, *op. cit.*). Availability of multiple methods to secure an advantageous copulatory position may enhance male fitness. The belly-to-belly mating position may allow easier introduction of the male's copulatory organ, a potential advantage with reluctant females.

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PHRYNOSOMA BRACONNIERI (Short-tail Horned Lizard). **DEFENSIVE BEHAVIOR**. Sherbrooke and Middendorf (2001. Copeia 2001:1114–1122) recently noted that all members of the genus *Phrynosoma* do not seem to utilize the ability to eject blood from ocular sinuses with the same frequency. Some species (*P. mcallii*, *P. modestum*, and *P. platyrhinos*) apparently are "non-blood-squirting" based on: 1) an extremely low frequency (0.07%) of squirting during field encounters with humans, compared to 5.9% with *P. cornutum* (Lambert and Ferguson 1985. Southwest. Nat. 30:616–617), and 2) experimental trials with a canid model, dogs (*Canis familiaris*), in which no blood squirting was observed in trials with all three species (N = 11, 10, and 15, respectively). Moreover, the three non-blood-squirting species may represent a

clade (Sherbrooke and Middendorf, *op. cit.*). For other species in the genus, particularly poorly known taxa in Mexico (*P. braconnieri*, *P. ditmarsi*, and *P. taurus*), available data were insufficient for a determination of the occurrence or frequency of blood squirting. Preliminary data on *P. ditmarsi* from trials with a dog (Sherbrooke and Middendorf, *op. cit.*; Hodges, Southwest. Nat., *in press*; W. L. Hodges, pers. comm.) suggest that this species uses blood squirting as an anti-predator defense, but its frequency of use remains unclear. A recent reevaluation of blood squirting in *P. taurus* (Sherbrooke et al. 2004 Herpetol. Rev. 35:345–347), involving field encounters by humans and trials with a canid model (dog), suggests that *P. taurus* may be a non-blood-squirting species (*contra* Ruthling 1919. Copeia 72:67–68). This new evidence of non-blood-squirting status for *P. taurus* suggested that reevaluation of its apparent sister taxon, *P. braconnieri*, was in order. Here, we use field encounters and trial observations of *P. braconnieri* to evaluate its blood-squirting status, which remains unreported (Sherbrooke and Middendorf, *op. cit.*).

Five *Phrynosoma braconnieri* were collected in xerophytic vegetation on 20–21 June 2003, ca. 5 km NE San Juan Tepango de López, Puebla, México (18°35'16"N, 97°32'38"W; elev. 1800 m). No lizard squirted blood when encountered, picked up, and placed in a cloth bag. Two were adult females (59 and 63 mm SVL) and three were juveniles (34, 37, and 39 mm SVL). We included juvenile *P. braconnieri* because juvenile *P. cornutum* and *P. hernandesi* squirt blood (Sherbrooke and Middendorf, *op. cit.*), and juvenile *P. braconnieri* might also display the behavior if this species squirts blood. Each lizard was tested in late afternoon on the day of capture with a canid model predator, a German Shepherd-mix dog. Air temperature was 20°C (20 June), and light rain fell before and after the five 3-min trials. During trials, the dog barked and vigorously tried to paw and mouth the lizards. Due to the size and strength of the dog, it was restrained on a leash to prevent injury to the lizards. Test lizards frequently ran from the dog, requiring recapture and return to the test area. Nevertheless, the lizards were presented with close (20 cm) visual, auditory, and chemical (saliva) cues from the dog, and tactile stimuli from the paws. Tactile stimulation of being picked up in the jaws of the surrogate predator was lacking. The person handling the lizards (WCS) had extensive experience with similar trials (Sherbrooke and Middendorf, *op. cit.*).

Throughout the trials, the lizards' eyelids remained open and unswollen, with one exception. Following one trial (37 mm juvenile), the lizard's eyelids became "puffy" (fide Middendorf and Sherbrooke 1992. Copeia 1992:519–527) during handling by the experimenter, indicating a change in blood pressure in the ocular sinuses. Tactile stroking of the eyelids (2 min) in a fashion similar to that use to obtain blood squirting in *P. cornutum* (Sherbrooke and Middendorf, *op. cit.*) resulted in their enlargement (stage two fide Middendorf and Sherbrooke, *op. cit.*), but no blood squirting was seen.

For human field encounters, our sample of five lizards, plus Hodges' six encounters, all lacking blood squirting events, support the hypothesis that *P. braconnieri* may be a non-blood-squirting species. Further, our five trials of *P. braconnieri* with a surrogate predator failed to elicit blood squirting. In similar trials with other species, the percentage of trials in which a positive response, blood squirting, was elicited were 70–100%, 50%, and 60%, with *P. cornutum* (N = 55), *P. hernandesi* (N = 6), and *P. solare* (N = 5), respectively (Middendorf and Sherbrooke, *op cit.*; Sherbrooke and Middendorf, *op. cit.*). This suggests that *P. braconnieri* is less likely to squirt blood in response to a canid predator threat than are these latter species. The likelihood of using this defense in *P. braconnieri* may be similar to that of *P. taurus*, where it seems low or absent (Sherbrooke et al. 2004, *op. cit.*). Given our re-evaluation of *P. taurus* as a possible non-blood-squirting species, and the preliminary data presented here, we suggest that the use of a blood-squirting defense by *P. braconnieri* remains incompletely understood. Sherbrooke and Middendorf (*op. cit.*) speculated that *P. braconnieri* may be a blood-squirting species; that evaluation now seems premature.

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UMA EXSUL **(Coahuila Fringe-toed Sand Lizard). BODY TEMPERATURE.** Relatively little ecological information exists about *U. exsul*, a Chihuahuan Province endemic (Norma Ecologica Mexicana, NOM-059-ECOL-2001. Diario Oficial de la Federación. 2002. México, D.F., México. 77 pp.) considered at risk of extinction (Gadsden et al. 2001. Bol. Soc. Herpetol. Mex. 9[2]:51–66) because of low genetic variability and agricultural development fragmenting populations. Here, we provide preliminary body temperature data on this species.

During a 1997–1999 population study near the municipality of Viesca, Coahuila, Mexico, we obtained body temperature data on *U. exsul* from two dune areas, Saucillo (25°26'23"N, 102°55'23"W; elev. 1100 m) and Gabino Vazquez (25°28'09"N, 103°02'09"W; elev. 1100 m), separated by a distance of ca. 10 km. Dune vegetation is almost entirely perennial shrubs: Creosote Bush (*Larrea tridentata*), Black Seepweed (*Suaeda nigrescens*), and Honey Mesquite (*Prosopis glandulosa*). We conducted 15 days of fieldwork in May and August between 1000 and 1300 h. Individuals of *U. exsul* were captured with a noose or by hand on a 2-ha plot in each study area. We obtained body temperatures only from lizards captured almost immediately after they were sighted. We also did not obtain body temperatures on lizards that ran more than 5 m before capture. Each lizard was permanently marked by toe-clipping and also given a temporary dorsal acetate mark that could be seen easily so as to prevent recapture of individuals on the same day. Gravid females were excluded from this analysis since too few were captured. One body temperature (T_b; to 0.1°C) was obtained for each lizard with a rapid-reading cloacal thermometer on each day. Data were taken within 10 sec of capture to avoid changes in T_b that

might result from manipulation. Gender was identified by the presence of large postanal scales or everted hemipenes in males. We measured SVL (to the nearest mm) using a flexible ruler and body weight (W; to the nearest 0.1 g) with a Pesola™ spring scale. Lizards were released at the point of initial sighting following processing. A Kolmogorov-Smirnov goodness of fit test revealed SVL, weight, and temperature to be normality distributed, so we used t-tests to compare means of SVL, body weight, and T_b between females and males. We assumed all tests to be significant at $\alpha = 0.05$; measurements are reported as mean ± SE.

We found no significant differences in T_b between Saucillo and Gabino Vazquez populations, so the data were pooled ($t = 1.22$, df = 202, $P > 0.05$). Mean SVL for females was 63.7 ± 0.5 mm (N = 108; range = 49–83 mm) and 78.5 ± 0.5 mm (N = 96; range = 45–100 mm) for males. The mean W of females was 8.3 ± 0.2 g (N = 108; range = 3–12 g) and 12.5 ± 0.1 g (N = 96; range = 3–25.5 g) for males. Females were significantly smaller than males in length ($t = 7.38$, df = 202, $P < 0.05$) and body weight ($t = 2.4$, df = 202, $P < 0.05$). The mean T_b for females (34.3 ± 0.2°C) and males (35.5 ± 0.4°C) was not significantly different ($t = 0.71$, df = 202, $P > 0.05$); T_b for both sexes pooled was 35 ± 0.1° C (N = 204, range = 31.5–40.0°C). The mean T_b of *U. exsul* was slightly lower than values reported for the other *Uma*. The T_b for *U. inornata* is 38°C (Mayhew 1964. Herpetologica 20:95–113), for *U. notata* is 37.8°C (Turner and Schwalbe 1998. Final Report. Arizona Game and Fish Department Heritage Fund. IIPAM Project No. I95042. 78 pp.), and Licht and Basn (1967. Nature 213:672–674) reported 37.5°C for *U. scoparia* (experimentally tested). On the contrary, *U. paraphygas*, the smallest species in the genus, has a mean body temperature of 34.26 ± 0.18°C (García-de la Peña, unpubl. data). *Uma inornata*, *U. notata*, and *U. scoparia* are more closely related to each other than *U. exsul* and *U. paraphygas*, and vice versa, so the similarity in preferred temperature among each of these groups of species may be a function of phylogeny. However, behavioral experiments and controlled cross-species comparisons will be required to address alternate hypotheses.

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SERPENTES

AGKISTRODON PISCIVORUS (Cottonmouth). **DIET**. On 23 May 1995, at ca. 1730 h, one of us (GY) observed and 15 minutes later photographed a Cottonmouth attempting to ingest, by the right forelimb, the carcass of a Domestic Cat (*Felis catus*) killed by a car the previous evening, and which was lying at the bottom of a slope adjacent to a road in Marion County, Mississippi, USA. Most authors consider *A. piscivorus* to be a generalist feeder known to ingest carrion (Gloyd and Conant 1992. Snakes of the *Agkistrodon* Complex. SSAR, Oxford, Ohio; Hamel 1996. J. Herpetol. 27:143; Heinrich 1996. J. Herpetol. 27:22), but this is the first record, to our knowledge, of this species attempting to scavenge on a Domestic Cat. The snake released the carcass and moved into nearby underbrush because of the activities of the photographer.

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ARIZONA ELEGANS ARENICOLA (Texas Glossy Snake). **DIET.** Medium-sized diurnal lizards comprise a large proportion of the diet of *Arizona elegans* (Rodríguez-Robles et al. 1999. J. Herpetol. 33:87–92). Rodríguez-Robles et al. (*op. cit.*) suggest that diurnal lizards may be captured "when they are inactive by nocturnally wide-foraging glossy snakes." Here, we record several observations of diurnal foraging by *A. elegans* among sand dunes near the municipality of Viesca, Coahuila, Mexico (ca. 70 km SE of Torreon). On 3 April 2002 at 1030 h, an *A. elegans arenicola* was observed consuming an *Aspidoscelis marmoratus* (ca. 78 mm SVL) beneath a Desert Seepweed (*Suaeda nigrescens*) plant. On 13 July 2002 at 1230 h, a second *A. e. arenicola* (670 mm SVL) was observed preying upon an *A. marmoratus* (ca. 80 mm SVL) that had been foraging beneath Creosote Bush (*Larrea tridentata*), Honey Mesquite (*Prosopis glandulosa*), and Desert Seepweed. The snake constricted the lizard for ca. 8 minutes and took 38 minutes to ingest it. We thank Adriana Jaime R. for field assistance.

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BOTHROPS NEUWIEDI PAULOENSIS (Jararaca Rabo-de-osso). **PREDATION**. Records of predation on neotropical snakes are scarce. The only documented record of predation on *Bothrops neuwiedi* reports the consumption of this snake by the burrowing owl *Speotyto* (*Athene*) *cunicularia* (Valdujo and Nogueira 2000. Herpetol. Rev. 31:45). Here, I report predation on *Bothrops neuwiedi pauloensis* by the Little Water Opossum, *Lutreolina crassicaudata* (Mammalia: Didelphidae). The observation occurred on 3 November 1999 at 1600 h in Emas National Park (18°06'S, 52°55'W), municipality of Mineiros, Goiás, Brazil. The snake and the opossum were fighting under the thick grass layer at the edge of a road and rolled to the open area of the road. The pitviper was

coiled on the opossum and the mammal tried to bite the snake. After some seconds, both returned to the grass and I could only hear them. The snake, with several bites on the head and body, emerged from the grass, trying to flee, but the opossum bit the snake again and pulled it. Next, I observed the opossum carrying the dead serpent. *Lutreolina crassicaudata* and *Didelphis albiventris* (both members of the Didelphidae) are reported to prey on other pitviper species, *Bothrops jararaca* (Sazima 1992. Biology of the Pitvipers, pp. 199–216). The venom of pitvipers is very active for most mammals, but some opossum species, including *L. crassicaudata*, have an anti-bothropic protein complex in the serum fraction of their blood (Perales et al. 1986. An. Acad. Bras. Ciênc. 58:155–162; Perales et al. 1994. Toxicon 32:1237–1249; Farah et al. 1996. Toxicon 34:1067–1071), which presumably confers a degree of resistance to pitviper venom.

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BUNGARUS FLAVICEPS (Red-headed Krait). **VERTICAL DISTRIBUTION**. *Bungarus flaviceps* is a conspicuous elapid snake distributed from southern Vietnam to the Malay Peninsula and on the islands of Sumatra, Nias, Bangka, Belitung, and Borneo (Kuch and Schneyer 1996. Sauria 18:3–16). Two subspecies are currently recognized. *Bungarus flaviceps baluensis* was long considered an endemic of Mount Kinabalu in northern Borneo but is more widely distributed on that island and may deserve recognition as a separate species (Kuch 2002. Herpetozoa 14:149–151; Kuch and Götzke 2000. Sauria 22:19–22). The nominate subspecies occurs throughout the remainder of the range (Brongersma 1948. Zool. Mededelingen 30:1–29). Although the known vertical distribution of *B. f. baluensis* extends from 1550 m to as low as 550 m (Kuch and Götzke, *op. cit.*), that of *B. f. flaviceps* has been known to range from sea level (near the coast of Perak, Malaysia; Tweedie 1983. The Snakes of Malaya. Singapore, Singapore National Printers, 167 pp.) to ca. 600 m (in the Nakhon Si Thammarat Mountains, Thailand; Smith 1930. Bull. Raffles Mus. 3:1–149).

Here we report a subadult *B. f. flaviceps* of undetermined sex (683 mm SVL, 67 g; MVZ 241564) collected by J. A. McGuire and Humberto Wong at 2050 h on 22 November 1997 in primary or mature secondary forest along the road between Gunung Hijau Resthouse and Telkom Station, near the summit of Bukit Larut (Perak, Malaysia) at ca. 1200 m elevation. The present record suggests that the vertical distribution of some populations of *B. f. flaviceps* may overlap that of *B. f. baluensis* (0–1200 m vs. 550–1550 m, respectively). Additional collecting efforts are required to better elucidate geographic and vertical distribution in Borneo, where both forms may occur in parapatry or sympatry.

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CROTALUS MITCHELLII STEPHENSI (Panamint Rattlesnake). **DIET**. Very few literature records exist on the diet of *Crotalus mitchellii stephensi*. Klauber (1972. Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind. Univ. California Press, Berkeley. 1533 pp.) reviewed diet in this taxon and reported stomach contents to include small mammals (*Dipodomys*, *Perognathus*, and *Citellus*) and lizards (*Callisaurus draconoides* and *Cnemidophorus tigris*). Cox and Tanner (1995. Snakes of Utah. Brigham Young Univ. Press, Provo. 92 pp.) report that *C. m. pyrrhus* opportunistically preyed on "lizards" from can traps at the Nevada Test Site in southern Nevada (this is probably a record for *C. m. stephensi*, as *C. m. pyrrhus* is not known to occur at the site). Here, I report on the stomach contents of an adult male *C. m. stephensi* (LACM 36696; 781 mm SVL) collected by Lester Northern on 20 June 1967 from the Deep Springs Valley, Inyo County, California. Upon dissection, I found the snake to contain the partially digested remains of a Desert Horned Lizard (*Phrynosoma platyrhinos*) and a passerine bird tentatively identified as a Thrasher (*Toxostoma* sp.). Both prey items had been ingested headfirst, with the *P. platyrhinos* situated posteriorly in the alimentary tract. The head and most of the neck were completely missing from the bird. Birds have been reported from the diet of *C. m. pyrrhus* (Klauber 1936. Trans. San Diego Soc. Nat. Hist. 8:149–184; Klauber, *op. cit.*), but not, to my knowledge, from *C. m. stephensi*. Although Lowe et al. (1986. The Venomous Reptiles of Arizona. Arizona Game and Fish Department, Phoenix. 116 pp.) included "desert horned lizards" as prey of *C. mitchellii*, specific data were not provided and the context of the statement suggests predation in captivity. To my knowledge, this is the first record of *C. m. stephensi* predation on *Phrynosoma*. I thank Kent Beaman for permission to examine specimens.

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CROTALUS WILLARDI OBSCURUS (New Mexico Ridge-nosed Rattlesnake). **FORAGING.** On 10 July 1996 we surgically implanted a male *Crotalus willardi obscurus* (507 mm SVL, 100 g) from the Animas Mountains (New Mexico, USA) with a 2.4 g radio-transmitter (helical antennae) and located him daily until 30 November. At 1130 h on 22 October 1996 he was found at ca. 2300 m elevation with a *Sceloporus jarrovii* in his mouth, which he proceeded to consume headfirst. Air temperature 1 m above the ground was 6.8°C and substrate temperature was 30.5°C. On 25 October 2003 we captured an adult female *C. w. obscurus* (457 mm SVL, 93.6 g) at an elevation of 1915 m in the Sierra San Luis (Sonora, Mexico). She contained a recent food bolus consistent in size, shape, and feel with a medium-sized lizard. On 13 September 2003 we surgically implanted a 5.2 g radio-transmitter in an adult female *C. w. obscurus* (531 mm SVL, 123.1 g) from the

Sierra San Luis (Chihuahua, Mexico). At 1358 h on 14 December 2003 we found her on a NE-facing slope among oak and manzanita chaparral (1908 m elev.). She was last located on 3 November at a distance ca. 100 m away. She lay in an S-shaped ambush posture 3 cm beneath a 10-cm diameter downed log in complete shade and 25 cm from a patch of snow. Her head overlooked a 2-cm diameter branch. When disturbed she rapidly retreated to a burrow entrance 30 cm away. Ten cm of snow had accumulated at this site on 11 and 12 December, but on 13 and 14 December clear and sunny conditions and highs of ca. 10°C resulted in significant snowmelt. Seven other radio-tagged *C. w. obscurus* were below ground when located on 13 and 14 December.

Our observations of 1) consumption of lizards, including *S. jarrovii,* and 2) ambush posture among fallen branches and logs, are consistent with previous descriptions of foraging biology in *C. willardi* (Holycross et al. 2002. *In* Schuett et al. [eds.], Biology of the Vipers, pp. 243–252. Eagle Mountain Publishing, Eagle Mountain, Utah). Our observations demonstrate that *C. w. obscurus* not only intermittently bask at low air temperatures (*see also* Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. University of New Mexico Press, Albuquerque, New Mexico. 431 pp.), but feed late into fall and perhaps in winter. We thank Rocky Mountain Research Station, U.S. Forest Service for funding.

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LEPTOPHIS NEBULOSUS (Oliver's Parrot Snake). **REPRODUCTION.** *Leptophis nebulosus* is a colubrid that occurs from extreme northeastern Honduras throughout Costa Rica (Savage 2002. The Amphibians and Reptiles of Costa Rica; A Herpetofauna Between Two Continents, Between Two Seas. University of Chicago Press, Chicago. 934 pp.). There is no information on clutch sizes in *L. nebulosus*. Here I present information on a single clutch from a specimen from Costa Rica.

One *L. nebulosus* (LACM 151850) collected May–June 1982 in Puntarenas Province, measured 710 mm SVL, contained eight enlarged ovarian follicles (mean length = 18.1 mm ± 1.4 SD, range = 16.8–20.1 mm). The eggs are deposited in the Natural History Museum of Los Angeles County (LACM), Los Angeles, California, USA.

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MASTICOPHIS FLAGELLUM (Coachwhip). **DIET.** *Masticophis flagellum* is known to take a large variety of prey items including insects, lizards, snakes, small turtles, birds and their eggs and rodents (e. g., Stebbins 1985. A field Guide to Western Reptiles and Amphibians. Houghton Mifflin Co., Boston, Massachusetts. 336 pp.). Here we report predation on Curve-billed Thrasher (*Toxostoma curvirostre*) chicks. On 28 June 2003 in the San Juan y Puentes conservation area, near Aramberri (Nuevo León, México) we observed two Curve-billed Thrasher chicks in a nest perched in a Tree Cholla (*Opuntia imbricata*). At 1132 h the same day we returned to find a *M. flagellum* (ca. 1300 mm TL) on top of the nest with a Curve-billed Thrasher chick in its mouth. The second chick was missing, presumably already consumed by the snake. The startled Coachwhip dropped the chick and escaped into a nearby kangaroo rat burrow. We extracted the snake for measurement and it promptly regurgitated the chick it had ingested.

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MICRURUS BALIOCORYPHUS (NCN). **DIET.** Little is known of the natural history of *Micrurus baliocoryphus*, and much of this is conjecture based on the biology of sympatric congeners. Members of the genus *Micrurus* are best known for their consumption of other snakes although amphisbaenians, caecilians, and lizards occasionally are recorded as prey (Cei 1993. Reptiles del Noroeste, Nordeste y Este de la Argentina. Mus. Reg. Scien. Natur. Torino, Monogr. XIV, Turin. 949 pp.; Schouten 1931. Rev. Soc. Cien. Paraguay 3:5–32). To our knowledge, this is the first record of a fish being consumed by a *Micrurus* in South America. At 1600 h on 10 November 1999 we found a dead male *M. baliocoryphus* (463 mm SVL, 502 mm TL) ca. 2 km W of National Route 9 "Carlos A. Lopez," on the way to Fortín General Díaz (Department of Presidente Hayes, Paraguay). The specimen (MNHNP 5143) was collected and an anguilliform fish *Synbranchus marmoratus* (209 mm TL) was found in the stomach upon dissection. The snake was found a few meters from an artificial pool on the side of the road among Chacoan Xerophytic Forest. The presence of fish in the diet of *M. baliocoryphus* suggests that it may be semi-aquatic, as has been observed for some other members of the genus (Pérez 1999. Serpientes de Panamá. Biosfera, UNESCO, Gráf. San Antonio, Sevilla. 312 pp.). The specimen is deposited in the Museo Nacional de Historia Natural del Paraguay and is also cited in Da Silva and Sites (1999. Herpetol. Monogr. 13:142–194). We thank Darío Mandelburguer for help identifying the fish.

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NERODIA ERYTHROGASTER NEGLECTA (Copper-bellied Watersnake). **FORAGING BEHAVIOR**. The foraging ecology of aquatic and semi-aquatic snakes has received much investigation. However, observations of prey capture are rare, with most studies of foraging ecology based on dissection of museum specimens or regurgitations of captured snakes, both of which offer limited information on the locations where snakes actually encountered prey. Here we report predatory behavior by *Nerodia erythrogaster neglecta* at substantial distances from water in northwestern Ohio, USA. The first instance occurred on 27 July 2001 at 1200 h. A radio-tagged male *N. e. neglecta* (750 mm SVL, 251 g) was followed into the upland forest where it was observed to encounter, capture, and attempt to swallow an adult *Bufo americanus*. The toad avoided being swallowed by inflating its body. On 29 July 2002 at 1330 h, a second radio-tagged male *N. e. neglecta* (760 mm SVL, 267 g) was located in a small temporary wetland that had been dry for two months. The snake was probing dry leaf litter when it encountered, captured, and successfully swallowed an adult *B. americanus*. Both observations of terrestrial foraging occurred in late summer, when temporary wetlands had dried and most toads were likely in terrestrial habitats. The nearest wetlands containing surface water were 75 and 90 m away from these locations. Whether these snakes were actively hunting or had opportunistically encountered prey is uncertain, because *N. e. neglecta* frequently travels through terrestrial habitats between isolated wetlands (Roe et al. 2003. Wetlands 23:1003–1014). To our knowledge, these are the first reported observations of terrestrial foraging by *Nerodia*.

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OXYBELIS AENEUS (Brown Vine Snake). **REPRODUCTION.** *Oxybelis aeneus* is a colubrid that occurs from extreme southern Arizona to southeastern Brazil (Stebbins 2003. A Field Guide to Western Reptiles and Amphibians, 3rd Ed., Houghton Mifflin Company, Boston, 533 pp.). Information on clutch sizes is summarized by Goldberg (1998. Texas J. Sci. 50:51–56). Data on reproduction in populations from Arizona and Mexico is in Goldberg (*op cit.*) and Censky and McCoy (1988. Biotropica 20:326–333). Previously reported clutches ranged from 3–6 (Goldberg, *op. cit.*). Here I present information on clutch sizes of *O. aeneus* from Costa Rica.

Three gravid female *O. aeneus* were examined from the herpetology collection of the Natural History Museum of Los Angeles County (LACM). One female (LACM 153902) collected in April from Cartago Province, 710 mm SVL, contained four oviductal eggs (mean length 26 mm ± 1.6 SD, range: 25–28 mm). The second female (LACM 153934) collected in August from Puntarenas Province, 785 mm SVL, contained four enlarged ovarian follicles (mean length 20 mm ± 4.5 SD, range: 13–24 mm). The third female (LACM 153925) collected in July from Puntarenas Province, 680 mm SVL, contained two enlarged ovarian follicles that were close to ovulating (mean length 28 mm ± 2.5 SD, range: 26–30 mm). This clutch of two eggs represents a new minimum clutch size for *O. aeneus*.

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OXYBELIS BREVIROSTRIS (Cope's Vine Snake). **REPRODUCTION.** *Oxybelis brevirostris* is a colubrid that ranges from eastern Honduras to western Ecuador (Savage 2002. The Amphibians and Reptiles of Costa Rica; A Herpetofauna Between Two Continents, Between Two Seas. University of Chicago Press, Chicago. 934 pp.). There is one report of a *O. brevirostris* with three oviductal eggs (Guyer and Donnelly, unpubl. ms.). Here I present information on three egg clutches from *O. brevirostris* from Costa Rica.

A female *O. brevirostris* (LACM 153887, 642 mm SVL) collected in Limón Province on 8 June contained three oviductal eggs (mean length = 22.6 mm ± 2.2 SD, range = 21–25 mm). A second female (LACM 153888, 605 mm SVL) collected in Heredia Province on 2 April contained two enlarged ovarian follicles (mean length =15.6 mm ± 0.4 SD, range = 15.3–15.8 mm). A third (LACM 153885, 613 mm SVL) female collected in Heredia Province on 28 March contained two oviductal eggs (mean length = 20.4 mm ± 1.2 SD, range = 20–21 mm). Two eggs represents a minimum clutch size for *O. brevirostris*. Eggs are deposited in the Natural History Museum of Los Angeles County (LACM).

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PHYLLORHYNCHUS DECURTATUS (Spotted Leaf-nosed Snake). **PREDATOR-PREY INTERACTIONS**. On 5 September 2002, 2115 h MST we collected a freshly hit and nearly dead male *Lampropeltis getula* (CAS 228326; 480 mm SVL, 36 g) on State Highway 238, Maricopa Co., Arizona, USA. The *L. getula* had a recently consumed an adult female *Phyllorhynchus decurtatus* (CAS 228327; 290 mm SVL, 15.3 g) in its stomach (orientation within the stomach was not noted); the *P. decurtatus* was completely intact, with no evidence of digestion. This is the first record of a Spotted Leaf-nosed Snake (*P. decurtatus*) in the diet of *L. getula* (Kevin D. Wiseman and Harry W. Greene, pers. comm.). In addition, the *P. decurtatus* had in its stomach an opened, but undigested, squamate eggshell, one end of which was missing (length 19.45 mm; estimated length including missing end 23.3 mm); the shell contained remnants of egg contents. September records of *P. decurtatus* in the Sonoran Desert are relatively rare, and of those, none had prey in their digestive tracts (Gardner and Mendelson 2003. Southwest. Nat. 48:550–556).

Submitted by **THOMAS R. JONES** (e-mail: trjones@gcu.edu) and **ROBERT H. HEGNA**, Department of Biology, Grand Canyon University, 3300 West Camelback Road, Phoenix, Arizona 85017, USA.

RHABDOPHIS MURUDENSIS (Gunung Murud Keelback). **DIET.** Little is known of the diet or natural history of *Rhabdophis murudensis* (reviewed by Stuebing and Inger 1999. A Field Guide to the Snakes of Borneo. Natural History Publications [Borneo] Sdn Bhd., Kota Kinabalu. 254 pp.). Stuebing and Tan (2002. Raffles Bull. Zool. 50:227–230) mention that captives of this natricine have been maintained on a diet of frogs (*Limnonectes kuhlii*) and occasionally white mice (presumably albinistic *Rattus rattus*).

An adult female *R. murudensis* (USDZ 2.5991; 738 mm SVL; head width 18 mm) collected 5 May 2003 on the ridge leading from Tukap Murud to Batu Linanit (03°55'N; 115°31'E, elev. 2200 m), Gunung Murud, Limbang Division, Northeast Sarawak, Malaysia (Borneo), regurgitated a recently-ingested adult megophryid frog (*Megophrys* sp.; ID-7779) with a head width of 34.5 mm and an SVL of ca. 79 mm. Although the condition of the frog (swallowed vent first) precluded specific identification, several traits suggest it is allied with *M. kobayashii*, a Gunung Kinabalu endemic (Malkmus et al. 2002. Amphibians & Reptiles of Mount Kinabalu [North Borneo], A. R. G. Gantner Verlag K.G., Ruggell. 424 pp.), from which it differs in lacking dermal projections at angle of jaws, paired conical tubercles on forehead, parallel rows of dark spots on abdomen, and by the presence of a dark dorsal saddle-like marking and a pale patch anterior to a dark interorbital bar. The systematic status of *M. kobayashii* is currently under study. The snake also regurgitated a large nematode (78 mm TL). All three specimens are deposited with the Zoological Museum of Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysia.

For assistance and support we thank Fatimah Abang, the Institute of Biodiversity and Environmental Conservation (Universiti Malaysia Sarawak), and the Sarawak Biodiversity Centre. Financial support was provided by an Intensification of Research in Priority Areas Grant (number: 08-02-09-10007-EA0001) from the Federal Government of Malaysia.

Submitted by **INDRANEIL DAS** (e-mail: idas@ibec.unimas.my) and **ANDREW ALEK TUEN** (e-mail: aatuen@ibec.unimas.my), Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, 94300, Kota Samarahan, Sarawak, Malaysia.

SAPHENOPHIS BOURSIERI (NCN). **HABITAT, REPRODUCTION and DIET**. *Saphenophis boursieri* is a neotropical snake known from the western slopes of the Andes (elev. 1100–1890 m) in Ecuador and southern Colombia, with disjunct records on the Amazonian lowlands of eastern Ecuador (Myers 1973. Amer. Mus. Novitates 2522). The genus *Saphenophis* is poorly represented in scientific collections (Myers, *op. cit.*; pers. obs.), and almost nothing is known of the natural history of any species of this genus. Myers (1969. Amer. Mus. Novitates 2385; *op. cit.*) reported "at least four large oviductal eggs, one (revealed by dissection) measuring 9 by 23 mm" in the paratype of *Saphenophis sneiderni* (394 mm SVL), and "large eggs in the oviducts" in the holotype of *Saphenophis antioquensis* (ca. 506 mm SVL). A specimen of *Saphenophis tristriatus* found "between 11 and 12 A.M… was lying in the sun on a wood bridge." Unfortunately, none of the specimens had collection dates. Herein I provide novel data on habitat, reproduction, and diet for *S. boursieri*.

Two female *S. boursieri* (DFCH-USFQ 701-702) were collected from the "Río Guajalito" protected forest (78°49'W, 0°14'S, elev. 1900 m), at the beginning of the dry season in June 2001 at 1400 h. This private reserve is located 59 km W of Quito among montane cloud forest on the northwestern slope of the Andes in Pichincha Province, Ecuador. One of the snakes (DFCH-USFQ 701) was found lying motionless upon sunlit leaf litter in the bottom of a dry ditch, ca. 5 m from the river and 25 m from human habitations. The other specimen (DFCH-USFQ 702) was found on the forest floor near a small trail, ca. 40 m from the river and 100 m from human habitations. Both females were gravid. Dissection revealed that DFCH-USFQ 701 (467 mm SVL, mass without eggs of 43.3 g) had five soft-shelled eggs that had a mean length of 30.4 mm (range 28.0–31.8 mm), mean width of 11.9 mm (range 10.1–13.0 mm), mean mass of 2.6 g (range 2.3–3.3 g, total clutch mass = 12.9 g), and a mean volume of 2.3 cm^3 (range 1.7–2.8 cm^3). The second female (DFCH-USFQ 702; 410 mm SVL) contained five immature ovarian eggs, the largest was 16.2 mm in length. Another female (FHGO-USFQ 003; 610 mm SVL) collected in April 1996 at San Antonio, Imbabura Province (near Ibarra, 78°09'W, 00°20'S, elev. 2500 m) contained seven unshelled oviductal eggs. Eggs had a mean length of 24.2 mm (range 15.7–29.6 mm). The stomach of one specimen (DFCH-USFQ 701) contained a larval hymenopteran and an orthopteran nymph (volume of both items = 0.2 cm^3). The other specimen (DFCH-USFQ 702) contained a partially digested gymnophthalmid lizard, *Proctoporus* cf. *unicolor* (volume = 0.6 cm^3). These observations of *S. boursieri* support Myers' hypothesis (1973, *op. cit.*) that snakes of the genus *Saphenophis* are principally diurnal. Moreover, *Saphenophis* seem to be essentially terrestrial and feed on a variety of prey from invertebrates to lizards.The three females and eggs are deposited at the Laboratorio de Anfibios y Reptiles, Universidad San Francisco de Quito.

I am grateful to Andres Leon, Kelly Swing, Maria Elena Heredia, Laura Heredia, and Vlastimil Zak for assistance, access to study sites, and financial support. This is contribution No. 4 of the Laboratorio de Anfibios & Reptiles FHGO-USFQ, Universidad San Francisco de Quito.

Submitted by **DIEGO F. CISNEROS-HEREDIA**, Laboratorio de Anfibios & Reptiles, Universidad San Francisco de Quito, Avenida Interoceanica y calle Diego de Robles, Campus Cumbaya, Edificio Maxwell, P.O. Box 17-12-841, Quito, Ecuador; e-mail: diegofrancisco_cisneros@yahoo.com.

THAMNODYNASTES STRIGATUS (NCN). **DIET**. Snakes are important predators of anurans, particularly in the tropics where anuran diversity is high. Species of *Thamnodynastes* are frequently cited as predators of adult anurans (Bernarde et al. 2000. Rev. Brasil. Biol. 60:695–699; Ruffato et al. 2003. Phyllomedusa 2:27–34). On 23 March 2004 at ca. 1530 h, we collected a *Thamnodynastes strigatus* (Museu de Ciências Naturais PUC Minas, MCNR 987, 220 mm SVL) foraging in a forest stream at Serra do Caraça, Minas Gerais State, Brazil. Upon dissection, a partially digested *Crossodactylus* cf. *bokermanni* (16.8 mm SVL, tibia 8.3 mm) was found in its stomach. SVL was estimated through correlative morphometric comparisons of tibia and SVL measurements with specimens of *Crossodactylus* cf. *bokermanni*. On 26

March 2004 at 1120 h, another *T. strigatus* (MCNR 988, 219 mm SVL) was captured on the edge of the same stream within 60 cm of two calling male *Crossodactylus* cf. *bokermanni* (SVL 23.8 and 22.0 mm). *Thamnodynastes* are primarily nocturnal, as are the majority of anurans that comprise their diet (Bernarde et al., *op. cit.*; Marques et al. 2001. Serpentes da Mata Atlântica. Guia Ilustrado para a Serra do Mar, Ribeirão Preto. Holos. 184 pp; Rufatto et al., *op. cit*). This is the first record *T. strigatus* preying on a diurnal anuran.

Submitted by **KATIA KOPP** (e-mail: kakopp@hotmail.com) and **MILENA WACHLEVSKI** (e-mail: milenawm@yahoo.com), Laboratório de Ecologia Evolutiva de Anfíbios e Répteis, Programa de Pós Graduação em Zoologia de Vertebrados, Pontifícia Universidade Católica de Minas Gerais, 30535-610, Belo Horizonte, Minas Gerais, Brazil.

TRIMERESURUS ALBOLABRIS (White-lipped Pitviper). **RESTING SITE.** Although *Trimeresurus albolabris* is occasionally found hunting on the ground at night, most accounts report that it is predominantly arboreal (Cox 1991. The Snakes of Thailand and their Husbandry. Krieger Publishing Company, Malabar. 526 pp.; Cox et al. 1998. A Photographic Guide to Snakes and other Reptiles of Thailand and Southeast Asia. Asia Books, Bangkok. 144 pp.; Das 2002. A Photographic Guide to Snakes and other Reptiles of India. New Holland Publishers, London. 144 pp.). Our own encounters have been primarily with individuals in trees and bushes, although several individuals were encountered moving on the ground at night (CAS 210108, 210665, 210690, 210691). Cox et al. (*op. cit.*) mention that during the day *T. albolabris* is typically found at rest in vegetation. On 13 April 2002 at 1609 h, one of us (HW) unearthed a male *T. albolabris* (625 mm SVL, 85 g; CAS 224646) near Nagmung Town, Kachin State, Myanmar (27°30'36.5"N, 97°49'50.4"E, WGS 84) at 613 m elev. The snake was inactive ca. 25 cm below ground level inside a termite mound located near a trail in an agricultural area in the midst of subtropical evergreen forest. This is the first record of any *Trimeresurus* using a termite mound as a retreat. We thank U Khin Maung Zaw, Alan Leviton, Jens Vindum, and the National Science Foundation (DEB-9971861).

Submitted by **GUINEVERE O. U. WOGAN**, Department of Herpetology, California Academy of Sciences, Golden Gate Park, San Francisco, California, USA 94118 (e-mail: gwogan@calacademy.org), and **HTUN WIN**, Nature and Wildlife Conservation Division, Forest Department, Ministry of Forestry, Bayintnaung Road, West Gyogone, Insein, Yangon, Myanmar.

GEOGRAPHIC DISTRIBUTION

Herpetological Review publishes brief notices of new geographic distribution records in order to make them available to the herpetological community in published form. Geographic distribution records are important to biologists in that they allow for a more precise determination of a species' range, and thereby permit a more significant interpretation of its biology.

These geographic distribution records will be accepted in a **standard format** only, and all authors *must* adhere to that format, as follows: SCIENTIFIC NAME, COMMON NAME (for the United States and Canada as it appears in Crother 2000. *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding*. SSAR Herpetol. Circ. 29:1–82, available online at <http://herplit.com/SSAR/circulars/HC29/Crother.html>; for Mexico as it appears in Liner 1994, *Scientific and Common Names for the Amphibians and Reptiles of Mexico in English and Spanish*. Herpetol. Circ. 23:1–113), LOCALITY (use metric for distances and give precise locality data), DATE (day-month-year), COLLECTOR, VERIFIED BY (*cannot* be verified by an author—curator at an institutional collection is preferred), PLACE OF DEPOSITION (where applicable, use standardized collection designations as they appear in Leviton et al. 1985. *Standard Symbolic Codes for Institutional Resource Collections in Herpetology and Ichthyology*, Copeia 1985[3]:802–832) and CATALOG NUMBER (required), COMMENTS (brief), CITATIONS (brief), SUBMITTED BY (give name and address in full—spell out state or province names—no abbreviations).

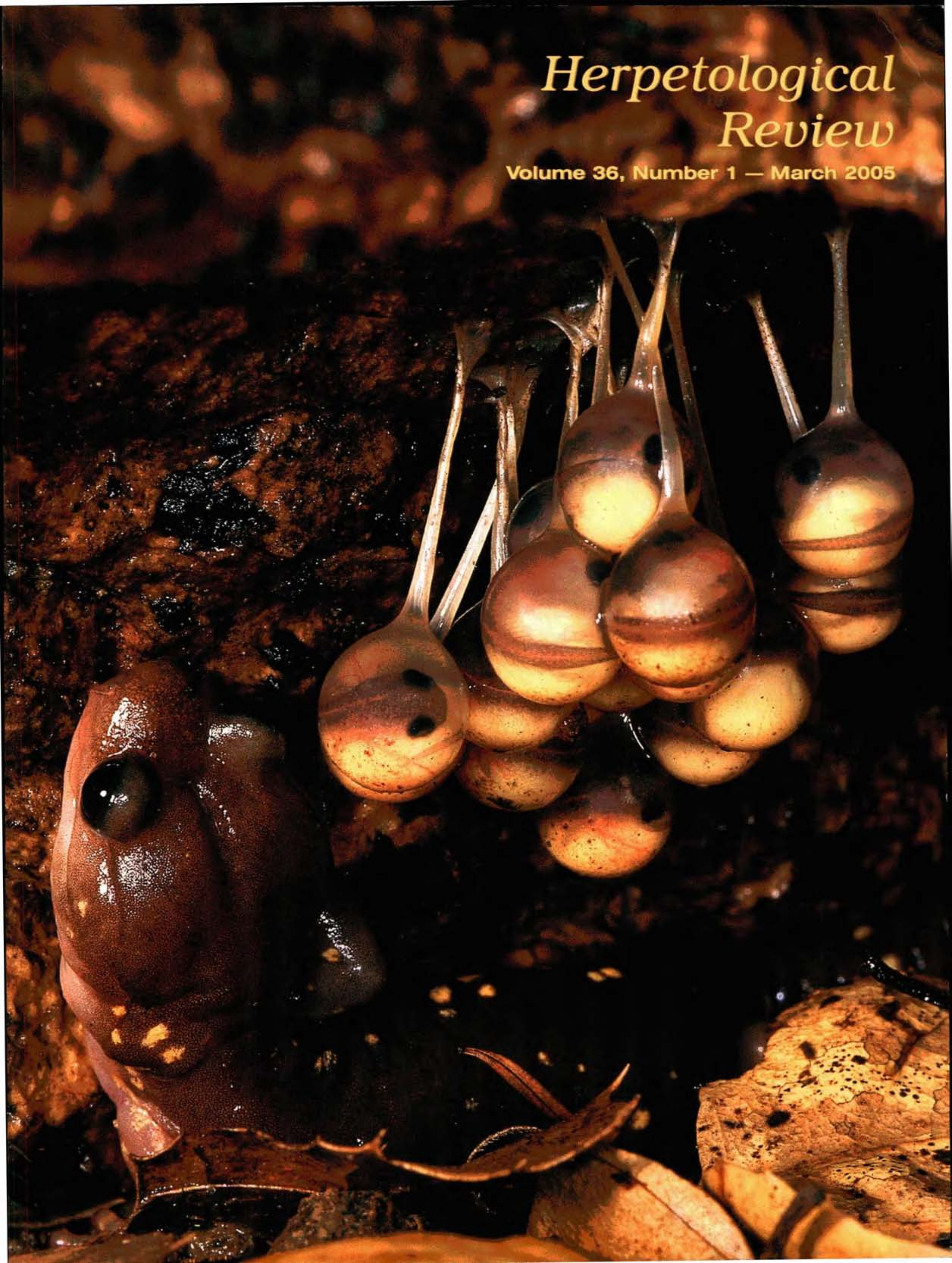
Some further comments. This geographic distribution section does not publish "observation" records. Records submitted should be based on preserved specimens which have been placed in a university or museum collection (private collection depository records are discouraged; institutional collection records will receive precedence in case of conflict). A good quality color slide or photograph may substitute for a preserved specimen *only* when the live specimen could not be collected for the following reasons: it was a protected species, it was found in a protected area, or the logistics of preservation were prohibitive (such as large turtles or crocodilians). Color slides and photographs *must* be deposited in a university or museum collection along with complete locality data, and the color slide catalog number(s) must be included in the same manner as a preserved record. Before you submit a manuscript to us, check Censky (1988, *Index to Geographic Distribution Records in Herpetological Review: 1967–1986*; available from the SSAR Publications Secretary) to make sure you are not duplicating a previously published record. The responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extensions unless a thorough literature review has been completed.

Please submit any geographic distribution records in the **standard format only** to one of the Section Co-editors: **Alan M. Richmond** (USA & Canadian records only); **Jerry D. Johnson** (Mexico and Central America, including the Caribbean islands); **Hidetoshi Ota** (all Old World records); or **Gustavo J. Scrocchi** (South American records). Short manuscripts are discouraged, and are only acceptable when data cannot be presented adequately in the standard format. **Electronic submission of manuscripts is required** (as Microsoft Word or Rich Text format [rtf] files, as e-mail attachments). Refer to inside front cover for e-mail addresses of section editors.

Recommended citation for new distribution records appearing in this section is: Schmitz, A., and T. Ziegler. 2003. Geographic distribution. *Sphenomorphus rufocaudatus*. Herpetol. Rev. 34:385.

CAUDATA

NOTOPHTHALMUS VIRIDESCENS LOUISIANENSIS (Central Newt). USA: INDIANA: Posey Co: Point Township: 14 km SSW Mount Vernon at Twin Swamps Nature Preserve. 16 June 2004. Zack Walker, Nathan Engbrecht, Andrew Berger, and Michael Lodato. University of Michigan Museum of Zoology (UMMZ 232002–06). Verified by Greg Schneider. New county record and first record for "pocket" of extreme SW Indiana. (Minton 2001. Amphibians and Reptiles of Indiana. 2nd ed., revised. Indiana Acad. Sci. 404 pp). Newts appear to be common at this locality with its bald cypress (*Taxodium distichum*) and overcup oak (*Quercus* lyrata) swamps surrounded by mature forest. Adults



Herpetological Review

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Herpetological Review

The Quarterly News-Journal of the Society for the Study of Amphibians and Reptiles

Society for the Study of Amphibians and Reptiles

www.ssarherps.org

The Society for the Study of Amphibians and Reptiles, the largest international herpetological society, is a not-for-profit organization established to advance research, conservation, and education concerning amphibians and reptiles. Founded in 1958, SSAR is widely recognized today as having the most diverse society-sponsored program of services and publications for herpetologists. Membership is open to anyone with an interest in herpetology—professionals and serious amateurs alike—who wish to join with us to advance the goals of the Society.

All members of the SSAR are entitled to vote by mail ballot for Society officers, which allows overseas members to participate in determining the Society's activities; also, many international members attend the annual meetings and serve on editorial boards and committees.

Annual Dues and Subscriptions: Annual membership dues for the year 2005 in the Society for the Study of Amphibians and Reptiles are as follows: **REGULAR** membership US$60 (Student $30)—includes *Journal of Herpetology* and *Herpetological Review*; **PLENARY** membership US$80 (Student $45)—includes *JH*, *HR*, and annual subscription to the *Catalogue of American Amphibians and Reptiles*; **INSTITUTIONAL SUBSCRIPTION** $115—includes JH and HR. Additional fee for airmail postage outside USA $35 for one year. Additional membership categories available on the SSAR webpage: http://www.ssarherps.org/pages/membership.html.

All members and institutions receive the Society's primary technical publication, the *Journal of Herpetology*, and its news-journal, *Herpetological Review*; both are published four times per year. Members also receive pre-publication discounts on other Society publications, which are advertised in *Herpetological Review*.

Payment must be made in USA funds, payable to "SSAR," or by International Money Order, or with Visa or MasterCard (account number and expiration date must be provided). Payment should be sent to: Theodora Pinou, SSAR Treasurer, Department of Biological & Environmental Sciences, Western Connecticut State University, 181 White Street, Danbury, Connecticut 06810, USA. Fax: (203) 837-8769; e-mail: PinouT@wcsu.edu.

Future Annual Meetings

2005 — University of South Florida, Tampa, Florida, 6–11 July (with ASIH, HL)
2006 — New Orleans, Louisiana, 12–17 July (with ASIH, HL)

About Our Cover: *Aneides lugubris*

The plethodontid salamander genus *Aneides* contains six species: four of these are confined to the Pacific Coast of North America, one occupies a small range in the mountains of south-central New Mexico, and a sixth ranges across the Appalachian Mountains of the eastern U.S. *Aneides lugubris*, the Arboreal Salamander, is the largest species in the genus (to 18 cm TL), and ranges from northern California to northern Baja California. It occupies habitats notably drier than for other members of the genus, extending its range southward to semi-arid chaparral habitat in northwestern Baja California. Over much of its range, *A. lugubris* is associated with large oak trees; salamanders occupy hollowed out sections of standing and fallen oaks, as well as rock crevices. A suite of morphological features—long limbs, expanded toe tips, and a prehensile tail—facilitate climbing (they have been found up to 18 m above ground in oaks). Dagger-like teeth, along with modifications of the jaws and skull, enable Arboreal Salamanders to capture and restrain relatively large prey.

Eggs, numbering 5–24, are laid in humid cavities in trees or beneath rocks or logs. The eggs are suspended on gelatinous stalks, an arrangement common to all members of the genus. The nest is attended by the female, and communal nesting is probably common. Recent reviews of the biology of *Aneides lugubris* are provided by Petranka (1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C., pp. 322–325) and Staub & Wake (2005. *In* M. Lannoo, ed., Amphibian Declines: The Conservation Status of United States Species. University of California Press, Berkeley and Los Angeles).

The female salamander on our cover was found in a wooded area north of San Francisco Bay, California, and temporarily collected for photography by **Tim Paine**. During the first week of April, the female deposited 15 eggs beneath a slab of cork bark. She attended the nest throughout development, with hatching occurring in early June.


PHOTO BY DOUG MASON

The cover image was captured on Fuji Velvia film using a Nikon F4s camera equipped with a 105mm Micronikkor lens. Light was provded by SB-29s ringlight and SB-28 flashes. The exposure was 1/60 second at f22. Paine, whose avocation is herpetology, is a ten-year veteran of the San Francisco Police Department. With a B.S. in Biology, he has aspirations of returning to school for a Ph.D., but appreciates the freedom his current job affords for travel and photography.

SSAR BUSINESS

Announcing the 2005 Joint Meeting of Ichthyologists and Herpetologists 6–11 July 2005

The annual meeting of the Society for the Study of Amphibians and Reptiles, The Herpetologists' League, and the American Society of Ichthyologists and Herpetologists will be held 6–11 July 2005, hosted by the University of South Florida at the Marriott Tampa Waterside Hotel and Marina, Tampa, Florida. Please refer to the Joint Meeting website <http://www.dce.ksu.edu/jointmeeting/> for information on how to register for the meeting. All material typically included in the Call for Papers is now accessible on the website.

SSAR Election Results

Results of the 2004 SSAR election are as follows:

President-Elect: .... Roy McDiarmid

Secretary: .... Marion Preest

Treasurer: .... Theodora Pinou

Board Members (Class of 2008):

.... Rafe Brown, Meredith Mahoney

.... Jim McGuire, Richard Shine

Thanks to all of the nominees who agreed to stand for positions and to Maureen Kearney (Elector).

NEWSNOTES

Kansas Herpetological Society Annual Meeting

The Kansas Herpetological Society held its 31st Annual Meeting at Kansas State University in Manhattan, Kansas, on November 6–7, 2004. Approximately 110 participants attended scientific paper sessions presented by scientists and students from across the nation. Featured speaker was Alicia Mathis, professor at Southwest Missouri State University in Springfield. Dr. Mathis spoke about salamander conservation.

Daphne Jones, a student at Emporia State University, received the 2004 Howard K. Gloyd/Edward H. Taylor Scholarship, honoring the memory of two great biologists with strong ties to Kansas. The 2004 Alan H. Kamb Grant for Research on Kansas Snakes were made to Erik Bartholomew, a student at Fort Hays State University. Dwight R. Platt, Bethel College, was recognized as the seventh recipient of "The Suzanne L. & Joseph T. Collins Award for Excellence in Kansas Herpetology."

In 2005, the Society will meet at Pittsburg State University in Pittsburg, Kansas.

Amphibian Conservation and Zoos

Kevin Zippel of the Detroit Zoo has produced an excellent overview of zoo amphibian conservation programs; this document is now available online at Berkeley's AmphibiaWeb site:

<http://www.amphibiaweb.org/aw/declines/zoo/index.html>

MEETINGS

Meetings Calendar

Meeting announcement information should be sent directly to the Editor (rwh13@csufresno.edu) well in advance of the event.

19–22 June 2005—Hellbender Symposium, a conference on the biology of giant salamanders. Gaston's White River Resort, Lakeview, Arkansas (USA). Information: http://www.ozarkhellbender.com/.

19–24 June 2005—Fifth World Congress of Herpetology, Stellenbosch University Campus, Stellenbosch, South Africa. Information: http://www.wits.ac.za/haa/5wch.htm.

6–11 July 2005—48th Annual Meeting, Society for the Study of Amphibians and Reptiles, together with The Herpetologists' League and the American Society of Ichthyologists and Herpetologists. University of South Florida, Tampa (USA). Information: http://www.dce.ksu.edu/jointmeeting/.

27–30 July 2005—29th Annual International Herpetological Symposium, Scottsdale, Arizona (USA). Information: www.kingsnake.com/ihs.

15–19 August 2005—VII Latin American Congress of Herpetology, Universidad Autónoma del Estado de Morelos, Cuernavaca, Morelos, México. Information: http://www.ibiologia.unam.mx/barra/congresos/frame.htm.

OBITUARIES

Herpetological Review, 2005, 36(1), 2.

Madge Rutherford Minton 1920–2004

Madge Rutherford Minton, 84, well known to the herpetological world as the wife of and collaborator with Sherman Minton, died November 7th, 2004. While earning her B.A. degree at Butler University, she was one of the first four women in the United States to graduate from the Advanced Civilian Pilot Training Program authorized by the Civil Aeronautics Authority. In 1943 she joined the newly organized Women's Airforce Service Pilots (WASPs) and was trained to ferry Army airplanes to domestic military bases for delivery to combat flight crews. After World War II Madge remained passionate about the role of women in aviation. She was a member of The Ninety-Nines, Inc. International Organization of Women Pilots, P-51 Mustang Pilots Association, The Confederate Air Force, and the Indianapolis Aero Club. She served as a regional vice president for the P-47 Thunderbolt Pilots Association. In the 1970s Madge took an active role in lobbying for and finally achieving recognition and veteran status for all former WASPs.

While serving in World War II, Madge and Naval Officer, Sherman A. Minton, M.D. were married on October 10, 1944 during a five-day leave. After the war, they settled in Indianapolis. With the exception of four years in Pakistan (1958–1962), Indianapolis was the family's home. Madge, mother of three daughters, was a teacher, an author, a lapidary, and an amateur herpetologist. She was an accomplished collector of unique primitive artifacts, fine art, and natural rarities. The Mintons co-authored two popular books: "Giant Reptiles" and "Venomous Reptiles." The two of them were regular attendees at annual herpetological society meetings. After Sherman's death in 1999, Madge and her daughter Holly attended the 2001 HL/SSAR meeting in Indianapolis and inscribed many copies of Sherman's just-published memoirs (issued posthumously), "Life, Love, and Reptiles" (2001. Krieger Publishing Co., Malabar, Florida). Additional information on the life of Sherman and Madge Minton is provided in Bernard Bechtel's tribute to Sherman (1999. Herpetol. Rev. 30:202–204), as well as in Bechtel's chapter in "Life, Love, and Reptiles" (see pp. 183–198). The June 1999 issue of *Life* magazine contains a feature article about Madge in her role as a war-time pilot.

Contributions may be made to WASP Memorials, P.O. Box 456, Sweetwater, Texas 79556, USA. Madge is survived by her three daughters, Brooks M. de Cervantes, April M. Kiesier, and Holly S. Minton; and her grandchildren, Natasha Cervantes M.D., and Benjamin Childers.

CURRENT RESEARCH

The purpose of **Current Research** is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, **María del Rosario Castañeda** or **Michele Johnson**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can be found at: http://www.herplit.com/contents.

Nest Site Selection in Leatherback Turtles

A female sea turtle's nest placement can strongly influence the survival of her offspring, which must orient themselves seaward after hatching. In this study, the authors investigated whether nest site choice in leatherback turtles (*Dermochelys coriacea*) is random, or if individuals consistently choose nesting sites with certain characteristics. To test this, a number of ecological measures were taken for 41 multiply-nesting turtles in French Guiana. Individual females showed repeatable preferences for only one measure: nesting at certain distances from the highest spring tide line (HSTL). While nest placement in regard to HSTL is nonrandom, individuals did not demonstrate nest site fidelity for subsequent clutches. To determine the adaptive value of nest placement, the authors performed orientation experiments in five different environments using 100 newly-emerged hatchlings from each of five clutches in Suriname. Results from this experiment showed that hatchlings are able to orient seawards regardless of distance from the beach, except when they are released in vegetated areas. Together, these results indicate that nest placement may be inherited and that vegetation acts as a strong selective pressure on nesting patterns. The authors also discuss conservation implications of their findings.

Kamel, S. J., and N. Mrosovsky. 2004. Nest site selection in leatherbacks, *Dermochelys coriacea*: individual patterns and their consequences. Animal Behaviour 68:357–366.

Correspondence to: Stephanie Jill Kamel, Department of Zoology, University of Toronto, 25 Harbord Street, Toronto, Ontario, Canada M5S 3G5; e-mail: skamel@zoo.utoronto.ca.

Increase in Genetic Variation of Brown Anole Populations During Invasion

Although there are both ecological and genetic reasons why small populations may face the risk of extinction, some introduced species that initially experience these conditions seem to evolve rapidly and become invasive. The authors examined one aspect of invasion biology—the genetic variation of an invasive species—using the brown anole, *Anolis sagrei*. Genetic variation is expected to decrease during an invasion as the result of a population bottleneck, which would in turn limit the population's ability to adapt to novel environments. Using mitochondrial haplotypes from 600 individuals in native and introduced populations, the authors found instead that introduced populations of the brown anole in Florida have more genetic variation than populations from the lizard's native range. This is the result of repeated (at least eight) introductions from across the native range, which allowed the genetic mixture of populations from different geographic sources. Further, they found that more recent brown anole introductions around the world have come from Florida, and some of the introduced populations have maintained high levels of variation. These results suggest that multiple introductions may be one key to successful invasions, and that the more genetically variable introduced populations may be particularly effective at invading elsewhere.

Kolbe, J. J., R. E. Glor, L. Rodríguez Schettino, A. Chamizo Lara, A. Larson, and J. B. Losos. 2004. Genetic variation increases during biological invasion by a Cuban lizard. Nature 431:177–181.

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Seed Dispersal by the Florida Box Turtle

Seed dispersal by animals is a well-studied plant-animal mutualism; however, dispersal of seeds by reptiles has been the focus of few investigations. The authors examined the effects of digestion by the Florida Box Turtle (*Terrapene carolina bauri*) on seed dispersal and germination in pine rockland forests. In fecal samples from 145 turtles, they found seeds of 13 plant species, equivalent to 39% of locally-occurring species with fleshy fruits. The authors then planted recovered seeds from nine of these species, and seeds of each species germinated. Germination experiments using two palm species (*Thrinax morrissii* and *Serenoa repens*) and a shrub (*Byrsonima lucida*) were performed with three treatments: seeds from box turtle feces, control seeds (i.e., collected from plants) with intact fruit, and control seeds with the fleshy fruit removed. Results from these experiments indicate that larger seeds are more likely to germinate after turtle digestion, while smaller seeds may become dormant as a result of digestion. In addition, removal of fruit from ungerminated seeds (manually or through digestion) may allow seeds to escape from insect predation. Together, these findings suggest that box turtles, with home ranges as large as 5 ha, may play an important role in seed dispersal.

Liu, H., S. G. Platt, and C. K. Borg. 2004. Seed dispersal by the Florida box turtle (*Terrapene carolina bauri*) in pine rockland forests of the lower Florida Keys, United States. Oecologia 138:539–546.

Correspondence to: Hong Liu, Department of Biological Sciences, Florida International University, Miami, Florida 33199, USA; e-mail: hliu@cas.usf.edu.

Morphological Homoplasy in Plethodontid Salamanders

Plethodontid salamanders comprise more than two-thirds of salamander species and exhibit extreme morphological homoplasy, yet no well supported molecular phylogeny exists for this group. To address this problem, the authors sequenced the complete mitochondrial genome for 24 taxa, representing 17 plethodontid genera and two outgroups. These partitioned and unpartitioned sequence data were analyzed using Bayesian statistics, maximum likelihood, and maximum parsimony. The analyses generated congruent trees that surprisingly, reject the monophyly of three of four major plethodontid groups whose relationships have previously been based on morphological characters. The revised phylogeny suggests that a larval stage re-evolved multiple times from a direct-developing ancestor, and that the scenarios for convergent evolution of projectile tongues, toe number, and tail auto-

tomy should be reconsidered. These results indicate that certain morphological traits may be more evolutionarily labile than previously thought. Furthermore, the proposed phylogeny provides no support for the "Out of Appalachia" biogeographic hypothesis for plethodontids. The authors advocate the use of multiple genetic markers for taxonomic revision of this group and to provide a better understanding of morphological evolution.

MUELLER, R. L., J. R. MACEY, M. JAEKEL, D. B. WAKE, AND J. L. BOORE. 2004. Morphological homoplasy, life history evolution, and historical biogeography of plethodontid salamanders inferred from complete mitochondrial genomes. Proceedings of the National Academy of Sciences 101:13820–13825.

Correspondence to: Rachel Lockridge Mueller, Museum of Vertebrate Zoology, 3101 Valley Life Sciences Building, University of California, Berkeley, California 94720-3160, USA; e-mail: rachel@socrates.berkeley.edu.

Yolk Partitioning in Lizard Embryos

Reptilian females deposit yolk in their eggs that provides nutrition for the embryos within. After embryonic growth in many species, a portion of this yolk remains and is drawn into the hatchling's body before hatching. This residual yolk may be a maternal contribution to maximize hatchling size, or it may be the result of active partitioning by the embryo between early growth and reserve post-hatching energy. To test these, the authors manipulated eggs from five females of the lizard *Calotes versicolor*. They found that eggs for which 8% of the yolk was experimentally removed (N = 44) produced smaller hatchlings than sham operated eggs (N = 43), and that manipulated eggs hatched after a shorter incubation period. However, the same amount of residual yolk remained for eggs in both groups. This indicates that embryos of this species can partition available yolk, and that post-hatching energy needs balance the advantage of larger hatchling body size.

RADDER, R. S., B. A. SHANBHAG, AND S. K. SAIDAPUR. 2004. Yolk partitioning in embryos of the lizard, *Calotes versicolor*: maximize body size or save energy for later use? Journal of Experimental Zoology 301A:783–785.

Correspondence to: Bhagyashri A. Shanbhag, Department of Zoology, Karnatak University, Dharwad – 580 003, India; e-mail: bhagyashri_shanbhag@hotmail.com.

Frog Community Persists Despite Endemic Chytrid Infection

Although the chytrid fungus (*Batrachochytrium dendrobatidis*) has been implicated as a causal agent in worldwide amphibian decline, little information is available regarding the impact of the fungus in natural populations. The authors performed a retrospective histological analysis of toe tips from six sympatric frog species in Queensland, Australia, collected ten years after a period of rapid decline. They determined that while four of the species were free of infection, two species, *Taudactylus eungellensis* (which experienced a population decline) and *Litoria wilcoxii/jungguy* (whose population remained stable), had been infected. Additionally, the authors conducted a mark-recapture study of infected and uninfected individuals in remnant populations of these two species and found no evidence of differential survival as a result of infection status. These results refute the hypothesis that frog populations recovered after the fungus had disappeared, and suggest that perhaps an evolved resistance to the pathogen allows frog populations to persist with stable, endemic infections of the chytrid fungus.

RETALLICK, R. W. R., H. MCCALLUM, AND R. SPEARE. 2004. Endemic infection of the amphibian chytrid fungus in a frog community post-decline. Public Library of Science Biology 2:1965–1971.

Correspondence to: Hamish McCallum, Department of Zoology and Entomology, University of Queensland, St. Lucia, Queensland, Australia; e-mail: hmccallum@zen.uq.edu.au.

Molecular Phylogeny of Caecilians

Caecilians are a remarkably diverse, yet little known, order of amphibians with six currently recognized families. To resolve the relationships among these families, the authors used complete sequences of the mitochondrial genome and the nuclear RAG1 gene from one representative of each family. Sequences were combined with data from other amphibians and subjected to separate and combined phylogenetic analyses using maximum parsimony, minimum evolution, maximum likelihood, and Bayesian inference. Results strongly supported the monophyly of the three orders of Amphibia and are consistent with a monophyletic Batrachia hypothesis. Within Gymnophiona, the optimal tree corresponds with recent morphological and molecular studies; however, relationships among higher caecilians remain unresolved.

SAN MAURO, D., D. J. GOWER, O. V. OOMMEN, M. WILKINSON, AND R. ZARDOYA. 2004. Phylogeny of caecilian amphibians (Gymnophiona) based on complete mitochondrial genomes and nuclear RAG1. Molecular Phylogenetics and Evolution 33:413–427.

Correspondence to: Rafael Zardoya, Departamento de Biodiversidad y Biología Evolutiva, Museo Nacional de Ciencias Naturales, CSIC, José Gutiérrez Abascal, 2, 28006, Madrid, Spain; e-mail: rafaz@mncn.csic.es.

Adaptations of Cold-Climate Reptiles

Cold-climate reptiles have three adaptations that provide a warmer environment for incubating embryos despite low ambient temperatures: maternal nest placement in warm sites, viviparity (embryos retained in the uterus are presumably more protected from low temperatures than those in nests), and increased basking during pregnancy. To determine the thermal consequences of these traits in sympatric Australian reptiles, the author measured temperatures of potential and actual nest sites of the oviparous skink *Bassiana duperreyi* and body temperatures of pregnant and non-pregnant viviparous skinks *Eulamprus heatwolei*. He found that nest site selection had a larger effect on average incubation temperatures than viviparity or maternal basking in cold climates. In particular, he showed that viviparous skinks provided embryos with bimodal daily thermal distributions rather than the unimodal distributions of nest temperatures; however, mean temperatures

between nests and females did not differ. Additionally, although pregnancy alters thermoregulatory behaviors, in cold climates effective basking opportunities may be severely limited. These conclusions contradict the paradigm under which pregnant heliothermic squamates are expected to maintain higher body temperatures than nest temperatures, and suggest that basking should be considered a preadaptation rather than an adaptation for viviparity.

SHINE, R. 2004. Incubation regimes of cold-climate reptiles: the thermal consequences of nest-site choice, viviparity and maternal basking. Biological Journal of the Linnean Society 83:145–155.

Correspondence to: Richard Shine, Biological Sciences A08, University of Sydney, NSW 2006 Australia; e-mail: rics@bio.usyd.edu.au.

Molecular Phylogeny of Squamates

Squamate reptiles are model systems for many ecological and evolutionary studies, and an accurate phylogeny is critical in drawing generalizations from such studies. In particular, the traditional morphology-based dichotomy between Iguania and Scleroglossa has been correlated with major evolutionary changes within Squamata, inferences that rely on correct rooting of the squamate tree. The authors present a molecular phylogeny of 69 squamate species representing all major clades and most major subclades, using 4600 bp of DNA sequence from three independent data sets: the nuclear genes *RAG-1* and *c-mos* and the mitochondrial *ND2* region. These sequences were subjected to separate and combined analyses using maximum likelihood, Bayesian statistics, and maximum parsimony. Results supported the monophyly of almost all recognized families, but found that several higher taxa do not form monophyletic groups. Iguania, previously considered the sister group of Scleroglossa, comes out deeply nested within Scleroglossa. Also, limbless taxa including snakes, amphisbaenians, and dibamid lizards appear to have independently evolved the limbless condition. Several other taxonomic groupings, suggested or confirmed by the new data, are also discussed.

TOWNSEND, T. M., A. LARSON, E. LOUIS, AND J. R. MACEY. 2004. Molecular phylogenetics of Squamata: The position of snakes, amphisbaenians, and dibamids, and the root of the squamate tree. Systematic Biology 53:735–757.

Correspondence to: Ted M. Townsend, Integrative Biology C0930, University of Texas, Austin, Texas 78712, USA; e-mail: townsend@mail.utexas.edu.

Sexual Dimorphism in the Cottonmouth Snake

While sexual selection is often cited as the cause of sexual dimorphism, natural selection that reduces intersexual resource competition is an important alternative explanation. The authors measured sexual dimorphism in head shape, a trait functionally related to resource use, in the cottonmouth snake *Agkistrodon piscivorus* using museum specimens (108 males, 106 females). They also determined intersexual differences in prey type and prey shape by dissecting the stomachs of those specimens. A principal component analysis revealed that overall head size and several aspects of head shape differ in males and females. Analysis of stomach contents showed that the sexes consume qualitatively different prey and that males consume significantly taller prey than females. Cottonmouth snakes are gape-limited predators, and the head shape differences observed in this study may reflect functional differences in maximum gape, which would in turn explain differences in consumed prey height between similarly sized males and females. However, as differences in prey may be the result of sexually-selected body size dimorphism, the authors encourage comparative studies on sexual differences in snakes to determine the generality of their findings.

VINCENT, S. E., A. HERREL, AND D. J. IRSCHICK. 2004. Sexual dimorphism in head shape and diet in the cottonmouth snake (*Agkistrodon piscivorus*). Journal of Zoology 264:53–59.

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Consumption of Toxic Prey as Protection From Predation

Although many amphibians secrete toxic compounds that are lethal to most predators, a number of snake predators have evolved resistance to these toxins. Common Garter Snakes (*Thamnophis sirtalis*) and their prey, the Rough-skinned Newt (*Taricha granulosa*) are an example of such a system. The authors investigate patterns of accumulation of tetrodotoxin (TTX), a neurotoxin produced by the Rough-skinned Newt, in garter snakes after ingesting newts, and consequences of that accumulation. After assuring that snakes were free of TTX, 15 snakes were each fed one newt of known toxicity; snake liver tissues were subsequently collected at weekly intervals to assess TTX retention. Data from this study show that after consuming a single newt, snakes retain TTX in the liver for a minimum of one month at levels that would incapacitate, if not kill, avian predators of the snake and would negatively affect mammals as well. After eating 3–8 newts, snakes harbored the toxin in their livers for at least seven weeks. The authors conclude that the concentration of TTX in the liver, away from the sites of action for the toxin, may serve as chemical protection against predation for garter snakes, as predators may quickly learn to avoid prey that are likely poisonous.

WILLIAMS, B. L., E. D. BRODIE, JR., AND E. D. BRODIE III. 2004. A resistant predator and its toxic prey: persistence of newt toxin leads to poisonous (not venomous) snakes. Journal of Chemical Ecology 30:1901–1919.

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ZOO VIEW

The Sad Tale of Two Zoos

The Belle Vue Zoological Gardens in Manchester, England, established in 1836, was important in the history of zoo herpetology (Fig. 1). The Zoo was not a conventional zoological garden but was part of an amusement park. There are fascinating historical documents concerning this Zoo: average longevity for 24 chameleons between the years 1898–1901 was slightly over three months and none survived for one year (Flower 1925), description of the reproduction of a pair of Seba Pythons (*Python sebae*) and exhibition of fertilized eggs by the Secretary of the London Zoological Society (Jennison 1909), a letter by George Jennison to the Secretary of the London Zoological Society describing reproduction and behavior of a pair of Pine Snakes (Jennison 1910), and studies on the mating behavior of American Alligators (Legge 1969).

Like many inner-city institutions, it faced shrinking financial support and visitation in the 1970s. Increasing vandalism was a major problem: windows in the glass roof were replaced five times within two months. The number of species over one twenty-year span was extraordinary: 6 salamanders, 15 anurans, a caecilian, 8 crocodilians, 41 chelonians, 94 lizards, and 106 snakes. These included the Chinese Giant Salamander, Marine and Rhinoceros Iguanas, False Gavial, African Dwarf and Slender-snouted Crocodiles, Galápagos and Aldabran Giant Tortoises and many unusual snakes. The herp staff created naturalistic exhibits with living plants — American Alligators bred in their enclosure for the first time in a European zoo. The complete story is told in a book by Clive Bennett and David Barnaby, published in 1989: "The Reptiles of Belle Vue 1950–1977. A Curator's Viewpoint." The Zoo closed in 1977.

Fig. 3. Frank Groves in 1976. Photo courtesy of John D. Groves.

Fig. 1. Front cover of visitor guide to Belle Vue Gardens in 1895. Courtesy of Smithsonian Institution Libraries, Washington, DC.

In 2004, the same fate as that of Belle Vue befell the Baltimore Zoo's herpetology department. Because of declining financial support for the Zoo, administrators decided that the reptile building, located outside the zoo boundaries in Druid Hill, needed to be closed. The collection was disbanded and the staff was declared to be redundant.

This facility opened on 12 August 1948 and Frank Buck of "Bring-Em-Back-Alive" fame was the guest of honor. Six months later, the late Frank Groves, Head Keeper of Birds, was placed in charge after his predecessor John E. Cooper (now at North Carolina Museum of Natural Sciences) opened the building before leaving the Zoo. Groves was elevated to Curator in 1973 and remained at the Zoo in this capacity until he retired sixteen years later (Fig. 2). He published many papers, some of which are listed below.

According to "International Zoo Yearbook" (1998:Volume 28), composition of the collection was nearly 90 taxa of reptiles with 365 specimens and 24 taxa of amphibians numbering 234. Virtually all of these specimens from this important collection will be sent to other facilities.

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— James B. Murphy, Section Editor

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Some Comments on Our Herpetological Collaborations with Zoos

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The charge associated with this article was the more-or-less straightforward question: how can zoo-academic collaborations work effectively? Although the authors have participated in a fair number of such collaborations that resulted in publications as well as oral presentations at scholarly meetings, we have never thought of our efforts as having been special in any way, nor have we imagined that any unusual providence (other than the asking of interesting herpetological questions) directed our work. Accordingly, we are not sure why our collaborations have worked and why some others have not. One idea we must consider is that there are dozens of potentially successful collaborators out there who have not yet hooked up with zoos because of various inertial forces. That is, the real problem is not only a matter of specific protocols and experimental designs, it is also a matter of too few bodies in the population of academic-zoo collaborators. This problem has been recognized by persons on both sides of the dyad, and is being dealt with through appropriate published invitations and conferences; hence, no more will be said about this matter in the present article. Another hypothesis that came quickly to mind is that we have been keenly interested in the questions that our data-gathering efforts were designed to answer, and this interest usually generated plenty of energy in us and maybe it generated a bit of sympathetic energy in our zoo colleagues. Motivation is certainly an important commodity, as this is the stuff that helped us get from Boulder to San Diego and to Dallas and to Washington, D.C. and to various other cities containing collaborating zoos. And, of course, once we arrived at the zoos, it was also necessary to make observations and to manage the empirical data that accumulated as a consequence. Lest we forget, energy was also necessary to write the proposals that were universally necessary to gain access to zoo collections, and plenty more energy was required to write the final papers.

So, could our successes be attributed to the energy-generating interest we had in the predatory behavior of rattlesnakes? Maybe, but we believe this is an arrogant position because it implies that other erstwhile zoo-oriented academics had less interest in their questions than we had in ours, and this cannot be. Virtually all herpetologists tend to be reasonably passionate about their interests, hypotheses and organisms, and we can't claim to have been unusual in this respect. Furthermore, while the authors are reasonably affable people, and while friendships with zoo-based collaborators certainly facilitate research, we do not think our collective affability is unusual. Indeed, each of us thinks the other is just barely above threshold in this department, a conclusion that would probably be seconded by our most frequent zoo collaborators (J. B. Murphy and C. W. Radcliffe).

Having rejected these ideas, we must look away from our personal attributes and toward the nature of the science we have done during our collaborations. This is not to say that the personal characteristics were irrelevant; they may have been necessary but they were not sufficient. For Aristotelian completeness in our analysis, we must go on to consider the structure of the questions we asked, the data we gathered, and the conclusions we reached. What we will say in the following paragraphs is, in our view, equally applicable to other successful zoo-academic collaborations known to us (e.g., projects done by C. C. Carpenter, W. E. Cooper, Jr., C. Gans, J. Gillingham, H. W. Greene, to name a few).

Some scientific questions can be meaningfully answered by studying zoo animals, whereas other questions require either more controlled (laboratory) environments or completely natural ones. It has been our good fortune to deal with questions that lent themselves to zoo collections. In particular, we have pursued numerous studies of strike-induced chemosensory searching (SICS) and related behaviors, using zoo collections to demonstrate the generality of the phenomena, as the research collection in our laboratory contained only a few species of rattlesnakes and we had good reason to believe that SICS occurred generally among pit vipers as well as in old world vipers, elapids and even in some non-ven-

omous species. Our zoo collaborations revealed this to be true, as have the research efforts of others working independently. In retrospect, it would be almost impossible to explore the herpetological generality of any appropriate behavioral or physiological phenomenon without partnering with at least a few zoos.

Our work with zoos hinges on an important assumption, namely, that SICS and related behaviors seen in long-term captive specimens are representative of the same events in free-living individuals. Although observations of predation in wild snakes are relatively rare, those that have been published are generally supportive of our assumption, lending ecological validity to both our laboratory work and the zoo studies. This factor undoubtedly contributes to the willingness of zoos to support the work by granting access to their collections and even participating in the data-gathering efforts.

Another factor that almost certainly played a role in the success of our collaborations has to do with the design of the experiments and the protocols associated with their execution. Our SICS experiments conform to a fairly standardized set of operations that have three properties, all of which are relevant in the present context. First, the operations are fairly straightforward, easy to comprehend and equally easy to carry out. Second, minimal danger is involved, either to the observers or to the animals. And, these matters are easy to supervise by zoo staff. Third, although the actual recording of data can be a bit tedious, the authors have generally done this work, so that we have been little or no burden on the zoo staff. Of course, we have needed some help from the staff, but we have always kept this to a minimum unless some persons actually volunteered their time and effort. In this connection, it should be noted that we make our observations through the glass fronts of otherwise closed and locked cages, frequently from public viewing areas, so that valuable time of zoo staffers is not required for continuous supervision. Likewise, it should be noted that animals need not be taken off exhibit in order for DC and HMS to do their work.

Once the data have been gathered, we have adhered to three policies regarding the preparation of manuscripts. First, we tried to generate a draft as quickly as possible, usually within a month of completing the collection of data. Second, the draft was forwarded to the zoo staffers with whom we have worked for their comments and for final decisions regarding co-authorships. Third, our zoo collaborators frequently had a chain-of-command through which the final manuscript must circulate for approval(s), and we never tried to rush this process, nor have we ever submitted a manuscript for editorial review until the zoo collaborators have said this was okay. Sometimes revisions have been required at this stage and these have been cheerfully executed.

Some experiments, particularly those involving trail-following behavior, are inherently more complicated and more tedious to execute than are the SICS experiments. Nevertheless, we have always used the clearest possible protocols, minimizing the complexities as well as the necessary equipment, and streamlining as much as possible the data-gathering procedures. In several cases, zoo staffers have taken responsibility for collecting data, and we have always tried to remain available by phone for advice, as needed. As our collaborators have developed skill in the design and analyses of experiments, they have become independent researchers, conducting their own projects with little or no assistance from us. Possibly the best indicator of the success of a collaboration is to see the collaborators carry on themselves, establishing their own lines of inquiry and their own publications.

By way of conclusions, we can tender five assertions: (1) only certain problems lend themselves to research with zoo collections and vice versa; (2) there are, however, a reasonable number of behavioral, life history and physiological issues that fall into this bailiwick, so we need not worry that our issue-domain is too restrictive, even if we rule out all forms of invasive experimentation; (3) simple and straightforward procedures are generally to be preferred over more complicated ones, especially for projects to be carried out in the limited facilities of most zoos; (4) credit should always be given to co-operating institutions, either in the form of an acknowledgment or co-authorship, as appropriate; and (5) manuscripts should always be circulated among collaborators and their chains of command, if necessary, prior to submission to journals.

Unfortunately academia is no longer the lodestone that it was in times past, because the very areas of potential research available in zoos now get relatively little emphasis in universities; appropriate collaborators are declining in number as a consequence of the de-emphasis of natural history and related fields. Nevertheless, there still are enough relevant academics to justify the relationship-building efforts of zoo professionals. The following anecdotes represent two points of light, so to speak, that can attract collaborators and point the way toward fascinating projects. A curator observed a strange behavior of a snake that formed a loop of itself, tail in mouth, to foil another snake that attempted to swallow it, with the latter snake ultimately giving up after mouthing the loop several times. In our lab, a whipsnake was observed seeking a lizard prey that could be detected only by its movement. The whipsnake thrashed its tail about while holding its head alert and steady, the tail apparently calculated to make the lizard reveal itself by movement while the snake's head was ready to strike. As long as there are zoo and academic professionals who appreciate such stories, there will be a basis for friendships and joint studies; there will also always be an element of serendipity attending such collaborations.

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ARTICLES

Herpetological Review, 2005, 36(1), 9–12.

Using Limb Morphology to Distinguish Two-lined Salamander Larvae (*Eurycea*) from Northern Dusky Salamander Larvae (*Desmognathus*)

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The Northern and Southern Two-lined Salamanders (*Eurycea bislineata, E. cirrigera*) have syntopic distribution with the Northern Dusky Salamander (*Desmognathus fuscus*) over a wide geographic area of eastern United States and Canada (Petranka 1998). A third member of the Two-lined Salamander complex, *Eurycea wilderae*, (see nomenclature of Collins and Taggart 2002) overlaps with *D. fuscus* within the Blue Ridge Physiographic Region of the Southern Appalachian Mountains (Petranka 1998).

Accurate identification of the larvae of these species can be a difficult task for both professional and amateur herpetologist alike. My investigation of voucher specimens at The Ohio State University Museum of Zoology revealed some collections where small Two-lined Salamander larvae were incorrectly identified as *D. fuscus*. Rocco et al. (2004) report that volunteers trained to monitor streamside salamander populations have problems separating *E. bislineata* larvae from *D. fuscus*. Of 58 *E. bislineata* larval vouchers, 18 (31%) were incorrectly identified, and 16 of the 18 (89%) were keyed to *D. fuscus*. Others also have found that students have difficultly with accurate identification of the larvae of these two species (Daryl Karns, pers. comm.). More often than not, when misidentification does occur, it is an *E. bislineata* larva that will incorrectly be identified as *D. fuscus* (Rocco et al. 2004).

A number of taxonomic keys have been proposed to help distinguish the larvae of the nominate Two-lined Salamander species (*E. bislineata*) from *D. fuscus* using characteristics of gill morphology (Brandon 1964; Downs 1989; Petranka 1998). However, manipulative gill based taxonomy for salamander larvae is not appropriate for live specimens, can deform gills of museum voucher specimens, and is not practical for amateur herpetologists that lack access to a microscope. Less destructive visual morphological characters have been proposed. Live *D. fuscus* larvae tend to have white or silvery gill pigment, whereas the gills of Two-lined Salamander larvae are darkly pigmented and tend to be longer and more feathery (Valentine 1989; see also gill color in Plate 17-*D. fuscus* and Plate 20-*E. bislineata* of Petranka 1998). Brandon (1964) used the number and size of pale dorsal spots as a

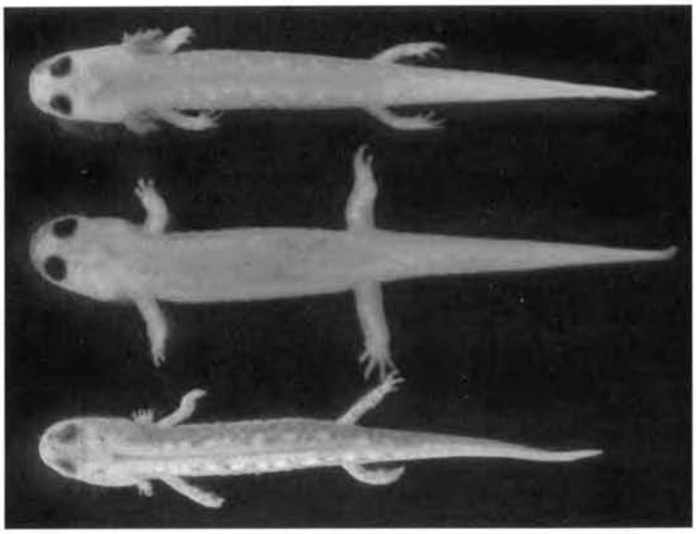

FIG. 1. Photograph of larval *Eurycea bislineata* (top, Geauga County, Ohio), *Desmognathus fuscus* (middle, Summit County, Ohio), and *Eurycea cirrigera* (bottom, Athens County, Ohio). The *D. fuscus* specimen is approximately 25 mm total length. Note the obvious difference in limb morphology of *D. fuscus* as compared to both *Eurycea* species.

taxonomic character, usually fewer in number and larger in *D. fuscus* larvae compared to *E. bislineata* (see also dorsal pattern for *D. fuscus* larvae in Bishop and Chrisp 1933).

While the above mentioned visual characters are helpful, there are problems with their use for taxonomy. The silvery color of *D. fuscus* gills may become discolored on preserved voucher specimens. Some recently hatched Two-lined Salamander larva may have gill length similar to dusky larvae (see *E. cirrigera* in Fig. 1). Ontogenetic and geographic variation in dorsal spot patterns also can lead to misidentification. According to Brandon (1964), older *D. fuscus* larvae (ca. 25–30 mm TL) may lose nearly all traces of light dorsal spots and replace these dots with a wavy dorsal pattern, thus reducing the usefulness of this character for taxonomy. To add to the confusion, dorsal spots of older Two-lined Salamander larvae also can merge to form a wavy dorsal pattern, making them appear very similar to large *D. fuscus* larvae to the untrained eye (pers. obs.).

Here, I present two new salamander taxonomic characters, the *limb length/width ratio* (Limb L/W), and the *hind limb width/SVL ratio* (HLW/SVL), which can be used to distinguish larvae of the Two-lined Salamander complex (*E. bislineata, E. cirrigera,* and *E. wilderae*) from *D. fuscus* larvae. I caution that these measures should be used only after regional taxonomic keys for salamander larvae eliminate other genera (e.g. Altig and Ireland 1984; Petranka 1998).

Salamander larvae of *E. bislineata* (N = 10), *E. cirrigera* (N = 8), and *D. fuscus* (N = 10) were collected from 16 populations located in 10 Ohio counties at various dates between 1999 and 2003. Geographic distributions for *E. bislineata* and *E. cirrigera* were determined using the range maps provided by Pfingsten (1998). For each species, individuals were selected for statistical analysis from a variety of populations to represent regional variation. Recent hatchings of all three species were included in the analysis. According to Petranka (1998), *D. fuscus* has a larval period less than one year throughout its range, thus I included specimens from both Two-lined Salamander species such that they overlap the reported maximum body length of *D. fuscus* larvae (about 30 mm according to Brandon 1964). In Ohio, Two-lined Salamanders have a two year larval period (Pfingsten and Downs 1989), thus it is likely that both year classes are represented in my samples. Total body length (TL) and snout-posterior vent length (SVL) were measured to 0.1 mm using a dial caliper. All specimens were fixed in 10% formalin, rinsed in distilled water, and stored in 70% ETOH.

Visually distinct differences are present in the relative width and length of fore and hind limbs of *D. fuscus* compared to Two-lined Salamander larvae of similar length (Fig. 1). In order to quantify these differences, limb measurements were made using an ocular micrometer fitted to a binocular microscope. The same magnification was used for all limb measurements taken on any given specimen. With the specimen positioned ventrally using forceps, the length of the proximal segment of the fore limb (humerus associated) and hind limb (femur) was measured starting from a point where the joint angle of the humerus and femur articulate with distal limb segments, then extending to the body (Fig. 2). The length of the fore limb was measured near the anterior margin; hind limb length was measured near the posterior margin (Fig. 2). It is helpful if the limbs are extended away from the body. The joint angle between the proximal and distal elements is usually clearly demarked. However, because the knee of the hind limb tends to point in an anterior direction in amphibians (Noble 1954), the exact location where the femur articulates with its distal limb segment often must be approximated. These two length characters are identified as FL (proximal fore limb length) and HL (proximal hind limb length). Limb width was measured where the humerus and femur articulate with the body, at an angle perpendicular to the FL and HL measurements (Fig. 2). The two width char-

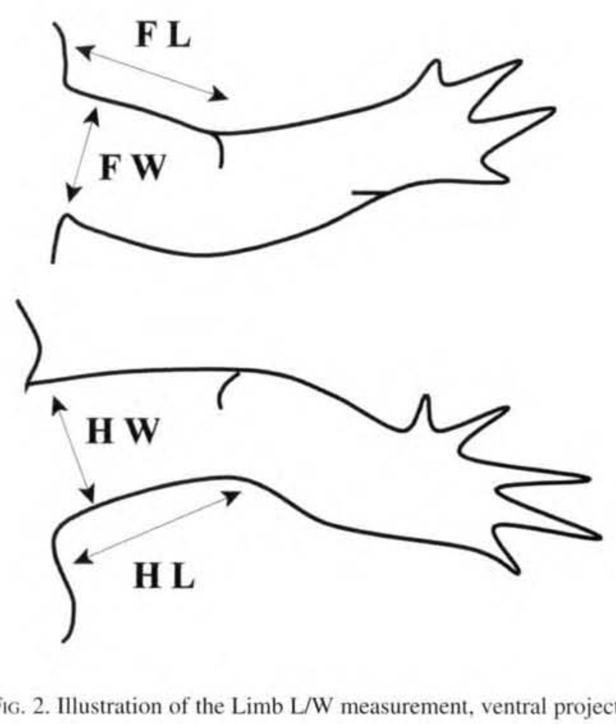

FIG. 2. Illustration of the Limb L/W measurement, ventral projection. FW = Forelimb Width; FL = Forelimb Length; HW = Hindlimb Width; HL = Hindlimb Length. Measurements are taken using an ocular micrometer fitted to a binocular microscope.

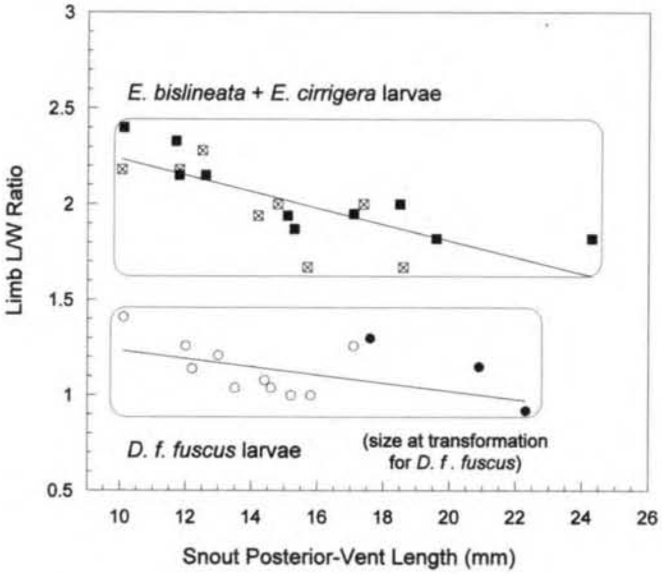

FIG. 3. Scatter plot of Limb L/W measures vs snout posterior–vent length for larvae of *Eurycea bislineata* and *Eurycea cirrigera* compared to *Desmognathus fuscus*. Solid squares = *E. bislineata* larvae; open squares = *E. cirrigera* larvae; open circles = *D. fuscus* larvae; solid circles = *D. fuscus* transformed juveniles. Lines represent least square regression; boxes outline the range of data points for each regression.

acters are identified as FW (proximal fore limb width) and HW (proximal hind limb width). Measures were taken on two limbs from the same side of the body.

Using the above measurements, a dimensionless limb length/width ratio was formulated as [(FL+HL) / (FW+HW)] = Limb L/W. For example, a larva of *E. bislineata* collected 18 Nov 1999 had a total body length of 20.0 mm and SVL of 11.8 mm. Measures on the fore limb were (FL = 13 micrometer units; FW = 6 units); measures on the hind limb were (HL = 15 units, HW = 7 units). A limb length/width ratio was calculated as [(13+15) / (6+7)] = 28/13 = 2.15]. Because the Limb L/W ratio is a dimensionless character, it may be calculated at any microscopic (or photographic) magnification, but the same magnification must be used for all measurements on any given specimen.

Limb L/W ratios were regressed for all three species against SVL to determine ontogenetic variation (Fig. 3). Because no visual difference was found in the regression data for *E. bislineata* and *E. cirrigera* (Fig. 3), they were combined for comparison with *D. fuscus*. The results indicate that the larvae of *D. fuscus* can be distinguished from the larvae of both *Eurycea* species at any body size using the Limb L/W measurement (Fig. 3). All larvae with a Limb L/W ratio less than 1.6 are identified as *D. fuscus* at any body size. In all three species, the Limb L/W ratio decreases with increasing body size (Fig. 3).

According to Brandon (1964), and Altig and Ireland (1984), accurately identified *D. fuscus* larvae have a total body length less than 30 mm. The largest *D. fuscus* larvae in Fig. 3 (collected 06 June 2003 from Geauga county) had SVL = 17.1 mm and TL = 31.3 mm, with gills that were nearly absorbed, an indication the larva was near transformation. Measurements on three small juvenile *D. fuscus* gave Limb L/W ratios that fit well the extrapolated regression curve for *D. fuscus* larvae (Fig. 3). Thus, the data in Fig. 3 capture the known range of body sizes for accurately identified *D. fuscus* larvae, and slightly extend the maximum recorded body length for *D. fuscus* larvae to just over 30 mm.

I also examined a series of Blue Ridge Two-lined Salamander larvae, *Eurycea wilderae*, that I collected from a spring-fed stream in Macon County, North Carolina over a two-year period (1980, 1981). Limb L/W measures on a select number of specimens within the body sizes shown in Fig. 3 were all greater than 2.0, well within the range of the Northern and Southern Two-lined Salamander species. No data for *E. wilderae* are presented in Fig. 3 since I only examined a single breeding population. However, the great similarity that I observed in limb morphology between *E. wilderae*, *E. bislineata*, and *E. cirrigera* larvae suggests that the data in Fig. 3 could be used to distinguish *D. fuscus* larvae from *E. wilderae* where they have syntopic distribution within the Southern Appalachian Mountains. Additional research is needed to determine if the Limb L/W character can be used to distinguish Two-lined Salamander larvae from other members of the "*fuscus*" complex (e.g., *D. conanti*, *D. santeetlah*; see Petranka 1998).

The Limb L/W morphological character can be used to distinguish *D. fuscus* larvae from Two-lined Salamander larvae using digital photographs that clearly show dorsal limb structure. I suggest that the use of photographs for salamander taxonomy would be especially useful for citizens that do not have access to a microscope. For example, color Plate 17-E in Pfingsten and Downs (1989) shows an "old larva" of *D. fuscus* from Ohio. Using a Pickett triangular ruler calibrated to 3/16 graduation, I estimate a Limb L/W = 1.2 for this larva, which is clearly within the regression curve prediction limits for *D. fuscus* (Fig. 3). Conversely, Plate 20-B of Pfingsten and Downs (1989) shows a "young larvae" of *E. bislineata* from Hocking County, Ohio (now *E. cirrigera*), which I estimate has a Limb L/W = 2.0, well within the range of the Southern Two-lined Salamander (Fig. 3). Even if these estimates have a measurement error of 0.2 Limb L/W units, each specimen still would be correctly identified from the photographs alone, without knowledge of body size. Increased use of digital photo-

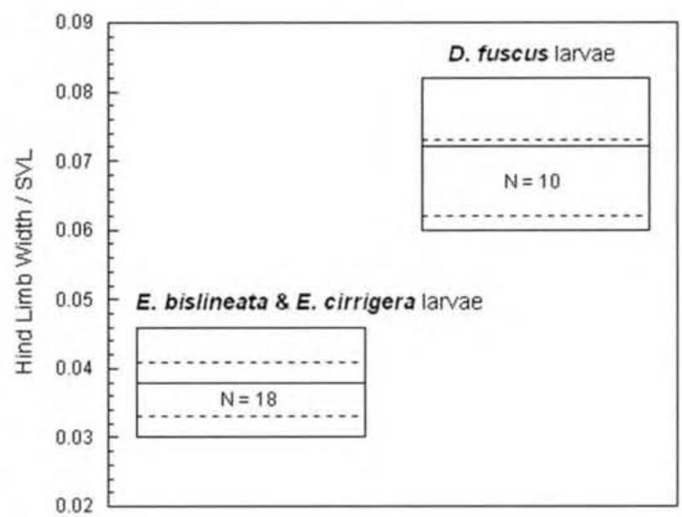

FIG. 4. Frequency plots showing taxonomic separation between Two-lined Salamander larvae and *D. fuscus* larvae using the Hind Limb Width/SVL character. Boxes show range of measurements; solid line represents the median; dotted lines are 25[th] and 75[th] percentile.

graphs taken on live animals for taxonomic purposes would reduce disturbance of local populations by unnecessary collection of numerous voucher specimens, a concern with acknowledged declines in amphibian biodiversity worldwide (Petranka 1998). Bailey (2004) recommends photo-identification for mark-recapture studies with salamanders.

It has been brought to my attention that separation of Two-lined Salamander and *D. fuscus* larva also is obtained by calculation of a ratio (HLW/SVL) of hind limb width (see Fig. 2) vs snout–posterior vent length (Gian Rocco, pers. comm.). The utility of this technique is that it reduces to two the number of required microscopic measurements. One disadvantage is that it cannot be used on photographs of specimens from the dorsal view. However, in lieu of SVL measurement, the approximate location of the vent can be estimated from a digital photograph at a position just posterior to the hind legs (see specimens in Fig. 1) to calculate the ratio.

There are evolutionary reasons why muscular-skeletal differences in limb morphology should be a useful taxonomic character to distinguish larvae of the salamander genera *Eurycea* and *Desmognathus*. As discussed by Duellman and Trueb (1986), obligate stream inhabiting salamander larvae, such as those found in the genus *Eurycea*, use limbs mostly to maintain position in the flowing water medium. Forward movement is more often by use of trunk and tailfin muscles, similar to the undulating motions of a fish. Aquatic locomotion in *Eurycea* larvae also would be aided by buoyancy considerations that tend to mediate the effects of gravity, thus allocation of energy to leg muscle development should be minimal. However, salamander larvae with an affinity to forage in terrestrial microhabitats must have limbs capable of producing forward motion by thrusting the limbs backwards against hard substrate. They also lack the energetic benefits of buoyancy found in a watery medium. Thus, more muscular elements of limbs would be adaptive for *D. fuscus* larvae to compensate for increased force needed for terrestrial locomotion, and may explain the lower Limb L/W ratios for *Desmognathus* compared to *Eurycea* (Fig. 3). It has long been known that newly hatched *D. fuscus* larvae can be found outside the flowing water environment (Wilder 1913), and older *D. fuscus* larvae can burrow in moist sand and fine gravel substrate, well away from flowing water (pers. obs.).

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Mycoplasma Testing of Gopher Tortoises (*Gopherus polyphemus*) in Relation to Military Training Activities at Camp Shelby Training Site, Mississippi

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When the western population of Gopher Tortoises (*Gopherus polyphemus*) was federally listed as "threatened" in 1987, threats included habitat loss, habitat alteration, and illegal taking (USFWS 1987). Upper respiratory tract disease (URTD) is another potentially serious threat that has been identified in many Gopher Tortoise populations throughout the southeast (Diemer Berish et al. 2000). The potential impacts of this disease in wild Gopher Tortoise populations are poorly understood, though significant mortality events that are possibly attributable to URTD have been recorded in some populations in Florida (Gates et al. 2002; McLaughlin 1990; Rabatsky and Blihovde 2002; Seigel et al. 2003).

URTD was first described in Desert Tortoises (*Gopherus agassizii*) in the desert southwest (Jacobson et al. 1991) and is considered a major contributing factor in the decline of Mojave Desert tortoise populations (Lederle et al. 1997). The first documented case of URTD in a wild Gopher Tortoise population was on Sanibel Island, Florida in 1989 (McLaughlin 1990). URTD is a highly infectious respiratory disease caused by a bacterium, *Mycoplasma agassizii* (Brown et al. 1999). The disease is spread through close contact between tortoises (McLaughlin 1997), and males may suffer the highest incidence of mortality, primarily because of differences in activity patterns (Christopher et al. 2003; Gates et al. 2002).

Currently there are three diagnostic tests to detect mycoplasmal infections of Desert and Gopher Tortoises (see Brown et al. 2002 and references therein). They are direct mycoplasmal culture, detection of mycoplasmal chromosomal DNA by polymerase chain reaction (PCR), and detection of anti-*Mycoplasma* antibodies in tortoise plasma by enzyme-linked immunosorbant assay (ELISA). In addition to these diagnostic tests, observations of clinical signs of disease also are frequently used to infer exposure to *M. agassizii* (Schumacher et al. 1997).

The potential long-term impacts of upper respiratory tract disease are unknown. Because of the Gopher Tortoise's protected status, activities that may adversely impact tortoise populations are closely monitored. Previous activities at Camp Shelby Training Site (CSTS) in Mississippi have required tortoise relocations, and the U.S. Fish and Wildlife Service (USFWS) required sampling for URTD before any relocation could occur. The presence of seropositive or suspect tortoises may influence relocation activities (e.g., off-site versus on-site relocation), and in some cases negatively impact military training activities. In 1995, ELISA testing of Gopher Tortoises began at CSTS in association with a relocation project on Range 45. Sampling of 9 individuals resulted in all tortoises either testing positive or suspect for exposure to *M. agassizii* (unpubl. data). Additional opportunistic ELISA sampling (1996–2000; N = 147), prior to the initiation of this study, resulted in 8% of tortoises sampled testing either positive or suspect for exposure to *M. agassizii* (Epperson and Heise 2001). Five of the tortoises opportunistically sampled were from Range 45. Testing of these tortoises resulted in one positive, one suspect, and three negative results. Unfortunately, none of these tortoises was a recapture from the original (1995) Range 45 sampling. Although these data indicate a relatively low percentage of tortoises previously exposed to *M. agassizii*, most of the suspect or positive results (9 of 12) came from tortoises in areas of high military impact (e.g., ranges, firing points). It has been suggested that anthropogenic impacts may cause sufficient physiological stress to trigger outbreaks of URTD in infected populations (McLaughlin et al. 2000). The impacts of tracked vehicles on Gopher Tortoises have been examined at Fort Benning, Georgia (Guyer et al. 1996). They determined that Gopher Tortoise colonies on sites associated with heavy, tracked vehicle maneuvers had an altered demography, as well as altered behavior patterns. Tortoises at these sites were active longer and had to travel farther to forage, potentially exposing them to increased predation risk as well as to physiological stress from increased movements. Testing for exposure to URTD was not part of the Fort Benning study. It is possible that tortoises at CSTS inhabiting areas used for tracked vehicle maneuvers are experiencing similar physiological stressors resulting in a higher prevalence of seropositive or suspect tortoises on these sites. The purpose of this study was to test the hypothesis that tortoises in areas with military training have a higher prevalence of seropositive or suspect ELISA results than tortoises in areas with no military training.

Tortoises were sampled in the summer of 2001 and 2002 in 15 areas of varying military use and habitat type throughout Camp Shelby. Camp Shelby is an Army National Guard training site of approximately 54,270 ha located in Perry, Forrest, and George counties, Mississippi. Three treatments were identified for sampling: ruderal habitat with military activity, ruderal habitat with no military activity, and forested habitat with no military activity. Sites with military activity (N = 6) were selected based on the presence of tracked vehicle maneuvers and resident tortoise colonies. These impacted sites consisted of ranges and firing points and included Range 45, the first site sampled at CSTS in 1995. Sites with no military activity (both ruderal [N = 3] and forested [N = 6]) showed no evidence of tracked vehicle activity, and in some cases were a considerable distance (> 20 km) from any military training activity. Areas without military activity varied from forests to food plots and powerline right-of-ways.

Tortoise burrows at each site were surveyed to determine size class and activity status (Alford 1980; Auffenberg and Franz 1982). Traps were placed at all active and inactive adult burrows. Tortoises were captured by placing a wire live-trap (81 x 25 x 18 cm) at the mouth of the burrow. The trap was shaded with burlap and covered with vegetation to minimize heat stress to trapped tortoises. Traps were checked twice daily. Upon capture, tortoises were evaluated for the presence of clinical signs and a variety of measurements were taken. Tortoises were permanently marked with a unique number by filing a series of notches in the marginal scutes (Cagle 1939). A blood sample was taken from the brachial sinus in the left forelimb. Approximately 0.5 cc of blood was collected and placed into a heparinized vacutainer. In 2001, a subset of tortoises (N = 13) were also sampled using both the culture and PCR diagnostic tests to try to detect the presence of an active *M. agassizii* infection. Nasal lavage samples were collected by flushing each nares with ca. 5 cc of sterile 0.9% NaCl and catching the fluid with a sterile collection cup. All samples (blood and nasal) were placed on ice until they could be transported to the office. All data were collected in the field and tortoises were released within a few hours of capture. Because of the infectious nature of URTD, all equipment was sprayed with a dilute (1:30) bleach solution after every tortoise was handled. All personnel handling tortoises wore rubber gloves and changed gloves before handling another tortoise.

Blood samples were centrifuged to separate the plasma from the red blood cells on the same day collected. Plasma was then drawn off, placed into a separate vial, and frozen. Both plasma and nasal lavage samples were placed into a non-frost free −11°C freezer. At the end of each summer field season, samples were sent to the University of Florida, College of Veterinary Medicine, Mycoplasma Research Lab for analysis. At the Mycoplasma Research Lab, blood samples were tested using an ELISA test to detect the presence of antibodies specific to the causal agent of URTD. Nasal lavage samples were tested using both the mycoplasmal culture and PCR diagnostic techniques as described in

TABLE 1. Summary of Gopher Tortoise ELISA testing for exposure to *M. agassizii* at Camp Shelby Training Site, Mississippi.

Site	Number of Tortoises	Military Use?	Habitat Type	Results
Firing Point 121	10	Yes	Ruderal	1 Suspect
Firing Point 68	11	Yes	Ruderal	Negative
Firing Point 72	11	Yes	Ruderal	Negative
Firing Point 140	10	Yes	Ruderal	Negative
Range 18	8	Yes	Ruderal	Negative
Range 45	4	Yes	Ruderal	1 Suspect
Leaf River WMA	10	No	Ruderal	5 Suspect
Dogwood Lake	8	No	Ruderal	2 Suspect
Ammunition Supply Point	2	No	Ruderal	Negative
T44 East	11	No	Forested	6 Suspect
T44 West	9	No	Forested	2 Suspect
Mars Hill	1	No	Forested	Negative
Cricket's Leap	8	No	Forested	Negative
Guyer	13	No	Forested	Negative
Deep Creek	8	No	Forested	Negative
TOTAL	**124**			**17 Suspect**

Brown et al. (2002). Samples were cultured prior to PCR analysis to increase the sensitivity of the assay. All test results were incorporated into the existing geographic information system (GIS) Gopher Tortoise database and will be used to track disease prevalence and distribution on CSTS.

During the 2001 and 2002 activity seasons (May–August), 124 tortoises were captured at 15 sites (Table 1). The number of tortoises captured at each site varied from 1–13 individuals. Of the 124 tortoises sampled for exposure to *M. agassizii*, there were no positive results; however, 17 tortoises were considered suspect (Table 1). Of the 17 suspect individuals, only two were associated with sites heavily impacted by military training. The remainder came from ruderal and forested sites not impacted by military training (i.e., no tracked vehicle maneuvers). Eight of twenty (40%) of the tortoises tested in Training Area 44 (T-44) had suspect results. Area T-44 is an 890-ha forested site that has been designated as a Gopher Tortoise refuge by the U.S. Forest Service (USFS) and the military. It consists of upland habitats dominated by Longleaf Pine (*Pinus palustris*) and is managed (by the USFS) primarily through prescribed burning. It is considered ideal tortoise habitat, and contains two of the largest Gopher Tortoise populations on Camp Shelby.

Only 16 tortoises exhibited clinical signs referable to URTD. The most common clinical sign observed was palpebral edema and swollen/red conjunctiva; nasal discharge has not been observed at Camp Shelby. The presence/absence of clinical signs did not predict exposure status. Of the tortoises observed with clinical signs, only three had suspect results for exposure to URTD. Similarly, of 17 tortoises with suspect results, only three had any clinical signs of disease. Culture and PCR test results were all negative. Of 13 tortoises tested using culture and PCR, there was only one with a suspect ELISA result and this tortoise had no observable clinical signs of URTD.

No Gopher Tortoises in this study tested positive either for exposure to, or infection by, *M. agassizii*. These data coupled with earlier studies (Epperson and Heise 2001) suggest that URTD is not currently a serious problem at Camp Shelby. Earlier studies in Mississippi (Smith et al. 1998; Thomas and Blankenship 2002) had mixed results. Thomas and Blankenship (2002) conducted an URTD study in association with a relocation project for a gas pipeline (Thomas and Blankenship 2002). They tested 26 tortoises in a five-county construction corridor as well as tortoises in the associated right-of-way. Of those tested, all were seronegative with the exception of one suspect individual that was later re-tested and found to be seronegative. Only one tortoise was observed with clinical signs of URTD, and it was ELISA negative and was later recaptured and no clinical signs were observed. Conversely, sampling of 16 tortoises by Smith et al. (1998) at the Marion County Wildlife Management Area in southern Mississippi resulted in 15 tortoises testing seropositive for exposure to *M. agassizii*. Tortoises were from forested areas open to the public and none exhibited any signs of clinical disease. Overall, these data suggest that URTD is not currently widespread in Mississippi.

McLaughlin et al. (2000) suggest that severe environmental stress (e.g., drought, hurricanes, extreme temperatures, etc.) as well as anthropogenic stress (e.g., habitat loss, relocation, pollution, disturbance) may cause sufficient physiological stress in some tortoise populations to trigger a proliferation of the mycoplasma and a recurrence of clinical signs. Gopher Tortoises are present on 19 military installations in the southeast (Wilson et al. 1997) and it is possible that military activities (i.e., anthropogenic stress) may impact disease prevalence. The potential impacts of military training on Gopher Tortoise populations can be both direct and indirect. Direct impacts include mortality, relocation, and habitat loss. Indirect impacts include habitat alteration/degradation and increased disturbance from training activities. The indirect impacts are harder to quantify as tortoise behavior may be modified in areas where training activities occur (Guyer et al. 1996). The physi-

ological impacts of modified behavior, as well as the associated direct impacts (e.g., pollutants, smoke, noise, etc.) from military activity on a site may act as a source of stress for some tortoise populations. Results from this study suggest no significant relationship between military training and increased exposure prevalence in Gopher Tortoises at Camp Shelby.

To monitor the overall health of a population, repeated sampling of individuals within the population is suggested (Brown et al. 1999). Individual tortoises may have considerable variation in antibody levels, particularly those close to the borderline cut-off values. Changes in the percentages of ELISA positive animals within a population could precede the appearance of clinical disease and provide an early warning of potential disease outbreaks in some populations (Brown et al. 1999). Serological testing is particularly important as URTD is usually clinically silent (i.e., no clinical signs). The data collected in this study, as well as earlier sampling at Camp Shelby, will provide a baseline exposure assessment against which further data can be compared.

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Pseudotriton ruber (Red Salamander). USA: Virginia: Greene County. Photographic illustration by Will Brown (www.blueridgebiological.com).

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Results of a Herpetological Survey in Ghana and a New Country Record

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The West African country of Ghana has a diverse herpetofaunal assemblage of more than 220 species (Hughes 1988). Ghana is environmentally heterogeneous (Lawson 1968). Although some species have broad distributions, others occur in more specialized vegetative zones (e.g., semi-deciduous forest, coastal thicket, or savannah woodland), offering great potential for studying geographic diversity at varying spatial scales. Myers et al. (2000) identified the Upper Guinean Forest that stretches into Ghana (excluding the Dahomey Gap, an area of savannah woodlands that interrupt the forest) as one of the 25 biodiversity hotspots and conservation priorities on the planet. Thus, it is surprising that Ghana has received so little attention in terms of herpetological research.

Methods

I conducted a herpetological survey of three study sites in Ghana during the dry season from 6–29 March 2003. These survey sites represent savannah woodland, semi-deciduous forest, and coastal thicket vegetative zones as defined by Lawson (1968; Fig. 1). Locality information and habitat descriptions of each survey site are provided in the following sections.

Specimens were found by visual encounter surveys (Heyer et. al. 1994) supplemented with acoustic searching, turning rocks and logs, peeling bark, digging through leaf litter, and excavating burrows. Surveys were conducted during the day and night. Specimens were collected by hand or blowgun (using blunt, plastic plugs as ammunition), and snake tongs were used to capture poisonous snakes. Sex, SVL, tail length, tail condition (complete, regenerated, or broken), weight, date, time, and reproductive condition and habitat (qualitative assessments) were recorded for each specimen. Up to ten individuals of each species were collected at a survey site, and all species encountered are recorded in Table 1. Tissue samples (liver) were flash frozen in liquid nitrogen for future genetic studies. Geographic coordinates for each survey site were determined in the field with a Garmin GPS 72 receiver. Coordinates were recorded as latitude and longitude in decimal degrees, and referenced to the WGS84 (World Geodetic System of 1984) datum. The number series of field tags associated with specimens is ADL 504–825 (Adam D. Leaché, personal field series). Voucher specimens and tissue samples are deposited at the Louisiana State University Museum of Natural Science (voucher specimen catalog series LSUMZ 86813–87134, frozen tissue collection series H20026–H20347).

Survey Sites

Savannah Woodland Site—The savannah woodland site was located in the Northern Region, 2.5 km SW of Buipe by dirt road (08.76877°N, 001.47732°W, 102 m elevation) and surveyed during 6–15 March. Most amphibians collected from this site were found on the margins of one small pond located 1 km N of camp, and the rest were collected along the northern edge of the Black Volta River, 0.5 km S of camp.

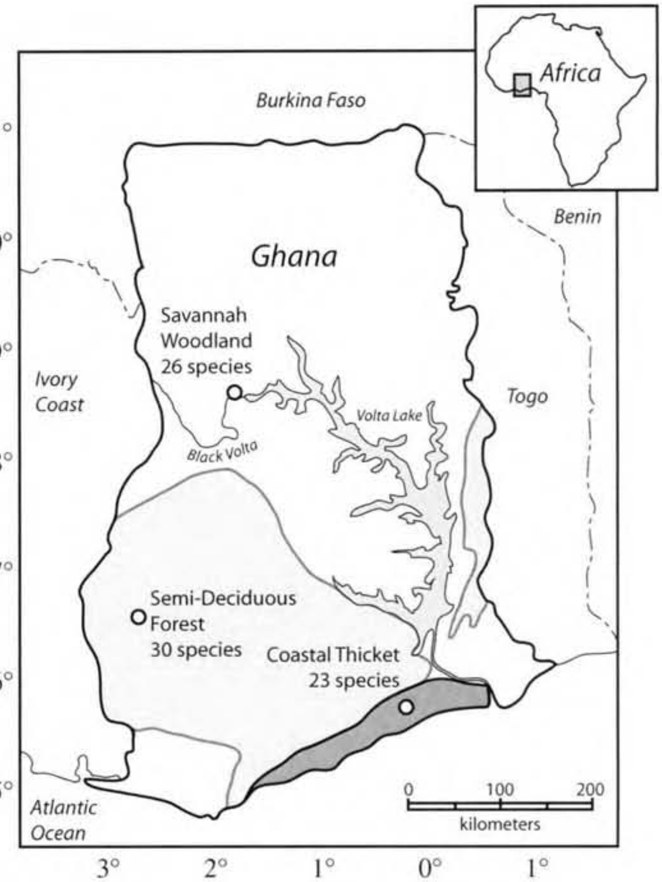

FIG. 1. Maps of Africa (inset) and Ghana (including neighboring countries) illustrating the vegetative zones (Lawson 1968), survey sites (indicated by open circles), and number of species recorded for each survey site.

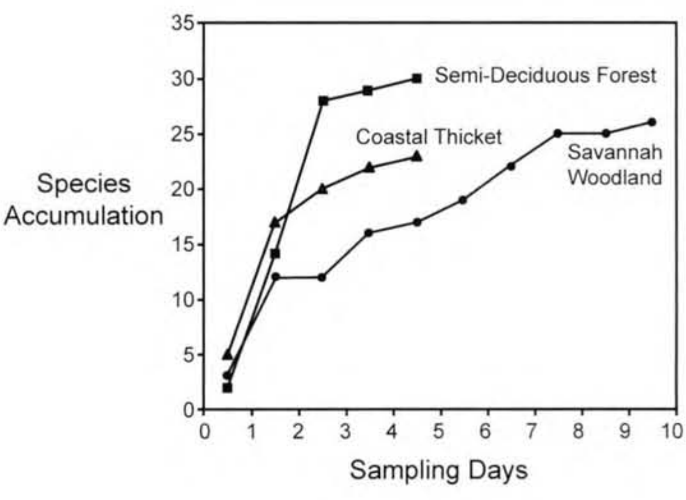

FIG. 2. Species accumulation curves of reptiles and amphibians sampled at the savannah woodland, semi-deciduous forest, and coastal thicket survey sites.

Semi-Deciduous Forest Site—The semi-deciduous forest site was located in the Brong-Ahafo Region, 26 km SW of Goaso (by road to Asumura), along the boundary line between Subim and Ayum Forest Reserves (06.70149°N, 002.07614°W, 101 m elevation) and surveyed during 17–21 March. The site included a mixture of cocoa plantations, urbanized area, and semi-deciduous forest. Although small ponds were present on the margins of the cocoa plantation and urbanized area, forest streams were dry during the survey. The site received a brief rain shower on the evening of 19 March, but it did not result in any water accumulation. Most amphibians were found in disturbed habitats along the margins of the cocoa plantations, but a few were restricted to the semi-deciduous forest

Coastal Thicket Site—The coastal thicket site represents three geographically proximate collecting areas in the Greater Accra Region, 26 km N of Accra, near Amrahia (05.76308°N, 000.10797°W, 87 m elevation), 34 km N of Accra (05.83910°N, 000.10850°W, 62 m elevation), and 55 km NE of Accra, near Nyibena (05.85287°N, 000.25972°E, 44 m elevation). These sites were surveyed during 23–29 March. Small ponds were present at the sites 26 km and 34 km N of Accra and were surveyed during the day and night. These sites received substantial rain on the night of 25 March. The site 55 km NE of Accra was devoid of any water and was only surveyed during the day.

Results

I found relatively equal numbers of species at the survey sites and recorded 26 species in the savannah woodland, 30 in the semi-deciduous forest, and 23 in the coastal thicket. Relatively more anurans were recorded in the semi-deciduous forest and coastal thicket compared to the savannah woodland, and the savannah woodland contained more snakes and turtles (Table 2).

The following LSUMZ specimen represents a new record for Ghana, based on the checklist of the reptiles and amphibians of Ghana (Hughes 1988). Jeff Boundy (Louisiana Department of Wildlife and Fisheries) verified the specimen identification.

Panaspis nimbaensis (Mt. Nimba Snake-Eyed Skink). Brong-Ahafo Region, 26 km SW of Goaso (by road to Asumura), along the boundary line between Subim and Ayum Forest Reserves (06.70149°N, 002.07614°W, 101 m elevation). 18 Mar 2003. LSUMZ 86975, tissue number H-20188, ADL 666. 68 mm SVL, 54 mm tail length (regenerated), 3.7 g. Found in a cocoa plantation adjacent to semi-deciduous forest. Captured by hand under a rotting log surrounded by leaf litter at 1000 h.

Discussion

Only a few surveys have focused on the reptile and amphibian diversity of Ghana. Schiøtz (1964), Leston and Hughes (1968), Raxworthy and Attuquayefio (2000), and Rödel and Agyei (2003) provided detailed information for particular localities and/or taxa, and Hughes (1988) presented a comprehensive checklist for the country. These authors concluded that the herpetological diversity of Ghana is underestimated. Raxworthy and Attuquayefio (2000) surveyed the herpetofaunal community at Muni Lagoon during the peak of the rainy sea-

TABLE 1. Summary of species collected and cumulative species count for each survey site. Numbers refer to specific habitat types and collection localities within the three survey sites (described in the text) and are defined as follows: 1. Savannah woodland, 2. Small pond, 3. Edge of Black Volta River, 4. Semi-deciduous forest, 5. Cocoa plantation, 6. Urbanized area, 7. Small ponds in disturbed areas, 8. Coastal thicket 26 km N of Accra, 9. Coastal thicket 34 km N of Accra, 10. Coastal thicket 55 km NE of Accra. Species collected from new vegetative regions (but not necessarily new habitat types) compared to Hughes (1988) are denoted with an asterisk symbol (*). *Phrynobatrachus* sp. 1 appears to belong to an undescribed species in Rödel (2000).

	Savannah Woodland	Semi-Deciduous Forest	Coastal Thicket
ANURA			
ARTHROLEPTIDAE			
Arthroleptis variabilis		4*	
Arthroleptis sp.		4	
BUFONIDAE			
Bufo maculatus		7	8, 9
B. regularis	2, 3	7	8, 9
HEMISIDAE			
Hemisus sp. (aff. *guineensis*)		7	9
HYPEROLIIDAE			
Hyperolius concolor		7	
H. nitidulus			9
Kassina senegalensis			8, 9
Leptopelis viridis		4*	8, 9
MICROHYLIDAE			
Phrynomantis microps			9
PIPIDAE			
Silurana tropicalis		7	
RANIDAE			
Amnirana galamensis	2, 3		9
Hoplobatrachus occipitalis	2, 3	7	8, 9
Phrynobatrachus accraensis		7	
P. francisci	3		
P. latifrons	3		
P. natalensis			9
P. sp. 1		4, 7	
P. sp.		4	
Ptychadena bibroni	2, 3		9
P. mascareniensis		7	8
P. oxyrhynchus	3	7*	8
P. tellini	2, 3		9
P. sp.	3	7	
LACERTILIA			
AGAMIDAE			
Agama agama	1	5, 6	8
GEKKONIDAE			
Cnemaspis spinicollis		4	
Hemidactylus brooki	1	6	
H. fasciatus		4, 5	
H. muriceus		5*	
H. mabouia			9
Hemitheconyx caudicinctus	1		
Lygodactylus conraui		5	
L. guttaralis	1*		
Tarentola ephippiata	1		
SCINCIDAE			
Mabuya affinis		5	9
M. albilabris	1*		

TABLE 1. *Continued.*

M. maculilabris		6*	
M. perrotetii	1		10
M. quinquetaeniata	1		
Panaspis nimbaensis		5*	
P. togoensis		5	
VARANIDAE			
Varanus exanthematicus			8, 10
SERPENTES			
ATRACTASPIDAE			
Atractaspis dahomeyensis			8
COLUBRIDAE			
Boiga blandingii		4	
Dasypeltis scabra			9
Gastropyxis smaragdina		5	
Lycophidion laterale		5	
Philothamnus irregularis	1		
Psammophis elegans	1		
P. phillipsii	1		
P. rukwae	1*		
ELAPIDAE			
Naja nigricollis			9
LEPTOTYPHLOPIDAE			
Leptotyphlops bicolor	1		
L. macrorhynchus	1*		
PYTHONIDAE			
Python regius	1		
VIPERIDAE			
Causus maculatus		5	
TESTUDINES			
PELOMEDUSIDAE			
Pelomedusa subrufa	2		8, 9
Pelusios castaneus	1		
TESTUDINIDAE			
Kinixys erosa		5	

son and found a maximum of 26 species at a site. Rödel and Agyei (2003) surveyed the amphibians of the Togo-Volta highlands in eastern Ghana and recorded 31 species. Both studies predicted higher species abundance at their study sites based on non-level species accumulation curves and prior collection records. In the present study of the savannah woodland, semi-deciduous forest, and coastal thicket sites, species accumulation curves failed to reach a plateau indicating that additional species remained to be recorded (Fig. 2).

Hughes (1988) provided a checklist of the herpetofauna of Ghana

TABLE 2. Summary of the number of species caught at the savannah woodland, semi-deciduous forest, and coastal thicket survey sites.

	Savannah Woodland	Semi-Deciduous Forest	Coastal Thicket
Frogs	9	15	14
Lizards	8	10	5
Snakes	7	4	3
Turtles	2	1	1
Total	26	30	23

that included undiscovered species, which were inferred to be likely inhabitants of the country. This list included *Panaspis nimbaensis*. This species is distributed throughout Gambia, Guinea, and Ivory Coast, and may have a broader distribution throughout the Upper Guinean Forest. It is likely that surveys of additional rain forest sites in Ghana will further extend the range of this species.

There has not been a rigorous study of the geographic diversity (molecular or morphological) of the widely distributed reptiles and amphibians of Ghana. Candidates for detailed studies of species that potentially occur in high abundance in Ghana include: *Bufo maculatus, B. regularis, Hoplobatrachus occipitalis, Phrynobatrachus accraensis, Ptychadena mascareniensis, P. oxyrhynchus, Agama agama, Hemidactylus brooki*, and *Mabuya affinis*. Additional candidate species occur throughout Ghana, but their low abundance (e.g., snakes) or seasonality (e.g., some anurans and *Chamaeleo gracilis*) make their collection more difficult. In addition, many widely distributed species are able to colonize degraded forest habitats and may be good indicators of habitat degradation (Rödel and Branch 2002; Branch and Rödel 2003). The new collection reported herein provides opportunities for pilot studies on the geographic variation and biodiversity sampling of the Ghanaian herpetofauna.

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Nest Switching in the Brown Toadlet (*Pseudophryne bibroni*): Do Males Use Chemical Signals?

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The view that vocalizations are the dominant form of communication in anuran amphibians has recently been challenged by papers reporting the existence of sexually attractive pheromones in aquatic breeding frogs (Pearl et al. 2000; Wabnitz et al. 1999). Pheromones in fecal pellets deposited on terrestrial substrates serve important roles in territorial defense and courtship in plethodontid salamanders (e.g., Jaeger and Gergits 1979), and in neighbor recognition in the voiceless, archaic frog *Leiopelma hamiltoni* (Lee and Waldman 2002). These and other studies have demonstrated that chemical communication is the most significant factor affecting social behaviors in voiceless amphibians. However, the function of chemosignals in anurans that also communicate acoustically remains enigmatic. Here I report observations of nest switching in a terrestrial breeding anuran, the Australian brown toadlet (*Pseudophryne bibroni*), and speculate that chemical cues may be involved in this behavior.

Pseudophryne toadlets are small, cryptic, terrestrial-breeding anurans characterized by aposematic ventral markings that warn potential predators of their toxicity (Williams et al. 2000; Fig. 1a). Male toadlets call from terrestrial sites that subsequently become flooded by seasonal rains, and mating occurs in subtle soil depressions constructed below leaf litter (e.g., Fig. 1b), or among grass roots or under rocks or logs. Occasionally, males call from discrete burrows, but nest sites are generally difficult to detect unless occupied by a frog or eggs.

During the course of a field experiment conducted in eucalyptus woodland in Watt's Gully Reserve, South Australia (see Mitchell 2001), six males occupied and called from nests that had previously been occupied by another male (Table 1). I was confident that the males that recolonized vacated nest sites were different individuals than the original male because toadlets are distinguishable by their unique ventral markings (Fig. 1a). None of the recolonized nests contained eggs, and the original occupant had vacated the nest up to two weeks before the second male occupied it. In particular, two features of the behavior were remarkable: first, some males moved up to 19 m to occupy a vacated nest (Table 1); and second, in most cases, males were calling from precisely the same location as the previous occupant (i.e., within 2–5 cm). Moreover, all nest sites were concealed beneath 5–15 cm of moist leaf litter, hence visual cues could not have been used to home in on the exact site.

In a separate case, a male toadlet called from a nest site used by another male in the previous breeding season (one year earlier). I was certain of the nest's location because the second occupant sat directly atop a 2 x 2 cm square of chromatography paper that I had inserted at the nest base the previous year during routine measures of nest water potential (the filter was still in place because I had been unable to relocate the nest). This nest was the third occupied by this particular male and was 55 m from the nest he occupied the previous year. The male moved a total of 46 m during the six-week breeding season, and the final nest he occupied was within 15 cm of another male's nest. Importantly, unlike other known cases of nest recycling (e.g., Kluge 1981; Mitchell 2002), nest sites were not obvious, nor were they a limiting resource: leaf litter piles were abundant and male densities were relatively low (between 1 male per 7 m^2 to 1 male per 76 m^2; Mitchell 2001).

While it is possible that males first identified a nest site while a satellite of a calling resident, and subsequently returned to the nest, it appears more likely that a chemical residue gave away the nest's

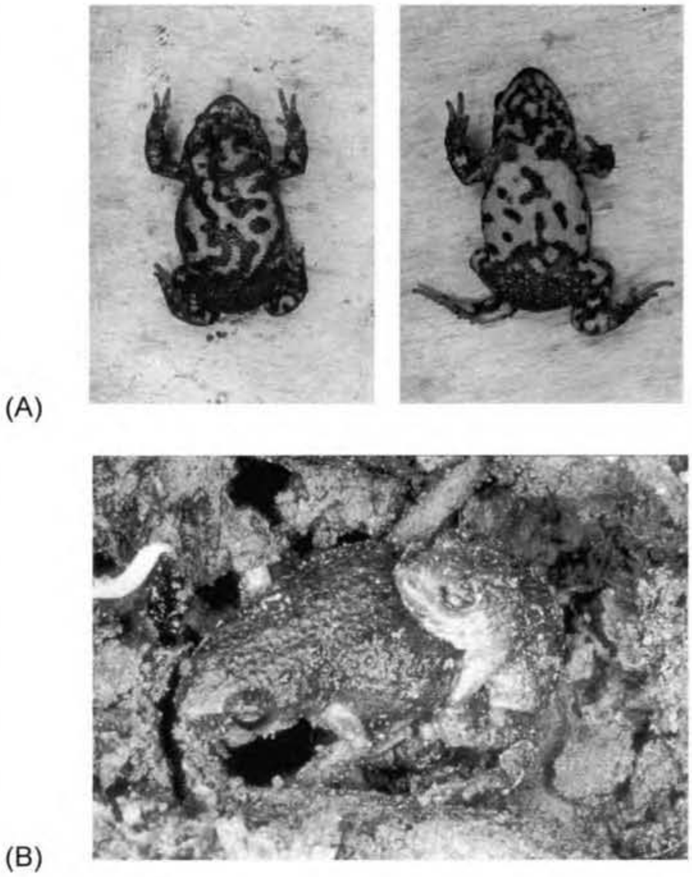

FIG. 1. A) Examples of the ventral markings of *P. bibroni* used for identification of individuals in the study; B) a *P. bibroni* pair in inguinal amplexus. The pair was buried beneath 15 cm of eucalyptus leaf litter, which was removed before the photograph was taken.

Table 1. Six cases where male *Pseudophryne bibroni* occupied a nest vacated by another male.

Nest	1	2	3	4	5	6
First male Identification Code*	98-20	99-M1	98-33	98-44	99-M1	98-8
Number of nights resident in nest	32	unknown	11	2	unknown	unknown
Number of call nights in first nest	13†	1	4†	2	1	1
Eggs in nest?	No	No	No	No	No	No
Second male Identification Code*	99-I1	98-23	99-M1	98-8	99-M3	99-O3
Distance moved from previous nest (m)	17.4	10.0	19.5	11.5	unknown	9.3
Number of nights resident in nest	15	2	12	26	3	1
Number of call nights in nest	13†	1	11†	16†	3	1
Eggs in nest?	No	No	Yes	No	No	No

* Photographs of ventral patterns were used to identify recaptured individuals. The first part of the identification code refers to the year a toadlet was first captured, and the second part to either the order of capture (1998) or an association with an experimental plot (1999 – see Mitchell 2001).

† A proportional estimate of the number of call nights, based on the number of nights during a male's residence that his call effort was monitored (on average, the chorus was monitored every 1–2 nights).

location. Recently, two classes of biologically active alkaloids have been isolated from granular skin glands on the dorsum of *Pseudophryne* toadlets: pumiliotoxins, which occur commonly in other frogs and toads, and pseudophrynamines, which are unique to the genus (Smith et al. 2002). Unusually, the latter compounds are biosynthesized (rather than sequestered from arthropod components of the diet), and *Pseudophryne* toadlets are the only vertebrates known to synthesize alkaloid poisons. These compounds presumably act as an antipredator mechanism, as toadlets are avoided by foraging snakes and have caused rapid death when mouthed (Shine 1987; White 1993).

In addition to dorsal glands, toadlets possess axillary and post-femoral glands that are not found in related genera (Woodruff 1972). These glands excrete copious quantities of odoriferous mucus when stimulated by light anaesthetization with ether; secretions from post-femoral glands are yellow, while secretions from other glands are colorless. Under natural conditions, male toadlets secrete mucus during calling bouts and amplexus, and are more odoriferous than females (M. J. Littlejohn, pers. comm., cited in Woodruff 1972). These observations imply that compounds produced in the skin may have a role in reproductive behaviors, but the chemical composition of these secretions is still to be characterized.

The crawling habit of *Pseudophryne* toadlets is suited to chemosensory communication in that a pheromonal trail is readily followed in complex habitats such as leaf litter where orientation may prove difficult. Male toadlets are thought to leave nest sites during the day to forage (Woodruff 1977), and may utilize chemosignals to return to their nest site. Limited data suggest that peptide pheromones are produced by aquatic amphibians and proteinaceous pheromones by terrestrial species (Houck 1998; Kikuyama et al. 2002; Rollman et al. 1999); certainly the chemicals involved in nest recognition in *Pseudophryne* must have low volatility to persist for such long periods in the field.

How might advertising from a previously vacated nest benefit a male toadlet? *Pseudophryne* toadlets are characterized by polyandrous matings; males may mate with up to three females within a single nest, usually over a period of 1–10 days (Woodruff 1976). In this study, however, recolonizing males were not exploiting a successful oviposition site, rather a subtle depression that had been vacated. A possible benefit to a recolonizing male was that it occupied a site where another male had made a calling investment. As male mating success is correlated with higher call investment (more call nights and higher call rates) in *P. bibroni* (Mitchell 2001), females apparently prefer males with a persistent acoustic signal and hence males may enhance their reproductive fitness by advertising from a nest in which a calling investment has already been made.

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Breeding Population Size of an Endemic Litter Frog, *Clinotarsus curtipes*, in the Western Ghats, South India

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Clinotarsus curtipes is a litter frog endemic to the forests of Western Ghats in the Indian states of Karnataka, Kerala, Tamil Nadu, and southern Madya Pradesh (Daniels 1997; Inger and Dutta 1986). Information on distribution (Dutta 1992), larval hormonal studies (Gramapurohit et al. 2000), and tadpole morphology and their habits (Daniel 2002; Hiragond et al. 2001) have been reported. Breeding occurs in perennial ponds and stream pools. Juveniles and adults forage in nearby canopy- covered forests (Daniel 2002). These frogs can be locally abundant in a particular habitat and might be considered an ideal species for population monitoring. For monitoring, it is essential to establish baseline population data. We examined the population size, survival rates between the successive capture periods, sex ratio and the adult limb deformation in a breeding population in secondary forests of the Western Ghats.

We studied the population biology of *Clinotarsus curtipes* in the Bisale Reserve Forest adjoining the Coorg Hills (12°15'N and 75°33'E), Karnataka State, South India. The study area was on the western slopes of the Western Ghats, ranging from 150–940 m elevation. The area is a tropical rainforest (annual average rainfall 5500 mm) with dense canopy cover and many perennial streams. Our study of breeding ecology and behavioral observations were conducted from May to July 2002 after the area received initial monsoon rains. The study pond was an oval-shaped tank, measuring about 20 m x 40 m. This pond was limited on two sides by a dyke (Fig. 1), on the third side by barren hill base, and on the fourth side by forest. This particular pond was also a breeding site for other frogs inhabiting the area, including *Rana aurantiaca, Rana temporalis*, and *Fejervarya limnocharis*.

A mark-recapture study was conducted at this pond to estimate the breeding population size of *Clinotarsus curtipes*. In order to sample the frogs that arrived at the breeding sites, four 10 x 10 m quadrats were delineated on the banks of the pond using nylon chords (Fig. 1). The sampling quadrats were positioned on all four sides of pond. For mark-recapture efforts five field assistants collected all frogs within each quadrat on 4 occasions, 31 August to 3 September 2002. To allow the frogs to mix thoroughly in the population, a time interval of about 20 h was maintained between each sampling occasion. Captures were uniquely toe-clipped (Donnelly et al. 1994), sexed, and measured (SVL). The recaptures were recorded and released. Individuals of this species are known to be sluggish in movement and were never observed to move by our field disturbances. We analyzed the capture data using the open test model program JOLLY (Hines 1988) for estimating the size of the breeding population.

We observed that these frogs entered and exited the pond from the forest side. The forest was a 40-ha plot with two 4-m wide perennial streams. To estimate the abundance of these frogs in the forest, we placed one 2-m wide by 1080-m long transect line in this forest habitat (Jaeger 1994). The line was positioned in such a way that it transected the entire forest habitat area potentially used by frogs: the transect line began at the pond edge on the forest

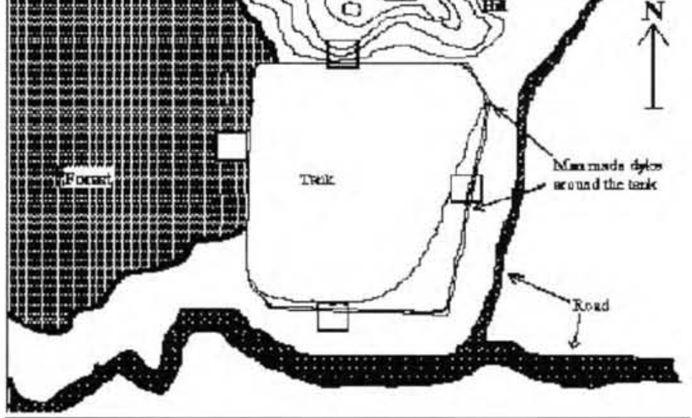

FIG. 1. Schematic representation of the traps placed around the tank for capturing *Clinotarsus curtipes*.

TABLE 1. Forest floor anurans sampled during the wet season in the forests of Bisale, Western Ghats, South India.

Species	Number of frogs	Relative abundance (%)
Bufo melanostictus	118	9.37
Indirana beddomii	285	22.65
Fejervarya limnocharis	285	22.65
Philautus sp.	44	3.49
Polypedatus pseudocruciger	3	0.23
Clinotarsus curtipes	450	35.93
Rana temporalis	66	5.24
Rhacophorus malabarica	5	0.39
Total	1258	100.00

side and passed through the forest, perpendicular to the pond edge. A total of 67 transect samplings of forest floor were conducted during the wet season (late May–October). The sampling was done from 0600–0800 h and 1700–2100 h when the species was known to be active.

Our forest floor line transect survey indicated that *Clinotarsus curtipes* was the most abundant species in our study area (35.93% of all captures, Table 1). Adults were found in the litter under forest canopy and moved towards the pond only during the breeding season. Breeding began in July and lasted until September, coinciding with the southwest monsoon season. Males called from diurnal retreats and emerged at the breeding ground on cool (20–21.5°C) and humid nights (relative humidity ca. 95%). A large chorus of litter frogs arrived at the pond for breeding at dusk (1820–1730h) during the breeding season. The juveniles synchronously emerged from the rearing sites during late May to early June and entered the adjoining forests. The newly emerged frogs were 15–18 mm SVL (mean 16.5 ± 2.3 mm; N = 94) and the breeding females grew to a maximum of 68.5 mm SVL (mean 59.19 ± 4.2; N = 38). Male frogs measured 41.6–51.4 mm SVL (mean 46.23 ± 2.3 mm; N = 40).

Our observations were similar to the reports by Daniel (2002). Adults arrived at the breeding sites during the night, emitted calls and were actively engaged in searching for mates. During the day they retreated to mud crevices or rocky hideouts. The total frog count at the breeding site varied from day to day. The closure test performed using the CAPTURE program (Otis et al. 1978) indicated that the breeding population of *C. curtipes* was not closed. It is understandable that there is a back-and-forth daily local movement among adults. Hence, we selected the open model JOLLY for analyzing data that uses daily survival rates for estimating the population size.

We captured 246 frogs and had 46 recaptures during four sampling days at quadrats. No frogs were retained or died during the study. We observed a male-biased sex ratio (6.5 males: 1 female) and 0.8% (2 of 246) limb deformity among the adult *C. curtipes*. The mean breeding population size estimates ranged between 345 and 452 (Table 2). Looking at the goodness-of-fit values, the data seem to fit all the Jolly models. Comparison of the general model (model A with both death and immigration) with the reduced parameter model (model D - constant survival rate per unit time, constant capture probability) showed that the extra parameters of model A are not justified for these data ($\chi^2 = 4.4372$, df = 3, p = 0.2). Therefore, we selected model D as the most parsimonious for the estimation of population size (range 107.97–736.17; mean 422 frogs), where survival and capture probabilities are assumed constant over time (Table 2). The survival rate between each period was 85% and the capture probability was 21%. The mean estimate of marked individuals at each capture period was 81.13 (± 30.54) and the mean number of new individuals arriving at the breeding site during each capturing occasion was 90.26 (± 51.89).

For forest frogs, such as *Clinotarsus curtipes*, vegetation and forest cover are needed for post-breeding dispersal (Osawa and Katsuno 2001). As *C. curtipes* depends on a large water body for breeding, the water source should be maintained in forest habitat for reproduction. The adult feeding grounds are canopy-covered forests where they feed on low flying insects like fruit flies (SNK, pers. observ.). We observed adults and juveniles entering and exiting the pond from the forested side. Thus, proximity of a breeding site to forest appears important for this frog. In the case of the forest frogs *Rana japonica* and *R. ornativentris* in Tama Hills, Japan, the dispersal was within 500 m of the breeding site and hence, a wide forest patch in a radius of about 300 m was recommended to be preserved for those species (Osawa and Katsuno 2001). Although we do not know the exact distance traveled by *C. curtipes* from the spawning ground, we have captured them at the maximum distance of 1008 m away from the breeding site. From our observations, we suggest that for such forest frogs, it is not only necessary to conserve a water source for breeding but also the forest habitats for their non-breeding activities and survival. Long term monitoring is required to study population fluctuations and the effect of human disturbance on their feeding habitat and the breeding sites. One of the major causes of anuran population decline around the globe is habitat destruction (Richards et al. 1993). Therefore it can be hypothesized that the habitat de-

TABLE 2. Goodness of fit test value and the estimated population size (N) for a breeding population of *Clinotarsus curtipes* at a pond in Bisale, Western Ghats, India. PHI is the survival rate between the sampling occasions, P is capture probability, M is the estimated number of recaptures and B is the estimated number of new captures.

Parameter	Chi-square (df)	p	PHI%(SE)	P% (SE)	M (SE)	B (SE)	N (SE)	95% CI
Model A	1.30 (3)	0.72	93.44 (16.35)	24.18 (12.84)	56.66 (11.89)	162.53	345.15 (86.80)	175.01–515.28
Model D	5.73 (6)	0.45	85.45 (11.82)	21.31 (4.6)	81.13 (30.54)	90.26 (51.89)	422.07 (160.25)	107.97–736.17
Model B	2.77 (4)	0.59	94.86 (17.16)	21.89 (0.55)	97.01 (45)	169.36 (78.23)	452.64 (210.71)	39.64–865.63

struction as a result of water diversion projects and pipelines in these forested areas would impact the breeding sites and the canopy covers that are vital for *C. curtipes* survival. Long-term demographic assessments are important because they provide quantitative measures to assess status and trends to guide management of species and habitats in these forests.

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Raising Semi-Terrestrial Tadpoles of *Nannophrys ceylonensis* (Anura, Ranidae) in the Laboratory

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Although uncommon, anuran species with semi-terrestrial larvae have evolved independently in at least six anuran lineages. In all cases the species have very restricted ranges. Survival of some of these species may ultimately depend on captive breeding programs. However, standard methods for raising terrestrial tadpoles have not been established.

We raised semi-terrestrial tadpoles of *Nannophrys ceylonensis*, a threatened ranid frog endemic to Sri Lanka (Bambaradeniya and Samarasekara 2001). We investigated the growth conditions and intraspecific interactions of these tadpoles, including interference competition and cannibalism. We describe larval feeding behavior on various types of food and document differences in microhabitat use among tadpoles at different stages and sizes in the laboratory. We also report on aspects of egg hatching in the laboratory. To our knowledge this is the first account of rearing semi-terrestrial tadpoles under artificial conditions.

Nannophrys ceylonensis is found in restricted locations in the lowland wet zone of Sri Lanka. We collected 42 eggs and 68 tadpoles (Gosner stages 25–45; Gosner 1960) of *N. ceylonensis* from exposed, vertical, wet rock surfaces within a mixed secondary forest close to the Man and Biosphere Reserve at Labugama (06°51'N, 80°11'E; 150 m elev.) and Waga (06°54'N, 80°07'E; 140 m elev.) in Colombo District.

Eggs and tadpoles of *N. ceylonensis* are most abundant during the rainy season (May–June and October–December), and we collected the eggs and tadpoles during this time. We used two dry leaves to gently lift tadpoles and eggs from the rock and transported them to our laboratory at the Department of Zoology, University of Colombo, in containers with a thin film of water (2–3 mm) and some moss collected from the rocks.

Tadpoles and eggs were housed in glass tanks (35 cm long x 16 cm wide x 20 cm high) covered with nylon mesh to exclude insects. About 30 ml of aged tap water were added to each tank

housing tadpoles. Every two days, 75% of the water was removed and replaced with fresh aged water. The tanks were kept at an angle of 20–30°, such that the water accumulated at one end (maximum depth: 5–6 cm), leaving the other end dry. Tadpoles kept without water showed stress behaviors within 2–3 min, such as abnormal writhing movements and jumping. This is an unusual behavior for these tadpoles in the laboratory but similar to their escape response when attacked by predators in the field. Stones (height 5–7 cm, surface area 40–45 cm^2) were brought from the field sites, and one was placed in the water in each tank to provide hiding and perching spots for the tadpoles. We also added pieces of twigs, aquatic macrophytes, and pieces of clay pots for the same purposes. In the tanks housing eggs, the eggs were placed on top of wet moss.

The tanks were placed next to windows to maintain a natural photoperiod. The temperature and relative humidity in the laboratory simulated natural conditions, and ranged from 27–31°C and 74–82% respectively.

Cannibalism and tadpole density.—High larval density is known to increase aggressive interactions among amphibian larvae (Reques and Tejedo 1996), such as biting behavior (Summers and Symula 2001) and cannibalism (Nyman et al. 1993; Summers and Symula 2001). In a pilot experiment, we stocked two tanks with seven tadpoles (all Gosner stage > 37) each. After two days, two tadpoles from one tank and three from the other had been cannibalized. The larger, more active tadpoles preyed on the smaller and less active ones (N = 5, predator snout–vent length [SVL] range: 7.3–7.9 mm, prey size range: 6.0–6.2 mm SVL). The predatory tadpoles typically directed their attacks first at the smaller individuals' tail tip. Once a considerable part of the tail was eaten, the smaller tadpoles were immobilized and became increasingly vulnerable to attack. Tadpoles with damaged tail tips also were observed in their natural habitats.

After the pilot experiment, we adjusted the number of tadpoles housed in each tank according to developmental stage: 1) young larvae (Gosner stages 25–31, three individuals in each of 7 tanks); 2) "mature" larvae (Gosner stages 32–40, three tadpoles in each of 7 tanks); and 3) metamorphic individuals (Gosner stages 41–45, three tadpoles in each of 4 tanks). Our observations of dietary preference, intraspecific competition, and microhabitat use for these tadpoles were made concurrently over 10 consecutive days.

Dietary preference.—We presented the tadpoles with ten different foods: powdered commercial dog food pellets, powdered fish meal, yeast suspension, raw chicken liver, live *Tubifex* worms, boiled egg yolk, boiled *Amarantus* leaves, powdered dried fish, powdered dried shrimp, and algae scraped from rocks in the natural habitat. Only one food was presented to the tadpoles at a time. Feeding behavior involved three consecutive stages: 1) *orientation*—movement towards the place where the food was added; 2) *contact*—the contact of the tadpole's snout with food particles (usually occurring within 3–5 sec of orientation), and 3) *ingestion*—taking food into the buccal cavity by movements of the jaws. Feeding (i.e., orientation, contact, and occasionally ingestion) lasted 15–75 sec in duration, and occurred in discontinuous bouts. The duration of feeding bouts was independent of the quantity of food available; feeding was intermittent even when excess food was present. Three food items (raw chicken liver, *Tubifex* worms, and boiled egg yolk) elicited orientation and contact, but were not ingested. Dog food, powdered fish meal, yeast suspension, boiled *Amarantus*, and powdered dry fish never stimulated orientation or contact. Only two items, algae and powdered shrimp, were readily eaten by tadpoles at all larval stages.

The most effective food for tadpole growth was powdered dried shrimp. Fresh shrimps were oven dried for 12 h and then ground with a mortar and pestle. This powder was passed through a mesh sieve to separate the finer particles (< 2.5 mm), which were kept in an airtight container to prevent rehydration and decomposition. Maximum growth was achieved when every two days an amount of shrimp powder, about 5–10% of the body weight of the tadpoles, was mixed with a few drops of aged water and placed at the higher end of the tank, right at the glass-water interface. Uneaten particles were removed from the tank after 30 min to avoid polluting the water. Once a month the shrimp powder was supplemented with a pinch (i.e., 2–5 mg) of multi-vitamin powder (Unical Multi-Vitamin Powder, Unical Ltd., [Ceylon] Sri Lanka).

If the food floated on the water surface, the tadpoles did not eat it. Tadpoles of all stages scraped the surface of the tank and the stone with their beaks, presumably in search of food, but the most food was eaten at the shallow border between the water and tank bottom.

Relatively little information is available on the natural diets of tadpoles (Hoff et al. 1999) and none is known for semi-terrestrial tadpoles. In their natural habitat *Nannophrys* larvae eat algae, mosses, and microscopic animals that are found on the rocks (Wickramasinghe, pers. obs.). However, later stage larvae also consume more rotifers, nematodes, and microscopic arthropods than do younger tadpoles.

The size of the food particles plays a major role in tadpole foraging. Seixas et al. (1998) reported that a particular food particle size (0.5 mm) resulted in the best tadpole growth in *Rana catesbeiana* larvae. We found that *N. ceylonensis* tadpoles, which are one to two orders of magnitude smaller than *R. catesbeiana* larvae, appeared to prefer particles < 2.5 mm.

Intraspecific competition.—Larger tadpoles (Gosner stage = 32) displayed dominance during feeding. If the tadpoles in one tank were of disparate sizes, the larger individuals were the first to approach the food. Individual tadpoles would curl their tail around a food patch, thereby preventing access to the food by smaller tadpoles. The tadpoles did not exhibit this circling behavior in the absence of other tadpoles. At least 3–4 min after the larger tadpoles finished eating the small ones were able to approach the food. However, when food was placed at more sites than there were tadpoles the smaller tadpoles faced no opposition to food access from larger conspecifics.

Wassersug (1975) reported that successful competition for food was directly related to the size of tadpoles; large tadpoles often dominated smaller ones when feeding. Savage (1961) reported foraging dominance of larger *Bufo bufo* tadpoles over smaller conspecifics in a pond. Similarly, in *R. catesbeiana*, smaller tadpoles were displaced by larger tadpoles in captivity when provided concentrated non-planktivorous food (Flores-Nava and Vera-Muñoz 1999). The larger tadpoles in that study "guarded" food by continuous movements around the food patches, thus keeping food out of reach of the smaller individuals. A similar behavior was shown by tadpoles of *Limnonectes kirtisinghei* in the laboratory (Wickramasinghe et al. 2001). We also observed the food circling

behavior of larger *N. ceylonensis* tadpoles in their natural environment.

Microhabitat use.—One of the purposes of our experiment was to determine the location (i.e., the microhabitat) in the tank preferred by the tadpoles for resting. On each study day, all three tadpoles in each tank were observed for a 2-minute period followed by another 2 minutes 45 minutes later. If any tadpole spent more than 75% of the 2-min observation period at a single location in the tank, this was recorded as the preferred resting microhabitat for that tadpole.

Microhabitat preference for tadpoles that moved continuously during the observation period was not recorded. For each developmental group the total number of tadpoles that rested in each tank position was summed and averaged. These numbers were then averaged over the 10-day study period (Table 1).

TABLE 1. Microhabitat selection by three developmental groups of *Nannophrys ceylonensis* tadpoles observed at two time intervals. Those tadpoles that moved continuously during the 2-min observation period are not included. Ratios in parenthesis represent the number of resting tadpoles out of the total number of tadpoles in all tanks.

Developmental Group (Gosner stage)	At time zero	After 45 min
Young (25–31)	Under a pebble (17/21)	Under a pebble (11/21)
"Mature" (32–40)	At tank-water interface (16/21)	Under a pebble (11/21) and at the tank-water interface (10/21)
Metamorphic (41–45)	At tank-water interface (10/12)	At tank-water interface (12/12)

The most common resting position was either under the submerged pebble or at the shallow tank-water interface. Tadpoles were not found on the pebbles. In the initial observation period, at time 0, some tadpoles from each developmental group were continuously moving; however, after 45 min all tadpoles post stage 32 and metamorphosing individuals were found resting. Microhabitat use by anuran larvae that changes with their growth, development and habitat quality has been reported for other species (Alford 1986; Schley et al. 1998; Vences et al. 2000). Aquatic tadpoles typically select a preferred position in the water column (e.g., Eterovick and Sazima 2001), but stationary *N. ceylonensis* tadpoles were always in contact with surfaces. Tadpoles in our experiment selected different microhabitats in the laboratory depending on their developmental stage. Tadpoles below stage 32 preferred hiding under the pebble, whereas more developmentally advanced tadpoles were found exposed to the air at the shallow end of the tank. Half of the tadpoles in the Gosner stage 32–40 group also were found under the pebbles after 45 minutes.

Observations of tadpoles in their natural environment suggested similar stage-specific patterns of microhabitat use. In general, larvae below stage 24 remained in their nest, a rock crevice guarded by the father (Wickramasinghe et al., *in press*). Usually tadpoles of stages 24–32 also remained in close proximity (range 15–75 cm) to their nest, and tadpoles older than stage 32 moved as far as 1.7 m from their nest onto exposed rock surfaces.

Tadpoles hatched in the laboratory.—Tadpoles hatched at stage 21 from the eggs collected in the field after at least two days in the laboratory. They generally started feeding at stage 25. The total time from hatching to metamorphosis in captivity was 51–60 days. In general, excluding the cannibalism at high density, the tadpoles we collected from the field all remained in good health in the laboratory with the exception of four individuals in a single tank that died two days after the end of the experiment. These tadpoles were lethargic and did not eat the day before they died. After death, they appeared externally normal, but microscopic examination revealed fungal hyphae on their body surfaces.

In conclusion, semi-terrestrial tadpoles of *Nannophrys ceylonensis* can be raised until metamorphosis and eggs can be hatched successfully in a laboratory. A diet high in animal protein appears to be best for these larvae, consistent with dietary analysis of field collected individuals. Given the highly convergent ecology and morphology of semi-terrestrial tadpoles from around the world we are optimistic that a similar diet could be used to raise semi-terrestrial tadpoles of other species and genera.

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Dicamptodon tenebrosus Larvae Within Hyporheic Zones of Intermittent Streams in California

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Lotic ecosystems are increasingly viewed as having three interactive spatial compartments, i.e., channel sediments, the hyporheic zone, and flood plains or riparian areas (Cummins et al. 1983; Ward 1989). The hyporheic zone is the sub-benthic habitat of interstitial spaces between substrate particles in the stream bed, and is the transition zone between surface flow and ground water (Boulton et al. 1998; Stanford and Ward 1988; White 1993). Extensive use of the hyporheic zone by invertebrates has been reported (Smock et al. 1992; Williams and Hynes 1974), but aside from several accounts of nesting in the hyporheic zone (e.g., Dethlefsen 1948; Henry and Twitty 1940), little is known about amphibian use of this habitat. The objective of this paper is to describe incidental captures of Pacific Giant Salamander (*Dicamptodon tenebrosus*) larvae within the hyporheic zone of two seasonally intermittent streams while sampling for macroinvertebrates in the Prairie Creek Redwoods State Park, Humboldt County, California.

We conducted the study in two small intermittent tributaries of Godwood Creek that drain relatively undisturbed late seral redwood forest (*Sequoia sempervirens*), within 1 km of each other. We sampled lower, middle, and upper reaches in each tributary. Streambed substrate included significant river deposits of Klamath origin (Dolezel 1974), consisting of a range of particle sizes from sand (0.06–2.0 mm) and gravel (2.0–32.0 mm) to pebble (32.0–64.0 mm), cobble (64.0–256 mm) and boulder (> 256 mm). However, smaller particle sizes (sand and gravel) tended to dominate the substrate, particularly in the lower gradient reaches of these tributaries. Lower basin sample points were located as close to the confluence with Godwood Creek as was practical while assuring that they were several meters upstream from Godwood Creek's bank full winter flow. Each was ca. 10 m from the confluence. Upper basin sample points were chosen by walking both tributary channels in late July 1999 and selecting sites at the extreme upper limits of the mid-summer surface flow. Middle basin sample points were located approximately midway between the upper and lower sample points. Upper and lower sample points were ca. 400 m apart with an estimated 100 m elevation change. Total stream reach length was ca. 600 m.

At each sample point hyporheic well traps were constructed of 10-cm diameter PVC, cut at 1 m or 1.6 m lengths. One-meter traps were used to sample the hyporheic zone from 0 to -30 cm beneath the streambed, and 1.6 m traps were used to sample from -30 to -60 cm deep. Each trap had a perforated region of 1-cm diameter holes drilled at 2-cm intervals beginning 4 cm from the bottom (Fig. 1). The perforated region extended 30 cm, with one vertical row of holes in each quadrant around the pipe. The holes allowed hyporheic fauna to enter the trap from upstream, downstream, or lateral directions. The unperforated chamber at the bottom of each pipe provided a holding area for trapped animals. The bottom of each pipe was permanently capped to prevent the loss of captured animals. A removable cap on the above ground top of each trap prevented the entrance of terrestrial animals and debris.

One 0 to -30 cm trap and one -30 to -60 cm trap (Fig. 1) were deployed at each of the sampling points in the upper, middle, and lower region of both intermittent tributaries. Shallow well traps were placed so that the first trap entry hole was positioned ca. 3 cm below the streambed. Traps were allowed to fill with water and were pumped out repeatedly to remove mud that entered through the perforations during placement and backfilling. The traps were allowed to equilibrate *in situ* for six weeks before the first samples were collected. Samples were then collected from the traps once every six weeks for 62 weeks, from July 1999 to October 2000, for a total of 102 samples. Trapped macroinvertebrates and *D. tenebrosus* were removed from the wells with a 7.6 cm diameter Beckson utility hand pump. Six-liter samples were pumped from each trap to insure standardization of sample volume.

We found individual larval *D. tenebrosus* in 22 samples. Fifteen larvae were captured in the 0 to -30 cm traps and seven in the -30 to -60 cm traps. Larvae ranged from 39–83 mm total length (mean $\pm$ SE = 55.2 $\pm$ 2.6 mm). Similar numbers of salamanders were captured in each tributary, and captures occurred throughout the year and did not appear to vary with season. *D. tenebrosus* were captured in all three stream locations, although more were captured at the lower sites (9) than in the middle (7) or upper (6) sites. All *D. tenebrosus* captures occurred when surface flow was < 4 cm deep, and the majority of captures (18 of 22) occurred when there was no surface flow.

Larval *D. tenebrosus* might use hyporeic zones to forage, escape predation, or as refuge from declining surface flows. Our captures might have been limited to small larvae by the pore size of our traps, and larger *Dicamptodon* may use hyporheic habitats for other activities such as nesting (Dethlefsen 1948; Henry and

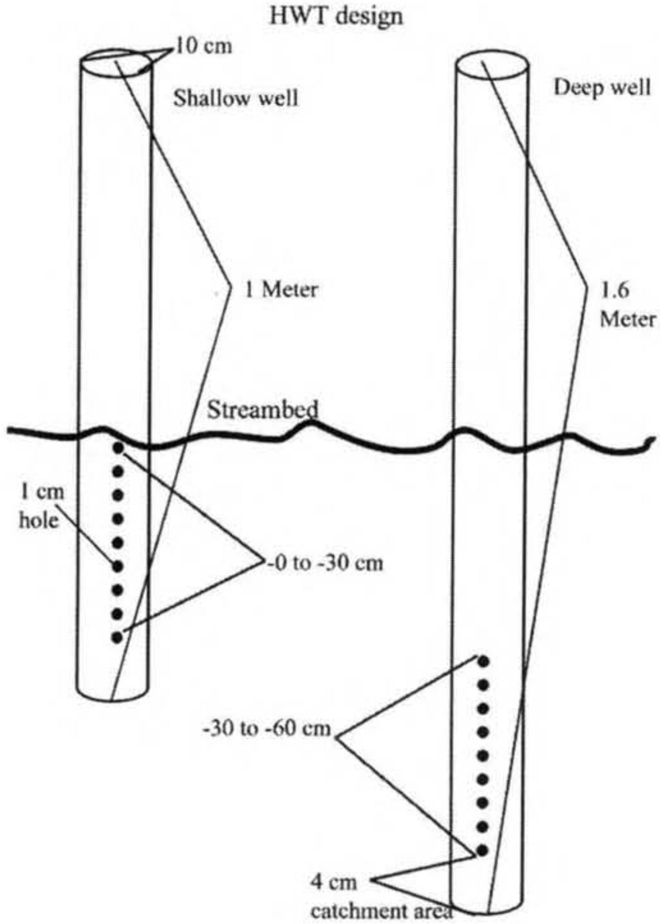

FIG. 1. Diagram of the hyporheic well traps for invertebrates designed for this study. Construction material was 10 cm diameter PVC pipe, permanently capped at the bottom and with a removable cap at the top to allow access for sampling.

Twitty 1940; Nussbaum 1969).

Our observations suggest that hyporheic zones might provide important and not previously recognized habitats for amphibians in intermittent headwater streams. Additional sampling is needed to better characterize hyporheic use by *Dicamptodon* and other stream amphibians such as the torrent salamanders (*Rhyacotriton* spp.). Better information notwithstanding, management regulations throughout the Pacific Northwest, particularly forestry protections for low order (headwater) stream courses, should include protections for these important spatially and temporally subterranean aquatic environments that are currently either unprotected or weakly protected (see Sheridan and Olson 2003).

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Instream Movements by Boreal Toads (*Bufo boreas boreas*)

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Determining the nature and extent of bufonid movements is critical to understanding the autecology of each species, as well as to developing effective conservation strategies. Within many toad (*Bufo* spp.) populations, individuals must migrate considerable distances to reach habitats essential for fulfilling requirements that change seasonally and ontogenically (deMaynadier and Hunter 2000; Sinsch 1990). Summer home range movements (*sensu* deMaynadier and Hunter 2000) are often necessary to allow individuals to meet multiple resource needs (e.g., food and thermoregulation sites; Zug et al. 2001). Documenting movement patterns helps biologists determine the nature, timing, spatial extent, and distribution of habitat use by a species. Moreover, understanding movements can be essential to predicting the population-level effects of some ecosystem alterations (e.g., habitat alteration, creation of barriers to movements, or introduction of predators along

travel corridors) and to planning habitat restoration that will conserve toad populations. Boreal Toads (*Bufo boreas boreas*) are declining throughout much of their range in western North America (Corn 2000); documenting their movement patterns may prove integral to understanding and arresting the declines.

Studies of toad movements often have documented long seasonal migrations and very limited summer home range movements, but the studies have focused on terrestrial travel and have not explored distances moved in aquatic habitats. Toads of many species make extensive movements, the longest are typically migrations up to several kilometers among spring breeding areas, summer foraging areas, and overwintering sites (deMaynadier and Hunter 2000; Kusano et al. 1995; Miaud et al. 2000; Sinsch 1988, 1990, 1992). Post-breeding movements within summer home ranges typically are restricted to several hundred meters (deMaynadier and Hunter 2000; Kusano et al. 1995; Sinsch 1988, 1990, 1992).

Several studies indicate that Boreal Toads, like other toad species, sometimes make long seasonal migrations (0.9–2.4 km; Bartelt 2000; Campbell 1970a; Muths 2003), but make considerably shorter summer home range movements (Campbell 1970b). Although metamorphosed Boreal Toads are considered "largely terrestrial" except during the breeding season (Nussbaum et al. 1983), they do occur along the edges of rivers and streams (Carpenter 1954; Olson et al. 1997; Robinson et al. 1998). Evaluating Boreal Toad travel via streams could enhance our understanding of home range size, dispersal distances and routes, and the effects of disturbance on dispersal (McGee et al. 2002). We evaluated instream movements in northern Rocky Mountain populations of Boreal Toads. Our objectives were to determine the prevalence, distance, and diel timing of summer movements by juvenile and adult Boreal Toads in three western Montana streams.

Materials and Methods.—In Summer 2001, we studied Boreal Toad movements in Chamberlain Creek, a second-order perennial tributary to the Blackfoot River, Powell County, Montana, draining 87.2 km^2 (Fig. 1). The study segment had channel slopes of 1.5–2.0%, a mean wetted width of 4.1 m, substrate dominated by gravel and cobble (2–64 and 64–256 mm diameter, respectively), and an elevation of 1180 m at its mouth. During the study, mean discharge was 0.09 m^3/s, and maximum water temperature was 17.3°C.

In Summer 2002, we studied movements in Little Blue Joint and Slate creeks, second-order streams in the West Fork Bitterroot River basin, Ravalli County, Montana (Fig. 1). Little Blue Joint Creek had a mean wetted width of 3.2 m, mean channel slope of 3.2%, median substrate particle size of 36 mm, and elevation of 1449 m at its mouth. The riparian zone adjacent to the study reaches in Little Blue Joint Creek burned in Summer 2000, but contained abundant coarse woody debris and lush regrowth of forbs and grasses in 2002. Slate Creek had a mean wetted width of 6.3 m, mean channel slope of 2.2%, median substrate particle size of 41 mm, and elevation of 1441 m at its mouth. Mature conifers and deciduous shrubs bordered the Slate Creek study reaches. Maximum water temperatures during the study were 17.9°C in Little Blue Joint Creek and 14.1°C in Slate Creek.

In both years, we captured Boreal Toads in streams using two-way weirs made of two hoop nets facing opposite directions that were connected to each other and to both banks by leads (0.5–4.0 m long). Hoop nets, constructed of multifilament nylon netting (0.6-cm bar length), were 2.0 m long. Minimum diameters of the funnels were 4.0–7.5 cm, and hoop diameters ranged from 30 to 38 cm, depending on stream size. We refer to the hoop nets that captured animals moving downstream as "downstream traps."

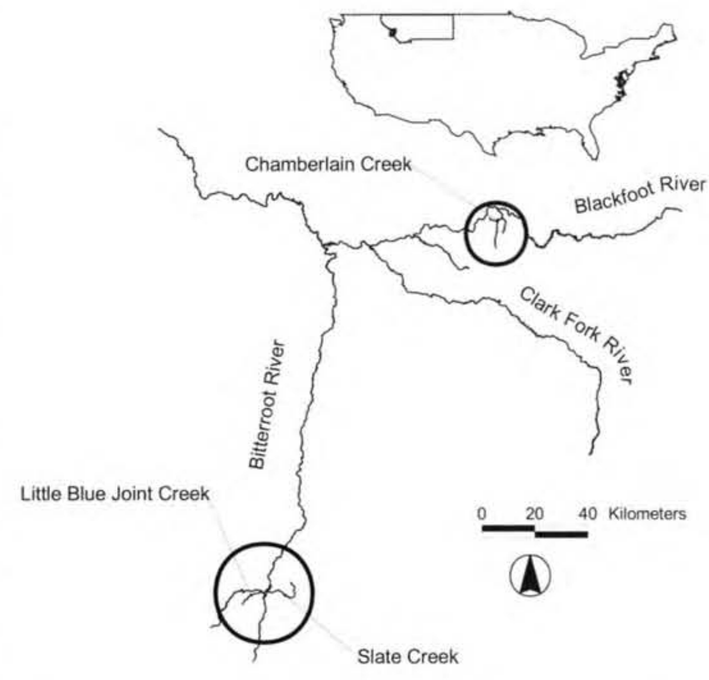

FIG. 1. Locations of the three study streams (circles) in western Montana, USA.

We operated the weirs in Chamberlain Creek from 23 July to 16 August 2001, except for 24 h beginning on 1 August during high stream flows. We divided the study segment into upper and lower sections, separated by a nonoperating, low-head diversion dam. On 23 July, we installed six two-way weirs, spaced 8–114 m apart (at least two riffle-pool sequences), in the upper section (Schmetterling and Adams 2004). On 30 July, we moved three of the weirs to the lower section and spaced them 16–18 m apart (one riffle-pool sequence). Three weirs in the upper section remained in place, so after 30 July, the six weirs encompassed 1.6 km of the creek. In all streams, we chose weir locations based on fish distributions and habitat features, but not on toad distributions.

During summer 2002, we operated eight weirs in both Little Blue Joint (11 July–16 August) and Slate (16 July–16 August) creeks. Spacing between weirs ranged from 185 to 2496 m, and weirs enclosed 4.5 km of Little Blue Joint Creek and 3.1 km of Slate Creek.

We checked all traps at least daily (except 5 August 2002), counted all and measured most boreal toads (snout–vent length, SVL) on a measuring board, and released toads in the direction they were moving when captured. To distinguish nocturnal or crepuscular from diurnal movements, we checked traps in mornings and evenings from 24 July to 1 August 2001 in Chamberlain Creek.

We distinguished juvenile from adult toads a posteriori based

TABLE 1. Number of juvenile and adult Boreal Toad captures and mean SVL (range) in three western Montana streams. Captures and mean lengths include multiple captures of individual toads.

Stream	Year	Juveniles		Adults	
		Captures	Length (mm)	Captures	Length (mm)
Chamberlain	2001	0	—	19[a]	93 (79–107)
Little Blue Joint[b]	2002	49	32 (24–47)	43	89 (67–110)
Slate	2002	21	31 (15–47)	119[c]	95 (55–125)

[a]Includes five captures of toads that were not measured but were known to be adults.
[b]One toad was not measured and is not included in counts.
[c]Includes one toad that was not measured but was known to be an adult.

on length. Length-frequency histograms showed two distinct groups; therefore, we classified toads < 55 mm SVL as juveniles and larger individuals as adults (Table 1; consistent with Nussbaum et al. 1983; Olson et al. 1986).

We marked adult toads with visible implant elastomer or acrylic paint on the ventral side of the mandible; most juvenile toads were too small to mark using this method. Although marks were unique to weirs, not individuals, we distinguished among marked individuals via a combination of marks, capture date, and SVL. In Chamberlain Creek, we marked all adult toads, beginning on the third day of trapping. In Little Blue Joint and Slate creeks, although we recorded captures and measured toads daily at all traps, we marked toads on only four days (Table 2) and at four traps in each stream. The four traps were each 195–607 m from neighboring traps and included the upstream-most trap on both streams. We checked toads for previous marks at all traps on four days (Table 2). Thus, the sample sizes for mark-recapture data were much smaller than for frequency-of-capture data in Little Blue Joint and Slate creeks.

We used capture data to describe the frequency and temporal patterns of toad movements in streams and to determine the ratio of juvenile to adult captures. We used linear regression to test for temporal trends in the number of captures of juvenile and adult toads in Little Blue Joint and Slate creeks. We used mark-recapture data to characterize the distances and directions moved by individual adult toads in all three streams. "Net movement" is the distance between the most distant captures for an individual.

Results.—We observed frequent movement by Boreal Toads in all streams. We made 252 captures (70 juveniles, 181 adults, 1 unknown; Table 1), all in downstream traps, and captured some toads more than once (e.g., see Table 3). During the eight days of diel movement comparisons in Chamberlain Creek, all six Boreal Toad captures (all adults) were made during night or twilight.

Recaptures of marked toads indicated that some adult toads moved hundreds of meters during both summers and in all three streams, although most recaptures were from Chamberlain and Slate creeks (Table 3). In Chamberlain Creek, we recaptured 5 of 11 marked toads, and the median net distance moved by recaptured individuals was 294 m (median daily movement, 73 m). In Little Blue Joint and Slate creeks, we recaptured 7 of 18 marked toads, and median distance moved was 353 m (median daily movement, 71 m). Two juvenile toads were marked, but neither was recaptured.

Toads traveled both up- and downstream, but downstream movements predominated. Although all recaptures were made in downstream traps, four recaptured toads had traveled upstream, bypassing weirs. The longest movement we documented (1.5 km in 6 days) was directed upstream, and the toad bypassed four weirs. In addition, at least two toads bypassed a weir while moving downstream.

The ratio of juvenile to adult toads captured varied among streams (Table 1, Fig. 2). We did not capture any juvenile toads in Chamberlain Creek. The proportion of juvenile-to-adult toad captures differed significantly between Little Blue Joint and Slate creeks, even when we restricted analysis to captures made during the same time period (15 July–15 August, $\chi^2 = 14.04$, $P < 0.001$). Although the numbers of juvenile toad captures made after 15 July were similar between the two streams, about three-fold more adult captures were made in Slate Creek.

TABLE 2. Number of Boreal Toads marked and recaptured by date in three western Montana streams. Number of recaptures includes repeat recaptures of the same individual, whereas cumulative number recaptured includes only the number of unique individuals recaptured.

Date	Cumulative number marked	Number recaptures	Cumulative number recaptured
Chamberlain Creek			
26-Jul-01	2	—	—
31-Jul-01	4	0	—
3-Aug-01	6	0	0
5-Aug-01	7	0	0
9-Aug-01	8	1	1
10-Aug-01	8	1	2
11-Aug-01	8	1	2
14-Aug-01	9	1	3
15-Aug-01	11	0	3
16-Aug-01	—	2	5
Little Blue Joint Creek			
29-Jul-02	1	—	—
30-Jul-02	1	0	—
3-Aug-02	2	0	0
4-Aug-02	4	1	1
9-Aug-02	—	0	1
Slate Creek			
29-Jul-02	6	—	—
30-Jul-02	11	2	—
3-Aug-02	12	2	4
4-Aug-02	14	4	6
9-Aug-02	—	1	6

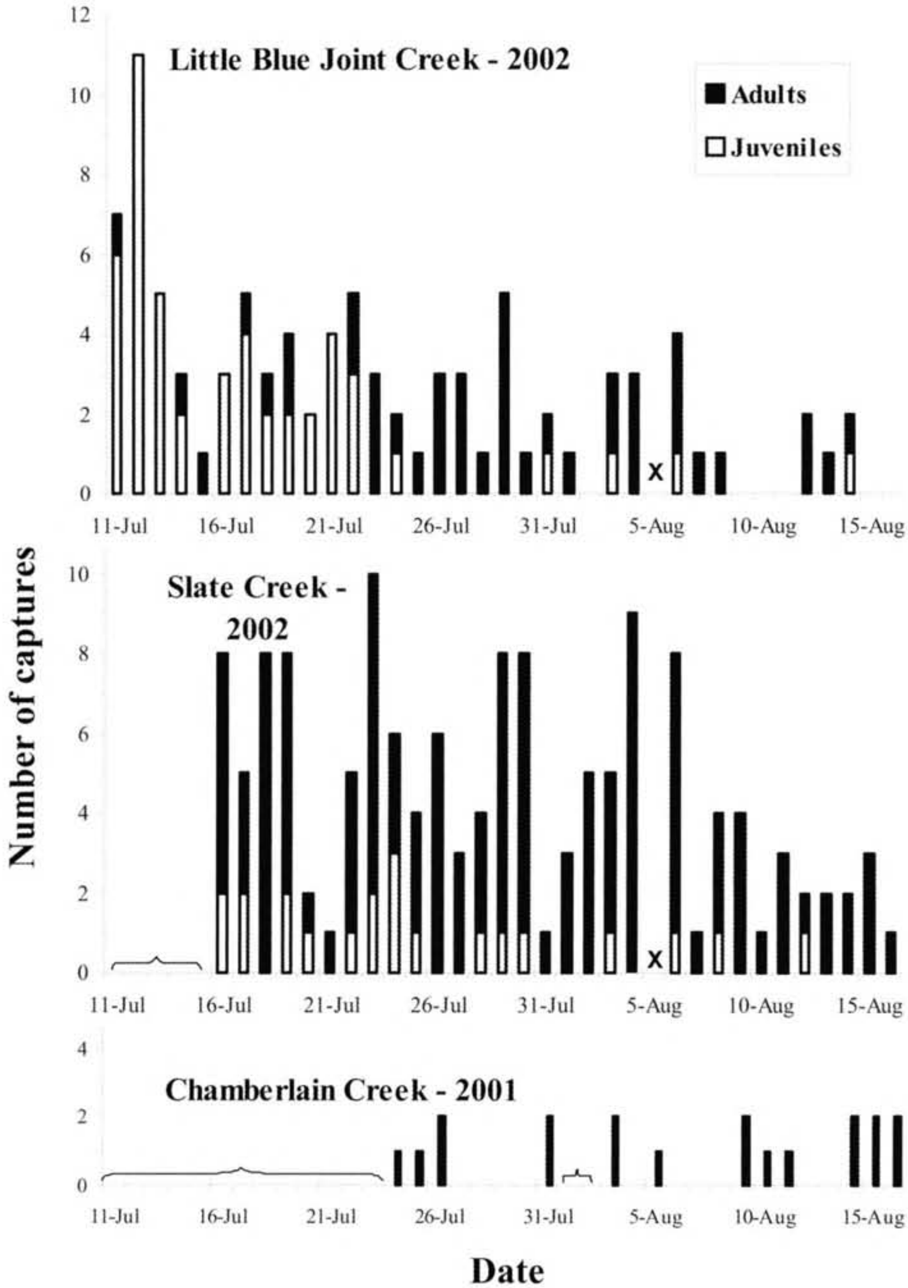

FIG. 2. Frequency of Boreal Toad captures in western Montana by stream, date, and life stage. Captures are from all traps in each stream. Brackets indicate dates when traps were not operated, and X's indicate when traps were operated but not checked. Although the Y-axis maximum varies among the graphs, the scales are identical.

Temporal trends in catch rates differed among streams. Captures of juvenile toads decreased significantly over the course of the study in Little Blue Joint ($N = 37$ days, $r = -0.65$, $P < 0.001$) and Slate creeks ($N = 32$ days, $r = -0.55$, $P = 0.001$). Captures of adult toads also decreased significantly as summer progressed in Slate Creek ($N = 32$ days, $r = -0.36$, $P = 0.04$), but not in Little Blue Joint Creek ($N = 37$ days, $r = -0.02$, $P = 0.89$). We made too few captures in Chamberlain Creek to test for trends.

Discussion.—Boreal Toads made extensive movements in streams. In three streams during two summers, we trapped numerous individuals that were moving downstream. During mid-summer, we detected movements as long as 1.5 km and maximum movement rates greater than 500 m/day. Moreover, the daily movement rates underestimated distances that toads would have traveled had our traps not interrupted their activity. No previous publications document Boreal Toads traveling long distances via water.

The observed movement patterns suggest that adult toads were using streams during their home range activities and that we were not documenting mass dispersal or migration behavior. Post-breeding migrations by toads are characterized by relatively rapid, straight, and directed movements, whereas summer home range

TABLE 3. Number of days, distances moved, and average movement rates since previous capture for individual toads. The letter portion of the toad identification indicates the stream (Chamberlain Creek - C, Little Blue Joint Creek - L, or Slate Creek - S).

Recapture Date	Toad I.D.	Days	Distance moved (m)	Net distance moved (m)	Average rate ($m \cdot d^{-1}$)	Toad length (mm)
9-Aug-01	C-8[a]	6	1,458	1,458	243	—
10-Aug-01	C-6	10	1,270	—	127	—
11-Aug-01	C-6	1	18	1,288	18	93
14-Aug-01	C-9	9	0	0	0	103
16-Aug-01	C-3	21	0	0	0	102
16-Aug-01	C-13	1	294	294	294	84
4-Aug-02	L-1 or 2[b]	1 or 6	669	669	669 or 112	95
30-Jul-02	S-1	1	200	—	200	—
4-Aug-02	S-1	5	0	—	0	—
9-Aug-02	S-1	5	0	200	0	110
3-Aug-02	S-2	5	505	505	101	115
30-Jul-02	S-4	1	505	—	505	—
4-Aug-02	S-4	5	200	705	40	90
4-Aug-02	S-5	6	185	185	31	97
4-Aug-02	S-8	5	200	200	40	98
3-Aug-02	S-10	4	505	505	126	85
Median for all streams				400	71	97

[a]Recaptured upstream of initial capture location, although toad captured in downstream trap. Toad length not measured.

[b] Unsure which marked individual was recaptured.

movements are more haphazard (Kusano et al. 1995; Sinsch 1988, 1990). In our study, marked toads moved both up- and downstream, up to 21 days passed between captures of the same individual, and a fairly steady number of captures were made daily for more than a month.

Although the maximum detected movement distances we report are shorter than migratory or dispersal distances reported in other studies, these appear to be the longest home range movements yet observed. Female Boreal Toads in Idaho and Colorado made overland, post-breeding migrations of up to 2.3–2.4 km (Bartelt 2000; Muths 2003), but in Idaho, they subsequently established summer home ranges with a radius less than 100 m (P. Bartelt, pers. comm.). Likewise, in late summer, Campbell (1970a,b) observed movements of 900 m to overwintering sites, whereas summer home ranges averaged 317 m^2. In Wyoming, Carpenter (1954) documented total movements during July and August of up to 100 m and average daily movements of up to 13 m.

We might have observed longer summer home range movements for two reasons. First, toads inhabiting the moist riparian zone may tend to travel more extensively than those primarily using drier upland sites. Second, largely because of the confined, linear nature of streams, our methods might recapture toads moving long distances via streams more efficiently than traditional recapture methods on land (e.g., pitfall traps and drift fences).

Downstream movements via water might not be unusual, but merely overlooked, because nearly all bufonid movement studies have focused on terrestrial movements. Carpenter (1954) noted that some Boreal Toads in his study made "extended movements downstream." During the breeding season in Bulgaria, *Bufo bufo bufo* moved downstream at rates up to 568 m/day, similar to rates we observed, and traveled distances up to 2.5 km (Beshkov et al. 1986). During pre-breeding migrations, several *B. bufo* traveled downstream in a water-filled ditch to reach their breeding pond (Sinsch 1988 and pers. comm., February 2003).

All Boreal Toads were moving downstream when captured, which implies passive captures by downstream traps. *B. bufo bufo* also moved passively downstream, and males moving upstream in the water traveled short distances (up to 40 m, Beshkov et al. 1986). However, Boreal Toads occasionally bypassed downstream traps, indicating that they sometimes either traveled over land in a downstream direction or climbed over the nets while traveling downstream via water. Drifting downstream could provide several advantages to toads. Relatively passive downstream movements are energetically efficient. Also, during hot, dry weather (common during summers in the northern Rocky Mountains), the frequency and extent of anuran terrestrial activity is physiologically restricted by water balance and thermoregulation requirements (Sinsch 1990); traveling via water would allow for long-distance movements throughout summer, irrespective of weather or terrestrial conditions. Finally, aquatic movements may reduce exposure to terrestrial predators or provide an escape route.

We noted a weak decline in adult captures over time in Slate Creek but not in Little Blue Joint Creek, though sample size was

smaller in the latter. In a southern Utah population, terrestrial captures of adults near streams and on moist riparian slopes were higher in June and July than in August and September (Robinson et al. 1998). Such temporal declines in captures might result from a gradual shift toward more terrestrial habitats as summer progresses.

Our captures of juvenile toads are noteworthy because the behavior and habitat use of juveniles represents a large gap in our knowledge of Boreal Toads (McGee et al. 2002). We inferred from the SVLs that most juveniles captured were at least one year old. McGee et al. (2002) reported that juveniles migrate away from aquatic areas and use primarily terrestrial habitats after metamorphosis, but Carpenter (1954) observed juveniles occupying summer home ranges along small streams in Wyoming. We observed that at least some juveniles use aquatic habitats in early summer in western Montana. Captures of juvenile toads decreased by late July in Little Blue Joint and Slate creeks, and the temporal trends were highly significant. Based on the pattern, we infer that the lack of juvenile captures in Chamberlain Creek might be because of our later initiation of trapping there (23 July). The juvenile movements might represent dispersal, but further research is necessary to confirm this.

Although we show unequivocally that Boreal Toads travel in streams and sometimes move relatively long distances during midsummer in western Montana, our conclusions are limited by small numbers of marked toads, a relatively short study duration each summer, and lack of information about the more terrestrial components of the populations and of individual movements. Further study will be necessary to determine the proportion of each population that moves via streams as well as to ascertain terrestrial habitat use and total distances traveled by toads that use streams. Studies in other regions and of other species are needed to determine the prevalence of instream movements among bufonids. Research illuminating the benefits derived from aquatic movements will help to identify the conservation implications of the behavior.

Extensive travel via streams implies that any instream alteration that interferes with downstream passage might reduce juvenile and adult survival and be detrimental to Boreal Toad populations. Water diversions might influence the distribution of Boreal Toads, as Reese (1972) hypothesized for Tiger Salamanders (*Ambystoma tigrinum*), and screened diversions might completely obstruct downstream passage. For example, after an irrigation ditch on a Blackfoot River tributary, Montana, was screened to eliminate fish entrainment, more than 20 adult Boreal Toads were found dead in a concrete collection facility immediately upstream of the screen (R. Pierce, Montana Fish, Wildlife and Parks, Missoula, pers. comm.). Toads moving passively downstream were probably impinged on the screen by high water velocities and could not ascend the smooth, vertical, concrete walls to escape.

Ecological sensitivity analyses indicate that *B. boreas* population growth rates are highly vulnerable to decreases in postmetamorphic vital rates (e.g., juvenile and adult survival or the probability of laying eggs; Biek et al. 2002). Biek et al (2002) placed a high priority on research and management aimed at documenting and preventing alterations of natural, post-metamorphic vital rates. We recommend that managers consider the consequences of any habitat alterations that may increase mortality rates or disrupt movements of post-metamorphic Boreal Toads traveling in streams and riparian areas. In particular, we recommend designing and testing water diversion screens that allow anurans to escape.

If instream movements prove to be widespread, trapping in streams during early summer may be an effective tool for detecting Boreal Toads in drainages. Furthermore, juveniles have proven to be particularly elusive to researchers. Instream trapping potentially provides an easy means to obtain juveniles for marking, genetic analyses, or other research needs. In drainages where breeding areas are unknown, highly variable, dispersed, or difficult to reach, trapping of juveniles in streams may provide an alternative for confirming recent reproduction within a population.

Acknowledgments.—We thank B. Liermann, M. Marler, J. McFee, C. Saunders, J. Shaffer, M. Spade, and N. Weber for field assistance and the Heart Bar Heart and Knob and Kettle ranches for access to their land. We thank C. Sestrich of Montana State University for 2002 temperature data. S. Corn, B. Maxell, D. Pilliod, D. Olson, and two anonymous reviewers provided helpful suggestions on the manuscript. Funding was provided by The Chutney Foundation, USDA Forest Service, Southern Research Station (to SBA), Lolo National Forest, Montana Power Company, Bureau of Land Management Missoula Field Office, Montana Fish, Wildlife and Parks, and the Bitterroot Ecosystem Management Research Project (to MKY).

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TECHNIQUES

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In Situ Prevention of Anuran Fertilization: A Simple Method for the Detection of Sperm Competition with Potential for Other Applications

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Sperm competition is recognized as an integral component of sexual selection, shaping life-history characteristics such as body size, morphology, physiology and behavior (Birkhead and Parker 1997). Sperm competition occurs when there is competition between the ejaculates of different males for the fertilization of a given set of ova (Parker 1970). Therefore sperm competition can be shown by detecting mixed paternity using molecular methods (Queller et al. 1993; Roberts et al. 1999), by direct observation of multiple male - single female copulations (Birkhead and Parker 1997; Jennions and Passmore 1993) and by comparing relative testis sizes and sperm traits among and within species based on sperm competition theory (Byrne et al. 2002; Harcourt et al. 1981). However, despite the relatively high number of proposed methods it remains difficult to assess sperm competition in external fertilizers, and our knowledge of the occurrence of sperm competition in externally fertilizing anuran taxa has remained scarce (Halliday 1998).

In the externally fertilizing anurans, the production of offspring often numbering in the hundreds or thousands may render molecular paternity analyses uneconomical. Similarly, comparative methods using testis sizes and sperm traits require large sample sizes (sometimes more than a hundred) of sacrificed animals (Jennions and Passmore 1993; Kusano et al. 1991). This method is also problematic because it does not provide direct evidence for sperm competition (Birkhead and Parker 1997). Behavioral observations (e.g., Fukuyama 1991; Kaminsky 1997; Kusano et al. 1991) also share the latter burden.

In order to demonstrate the occurrence of sperm competition in a rhacophorid frog, Jennions and Passmore (1993) proposed a simple method for the documentation of sperm release by peripheral males in multiple male amplexes. Before oviposition, they placed the amplexed male's lower body in a plastic bag (20 x 20 cm) and let the pair spawn in the presence of peripheral males. After embryonic development they counted hatching larvae and unfertilized eggs. In control treatments, where peripheral males were excluded, fertilization success was zero, whereas in the experimental trial, where peripheral males were present, hatching success was nearly 37%. They concluded that plastic bags act as effective condoms, and that peripheral males sired the tadpoles in experimental treatments. Their method, however, has some substantial weaknesses: Jennions and Passmore only performed

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NATRIX NATRIX (European Grass Snake) **MALE COMBAT**. On 1 May 2001 during my field studies in the Stawy Milickie Nature Reserve (51°31'51"N, 17°20'12"E; Wroclaw, Poland) I observed two male (545 and 555 mm SVL) *Natrix natrix* engaged in combat in the presence of a female. Each male attempted to force his rival's anterior body to the ground. The snakes were often completely entwined. After three to five minutes the female moved into high grass, apparently in response to my presence, while the males continued to fight. After half a minute the males rapidly moved 60–70 cm forward, while still wrestling. This sequence was repeated several times before the two males suddenly ceased combat (ca. four minutes after the female left) and both began to follow the female's path while rapidly flicking their tongues. At this point I captured both males and measured and marked them for future identification.

Although *N. natrix* is common across most of Europe, this is the first report of combat in the species. The only previously reported form of male-male competition is tail wrestling (e.g., Madsen 1983. Oikos 40:77–82). Male combat can shape population structure and lead to the evolution of sexual size dimorphism (Shine 1993. *In* Seigel and Collins [eds.], Snakes: Ecology and Behavior, pp. 49–86. McGraw Hill, New York; Shine 1994. Copeia 1994:326–246) and is given much attention in snake studies. It is therefore difficult to conceive how such a conspicuous behavior has remained unreported in this common and widespread species. I believe that male combat is not ubiquitous in *N. natrix*, and expression of the behavior might vary geographically.

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GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 35, Number 1 (March 2004). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extension reports unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA MACULATUM (Spotted Salamander). USA: ILLINOIS: Hardin Co: Shawnee National Forest wildlife pond, 0.8 km N side FR 1726 and 0.3 km E Co. Rd. 700E (N37°33'38", W88°16'29"). 12 July 2004. Kurt J. Regester, Patrick T. McDonald, and Julius A. Frazier. Verified by Ronald A. Brandon. SIUC H-07765. Juvenile, metamorphosed in laboratory. New county record (Philips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, Champaign, Illinois. xii + 282 pp.).

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AMBYSTOMA TALPOIDEUM (Mole Salamander) USA: ARKANSAS: Clark Co: Populations of *Ambystoma talpoideum* in southwestern Arkansas appear to be isolated or disjunct from populations in northern Louisiana, northeastern Texas, and eastern Oklahoma (Trauth et al. 1993. Proc. Arkansas Acad. Sci. 47:154–156; Conant and Collins 1998. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. 3rd ed. Houghton Mifflin Co., Boston, Massachusetts, 509 pp; Petranka 1998. Salamanders of the United States and Canada. Smithsonian Inst. Press, Washington, D.C., 587 pp; Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville, 421 pp.), and available information seldom defines whether populations are metamorphic or paedomorphic. Recent records (Caldwell and Tumlison 2003. Herpetol. Rev. 34:379; Tumlison and Campbell 2002. Herpetol. Rev. 33:143–144) prompted a survey for *A. talpoideum* in southwestern Arkansas, outside of its previously known range. Using dipnets and seines, we sampled aquatic habitats because aquatic *A. talpoideum* are more easily captured than the burrowing terrestrial adults (Bishop 1947. Handbook of Salamanders. Comstock Publishing Company, Inc, Ithaca, New York). All specimens are housed in the Henderson State University (HSU) Vertebrate Collections in Arkadelphia, Arkansas. Identifications were verified by Stan Trauth. Metamorphic salamanders were collected from temporary pools. Paedomorphic forms were collected in small, permanent, fishless ponds. Clark Co., 0.8 km NW Gurdon (S27 T9S R21W), 23 February 2002 and 15 March 2002, R. Tumlison, HSU 903–906 paedomorphic larvae, HSU1281 metamorphic form. Other paedomorphic and metamorphic specimens from Clark County locations are catalogued as HSU 1041, 1278, and 1299. Columbia Co., 3 km E McNeil (S16 T16S R20W), 25 April 1992, R. Tumlison, HSU1282, metamorphic larvae. Dallas Co., jct. County Roads 245 and 247 (S6 T9S R17W), 22 April 2003, B. Caldwell and T. Fulmer, HSU 1293, metamorphic larvae. An additional Dallas County specimen is catalogued as HSU 1294. Hempstead Co., County Rd. 32, 0.6 km from jct. with County Rd. 27 (S9 T9S R26W), 26 April 2003, B. Caldwell, HSU 1295, metamorphic larvae. Howard Co., 5 km W jct. Hwys 26 and 369, (S30 T8S R27W), 27 and 28 April 2003, B. Caldwell, HSU 1297, 1302, metamorphic larvae. Pike Co., 3 km SW of Murfreesboro, off Hwy 27 (S14 T8S R26W), 27 April 2002 and 26 April 2003, B. Caldwell and T. Fulmer, HSU 1274, 1300, metamorphic larvae. Additional Pike county vouchers are catalogued as HSU 1275–1277, 1279, 1296, and 1305.

We thank Stan Trauth for verifying identification of specimens, Fred Kizzia for permission to collect on his land, and Tobin Fulmer for field assistance.

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AMBYSTOMA TIGRINUM (Tiger Salamander). USA: FLORIDA: Calhoun Co: Florida Road 71, 10.1 km S of jct with Florida Road 20 at Blountstown (30°22.17'N, 85°5.75'W). 31 De-

cember 1969. D. Bruce Means and Clive J. Longden, spent female. Florida Museum of Natural History (UF 139288). TAYLOR Co: Florida Road S-14, 5.6 km S of bridge over Aucilla River (30°13.65'N, 83°52.27'W). 24 May 1970. D. Bruce Means. Large metamorph (UF 139289). Both specimens verified by Kenneth L. Krysko. First records for species in Calhoun and Taylor counties. The Taylor Co. record is the only known occurrence in the Coastal Lowlands physiographic province, about 13 km S of the Cody Scarp in the Florida panhandle. (Travis 1992, *In* Moler [ed.], Rare and Endangered Biota of Florida. Volume III. Amphibians and Reptiles, pp. 70–76. University Press of Florida, Gainesville).

Submitted by **D. BRUCE MEANS**, Coastal Plains Institute and Land Conservancy, 1313 Milton Street, Tallahassee, Florida 32303, USA.

NOTOPHTHALMUS PERSTRIATUS (Striped Newt). USA: GEORGIA: TAYLOR Co: Depressional wetland 1.3 km N of Georgia Highway 96, ca. 2.5 km W of Butler. 28 March 2004. John B. Jensen. GMNH 49903–04. Verified by Steve Johnson and Dirk Stevenson. First county record and first record within the Fall Line Sandhills physiographic region. Extends range ca. 130 km NW of nearest record (Wilcox Co., Georgia; Dodd and LaClaire 1995. Herpetol. Nat. Hist. 3:37–46). Many paedomorhpic adults captured by dip net. The shallow, open wetland is dominated by spikerush and rarely, if ever, dries completely. Off-site loblolly pine (*Pinus taeda*) plantations on deep, sandy soils surround the wetland.

Submitted by **JOHN B. JENSEN** and **NATHAN A. KLAUS**, Georgia Department of Natural Resources, Nongame-Endangered Wildlife Program, 116 Rum Creek Drive, Forsyth, Georgia 31029, USA (e-mail: john_jensen@dnr.state.ga.us).

NOTOPHTHALMUS VIRIDESCENS (Eastern Newt). USA: ILLINOIS: GALLATIN Co: Shawnee National Forest wildlife pond, SE side York Lane and 1.2 km E Pounds Hollow Road (37°36'14"N, 88°15'47"W). 21 March 2004. Patrick T. McDonald, Julius A. Frazier, and Kurt J. Regester. Verified by Ronald A. Brandon. SIUC H-07764. Adult male. New county record (Philips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, Champaign, Illinois. xii + 282 pp.).

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ANURA

ELEUTHERODACTYLUS PLANIROSTRIS (Greenhouse Frog). USA: MISSISSIPPI: HARRISON COUNTY: 1744 Magnolia St., Gulfport (30º24'12.3"N, 89º01'07.0"W) 5.42 km S of Interstate 10. 21 September, 24 September, and 4 October 2003. Abigail Dinsmore. Verified by Roy W. McDiarmid and Ronald I. Crombie. Mississippi Museum of Natural Science (MMNS 9274–76) and United States National Museum of Natural History (USNM 559976). Four adults of unknown gender were captured by hand under cover boards placed in a residential back yard. First record for the Mississippi Gulf Coast (Conant and Collins 1998. Reptiles and Amphibians: Eastern/Central North America, 3rd ed., expanded. Houghton Mifflin Co., Boston, Massachusetts, 509 pp.; R. L. Jones, pers. comm.); second specimen collected in Mississippi (first specimen collected by Ron Altig in Starkville, 421.79 km N (USNM 318495, collection date unknown). Appears established in Gulfport, as an individual overwintered under the cover board and 2–4 males have been heard calling every evening since 1 May 2004. About 20 adults have been observed since September 2003. Original introduction probably came from a nursery one block south that also contains the species and receives nursery plants from Florida and Louisiana.

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HYLA CINEREA (Green Treefrog). USA: TENNESSEE: MONTGOMERY Co: 1) Fort Campbell Military Reservation, N end of Los Banos Drop Zone (36°35'39"N,87°36'26"W). 14 May 2004. Scott Sutton and Tim Brown. Austin Peay State University Museum of Zoology (APSU 17544). Adult male on cattail (*Typha latifolia*) in open wetland. 2) Lylewood Road, 0.3 km E of Montgomery-Stewart county line (36°25'22"N,87°35'55"W). 19 July 2004. Josh Ennen and Josh Maloney. APSU 17652. Adult male on trunk of hardwood tree ca 0.5 m above water in floodplain swamp. 3) Lylewood Road, 4.0 road km S of Needmore in N floodplain of Cumberland River opposite river mile 109 (36°26'07"N,87°34'27"W). 19 July 2004. Josh Ennen and Josh Maloney. APSU 17653. Adult male on trunk of hardwood tree ca. 0.5 m above water in floodplain swamp. All specimens verified by A. Floyd Scott. These records represent the first verified reports of the species from Montgomery County and extend its range 27 km up the Cumberland River basin from the nearest reported site at Cross Creeks National Wildlife Refuge in Stewart County (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.; [http://www.apsu.edu/amatlas/]; Therrell and Therrell 1999. Herpetol. Rev. 30:172). Collections were made under authority of Tennessee Wildlife Resources Agency Permit 1662; field work was supported in part by Austin Peay State University's Center for Field Biology.

Submitted by **SCOTT SUTTON** and **TIM BROWN,** Land Condition Trend Analysis, ITAM Division, Fort Campbell, Kentucky 42223, USA; and **JOSH ENNEN** and **JOSH MALONEY**, Department of Biology and Center for Field Biology, Austin Peay State University, Clarksville, Tennessee 37044, USA; e-mail: timothy.sutton@campbell.army.mil.

HYLA CINEREA (Green Treefrog). USA: TEXAS: RAINS Co: Fork Lake on CR 3330 (32°53'691"N, 95°40'956"W). One individual was collected from the lakeshore in a chorus of ca. 40 frogs, at 1045 h on 22 June 2004 (22.3°C ambient temperature, 84% humidity). P. M. Hampton and M. L. Nicholson. Texas Cooperative Wildlife Collection (TCWC 88177). Verified by S. Peterson. New county record (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station. 421 pp.).

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HYLA JOANNAE. PERÚ: DEPARTAMENTO MADRE DE DIOS: Wasaí Lodge, Tambopata, 12°50'S, 69°28'W, 238 m elevation. 28 April 2004. D. R. Neira and C. L. Barrio. Herpetological collection, Museo de Historia Natural, Universidad Nacional San Agustín, Arequipa, Perú (MUSA 0374–77). Verified by M. Ugarte. *Hyla joannae* was described from Cobija, Departamento Pando, Bolivia (Köhler and Lötters 2001. Stud. Neotrop. Fauna Environ. 36[2]:105–112), and was known only from that locality and immediate surroundings. First country record, extends known distribution 210 km SSW from the type locality.

Submitted by **CÉSAR LUIS BARRIO-AMORÓS**, Fundación AndígenA, Apartado Postal 210, 5101-A, Mérida, Venezuela (e-mail: cesarlba@yahoo.com) and **DANIEL R. NEIRA**, Museo de Historia Natural, Universidad Nacional de San Agustín y, Asociación Sallqa Perú Calle Indo 114, Coop. 58. J.L.B. y R. Arequipa, Perú; e-mail: dneirah@yahoo.com.

HYLA PHYLLOGNATHA (NCN). ECUADOR: PROVINCIA DE ZAMORA-CHINCHIPE: Numbami and Romerillos Bajo, Jamboe River basin, Podocarpus National Park (ca. 04°14'S, 78°56'W, 1500–1700 m). 28–30 April 1999. F. Nogales and D. Almeida. Universidad San Francisco de Quito/Fund. Herpetológica Orcés, Quito (FHGO-USFQ 2346, 2434). Verified by Jean-Marc Touzet. Previously known along the Amazonian slopes of the Andes and associated ranges in Colombia, Ecuador, and Peru (Duellman 1972. Occ. Pap. Mus. Nat. Hist. Univ. Kansas 11:1–31; Ruiz-Carranza and Lynch 1982. Caldasia XIII [64]: 647–671; Frost 2002 Amphibian Species of the World. V2.21 [15 July 2002]. <http://research.amnh.org/herpetology/amphibia/index.html> [Accessed: 19 July 2004]). There is a gap of ca. 500 km between the Ecuadorian records in the provinces of Sucumbíos, Napo, Pastaza, Tungurahua, and Morona-Santiago, and the Peruvian records in the departments of San Martín, Ucayali, Cusco, Pasco, and Junín (Duellman, *op. cit.*; Lehr 2001. Herpetol. Rev. 32:130–132). Specimens reported herein constitute the first locality within the province of Zamora-Chinchipe, partially filling the gap between Ecuadorian and Peruvian records. This locality is the westernmost record for the species, extending its range ca. 230 km SSW from the nearest locality in the province of Morona-Santiago (Macas; Duellman, *op. cit.*).

Submitted by **DIEGO F. CISNEROS-HEREDIA**, College of Biological and Environmental Sciences, Universidad San Francisco de Quito, Ave. Interoceánica y calle Diego de Robles, Campus Cumbayá, Edif. Maxwell, Casilla Postal 17-12-841, Quito, Ecuador; e-mail: diegofrancisco_cisneros@yahoo.com.

HYLA VERSICOLOR (Gray Treefrog). CANADA: ONTARIO: THUNDER BAY DISTRICT. Ware Twp., 8.5 km NE of Hwys 11/17 and 102 intersection (NAD 27: UTM Zone 16: N5386700m, E308100m). 8 June 2002. Wayne F. Weller and Alessandra Weller. Royal Ontario Museum (ROM 39374 [segment 26], audio cassette tape). All tape recordings verified by Ross D. MacCulloch. Six individuals calling from marsh and pond near mixed woods at 2235 h. THUNDER BAY DISTRICT. Oliver Twp., 11.0 km SW of Hwys 591 and 589 intersection (NAD 27: UTM Zone 16: N5374600m, E319000m). 6 June 1999. Wayne F. Weller and Alessandra Weller. ROM 38443 [segment 5], audio cassette tape. Two individuals calling from cattail pond near mixed woods at 2250 h. THUNDER BAY DISTRICT. McIntyre Twp., 6.7 km NW of Hwy 11/17 and 130 intersection (NAD 27: UTM Zone 16: N5367800m, E324700m). 28 May 1999. Wayne F. Weller and Alessandra Weller. ROM 38443 [segment 2], audio cassette tape. Three individuals calling from flooded roadside ditch at 2215 h. THUNDER BAY DISTRICT. Paipoonge Twp., Mt McKay, Thunder Bay (NAD 27: UTM Zone 16: N5357800m, E330900m). 27 May 1999. Wayne F. Weller and Alessandra Weller. ROM 38443 [segment 1], audio cassette tape. Four or five individuals calling from marsh at 2230 h. THUNDER BAY DISTRICT. Devon Twp., 4.3 km SE of Hwy 593 and Arrow River intersection (NAD 27: UTM Zone 16: N5331200m, E289400m). 18 June 1997. Wayne F. Weller. ROM 32576, audio cassette tape. Calling from spruce swamp at 2330 h. THUNDER BAY DISTRICT. Lismore Twp., Hwy 593, 1.6 km SW of Strange/Lismore Twp boundary (NAD 27: UTM Zone 16: N5343700m, E284800m). 18 June 1997. Wayne F. Weller. ROM 32576, audio cassette tape. Five to ten individuals calling from marsh at 2240 h. The documented eastern range limit in northwestern Ontario is represented by a specimen from the Shebandowan Lakes region (ROM 9911 – June 1964). The 6 records noted represent an extension of the documented range 35 km E, 70 km ESE, and 60 km SSE of the Shebandowan Lakes locality. Within an approximate 3500 km^2 area (enveloped by these 6 records) extending to the Lake Superior coastline and southward to the Minnesota/Ontario border, 8 additional localities have been documented with taped calls (June 1997, June 1999, May and June 2002. Wayne F. Weller and Alessandra Weller. ROM 39374 [segments 22, 23, 25, 27]; ROM 38443 [segment 4]; ROM 32576 [3 tape segments]). Collectively, these 14 documented localities substantiate observations made since 1997 at 201 localities within the 3500 km^2 area during field investigations for "atlasing" (Oldham and Weller 2000. Ontario Herpetofaunal Atlas. Natural Heritage Information Centre, Ontario Ministry of Natural Resources, Peterborough, Ontario, Canada. Website mnr.gov.on.ca/MNR/nhic/herps/ohs.html) conducted by WFW and others, and for population and environmental studies conducted by SJH. THUNDER BAY DISTRICT. Unnamed Twp., Swede Island, S of Black Bay Peninsula, Lake Superior (NAD 27: UTM Zone 16: N5371600m, E397500m). 19 July 2000. Brian Ratcliff and others. ROM 39423, photograph. Verified by Ross D. MacCulloch. This represents the first documentation on islands along the northern coastline of Lake Superior, and extends the range 125 km E of the Shebandowan Lakes locality.

Submitted by **WAYNE F. WELLER**, 250 Chercover Drive, Thunder Bay, Ontario P7G 1A2, Canada, and **STEPHEN J. HECNAR**, Department of Biology, Lakehead University, 955 Oliver Road, Thunder Bay, Ontario P7B 5E1, Canada.

HYPEROLIUS ACUTIROSTRIS (NCN). EQUATORIAL GUINEA: PROVINCE WELE-NZAS: Parque Nacional Los Altos de Nsork: 01°13'52.4"N, 11°00'53.4"E, 550 m asl. 30 March 2003. Jorge de Leon. Yale Peabody Museum of Natural History (YPM 8000). Verified by Robert Drewes. New country record. This species was previously only known from Cameroon (Schiøtz 1999. Treefrogs of Africa. Edition Chimaira, Frankfurt, Germany). This specimen extends the known range of this species by ca. 300 km S. The Guinea collecting site is proximal to the Gabon border and the prevailing rainforest habitat extends uninterrupted across the border. Therefore, it likely that this species will be found in

Gabon as well.

Submitted by **TWAN A.A.M. LEENDERS**, Division of Vertebrate Zoology, Yale Peabody Museum of Natural History, 170 Whitney Avenue, P.O. Box 208118, New Haven, Connecticut 06520-8118, USA; e-mail: leendersa@sacredheart.edu.

KASSINA SENEGALENSIS. MAURITANIA: WILAYA ASSABA: Bou Bleï'Îne (17°0'34"N, 10°59'24"W). J. M. Padial. 26 May 2002. Juvenile. Museo Nacional de Ciencias Naturales (MNCN 41782). Verified by Ignacio de la Riva. First country record of the family (Hyperoliidae). The specimen was found under a trunk on the shore of an isolated wetland in the Saharan border, surrounded by the Sahel Savannah. The area was largely xeric under the strong influence of extremely dry condition of Sahara but with a seasonal rainfall. Other amphibian species found there include *Bufo xeros*, *Hoplobatrachus occipitalis*, and *Tomoptera cryptotis*.

Submitted by **JOSÉ M. PADIAL**, Museo de Historia Natural Noel Kempff Mercado, Área de Zoología, Sección Herpetología, P.O. Box 2489, Santa Cruz de la Sierra, Bolivia; e-mail: jmpadial@yahoo.com.

MYERSIELLA MICROPS. BRAZIL: MINAS GERAIS. Municipality of Cristina (22°13'05"S, 45°15'25"W), 1150 m. 27 March 2004. A. F. B. Junqueira. Coleção Científica de Vertebrados do Laboratório de Zoologia da Universidade de Taubaté, UNITAU, Taubaté, São Paulo, Brazil (IAM/CCLZU 1429, male SVL: 22.2 mm). 1 April 2004. A. F. B. Junqueira (IAM/CCLZU 1430–1431, 2 subadult males SVL: 19.3 and 19.6 mm). 14 May 2004. A. F. B. Junqueira and F. B. R. Gomes, (IAM/CCLZU 1432, female SVL: 37.8 mm; 1433, subadult male SVL: 18.6 mm) and Célio F. B. Haddad collection, deposited in Departamento de Zoologia, Universidade Estadual Paulista, Rio Claro, SP, Brazil (CFBH 7308, female SVL: 33.2 mm). Verified by C. F. B. Haddad. Previously known from coastal Atlantic forest of southeastern Brazil, at low and moderate elevations in Espírito Santo, Rio de Janeiro, Serra do Mar in São Paulo and north of Minas Gerais, (Heyer et al. 1990, Arq. Zool. Univ. São Paulo 31[4]:231–410; Izecksohn and Potsch de Carvalho-e-Silva. 2001, Anfíbios do Município do Rio de Janeiro, Editora UFRJ. 148 pp; Hartmann et al. 2002, J. Herpetol 36:509–511; Frost 2002, Amphibian Species of the World: An online reference V2.21, http://research.amnh.org/herpetology/amphibia/index.html; Feio et al. 2003, Herpetol. Rev. 34:259). This record for southern Minas Gerais, in southeastern Brazil, extends known distribution ca. 480 km SW from Caratinga, MG (Feio et al., *op. cit.*); ca. 300 km NNW from the Serra do Mar (Izecksohn and Potsch de Carvalho-e-Silva, *op. cit.*; Hartmann et al., *op. cit.*) and ca. 450 km NE of Boracéia (Heyer et al. 1990, *op. cit.*). This is also the first record for the Serra of Mantiqueira.

Submitted by **ITAMAR ALVES MARTINS**, and **ALVARO FRANCISCO B. JUNQUEIRA**, Universidade de Taubaté - UNITAU, Departamento de Biologia, Laboratório de Zoologia. 12030-010, Taubaté, SP, Brazil. BIOTA/FAPESP (Process n. 01/13341-3); e-mail: istama@uol.com.br.

OSTEOPILUS SEPTENTRIONALIS (Cuban Treefrog). USA: FLORIDA: GADSDEN CO: Havana, house at 1241 Tallavana Trail (30.593°N, 84.460°W). 17 July 2004. Beth Bloomquist. Verified by Kenneth L. Krysko. Florida Museum of Natural History, University of Florida (UF 141849). One adult female (76 mm SVL) was collected from inside a plastic container on the back deck of the house. The two most likely scenarios for the frog's arrival at this isolated site are that it was transported in: 1) one of several potted orchids purchased in Sarasota, Florida in September 2003, or 2) a vehicle from Sarasota in April 2004. *Osteopilus septentrionalis* is extremely common in Sarasota in the southwestern Florida peninsula. This specimen appears to be the first of the species confirmed from the Florida panhandle.

Although there are records of Cuban Treefrogs in the literature for three counties in the Florida panhandle, for reasons outlined below these previous records should be disregarded. Ashton (1976. Florida State Mus. Herpetol. Newsletter 1:1–16) reported Cuban Treefrogs from Leon and Washington counties and indicated that voucher specimens were deposited in the Florida State Museum (now known as the Florida Museum of Natural History [FLMNH]). However, no specimens from these counties exist in the FLMNH (K. Krysko, pers. comm.). It is most probable that Ashton (1976, *op. cit.*) made a mistake when compiling the species list of county records that comprises 11 pages of the newsletter. In their map of Cuban Treefrog distribution in Florida, Meshaka et al. (2004. The Exotic Amphibians and Reptiles of Florida. Krieger Publ. Co., Malabar, Florida, 155 pp.) include Ashton's unsubstantiated records and an additional record for Holmes Co. in the western panhandle. The source of the Holmes Co. location is given as Meshaka (1996. Herpetol. Rev. 27:37–40). However, Meshaka (1996, *op. cit.*) does not mention any Cuban Treefrogs from Holmes County. Therefore, the Meshaka et al. (2004, *op. cit.*) record is also questionable. A search for *O. septentrionalis* vouchers in national and southeastern U.S. regional collections failed to locate a record of this species from any county in the panhandle. Thus, the Gadsden Co. specimen reported here is the first vouchered specimen of *O. septentrionalis* from the Florida panhandle.

Submitted by **STEVE A. JOHNSON**, Department of Wildlife Ecology and Conservation, University of Florida–IFAS Plant City Education Center, 1200 North Park Rd., Plant City, Florida 33563, USA; e-mail: johnsons@wec.ufl.edu.

PLEURODEMA NEBULOSUM (Mendoza Four-eyed Frog). ARGENTINA: NEUQUÉN: DEPARTAMENTO AÑELO (38°21'S, 68°47'W): Arroyo Ojos de Agua. 14 November 1976. O. de Ferrariis. Museo Argentino de Ciencias Naturales "Bernardino Rivadavia," Buenos Aires, Argentina (MACN 36078); Auca Mahuida (37°53'S, 68°31'W). April 1945. O. Adams (MACN 7980). DEPARTAMENTO CATAN-LIL (39°33'S, 70°35'W): Charahuilla. 4 February 1973. O. de Ferrariis. Colección del Centro Nacional de Investigaciones Iológicas, housed at MACN (CENAI 7081). First province records, extend the known distribution 275 km W from closest record (General Roca, La Pampa province; Gallardo 1965. Rev. Mus. Arg. Cs. Nat. B. Rivadavia [Zool.] 1[2]:57–77). SALTA: DEPARTAMENTO CAFAYATE (26°06'S, 65°57'W): Cafayate. 11 January 1991. J. McGuire. Fundación Miguel Lillo, Tucumán, Argentina (FML 5245); Cafayate, on Ruta Nacional Nº 68, between 8 and 12 km N of its intersection with Ruta Provincial Nº 40. 11 January 1991. R. Etheridge (FML 5246, three specimens); Cayafate, los Médanos. 2 January 1993. N. Abdala (FML 5232, three specimens). DEPARTAMENTO SAN CARLOS (25°53'S, 65°56'W):

San Carlos, ca. 10 km E from Animaná. 4 January 1993. E. O. Lavilla (FML 5234, two specimens). First vouchered specimens, previously mentioned from Salta Province by Lavilla (1999. Anfibios. *In* Lavilla and González [eds.], Biodiversity of Agua Rica, Catamarca, Argentina. Fund. M. Lillo - BHP Copper). DEPARTAMENTO ANTA (24°55'S, 64°28'W): Finca Los Colorados. 13 January 2000. E. O. Lavilla and R. Heyer (FML 9094–96). First Department record. Salta Province reports extend the known distribution 350 km NE from previous closest record (Andalgalá, Catamarca province; Lavilla 1999, *op. cit.*). TUCUMÁN: DEPARTAMENTO TAFÍ DEL VALLE: Quilmes (26°30'S, 66°00'W). 18 January 1975. R. Laurent and C. Halloy (FML 2427, 43 specimens). New province record, cited by Laurent to Tucumán Province (1969. Acta zool. lilloana 25[7]:81–96). This report extends known distribution 102 km NE from closest record (Andalgalá, Catamarca Province; Lavilla 1999, *op. cit.*). Boundary between CATAMARCA and TUCUMÁN provinces: Arroyo los Médanos, between Santa María and Amaicha del Valle. 20 January 1975. R. Laurent and C. Halloy (FML 2425, three specimens); ca. 10 km from bridge of Santa María River. 25 January 1975. R. Laurent and C. Halloy (FML 2429, two specimens). New record for this area, extends known distribution ca. 111 km N from closest record (Andalgalá, Catamarca Province; Lavilla 1999, *op. cit.*). All specimens verified by Esteban O. Lavilla. The previously known range of this species includes the western Argentinian provinces from Catamarca to Río Negro (Cei 1980. Amphibians of Argentina. Monit. Zool. Ital. [N.S.] Monogr. 2: [i-xii] + 1–609; Aun and Martori 1999. Herpetol. Rev. 30:231) and Tucumán Province (Laurent 1969, *op. cit.*).

Submitted by **DAIANA PAOLA FERRARO**, Sección Herpetología, División Zoología Vertebrados, Museo de La Plata, Paseo del Bosque S/N° (1900) La Plata, Buenos Aires, Argentina; e-mail: dferraro@fcnym.unlp.edu.ar.

PSEUDACRIS CRUCIFER (Spring Peeper). USA: TEXAS: GREGG CO.: Three specimens were collected from a small pond on private land, ca. 9 km E of Kilgore. (32°22'23"N, 94°47'35"W). 28 February 2004. Collected by Shelby C. Braman. Specimens deposited with the Texas Cooperative Wildlife Collection (TCWC 88174–88176). Verified by Ronald L. Gutberlet, Jr. Upland Chorus Frogs (*P. triseriata*) in amplexus and Bullfrogs (*Rana catesbiana*) were also collected in this particular pond. All three species were abundant and chorusing. These specimens represent the first Gregg County records for *P. crucifer* and partially fill the distribution gap of Gregg, Rusk, and Panola Counties of east Texas (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M University Press, College Station, Texas. 421 pp.).

Submitted by **SHELBY C. BRAMAN**, Department of Biology, The University of Texas at Tyler, Tyler, Texas 75799, USA; e-mail: shelbybraman@hotmail.com.

PSEUDACRIS FERIARUM (Upland Chorus Frog). USA: TENNESSEE: CANNON CO: Cooper Hollow. Captured in a small rain barrel in pasture off Sinks Miller Road, ca. 1 km W Burt-Burgen Road. 17 May 2004. J. L. Miller. Verified by B T. Miller. Middle Tennessee State University (MTSU 130A). New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee, Misc. Publ. No. 12, Austin Peay State University, 89 pp.).

Submitted by **JOYCE L. MILLER**, Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee 37132, USA.

RANA CLAMITANS (Green Frog). USA: ILLINOIS: GALLATIN CO: Shawnee National Forest wildlife pond, NW side York Lane and 1.3 km E Pounds Hollow Road (37°36'20"N, 88°15'34"W). 6 June 2004. Julius A. Frazier, Patrick T. McDonald, and Kurt J. Regester. Verified by Ronald A. Brandon. SIUC H-07275. Adult. New county record (Philips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, Champaign, Illinois. xii + 282 pp.).

Submitted by **JULIUS A. FRAZIER**, **PATRICK T. McDONALD**, and **KURT J. REGESTER**, Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901, USA.

PSEUDACRIS TRISERIATA (Western Chorus Frog). USA: ARKANSAS: LONOKE CO: 2.2 km E. Ward (T5N, R9W, S25). 22 August 2004. Patrick F. McKenzie. Verified by Stanley E. Trauth. Arkansas State University Museum of Zoology Herpetological Collection (ASUMZ 28736). New county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **MICHAEL V. PLUMMER**, Department of Biology, Box 12251, Harding University, Searcy, Arkansas 72149, USA (e-mail: plummer@harding.edu) and **DONALD F. MCKENZIE,** Wildlife Management Institute, 2396 Cocklebur Road, Ward, Arkansas 72176, USA (e-mail: wmidm@ipa.net).

RANA CATESBEIANA (Bullfrog). ECUADOR: PROVINCIA DE NAPO: Carretera Puyo-Tena, ca. 50 km (by road) from Puyo (ca. 77°50'W, 01°08'S, ca. 400 m elev.). 18 March 2000. D. F. Cisneros-Heredia, M. Brandt, A. Chiriboga, G. Reck. Universidad San Francisco de Quito, Quito (DFCH-USFQ 750; juvenile active at 1830 h in flooded grassland, ca. 100 m from an abandoned bullfrog farm). Verified by J. M. Touzet. *Rana catesbeiana* was introduced to Ecuador in 1988 with the importation of 100 adults and 70,000 tadpoles for commercial purposes; and although initially the bullfrog farms were located in western Ecuador, now they are spread along the western and eastern lowlands (ECOLAP. 1998. El Manejo para la Protección y el Uso Sustentable de la Vida Silvestre en el Ecuador. Proyecto INEFAN/GEF act. 20, Quito; Cano et al. 2000. *In* La Biodiversidad del Ecuador Informe 2000. Ministerio del Ambiente, EcoCiencia and IUCN.). Specimen reported herein is the first of this alien taxon from outside of farms. This record and observations in the surroundings of Bahía de Caráquez (ca. 80°20'W, 00°40'S, ca. 8 m elev.), province of Manabí, confirm that Bullfrogs are escaping and probably establishing feral populations in Ecuador (tadpoles and amplectant pairs were observed in ditches at the locality in the province of Napo).

Submitted by **DIEGO F. CISNEROS-HEREDIA**, College of Biological and Environmental Sciences, Universidad San Francisco de Quito, Ave. Interoceánica y calle Diego de Robles, Campus Cumbayá, Edif. Maxwell, Casilla Postal 17-12-841, Quito, Ecuador; e-mail: diegofrancisco_cisneros@yahoo.com.

RANA CLAMITANS (Green Frog). USA: TENNESSEE: CANNON Co: Cooper Hollow. Captured near a small pond in pasture off Sinks Miller Road, ca. 1 km W Burt-Burgen Road. 17 September 2004. J. L. Miller. Verified by B. T. Miller. Middle Tennessee State University (MTSU 131A). New county record. (Redmond and Scott 1996. Atlas of Amphibians in Tennessee, Misc. Publ. No. 12, Austin Peay State University, 89 pp.).

Submitted by **JOYCE L. MILLER**, Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee 37132, USA.

RANA SYLVATICA (Wood Frog). USA: TENNESSEE: HOUSTON Co: North floodplain of Whiteoak Creek at stream mile 8, ca. 100 m SE of Lewis Branch Road, 1.8 road km SE of junction of Lewis Branch Road and Cooley Ford Road (36°14'55"N,87°49'05"W). 2 April 2004. Josh Ennen. Austin Peay State University Museum of Zoology (APSU 17500). 17 tadpoles found along with *Ambystoma maculatum* egg masses in road-rut pool in deciduous woods beside creek. HUMPHREYS Co: Concord Community, Tennessee Ridge Road, 0.6 km S of junction with Gander Branch Road (36°13'34"N,87°45'50"W). 29 April 2004. Josh Ennen and Nathan Parker. APSU 17501. Two tadpoles in road-rut pool just E of highway. All specimens verified by A. Floyd Scott. New county records that extend range of the species in Tennessee to the western edge of the Western Highland Rim (Redmond and Scott. 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. (Hard copy and Internet versions, the latter of which includes links to information on Tennessee herpetology having appeared since 1996), http://www.apsu.edu/amatlas/, accessed 1 September 2004). Collections made under authority of Tennessee Wildlife Resources Agency Permit 1662; field work was supported by Austin Peay State University's Center for Field Biology.

Submitted by **JOSH ENNEN** and **NATHAN PARKER**, Department of Biology and Center for Field Biology, Austin Peay State University, Clarksville, Tennessee 37044, USA, ennenj@apsu.edu.

SPEA HAMMONDII (Western Spadefoot). USA: CALIFORNIA: VENTURA Co.: Simi Valley: Tadpoles observed in cattle pond in rolling hills supporting grasslands and sage scrub, ca. 3.6 km NE of the intersection of Brea Canyon and State Route 118 (NAD 83: UTM Zone 11S: 3797296mN, 336543mE, 320 m elev.). 15 March 2000. One collected by Robert B. Johnson III. CAS 228523. Hundreds of recently metamorphosed juveniles emerging from vernal pool in similar habitat ca. 1.8 km NW of intersection of Alamos Canyon and State Route 118 (NAD 83 UTM Zone 11S: 3797004mN, 332238mE, 285 m elev.). 22 April 2003. One salvaged by Sandra J. Leatherman. CAS 228524. Both specimens verified by Robert Fisher. New county records (Jennings and Hayes 1994. Amphibian and Reptile Species of Special Concern in California. California Department of Fish and Game, Inland Fisheries Division. Contract No. 8023). Numerous records exist from the surrounding counties of Los Angeles, Santa Barbara, and Kern.

Submitted by **BRIAN M. LEATHERMAN**, White & Leatherman BioServices, 4848 Lakeview Drive, Suite 100E, Yorba Linda, California 92886, USA.

SYRRHOPHUS CYSTIGNATHOIDES CAMPI (Rio Grande Chirping Frog). USA: TEXAS: WILSON CO.: Eagle Creek Ranch Subdivision, near intersection of Cherry Ridge and Palo Alto; 29°15.339'N, 98°12.668'W. 29 June 2004. Adult collected under a board at 1930 h during light rain. TNHC 63067. Verified by Travis LaDuc. First county record, shows continued expansion of range from Lower Rio Grande Valley, presumably from inadvertent human transport (Dixon 2000. Amphibians and Reptiles of Texas, 2nd edition, Texas A&M University Press, 421 pp.). Individuals heard calling at same location in May 2004. Record marks tenth county in Texas outside of native range of *S. cystignathoides* (thought to be restricted to Cameron and Hidalgo counties). This locality is ca. 3 mi from Bexar County, where the species had been recorded previously.

Submitted by **FRANZ J. SCHMIDT**, 562 Cherry Ridge, Floresville, Texas 78114, USA.

TESTUDINES

CHELYDRA SERPENTINA SERPENTINA (Eastern Snapping Turtle). USA: TEXAS: LEE CO.: Yegua Knobbs Preserve (30°20.323'N, 97°11.050'W). 2 May 2004. Caught in pond at the preserve. William B. Montgomery. Verified by Travis LaDuc. University of Texas Natural Hisory Collection (TNHC 63004, color slide). New county record (Dixon 2000. Amphibians and Reptiles of Texas. Second Ed. Texas A&M Press, viii + 421 pp.).

Submitted by **WILLIAM B. MONTGOMERY**, P.O. Box 656, Elgin, Texas 78621, USA; e-mail: montgomery6@earthlink.net.

PSEUDEMYS GORZUGI (Rio Grande River Cooter). USA: TEXAS: MAVERICK CO.: 4 km SE of Jimeacutenez, Coahuila, Mexico (29°00'42"N, 100°38'34"W). 11 July 2003. M. R. J. Forstner and Josephine Duvall. Verified by J. R. Dixon. Texas A&M University, Texas Cooperative Wildlife Collection, TCWC 88216. New county record. The juvenile female was collected in an agricultural irrigation waterway. The specimen had a carapace length of 72.3 mm, a carapace width of 65.4 mm, a plastron length of 62.1 mm, a plastron width of 50.1 mm, a shell depth of 31.2 mm, and weighed 71 g.

Submitted by **LINDLEY BAILEY** and **M. R. J. FORSTNER**, Department of Biology, Texas State University, 601 University Drive, San Marcos, Texas 78666, USA; e-mail [LB]: lb1122@txstate.edu.

TERRAPENE ORNATA (Ornate Box Turtle). USA: ARKANSAS: COLUMBIA Co: Hwy 79, 3 km SE McNeil, Sec. 5 T16S R20W. June 1992. Jim Gann. Henderson State University collection 832. Distribution into southwestern Arkansas is indicated by Conant and Collins (1998. Reptiles and Amphibians Eastern/Central North America, 3rd ed., Houghton Mifflin Co., Boston, Massachusetts) but no records are shown in Trauth et al. (2004. The Amphibians and Reptiles of Arkansas, Univ. Arkansas Press, Fayetteville). Specimen provides verification of the species in southwestern Arkansas.

Submitted by **JIM GANN,** Logoly State Park, McNeil, Arkansas 71752, USA, and **RENN TUMLISON**, Department of Biology, Henderson State University, Arkadelphia, Arkansas 71999, USA; e-mail: tumlison@hsu.edu.

LACERTILIA

AMPHISBAENA MUNOAI (NCN). BRAZIL: RIO GRANDE DO SUL: Municipality of Três Passos (53°55'55"S, 27°27'20"W). October 1981. J. R. Collares. Herpetological collection of the Museu de Ciências e Tecnologia of the Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil. (MCP 1457). Municipality of Santo Cristo (54°39'46"S, 27°49'26"W), collected by students of a local school (no additional data available) (MCP 11636). Verified by R. Baptista de Oliveira. *Amphisbaena munoai* was known to occur from Passo Fundo, northern Rio Grande do Sul, Brazil, to southern and central Uruguay (Gans 1966. Bull. Amer. Mus. Nat. Hist. 134[3]:187–260). Northwesternmost record for the species, the record in Três Passos extends the known range ca. 227 km NW from Passo Fundo (Gans, *op. cit.*).

Submitted by **JORGE S. BERNARDO-SILVA** (e-mail: 98203483@pucrs.br) and **MARCOS DI-BERNARDO**, Laboratório de Herpetologia, Faculdade de Biociências and Museu de Ciências e Tecnologia of the Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), Av. Ipiranga, 6681, 90619-900 Porto Alegre, Rio Grande do Sul, Brazil (e-mail: [MDB] madibe@pucrs.br).

ASPIDOSCELIS (= CNEMIDOPHORUS) NEOMEXICANA: (New Mexico Whiptail). USA: NEW MEXICO: LINCOLN CO., prairie dog town in Taylor Draw, ca. 12 air mi SW Carrizozo (T8S R8E SE1/4 Sec 27). 23 June 2004. D. W. Burkett, M. Hartsough, and M. Swink. University of New Mexico Museum of Southwestern Biology (MSB 71138). Verified by C. W. Painter. County record (Degenhardt et al. 1996. The Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque).

Submitted by **DOUGLAS W. BURKETT, MATT HARTSOUGH, MIKE SWINK,** P.O. Box 399, White Sands Missile Range, New Mexico 88002, USA.

CNEMIDOPHORUS LACERTOIDES. BRAZIL: SANTA CATARINA: FLORIANÓPOLIS MUNICIPALITY: Ilha de Santa Catarina: Restinga da Joaquina (27°35'36"S; 48°35'56"W). 8–10 December 2003. C. F. D. Rocha, D. Vrcibradic, V. A. Menezes, and C. V. Ariani. Museu Nacional, Rio de Janeiro (MNRJ 11289–303). Verified by G. Skuk and G. Scrocchi. This species has been reported to occur in Uruguay, Argentina, and southern Brazil, where it was previously known only from the state of Rio Grande do Sul (Maslin and Secoy 1986. Contr. Zool., Univ. Colorado Mus. 1:1–60; Lema 1994. Comunic. Mus. Ciênc. Tecnol. PUCRS, Sér. Zool. 7:41–150). This note provides the first record for the state of Santa Catarina and the northernmost record for the species. It extends the distribution ca. 300 km NE from the previous northernmost locality (Torres, on the northern coast of Rio Grande do Sul state; Lema, *op. cit.*).

Submitted by **DAVOR VRCIBRADIC, CARLOS FREDERICO D. ROCHA, VANDERLAINE AMARAL DE MENEZES,** and **CRISTINA VALENTE ARIANI,** Departamento de Ecologia, Instituto de Biologia, Universidade do Estado do Rio de Janeiro, Rua São Francisco Xavier 524, 20550-011, Rio de Janeiro, RJ, Brazil.

CNEMIDOPHORUS SERRANUS. ARGENTINA: SAN LUIS: CORONEL PRINGLES: campground on the shore of Embalse La Florida. 25 December 2003. E. C. G. López. Herpetological Collection Museo de La Plata, La Plata, Buenos Aires, (MLPS 2574). Verified by J. C. Acosta. First province record (Avila and Carrizo 2003. Acta Zool. Lilloana 47[1–2]:93–115), and westernmost record for the species, extending known range 139 km W from El Chacay, Rio Cuarto Department, Cordoba Province (Martori and Aun 1995. Acta Zool. Lilloana 43[1]:87–97). Previously known only from the eastern slope of Sierras Grandes de Córdoba Mountains and related formations in Córdoba Province.

Submitted by: **CRISTIAN HERNAN FULVIO PEREZ** (e-mail: liolaemu@criba.edu.ar), Julián Álvarez 1182 "A," 8000 Bahía Blanca, Buenos Aires, Argentina; **EBER CRISTIAN GASTON LOPEZ** (e-mail: gclopez@criba.edu.ar), Barrio Los Paraísos, Manzana 262, Casa 4, 5700, San Luis, Argentina; and **LUCIANO JAVIER AVILA** (e-mail: avila@cenpat.edu.ar), CENPAT-CONICET, Boulevard Almirante Brown s/n, U9120ACV, Puerto Madryn, Chubut, Argentina.

EUMECES FASCIATUS (Five-lined Skink). USA: ARKANSAS: LONOKE CO: 2.2 km E. Ward (T5N, R9W, S25). 22 August 2004. Kelly E. McKenzie. Verified by Stanley E. Trauth. Arkansas State University Museum of Zoology Herpetological Collection (ASUMZ 28735). New county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **MICHAEL V. PLUMMER**, Department of Biology, Box 12251, Harding University, Searcy, Arkansas 72149, USA (e-mail: plummer@harding.edu) and **DONALD F. McKENZIE,** Wildlife Management Institute, 2396 Cocklebur Road, Ward, Arkansas 72176, USA (e-mail: wmidm@ipa.net).

EUMECES FASCIATUS (Five-lined Skink). USA: WISCONSIN: CRAWFORD CO.: Hwy F, 4 km SE of Lynxville. 5 September 2002. Brenda and Richard Rozelle. Photograph HDW-NIU 2002.10. Sect. 36 R6WT9N. Verified by Julie Ray. New county record. Extends the state distribution SW 60 km from the eastern Iowa and Sauk county records, and 105 km from Juneau Co. to the northeast. All three of these counties are within the unglaciated drift less area of Wisconsin of Casper (1996. Geographic Distributions of the Amphibians and Reptiles of Wisconsin, Milwaukee Public Mus. Interim Report of the Wisconsin Herpetological Atlas Project, 87 pp.) Found basking on a woodpile. In conversing with local naturalist Bill Peterson and other individuals from the area, HDW was informed that occasional specimens have been observed on the bluffs overlooking the Mississippi River at Lynxville and nearby areas.

Submitted by **HARLAN D. WALLEY**, Department of Biology, Northern Illinois University, Dekalb, Illinois 60115, USA (e-mail: hdw@niu.edu), and **BRENDA L. ROZELLE**, N835 Hwy N.,Whitwater, Wisconsin 53190, USA.

GONATODES PETERSI. VENEZUELA: ZULIA: Municipio Mara, Sierra de Perijá, Fundo "La Orchila" (10°48'N, 72°21'W), 230 m. 29 May 2004. C. Hernández González. Museo de Biología de La Universidad del Zulia, Maracaibo (MBLUZ-R-0799). Verified by T. Barros Blanco. This poorly known gekkonid is an en-

demic from the Perijá Range, previously known from La Misión del Tokuko, Kasmera, and Kunana—localities on the eastern slopes of the southern Perijá Range (Donoso-Barros 1967. Notic. Mens. Mus. Nac. Hist. Nat. Santiago de Chile 11[129]: one page unnumbered.; Donoso-Barros 1968. Carib. J. Sci. 8[3–4]:105–122.; Peters and Donoso-Barros 1986. Catalogue of the Neotropical Squamata. Part II. Lizards and Amphisbaenians [Revised Edition], Smithsonian Institution Press, Washington D.C., 293 pp.; Rivero-Blanco 1979. The Neotropical Lizard Genus *Gonatodes* Fitzinger [Sauria: Spaherodactylinae]. Unpubl. Ph.D. thesis, Department of Biology, Texas A&M University, Texas, 233 pp.). Northernmost locality for this species, extending the distribution ca. 117 km (airline) N from the known range.

Submitted by **FERNANDO J. M. ROJAS-RUNJAIC** (e-mail: rojas_fernando@hotmail.com) and **EDWIN E. INFANTE RIVERO** (e-mail: edwinfantembluz@hotmail.com), La Universidad del Zulia, Facultad Experimental de Ciencias, Museo de Biología de La Universidad del Zulia, Sección de Herpetología, Apartado Postal 526, Maracaibo 4011, Venezuela.

HEMIDACTYLUS LONGICEPHALUS (Long-headed Tropical House Gecko). EQUATORIAL GUINEA: PROVINCE WELE-NZAS: Parque Nacional Los Altos de Nsork: 01°13'52.4"N, 11°00'53.4"E, 600 m asl. 4 April 2003. Twan Leenders. Yale Peabody Museum of Natural History (YPM 14399). Verified by Aaron M. Bauer. Loveridge (1947. Bull. Mus. Comp. Zool. 98:1–469) roughly outlines the distribution of *Hemidactylus longicephalus* as "Angola north to British Cameroons east to Lake Tanganyika" and mentions several specific localities in countries within this range, but not Equatorial Guinea. Although expected there, no voucher specimens of this species had been collected from Equatorial Guinea. This specimen represents the first record of this species for mainland Equatorial Guinea, and extends the confirmed range of this species from the nearest vouchered locality in Cameroon, ca. 250 km to NNE (Perret 1963. Rev. Suisse Zool. 70:47–60).

Submitted by **TWAN A.A.M. LEENDERS**, Division of Vertebrate Zoology, Yale Peabody Museum of Natural History, 170 Whitney Avenue, P.O. Box 208118, New Haven Connecticut 06520-8118, USA; e-mail: leendersa@sacredheart.edu.

MABUYA DORSIVITTATA. BRAZIL: SANTA CATARINA: FLORIANÓPOLIS MUNICIPALITY: Ilha de Santa Catarina: Restinga da Joaquina (27°35'36"S, 48°35'56"W). 10 December 2003. D. Vrcibradic, C. F. D. Rocha, V. A. Menezes, and C. V. Ariani. Museu Nacional, Rio de Janeiro (MNRJ 11117). Verified by R. Fernandes. This species has been reported from Argentina, Paraguay, Uruguay, Bolivia, and Brazil (Peters and Donoso-Barros 1970. Catalogue of the Neotropical Squamata. Part II. Lizards and Amphisbaenians. Bull U.S. Natl. Mus. 297:1–293; Cei 1993. Monogr. Mus. Reg. Sci. Nat. Torino 14:1–949; Lema 1994. Comunic. Mus. Ciênc. Tecnol. PUCRS, Sér. Zool. 7:41–150). In Brazil, it is known from Rio de Janeiro state to the south (Dunn 1935. Proc. Acad. Nat. Sci. Philadelphia 87:533–577), but there are few literature records giving precise Brazilian localities. These include records from the montane region of Itatiaia in Rio de Janeiro state and from a few localities in the states of São Paulo and Rio Grande do Sul (Dunn, *op. cit.*; Gallardo 1968. Rev. Mus. Argentino Cs. Nats., Zool. 9:177–196), one record from Castro, in Paraná state (Bérnils and Moura-Leite 1990. Arq. Biol. Tecnol. 33:469–480), and a few records from montane and inland localities in Rio Grande do Sul state (Lema, *op. cit.*). Ilha de Santa Catarina is a large continental island separated from the mainland by about 0.5 km at the closest point. This note provides the first insular record for the species and also the first vouchered record from the state of Santa Catarina.

Submitted by **DAVOR VRCIBRADIC, CARLOS FREDERICO D. ROCHA, VANDERLAINE AMARAL DE MENEZES,** and **CRISTINA VALENTE ARIANI,** Departamento de Ecologia, Instituto de Biologia, Universidade do Estado do Rio de Janeiro, Rua São Francisco Xavier 524, 20550-011, Rio de Janeiro, RJ, Brazil.

PHYLLOPEZUS PERIOSUS. BRAZIL: CEARÁ: NOVA JAGUARIBARA (05°35'26.3"S, 38°26'40.7"W). 19 March 2004. Museu de Zoologia da Universidade de São Paulo (MZUSP 93989). Adult specimen (SVL 10.26 cm, TL 11.2 cm) collected in fractured boulders. Verified by H. Zaher. Previously known only from semi-arid northeastern Brazil, in the states of Alagoas (Piranhas), Paraiba (Cabaceiras and Congo), Pernambuco (Sítio dos Nunes and Ibimirim), and Rio Grande do Norte (Serra Negra do Norte) (Rodrigues 1986. Pap. Avuls. Zool. 36[20]:237–250; Freire et al 2000. Herpetol. Rev. 31:54). First state record, extends the known distribution 175 km NW from the closest known locality in Serra Negra do Norte, state of Rio Grande do Norte (Freire et al., *op. cit.*),

Submitted by **IGOR JOVENTINO ROBERTO** and **PAULO THIERES PINTO DE BRITO**, Associação de Pesquisa e Preservação de Ecossitemas Aquáticos – AQUASIS. Rua Praia de Iparana, SESC Iparana, Iparana, 61600-000, Caucaia, Ceará, Brazil.

SERPENTES

AGKISTRODON CONTORTRIX (Copperhead). USA: TEXAS: FRANKLIN CO: 12.1 km SE Mount Vernon at Walleye Park on Lake Cypress Springs. 4 September 2004. M. L. Cameron. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28726). Verified by Stanley E. Trauth. New county record completely filling county distributional hiatus in east and eastcentral Texas (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station, 421 pp.; Werler and Dixon 2000. Texas Snakes: Identification, Distribution, and Natural History. Univ. of Texas Press, Austin, 437 pp.). Juvenile specimen collected within reported zone of intergradation of *A. c. contortrix* x *A. c. laticinctus* (Gloyd and Conant 1990. Snakes of the *Agkistrodon* complex. SSAR Contributions in Herpetology No. 6:1–614).

Submitted by **MICHELLE L. CAMERON, STEPHANIE F. BARCLAY,** and **CHRIS T. McALLISTER,** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA; e-mail: chris.mcallister@tamut.edu.

AGKISTRODON PISCIVORUS LEUCOSTOMA (Western Cottonmouth). USA: TEXAS: LEE CO. / BURLESON CO.: Yegua Creek above Lake Summerville. Collected in March 2003. Natu-

ral History Museum, University of Kansas color slide (KU CT-11922). Verified by John E. Simmons. This specimen was collected in the middle of Yegua Creek. This species has not been recorded previously from Lee County (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station, 421 pp.). Yegua Creek represents the border between the two counties.

Submitted my **WILLIAM B. MONTGOMERY,** P.O. Box 656, Elgin, Texas 78621, USA; e-mail: montgomery6@earthlink.net.

BOTHRIOPSIS TAENIATA (Speckled Forest-pitviper). GUYANA: Mazaruni-Potaro District, Wokomung Massif, lat. 05°04'03.3" by long. 59°51'44.8", ca. 1135 m elev. 16 July 2003. Collected about 1 m off the ground in cloud forest vegetation by the David Clarke Smithsonian botanical expedition and given to D. Bruce Means. Two 35mm slides deposited in Florida Museum of Natural History Museum (UF-142004). Verified by William W. Lamar. First record of species in Guyana and extends range about 105 km E of closest previously known location in the saddle between Cerro Kukenan and Mt. Roraima, Estado Bolivar, Venezuela (Means 1994. South American Explorer 36:23–29; Campbell and Lamar 2004. The Venomous Reptiles of the Western Hemisphere. Vol. I. Cornell Univ. Press, Ithaca, New York). The record is notable because it fills a distributional gap between Suriname on the east and Venezuela on the west.

Submitted by **D. BRUCE MEANS**, Coastal Plains Institute and Land Conservancy, 1313 Milton Street, Tallahassee, Florida 32303, USA.

ECHINANTHERA MELANOSTIGMA. BRAZIL: MINAS GERAIS: Municipality of Ouro Preto (20°23'S, 43°30'W, ca. 1159 m elev.), area of transition between Atlantic Forest and "Cerrado" biomes. Two specimens from Estação Ecológica do Tripuí collected 13 June 2000 by A. L. Silveira (Laboratório de Zoologia dos Vertebrados, Universidade Federal de Ouro Preto, Ouro Preto, Minas Gerais, Brazil; LZVUFOP 030 S) and Parque Estadual do Itacolomi collected in 1999 by A. S. Guimarães Neto (LZVUFOP 376 S). Verified by R. Fernandes (Museu Nacional / UFRJ, Rio de Janeiro). Previously known from southeastern Bahia, Rio de Janeiro and mid-east of São Paulo, Brazil, in Atlantic Forest near coastline (Di-Bernardo 1992. Comun. Mus. Ciênc. PUCRS, sér. zool. 5[13]:225–256). First state record, extends known distribution ca. 235 km NW from the previous closest record (Brazil, Rio de Janeiro, Teresópolis; IB 41042) (Di-Bernardo, *op. cit.*).

Submitted by **ADRIANO LIMA SILVEIRA**, Setor de Herpetologia, Departamento de Vertebrados, Museu Nacional / Universidade Federal do Rio de Janeiro, Quinta da Boa Vista, São Cristóvão, CEP 20940-040, Rio de Janeiro, RJ, Brazil (e-mail: biosilveira@yahoo.com.br); **MARIA RITA SILVÉRIO PIRES,** Laboratório de Zoologia de Vertebrados, Instituto de Ciências Exatas e Biológicas, Universidade Federal de Ouro Preto, Campus Morro do Cruzeiro, CEP 35400-000, Ouro Preto, MG, Brazil (e-mail: mritasp@iceb.ufop.br); and **GISELLE AGOSTINI COTTA**, Serviço de Animais Peçonhentos, Fundação Ezequiel Dias, Rua Conde Pereira Carneiro, nº 80, Bairro Gameleira, CEP 30510-010, Belo Horizonte, MG, Brazil (e-mail: crotalus@funed.mg.gov.br).

ELAPHE PRASINA (Green Bush Rat Snake). THAILAND: TAK PROVINCE: Muang Tak District: 30 km SW of Tak; ca. 700 m asl. 1 August 2003. G. Vogel. Institut Royal des Sciences Naturelles de Belgique (IRSNB 16981). Verified by Georges Lenglet (IRSNB). Juvenile male (SVL 278 mm, tail L 98 mm) found dead on a small road at the edge of old secondary forest. First provincial record. The closest Thai records are situated ca. 230 km ENE in Loei Province (Schulz 1996. A Monograph of the Colubrid Snakes of the Genus *Elaphe* Fitzinger. Koeltz Scientific Books, Havlickuv Brod, iii + 439 pp.; Manthey and Grossmann 1997. Amphibien und Reptilien Südostasiens. Natur und Tier – Verlag, Münster, 512 pp.; Chan-ard et al. 1999. Amphibians and Reptiles of Peninsular Malaysia and Thailand. An Illustrated Checklist. Bushmaster Publications, Würselen, 240 pp.; Schulz and Grossmann 2000. Sauria 22[2]:31–36). Even including the present findings, records of *E. prasina* in Thailand are confined to the two northern provinces of Loei and Tak, although the species is broadly distributed outside the country, from eastern India to Peninsular Malaysia. We thank Tanya Chan-ard (National Science Museum, Pathumthani) for useful information.

Submitted by **GERNOT VOGEL**, Im Sand 3, 69115 Heidelberg, Germany (e-mail: gernot.vogel@t-online.de), and **OLIVIER S. G. PAUWELS,** Department of Recent Vertebrates, Institut Royal des Sciences Naturelles de Belgique, Rue Vautier 29, 1000 Brussels, Belgium (e-mail: osgpauwels@yahoo.fr).

ELAPHE VULPINA (Western Fox Snake). USA: WISCONSIN: CRAWFORD CO: Specimen found DOR at Lynxville. HDW-NIU 1937. Sect. 23, T9N, R6W. 25 May 2003. Alan Hagensick and Jeff Hughes. Verified by Julie Ray. New county record (Casper 1996. Geographic Distributions of the Amphibians and Reptiles of Wisconsin. Interim Report Wisconsin Herpetological Project, Milwaukee Public Museum. 87 pp.), previously having been taken in adjacent Grant, Richland, and Vernon counties.

Submitted by **HARLAN D. WALLEY,** Department of Biology, Northern Illinois, Dekalb, Illinois 60115, USA (e-mail: hdw@niu.edu), and **JORDAN R. WALLEY**, Department of Biology, Northern Illinois University, Dekalb, Illinois 60115, USA, and 640 East McKinley Street, Hinckley, Illinois 60520, USA.

ERYTHROLAMPRUS MIMUS MICRURUS (False Coral Snake). ECUADOR: PROVINCIA DE BOLÍVAR: San Luis de Pambil (79°14'W, 01°15'S, ca. 300 m). 21 February 1992. C. Cabrera. Universidad San Francisco de Quito and Fundación Herpetológica Orcés, Quito, Ecuador. (FHGO-USFQ 429). Verified by J. M. Touzet. *Erythrolamprus mimus micrurus* occurs from Panama to western Ecuador (Dunn and Bailey 1939. Bull. Mus. Comp. Zool. 86:12; Peters 1960. Bull. Mus. Comp. Zool. 122:9). First province record, extending distribution ca. 70 km S from nearest known locality in the province of Los Ríos (Perez-Santos and Moreno 1991. Serpientes de Ecuador. Monogr. XI. Mus. Reg. Scien. Nat. Torino. 540 pp.). The species was previously known in Ecuador from the provinces of Esmeraldas, Los Ríos. and Pichincha (Peters 1957. Amer. Mus. Novitates 1851; Peters 1960, *op. cit.*; Perez-Santos and Moreno, *op. cit.*; Kuch and Freire 2002. Herpetozoa 15[3/4]: 182).

Submitted by **DIEGO F. CISNEROS-HEREDIA**, College of Biological and Environmental Sciences, Universidad San Francisco

de Quito, Ave. Interoceánica y calle Diego de Robles, Campus Cumbayá, Edif. Maxwell, Casilla Postal 17-12-841, Quito, Ecuador; e-mail: diegofrancisco_cisneros@yahoo.com.

HYPSIGLENA TORQUATA (Nightsnake). USA: WASHINGTON: DOUGLAS Co: Moses Coulee/Palisades Rd., ca. 13.8 km NE of junction with State Route 28, elevation: ca. 306 m (UTM 11 277744 E 5251432N, 47°22.7'N, 119°56.6'W). DOR female (CWU 1678, 330 mm SVL, 14 g) collected 23 July 2004. Robert E. Weaver. Verified by David M. Darda. Some regional field guides depict the range of *Hypsiglena torquata* throughout Douglas County (Storm et al. 1995. Reptiles of Washington and Oregon, Seattle Audubon Society, Seattle. 176 pp.). However, this specimen represents the first record from within the county (Washington State Herp Atlas 2003. Washington Natural Heritage Program, Washington Dept. Fish and Wildlife, and USDI Bureau of Land Management [http:// www.dnr.wa.gov/nhp/refdesk/herp/] Nussbaum et al. 1983. Amphibians and Reptiles of The Pacific Northwest. Univ. Idaho Press, Moscow. 337 pp.).

Submitted by **ROBERT E. WEAVER**, Department of Biological Sciences, Central Washington University, 400 East University Way, Ellensburg Washington, 98926-7537, USA; e-mail: weaverr@cwu.edu.

LEPTOTYPHLOPS DIMIDIATUS. BRAZIL: MINAS GERAIS: Municipality of Ouro Preto (20°23'S, 43°30'W, ca. 1100 m elev.), Estação Ecológica do Tripuí, an area of transition between Atlantic Forest and "Cerrado" biomes. 1999. A. S. Guimarães Neto. Laboratório de Zoologia dos Vertebrados, Instituto de Ciências Exatas e Biológicas, Universidade Federal de Ouro Preto, MG, Brazil (LZVUFOP 372 S). Verified by R. Fernandes. Species known from Guyana, Suriname, southeastern Venezuela, and northern Brazil in the Rupununi Savanna and its extension, usually in only slightly elevated coastal areas (McDiarmid et al. 1999. Snake Species of the World: A Taxonomic and Geographic Reference, volume 1. The Herpetologists' League, Washington. 511 pp.). First record for the State of Minas Gerais, southeastern Brazil and the "Cerrado" biome, extending the known distribution southeast limit, ca. 3300 km of the previous record (type locality: Brazil, Roraima, São Marcos near confluence of the Rios Uriracuera and Tacatu, both tributaries of the Rio Branco) (Peters and Orejas-Miranda 1970. Catalogue of the Neotropical Squamata: Part I Snakes. U. S. Natl. Mus. Bull. 297:169).

Submitted by **ADRIANO LIMA SILVEIRA**, Setor de Herpetologia, Departamento de Vertebrados, Museu Nacional / Universidade Federal do Rio de Janeiro, Quinta da Boa Vista, São Cristóvão, CEP 20940-040, Rio de Janeiro, RJ, Brazil (e-mail: biosilveira@yahoo.com.br); **MARIA RITA SILVÉRIO PIRES,** Laboratório de Zoologia de Vertebrados, Instituto de Ciências Exatas e Biológicas, Universidade Federal de Ouro Preto, Campus Morro do Cruzeiro, CEP 35400-000, Ouro Preto, MG, Brazil (e-mail: mritasp@iceb.ufop.br); and **GISELLE AGOSTINI COTTA**, Serviço de Animais Peçonhentos, Fundação Ezequiel Dias, Rua Conde Pereira Carneiro, nº 80, Bairro Gameleira, CEP 30510-010, Belo Horizonte, MG, Brazil (e-mail: crotalus@funed.mg.gov.br).

LEPTOTYPHLOPS SUNDEWALLI GESTRI (Sundevalls Worm Snake). CAMEROON: SOUTHWEST PROVINCE: Nyasoso (Mt Kupe): 4°49'85"N, 9°41'25"E, 910 m asl. In garden. 5 January 2003. Patricia A. Herrmann. Verified by Wolfgang Böhme. Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany (ZFMK 82153). Second record from Cameroon and northernmost locality by an extension of ca. 100 km. The first specimen (one of the type series of *Glauconia gestri*) was collected from Buea (Boulenger 1906. Ann. Mus. civ. Stor. Nat. Genova 2:196–216). Although the species has been mentioned for Cameroon by Perret (1961. Bull. Soc. Neuchateloise Sci. nat. 84:133–138) and Hughes (1983. Bonn. Zool. Beitr. 34:311–356), we were unable to trace any vouchers.

Submitted by **HANS-WERNER HERRMANN**, Center for Reproduction of Endangered Species (CRES), Zoological Society of San Diego, PO Box 120551, San Diego, California 92112-0551, USA (e-mail: hwherrmann@sandiegozoo.org), **PATRICIA A. HERRMANN**, Messa, Yaounde, Cameroon, and **VAN WALLACH**, Museum of Comparative Zoology, Harvard University, 26 Oxford Street, Cambridge, Massachusetts 02138, USA.

LIOTYPHLOPS ALBIROSTRIS. VENEZUELA: ZULIA: Municipio Insular Padilla, Isla de Toas (10°76'N, 72°40'W), 3 m. 1 December 1997. A. Rincón Rincón. Museo de Biología de La Universidad del Zulia, Maracaibo (MBLUZ-R-0736); Municipio Mara, Sierra de Perijá, Fundo "La Orchila" (10°48'N, 72°21'W), 200 m. 13 November 2003. Fernando Rojas-Runjaic. (MBLUZ-R-0768). Both verified by T. Barros Blanco. The range of this neotropical species includes southern Central America and northern South America (McDiarmid et al. 1999. Snake Species of the World: A Taxonomic and Geographic Reference, Volume I, The Herpetologists' League, Washington, DC, 511 pp.). Its distribution in Venezuela includes the Capital District, Vargas, and Miranda up to Mérida and Maracaibo states (Barros 1991. V Jornadas Científicas, Universidad del Zulia, Facultad Experimental de Ciencias, Resúmenes, 68 pp; Barros and Soler 1990. II Congreso Latinoamericano de Herpetología, Libro de Resúmenes, 114 pp.; Dixon and Kofron 1983. Amphibia-Reptilia 4:241–264; Lancini 1986. Serpientes de Venezuela [Armitano, Ed.], 262 pp.; Lancini and Kornacker 1986. Die Schlangen von Venezuela [Verlag Armitano, Eds.], 381 pp.; Markezich 2002. Herpetol. Rev. 33:69–74; Roze 1952. Mem. Soc. Cienc. Nat. La Salle 12[32]:143–158; Roze 1966. La Taxonomía y Zoogeografía de los Ofidios de Venezuela, Ed. Biblioteca, Caracas, 362 pp.). Previous records from Zulia State are from the Lagunillas and Maracaibo municipalities (Barros and Soler, *op. cit.*; Barros, *op. cit.*). This record extends the distribution ca. 90 km (airline) W and ca. 33 km (airline) N of the previous westernmost locality, and establishes the presence of the species in the Perijá Range and on Toas Island.

Submitted by **FERNANDO J. M. ROJAS-RUNJAIC** (e-mail: rojas_fernando@hotmail.com) and **EDWIN E. INFANTE RIVERO** (e-mail: edwinfantembluz@hotmail.com), La Universidad del Zulia, Facultad Experimental de Ciencias, Museo de Biología de La Universidad del Zulia, Sección de Herpetología, Apartado Postal 526, Maracaibo 4011, Venezuela.

LIOTYPHLOPS TERNETZII. URUGUAY: Dpto. Río Negro: M´Bopicuá, Estancia Eufores (32°57'S, 58°07'W). November

2000. J. S. Villalba. Colección Zoología Vertebrados, Reptiles, Facultad de Ciencias, Montevideo (ZVC-R 5993, adult male). Previously known from San Pablo, Brasilia, Matto Grosso, Goiás, Paraná, and Pará, Brazil; S of Misiones, Corrientes, and Entre Ríos, Argentina; Paraguay and Uruguay (Koslowsky 1898. Revta. Museo de La Plata, 8:161–200; Peters and Orejas-Miranda 1970. Catalogue of the Neotropical Squamata: Part. I. Snakes. Smithsonian Institution, U.S. Nat. Hist. Mus. 297: viii + 347 pp.; Cunha and Nascimento 1975. Bol. Mus. Paraense E. Goeldi 82:1–8; Melgarejo and Meneghel 1985. Bol. Soc. Zool., Uruguay, 2da época. 2:12–17; Bergna et al. 1992. FACENA 8:101–110; Cunha and Nascimento 1993. Bol. Mus. Para. Emílio Goeldi, sér. Zool. 9[1]:1–191; Kretzschmar 1998. Herpetol. Rev. 29:114; Giraudo 2001. Serpientes de la selva Paranaense y del chaco Húmedo. L.O.L.A., Buenos Aires, 328 pp.). Second country record, extends known distribution ca. 150 km S from Ciudad de Salto (31°23'S; 57°58'W), Dpto. Salto, Uruguay, (Melgarejo and Meneghel, *op. cit.*). The nearest population is from Entre Ríos, Argentina, from the other side of the Uruguay River (Kretzschmar, *op. cit.*).

Submitted by **SANTIAGO CARREIRA**, Sección Zoología Vertebrados, Facultad de Ciencias, Iguá 4225, CP 11400, Montevideo, Uruguay; e-mail: carreira@fcien.edu.uy.

LYSTROPHIS NATTERERI. BRAZIL: MINAS GERAIS: Municipality of João Pinheiro (17°44'S, 46°11'W, 720 m elev.). 2001. A. L. Silveira. Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil (MNRJ 11305). Municipality of Três Marias (18°12'S, 45°15'W, 740 m elev.). 20 November 1987. G. Kisteumacher, M. Porto, and L. C. Carcerelli. Museu Nacional (MNRJ 4615, 8202). Verified by R. Fernandes. Previously known in the states of Piauí, Distrito Federal, Mato Grosso, Goiás, São Paulo, Paraná, and Bahia, Brazil (Hoge et al. 1975. Mem. Inst. Butantan 39:37–50; Argôlo 2002. Herpetol. Rev. 33:150). First record for the State of Minas Gerais, ca. 317 km E of the closet previous record (Brazil, Goiás, Ipameri; IBH 33.107) (Hoge et al., *op. cit.*).

Submitted by **ADRIANO LIMA SILVEIRA** (e-mail: biosilveira@yahoo.com.br), **ELIZA RIBEIRO COSTA,** and **LOUISE MAY SALLES**, Setor de Herpetologia, Departamento de Vertebrados, Museu Nacional / Universidade Federal do Rio de Janeiro, Quinta da Boa Vista, São Cristóvão, CEP 20940-040, Rio de Janeiro, RJ, Brazil.

OPHEODRYS AESTIVUS (Rough Greensnake). USA: TEXAS: Lee Co.: CR 316, 2 miles N of FM 696, 10 miles W of Lexington. Hugh Brown Wildlife Sanctuary. May 2003. Natural History Museum, University of Kansas color slide (KU CT-11921). Verified by John E. Simmons. This species has not been recorded previously from Lee County (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station).

Submitted by **WILLIAM B. MONTGOMERY**, P.O. Box 656, Elgin, Texas 78621, USA; e-mail: montgomery6@earthlink.net.

RHACHIDELUS BRAZILI. BRAZIL: MINAS GERAIS: Municipality of João Pinheiro (17°44'S, 46°11'W, 720 m elev.), area of "Cerrado." 31 January 2001. A. L. Silveira. Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil (MNRJ 11404). Verified by Ronaldo Fernandes. Previously known from São Paulo, Goiás, Distrito Federal, and Rio Grande do Sul, Brazil and Misiones, Argentina (Peters and Orejas-Miranda 1970. Catalogue of the Neotropical Squamata: Part I Snakes. U.S. Natl. Mus. Bull. 297:261; Fernandes and Passos 2002. Herpetol. Rev. 33:150; Nogueira 2001. Herpetol. Rev. 32:285–287). First state record, ca. 285 km SE from the closest previous record (Brazil, Distrito Federal, Brasília Municipality; CHUNB 03886) (Nogueira, *op. cit.*) and ca. 637 km N from the type locality (Brazil, São Paulo, near São Paulo Municipality) (Peters and Orejas-Miranda, *op. cit.*).

Submitted by **ADRIANO LIMA SILVEIRA**, Setor de Herpetologia, Departamento de Vertebrados, Museu Nacional / Universidade Federal do Rio de Janeiro, Quinta da Boa Vista, São Cristóvão, CEP 20940-040, Rio de Janeiro, RJ, Brazil; e-mail: biosilveira@yahoo.com.br.

REGINA RIGIDA SINICOLA (Gulf Crayfish Snake). USA: ARKANSAS: Lonoke Co: 2.2 km E Ward (T5N, R9W, S25). 14 August 2004. Patrick F. McKenzie. Verified by Stanley E. Trauth. Arkansas State University Museum of Zoology Herpetological Collection (ASU 28703; photo voucher). Juvenile female captured at edge of farm pond. New county record and fills gap in known range (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville, 421 pp.).

Submitted by **MICHAEL V. PLUMMER**, Department of Biology, Box 12251, Harding University, Searcy, Arkansas 72149, USA (e-mail: plummer@harding.edu), and **DONALD F. McKENZIE**, Wildlife Management Institute, 2396 Cocklebur Road, Ward, Arkansas 72176, USA (e-mail: wmidm@ipa.net).

SISTRURUS MILIARIUS STRECKERI (Western Pigmy Rattlesnake). USA: OKLAHOMA: McIntosh Co.: 9.7 km N Eufaula off Oklahoma St. Hwy 150. 11 September 2004. C. T. McAllister. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28732). Verified by Stanley E. Trauth. New county record partially filling distributional gap between previous records in adjacent Haskell, Hughes, Muskogee, Okfuskee, and Okmulgee counties (Webb 1970. Reptiles of Oklahoma. Univ. Oklahoma Press, Norman, Oklahoma, 370 pp.; Secor and Carpenter 1984. Oklahoma Herp. Soc. Spec. Publ. 1:1–57; Sam Noble Oklahoma Museum of Natural History Database of Reptiles ([http://www.snomnh3.ou.edu/db/reptiles/Action.Lasso]; Oklahoma Biological Survey's Distribution of Oklahoma Amphibians and Reptiles by Recorded Sightings, DOKARRS [http://www.biosurvey.ou.edu/dokadesc.html]). Adult specimen found beneath wooden board at dump site.

Submitted by **CHRIS T. McALLISTER**, Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA; e-mail: chris.mcallister@tamut.edu.

THAMNOPHIS RADIX (Plains Gartersnake). USA: WISCONSIN: Crawford Co.: Floodwater marsh bordering the Mississippi River, Lynxville. Three specimens collected from a marshy area bordering the Mississippi River backwaters, near Withey's. Two specimens were used for blood samples, and the third specimen was kept as a voucher specimen HDW–NIU 1936. 43°14.621'N, 981°03.347'W, Sect. 23, T9N, R6W. 26 April 2003. Alan Hagensick and Jeff Hughes. Verified by Richard King. New county record,

extending the range westward from Iowa County. (Casper 1996. Geographic Distributions of the Amphibians and Reptiles of Wisconsin. Interim Report Wisconsin Herpetological Atlas Project, Milwaukee Public Museum. 87 pp.).

Submitted by **HARLAN D. WALLEY** and **JORDAN R. WALLEY,** Department of Biology, Northern Illinois University, Dekalb, Illinois 60115, USA, and 640 East McKinley Street, Hinckley, Illinois 60520, USA.

TRACHYBOA BOULENGERI (Northern Eyelash Boa). ECUADOR: PROVINCIA DE ESMERALDAS: Bilsa Reserve, Mache Chindul Hills (79°45'W, 00°22'S). 7 January 2000. D. Dávalos. Universidad San Francisco de Quito and Fund. Herpetológica Orcés, Quito (FHGO-USFQ 2687–8, 2976); km 17 on Lita-Alto Tambo Road (78°31'W, 00°51'N, 830 m). 14 November 1990. J.-M. Touzet. (FHGO-USFQ 374); km 5 on Lita-Ibarra Road (78°25'W, 00°49'N, 550 m). 18 February 1991. J.-M. Touzet. (FHGO-USFQ 403); Sector Las Golondrinas (79°02'W, 00°20'N, 450 m). 29 November 1994. J.-M. Touzet. (FHGO-USFQ 1121); Zapallo Grande - Río Cayapas (78°57'W, 00°54'N, 90 m). 20 November 1989 – 13 July 1992. J. C. Vieira, J. Coroso, T. Leetz. (FHGO-USFQ 135, 344, 542). Verified by J.-M. Touzet. *Trachyboa boulengeri* occurs along the Chocoan lowlands of Panamá, Colombia, and Ecuador. It has been recorded in Ecuador in the provinces of Los Ríos and Pichincha (Perez-Santos and Moreno 1991. Serpientes de Ecuador. Monogr. XI. Mus. Reg. Scien. Nat. Torino. 540 pp.). Specimens herein reported represent the westernmost locality of the species and the first record for the province of Esmeraldas, extending its range ca. 90 km NW from the nearest known locality in Pichincha and filling the gap between Colombian and Ecuadorian localities (Perez-Santos and Moreno, *op. cit.*).

Submitted by **DIEGO F. CISNEROS-HEREDIA**, College of Biological and Environmental Sciences, Universidad San Francisco de Quito, Ave. Interoceánica y calle Diego de Robles, Campus Cumbayá, Edif. Maxwell, Casilla Postal 17-12-841, Quito, Ecuador; e-mail: diegofrancisco_cisneros@yahoo.com.

TROPIDOCLONION LINEATUM (Lined Snake). USA: ILLINOIS: Jo Daviess Co.: Lost Mound Unit of the Upper Mississippi River National Fish and Wildlife Refuge. Specimen found dead on River Road ca. 0.5 km N of overlook. 1 June 2004. Kenneth D. Bowen. Verified by Fredric J. Janzen. Iowa State University Collection of Amphibians and Reptiles, ISUA 20041. First record from Jo Daviess County (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, 282 pp.).

Submitted by **KENNETH D. BOWEN**, Department of Ecology, Evolution, and Organismal Biology, Iowa State University, Ames, Iowa 50011, USA; e-mail: kbowen@iastate.edu.

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New Records for Reptiles and Amphibians from Milne Bay Province, Papua New Guinea

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The Milne Bay area and some of its adjacent islands were among the earliest parts of New Guinea to be collected for reptiles and amphibians, resulting in the descriptions of a variety of new species (Boulenger 1890, 1896, 1897, 1898a, b, 1903a, b; de Vis 1892). For the next several decades, this area was largely ignored by herpetologists until two of the American Museum of Natural History's Archbold expeditions visited Milne Bay Province for extended stays from March to November, 1953, and March, 1956 to January, 1957 (Brass 1956, 1959). These expeditions collected on Mt. Dayman, second highest peak on mainland Milne Bay Province, and on most of the major offshore islands of the province. Although trained herpetologists did not accompany either expedition, large numbers of new amphibian species were collected and later described by Zweifel (1956, 1958, 1962, 1963, 1972a, 2000). Since the Archbold expeditions, additional collecting in the province was conducted by James Menzies and some of these specimens were used in his taxonomic studies (Menzies 1987, 1993; Menzies and Tyler 1977; Menzies and Zug 1979; Menzies and Zweifel 1974; Tyler and Menzies 1971), but with little direct consideration of the herpetofaunal composition of the province per se. Lastly, fairly broad collections were made during the 1980s on some of the offshore islands by parties from the Australian Museum but have never been reported on.

Milne Bay Province, like many other districts in New Guinea, has a large number of regional endemics found nowhere else. Because of this regional endemism and a desire to survey previously unstudied locations in the province, from April, 2002 to March, 2003 we conducted a series of three expeditions to survey for reptiles and amphibians in the province. Our activities resulted in the discovery of a number of species of reptiles and amphibians new to science as well as significant range extensions for a large number of other species. We herein provide a summary of the noteworthy range extensions for known species and supplement those with important records from the previously unreported material in the Australian Museum for which we were able to verify species identification.

Acrochordus granulatus. NORMANBY ISLAND: Samoau, N end Sewa Bay, 9.9519°S, 150.9455°E, 10 m asl. 26 September 2002. F. Kraus. Bernice P. Bishop Museum (BPBM) 16510. First record for D'Entrecasteaux Islands (O'Shea 1996).

Austrochaperina palmipes. FERGUSSON ISLAND: E slope Oya Tabu, 9.4576°S, 150.7888°E, 960 m asl. 23–25 August 2002. F. Malesa and D. Salepuna. BPBM 16113-115; E slope Oya Tabu, 9.4606°S, 150.7769°E, 1400–1500 m asl. 27 August 2002. F. Malesa and D. Salepuna. BPBM 16116–118; E slope Oya Tabu,

9.4601°S, 150.7723°E, 1720 m asl. 29 August 2002. F. Malesa and D. Salepuna. BPBM 16119; S slope Oya Waka, 9.4562°S, 150.5596°E, 980 m asl. 15 September 2002. F. Kraus and F. Malesa. BPBM 16120. First records for island (Zweifel 2000).

Boiga irregularis. WOODLARK ISLAND: Guasopa, 9.2233°S, 152.9433°E, 5 m asl. 22–28 January 2003. A. Allison and native collectors. BPBM 17863–866. First record for island (O'Shea 1996).

Callulops robusta. FERGUSSON ISLAND: summit of Oya Tabu, 9.4624°S, 150.7668°E, 1830 m asl. 29 August 2002. F. Kraus and D. Salepuna. Voice recording only. Also heard at summit of Oya Waka but neither captured nor recorded. First record for island (Zweifel 1972a).

Candoia paulsoni. AMPHLETT ISLANDS: S side Wagabu Is., 9.3374°S, 150.6885°E, 1 m asl. 23 May 2002. F. Kraus and D. Mitchell. BPBM 16511. First record for island group (Smith et al. 2001). EAST CAPE: Boiaboiawaga Island, 10.2110°S, 150.9044°E, 1 m asl. 25 May 2002. F. Kraus and D. Mitchell. BPBM 16512. First record for island (Smith et al. 2001).

Carlia eothen. KILLERTON ISLANDS: Gau Hi Lama Island, 10.3502°S, 150.6633°E, 1 m asl. 26 May 2002. F. Kraus and D. Mitchell. BPBM 15887. First record for island group (Zug 2004).

Copiula minor. CLOUDY MTS.: 10.5009°S, 150.2302°E, 800 m asl. BPBM 15665–673. First record for mainland New Guinea; previously known only from Goodenough Island (Menzies and Tyler 1977).

Copiula oxyrhina. FERGUSSON ISLAND: E slope Oya Tabu, 9.4555°S, 150.7857°E, 1100 m asl. 21 August 2002. F. Kraus and D. Salepuna. BPBM 16158–160; E slope Oya Tabu, 9.4604°S, 150.7846°E, 1330 m asl. 22 August 2002. F. Kraus and D. Salepuna. BPBM 16161; E slope Oya Tabu, 9.4576°S, 150.7888°E, 960 m asl. 25 August 2002. F. Kraus and D. Salepuna. BPBM 16162; S slope Oya Waka, 9.4562°S, 150.5596°E, 980 m asl. 9–16 September 2002. F. Kraus and F. Malesa. BPBM 16163–178. First records for D'Entrecasteaux islands (Menzies and Tyler 1977). WOODLARK ISLAND: Guasopa, 9.2233°S, 152.9433°E, 5 m asl. 23–24 January 2003. A. Allison and native collectors. BPBM 18167–171; vic. Talpos River, 6.9 km N, 18.5 km W Guasopa, 9.1640°S, 152.7801°E, 100 m asl. 26 January 2003. A. Allison and native collectors. BPBM 18172–180. First records for island (Menzies and Tyler 1977).

Dendrelaphis calligastra. FERGUSSON ISLAND: Basima, 9.4683°S, 150.8315°E, 5 m asl. 3 September 2002. Native collector. BPBM 16524. First record for island (O'Shea 1996).

Dendrelaphis punctulatus. NORMANBY ISLAND: Saidowai, 9.9637°S, 150.9546°E, 5 m asl. 30 September 2002. F. Kraus. BPBM 16526; near S end Sewa Bay, 10.0380°S, 150.9817°E, 80 m asl. 26 January 2003. F. Kraus. BPBM 17245; near S end Sewa Bay, 10.0331°S, 150.9812°E, 40 m asl. 30 January 2003. K. Helgen and F. Francisco. BPBM 17246. First records for island (O'Shea 1996).

Emoia atrocostata. NORMANBY ISLAND: Guleguleu. 29 December 1988. P. German and L. Seri. Australian Museum (AMS) R-129748–753, 129773–774. First record for island (Brown 1991). *Emoia jakati*. NORMANBY ISLAND: Saidowai, 9.9637°S, 150.9546°E, 5 m asl. 30 September 2002. F. Kraus. BPBM 15957–962; Samoau, 9.9519°S, 150.9455°E, 5 m asl. 26 September 2002. F. Kraus. BPBM 15956; Sibonai, 10.1358°S, 150.9708°E, 40 m asl. 31 January 2003. F. Kraus, F. Francisco, and G. Shea. BPBM 16875–877. First records for island (Brown 1991).

Emoia longicauda. NORMANBY ISLAND: Sibonai, 10.1358°S, 150.9708°E, 40 m asl. 31 January 2003. F. Kraus, F. Francisco, and G. Shea. BPBM 16803. First record for island (Brown 1991).

Emoia obscura. FERGUSSON ISLAND: E slope Oya Tabu, 9.4524°S, 150.7970°E, 650 m asl. 31 August 2002. F. Kraus. BPBM 15963; S slope Oya Waka, 9.4632°S, 150.5576°E, 690 m asl. 9 September 2002. F. Kraus. BPBM 15964; S slope Oya Waka, 9.4562°S, 150.5596°E, 990 m asl. 14–15 September 2002. F. Kraus. BPBM 15965–966; Saibutu, 9.4692°S, 150.5471°E, 240 m asl. 19 September 2002. F. Kraus. BPBM 15967-971. NORMANBY ISLAND: Saidowai, 9.9637°S, 150.9546°E, 5 m asl. 2 October 2002. F. Kraus. BPBM 15978. CLOUDY MTS.: SW of Gadowalai, 10.4971°S, 150.2330°E, 715–770 m asl. 9-23 April 2002. F. Kraus and I. Bigilale. BPBM 15521–552. OWEN STANLEY MTS.: SE slope Mt. Pekopekowana, 10.2826°S, 150.1548°E, 590 m asl. 13 May 2002. F. Kraus and I. Bigilale. BPBM 15553–556; SE slope Mt. Pekopekowana, 10.2851°S, 150.1822°E, 330 m asl. 16 May 2002. F. Kraus and I. Bigilale. BPBM 15563–566; ca. 15 km E Alotau, 10.3136°S, 150.6222°E, 270 m asl. 22-23 September 2002. F. Kraus and B. Yawi. BPBM 15972–975. First records for each island and for SE extremity of mainland New Guinea (Brown 1991).

Emoia pallidiceps. NORMANBY ISLAND: E end Sewa Bay, 10.0330°S, 150.9771°E, 40 m asl. 28 September 2002. F. Kraus. BPBM 15982–983; near Saidowai, 9.9530°S, 150.9607°E, 40 m asl. 2 October 2002. F. Kraus and F. Malesa. BPBM 15984–987; Sibonai, 10.1358°S, 150.9708°E, 40 m asl. 31 January 2003. F. Kraus, F. Francisco, and G. Shea. BPBM 17197–200. First records for island (Brown 1991).

Emoia tetrataenia. NORMANBY ISLAND: S of Sewa Bay, 10.0394°S, 150.9814°E, 110 m asl. 26–30 January 2003. G. Shea and native collectors. BPBM 16712, 16714; 10.0331°S, 150.9840°E, 60 m asl. 30 January 2003. G. Shea and native collectors. BPBM 16713; 10.0331°S, 150.9812°E, 40 m asl. 30 January 2003. G. Shea and native collectors. BPBM 16715; Sibonai, 10.1358°S, 150.9708°E, 40 m asl. 31 January 2003. F. Kraus, F. Francisco, and G. Shea. BPBM 16716–717; Gwalalahuwa, near Guleguleu. 25 December 1988. P. German and L. Seri. AMS R-143500–502. First records for island (Brown 1991).

Gehyra mutilata. WOODLARK ISLAND: Guasopa, 9.2233°S, 152.9433°E, 5 m asl. 27–29 January 2003. A. Allison and native collectors. BPBM 17708–711. First record for island (Bauer and Henle 1994).

Gehyra oceanica. AMPHLETT ISLANDS: S side Wagabu Is., 9.3374°S, 150.6885°E, 1 m asl. 23 May 2002. F. Kraus. BPBM 15833. First record for island group (Bauer and Henle 1994). FERGUSSON ISLAND: Basima, 9.4683°S, 150.8315°E, 5 m asl. 1 September 2002. F. Kraus. BPBM 15834. First record for island (Bauer and Henle 1994). WOODLARK ISLAND: Guasopa, 9.2233°S, 152.9433°E, 5 m asl. 29 January 2003. A. Allison and native collectors. BPBM 17712–713. First record for island (Bauer

and Henle 1994).

Genyophryne thomsoni. WOODLARK ISLAND: vic. Talpos River, 6.9 km N, 18.5 km W Guasopa, 9.1640°S, 152.7801°E, 100 m asl. 26 January 2003. A. Allison and native collectors. BPBM 17780–791; Unapoi Homestead, W shore Suloga Harbor, 9.1983°S, 152.7317°E, 80 m asl. 30 January 2003. A. Allison and native collectors. BPBM 17793–796. First records for island (Zweifel 1971).

Hemidactylus frenatus. MISIMA ISLAND: Liak, 10.6607789S, 152.6854395E, 3 m asl. 11–20 January 2003. F. Kraus. BPBM 16830–833. WOODLARK ISLAND: Guasopa, 9.2233°S, 152.9433°E, 5 m asl. 23 January–1 February 2003. J. Slapcinsky. BPBM 17715–725. First records for each island (Bauer and Henle 1994).

Hemiphyllodactylus typus. PINI RANGE: Duabo, 10.4184°S, 150.3068°E, 300 m asl. 30 April 2002. F. Kraus. BPBM 15442. First record for province and southeastern peninsula of New Guinea (Bauer and Henle 1994).

Hypsilurus papuensis. NORMANBY ISLAND: Near S end Sewa Bay along Koyakakapowa [=Wasasaia] River, 10.0516°S, 150.9717°E, 50–65 m asl. 28 January 2003. Native collectors. BPBM 17251. First record for island (de Vis 1892; de Rooij 1915).

Lamprolepis smaragdina. MISIMA ISLAND: Nulia River, Liak, 10.6607789°S, 152.6854395°E, 5 m asl. 15 January 2003. F. Kraus and B. Seta. BPBM 16858. NORMANBY ISLAND: Saidowai, 9.9637°S, 150.9546°E, 5 m asl. 30 September 2002. A. Toginitu. BPBM 15995. WOODLARK ISLAND: Guasopa. 10–11 August 1987. G. Mengden. AMS R-124833, 124863, 124888; Guasopa, 9.2233°S, 152.9433°E, 5 m asl. 22–30 January 2003. A. Allison and native collectors. BPBM 17575–586. First records for each island (de Rooij 1915; Mys 1988).

Laticauda colubrina. WOODLARK ISLAND: Guasopa. 9–11 August 1987. G. Mengden and T. Flannery. AMS R-124861, 124893–894, 124901–903, 125271; vic. Guasopa, 9.2183°S, 152.944°E, 0–5 m asl. 23 January 2003. A. Allison. BPBM 17879. First records for island (O'Shea 1996).

Lechriodus aganaposis. AGAUN AREA: Munimum Village. 8 August 1992. P. German. AMS 137939. First record for province (Zweifel 1972b).

Lepidodactylus lugubris. AMPHLETT ISLANDS: S side Wagabu Island, 9.3374°S, 150.6885°E, 1 m asl. 23 May 2002. F. Kraus and D. Mitchell. BPBM 15835-839. KILLERTON ISLANDS: Gau Hi Lama Island, 10.3502°S, 150.6633°E, 1 m asl. 26 May 2002. F. Kraus and D. Mitchell. BPBM 15840. First records for each island group (Bauer and Henle 1994). WOODLARK ISLAND: Guasopa, 9.2233°S, 152.9433°E, 5 m asl. 23–27 January 2003. J. Slapcinsky. BPBM 17727–731. First record for island (Bauer and Henle 1994).

Lepidodactylus novaeguineae. EAST CAPE: Boiaboiawaga Island, 10.2110°S, 150.9044°E, 1 m asl. 25 May 2002. F. Kraus and D. Mitchell. BPBM 15841–847. First record for province and range extension of ca. 450 km from nearest record in Morobe Province (Bauer and Henle 1994; Brown and Parker 1977).

Lipinia longiceps. WOODLARK ISLAND: Sinkwarai River, 9.195°S, 152.8867°E, 5 m asl. 1 February 2003. A. Allison. BPBM 17587. GAWA ISLAND: SW side of island, 8.9783°S, 151.9709°E, 40 m asl. 1 February 2003. A. Allison. BPBM 17588. First records for each island (Günther 2000).

Lipinia noctua. NORMANBY ISLAND: Wamula. 1 January 1989. S. Donnellan. AMS R-129775. First record for island (Mys 1988; Zweifel 1979).

Litoria arfakiana. MT. SIMPSON: Bunisi Village, 10.0171°S, 149.6002°E, 1420 m asl. 16-24 February 2003. F. Kraus and B. Uruwa. BPBM 17098, 17118–124; Uga River near Bunisi Village, 10.0045°S, 149.6020°E, 1000–1400 m asl. 22 February 2003. Native collectors. BPBM 17099–110; Uga River near Gasu Village, 9.9982°S, 149.61066°E, 940 m asl. 24 February 2003. B. Uruwa. BPBM 17112–116; Etakaba Creek near Bunisi Village, 10.0290°S, 149.5947°E, 1540 m asl. 26 February 2003. F. Kraus and B. Uruwa. BPBM 17125. First records for province (Menzies and Zweifel 1974).

Litoria modica. MT. SIMPSON: Etakaba Creek near Bunisi Village, 10.0290°S, 149.5947°E, 1540 m asl. 26–27 February 2003. F. Kraus and B. Uruwa. BPBM 17894–908. First record for province (Tyler 1968).

Litoria wollastoni. FERGUSSON ISLAND: E slope Oya Tabu, 9.4576°S, 150.7888°E, 960 m asl. 19–28 August 2002. F. Kraus, F. Malesa, and D. Salepuna. BPBM 16081–111. First record for island (Menzies 1975; Menzies and Zweifel 1974; Tyler 1968).

Lobulia elegans. MT. SIMPSON: Bunisi Village, 10.0171°S, 149.6002°E, 1420 m asl. 16 February 2003. Native collectors. BPBM 16761–764; N slope Mt. Simpson, 10.0364°S, 149.5749°E, 2480 m asl. 16–21 February 2003. F. Kraus, F. Malesa, B. Uruwa, and native collectors. BPBM 16765–770, 16774–777, 16780; summit of Mt. Simpson, 10.0362°S, 149.5677°E, 2880 m asl. 18–20 February 2003. F. Malesa and native collectors. BPBM 16771–773, 16778–779; 0.5 km S Bunisi Village, 10.0209°S, 149.5947°E, 1490 m asl. 23 February 2003. Native collectors. BPBM 16781–783; Siyomu Village, 10.0145°S, 149.5970°E, 1300 m asl. 23 February 2003. Native collectors. BPBM 16784–788. First records for province (Mys 1988).

Mantophryne lateralis. NORMANBY ISLAND: Wamula. 30 December 1988. P. German and L. Seri. AMS R-129881; also heard, but uncollected, by us near Sibonai. 28 September 2002. First record for offshore islands (Menzies 1975; Zweifel 1972a).

Morelia amethistina. FERGUSSON ISLAND: Basima, 9.4683°S, 150.8315°E, 5–40 m asl. 30 August 2002. Native collectors. BPBM 16521. First record for island (O'Shea 1996).

Nyctimystes kubori. MT. SIMPSON: Uga River near Bunisi Village, 10.0244°S, 149.5902°E, 1000–1400 m asl. 26–27 February 2003. F. Kraus and native collectors. BPBM 17990–18001. First record for province and range extension of ca. 420 km from nearest reported locality at Wau (Zweifel 1980).

Nyctimystes persimilis. MT. SIMPSON: Bunisi, 10.0171°S, 149.6002°E, 1420 m asl. 15–26 February 2003. F. Kraus, B. Uruwa, and native collectors. BPBM 17909–932; along Etakaba Creek, 10.0290°S, 149.5947°E, 1540 m asl. 26 February 2003. F. Kraus and B. Uruwa. BPBM 17933–936. Range extension of ca. 40 km from only prior report at Mt. Dayman (Zweifel 1958).

Nyctimystes trachydermis. MT. SIMPSON: N slope Mt. Simpson, 10.0389°S, 149.5765°E, 2480 m asl. 18–19 February 2003. F. Kraus, B. Uruwa, F. Malesa, and native collectors. BPBM 18181–198; 10.0316°S, 149.5767°E, 2170 m asl. 20 February 2003. Native collector. BPBM 18199; MT. WANIP: Kawaya Village, 9.8667°S, 149.3833°E, 1400 m asl. 12 August 1992. P. German. AMS 137976. First records for province and range extension of ca. 370 km (Zweifel 1983).

Oreophryne inornata. FERGUSSON ISLAND: E slope Oya Tabu, 9.4604°S, 150.7846°E, 1330 m asl. 22–26 August 2002. F. Kraus, F. Malesa, and D. Salepuna. BPBM 16217–239; E slope Oya Tabu, 9.4574°S, 150.7764°E, 1480 m asl. 26 August 2002. F. Malesa and D. Salepuna. BPBM 16240–241; E slope Oya Tabu, 9.4601°S, 150.7714°E, 1770 m asl. 29 August 2002. F. Kraus and D. Salepuna. BPBM 16245; summit Oya Tabu, 9.4624°S, 150.7668°E, 1830 m asl. 28 August 2002. F. Malesa and D. Salepuna. BPBM 16243; S slope Oya Waka, 9.4562°S, 150.5596°E, 980 m asl. 9–13 September 2002. F. Kraus and F. Malesa. BPBM 16249–256. First records for island; previously known only from Goodenough Island (Zweifel 1956).

Oreophryne insulana. FERGUSSON ISLAND: E slope Oya Tabu, 9.4601°S, 150.7723°E, 1720 m asl. 29 August 2002. F. Kraus and D. Salepuna. BPBM 16548–551; summit Oya Tabu, 9.4624°S, 150.7668°E, 1830 m asl. 28 August 2002. D. Salepuna. BPBM 16546–547. First records for island; previously known only from Goodenough Island (Zweifel 1956).

Oxydactyla crassa. MT. SIMPSON: N slope Mt. Simpson, 10.0364°S, 149.5749°E, 2480 m asl. 16-21 February 2003. F. Kraus, F. Malesa, B. Uruwa, J. Slapcinsky. BPBM 17060–067, 17071–073; summit Mt. Simpson, 10.0362°S, 149.5677°E, 2880 m asl. 20 February 2003. F. Malesa. BPBM 17070. Range extension of ca. 40 km from only prior report at Mt. Dayman (Zweifel 2000).

Prasinohaema flavipes. MT. SIMPSON: Bunisi Village, 10.0171°S, 149.6002°E, 1420 m asl. Native collector. 24 February 2003. BPBM 16736; near Bunisi Village, 10.0209°S, 149.5947°E, 1490 m asl. 26 February 2003. Native collector. BPBM 16737–738. First record for province and range extension of ca. 250 km from nearest prior locality (Mys 1988; Zweifel 1980).

Prasinohaema virens. NORMANBY ISLAND: S of Sewa Bay, 10.0331°S, 150.9812°E, 40 m asl. 30 January 2003. G. Shea and native collectors. BPBM 16857. WOODLARK ISLAND: Guasopa, 9.2233°S, 152.9433°E, 5 m asl. 22–30 January 2003. A. Allison and native collectors. BPBM 17589–594. First records for each island (Mys 1988).

Ramphotyphlops braminus. TROBRIAND ISLANDS: Kiriwina. June 1970. Australian Museum collecting party. AMS R-86839–840. First record for province (O'Shea 1996).

Ramphotyphlops depressus. WOODLARK ISLAND: Guasopa, 9.2233°S, 152.9433°E, 5 m asl. 22 January 2003. J. Slapcinsky. BPBM 17889. First record for island, separated by ca. 370 km of open water from nearest populations on Bougainville and New Britain (Wallach 1996a).

Rana papua. NORMANBY ISLAND: near Sibonai, S end Sewa Bay, 10.0330°S, 150.9771°E, 40 m asl. 28–30 September 2002. F. Kraus, F. Malesa, and F. Francisco. BPBM 16317–335. First record for province (Menzies 1987, 1992).

Rana supragrisea. FERGUSSON ISLAND: E slope Oya Tabu, 9.4555°S, 150.7857°E, 1100 m asl. 22–24 August 2002. F. Kraus, F. Malesa, and D. Salepuna. BPBM 16336; E slope Oya Tabu, 9.4576°S, 150.7888°E, 960 m asl. F. Kraus, F. Malesa, and D. Salepuna. BPBM 16337–351; S slope Oya Waka, 9.4562°S, 150.5596°E, 980 m asl. 9–16 September 2002. F. Kraus and F. Malesa. BPBM 16352-358. NORMANBY ISLAND: S of Sewa Bay, 10.0406°S, 150.9826°E, 120 m asl. 27–28 January 2003. F. Kraus and G. Shea. BPBM 17126-136; 10.0394°S, 150.9822°E, 110 m asl. 29–30 January 2003. F. Kraus and G. Shea. BPBM 17137–143. First records for offshore islands (Menzies 1987).

Sphenomorphus aignanus. NORMANBY ISLAND: along Wasasaia River, S of Sewa Bay, 10.0516°S, 150.9717°E, 50 m asl. 28 September 2002. F. Kraus, F. Malesa, and F. Francisco. BPBM 16432; Wamula. 29 December 1988. P. German and L. Seri. AMS R-129746–747; 1–3 January 1989. S. Donnellan. AMS R-129770–771, 129779, 129793; WOODLARK ISLAND: Guasopa. 10 August 1987. G. Mengden. AMS R-124870; Guasopa, 9.2233°S, 152.9433°E, 5 m asl. 24 January 2003. A. Allison and native collectors. BPBM 17530; vic. Talpos River, 6.9 km N, 18.5 km W Guasopa, 9.1640°S, 152.7801°E, 100 m asl. 26 January 2003. A. Allison and native collectors. BPBM 17532–535; Sinkwarai River, 9.195°S, 152.8867°E, 5 m asl. 1 February 2003. A. Allison. BPBM 17536–537. First records for each island (Boulenger 1898b; de Rooij 1915).

Sphenomorphus forbesi. FERGUSSON ISLAND: S slope Oya Waka, 9.4562°S, 150.5596°E, 990 m asl. 12–16 September 2002. F. Kraus. BPBM 16001-005. NORMANBY ISLAND: Guleguleu. 23 December 1988. P. German and L. Seri. AMS R-129727. First records for each island (Greer 1973).

Sphenomorphus granulatus. FERGUSSON ISLAND: E slope Oya Tabu, 9.4508°S, 150.7990°E, 560 m asl. 17 August 2002. F. Kraus. BPBM 16007; E slope Oya Tabu, 9.4604°S, 150.7846°E, 1330 m asl. 23 August 2002. F. Kraus, F. Malesa, and D. Salepuna. BPBM 16008–009; E slope Oya Tabu, 9.4548°S, 150.8043°E, 220-250 m asl. F. Kraus and D. Salepuna. BPBM 16010; E slope Oya Tabu, 9.4519°S, 150.7987°E, 570 m asl. F. Kraus and D. Salepuna. BPBM 16011; S slope Oya Waka, 9.4562°S, 150.5596°E, 990 m asl. 10–16 September 2002. F. Kraus. BPBM 16014–015; S slope Oya Waka, 9.4611°S, 150.5573°E, 790 m asl. 9 September 2002. F. Kraus. BPBM 16012-013. NORMANBY ISLAND: NE end Sewa Bay, 9.9530°S, 150.9607°E, 10 m asl. 2 October 2002. F. Kraus. BPBM 16016; Guleguleu. AMS R-129785; Wamula. AMS R-129754, 129769, 129772, 129776–778. CLOUDY MTS.: along Upaelisafupi Stream, SW of Gadowalai, 10.4971°S, 150.2330°E, 715 m asl. 9-23 April 2002. F. Kraus and I. Bigilale. BPBM 15615–626; OWEN STANLEY MTS.: along Wailahabahaba Creek (trib. of Sagabada River), SE slope Mt. Pekopekowana, 10.2826°S, 150.1548°E, 590 m asl. 10 May 2002. F. Kraus and I. Bigilale. BPBM 15627–628. First records for province and range extensions of 370+ km from nearest reported localities (Mys 1988).

Sphenomorphus jobiensis. MISIMA ISLAND: Umuna mine site. 20 August 1987. G. Mengden. AMS R-125008. First record for island (Mys 1988).

Sphenomorphus minutus. FERGUSSON ISLAND: E slope Oya

Tabu, 9.4591°S, 150.7809°E, 1400 m asl. 23 August 2002. F. Kraus, F. Malesa, and D. Salepuna. BPBM 16031; E slope Oya Tabu, 9.4548°S, 150.8043°E, 220–250 m asl. 31 August 2002. F. Kraus and D. Salepuna. BPBM 16032-037; Bwedoa, 9.4518°S, 150.8099°E, 160 m asl. F. Kraus and D. Salepuna. BPBM 16038; S slope Oya Waka, 9.4611°S, 150.5573°E, 790 m asl. 9 September 2002. F. Kraus. BPBM 16039. MISIMA ISLAND: Ridge above Bwaga Bwaga, 10.6740°S, 152.6828°E, 440 m asl. 12–13 January 2003. F. Kraus, B. Seta, and native collectors. BPBM 16840–842. NORMANBY ISLAND: Samoau, 9.9519°S, 150.9455°E, 5 m asl. 26 September 2002. F. Kraus. BPBM 16040; near Saidowai, 9.9530°S, 150.9607°E, 10 m asl. 2 October 2002. F. Kraus. BPBM 16041; Guleguleu. 23 December 1988. P. German and L. Seri. AMS R-129729. CLOUDY MTS.: near Upaelisafupi Stream, SW of Gadowalai, 10.4971°S, 150.2330°E, 770 m asl. 16–24 April 2002. F. Kraus and I. Bigilale. BPBM 15655–659. First records for each island and confirms presence on adjacent mainland (Mys 1988).

Sphenomorphus nigrolineatus. CLOUDY MTS.: near Upaelisafupi Stream, SW of Gadowalai, 10.4957°S, 150.2356°E, 770 m asl. 21 April 2002. F. Kraus and I. Bigilale. BPBM 15660. OWEN STANLEY MTS: along Wailahababaha Creek (trib. of Sagabada River), SE slope Mt. Pekopekowana, 10.2826°S, 150.1548°E, 590 m asl. 11 May 2002. F. Kraus and I. Bigilale. BPBM 15661. First records for province and range extensions of ca. 300 km from nearest localities in Central Province (Greer and Parker 1974).

Sphenomorphus solomonis. FERGUSSON ISLAND: Basima, 9.4683°S, 150.8315°E, 5 m asl. 1–2 September 2002. F. Kraus. BPBM 16043–044; Bwedoa, 9.4518°S, 150.8099°E, 160 m asl. F. Kraus and D. Salepuna. BPBM 16042; Ulua, 9.4520°S, 150.8251°E, 5 m asl. 3 September 2002. F. Kraus. BPBM 16045; Awatoa River, between Basima and Ulua, 9.4601°S, 150.8306°E, 5 m asl. 3 September 2002. F. Kraus. BPBM 16046–048; S slope Oya Waka, 9.4562°S, 150.5596°E, 990 m asl. 13–17 September 2002. F. Kraus. BPBM 16049–051; Iamalele mission station, 9.5109°S, 150.5291°E. 18 September 2002. F. Kraus and F. Malesa. BPBM 16052. MISIMA ISLAND: Between Liak and Bagilina, 10.6608°S, 152.6804°E, 20 m asl. 20 January 2003. F. Kraus and native collectors. BPBM 16734–735; near Bwagaoia. 16 August 1987. G. Mengden. AMS R-124924. WOODLARK ISLAND: Guasopa, 9.2233°S, 152.9433°E, 5 m asl. 24–29 January 2003. J. Slapcinsky. BPBM 17678–679. First records for each island (Greer and Parker 1974; Mys 1988).

Stegonotus cucullatus. TROBRIAND ISLANDS: Kiriwina. June 1970. Australian Museum collecting party. AMS R-86836. First record for island group (O'Shea 1996).

Tiliqua gigas. NORMANBY ISLAND No date. S. Donnellan. AMS R-129710. First record for island (Shea 2000).

Toxicocalamus loriae. CLOUDY MTS.: near Upaelisafupi Stream, SW of Gadowalai, 10.4971°S, 150.2330°E, 715 m asl. 22 April 2002. F. Kraus. BPBM 15771. FERGUSSON ISLAND: Basima, 9.4683°S, 150.8315°E, 0–10 m asl. 3 September 2002. Native collector. BPBM 16544; S slope Oya Waka, 9.4562°S, 150.5596°E, 980 m asl. 10 September 2002. P. Robert. BPBM 16545; MT. SIMPSON: Bunisi Village, 10.0171°S, 149.6002°E, 1420 m asl. 25–26 February 2003. Native collectors. BPBM 17989, 18166; 0.5 km S Bunisi Village, 10.0209°S, 149.5947°E, 1490 m asl. 26 February 2003. Native collector. BPBM 18164; Siyomu Village, 10.0145°S, 149.5970°E, 1300 m asl. 23–26 February 2003. Native collectors. BPBM 17987–988, 18165. First records from mainland portion of province and for Fergusson Island (McDowell 1969; O'Shea 1996).

Tropidonophis statisticus. OWEN STANLEYS: SE slope Mt. Pekopekowana, 10.2806°S, 150.1721°E, 500 m asl. 8 May 2002. F. Kraus. BPBM 15160. MT. SIMPSON: Bunisi Village, 10.0171°S, 149.6002°E, 1420 m asl. Native collectors. 16–28 February 2003. Native collectors. BPBM 17293, 17299–300; 0.5 km S Bunisi Village, 10.0209°S, 149.5947°E, 1490 m asl. 23 February 2003. Native collectors. BPBM 17294–295; Siyomu Village, 10.0145°S, 149.5970°E, 1300 m asl. 24–25 February 2003. Native collectors. BPBM 17296–298. First records for province, as reported presence on Goodenough Island (Malnate and Underwood 1988; O'Shea 1996) is a misidentification of an undescribed species.

Typhlops inornatus. MT. SIMPSON: Bunisi Village, 10.0171°S, 149.6002°E, 1420 m asl. 22 February 2003. Native collector. BPBM 17236; Siyomu Village, 10.0145°S, 149.5970°E, 1300 m asl. 23 February 2003. Native collector. BPBM 17237; Ikara Village, 9.9801°S, 149.6311°E, 800 m asl. 2 March 2003. Native collector. BPBM 17238. First records for province and range extension of ca. 160 km from nearest locality in Northern Province (McDowell 1974; Wallach 1996b).

Varanus indicus. NORMANBY ISLAND: Guleguleu. 23 December 1988. P. German and L. Seri. AMS R-129730. WOODLARK ISLAND: Guasopa. 9 August 1987. G. Mengden. AMS R-124815, 124841; Guasopa, 9.2233°S, 152.9433°E, 5 m asl. 30 January–1 February 2003. A. Allison and native collectors. BPBM 18220–221. First records for each island (de Rooij 1915).

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The creation of the Illinois Herpetological Database and its subsequent publication (Phillips et al. 1999) has allowed Illinois herpetologists to quickly and easily determine areas in the state that require additional surveying. As a result, numerous contributions focusing on new records in Illinois have recently appeared in *Herpetological Review*. These studies have focused on state (Petzing et al. 2002; Petzing et al. 2000), regional (Crawford and Meyer 2002, Markezich and Beckett 2001), and county (Giazzon 2002) levels. Following this trend, we herein report new amphibian and reptile records from Pulaski County, located at the southern tip of Illinois. Specimens were collected during fall 2002 and spring 2003. All specimens were verified by C. A. Phillips and deposited in the Illinois Natural History Survey (INHS) herpetological collection. County records were verified by consulting published distributions in Phillips et al. (1999) and the Illinois Herpetological Database maintained at the Illinois Natural History Survey. The database contains information on Illinois amphibian and reptile species compiled from 30 U.S. collections as well as unvouchered records from herpetologists and other reliable sources. County level distribution data can be accessed from this database on the web at the following URL:

http://www.inhs.uiuc.edu/cbd/herpdist/herp.html

Caudata

Ambystoma maculatum (Spotted Salamander). Pulaski Co.: 1.5 km NNW of Perks, in wooded wetland W of North Boundary Rd. (NAD 83 UTM Zone 16: N4132788m E314768m). 29 October 2002. A. R. Kuhns. INHS 18694. Adult found under rotting log.

Ambystoma opacum (Marbled Salamander). Pulaski Co.: Section 8 Woods Nature Preserve (NAD 83 UTM Zone 16: N4130604m E321351m) 28 September 2002. J. A. Crawford and A. R. Kuhns. INHS 18710. Adult male found under rotting log. *A. opacum* were also encountered on the same day 7.2 km E of this site (NAD 83 UTM Zone 16: N4129961m E328500m) and 6.9 km NW (NAD 83 UTM Zone 16: N4132788m E314768m) of this site in a wooded wetland northwest of Perks on 29 October 2002.

Ambystoma talpoideum (Mole Salamander). Pulaski Co.: 1.5 km NNW of Perks, in wooded wetland W of North Boundary Rd. (NAD 83 UTM Zone 16: N4132586m E314733m). 29 October 2002. A. R. Kuhns. INHS 18695. Adult found under natural wood cover.

Anura

Pseudacris crucifer (Spring Peeper). Pulaski Co.: 1.5 km NNW of Perks in wooded wetland W of North Boundary Rd. (NAD 83 UTM Zone 16: N4132580m E314740m) 12 March 2003. A. R. Kuhns and J. A. Crawford. INHS 18818. A large chorus of this species was calling. On the same evening we also collected this species from a chorus 4.5 km WSW of this site at an ephemeral pool along Big Creek (NAD 83 UTM Zone 16: N4130341m E310746m).

Pseudacris triseriata (Western Chorus Frog). Pulaski Co.: 1.5 km NNW of Perks, in wooded wetland W of North Boundary Rd. (NAD 83 UTM Zone 16: N4132839m E314773m). 29 October 2002. A. R. Kuhns. INHS 18998. One individual found on leaf litter. Large chorus heard on 12 March 2003 at this site. On the same evening we collected this species from a chorus 4.5 km WSW of this site at an ephemeral pool along Big Creek (NAD 83 UTM Zone 16: N4130341m E310746m).

Serpentes

Agkistrodon contortrix (Copperhead). Pulaski Co.: 3 km NE of Olmstead near Chestnut Hills Nature Preserve (NAD 83 UTM Zone 16: N4119101m E316914m). 27 September 2002. A. R. Kuhns and J. A. Crawford. INHS 18784. DOR adult male.

Coluber constrictor (Racer). Pulaski Co.: 4.4 km NE of Olmstead at N entrance to Olmstead Lock and Dam (NAD 83 UTM Zone 16: N4119800m E318049m). 28 September 2002. A. R. Kuhns and J. A. Crawford. INHS 18717. DOR juvenile. Additional individuals were observed DOR 4.5 km NNE (NAD 83 UTM Zone 16: N4123943m E319860m) on 1 May 2003 and 8.6 km NNE of this site (NAD 83 UTM Zone 16: N4126703m E323240m) on 29 June 2003.

Nerodia rhombifer (Diamond-backed Watersnake). Pulaski Co.: 2.9 km E of I-57 on Shawnee College Road (NAD 83 UTM Zone 16: N4127002m E311587m). 29 June 2003. A. R. Kuhns. INHS 19032. DOR. Two DOR individuals were found at this site with the first on 1 May 2003. Because of the poor condition of both specimens, only the head and neck of the second individual was vouchered.

Acknowledgments.—We thank Jim Waycuilis for approving activities at Section 8 Woods. John Petzing and Christopher Phillips provided access to historical records at the Illinois Natural History Survey and John Petzing assisted with specimen preparation and preservation. We thank Michael Dreslik and Mathys Meyer for critically reviewing this manuscript. This project was partially funded by an Illinois Wildlife Preservation Fund of the Illinois Department of Natural Resources, Division of Natural Heritage grant #03-036W (to ARK). Specimens were collected under Illinois Department of Natural Resources permit numbers A02. 0749 and A03.0749 and Illinois Nature Preserves Commission special use permit for Section 8 Woods Nature Preserve.

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BOOK REVIEWS

Herpetological Review, 2004, 35(4), 420–422.

The Venomous Reptiles of the Western Hemisphere, by Jonathan A. Campbell and William W. Lamar. 2004. Cornell University Press, Ithaca, New York (http://www.cornellpress.cornell.edu). Vol. 1 xviii+1–476+28 pp. Vol. 2 xiv+477–870+28 pp. Hardcover, 32 cm. US $149.95. ISBN 0-8014-41-41-2.

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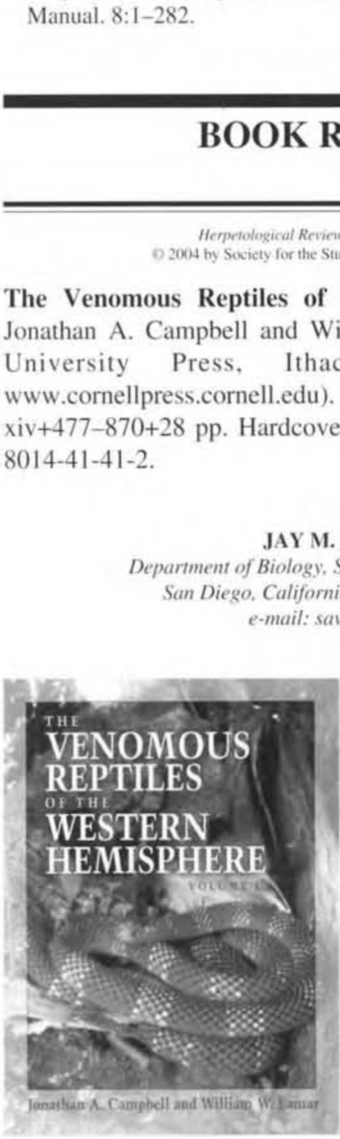

Perhaps, once in a generation a treatise in ophidology breaks new ground and sets the stage for remarkable advances in herpetology. The fascination with snakes which fuels such interest is universal among humankind, whether from fear or admiration. Most herpetologists are driven by that fascination to become scientists and to prove, often unconsciously through knowledge, their supremacy over these magnificent creatures of symbolic power. And yet that power is never diminished. The present volumes (hereafter VRWH) are an expansion and extensive revision of Campbell and Lamar's 1989 work, *The Venomous Reptiles of Latin America* (hereafter VRLA), form such a landmark in knowledge bringing to mind Boulenger's *Catalogue of Snakes in the British Museum* (1882–1896) and Klauber's *Rattlesnakes* (1956) in terms of the impact on our science.

Of dangerously venomous reptiles, aside from the two lizards treated in another catalogue, Boulenger recognized and described 61 venomous snake species for the Americas in 75 pages out of the 727 pages of his worldwide coverage. Klauber's work was more restricted in treating 30 species of rattlesnakes but in astonishing detail and breadth of coverage (1505 pp.) from morphology and biology to venoms and snakebite. Klauber's book also was enlivened by extensive quotations from his many correspondents. Compare these to the present work which consists of the detailed treatment of the two venomous lizards, one seasnake, 72 coral snakes, and 117 pitvipers , including 30 kinds of rattlesnakes. The VRWH is more comparable to Klauber's than Boulenger's work with its broader coverage of the biology, venoms, and phylogeny of the included species. Klauber's *Rattlesnakes* also consists of two volumes, has no color illustrations, only 10 distribution maps but has 52 black-and-white photographs of living snakes and 186 black-and-white figures. On average there are 50 pages for each species described in this book. The earlier Campbell and Lamar's VRLA is one volume of 437 printed pages with six color maps, 109 black-and-white distribution maps, 520 color plates, and 48 black-and-white figures. The text averages 30 pages per species. The VRWH is 959 pages in length with 8 color maps, 113 black-and-white distribution maps, 1500 color plates (1365 of reptiles) and 282 black-and-white figures. The text averages 50 pages per species.

Volume one of VRWH opens with material that introduces the reader to the two main sections of the book. A cogent justification is presented for the construction of dichotomous keys for these reptiles by political units or in the case of the United States and Canada by region. It is noteworthy that additional keys are provided for genera by family and all species by genus in the taxon accounts. This is followed by a statement on species concepts that recommends a conservative approach to recognizing diagnosable allopatric populations as distinct species. However, Campbell and Lamar regard the allopatric *Micrurus tener* as distinct from *M. fulvius*, partition *Crotalus durissus* (sensu lato) into three species, and retain binominals for two insular Brazilian pitvipers. Although subspecies are mapped and often discussed for many taxa in VRWH, the authors do not comment on the viability of this arguably passé approach for describing infraspecific variation and or their interpretation of its usage. A section provides an update of changes in taxonomy from the 1989 book that are followed in the VRWH and another an overview of material to be covered in the individual species accounts.

A major portion of this volume is formed by the Regional Accounts and Keys to Venomous Reptiles (pp. 11–91). The organization and coverage is similar to that of the 1989 opus, but now includes coverage for the United States and Canada. Eight new full-page color maps of physiography and vegetation are provided. Tables detailing the distribution of all species with reference to the maps are a valuable feature. This section has been enhanced by having some keys in both English and Spanish (United States and Canada, Colombia, Mexico, and Peru) or Portuguese (Brazil). It is not clear why this was not done for the other keys for Spanish-speaking countries in this section.

Taxon Accounts (pp. 95–616) make up the remainder of volume one (pp. 95–475) and around a third of volume two (pp. 477–616). Each of the major taxonomic groups, venomous lizards, the elapids, and pitvipers, are introduced in slightly different modes. Information for the Helodermatidae is contained in the coverage of the genus *Heloderma*. A brief section provides data on the elapids and a somewhat longer one on pitvipers. Individual generic accounts cover each genus. A key to genera in English and Spanish is provided in all cases and one in English, Spanish, and Portuguese for coral snake genera. The accounts include: synonomy, etymology, characteristics, and an extensive summary of natural history, especially activity and behavior, conservation, prey, venom, parasites, predators, reproduction, and longevity. Tables summarizing diagnostic features and/or variation in scalation and coloration are provided for most genera. This material is supported by line drawings of the skull of the least once species for most genera and usually by the illustration of the hemipenes of one or more species as well. In the case of coral snakes the natural history material for the three genera is combined into a single section but the other materials are contained in the individual generic accounts. Keys to the species in English and Spanish are included for all genera and also in Portuguese for *Leptomicrurus*, *Micrurus*, and *Bothrops*. Species accounts include: synonyms, lists of vernacular names, etymology, a detailed description, extensive coverage of distribution, habitats, comparisons to similar species, and remarks (usually relating to taxonomy and variation). Detailed black-and-white figures of color pattern and/or cephalic scalation supplement the descriptions of most taxa. Most figures are of very high quality, but some copied from other works and some photographs have poor differentiation. 1365 spectacular color photographs, most taken by the authors, illustrate every species and noteworthy variants. Distributions are shown for each species on newly constructed dot maps. Those for many species show the ranges of named subspecies. However, there is no consistency in treatment in the text. In some cases (e.g., *Crotalus lepidus*) there is a detailed discussion of subspecific features; in others (e.g., *Micrurus proximus*) none at all.

The depth of coverage in the generic and species accounts is extraordinary and supported by numerous references to the literature and the authors' own extensive field and laboratory experiences with these reptiles. Many open with a delightful, insightful, informative or dramatic quotation by an earlier author, often from the 18th or 19th century, on a particular taxon. The Remarks sections make particularly good reading as they explain some of the idiosyncracies of previous workers, shed light where only fog previously prevailed and are filled with pithy comments on the exigencies of herpetological research. The glorious coverage in the Taxon Accounts section would by itself rate VRNW as an all-time great! It deserves both a 10 for contents and 10 in style points too! But there is more to come! Completely new additions to Volume 2 are major sections on mimicry, evolutionary relationships, and two on reptile envenomations and their treatment.

E. D. Brodie IIII and E. D. Brodie, Jr. provide a conceptual overview of venomous snake mimicry (pp. 617–633) and suggest ways that its study may contribute to general mimicry theory. In addition to a summary of the current status of coral snakes mimicry, the less familiar but interesting topics of viper and acoustic mimicry and tail luring are explored. I was surprised that there was no reference to Savage and Slowinski's (1992) extensive review of the variety of color patterns in coral snakes (venomous or not). A paper by Greene and McDiarmid (2004) referenced throughout is not in the Literature Cited. The list of potential venomous coral snakes mimics (Table 53) should also include the genus *Coniophanes* (*C. lateritus* and *C. meridanus*). Additionally, *Elaphe* (see pls. 1090–91), *Leptodeira* (see pl. 1169), and *Phyllorhynchus* (see pl. 1242) could be listed both as potential coral snake and pitviper mimics. Illustrations of all mentioned snakes are included in a gallery of fine color photographs (plates 1024–1360).

R. L. Gutberlet, Jr. and M. B. Harvey author the chapter on phylogeny for this work (pp. 634–662). Phylograms for snake family relationships and relationships within the Elapidae are provided based on the most recent published analyses. Original phylograms for coral snake relationships, New World pitviper genera, and species within pitviper genera grace the chapter. Contrary to these authors, it seems likely that coral snakes were in North and South America from Paleocene on with sympatry between the two major clades only developing after the Isthmian Link was restored in Pliocene. That pitvipers did not reach South America until Pliocene seems confirmed by their analysis.

The chapter on venom poisoning in North America by R. Norris (pp. 683–708) covers venoms, their clinical features, field and hospital management, and morbidity and mortality. This chapter is a must have reference for clinicians in regions where highly venomous reptiles occur. Differences among species in venom characteristics and yields, especially for pitvipers are detailed as these are crucial factors in any treatment regimen.

A final chapter by D. Warrell (pp. 709–761) is an extensive review of snakebite occurrence, clinical features, and management for Central and South American venomous reptiles. A significant feature is an original review of 41 rear-fanged or mildly venomous colubrid snakes of the Americas known or suspected to be capable of human envenoming. Four species, *Phalotris lemniscatus*, *Philodryas olfersi*, *Tachymenis peruvianus*, and *Xenodon severus*, have been implicated in systemic and allegedly fatal bites. In several of these cases it is a small child that has died. Morrell states (p. 719) "it is questionable whether any colubrid snake can be regarded as definitely nonvenomous...." suggesting that there are toxic characteristics to oral secretions in most if not all species. Of course, the size of the snake, the nature of the saliva or venom, and the mass and physiology of the bite victim affects whether a bite is possible or will have a serious outcome. One has mixed feelings about the listing of so many snake species as possibly venomous. Certainly there is a need for some warning of possible harmful effects from bites by presumably inoffensive or mildly venomous snakes. However, one can see such a listing used to justify indiscriminate killings of harmless snakes by people who have an irrational fear of them. It is clear that some human individuals may exhibit allergic responses to the bite of a particular snake species while others will not. The great variation in saliva, venom, and human physiological sensitivity begs for focused research on supposed colubrid envenoming. The remainder of this chapter covers known envenomations by dangerously venomous American reptiles, species by species.

Treatment of victims and a thorough discussion of antivenom use and availability (Table 63) complete this section. The two chapters on snakebite are supported by a gallery of graphic and horrific color photographs (pls. 1366–1500) of snakebite injuries. These certainly should be enough to discourage beginning snakers from handling venomous reptiles. Although we all know it won't, at least it will encourage more caution.

In my review of the VRLA in 1990 I extolled the virtues of that marvelous contribution even then looking forward to a second expanded edition. The VRWH is much more than that! The breadth and depth of coverage, as illuminated by the authors' knowledge of these animals in life, makes it a truly phenomenal contribution. It is a must buy for all herpetologists. In addition, it is an essential reference for anyone interested in tropical biology and conservation, hobbyists, medical and veterinary clinicians, and field biologists. Every biology department library and every field station in the Americas should have a copy of these volumes on its shelves. To paraphrase my conclusion in my 1990 review: if you can afford only one book on venomous reptiles of the Americas buy this one! Better yet buy one for home and one for the field! Or even better, buy another and send it to a colleague in Mexico, Central or South America. To Campbell and Lamar this time around, I can only add c'est magnifique!

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Herpetological Review, 2004, 35(4), 422–424.

The Venomous Reptiles of the Western Hemisphere, by Jonathan A. Campbell and William W. Lamar, with contributions by Edmund D. Brodie III, Edmund D. Brodie Jr., Ronald L. Gutberlet Jr., Michael B. Harvey, Robert Norris, David A. Warrell, and Vinícius Xavier Da Silva. 2004. Comstock Publishing Associates, Cornell University Press, Sage House, 512 East State Street, Ithaca, New York 14850, USA. Volume I: xviii, 1–476, [28] pp., Color Plates 1–751, Volume II: xiv, 477–870, [28] pp., Color Plates 752–1500, hardcover. US $149.95. ISBN 0–8014–4141–2.

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The Venomous Reptiles of the Western Hemisphere (*VRWH*) is an expanded and updated version of *The Venomous Reptiles of Latin America* (*VRLA*), also by Campbell and Lamar (1989). *VRWH* is expanded geographically to cover the United States and Canada and taxonomically to include five new species of venomous coralsnakes and nine new species of pitvipers described since *VRLA*. In addition, "11 novel species of coralsnakes and 19 species of pitvipers have been added to the valid species list owing to recognition of certain populations or taxonomic rearrangements" (p. xiii). Thus, *VRWH* contains several novel taxonomic arrangements (e.g., the splitting of the *Atropoides nummifer* and *Crotalus durissus* complexes into three species each; the transfer of the species *Sistrurus ravus* to *Crotalus*). Another change in *VRWH* from that of *VRLA* is the inclusion of dot locality maps for most species and the depiction of subspecies ranges for some species.

A preface (pp. xiii–xv), which also includes acknowledgments, precedes the Introduction (pp. 1–8). These short sections are followed by a section titled Regional Accounts and Keys to Venomous Reptiles (pp. 11–91). Color Plates 1–751 follow p. 91 and include the lizards of the genus *Heloderma*, the venomous coralsnakes, the sea snake *Pelamis platurus*, and the pitvipers, exclusive of the rattlesnakes. The Taxonomic Accounts begin on p. 95 and are arranged in the same sequence as are the color plates. An index of 28 pp. that covers both volumes closes out Vol. I. Color Plates 752–1365 covering the rattlesnakes and some snake species considered to mimic dangerously venomous snakes and/or to be slightly toxic themselves begin Vol. II. The Taxon Accounts for the rattlesnakes cover pp. 477–616. These accounts include the following sections for each species: synonymy, local name(s), English name, etymology, distribution, habitat, description, and similar species. A remarks section is also included for most species. Distribution maps of all species are included (most have dot locality symbols and overall perceived ranges indicated by shading), but as some maps include more than one species, a few maps are some page distance from their respective species account (i.e., the species account of *Crotalus triseriatus* is 66 pages from its map). Following the Taxon Accounts are four chapters written by contributors. These chapters are: 1) Venomous Snake Mimicry by Edmund D. Brodie III and Edmund D. Brodie Jr. (pp. 617–633); 2) The Evolution of New World Venomous Snakes by Ronald L. Gutberlet Jr. and Michael B. Harvey (pp. 634–682); 3) Venom Poisoning by North American Reptiles by Robert Norris (pp. 683–708); and 4) Snakebites in Central and South America: Epidemiology, Clinical Features, and Clinical Management by David A. Warrell (pp. 709–761). Color Plates 1366–1500 depicting consequences of reptile bites are nested between pp. 684–685 in the Norris chapter. The last of these four chapters is followed by a Glossary (pp. 763–773), the Literature Cited (pp. 775–870), and a repeat of the same index that closed out Vol. I.

Each of the four chapters written by the contributors is well researched, well written, and reflects the expertise of its author(s). The images depicting some of the consequences of snakebites will be troublesome to some of the users of these volumes, but should also serve as a reminder to the damage some of these venomous creatures are capable of inflicting.

The quality of the photographs making up the color plates is generally very good to excellent. These images were either taken by the authors themselves or obtained from numerous colleagues (these latter photographers are named in the respective Plate Legends) and Campbell and Lamar are to be commended for bringing together all of these photographs into one standard work. I could find only four minor critiques of the species photographs: 1) the

five images (Plates 1361–1365) of the highly venomous species following the last image of the mimics and/or slightly venomous species are out of place and seem to have been added as an afterthought; 2) the locality data "mainland opposite Los Cayos Cochinos, Atlántida, Honduras" accompanying Plates 66–67 are erroneous as *Micrurus diastema* does not occur in that part of Honduras (see next number); 3) the locality data "mainland opposite Los Cayos Cochinos, Atlántida, Honduras" accompanying Plate 138 are erroneous as *Micrurus nigrocinctus* from that area are bicolor (see Plate 142; the presence of an animal dealer at that locality in the 1980s probably reflects the source of these erroneous data); and 4) the specimen of *Sibon longifrenis* depicted in Plate 1290 cannot be a paratype as indicated.

Since I have examined much of the literature on, and many Honduran specimens of the 16 species of dangerously venomous snakes of the families Elapidae and Viperidae occurring in that country for a manuscript on the reptiles of Honduras, I took a hard look at those respective species accounts and the section on Honduras in the Regional Accounts.

The section on Honduras is slightly changed from that version in *VRLA*, but the statement (p. 38) "It is probable that *Micrurus alleni* occurs in extreme eastern Honduras" remains in *VRWH* even though McCranie (1993) reported that species from the country as noted elsewhere in *VRWH*. The Key to the Venomous Snakes of Honduras contains one notable error. The second part of couplet 1 should lead to couplet 7, not 6 as stated in *VRWH*. Because of that error in the Honduran key, I checked the keys for the other countries and found the following errors: Guatemala—the second part of couplet 1 should lead to couplet 10, not 9; Belize—the second part of couplet 3 should lead to couplet 4, not 5, the second part of couplet 4 should lead to couplet 5, not 6, and the second part of couplet 5 should lead to couplet 6, not 7; Panama—the second part of couplet 1 should lead to couplet 13, not 12, the second part of couplet 9 should lead to couplet 12, not 11, and the second part of couplet 18 should lead to couplet 19, not 18; Venezuela—the second part of couplet 3 should lead to couplet 10, not 9; Brazil—the second part of couplet 35 should lead to couplet 45, not 46 (also in the Portuguese version); Ecuador—the second part of couplet 26 should lead to couplet 27, not 26; Bolivia—the second part of couplet 1 should lead to couplet 10, not 11, the second part of couplet 2 should lead to couplet 9, not 10, and the second part of couplet 16 should lead to couplet 19, not 18; and Paraguay—the second part of couplet 8 should lead to couplet 13, not 14. Although these errors should be obvious to any user of the keys, they should have also been obvious to the authors and not allowed into print. Another curious aspect of the country keys is that a Spanish translation of the English keys was included for the Canada and United States key, but not for the keys to the seven Central American countries nor for the South American countries of Ecuador, Bolivia, Paraguay, Uruguay, and Argentina in which Spanish is the primary language.

With reference to the 16 species accounts critically read by me, I offer the following comments. The KU number for the specimen of *Micrurus* with conflicting identity is 214785, not 214784 (p. 154). Seven subspecies of *Micrurus diastema* are recognized in *VRWH* (see Plates 59–78, Map 9), but the statement (p. 163) "that recognition of these subspecies on any basis other than geographical distribution is difficult to justify" is odd and contrary to taxonomic principles. USNM 7347 is said to be the holotype of *M. nigrocinctus* (p. 179), but according to Cochran (1961) there are two syntypes under that number and Girard (1854) did not designate either of these as the holotype. BMNH 1946.1.21.20 is said to be the holotype of *M. ruatanus* (p. 191), but the describer (Günther, 1895) did not designate a holotype from among the eight specimens on which he based his description (these eight syntypes are BMNH 1946.1.21.16–22, MCZ 26930). The range of the ventral scales in male *M. ruatanus* is given as both 178–188 and 183–185 (p. 191). The presently valid combination *Pelamis platurus* is not given in that species synonymy (pp. 236–237). The first user of that combination was Stoliczka (1870). In reading the statement in brackets clarifying the type locality of *Bothriechis marchi* (p. 301), I had a feeling of déjà vu. That type locality was first clarified by Wilson and McCranie (1992) and the statement in *VRWH* is essentially identical to that in Wilson and McCranie (1992) without acknowledging the source. Although the publication in which the name *Trigonocephalus schlegelii* Berthold was first proposed has been well documented (Berthold, 1845; see Myers and Böhme, 1996) a later Berthold publication is cited as the original description (p. 304) in *VRWH*. Myers and Böhme (1996) also presented strong evidence clarifying the type locality of *Trigonocephalus schlegelii* Berthold of which the authors of *VRWH* were apparently unaware. The correct number of the holotype of *Trigonocephalus schlegelii* Berthold is ZFMK 32554 (see Böhme and Bischoff, 1984), not the number given in *VRWH*. MCZ 2718 is given as the holotype of *Trigonocephalus asper* Garman (p. 372), but Garman (1884) did not designate a holotype from among the specimens he used to draw up his description. Also, according to Barbour and Loveridge (1929), MCZ 2718 consists of two heads and Garman (1884) had at least one entire specimen that he used in his description. In the *Bothrops* key in *VRWH* (p. 358), the presence versus absence of dark spots or dark mottling on the supralabials was the sole character given to distinguish *B. asper* from the closely related *B. atrox*. But curiously enough, this character is not mentioned among the characters given in the similar species section for these two species that will distinguish them from one another. Also, the head drawing showing the color pattern in *B. atrox* (supposed to usually have at least two dark spots or dark mottling on the supralabials) does not show such spots or dark mottling (p. 377). Stuart (1963) is cited as the first use of the combination *Bothrops asper* (p. 372), but Stuart (1963) used the combination *B. atrox asper*. Three subspecies of *Crotalus simus* are recognized in *VRWH*, but no information is given on how to distinguish them from one another. On p. 584, the geographical distribution of *C. simus* is given as from "Mexico to Costa Rica," but on p. 586 it is said that the species occurs on "the Atlantic side of Colombia." Finally, Hoge and Romano Hoge (1983) used the presently valid combination *Porthidium ophryomegas* before Campbell and Lamar (1989) did.

One other notable error I found was that *Bothrops lanceolatus* Wagler, 1830, is given as the type species of the genus *Bothrops*. *Bothrops lanceolatus* cannot be the type species of *Bothrops* since it was not included in the nominal genus by Wagler (1824) (see Article 67 in the International Commission on Zoological Nomenclature, 1999). The correct type species of the genus *Bothrops* is *B. megaera* Wagler (1824) (= *B. lecurus* Wagler, 1824, by subsequent designation of Hoge, 1966).

VRWH is a long anticipated publication and despite my criticisms, wonderfully puts virtually everything known about these interesting and medically important creatures into one work. The authors' knowledge of the literature is impressive and comprehensive and speaks of a long time study and interest in these fascinating animals. I would highly recommend these two volumes to anyone with an interest in venomous reptiles in any part of the Western Hemisphere. However, given the number of errors detected in my sampling of *VRWH*, I recommend that serious users of these volumes consult the original literature if possible.

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Reptiles of Central America, by Gunther Köhler. 2003. Herpeton. Rohrstr. 22, D-63075 Offenbach, Germany (www.herpeton-verlag.de). 367 pp. Hardcover. 78.00 € (approx. US $95). ISBN 3-936180-02-4.

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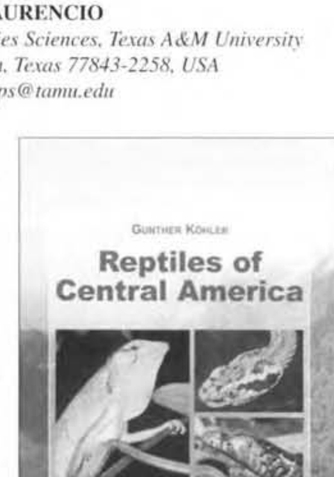

Central America's reptile diversity has attracted scientists in ever-increasing numbers for many decades. Recently, a burgeoning eco-tourism industry and an increase in the popularity of reptiles have introduced the Central American herpetofauna to a new group of non-scientists. With interest in the region at an all time high, the need for guides to the area's species has led to several quality publications (Campbell 1998; Köhler 2001a; Lee 2000; McCraine and Wilson 2002; Savage 2002; Stafford and Meyer 2000). However, no English language guide exists covering the entire Central American region. With *Reptiles of Central America*, Köhler takes on the considerable task of filling this void.

The book is based upon Köhler's two-volume, German language *Reptilien und Amphibien Mittelamerikas* (2000, 2001b). It is not, however, merely a translation of the combined German volumes. Updated and expanded by 23 species, it now covers all three crocodilian, 25 turtle, 230 lizard, three amphisbaenian, and 276 snake species found in Central America. The author's stated goals for the book are to summarize widely scattered information on the reptiles of Central America, and "provide an identification guide for both scientists and travelers to the numerous reptile species found in Central America." To accomplish these goals, Köhler utilizes 644 color photographs, 103 drawings and diagrams, 210 maps and an extensive literature cited in this compact (17 x 23.5 cm), travel-friendly book.

The book can be divided into three parts: introductory sections, species accounts, and appendices. Introductory sections include the forward, introduction, comments on how to use the book, classification of reptiles, environment, and geographic history and zoogeography. These sections provide background for understanding the distribution and diversity of the Central American reptilian fauna. The forward by Larry David Wilson exalts the importance of herpetological research in Central America and points out the importance of this volume as a compilation of knowledge, as well as a springboard for future publications. A short, one and a half page introduction follows. It defines the region covered by the book as Mexico east of the Isthmus of Tehuantepec, south to the southern border of Panama. It then gives a brief history of herpetology in Central America and discusses the region's reptile

diversity. The introduction is followed by "comments on the usage of the book" (1.5 pages) where the author states the book's purpose, explains its layout, and suggests how to best utilize it. This section targets those unfamiliar with field guides and dichotomous keys, and introduces these topics well. Following the usage section, the author summarizes the classification of reptiles with a four page color-coded flow chart, which includes a list of the genera found in each family and the number of species in each genus. A representative photograph for every family (or subfamily) is included. The environment section (eight pages) points out the major geographical landmarks of the isthmus and describes its major habitats. Each habitat (sandy beaches, mangroves, dry forest, savanna, rain forest, cloud forest) is described and its distribution in the region is provided. At least one representative photograph illustrates each habitat type. The section continues with two full-page color maps depicting elevation and vegetational zones, followed by two pages devoted to climate in Central America. Climate data are summarized by a series of climographs, representing one locality in each country. The geographical history and zoogeography section (four pages), based primarily on Savage's work (1966, 1982, 2002), provides an excellent summary of the historical events that shaped present day reptilian fauna in Central America.

The bulk of the book (278 pages) consists of the species accounts, grouped by order or suborder (crocodilians, turtles, lizards, amphisbaenids and snakes). Each group is structured in a similar manner. After a brief description, a key to families is provided, followed by the family accounts, arranged alphabetically. Similarly, familiar accounts include a description, key to genera (if applicable) and generic accounts, again arranged alphabetically. Generic accounts contain a description, a key to species (where applicable), the species accounts and suggested further reading. The species accounts are shaded yellow and contain the scientific name, author, citation of original description and type locality, maximum size, and distribution of each species. When applicable, subspecies status is discussed. Ecological and reproductive data are presented in the generic descriptions, which range from half a page to 29 pages. Species photographs and range maps are included within the generic accounts, not in separate sections.

Three appendices follow the species accounts: a table of scalation characters in snakes, a section on snakebite, and one on mimicry in snakes. The table of scalation characters (six pages), includes the number of ventral and subcaudal scales, number of scale rows at mid-body and one head length anterior to the cloaca, as well as the state of dorsal scales (keeled/not keeled) and the cloacal scale (divided/undivided). The snakebite section (four pages) covers safety precautions and recommended first aid. It also includes a section on rear-fanged snakes and provides suggestions for further reading. This section is a great addition especially in light of the book's wide audience. A review of this section will benefit all who might come across venomous species. The section on mimicry in snakes (four pages) provides results of the latest research on mimicry, and includes 15 photographs of coral snake mimics. Suggestions for further reading on the topic are provided.

The book concludes with acknowledgements, an extensive 36-page literature cited, a glossary, and an index. The 119-term glossary (three pages) focuses on morphological terminology and references figures where terms are used. The seven-page index lists all species, genera and families found in the book but little else. Pages containing photographs are in bold; however, contrary to what the author states in the usage section, pages containing range maps are not italicized. The editing of the book is tight. I found only three typos (e.g., reptils for reptiles on page 12). The book's binding is of good quality and it has held up well to continuous use.

Köhler has clearly met the criteria he set for this book. First, he has compiled a wealth of widely scattered information, as evidenced by the 1087 citations. Most of this information is contained in the generic accounts and is supplemented by information from the author's extensive research. Second, he provides a good field guide to the reptiles of Central America. To accomplish this second goal, Köhler utilizes two of the book's greatest strengths, its photographs and dichotomous keys. The photographs, provided as the first method for identifying species, are of good quality, although a couple may be too small to be of use. Four hundred of the 537 species and all but three genera (*Atractus*, *Coloptychon*, *Diaphorolepis*) are pictured. In the case of the latter two genera, a line drawing is provided. Additionally, localities are given for all but a handfull of photographs. Of special note are the four pages devoted to photographs of anole dewlaps. Thirty-nine of the 81 species of anoles presented in the book have dewlap photographs.

The strength of the keys provided is that anyone, regardless of expertise, can successfully use them given minimal effort. Kohler explains dichotomous keys in the usage section and defines morphological terms that may be new to some readers in the glossary. Furthermore, the keys are supported by numerous figures. These visual representations of diagnostic characters greatly increase the ease of use. Additionally, many figures dealing with scalation characters are color-coded making them especially helpful. In reviewing this book, I worked through several of the keys (*Norops*, *Sphaeradactylus*, *Lepidoblepharis*, *Imantodes*, *Leptodeira*) with excellent results. That being said, keying out live individuals of small species in the field could prove difficult.

Good qualities notwithstanding, no book is without its drawbacks, however minor, and this volume is no exception. The range maps are small, contain multiple species (or genera), and due to the extent of the area covered, some tend to over-generalize distributions (e.g., *Crocodylus acutus* are not found in highland regions). Additionally, they contain no reference to museum specimens. The placement of range maps and photographs is sometimes awkward, in some instances appearing on a separate page with a different species account. Another point of contention is the author's quick acceptance of recently proposed taxonomic changes (e.g., *Aspidoscelis* for *Cnemidophorus* and *Mesoscincus* for *Eumeces*). Some may find these changes premature. Additionally, on at least one occasion, the author uses non-published data (a Master's Thesis) to make a taxonomic decision (the synonomy of *Norops oxylphus* with *N. lionotus*). While the data may indeed support the change, without peer review, its acceptance is questionable.

Nevertheless, these issues are, for the most part, minor and should not keep anyone from acquiring the book. *Reptiles of Central America* will make an excellent addition to the library of anyone, professional or amateur, interested in the reptiles in Central America. It delivers what it promises, and while the price (about $95) may seem steep to travelers with only a casual interest in

reptiles, the information contained within, and its ease of use make it well worth the price.

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Guide to the Reptiles of the Eastern Palearctic, by Nikolai Szczerbak. 2003. Krieger Publishing Company, P.O. Box 9542, Melbourne, Florida 32902-9542 (www.krieger-publishing.com). 260 pp. + 72 pp. pls. Hardcover. US $73.50. ISBN 1-57524-004-1.

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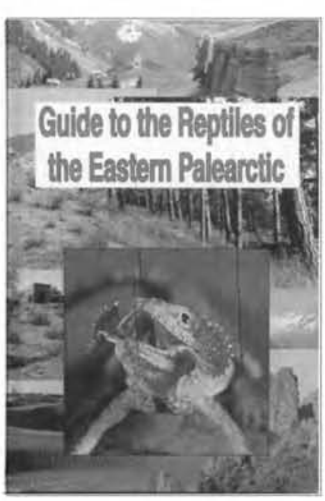

This long-awaited book is the first English language guide to the reptiles of the former Soviet Union (FSU). The fauna covered includes 161 species comprising five chelonians in three families, 93 lizards in seven families, and 63 snakes in six families. Some overview of the history of the book is necessary in order to place this review in context. The author, the well-known Ukrainian herpetologist Nikolai Szczerbak, died in 1998. The book, which was not complete at the time of his death, was prepared for publication by Mikhail Golubev, who is credited as technical editor. While the book was thus completed and translated into English, it was not updated, resulting in a work that reflects the nomenclatural and taxonomic status of the eastern Palearctic species as they stood nearly a decade ago. While this is not a fault of anyone in particular, and certainly not of the late author, it nonetheless detracts from the book.

The book opens with an editor's preface, providing an overview of Szczerbak's life and work and a short introduction dealing with biogeography and the basic geography of the former USSR. Szczerbak recognizes four main herpetogeographic divisions: the Arctic, Boreal European-Siberian, Himalayan-Manchurian, and Arid Mediterranean, each except the first with further subdivisions. Not surprisingly, the majority of species occupy the more temperate regions from the Caucasus to Middle Asia.

Identification keys are provided to families, genera, and to species in all non-monotypic groups. Unfortunately, the lack of accompanying labeled scale diagrams will prevent novice users from using the key effectively. Accounts are provided for all of the species of the FSU recognized through the mid-1990s except *Ablepharus darvazi* Panfilov and Jeriomtschenko, 1990, which is included in the key to species of the genus, but is not accorded its own account. The accounts, each one half to three pages in length, occupy the majority of the volume and include the standard subsections: Scientific name and author, Distribution (in the FSU and extralimitally), Natural History (including habitat, diet, seasonal activity, breeding, egg size, age at maturity, and maximum size), Status (including Red Data Book entries), References, and Remarks (often referring to the taxonomic status of subspecies or isolated populations). Accounts are accompanied by a distribution map with the range in the FSU shaded. The base map used shows major rivers, but not the boundaries of the countries of the FSU, which makes it rather difficult to use.

Three features promised in the "about the book" blurb on the back cover: type localities, discussion of ontogenetic, sexual and geographic variation, and point locality maps, are not actually provided. While these are not necessary components in such a guide, they would have made useful additions. We assume that the author had originally intended to include these features, but as they did not make it into the published version they certainly should not have been listed as selling points.

Major revisions have affected the taxonomy of many of the groups dealt with in the book. Some such changes are too recent to have been incorporated, even had the book been updated through 2002 or early 2003, and some changes have not yet been widely used or accepted. Nonetheless, users of Szczerbak's book will encounter discrepancies with the taxonomy employed in recent papers and it is worth noting at least some of these changes. Lizards assigned to *Lacerta* in the book include *L. vivipara* (p. 127), now often assigned to the genus *Zootoca*, and many species now assigned to *Darevskia* (Arribas 1999). Other lizard genera are in flux, and at least some authors employ different generic arrangements for *Eumeces* (e.g., Griffith et al. 2000; Schmitz et al. 2004) and for the Palearctic bent toed geckos *Mediodactylus* and *Tenuidactylus* (e.g., Khan 2003), and *Mabuya aurata* (p. 147) should now be assigned to *Trachylepis* following the recent subdivision of *Mabuya* (Mausfeld et al. 2002; Mausfeld and Schmitz 2003; Bauer 2003). As a representative of specific level issues,

Laudakia microlepis (given as a subspecies of *L. caucasica* [sic] in the book) has long been recognized as a distinct species (Ananjeva and Ataev 1984).

Even greater changes have taken place in the snakes. For example, the species of *Coluber* of the FSU are now assigned to *Platyceps*, *Hemorrhois* and *Hierophis* and some *Eirenis* have been removed to *Platyceps* as well (Schätti and Utiger 2001). The species of *Elaphe* treated in the book are now assigned to *Zamenis*, *Orthriophis* and *Oocatochus* (Utiger et al. 2002). Among vipers (divided into the Viperidae and Crotalidae by Szczerbak) *Vipera* (*Daboia*) *lebetina* is now *Macrovipera lebetina* (Hermann et al. 1992) and the *Agkistrodon* of the FSU are *Gloydius* (Hoge and Romano-Hoge 1981).

There are some minor spelling errors scattered throughout the book. For example: *Tachydromus* (p. 133) should be *Takydromus*, *Laudakia caucasica* should be *L. caucasia*, *Psammophis lineolatum* should be *P. lineolatus*, and *Ptyas mucosus* should be *P. muscosa* (David and Das 2004). Many accents and diacritical marks are missing from author's names or the names are incomplete, e.g. Lacepede (p. 190) instead of Lacepède, Menetrie (p. 137) or Menetries (pp. 169, 177) instead of Ménetries, Hallow (p. 144) instead of Hallowell, and Forskal (p. 142) and Forsskal (p. 205) instead of Forsskål. In a few places the date of authorship is incorrect: *Pelodiscus sinensis* Wiegmann, 1835 should be cited as *P. sinensis* (Wiegmann, 1834) (Bauer and Adler 2002) and *Coluber caspius* Gmelin, 1779 should be *C. caspius* Gmelin, 1789. The genus *Ablepharus*, attributed to Fitzinger in Lichtenstein, 1823 (p. 136), should be attributed to Fitzinger (1824) (Bauer et al. 2003). The 203 plates (194 in color) are arranged on 72 pages and include 10 views of representative habitats from Lithuania to the Russian far east, five chelonians, 119 lizards (36 agamids, 2 anguids, 2 eublepharids, 15 gekkonids, 52 lacertids, 11 skinks, and 1 varanid), and 69 snakes (4 boids, 46 colubrids, 6 crotalids, 1 elapid, 1 typhlopid, and 11 viperids). Many images are only fair in quality. Some suffer from color fading, others from extensive shadows, and some from poor focus or the use of unnatural backgrounds. Others, however, are quite good portraits, and virtually all are serviceable as aids to identifying the species depicted. Virtually all species are figured except *Ablepharus darvazi* and *Telescopus rhinopoma*.

The book concludes with a reference section of 203 entries. Naturally these include many works in Russian, although these are all presented with their titles translated into English. No references are later than 1996, highlighting the major problem with the currency of the book. On the other hand, the bibliography also lacks citations to most of the classic works of Russian herpetology; fewer than 10 references are older than 1960 and only one dates from the 19th century. In addition to many relevant Russian works of the last decade, also missing are the important references to adjacent regions that share components of the fauna of the FSU, for example Iran. Most of the citations included appear to be correct, although we noted several minor editorial errors including Schatti for Schätti, nouvean for nouveau, and a lack of capitalization of some German nouns in some titles.

Although those actually working in the region or dealing with the systematics of eastern Palearctic groups will certainly recognize that this book needs to be updated, it nonetheless fills an important gap in the literature that had previously existed. It will be the one basic reference that most English-speaking herpetologists will want to have in order to get an overview of the reptiles of the vast territory of the former USSR. Its keys will facilitate specimen identification and its bibliography will serve as an entrée into the extensive Russian herpetological literature, much of which will be unfamiliar to the intended audience. This posthumous work is a fitting cap to the body of published contributions of one of the leading herpetologists of the former USSR.

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Herpetological Review, 2004, 35(4), 428–429.

Amphibians and Reptiles of North-west Europe: Their Natural History, Ecology and Conservation, by Ian F. Spellerberg, with a foreword by J. L. Cloudsley-Thompson. 2002. Science Publishers, Inc., Enfield, New Hampshire. xii + 203 pp., 28 color plates. Softcover. US $39.00. ISBN 1-57808-259-5.

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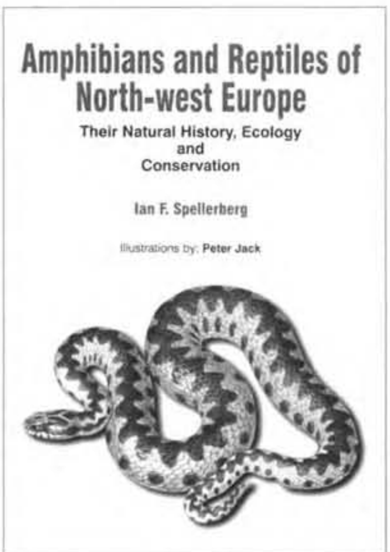

Ian Spellerberg adds another book to the rather long list of titles on European herpetology, but restricts it to the northwest of the continent and devotes it mainly to natural history and ecological and conservation issues. The geographic restriction is defined as the Atlantic Climatic Region which includes (according to figure 2 of the book) areas such as northeastern Germany, western Poland and even western Lithuania and Latvia, that are commonly considered to have a continental climate. The eastern borderline of this presumed Atlantic Climatic Region is indicated by a dashed line in each of the distribution maps of Spellerberg's book.

The introductory paragraphs deal with an overview of the current literature on the amphibians and reptiles of Europe, and they formulate the main aim of the book, viz. the promotion of conservation of the European herpetofauna. The selection of species (based on Spellerberg's own research interests in those taxa adapted to temperate and cold climates—hence the geographic region covered) and the structure of the species accounts is briefly explained. The next chapter is devoted to the ecology of amphibians and reptiles worldwide. Interestingly, "taxonomy and systematics" constitute a subchapter within ecology, thus shedding more light on the emphasis given by the author. The information contained in these introductory remarks is directed to readers without any preknowledge of zoology, explaining in a very simple way what a species is, what other systematic categories are, etc. Several misprints that would have been avoidable by careful proofreading, as well as some misleading statements, occur in this section. For example: (1) *Triturus cristatus* is said to have "poison glands on its back and tail," but the species for which this feature is most characteristic is certainly *Salamandra salamandra.* (2) It is stated that some quadrupedal lizard species may have lost one or both pairs of limbs, but "all retain at least traces of the pectoral girdle." It is obvious that this should read pelvic girdle. (3) "The lizards can re-grow another tail." This is generally true, but does not apply to *Anguis fragilis*, one of the species treated in the book. The sections that follow, on distribution and habitat, seasonal behavior, vagility and population ecology, feeding ecology, thermal ecology and reproduction, are better, underlining again the author's research interests and experience.

The main part of the book is the chapter containing species accounts. These accounts are subdivided following a uniform scheme. Species names (without author and year of description) appear under their respective family names, and a variety of European vernacular names are given (English, French, German, Dutch, Spanish, and Swedish). The single paragraph text sections are diveded into: introduction, taxonomy, protection, description, distribution and habitat, seasonal movements and behavior, vagility and population ecology, feeding ecology, thermal ecology, reproduction, growth and development, general comments, and major references. Each account is accompanied by a large, crudely-drawn distribution map with a roughly delimited range, and by a watercolor painting showing a typical specimen or, in the case of a sexual or ontogenetic dimorphism, a couple and a juvenile stage of the respective species. These paintings are generally well done, although in *Triturus cristatus* the male looks so slender that it resembles its relative *T. dobrogicus* (not an inhabitant of the Atlantic Climatic Region), and in *Rana dalmatina* the snout is much too blunt, resembling that of *R. temporaria*.

Unfortunately, the species accounts also contain a lot of misleading information and inconsistencies which cannot all be listed in this review. To give a few examples: The map for *T. helveticus* (p. 42) is far from being complete. Vast parts of the range are lacking on the map. For example, it reaches as far as the Czech Republic in the east (Günther 1996). In contrast, *Bombina variegata* (p. 56) is shown to be lacking in the Benelux and west German areas where it is actually common (Gasc et al. 1997). The section on *Hyla arborea* (p. 83) mentions the closely related *H. meridionalis,* but restricts it to North Africa, although it is the dominant species in the Iberian peninsula and in southern France. The Italian endemic species *Hyla intermedia* is not mentioned at all (see Dubois 1995). *Lacerta viridis* (p. 131) has been recognized as consisting of two species for the last 10 years (Günther 1996). The western European form is now called *Lacerta bilineata,* a form really adapted to Atlantic climatic conditions (Böhme 1978; Rykena 1991). The Greek generic name *Podarcis* does not mean "sure-footed" (p. 143), but swift-footed, quick, nimble (Böhme 1997, Arnold 2000). According to Spellerberg, *Coronella austriaca* (p. 149) was discovered in Britain by "a Mr. Gray." This formulation seems inappropriate for one of the historically most important British herpetologists.

On the other hand, there is information that seems peripheral to the stated aims of the book. Under the heading "General" in the *Alytes obstetricans* account, the reader is informed about the Austrian biologist Paul Kammerer and his experiments, the biography about him by Arthur Koestler, and the controversy that arose about Kammerer's theoretical background. And in another example, in the acount of *Lacerta* (now *Zootoca*) *vivipara*, we are informed that the author of the species, Baron Joseph von Jacquin, was "a friend of Mozart"!

The concluding chapter of this book is devoted to conservation. After a short treatment of turtles and tortoises (as a whole, regardless of their occurrence or absence in the Atlantic Climatic Region), Spellerberg provides an engaging overview of the different kinds of threats and of conservation needs and measures. Moreover, he offers some case studies focussed on Britain.

Although the author has compiled a list of interesting and important references, both for the general part of the book as well as for the single species accounts, the reference section looks a bit like a random compilation. Some of the references look as if they come from a first draft of a manuscript, such as that on p. 109 (*Rana ridibunda* account), where the initials of Mrs. Kyriakopoulou-Sklavounou are lacking, and have been substituted by "xx." There is no reference later than 1997, while the book was not published until five years after that date. Some references are only incompletely cited, including a major European reference edited by me, of which only the first of five volumes available up to 1999 is noted. Likewise, Spellerberg cites the first of the conservation-relevant monographs of the German Herpetological Society, on *Lacerta agilis* (Bischoff and Podloucky 1981), but not numbers 3 (on the snakes of Central Europe; Gruschwitz et al. 1993), 4 (on *Salamandra*; Greven and Thiesmeier 1994), 6 (on *Hyla arborea*; Geiger 1995), or 10 (on *Emys orbicularis*; Fritz et al. 1998), considering only those numbers published through 1999. German references are not the only ones lacking; important Scandinavian, Dutch, Belgian, and French sources are also missing, including the important *Atlas of Amphibians and Reptiles in Europe* (Gasc et al. 1997).

The book as a whole would have profitted much from more careful proofreading and from a different layout; much space was wasted and many pages could have been saved. Unfortunately, the question the author asked himself in the introductory section: "Why write another book about these animals...?" does not seem to have been convincingly answered.

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PUBLICATIONS RECEIVED

Endangered and Threatened Animals of Florida and their Habitats, by Chris Scott. 2003. University of Texas Press, P.O. Box 7819, Austin, Texas 78713-7819, USA. xvi + 315 pp., 47 pp. pls. Softcover. US $29.95. ISBN 0-292-70529-8.

This book is divided into two main sections, a 100-page portion consisting of the chapters: Listed Species, Biological Pollution (invasive exotics), Saving Florida's Endangered Species, and Florida's Habitats, and a series of 63 species or subspecies accounts covering the threatened or endangered animals of the state. The first section highlights the great diversity of Floridian biota and the many threats faced by animals occurring in the state, as well as the measures in place to protect them. Black-and-white photographs in the four constituent chapters illustrate both habitats and animals, including native and invasive amphibians and reptiles. Reptiles constitute an especially significant component of the book. Accounts are provided for the two Floridian crocodilians and five sea turtles, as well as for one freshwater turtle, two skinks, and seven snakes. All but one of these (as well as two species not listed) are depicted in color in the section of plates that opens the books. Information provided for each species profiled includes state and federal status, description, distribution, biology, causes for decline and/or threat, and current trend (increasing, declining, or stable). Florida-specific threats, often at the geographic scale of counties, are emphasized and local data and case histories are summarized. The book concludes with a glossary, an extensive (14 pp.) bibliography, and a general index. This volume should be of interest to a broad audience of conservation biologists as well as professional zoologists and amateur naturalists who live in or visit Florida. It is available in hardcover as well ($60.00).

The Chameleons of Madagascar [DVD], produced by Ardith Abate and Edward Abate. 2004. Bella Natura Productions and The Chameleon Information Network (Chameleon Information Network, 13419 Appalachian Way, San Diego, California 92129-2601, USA; chamnet1@san.rr.com). US $19.95 + shipping and handling ($2.95 within the U.S.; California residents add $1.51 sales tax).

This 80-minute DVD includes footage of 28 Madagascan chameleon species of the genera *Furcifer*, *Calumma,* and *Brookesia* filmed in their natural habitats throughout Madagascar. In addition, a variety of other endemic Malagasy lizards, snakes, and frogs, as well as birds and mammals, are shown. These include leaf-tailed geckos, boas, and lemurs. The DVD is narrated on a stereo soundtrack. The film itself is accompanied by supplementary ma-

terial in the form of species profiles of each chameleon species including: scientific name, size, distinguishing characteristics, distribution, conservation status, and a still photograph. It should be of interest to those interested in the Afro-Malagasy herpetofauna from either an academic or conservation/law enforcement perspective, as well as to chameleon enthusiasts.

Mountains Kings: A Collective Natural History of California, Sonoran, Durango and Queretaro Mountain Kingsnakes, by Brian Hubbs. 2004. Tricolor Books, P.O. Box 24811, Tempe, Arizona 85285, USA; www.mountainkingsnake.com. Softcover. xxiii + 319 pp. US $45.00 (+ $5.00 postage for U.S. delivery; Arizona residents add $3.65 sales tax). ISBN 0-9754641-0-8.

This book is the first to present natural history information on the "mountain kingsnakes" of the western U.S. and parts of Mexico. The species included—*Lampropeltis zonata, L. pyromelana, L. mexicana* (part), and *L. ruthveni*—are probably not a natural grouping, but are treated together owing to their common association with montane or near-montane habitats as well as their popularity among herpetoculturists and hobbyists. The first two species are treated in great detail, a result of the author's considerable field experience with both, while the accounts for the species confined to Mexico are comparatively quite limited. Color and black-and-white photographs are included for all species and their habitats. Range maps indicating known and potential localities are provided; the maps for *L. zonata* and *L. pyromelana* are oversize foldouts. Sections on habitat damage, conservation laws, field searching tips, and captive care round out the book.

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NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 35, Number 1 (March 2004).

CAUDATA

AMBYSTOMA OPACUM (Marbled Salamander). **FREQUENCY OF ALBINO LIFE STAGES.** Complete albinos, partial albinos, and leucistic specimens have been observed among many species of North American amphibians and reptiles (Hensley 1959. Publ. Mus. Michigan St. Univ. 1. 159 pp.; Brame 1962. Abhandl. und Ber. für Naturk. und Vorgesch. 11:65–81; Drykacz 1981. SSAR Herpetol. Circ. 11. 31 pp.). However, there is limited information on the frequency of these uncommon phenotypes in natural populations. Although *Ambystoma opacum* is well-studied and abundant throughout the eastern United States, albino larvae have been reported in only three populations from Maryland, Mississippi, and Rhode Island (Drykacz, *op. cit.*; Deegan et al. 1998. Herpetol. Rev. 29:229; Petranka 1998. Salamanders of the United States and Canada. Smithsonian Inst. Press, Washington, D.C., 587 pp.). Here, we report on the frequency of albino salamanders among larval, metamorphic, and adult *A. opacum* from a population in southern Illinois.

On 9 March 2002 we discovered partial albino (*sensu* Brame, *op. cit.*) larvae while surveying an ephemeral pond in the Shawnee National Forest, Alexander County, Illinois (37°15'26"N; 89°21'36"W). Larvae typically have evenly dispersed stippling on the dorsal surface, speckled throats, and a distinct row of lateral light spots (Brandon 1961. Copeia 1961:377–383). These specimens appeared unusually pale due to a reduction in the intensity of pigmentation across the body; markedly reduced numbers of melanophores in the integument, and a faint indication of lateral spots. We measured two larvae (17.4, 18.1 mm SVL) and deposited them in the SIUC museum (SIUC-H07215). On 27 Sept 2002 we trapped one partial albino adult (67.6 mm SVL) while monitoring pitfall traps at a drift fence that completely encircled the pond. Adults are typically black in ground color with distinctive white to silver cross bands (Petranka, *op. cit.*). This gravid, female specimen appeared rosy-brown to pale tan in color and had normal retinal pigments; dull white cross bands were present. The salamander was photographed (SIUC-H07216) and released. Between 19 September and 10 October 2002 we trapped 184 male and 235 female *A. opacum* migrating to the pond, thus the partial albino phenotype occurred at a frequency of 0.24 in the breeding population. We captured one partial albino larva (22.1 mm SVL), similar in pigmentation to those described above, during quantitative sampling of the larval population on 9 June 2003. We estimated the size of the population on this day at ca. 4100 using a mean density of 331 larvae/m^3 (enclosure sampler, N = 8) thus the partial albino phenotype occurred at a frequency of ca. 0.024 in the larval population. All metamorphs trapped while emigrating from the pond in 2003 (N = 394) had typical amounts and patterns of pigmentation. Our report is the first to describe partial albino specimens of *A. opacum* in Illinois and provide data for comparing the frequency of this phenotype among populations and other amphibian species. We thank L. Woosley for her assistance in monitoring amphibians at this site.

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CYNOPS PYRRHOGASTER (Japanese Fire-bellied Newt). **ENDOPARASITES.** *Cynops pyrrhogaster* is known from Honshu, Shikoku, and Kyushu Islands, Japan (Frost [ed.] 1985. Amphibian Species of the World: A Taxonomic and Geographical Reference. Allen Press, Inc. and The Association of Systematics Collections, Lawrence, Kansas, 732 pp.). Four species of Digenea, *Diplodiscus japonicus, Echinostoma hortense* (as metacercariae), *Mesocoelium brevicaecum, Phyllodistomum patellare*; three species of nematodes, *Amphibiocapillaria tritonispunctati, Gnathostoma spinigerum* (as larvae), *Rhabdias tokyoensis;* and one species of Acanthocephala, *Acanthocephalus nanus*, have been reported from *C. pyrrhogaster* (Uchida 1975. Bull. Azabu Vet. Coll. 30:63–81). In addition, *C. pyrrhogaster* has been experimentally infected with the nematode, *Spinitectus ranae* (Hasegawa and Otsuru 1977. Jap. J. Parasitol. 26:336–344). The purpose of this note is to report an additional species of Nematoda, *Cosmocercoides tridens,* from *C. pyrrhogaster.*

Twenty-four *C. pyrrhogaster* (mean SVL = 51.5 mm ± 4.5 SD; range 44–61 mm) were collected in Kanagawa and Shizuoka Prefectures, Honshu Island, Japan. Specimens were deposited in the herpetology collection of the Natural History Museum of Los Angeles County, Los Angeles, California as LACM 141230–141238, 143235–143237, 143265–143269, 144331–144336, 146590. The esophagus, stomach, small and large intestines, and lungs were opened and separately examined for helminths under a dissecting microscope. The body cavity was also examined for helminths. One species of Nematoda, *Cosmocercoides tridens*, was found in the small and large intestines. Both LACM 141234 and 143265 were infected. Prevalence (infected salamanders/salamanders examined x 100) was 8%. Mean intensity ± 1 SD (mean number of nematodes/number infected salamanders) was 2.0 ± 1.4 SD, range 1–3. Voucher nematodes were deposited in the United States National Parasite Collection, Beltsville, Maryland as USNPC 93532.

Cosmocercoides tridens is known from *Cynops ensicauda* and *Echinotriton andersoni* from Okinawa, Japan (Hasegawa 1988. Can. J. Zool. 67:1189–1193). *Cynops pyrrhogaster* represents a new host record for *C. tridens.* Mainland Japan is a new locality record.

Tatsuo Ishihara, Hakoné Woodland Museum, Hakoné, Kanagawa Prefecture, provided the specimens for this study.

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NEURERGUS STRAUCHII (Anatolia Newt). **ENDOPARASITES.** *Neurergus strauchii* occurs in Turkey, Iran, and Iraq. In Turkey it occurs in east Anatolia (Baran and Atatur 1998. Turkish

Herpetofauna [Amphibians and Reptiles]. Republic of Turkey, Ministry of Environment, Ankara, 214 pp.). We know of no parasites reported from this salamander. The purpose of this note is to report the nematode *Cosmocerca commutata* in *N. strauchii.*

Nineteen *N. strauchii* (SVL = 154.6 mm ± 17.6 SD, range: 130–182 mm) were collected in Bitlis, Turkey (38°19'N, 42°05'E) during 2000–2002. Twenty two *N. strauchii* (SVL = 152.9 mm ± 11.9 SD, range: 130–171 mm) were collected in Malatya, Turkey (38°14'N, 38°37'E) during 2001. The esophagus, stomach, small and large intestines were opened and separately examined for helminths under a dissecting microscope. The infection site was the small and large intestines. Prevalence (infected salamanders/sample examined x 100) were: Bitlis (65%), Malatya (86%); mean intensity ± SD and range were: Bitlis 3.9 ± 3.0 SD, range 1–9; Malatya 10.9 ± 6.6 SD, range 1–23. Mean number of helminths was significantly higher at Malatya than at Bitlis, $t = 3.5$, $df = 30$, two tailed P value = 0.001. Selected nematodes were deposited in the United States National Parasite Collection, Beltsville, Maryland as USNPC 93984. Voucher salamander specimens were deposited at Uludag University, Department of Biology.

Cosmocerca commutata is widely distributed in Palearctic anurans as well as the salamanders *Salamandra atra, S. salamandra*, and *Triturus cristatus* (Skrjabin et al. 1961. Oxyurata of Animals and Man, Part 2, Izdatel'stvo Akademii Nauk SSSR, Moskva. 460 pp.). *Cosmocerca commutata* in *N. strauchii* is a new host record.

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PLETHODON CINEREUS (Red-backed Salamander). **ANOPHTHALMIA**. Abnormalities and malformations of limbs and eyes of amphibians are well documented in anurans (Ouellet et al. 1997. J. Wildl. Diseases 33:94–104; Meteyer 2000. Field Guide to Malformations of Frogs and Toads with Radiographic Interpretations. Biol. Sci. Rept., USGS/BRD/BSR-2000-0005, Madison, Wisconsin; Meteyer et al. 2000. Teratology 62:151–171). Deformities are known to occur on limbs and tails in the terrestrial salamander genus *Plethodon* (Wake and Dresner 1967. J. Morphol. 122:265–306) but abnormalities of the eyes have not been described for any plethodontid salamander, including *Plethodon cinereus* (J. Hanken, pers. comm.).

On 5 April 2002 an adult male lead-back phase *P. cinereus* missing its right eye was found by H. Germaine and M. Kangas in a sample of 35 under 22 pairs of coverboards in the Turkey Run Park section of the George Washington Memorial Parkway National Park (GWMP, Fairfax Co., Virginia). The habitat was hardwood forest dominated by oaks (*Quercus* sp.). The orbit was covered entirely with normally pigmented skin and did not appear injured, scarred, or unusual except for the missing eye. The abnormality appears to be congenital. Two other adult males each missing one eye were observed on 30 June and 4 July 2002 by E. Lanham in a sample of 400 studied at Mountain Lake Biological Station, Giles Co., Virginia. Like the one found in Fairfax County, the orbit on each was covered with normally pigmented skin suggesting a congenital defect. All of the salamanders appeared healthy. The GWMP specimen was lost following refrigerator mishap; the salamanders at Mt. Lake were released. Single cases of *P. cinereus* missing an eye (May 2001, Page Co., Virginia and July 2001, Fairfield Co., Ohio) are listed on the North American Reporting Center for Amphibian Malformations website (http://www.npwrc.usgs.gov/narcam/), although no descriptive information is available. Our observations are the first published records of anophthalmia in *P. cinereus* and the family Plethodontidae.

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PLETHODON DUNNI, P. VEHICULUM (Dunn's Salamander, Western Red-backed Salamander). **BEHAVIOR**. Many amphibians that inhabit desert environments with a marked warm season display specialized behavior, morphology, or physiology that allow survival in hot dry conditions (Seymour and Lee 1974. Austral. Zool. 18:53–65; McClanahan et al. 1976. Copeia 1976:197–185; van Beurden 1980. Copeia 1980:787–799; Loveridge and Withers 1981. Physiol. Zool. 54:203–214). In contrast, amphibians that live in wetter environments often use mesic subterranean or woody debris refuges to evade seasonally brief drier or warmer conditions (Dumas 1956. Ecology 37:484–495; Hagar et al. 1995. *In* Beschta et al. [eds.], Cumulative Effects of Forest Practices in Oregon: Literature and Synthesis. Chapter 9, pp. 1–150. Oregon Dept. of Forestry, Salem, Oregon, USA.), and generally lack distinctive behavior to cope with unusually hot dry conditions. For this reason, we describe immersion and stream-use by *Plethodon dunni* and *P. vehiculum*, two terrestrial salamanders characteristic of the more pluvial North American Pacific Northwest, under drought and high temperature conditions.

During 29 July–5 August 2003, AEM and EPU made these observations while conducting amphibian surveys of 2nd-order stream reaches (*sensu* Strahler 1952. Bull. Geol. Soc. Amer. 63:1117–1142) of two non-fish bearing streams (A and B) in the Stillman Creek Basin, southwestern Washington State (Stream A: 46°31'28–35"N, 123°13'12–43"W; elev. 226–366 m; Stream B: 46°31'39–46"N, 123°13'17–14"W; elev. 238–390 m). Forests around the survey stream consisted of managed second growth stands of Douglas-fir (*Pseudotsuga menziesii*) over 40 years old. During surveys, two people moved upstream searching across the wetted width overturning moveable surface objects to enhance species detection. Before the first survey date on these streams, <12 mm of precipitation had fallen over the previous 10 weeks; the 2003 summer season was the driest in recorded history for Washington State (http://www.climate.washington.edu/details.html). Regional high air temperatures on the initial survey day were ≥ 34°C. Over

the 280 m of Stream A surveyed on that date, at least 20 *P. dunni* and 4 *P. vehiculum* were encountered, over 60% of which were found entirely immersed in the 160 m watered section of stream channel. Examination of both banks just centimeters above the wetted channel revealed it to be extraordinarily dry, both above and beneath surface objects. Furthermore, the water content of conifer needle litter and small organic debris on the substrate seemed very low, as it was brittle underfoot. Maximum daytime temperatures during the next four days (30 July, 4–6 August) when surveys were conducted in both streams were 3–5°C lower than on 29 July. Surveys over the next 660 m of Stream A on 30 July and 1660 m of Stream B on 4–6 August revealed 62 *P. dunni* and 46 *P. vehiculum* within a combined ca. 1900 m of watered channel length; no more than two of these were observed over the 450 m length of unwatered channel. In contrast to the individuals observed on the warmest survey date, 6.5% (N = 4) of the *P. dunni* and 7.1% (N = 3) of the *P. vehiculum* were immersed on the combined remaining survey dates, but all remaining non-immersed salamanders were encountered on moist or wet substrates within the hydrological influence of each of the two stream channels.

Although their hydration requirements differ somewhat (Dumas, *op. cit.*), *P. dunni* and *P. vehiculum* both exhibit greater near-surface activity under moist substrate conditions (Dumas, *op. cit.*; Peacock and Nussbaum 1973. J. Herpetol. 7:215–224; Ovaska and Gregory 1989. Herpetologica 45:133–143; unpubl. data). Furthermore, exposure to 32°C for < 20 minutes appear to be lethal to both species and stress becomes evident at 28–32°C (Dumas, *op. cit.*). Given this context, two aspects of our observations are notable. First, appearance of both species almost exclusively within the wetted channel margins implies that streambanks, a habitat both species often use (Dumas, *op. cit.*), became too dry to remain there. Second, salamanders being found predominantly in water only on the warmest day implies that air temperatures were high enough to make immersion in the stream channel a critically important refuge. More tolerable temperatures on subsequent days eliminated the importance of the water refuge. Both species are capable of swimming and surviving for some time in water (Dumas, *op. cit.*) and *P. dunni* in particular can be found in ponded or running water margins (unpubl. data), although observations suggest that both species typically avoid total immersion (Dumas, *op. cit.*). These observations suggest that even mesic-adapted plethodontids have an ability to respond to selected dry and warm condition extremes when suitable subterranean refuges may be unavailable. Greater attention needs to be given to understanding the range of such responses in view of global warming trends.

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RHYACOTRITON CASCADAE (Cascade Torrent Salamander). **NEST**. On 14 Aug 2003, I discovered a nest of *Rhyacotriton cascadae* in a 2nd-order headwater stream on the west slope of the Cascade Mountains in Skamania County, Washington, USA (45°41'6"N, 122°1'48"W; elev. 740 m). The stream did not contain fish, but did support Tailed Frogs (*Ascaphus truei*) and giant salamanders (*Dicamptodon* spp.) A clutch of 5 eggs was found under a cobble-sized (14 x 15 x 5 cm) rock in the thalweg of a glide 10 cm deep x 60 cm wide x 72 cm long. The nest was located 473 m downstream of the flowing origin. Stream discharge immediately above the nest, measured by establishing a weir and recording fill time of a known volume, was 96 cm^3/sec and water temperature (at 0915 h) was 12°C. Eggs were neither attached to the substrate or each other; the current swept them away when I overturned the rock concealing them, precluding precise measurement. However, I was able to see that the ova were white, ca. 3–4 mm in diameter, and with ca.1-mm layer of clear jelly. The nest was unattended, but an adult female *R. cascadae* (46.3 mm SVL, 3.0 g, not visibly gravid) was captured 8 m upstream. The stream reach where the nest was located had a southerly aspect, 10% gradient, and bisected a power line right-of-way cleared of trees. However, vegetation cover over the nest site was 100%, multilayered, and made up of vine maple (*Acer circinatum*), salmonberry (*Rubus spectabilis*), and green alder (*Alnus sinuata*). The stream above the right-of-way to the origin was within a 30–121 m wide buffer (total width) within a 2–3 year old Douglas-fir (*Pseudotsuga menziessi*)-Noble Fir (*Abies procera)* plantation.

To date, the eggs of *R. cascadae* had not been found and oviposition in habitats similar to that of other *Rhyacotrotion*, i.e., in springs and seeps in deep cracks and crevices, may have been assumed (Nussbaum et al. 1983. Amphibians and Reptiles of the Pacific Northwest, Univ. Idaho Press, Moscow, 332 pp.; Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, DC, 587 pp.). However, more recent information suggests that *R. variegatus* (Karraker 1999. Herpetol. Review 30:160–161) and *R. kezeri* (Russell et al. 2002. Northwest. Nat. 83:19–22) also oviposit in mid-channel under boulders and logs, well below the stream origin. Given the relatively few nest descriptions, understanding of habitat variation over which oviposition occurs undoubtedly is far from complete.

The number of eggs in the nest I found was less than that reported for other *Rhyacotriton* clutches (7–75; Nussbaum 1969. Herpetologica 25:277–278, Karraker, *op. cit.*; Russell, *op. cit.*), but within the range of mature ovarian eggs found in *R. cascadae* (Nussbaum and Tait 1977. Amer. Midl. Nat. 98:176–199).

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TARICHA GRANULOSA (Roughskin Newt). **FEEDING**. Roughskin Newts are predatory during both larval (Leonard et al. 1993. Seattle Audubon Society, Seattle, Washington. 56 pp.) and adult life stages (Chandler 1918. Oregon Agric. College Exp. Stat. Bull. 152:1–24; Efford and Tsumura 1973. Trans. Amer. Fish. Soc. 1:33–47; Evenden 1948. Copeia 1948:219–220). Adult Roughskin Newt predation on vertebrates has been recorded, but heretofore

prey taxa have been limited to the eggs and larvae of selected amphibians (Chandler, *op. cit.*; Efford and Tsumura, *op. cit.*; Evenden, *op. cit.*), all of which have limited evasive abilities when faced with a predator. By comparison, generally more elusive fishes are largely unrecorded as prey except among salamander taxa with aquatic life stages that engage in ambush predation and/or successfully co-occur with fishes. Here, we add *T. granulosa* to the list of salamanders known to consume fish, and describe their opportunistic predation on injured, disoriented fish.

On 2 July 2001, while performing amphibian surveys on the South Santiam River 6 mi E of Sweet Home (Linn Co., Oregon), CJR encountered a mixed-species school of ca. 200 small fish (ca. 30–60 mm fork length [FL]) in a seasonally isolated bedrock pool at the river edge. The pool, 1.5 x 2.0 m with a maximum depth of 7 cm, had ca. 3 cm of silt over its bottom, was surrounded by sedges (*Carex* sp.) 0.5 m high, and was connected to the river through a 70-cm wide channel that opened into a larger pool before reaching the river. Juvenile Northern Pikeminnow (*Ptychocheilus oregonensis*), adult Speckled Dace (*Rhinichthys osculus*), and Redside Shiner (*Richardsonius balteatus*) were the three dominant fish species in the pool; no newts were initially seen. After making one scoop through the school, CJR withdrew ca. 60 fish with a dipnet; they were examined briefly for identification. About 5 seconds after taking the sweep, 6 adult (65–85 mm SVL) *T. granulosa* emerged from among the sedge stems on the pool margin. During the sweep, a ca. 40 mm FL Speckled Dace that had been injured dropped into the water in front of an 85 mm SVL newt. This newt approached the fish and examined it briefly before engulfing it headfirst. Subsequently, CJR noticed 12 other fish in mid-pool (representing each of the three species observed) that the sweep had disoriented or incapacitated; all six newts converged on the fish and ate them. Observer presence did not appear to deter the feeding newts. Positioning of prey during ingestion appeared undirected; some fish were eaten headfirst, whereas others were grasped by the tail or at mid-body. On three occasions, a newt bit a fish protruding from the mouth of another newt and attempted to pull it away; all such attempts were unsuccessful. On one occasion, one newt grasped the leg of another newt and attempted to ingest it. The entire episode lasted ca. 10 min, during which time all compromised fish were eaten. Individual fish were completely ingested within ca. 45 sec. During the episode, five additional newts appeared in the pool connecting this one to the river, and approached the pool in which the feeding was taking place. After all compromised fish were eaten, both the newcomers and the feeding newts continued to search the pool. During this search, a 65 mm SVL newt lunged upward and captured an apparently healthy ca. 40 mm FL Redside Shiner from a passing school; the newt made one complete vertical revolution in the water and swallowed the fish in two gulps.

Fish consumption among salamanders can be grouped into those genera where it is more important (*Amphiuma, Cryptobranchus, Necturus*) versus less important (*Dicamptodon, Siren*). For all these genera, prey detection outside of the immediate visual field is probably based on olfaction (Green 1933. Proc. West Virginia Acad. Sci. 7:28–30; Green 1935. Proc. West Virginia Acad. Sci. 9:36; Harris 1959. Field Lab. 27:105–111; Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, DC, 587 pp.; Smith 1907. Biol. Bull. 13:5–39). Our observations suggest that *T. granulosa* fits the less important grouping and that rapid recognition of compromised prey likely involved a non-visual modality as no *T. granulosa* appeared to be within visual range of the fish when they were injured. Furthermore, the five newts that approached the pool after feeding began did so from downstream, suggesting the presence of current-transported olfactory cues. As injured fishes, especially cyprinids, are known to release chemical compounds attractive to predators (Mathis et al. 1995. Amer. Nat. 145:994–1005; Wisenden 2002. J. Chem. Ecol. 28:433–438), the *T. granulosa* we described may have recognized and been attracted by such a cue (Neish 1970. A comparative analysis of the feeding behavior of two salamander populations in Marion Lake, B.C. PhD Diss., Univ. British Columbia, Vancouver. 108 pp.). Available data imply that *T. granulosa* consumes mostly small, slow-moving prey (Chandler, *op. cit.*; Evenden, *op. cit.*; Efford and Tsumura, *op. cit.*) but represent generalist predators that will eat almost any prey they can capture (White 1977. Northwest Sci. 51:114–118). We expect that Roughskin Newts rarely take fish due to the relative size and swiftness of such prey; however, our observations document the ability of Roughskin Newts to capture and consume fish when opportunities arise.

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ANURA

ALSODES GARGOLA (Rana del Catedral). **OVERWINTERING TADPOLES**. Overwintering is a strategy that tadpoles seldom utilize. So far, the majority of the few published observations have come from the Northern Hemisphere (Bradford 1983. Ecology 64:1171–1183; Brown 1990. J. Zool. 220:171–184; Fellers et al. 2001. Herpetol. Rev. 32:156–157). Here, we report overwintering tadpoles for a South American species, *Alsodes gargola*, an endemic leptodactylid frog from the North Patagonian Andes of Argentina that has successfully colonized alpine environments.

At the end and at the beginning of three consecutive austral winters, as well as during the growing seasons in-between (2000–2003), we systematically surveyed two alpine lakes (Toncek, 1750 m and Schmoll, 1950 m elev.; 41°12'S, 71°30'W) along with the surrounding streams and shallow (depth < 1.5 m) pools. These water bodies are located within the Nahuel Huapi National Park (Río Negro Province, Argentina) and remain superficially frozen for 7–8 mo. per year.

At the end of each winter (December), just when the thawing period was starting, we observed several *A. gargola* tadpoles (ca. 5–20 per visit to the study site) through openings in the ice cap in the shallow (< 1 m) littoral zone of both lakes. These individuals were either hiding among the bottom rocks or swimming near the ice cap. Moreover, in slow current sections of streams and at the bottom of pools, some tadpoles (ca. 5–10) were observed through ruptures in the ice cap. All tadpoles observed during this period appeared in good physical condition.

During each growing season (January–April) many individuals (ca. 50–100 per visit) were seen in different sections of the shoreline of both lakes as well as at the bottom of pools and streams.

Many tadpoles were observed metamorphosing at the middle of the growing seasons. Judging from the size of the cohorts at the time, these were at least one year old.

At the beginning of each winter (May), when all the water bodies were already superficially frozen, we observed several tadpoles (ca. 10–25 per visit) along the shore of both lakes. They were either swimming just below the ice cap or hiding among the bottom rocks. Several individuals (ca. 5–15) were also found, under the ice cap, in the streams and pools.

Throughout the visits, tadpoles were normally found aggregated (ca. 2–20 individuals) in what seemed the most favorable microhabitats. These aggregations included individuals belonging to up to three cohorts (i.e., each cohort hatched in different summers) with total body lengths ranging between 20–90 mm (stages 32–38; Gosner 1960. Herpetologica 16:183–190). At the beginning and at the end of each winter, tadpoles were found in water at 0.1–3.0°C. Despite these low temperatures, they were usually active and, when inactive, they responded rapidly to mechanical stimuli. In conclusion, tadpoles of *A. gargola* overwinter (at least once) for 7–8 mo. in ice-covered alpine lakes, pools, and streams in the northern Patagonian Andes. During this period individuals do not enter a dormant state. Moreover, they seemingly do not experience high levels of winter mortality. The strategy of *A. gargola* tadpoles involves gaining as much biomass as possible by exploiting at least one complete growing season and thus metamorphose, at the middle of a certain summer, as bigger juveniles with higher probabilities to survive the approaching long winter.

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AMOLOPS VIRIDIMACULATUS (Dahaoping Sucker Frog) **ARBOREAL ACTIVITY**. Frogs of the genus *Amolops* generally are reported from torrent streams. Adults usually are found at night on rocks at the sides of or in the middle of streams, or on wet vertical surfaces of waterfalls. During the day they have been found in rock crevices and low dense vegetation within the splash zone of the stream (Fei 1999. Atlas of Amphibians of China. Publishing House for Scientific and Technical Literature, Hunan, China. 432 pp.; Inger et al. 1990. Field. Zool. 58:1–24; Inger et al. 1999. Field. Zool. 92:1–46; Schleich and Kästle 2002. Amphibians and Reptiles of Nepal. A.R.G. Gantner Verlag Kommanditgesellschaft, FL 9491 Ruggell. 1201 pp.). Studies have shown that the expanded toe tips of *Amolops* are optimized for this type of wet surface habitat (Ohler 1995. Asiatic Herp. Res. 6:85–96). To date, no adult individuals of this genus have been reported from a high perch in vegetation outside of the splash zone. On 14 March 2002 at 2019 h during a light rain, an adult male *Amolops viridimaculatus* (76.9 mm SVL; California Academy of Sciences CAS 224378) was found at a height of 3.5 m on a bamboo plant above a stream. The animal jumped from one branch to another before diving into the stream. The *Amolops* was collected in Myanmar, Kachin State near Ngar Ngar village 27°49'55.9"N, 97°45'49.5"E (WGS 84) at an elevation of 1176 m in evergreen forest.

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BUFO BOREAS BOREAS (Boreal Toad). **SCATS AND BEHAVIOR**. Adult Boreal Toads are known to engage in movements which sometimes are extensive (Carpenter 1954. Copeia 1954:197–200; Pimentel 1955. Herpetologica 11:72; Muths 2003. Copeia 2003:161–165), but the basis of movements is often unclear (Pimentel, *op. cit.*). Scattered data also indicate that *B. b. boreas* often eats ants, but identification of ant prey beyond a family level typically is not provided (Schonberger 1945. Copeia 1945:120–121; Campbell 1970. J. Herpetol. 4:83–85; Miller 1978. Northwest Sci. 52:243–239). Here, we report on the carpenter ant-filled scats of boreal toads from the Sky Lakes Wilderness in the Cascade Mountains of southern Oregon (USA), link their deposition to toad movements, and show their utility in revealing adult toad habitat use.

Observations were made during June–September in the Sky Lakes Basin (42°33'–42°38'N, 122°10'–122°14'W), a high-elevation (> 1700 m) plateau with > 200 lakes and ponds (0.01–9.62 ha in size) within a subalpine forest (Franklin and Dyrness 1973. Natural Vegetation of Oregon and Washington. USDA Forest Service, Portland, Oregon, General Technical Report PNW-8.) of mostly *Abies lasiocarpa*, *Pinus contorta*, and *Tsuga mertensiana*. In 1994, we conducted two visual encounter surveys (VES) between 0900 and 1700 h on 65 of these lakes and ponds with 2–3 surveyors via a slow perimeter walk that involved searching shallow water to a depth of around 0.4 m (Thoms et al. 1997. *In* Olson et al. [eds.], Sampling Amphibians in Lentic Habitats, pp. 35–46. NW Fauna 4, Soc. NW Vertebrate Biology, Olympia, Washington). In 1995–7, we similarly resurveyed nine of these sites twice yearly. We also made headlamp-assisted observations on 2–3 nights in all four years.

At 2330 h on 20 July 1994, we encountered two large (> 120 mm SVL) female Boreal Toads sitting ca. 0.5 m apart each within 15 cm of a Modoc Carpenter Ant (*Camponotus modoc*) column that was crossing the trail 30 m SW of Lake Elizabeth. Over the next five hours, we observed each toad take > 60 ants from the column. Feeding was irregular (3–18 min intervals between captures), and each toad made few movements, often capturing ants that strayed close rather than moving towards or interrupting the column to feed. Each toad stopped feeding ca. 30 min before sunrise. After feeding ceased, one female moved 35 m to the nearest lake margin to the NW; the other moved 80 m to the nearest lake edge to the SE. Each toad spent 10-15 min in shallow water after which each deposited a large, subovoid scat (25–30 x 10–13 mm).

Each scat had a gel-like translucent outer layer, which thickened slightly with hydration, and a dark interior. Examination of the interior revealed the scats to contain entirely carpenter ant parts. In one scat, the ant parts were entirely those of *C. modoc*; in the other, *C. laevigatus* and *C. modoc* parts were found. We made additional nocturnal observations of Boreal Toads feeding on carpenter ants on six different occasions during 1995–1997. Each observation began in the interval 2230–0250 h, and were similar in that adult toads were involved, toads posted on ant columns that crossed largely unvegetated patches, and in the four instances where we continued observations until the toads stopped feeding, each moved to shallow water and, after a period of 10–20 minutes, deposited one or two scats of a size and shape similar to that described above. In each case, scats were almost entirely *Camponotus* parts. The latter four observations differed from the above in that individual adults moved distances 15–285 m to the nearest water after feeding stopped, and cessation of feeding and movement to water occurred over the hour before sunrise.

Using VES in 1994, we found Boreal Toad life stages at nine sites: Big Heavenly Twin, Elizabeth, Isherwood, Liza, Florence, and North and South Snow Lakes, and two unnamed ponds (42°35'52"N, 122°11'27"W and 42°34'34"N, 122°12'32"W). During 1995–97 resurveys, which included Isherwood and Liza among resurveyed units, we found Boreal Toads at 4 sites, but recorded them in all resurvey years only from Isherwood and Liza. We also recorded them from Notasha and South Puck, respectively, only in 1995 and 1996. By contrast, we found evidence of reproduction (i.e., eggs, larvae, or metamorphosing toadlets) at only Isherwood and North Snow in 1994. During resurvey years, we recorded toad reproduction only at Isherwood every year and at Liza only in 1995.

After our initial observation of carpenter ant-filled scats in 1994, we were alert to similar-looking scats during VES. Ultimately, we recorded 47 carpenter ant-filled scats attributable to boreal toads in 20 different lakes and ponds in 1994, including 11 stillwater habitats at which we had not recorded boreal toads directly during VES. The latter were 4 named lakes (Deep, Martin, Tsuga, and Wind) and 7 unnamed ponds. Notably, Martin, Tsuga, and Wind were within 0.5 km of North Snow, one of two lakes with boreal toad reproduction (see above), whereas Deep and the remaining 7 ponds were within 0.6 km of Isherwood, the only other lake in which we identified toad reproduction. Similarly, during resurvey years, we found 13 toad scats at five sites, three at which we had not recorded toads during VES, and all of the latter were within 0.4 km of Isherwood.

Our observations are significant for three reasons. Data based on VES, a widely used method for amphibians (Thoms et al., *op. cit.*), had fewer than half the Boreal Toad sites than the scat data revealed. As Boreal Toads may be crepuscular or nocturnal (Linder and Fichter 1977. The Amphibians and Reptiles of Idaho. The Idaho State Univ. Press, Pocatello. 78 pp.), especially during the warmer months when many surveys are done, likelihood of making a Type II error about toad habitat use (not detecting a species when it actually uses a site) may be high, especially if one uses diurnal VES. Identifying the presence of toad scats offers one way to decrease Type II error if applying diurnal VES and perhaps other survey methods. This method needs further scrutiny to determine its effectiveness, but the approach might be more useful for high-elevation Boreal Toads. At high elevation, toads may be more dependent on carpenter ants, resulting in their consistently having more distinctive-looking scats that are less likely to be confused with those of other subalpine vertebrates, assemblages which are typically less speciose than their lower elevation counterparts. Second, all stillwater habitats where the only evidence of toad presence was scats found within 0.6 km of breeding sites shows that scat data can also augment understanding of the scale and foci of habitats used. This may be especially useful in landscapes densely populated with discreet stillwater habitats, such as the Sky Lakes Basin. Notably, aforementioned distances are in the range of reported movements for Boreal Toads (Muths, *op. cit.*; Carpenter, *op cit.*; Pimentel, *op. cit.*). Lastly, heavy carpenter ant use is consistent with the availability of this resource in high elevation systems, as several other organisms (e.g., woodpeckers) also heavily exploit this food source at high elevation (Torgersen and Bull 1995. Northwest Sci. 69:294–303).

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BUFO* cf. *CRUCIFER (Sapo Cururu). **DEFENSIVE BEHAVIOR.** Bufonids have characteristic paratoid glands on their dorsum that may help prevent predation (Stebbins and Cohen 1995. A Natural History of Amphibians. Princeton Univ. Press. 316 pp.). Field observations reported herein were carried out at the Ecological Station of Itirapina (ESI), municipality of Itirapina and Brotas, São Paulo State, southeastern Brazil. On 25 Nov 2002 an adult male *Bufo* cf. *crucifer* was found crossing a road at the ESI. At first, the individual tried to escape by making short and unidirectional hops for ca. 100 m. Apparently tired, it became immobile until my hand touched its back. The animal immediately tilted its body sideways in the direction that I had touched. When I touched its head, the animal flexed the head downward (Fig. 1A); when I touched its back, the anuran assumed a roughly erect posture, with its arms strongly stretched (Fig. 1B); when I touched one of the flanks, it tilted laterally toward the same side. This behavior may be common in species of the genus *Bufo* (Hanson and Vial 1956. Herpetologica 12:141–149; Duellman and Trueb 1994. Biology of Amphibians. McGraw-Hill Publ. Co., 670 pp.), although it has never been described for this species complex. This postural behavior 1) increases the likelihood that a predator might ingest toxic skin secretions; and 2) presents a large body surface that would make head-first ingestion (for example, by snakes) more difficult.

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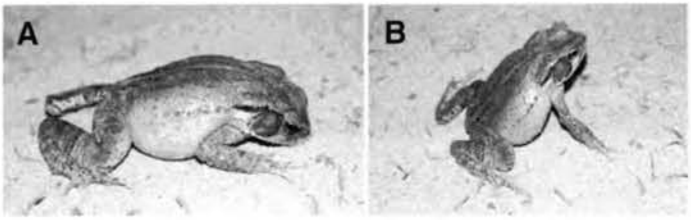

FIG. 1. Adult male *Bufo* cf. *crucifer* tilting toward the touched body area: A) animal touched on the head; B) animal touched on its back.

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BUFO MARINUS (Marine Toad). **DEFENSIVE BEHAVIOR.** *Bufo marinus* occurs from extreme southern Texas (USA) through tropical Mexico and Central America to northern South America (central Brazil and Peruvian and Bolivian Amazon). It has been widely introduced (Antilles, Hawaii, Mauritius, Fiji, Philippines, Taiwan, Ryukyu Is., New Guinea, Australia, and many other Pacific islands) (Frost 2002. Amphibian Species of the World: an online reference. V2.21. http://research.amnh.org/herpetology/amphibia/index.html). On 6 July 2003, three juvenile *B. marinus* [Museu de Ciência e Tecnologia of the Pontifícia Universidade Católica do Rio Grande do Sul; MCP 7502, female, 39.2 mm SVL; MCP 7503, female, 42.5 mm SVL; MCP 7504, male, 51.4 mm SVL,] were collected in Itaituba municipality (04°29'40"S; 55°49'00"W), Pará State, Brazil. While being manipulated for photographs the specimens assumed a defensive behavior feigning death (Fig. 1). The posture observed during 45 sec was of retracted limbs and exposed belly. Defensive behavior is variable among Leptodactylidae, Hylidae, and Bufonidae (Duellman and Trueb 1994. Biology of Amphibians. Johns Hopkins Univ. Press 670 pp.). A behavior similar to the one presented here has been observed in *Rhinoderma darwini* (Pough et al. 2001. Herpetology. 2nd Ed. Prentice Hall, New Jersey, 612 pp.), *Dendrophryniscus minutus* (Russel 2002. Herpetol. Rev. 33:302), and *Epipedobates femoralis*

FIG. 1. *Bufo marinus* in defensive behavior (photo by J.G. Frota).

(W. Vaz-Silva, pers. com.). We thank Roberto E. Reis and Thales de Lema for their assistance with this manuscript.

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ELACHISTOCLEIS* cf. *OVALIS (Common Oval Frog). **DEATH FEIGNING.** Numerous amphibian defense strategies have been described, including death feigning, or thanatosis, which is quite widespread in anurans. This strategy is utilized by members of several families including Bufonidae (Zamprogno et al. 1998. Herpetol. Rev. 29:96–97); Hylidae (Azevedo-Ramos 1995. Rev. Bras. Bio. 55[1]:45–47): Leptodactylidae (Hartmann et al. 2003. Herpetol. Rev. 34:50), and Ranidae (Gramapurohit et al. 2001. Herpetol. Rev. 32:103), although its function is still not well understood (Azevedo-Ramos, *op. cit.*). Observations reported herein occurred during January 2003 at Floresta Estadual "Edmundo Navarro de Andrade" (22°25'S; 47°33'W, 650 m elev.), municipality of Rio Claro, São Paulo State, Brazil. An adult male *Elachistocleis* cf. *ovalis* (25 mm SVL) was captured while calling and when manipulated for photographs, it turned its belly, arms, and legs up, with the arms outstretched and the legs close to the body (Fig. 1). The animal remained motionless for nearly 3 minutes. After resuming its normal position, the animal was handled again and it repeated the behavior twice. Rödel and Braun (1999. Biotropica 31[1]:178–183) described a similar behavior in *Kassina fusca*, although it was not identified as thanatosis. Thus this is the first observation of thanatosis in a microhylid, and the third defensive behavior described for the genus (Kokubum and Menin 2002. Herpetol. Rev. 33:198; Kwet and Solé 2002. Herpetol. Rev. 33:46). The effectiveness of death feigning needs to be tested as there are few data available that support the idea that such behavior could lead to avoidance by predators (Rödel and Braun 1999, *op. cit.*).

FIG. 1. Adult male *Elachistocleis* cf. *ovalis* feigning death after been handled.

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ELEUTHERODACTYLUS MIMUS (NCN). **DIET**. On 13 Jan 2003 at 1600 h at the La Selva Biological Station, Heredia Province, Costa Rica, an adult female *Eleutherodactylus mimus* (~45 mm SVL) captured and consumed an anole, *Norops limifrons* (~40 mm SVL; ~80 mm total). *Eleutherodactylus mimus* is not previously reported to take vertebrate prey.

The *E. mimus* jumped 13 cm vertically from the leaf litter to a small arching stick, apparently in response to movement of the *N. limifrons*. The frog bit the anole at midbody and dropped to the ground. The frog sat without moving, occasionally clenching its jaws while the anole struggled and appeared to gasp for air. After 15 min, the *E. mimus* used its forelegs to push the anole's head into its mouth with a lunging motion. Over a three-minute period, the *E. mimus* then swallowed the anole with quick, lunging bites followed by pauses. Once the anole had been completely consumed, it continued to move inside the frog for ca. 5 min, when the frog was captured by hand to verify identification.

Diet samples from 14 individuals of this species listed by Lieberman (1986. Acta Zool. Mex. 15:1–71) included no vertebrate prey. Lieberman reported that the greatest proportion of the diet is made up of termites (30%), orthopterans (20%), and miscellaneous larvae (20%). My observation suggests that occasional small vertebrate prey may be an important protein source for *E. mimus*.

I thank the Organization for Tropical Studies, Peace Frogs, and the Auburn University College of Agriculture, International Scholars Program for pilot funds supporting research during which this observation was made.

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FEJERVARYA LIMNOCHARIS (Boie's Wart Frog). **OPHIOPHAGY.** Diet studies of *Fejervarya limnocharis* have been carried out in Japan (Hirai and Matsui 2001. Current Herpetol. 20[2]:97–103), China (Zhao 2001. Chinese J. Zool. 36[5]:43–45), and Vietnam (Kuzmin and Tarkhnishvili 1997. Adv. Amphib. Res. Form. Sov. Un. 2:103–109). None of these studies report *F. limnocharis* ingesting reptiles. On 27 July 2003 at 1914 h after heavy rains, in Myanmar, Shan State, Taung Gyi District, near Mine Thaung Village (20°34'39.8"N, 96°57'24.1"E datum WGS 84), G. Wogan and Kyi Soe Lwin found an adult *F. limnocharis* (California Academy of Sciences CAS 226161) on the ground with a half-ingested *Ramphotyphlops braminus* (CAS 226162). The *R. braminus* measured 122 mm total length and weighed 0.9 g. The *F. limnocharis* measured 40.6 mm SVL and weighed 7.8 g (after preservation). A second *R. braminus* (CAS 225157) was found within 3 m of the above animals, suggesting that they were active that night. Ophiophagy in *F. limnocharis* is likely opportunistic.

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HYLA CINEREA (Green Tree Frog). **DIET.** *Hyla cinerea* is commonly found on low-growing vegetation throughout the southeastern United States (Phelps and Lancia 1995. Brimleyana 22:31–45). Documented prey include 35 families of arthropods, with noctuid moth (Lepidoptera: Noctuidae) and soldier beetle larvae (Coleoptera: Cantharidae) the most commonly observed prey recorded from stomach samples (Freed 1982. Oecologia 53:20–26).

In August 2001, small forest gaps were created in bottomland hardwood forests on the Savannah River Site, Barnwell Co., South Carolina, USA. These gaps provide valuable habitat and resources for plants and animals that prefer open areas. In a recent survey, we found *H. cinerea* to be 7.5 times more abundant in the forest gaps than in the interior forest (unpubl. data). Previous researchers have noticed a similar preference for clearings by this species (Phelps and Lancia, *op. cit.*).

On 4 Sept 2003 (ca. 1030 h) we observed an immature *H. cinerea* (3–4 cm SUL) on switchcane (*Arundinaria gigantea*) in a 0.26 ha flooded canopy gap. The tree frog was observed consuming a narrow-winged damselfly (Odonata: Coenagrionidae). To our knowledge, this is the first record of *H. cinerea* preying upon this group of insects.

Dragonflies and damselflies (Odonata) occur in a number of habitats including streams, ponds, and swamps (Borror et al. 1981. An Introduction to the Study of Insects, 5th ed. Saunders College Publ., Philadelphia. 827 pp.). They seem to have benefited from the creation of forest gaps as they are much more abundant there than in the forest (pers. obs.). The most common prey of *H. cinerea* are immature insects, ants, spiders, or beetles which are weak fliers commonly found walking on vegetation (Freed, *op. cit.*). Although the majority of its prey may be small and slow-moving, our observation of *H. cinerea* catching and consuming such a large and actively flying insect shows it to be an opportunistic predator.

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LEPTODACTYLUS FRAGILIS (White-lipped Foamfrog). **COURTSHIP.** Female reciprocal calling is a rare phenomenon in anurans and has been reported in only 14 species (Schlaepfer and Figueroa-Sandí 1998. Copeia 1998[4]:1076–1080). Two of these species are in the family Leptodactylidae, but none are *Leptodactylus*. Here we report an observation of courtship behavior and potential female reciprocal calling in *L. fragilis*. The observation took place in the canal area, Gamboa, Panama (9°07.0'N, 79°41.9'W).

During a rainy evening on 16 July 2003 we observed two *L. fragilis* apparently courting. One frog, almost surely a male, while hopping, intermittently emitted a characteristic advertisement call (Ibañez et al. 1999. The Amphibians of Barro Colorado Nature Monument, Soberania National Park and Adjacent Areas. Editorial Mizrachi & Pujol, Panama). The male called from open, exposed areas and kept moving, covering a distance of ca. 1.5 m during the period of observation. The other individual, presumably a female, followed him ca. 20 cm away. While this occurred, we heard a second type of call. This call was a rapid series of notes or short trill, longer and softer than the advertisement calls. Some of these calls were synchronized with movements of the abdomen of the male. Other calls were not and may have been given by the presumptive female. The second type of call, in contrast to the advertisement call, was barely audible at a distance of 2 m. While the male was broadcasting the second type of call, the other individual approached him until they were side to side, touching each other laterally. The male disappeared under some vegetation, apparently entering a burrow on the ground, and the other frog followed him. They were not seen again.

In *L. fragilis* males call during late afternoon and night during the rainy season (Ibañez et al. 1999, *op. cit.*). They construct burrows next to pools, where females deposit eggs (Heyer 1969. Evolution 23:421–428). Early development takes place within a foam nest until the burrow is flooded and the tadpoles reach the water (Ibañez et al. 1999, *op. cit.*; Prado et al. 2002. Copeia 2002:1128–1133). This reproductive mode is shared by members of the *L. fuscus* species group (Prado et al. 2002, *op. cit*). We are aware of descriptions of courtship behavior in *Leptodactylus* only for *L. fuscus* (Freitas et al. 2001. Comun. Mus. Ciênc. Technol. PUCRS, Sér. Zool., Porto Alegre 14:121–132) and *L. mystacinus* (Sazima 1975. Dissertação de Mestrado, USP Sao Paulo. 71 pp.). Touching was described to be present in both species. If the calling behavior that we observed in *L. fragilis* is associated with their reproductive mode, it is likely that female reciprocal calling occurs in other species of the *L. fuscus* group as well. The absence of previous reports may be explained by their secretive underground behavior that makes them difficult to locate and observe while breeding.

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LEPTODACTYLUS OCELLATUS (Rã-manteiga). **TADPOLE ALBINISM.** Because they are more conspicuous to predators, albino individuals are expected to be relatively rare in nature (Sazima and Pombal 1986. Rev. Biol. 46[6]:377–381; Sazima and Di Bernardo 1991. Mem. Inst. Butantã. 53[2]:167–173).

On 4 Oct 2002, in the municipality of Uberlândia (Minas Gerais, Brazil), we found an albino *Leptodactylus ocellatus* tadpole. The tadpole was in a dense school of black siblings (>150 individuals) which was attended by an adult female, as is typical for the species (Vaz-Ferreira and Gehrau 1975. Physys 34, 88:1–14). The albino was in Gosner stage 25 (Gosner 1960. Herpetologica 16:183–190) and measured ca. 25 mm TL. Survival of this albino tadpole to a large size may have been facilitated by the schooling behavior and by maternal care.

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MEGAELOSIA BOTICARIANA (NCN). **ADULT SIZE.** *Megaelosia boticariana* is a rare and threatened species from southeastern Brazil (Giaretta and Aguiar 1998. J. Herpetol. 32:80–83). This species was diagnosed chiefly by its karyotypical features and the holotype is a female of uncertain degree of maturity; the two paratypes are juveniles. Herein we describe an adult male topotype (Parque Florestal do Itapetinga, Atibaia, São Paulo), housed at Museu de História Natural da Universidade Estadual de Campinas (ZUEC), Campinas, São Paulo. This male was found dead, from unknown causes, in a forest rivulet on 9 July 2000. Decomposition of this individual was not far advanced so that reliable measurements could be taken and morphological details analyzed as follows: adult male *M. boticariana* (ZUEC 11843); 100.4 mm SVL; vocal sacs visible externally as a thin whitish skin on each side of the head, slightly distended (inflated); each vocal sac with its correspondent vocal slit; tympanum ovoid, its diameter (parallel to the main body axis) being about 24% of the eye diameter; back smooth, uniformly gray; lower surfaces of thighs entirely smooth. Body proportions, in relation to SVL are: head length 37.8% (from posterior border of tympanum to tip of snout); head width 42.4%; thigh length 48.1%; shank length 47.8%; foot length 49.2%. In addition to the karyotypical features, the smaller size (about 13% in SVL) and lighter dorsal coloration help differentiate *M. boticariana* from *M. massarti*. SVL of this male *M. boticariana* (ZUEC 11843) is about 25% larger than the holotype (ZUEC 9561), which suggests the latter is a juvenile.

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NYCTIXALUS PICTUS (Cinnamon Tree Frog). **DEFENSIVE BEHAVIOR.** *Nyctixalus pictus* is a common and widespread species from the Sunda regions of Southeast Asia, from southern Thailand, the Malay Peninsula, Sumatra, Borneo, and Palawan (Inger and Stuebing 1997. A Field Guide to the Frogs of Borneo. Natural History Publications [Borneo] Sdn Bhd., Kota Kinabalu, Sabah, Malaysia. 205 pp.). In our experience with this relatively com-

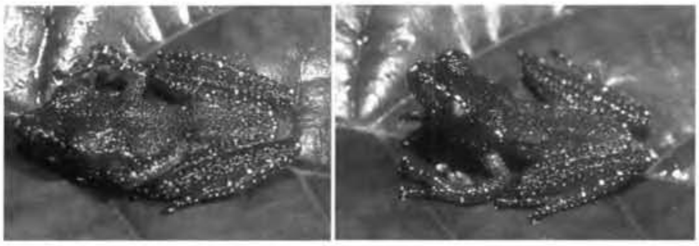

FIG. 1. Left: Defensive posture of *Nyctixalus pictus*, with eyes shut, back arched, and forearms covering part of head. Right: The same frog, ca. 30 secs later, in the more typical alert position.

mon rhacophorid species, about three out of four specimens handled will display a defensive response. Such behavior is herein described from observations of individuals encountered and/or collected in the field from different localities.

On 7 Aug 2003, while walking in the lowland dipterocarp forest, ca. 04°03'96"N, 114°51'99"E, 495 m elev., adjacent to the base of Sarawak Chamber, the largest cave chamber in the world, within the Mulu National Park, Sarawak, East Malaysia (Borneo), an adult female *Nyctixalus pictus* (31.4 mm SVL), was encountered sitting on a leaf of a sapling and was collected for photography. Upon manipulation of the frog, it closed it eyes, arched its back, and placed its forearms alongside its head with the palmal surface turned away from the body partially covering the posterior portion of the eyes (Fig. 1, left), at the same time, releasing a mossy smell. After ca. 30 secs, it returned to its typical position (Fig. 1, right), with eyes open, body upright, and hands and feet firmly on the ground. Similar reactions from individuals of this species have been elicited as a result of handling from other parts of Southeast Asia.

It is worth noting that *Nyctixalus pictus* shows a bright orange, red or cinnamon-brown coloration that may be considered aposematic, as is typical of many other species that show this "unken reflex".

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OSTEOPILUS SEPTENTRIONALIS (Cuban Treefrog). **REPRODUCTIVE BEHAVIOR.** The Cuban Treefrog (*Osteopilus septentrionalis*) was first recorded on mainland Florida in Dade County in 1951 (Schwartz 1952. Copeia 52:117–118). The subsequent spread of *O. septentrionalis* throughout peninsular Florida led to speculation concerning the impacts of this species on native anurans (Wilson and Porras 1983. The Ecological Impact of Man on the South Florida Herpetofauna. Univ. Kansas Mus. Nat. Hist. Spec. Publ. No. 9. 89 pp.; Meshaka 2001. The Cuban Treefrog in Florida. Univ. Press of Florida, Gainesville. 191 pp.). Here, I report an observation of reproductive interference by *O. septentrionalis* on a native anuran.

On 23 May 2003 at ca 0240 h, I observed a male *O. septentrionalis* in amplexus with a female Southern Leopard Frog (*Rana sphenocephala*) (Fig. 1). These individuals were found on the grassy margin of a drainage ditch in a residential development at the southeast corner of Kings and Lumsden Avenues in Brandon, Hillsborough Co., Florida. Thunderstorms had moved through the area late on 22 May. At the time of the observation, the air temperature was ca. 23°C and the relative humidity was 95%. *Osteopilus septentrionalis*, Eastern Narrow-mouthed Toads (*Gastrophryne carolinensis*), Pig Frogs (*Rana grylio*), and Florida Cricket Frogs (*Acris gryllus*) were calling from the drainage ditch. No other *R. sphenocephala* were seen or heard in this habitat, but several males were heard calling later from a retention pond ca. 200 m away.

FIG. 1. Male *Osteopilus septentrionalis* and female *Rana sphenocephala* in amplexus, Brandon, Hillsborough County, Florida.

This is the first published observation of reproductive interference by *O. septentrionalis*. The breeding calls of males of *R. sphenocephala* and *O. septentrionalis* are qualitatively similar (*pers. obs.*), but whether the female *R. sphenocephala* was drawn to the site by calling *O. septentrionalis* could not be determined. Although hybridization is a potential negative effect of nonindigenous species on native species (Simberloff 1997. *In* Simberloff et al. [eds.], Strangers in Paradise, pp. 3–17. Island Press, Washington, D.C.), hybridization between *O. septentrionalis* and *R. sphenocephala* seems unlikely since hybridization between families is uncommon. However, reproductive interference such as that reported here may decrease an individual's fitness if time and energy are spent in unsuccessful amplexus. The population-level effects of reproductive interference by *O. septentrionalis* on *R. sphenocephala* are probably minimal, however, since there is little temporal overlap in the breeding phenologies of these two species in Florida (Bartlett and Bartlett 1999. A Field Guide to Florida Reptiles and Amphibians. Gulf Publ. Co., Houston, Texas 280 pp.; Meshaka 2001, *op. cit.*).

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PROCERATOPHRYS BOIEI (Smooth Horned Frog). **DEFENSIVE BEHAVIOR.** The leptodactylid *Proceratophrys boiei* has a large geographic range from northeast to southeast Brazil (Haddad and Sazima 1991. *In* Morelato [ed.], História Natural da Serra do Japi: Ecologia e Preservação de uma Área Florestal no Sudeste do Brasil, pp. 188–210). On 23 Oct 2003 an adult male (51.1 mm SVL) was captured in a semidescidual forest (Mata São José), at the municipality of Rio Claro, São Paulo State, Brazil (22°21'278"S; 47°28'722"W, 659 m). When manipulated for photographs the frog flattened its body, stretched its rear legs backwards and its front legs forwards. It remained motionless for about 5 minutes even when carefully touched on its back. This behavior was repeated whenever the animal was touched. Sazima (1978. Biotropica 10[2]:158) described a similar behavior in *P. appendiculata*, and suggested this behavior could enhance its appearance as fallen leaves, confusing visually oriented predators. It is also possible this posture could make the individual difficult for a predator to swallow or create a "hard-to-ingest-prey" image (Azevedo-Ramos 1995. Rev. Bras. Biol. 55[1]:45–47). This defensive strategy has been described in two species (*P. appendiculata* and *P. boiei*), suggesting that it could be a common behavior within the genus. Furthermore, this observation reinforces the suggestion that there is a behavioral convergence among anurans that inhabit leaf litter and are subject to similar predation pressures (Sazima 1978, *op. cit.*; Garcia 1999. Herpetol. Rev. 30:224).

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RANA AURORA (Northern Red-legged Frog) **HABITAT AND MOVEMENT**. Live trees retained in harvested areas may provide critical habitat for forest vertebrates that might otherwise disappear after timber removal (Franklin et al. 1997. *In* Kohm and Franklin [eds.], Creating a Forest for the 21st Century, pp. 111–140. Island Press, Washington, D.C.; Mitchell and Beese 2002. Forest. Chron. 78:397–403). Although the benefits of residual trees to birds (Tittler et al. 2001. Ecol. Appl. 11:1656–1666; Schieck et al. 2000. Forest. Ecol. Manag. 126:239–254) and mammals (Moses and Boutin 2001. Can. J. For. Res. 31:483–495; Sullivan and Sullivan 2001. J. Appl. Ecol. 38:1234–1252) have been well documented, the effects of residual trees on amphibians have received scant attention. Chan-McLeod and Moy (ms. submitted) recently quantified the 3-day use of residual trees by transplanted *R. aurora*, but longer-term use of residual trees by native amphibian inhabitants have not been documented.

Herein we report seven observations of resident, adult *R. aurora* in residual tree patches. The tree patches were located in three, 1-year old variable-retention cut blocks that had been harvested to leave 10–20% of the live trees standing as residual tree patches and as single residual trees. All frogs were observed in tree patches > 0.7 ha; none were observed in the cut matrix or in abundant, smaller tree patches. Most of the observed frogs were in tree patches that were close to or right at the cut block boundary. At cut block R799, two frogs were observed in a residual tree patch that was 50 m from a block boundary bordering a highway. The patch was 7424 m^2 in size and had an ephemeral stream that was dry when the frogs were observed. At cut block R818, four frogs were observed in two different tree patches. Two frogs were sighted at the edge of a 26,700 m^2 tree patch that was bordered by a running stream and a 13-year old regenerating stand defining the block boundary. Another two frogs were observed in an 8000 m^2 tree patch that was also at the block boundary and contiguous with an old-growth forest. One of these frogs was not actually a native inhabitant but had lived in or near the patch for the past year. This frog was transplanted to the residual patch the previous year in a failed attempt to radio-track its movements in the variable-retention cut block. The radio-transmitter failed soon after the frog was released, and it was not recovered until 12 months later when the frog was serendipitously observed, still wearing its failed transmitter, in the same residual tree patch < 3 m from where it was last observed a year earlier. At R800, a frog was observed in a 9670 m^2 tree patch located in the middle of the cut block and > 170 m from the nearest cut block boundary. The tree patch did not contain a wet stream but had two dry streambeds ending at its edge.

We were able to capture and radio-track four of the seven resident frogs. Three of the four radio-tracked frogs did not leave the tree patch where they were first observed; one frog was radio-tracked in the 7424 m^2 tree patch in R799 between 5–8 Aug; a second frog was radio-tracked from the 8000 m^2 tree patch in R818 between 1 July and 5 August; a third frog was radio-tracked from the same patch between 1–28 July. These three frogs were highly stationary and moved only a few meters between relocations, which were done at 1–3 day intervals. The frog that moved out of the patch from which it was first observed (7424-m^2 tree patch in R799) did so shortly after being radio-harnessed. The frog had crossed the 50-m matrix between the patch and the cut block boundary, then crossed the highway and was ca. 100 m up a forested slope on the other side of the highway when it was relocated two days after.

These observations were made during a frog movement study funded by Weyerhaeuser Ltd.

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RANA AURORA (Northern Red-legged Frog). **PREDATION.** Anurans have been at least occasionally recorded in Mallard (*Anas platyrhynchos*) diet, but historically, the species taken were not identified (McAtee 1918. U.S. Dept. Agric. Bull. [720]:1–36; Bent 1923. U.S. Nat. Mus. Bull. [126]:1–244; Martin and Uhler 1939. U.S. Dept. Agric. Tech Bull. [634]:1–156). Observations of wild Mallards consuming specific anurans, all relatively recent, remain infrequent. Mjelstad and Saetersdal (1989. Fauna norvegica Series C 12:47–48) recorded adult Mallards eating juvenile Com-

mon Frogs, *Rana temporaria*, in western Norway, and Eaton and Eaton (2001. Can. Field-Nat. 115:499–500) saw a female Mallard take an adult Wood Frog, *Rana sylvatica,* in central Alberta (Canada). Here, we augment available data on Mallard predation of anurans with observations of near-adult Mallards preying on juvenile Northern Red-legged Frogs (*Rana aurora*) in southwestern Oregon, USA.

We made the observations at a small (0.03 ha) pond on the Squaw Flat Research Natural Area (Tiller Ranger District, Umpqua National Forest; 42°57'52"N, 122°40'10"W; elev. 747 m) which is used by *R. aurora* for overwintering (unpubl. data) and is located ca. 50 m NE of a 0.6-ha pond used by the same species for breeding (Hayes et al. 2001. Herpetol. Rev. 32:35–36). Groundwater input gives the overwintering pond relatively stable water levels year-round. Except for a few clumps of low emergent vegetation along the N–NW shoreline, floating duckweeds (mostly Star Duckweed [*Lemna trisulca*]) and Watermeal (*Wolffia punctata*) cover most of the pond surface. A mature tree canopy of Douglas-fir (*Pseudotsuga menziesii*), Grand Fir (*Abies grandis*), Ponderosa Pine (*Pinus ponderosa*), and Madrone (*Arbutus menziesii*) keeps the pond relatively well shaded year-round. Little understory vegetation exists around the N half of the pond; in contrast, the S half has a dense Salal (*Gaultheria shallon*) bed that extends ≥ 10 m into the surrounding uplands. The pond has outflows on its NW and SW lobes, both of which drain into the aforementioned breeding pond.

While measuring *R. aurora* caught in this pond on 28 July 1998, we noted a pre-dispersal brood of seven subadult Mallards foraging in the pond. At 1510 h, we heard what sounded like the piercing scream (sensu Camp in Storer 1925. Univ. California Publ. Zool. 27:1–342) of a juvenile *R. aurora* coming from the NW lobe of the pond. After turning to examine the source of the sound, we saw one of the Mallards agitating the water in what appeared to be a frenetic search, but we could not identify the basis of its behavior. Two minutes after we had resumed processing frogs, we saw another of the Mallards make a flying run at the SW shoreline. Six meters in front of this duck, we saw a juvenile *R. aurora* (ca. 35 mm SVL) fleeing by rapid leaps over the dense duckweed mat in a shoreward direction. The Mallard caught the juvenile frog from behind just as it reached the shoreline, whereupon the frog gave a shrill scream identical to that heard earlier. Using two flips of its head, the Mallard swallowed the frog within 20 sec. As the other Mallards were still foraging in the pond, we stopped processing frogs to watch the ducks, in the event further predation might occur. Over the next 40 min, we witnessed different Mallards capture six more *R. aurora* juveniles, all in the 30–40 mm SVL range. Juvenile frogs were captured following chases lasting 15 sec to 6 min, and we heard one additional juvenile *R. aurora* make the shrill scream following its capture. During our subsequent survey of this pond, we captured five additional juvenile *R. aurora* in the size range taken by the mallards. These frogs averaged 34.5 mm SVL (range: 32.0–38.5 mm).

Two aspects merit comment. First, our observations suggest that amphibian prey may sometimes be more than incidental (see also Mjelstad and Saetersdal, *op. cit.*). We have observed a successful hatch and fledging from the only Mallard nest known to occur at this site in five of our six years of fieldwork there, so opportunity might exist for Mallard predation to alter frog recruitment if the predation levels we observed occur over extended periods. Second, apparent rarity of amphibians in Mallard diet may result in part from a bias against detecting more rapidly digestible animal food (Swanson et al. 1979. *In* Bookhout [ed.], Waterfowl and Wetlands—An Integrated Review, pp. 47–55. The Wildlife Society, Washington, DC), like frogs or anuran larvae. Direct observations may be important in testing this possibility.

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RANA CATESBEIANA (Bullfrog). **GIGANTIC TADPOLE.** North American Bullfrog tadpoles are known to attain a large size and take 1–3 years to metamorphose, however, there are few accounts of maximum size for Bullfrog tadpoles or other anuran species (McDiarmid and Altig 1999. Tadpoles, the Biology of Anuran Larvae. Univ. Chicago Press, Chicago. 444 pp.). Bullfrog tadpoles normally range from 76–170 mm (Ashton and Ashton 1988. Handbook of Reptiles and Amphibians of Florida, Part Three. The Amphibians. Windward Publishing Inc. 191 pp.; Wright 1929. Proc. U.S. Nat. Mus. 74:1–70). However Dickerson (1969. The Frog Book. Dover Publ., Inc. New York. 253 pp.) reported *R. catesbeiana* tadpoles can attain 177 mm. On 31 July 2002, we collected a 190 mm (total length) Bullfrog tadpole (Gosner stage 37, Fig. 1) from Nevens Pond, Keith County, Nebraska (41.20710°N, 101.4085°W), a small cattle tank overflow pond. To our knowledge this is the largest Bullfrog tadpole ever reported. Other tadpoles from this location were also large (ca. 150–160 mm TL), although none was comparable in size to this giant. Collins (1979. Ecology 60:738–749) indicated that biotic factors, especially density of conspecifics and the time of oviposition influence variation in size at metamorphosis of Bullfrogs. Additionally, abundant food and lower water temperatures during development increase anuran time to and body size at metamorphosis. We have no density data on the number of tadpoles from Nevens Pond, although our observations suggest that it was comparable to other ponds that had smaller Bullfrog tadpoles. Unfortunately, this gigantic individual died while being transported back to the laboratory, and we cannot say if this giant could transform into a froglet. Allen (1917. J. Exp. Zool. 26:499–519) produced giant tadpoles in *R. pipiens* by performing thyroidectomies on young tadpoles, and it may be that this individual did not posses a thyroid gland. However, two other large tadpoles collected from this locality (but not measured) metamorphosed in the laboratory, yielding froglets 65–70 mm SVL, indicating that some large tadpoles can metamorphose from this pond. The reported variation in tadpole size and size at metamorphosis in *R. catesbeiana* is probably related to the number of years that tadpoles took to metamorphose. To our knowledge, these are some of the largest newly transformed Bull-

FIG. 1. *Rana catesbeiana* tadpole Gosner stage 37. Bar = 50 mm.

frogs (see Collins *op. cit.*) and it suggests that some Bullfrogs at Nevens Pond take three years to develop before metamorphosing. During late summer and early fall most adult frogs in the large population at Nevens Pond look emaciated, probably due to a food shortage. It is unlikely that these Bullfrogs can migrate to other ponds during this time of year to feed, because of the large distances between ponds and the dry conditions of the sand hills of western Nebraska. We suspect that it might be advantageous for Bullfrog tadpoles at this location to metamorphose at a larger size to prevent being preyed upon by conspecific metamorphosed Bullfrogs, which are gape-limited predators.

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SCAPHIOPUS HOLBROOKII (Eastern Spadefoot). **COLORATION AND BEHAVIOR.** Both albinism (Childs 1953. Evolution 7:228–233) and aggregational behavior (Richmond 1947. Ecology 28:53–67; Bragg 1954. Herpetologica 10:97–102) have been previously observed among larval *Scaphiopus* spp. in various parts of the United States, mostly from central and western parts of the country. Herein, we report the discovery of two leucistic-like *S. holbrookii* tadpoles within larval aggregations at the Brookhaven National Laboratory, Upton, Suffolk County, New York, USA (40°52'20"N, 72°52'04"W).

During field research on 16 June 2003, we encountered *S. holbrookii* tadpoles in a temporary pool that had formed in a grassland area after a period of heavy precipitation. We estimate that the pool contained thousands of tadpoles, most of which were participating in several mass aggregations. Based on observations by Bragg (1954, *op. cit.*), the aggregations we found were likely feeding aggregations. At ca. 1700 h, we observed two leucistic-like tadpoles that were quite obvious among the black background created by their aggregating cohorts (Fig. 1). Using dip nets we captured both individuals in ca. 20 cm of water and brought them back to the lab for rearing.

The coloration of both tadpoles was identical. Their bodies were pale beige, but their eyes exhibited the dark color of a normal tadpole. Snout–vent length for the two tadpoles was 16 and 17 mm at time of capture. We maintained the tadpoles in captivity for 97 days, but the larvae failed to reach metamorphosis. To our knowledge, this is the first report of leucistic-like tadpoles and breeding aggregations for this species in New York.

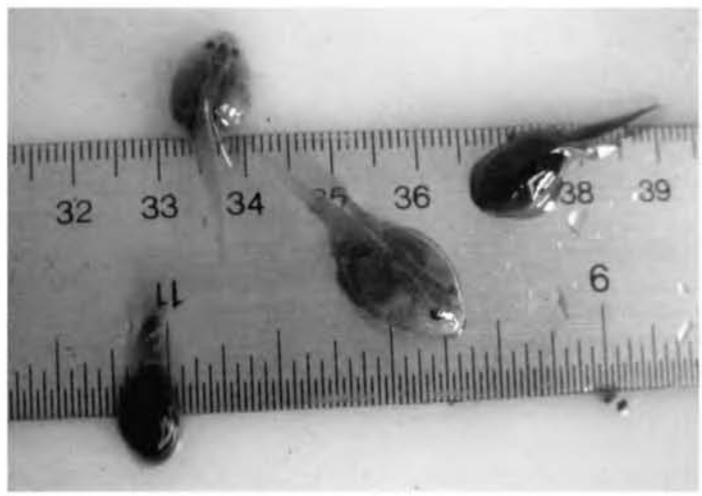

FIG. 1. Live tadpoles of *Scaphiopus holbrookii*. Tadpoles of normal coloration (black color) and leucistic-like (pale-beige color).

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SCINAX FUSCOMARGINATUS (NCN). **DEFENSIVE BEHAVIOR.** Anurans are known to be an important component in the diet of a large number of predators, although they have evolved several defensive mechanisms (Duellman and Trueb 1994. Biology of Amphibians. McGraw-Hill Book Co. 670 pp.). Some of the defensive mechanisms are shown by some hylid species (Azevedo-Ramos 1995. Rev. Bras. Bio. 55[1]:45–47; Manzanilla et al. 1998. Herpetol. Rev. 29:39–40; Napoli 2001. Herpetol. Rev. 32:36–37), however there is lack of descriptions of any of these

behaviors for *Scinax* species. Field observations were carried out in the Ecological Station of Itirapina (22°13'S; 47°54'W, 725 m elev.), municipalities of Itirapina and Brotas, São Paulo State, Brazil. Approximately 200 male *Scinax fuscomarginatus* were handled between October 2002 and March 2003. When handled they exhibited at least three identifiable defensive strategies: 1) to escape, some individuals jumped into the water staying submerged motionless for over two minutes while holding onto the submerged vegetation; 2) every adult male was noted to perform death feigning (thanatosis), with its belly, arms, and legs upturned, remaining immobilized for less than 1 min in most of cases, but for over 12 min during one observation; and 3) males inflated their lungs, puffing up the body for ca. 30 sec. The first strategy suggests the frog might be looking for a shelter to avoid possible terrestrial predators; nevertheless, the frog becomes exposed to aquatic predators instead (Hinshaw and Sullivan 1990. J. Herpetol. 24[2]:196–197; Haddad and Bastos 1997. Amphibia-Reptilia 18:295–298). Likewise, the efficiency of the two other strategies remains unrecognized (Azevedo-Ramos 1995, *op. cit.*). Data suggesting that sheltering underwater, feigning death, or creating a larger image actually reduces the risks of predation in most of Neotropical anurans (Azevedo-Ramos 1995, *op. cit.*) are lacking.

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SMILISCA BAUDINII (Mexican Treefrog). **EGG PREDATION.** During June and July 2002, one of us (KK) found an apparent predator of the eggs of *Smilisca baudinii* near Las Cuevas Research Station (LCRS), in the Chiquibul Forest Reserve, Cayo District, Belize. The predator (Fig. 1) was vermiform, ca. 2–3 mm in length at time of emergence from frog eggs, and was found only within the eggs of *S. baudinii*. Herein we refer to this organism as a "worm" for lack of a more appropriate term, although its identity has not been determined. Under a compound light microscope at 300x, cilia were visible on the outside of the organism, and structures that appeared to be eyespots also were evident. Six of 10 clutches seen in June, and 1 of 50 clutches observed in July and August, were infested with this worm. Infected eggs displayed an amorphous gray region within the jelly, in place of the usual discrete black sphere. Every egg in an infested clutch contained one worm and was non-viable; no tadpoles hatched from any infected eggs. We do not know if the worms killed and consumed viable eggs, or if they entered eggs that were unfertilized or that had died from some other cause. On one occasion, KK found infested and non-infested clutches on the same day in the same pond. Infested clutches were found in two temporary ponds about 1 km apart, but not in an intervening permanent pond, nor in another temporary pond 5 km distant, despite the presence of *S. baudinii* eggs at all four sites.

KK collected portions of several infested clutches and held them in plastic containers containing pond water. Worms emerged from the frog eggs within 24 h, which is within the range that uninfected eggs would be expected to hatch (Pyburn 1966. Southwest. Nat. 11:1–18). Upon emerging from the frog eggs, worms were free-living, at first congregating along the edges of the container and then swimming throughout the water column 2–3 days later. Eggs were visible within the worms (Fig. 1) when they were viewed under a dissecting scope shortly after they emerged from the frog eggs, and eggs were found in the water after 3–4 days. Smaller worms were found in the containers several days after collection. Several worms were preserved in formalin and returned to Cleveland State University for identification. Specimens are available for loan upon request. Living specimens have been examined at LCRS by Dr. Jon Martin of the Natural History Museum, London, and images and/or preserved specimens have been examined by Drs. David Green of the USGS, Charles R. Bursey of Pennsylvania State University, Shenango, and Skip Sterner of the Manter Parasitology Lab, University of Nebraska, experts in anuran disease, platyhelminths, and nematodes, respectively. To date, identification of the organism is unknown.

Throughout much of its wide geographical distribution, *S. baudinii* is abundant, yet it may be less common than would be expected in the Las Cuevas area (Fitzherbert et al. 2001. Project Anuran Phase I Main Report). The worms described herein could be an important source of mortality for *S. baudinii* and possibly for other anurans in the Las Cuevas area. Many of the ponds in the vicinity of LCRS are heavily stained with organic matter or clouded with suspended material. Most species of anurans that reproduce at these ponds deposit their eggs within the water column or on the bottom, where they can be difficult to examine closely. The Mexican Treefrog, however, deposits its eggs in a dispersed monolayer at the surface where they can be observed closely, even if the water is opaque. This frog therefore may have represented one of the best opportunities at LCRS to detect this worm. Its apparent absence from the eggs of other anurans at LCRS may be as attrib-

Fig. 1. Photomicrograph of an unidentified predator found in the eggs of the Mexican Treefrog. The image is of a contracted specimen preserved in formalin a few days after it emerged from a frog egg. Scale bar represents 100 micrometers. The dark spots near the right end of the image may be eyespots. The oval masses within the body of the organism are assumed to be eggs.

utable to difficulty of observation as it is to possible specificity by the worm to the eggs of *S. baudinii*. We plan to continue to assess the impact of this apparent egg predator on anurans at LCRS, and to describe more fully the nature of the frog-predator relationship. We encourage others with the opportunity to examine the eggs of *S. baudinii* and other pond-breeding tropical anurans to look for this predatory organism.

We thank Barbara K. Modney for photographing the specimen. The Belize Forestry Department issued permits for research at LCRS and for export of organisms. The Columbus Zoo and Aquarium and the Department of Biological, Geological, and Environmental Sciences of Cleveland State University provided funding that made this research possible. We thank Las Cuevas Research Station and the Natural History Museum, London, for permission to use their site, and the staff at LCRS for aide and expertise in the field. We are grateful to Jon Martin for help in examining and preserving the specimens at LCRS, and to David Green, Charles Bursey, and Skip Sterner for examining the specimens or photographs thereof. Julian C. Lee reviewed the manuscript and provided much helpful advice.

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CROCODYLIANS

ALLIGATOR MISSISSIPPIENSIS (American Alligator). **NEST and NESTLING ECOLOGY.** The ecology of hatchling *Alligator mississippiensis* has been studied over much of its range. Yet, information on the ecology and natural history of *A. mississippiensis* within Arkansas, the northwesternmost part of its range, is particularly sparse. Here we help fill this gap with *A. mississippiensis* observations from southeast Arkansas.

On 7 August 2001, we found the first *A. mississippiensis* nest on record at Arkansas Post National Memorial, Arkansas County since prior to the 1980s (pers. comm., Kevin Eads, Resource Management Specialist, Arkansas Post National Memorial). This nest, located along Alligator Slough (a backwater of the Arkansas River) on the west side of the park, was ca. 2 m from the shore, 30 cm high and 1–1.5 m in diameter, and constructed of grasses and water lily leaves. No female was observed at the nest. We excavated only enough of the nest to reveal > 10 eggs. More eggs were apparent under the first layer, but we chose not to disturb them and repaired our excavation. Further searching of both banks of the slough and the rest of the park did not reveal more nests. Eggs in this nest were evidently close to hatching as Eads (pers. comm.) informed us that the nestlings emerged in mid-September.

At 2200 h on 12 April 2002, we returned to the nest site and observed 22 hatchlings within a 50-m radius of the original nest site. Numerous ghost shrimp (*Natantia* sp.) were present. While observing the hatchlings forage, they appeared to be feeding on these shrimp. Hatchlings averaged 31.6 mm TL (SD = 1.9, N = 5), 14.9 mm SVL (SD = 0.7, N = 5), and 81.7 g (SD = 7.6, N = 3) in mass.

Our observations suggest that spring body sizes of hatchlings from Arkansas may be substantially smaller than those in other parts of its range. Hatchlings (N = 220) from South Carolina that were 24.5 cm TL (SD = 1.4; 50 g, SD = 5.4) in September reached 36.2 cm TL (SD = 5.4; 128 g, SD = 5.2) the following May (Brandt 1991. Copeia 1991:1123–1129). This may indicate slower growth rates in Arkansas. Resource limitations caused hatchling *A. mississippiensis* from the Everglades to grow slower (i.e., ca. 16 cm/yr), and mature at a smaller size and at an older age than those known elsewhere in alligator range (Dalrymple 1996. Copeia 1996:212–216). Little research exists on growth rates and seasonal body sizes in *A. mississippiensis* from Arkansas; however, the longer winter may limit resources in a manner similar to the pattern observed in the Everglades, explaining why our May body sizes were smaller than those observed in South Carolina during May (Brandt, *op. cit.*).

The basis of the smaller size of Arkansas hatchlings has management implications because juvenile survivorship is size-specific; probability of death decreases as an individual grows (Rootes et al. 1991. Estuaries 14:489–494), and age is often determined by their size. It is crucial to know whether alligator growth is actually slower in Arkansas than in other parts of its range. At reduced growth rates, smaller animals may be vulnerable to a larger predator set for a longer interval. Thus, management of *A. mississippiensis* in Arkansas would require a somewhat different approach than in the more southerly parts of its range. More information is needed regarding growth rates of *A. mississippiensis* in Arkansas to effect proper management.

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TESTUDINES

CHELONIIDAE (Marine Turtle). **NEST PREDATION**. On 19 June 2003 at 0217 h, an Opossum (*Didelphis virginiana*) was observed for 10 min while digging into a marine turtle nest and eating 4 eggs on the beach at St. Lucie Inlet Preserve State Park (SLIPSP) on Jupiter Island, Florida. The predation event was observed using night vision equipment as part of nightly patrols to protect turtle nests from Raccoon (*Procyon lotor*) and Armadillo (*Dasypus novemcinctus*) predation during the nesting season (Engeman et al. 2003. Biol. Cons. 113:171–178). After verification of an ongoing predation event, the Opossum was euthanized and removed. Prior to implementing predator removal on this beach, up to 95% of the turtle nests were destroyed annually by Raccoons (Bain et al. 1997. Sea turtle nesting and reproductive success at the Hobe Sound National Wildlife Refuge (Florida), 1972–1995. Report to U.S. Fish and Wildlife Service, ARM Loxahatchee NWR). In recent years, Armadillos, a species exotic to the east coast of Florida, have become severe predators of turtle nests (Bain et al., *op. cit.*; Engeman et al., *op. cit.*). While Foote

(2000. Proc. Sea Turtle Symp. 18:189–190) lists Opossums as incidental predators at marine turtle nests, our observation is the first that identifies an Opossum as a primary predator (excavator) of a marine turtle nest.

Three species of marine turtles nest on the SLIPSP beach: Loggerhead (*Caretta caretta*), Green (*Chelonia mydas*), and Leatherback (*Dermochelys coriacea*). Based on the ca. 60-cm depth of the nest, the nest could have belonged to either a Loggerhead or Green Turtle, but because nearly 90% of the marine turtle nests on the beach are Loggerhead (Engeman et al., *op. cit.*), the Opossum-predated nest most likely was Loggerhead. A Leatherback nest was unlikely, because it was too shallow and Leatherbacks nest infrequently on this beach (Engeman et al., *op. cit.*).

When a mammalian predator is not observed directly, determination of the species responsible for turtle nest predation is typically based on tracks. Our observation indicates that marine turtle researchers should pay close attention to track nuances, because superficial observation of a tail drag in the sand at a predated nest may not implicate an Armadillo as the predator. Care should be taken to also verify the footprints of the animal responsible. Opossum footprints are easily distinguished from Armadillo prints, because Opossum prints are hand-like with five digits on each foot, whereas Armadillo prints have all toes facing forward with claws usually evident and only four digits on the front feet (Murie 1974. A Field Guide to Animal Tracks, 2nd Edition. Houghton Mifflin Co., Boston, Massachusetts. 375 pp.).

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CHELYDRA SERPENTINA (Snapping Turtle) **and *SCAPHIOPUS HOLBROOKII*** (Eastern Spadefoot). **PREDATION and DIET.** Snapping turtles are known to have an extremely wide and varied diet (Ernst et al. 1994. Turtles of the United States and Canada, Smithsonian Institution Press, Washington D.C. 578 pp). Here we note predation on the larvae of *S. holbrookii*.

On 16 June 2003, at 1000 h, while conducting fieldwork at the Brookhaven National Laboratory (Upton, Suffolk County, New York, USA [40°53'24"N, 72°52'27"W; WGS84/NAD83]) we observed a female *C. serpentina* submerged in ca. 15 cm of water with several *S. holbrookii* tadpoles clenched in her jaws. This observation was made adjacent to a dirt road in a depression that had filled with water following heavy precipitation. Thousands of *S. holbrookii* tadpoles were observed in the flooded depression, and these tadpoles may constitute an important seasonal food source for *C. serpentina* in temporarily flooded habitats. Predation on *S. holbrookii* by *C. serpentina* has been documented previously (Ernst et al. 1994, *op. cit.*), but to our knowledge, this is the first documentation of predatory interaction for these two species in New York.

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DEIROCHELYS RETICULARIA (Chicken Turtle). **DIET**. Predation can be a key factor affecting the diversity and structure of larval aquatic amphibian communities (Azevedo-Ramos et al. 1999. Copeia 1999:22–33; Gomez-Mestre and Keller 2003. Copeia 2003:349–356). The role of reptiles and amphibians as predators of tadpoles may be more widespread than appreciated (e.g., Aresco and Reed 1998. Herpetol. Rev. 29:40; Beard and Baillie 1998. *ibid;* Gomez-Mestre and Keller 2003). Two recent studies (Jackson 1996. Chelonian Cons. Biol. 2:105–108; Demuth and Buhlmann 1997. J. Herpetol. 31:450–453), based on gut and fecal analyses, have confirmed *Deirochelys reticularia* as a specialized predator of aquatic organisms, chiefly arthropods, in the southeastern U.S. Although Carr (1940. Univ. Florida Publ., Biol. Sci. Ser. 3[1]:1–118; 1952. Handbook of Turtles: The Turtles of the United States, Canada, and Baja California. Cornell Univ. Press, Ithaca, New York. 542 pp.) noted seeing *Deirochelys* feed upon both dead and live tadpoles, neither of the recent studies identified amphibians as an important dietary component. Demuth and Buhlmann (1997, *op. cit.*) suggested, however, that this may relate to the lack of conspicuous, indigestible parts among amphibian larvae, which might conceal their presence because of rapid digestion. Here I report several instances of wild-caught *Deirochelys* consuming a large number and diversity of amphibian larvae offered to them in captivity, as well as an additional observation from nature.

In February 1997, I obtained two gravid female Chicken Turtles (197 and 173 mm plastron lengths) from Grady County, Georgia. Following induction of oviposition via oxytocin injection, turtles were maintained in a tank measuring 71 x 30 cm and filled with water to a depth of 22 cm. On 12 April I provided a large sample of living potential prey netted from a seasonal pond in Leon County, Florida. The sample included mostly odonate (dragonfly) nymphs, crayfishes, and approximately 150 larval amphibians, chiefly *Rana sphenocephala, Pseudacris* spp., and *Ambystoma talpoideum*. Amphibians measured 20–60 mm in total length (TL) and comprised ca. 80% of the sample biomass. Within 30 minutes, only three small beetles remained uneaten.

Subsequently, I experimentally introduced tadpoles to three other adult *Deirochelys* collected in northern Florida. From May-August 2000, an adult female (170 mm PL; Franklin County), whose fecal analysis indicated a typical diet of aquatic arthropods (crayfish, *Procambarus* sp.; aquatic hemipterans, *Ranatra* and *Pelocoris*), consumed the following tadpoles in captivity: 7 very large *Rana grylio* (100 mm TL, 10 g mass; body girth exceeded turtle's head diameter), 2 *R. sphenocephala* (20, 85 mm TL), 1 *R. clamitans* (45 mm TL), 8 *Acris gryllus* (25 mm TL), 1 *Hyla chrysocelis* (55 mm TL), 42 *H. femoralis* (30 mm TL), 2 *H. gratiosa* (50 mm TL), and 34 *Gastrophryne carolinensis* (25 mm TL). Many of the more advanced tadpoles bore hind legs. The turtle also ate a juvenile *Bufo terrestris* (20 mm body length).

Another adult female turtle (175 mm PL; Leon County) consumed four 30-mm *R. clamitans* tadpoles offered to it on 13 January 2000. An adult male (125 mm PL; Wakulla County) consumed 32 of 42 *R. sphenocephala* tadpoles (30–60 mm TL) within three days of the 20 April 2002 offering date. When fed conspecific tadpoles (35–50 mm TL) again one year later, it ate all 50 offered within 48 hours, as well as seven odonate nymphs. In none of the instances cited was there evidence, in the form of rejection, that any of the prey species was unpalatable to *Deirochelys* (contrast results for *Mauremys leprosa*: Gomez-Mestre and Keller 2003).

At least one herpetologist besides Carr has observed *Deirochelys* feeding on tadpoles in nature. M. A. Nickerson (pers. comm., 2003) observed an individual feeding on *Rana* tadpoles in a roadside ditch in Butler County, southeastern Missouri, in late spring 1983.

Amphibian larvae comprise a major if not principal component of the animal biomass in many seasonal ponds. Because of their ephemeral nature, such ponds typically lack predatory fish species large enough to prey upon most larvae. However, vertebrate predators that are not bound to water, such as turtles and snakes, may have a major predatory role in limiting (or even extirpating) amphibian larvae in such systems (Newman 1987. Oecologia 71:301–307; Gomez-Mestre and Keller 2003, *op. cit.*). In the southeastern U.S., the Chicken Turtle is one of the few reptiles that regularly inhabit such ponds. With its ability to strike prey rapidly, it can easily capture resting or schooling amphibian larvae and thus is a potentially important predator of the amphibian community, as may be turtles occupying similar habitats elsewhere (e.g., *Pseudemydura umbrina*: Kuchling 1999. The Reproductive Biology of the Chelonia. Springer. 223 pp.; *Emys orbicularis*: Gomez-Mestre and Keller 2003, *op. cit.*). At least three species of conservation concern (*Rana capito*, *Ambystoma cingulatum*, and *Notophthalmus perstriatus*) are among the roughly two dozen amphibian species that breed in ephemeral ponds that are sometimes occupied by *Deirochelys*.

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GOPHERUS AGASSIZII (Desert Tortoise). **ASSOCIATION WITH AFRICANIZED BEES.** In the Sonoran Desert, *Gopherus agassizii* often utilize rocky outcrops and caliche caves as shelter sites (Van Devender 2002. *In* Van Devender [ed.], The Sonoran Desert Tortoise: Natural History, Biology, and Conservation, pp. 3–28. University of Arizona Press, Tucson). Native vertebrates and a variety of invertebrates also use these shelter sites. Here we report observations of Desert Tortoises sharing shelter sites with Africanized Honey Bees (*Apis mellifera scutellata*), a recent immigrant to the desert southwest.

During a radio telemetry study east of Tucson, Arizona in 2001 and 2002, four *G. agassizii* frequented (were found on > 20 weekly tracking occasions) rock outcrops or caliche caves with large, active, Africanized Honey Bee colonies. Tortoises freely moved in and out of the occupied shelters and appeared not to disturb the bees, even when within 0.5 m of the colony. However, when we approached with radio telemetry equipment, bees quickly became agitated. On warmer days (≥ 20°C), these occupied shelters with hives could not be approached to within 5 m without bees acting very aggressively toward us. On one occasion (April 2001), one of us (EWS) was chased > 50 m by an agitated colony but was not stung. In two additional encounters with different hives, (June 2002) we were stung before we could escape the infested area.

Africanized Honey Bees are the result of an accidental release in Brazil in the mid 1950s, and have slowly spread north into the southwestern United States. They reached Tucson, Arizona in 1993 (Kunzmann et al. 1995. *In* LaRoe, et al. [eds.], Our Living Resources: A Report to the Nation on the Distribution, Abundance and Health of U.S. Plants, Animals, and Ecosystems, pp. 448–451. USDI Nat. Biol. Serv., Wash. D.C.) and quickly displaced existing populations of non-native European Honey Bees (*Apis mellifera*). Distance sampling of Africanized Honey Bee colonies and tortoises indicates that both species occur at high densities in desert areas of Saguaro National Park (DES, unpublished data). Desert Tortoises apparently do not elicit bee attacks; perhaps their cool body temperatures, low carbon dioxide emissions, and slow movements are factors.

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GOPHERUS AGASSIZII (Desert Tortoise). **MOVEMENT**. In the Sonoran Desert, *Gopherus agassizii* occurs in rocky foothills associated with saguaro cactus (*Carnegiea gigantea*) and foothill paloverde (*Parkinsonia microphylla*) characteristic of Upland Sonoran Desert Scrub plant community (Turner and Brown 1992. *In* Brown 1992. Desert Plants 4, pp. 180–221). Although these populations appear to be isolated by low desert valleys, radiotelemetry data have shown that tortoises are capable of making long distance movements between populations (Barrett et al. 1990. Final report, Bureau of Reclamation, Arizona Projects Office, Phoenix; Averill-Murray and Klug 2000. Technical Report 161, Arizona Game and Fish Dept., Phoenix). Long-distance movements between disjunct populations may facilitate genetic exchange (Britten et al. 1997. Copeia 1997:523–530) and be important for long-term maintenance of populations. Here we report an extraordinary movement by a female *G. agassizii* and the anthropogenic barriers encountered during this event. We show that, while Desert Tortoises are capable and sometimes motivated to make inter-population movements, the urban topography of our modern landscape makes such movements increasingly difficult.

We affixed a radio transmitter (AVM G3, AVM Industries, Colfax, California) to an adult female *G. agassizii* (238 mm MCL, 2700 g) on 14 August 2000, as part of an ongoing study in the

Rincon Mountains at Saguaro National Park (SNP; 32°08'N, 110°41'W), Tucson, Arizona. At the time of transmitter attachment, the tortoise presented signs of upper respiratory tract disease (URTD; nasal discharge, wheezing, occluded nares, and exudate). Other tortoises at this study site have tested positive for *Mycoplasma agassizii*. We located the tortoise approximately every week. By 06 September, she had moved ca. 500 m SW of the original capture location. We then lost contact with her until 18 September when a SNP volunteer observed the tortoise along a roadway ca. 1.5 km S of the original locality (32°06'N, 110°41'W). On 25 September, we found her ca. 8 km further south on a rocky slope surrounded by low-density housing (32°02'N, 110°40'W). The terrain between these locations is primarily flat ground dominated by creosote bush (*Larrea tridentata*) and is atypical of Sonoran Desert tortoise habitat (Barrett 1990. Herpetologica 46:202–206). On 2 October, we found her on private property along a chain-link fence. We obtained permission and put her across. At this time, we affixed a note to the tortoise's carapace indicating she was part of a study at Saguaro National Park and included a contact phone number. We believe the tortoise over-wintered in Arizona Upland Sonoran Desert Scrub on a large expanse of private land; however, we did not receive a signal from her between 2 October 2000 and late July 2001.

On 31 July 2001 we were contacted by a resident who had found the tortoise in Vail, Arizona, in the middle of a paved street at a railroad crossing (ca. 15 km S of where she was first marked; 32°03'N, 110°42'W). We placed her south of the railroad tracks (within 0.5 km E of the crossing), oriented in the same general direction she was moving but away from residential housing. Over the next two months, we received three phone calls from residents who had found the tortoise and brought her home. Each time, we returned the tortoise to uninhabited areas in the vicinity. During this period she remained within 1.5 km N of Interstate 10 (a four-lane freeway due south of Vail), and traversed an approximately 3-km east-west distance. We made an *a priori* decision to facilitate the tortoise's movement across Interstate 10 if she continued moving south.

On 29 August 2001, we located the tortoise on a frontage road beside I-10 (32°01'N, 110°42'W) and decided to transport her across the interstate. We placed the tortoise on a north-facing slope of the Santa Rita Mountains ca. 7 km S of the interstate, where we observed tortoise sign (31°55'N, 110°42'W). We decided the 7-km distance was necessary because medium density housing and many fences bisect land south of the interstate. The tortoise made several east-west movements along the foothill slopes at the new location, and on 18 September, 2001 we were contacted by a landowner who found her in the middle of a new residential development, 5 km W of the release point (31°54'N, 110°53'W). We collected her and returned her to the original release site in the Santa Ritas. She spent the winter of 2000–2001 in the north end of the Santa Rita Mountains. We periodically found the tortoise at this same location until June 2002, when her transmitter failed prematurely. Not including the human-facilitated movement of ca. 7 km, this tortoise moved more than 30 km straight-line distance over the span of one year.

On 22 August 2002, we were contacted yet again by a family who found her on Interstate 10 under an overpass (32°01'N, 110°43'W), 7 km N of her overwintering site, toward the original capture site. We changed transmitters and re-released her at the first point of capture, at the south end of Saguaro National Park. She has remained at this site through the winter of 2003. The tortoise currently presents signs of URTD, but did not do so consistently since the time of transmitter attachment.

It seems unlikely that the behavior exhibited by this tortoise was in response to stress caused by initial handling because we have placed transmitters on > 70 tortoises since 1992 and no other tortoises have made long distance movements. Occasionally, within 24 h of being handled, tortoises will move from the capture site, but less than 1 km. It is possible that humans other than researchers facilitated portions of the movements reported here, particularly during the initial 8 km movement during 18 – 25 September 2001, which crossed two roads. However, the tortoise had already begun an unusually long movement through an unpopulated area to reach the first road from the study site (1.5 km) and was in atypical habitat.

This tortoise encountered several barriers that, without human facilitation, would likely have been insurmountable. A residential fence and an interstate highway both required human assistance to cross. We believe a set of railroad tracks may also have acted as a barrier and that the tortoise followed them for some distance before encountering a place to cross. Lastly, we note that at least four residents collected the tortoise and contacted us. It is possible the tortoise would have become someone's illegal pet if the identifying label had not been affixed to the carapace.

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GRAPTEMYS OUACHITENSIS SABINENSIS (Sabine Map Turtle). **REPRODUCTION.** A clutch size of one egg (the minimum possible) has long been regarded as one expression of tropical adaptation in turtles (Moll and Legler 1971. Bull. Los Angeles Co. Mus. 11:1–102). Although not a tropical turtle, *G. ouachitensis* has a wide latitudinal distribution in North America (Vogt 1993. Cat. Am. Amphib. Rept. 603:1–4). We here report on its reproduction from close to the lowest latitudinal limit of its range (29.8°N; Dundee and Rossman 1989. The Amphibians and Reptiles of Louisiana. Louisiana State Univ. Press, Baton Rouge, 300 pp.). Our data reflect on several aspects of reproduction, including intraseasonal clutch frequency, and clutch, egg, and hatchling size. We made 11 independent visits to nesting habitat in Louisiana and

Texas (from 30.6° to 31.1°N) during six years from 1972 to 2002. All data came from recently laid nests or dissection of female reproductive tracts.

The reproductive tract of a nongravid female collected on 16 May had numerous enlarged follicles. One female from 13 June and two females from 18 June contained two sets of corpora lutea, which indicate production of an initial clutch in late May or early June. Dates with recent nests or with females found gravid on land spanned 13 June 16 July. Reproductive tracts from eight females indicated productive capabilities of two clutches (by 1 turtle), three clutches (by 3 turtles), and two or three clutches (by 4 turtles) during the season.

Clutch size varied between one and four eggs, with a mean clutch size for 55 clutches of 2.34 ± 0.80 SD eggs, which includes means of 1.96 ± 0.49 SD (N = 30) for the Calcasieu River and 2.80 ± 0.87 SD (N = 25) for the Sabine River. The average mass of 61 eggs was 9.85 ± 1.44 SD g (from the Sabine habitat only) and of 94 hatchlings was 7.38 ± 1.17 SD g (36 from the Calcasieu at 7.6 ± 0.8 SD g; 58 from the Sabine at 7.2 ± 1.3 SD g).

One-egg clutches comprised 11% of the total and were found along both the Calcasieu River (N = 4) and the Sabine River (N = 2). However, 4-egg clutches (N = 5) came only from the Sabine. The modal clutch size was 2 eggs. Four of the 4-egg clutches came from June and one from July. Five of the six 1-egg clutches came from July, suggesting that clutch size declines during the season. We did not observe any 6-egg clutches as reported by Dundee and Rossman (1989, *op. cit.*), and their report left reason to question the assignment of such a clutch to *G. o. sabinensis* (Dundee, pers. comm.). However, we cannot rule out the occurrence of such clutches in *G. o. sabinensis* at localities farther north in the Sabine drainage.

That *G. o. sabinensis* has single-egg clutches and a small mean clutch size becomes appreciably more interesting in a contrast with the mean clutch size of *G. o. ouachitensis* from near the high latitude limit of the species distribution (i.e., 10.9 eggs; range: 6–17 eggs, N = 99; 43.7°N latitude; from Vogt 1980. Tulane Stud. Bot. Zool. 22:17–48 [fig 2], plus Janzen et al. 1995. Funct. Ecol. 9:913–922). Thus, across the range of *G. ouachitensis* there is a 4.66-fold difference in mean clutch size. This proportional difference may be the largest in any North American species of turtle. In contrast, the high latitude mean egg size of 10.97 g and hatchling size of 8.21 g (Vogt 1980, *op. cit.*; Janzen et al., *op. cit.*) differ relatively little from low latitude values (given above). The low latitude eggs and hatchlings are not larger as might be expected in a tradeoff between clutch size and egg size (sensu Smith and Fretwell 1974. Am. Nat. 108:499–506; Roosenberg and Dunham 1997. Copeia 1997:290–297). In absolute measures, no such tradeoff is apparent in this latitudinal comparison.

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RHINOCLEMMYS AREOLATA (Furrowed Wood Turtle). **MAXIMUM SIZE**. The maximum straight-line carapace length (CL) given for *Rhinoclemmys areolata* is up " to 20 cm" (Ernst and Barbour 1989. Turtles of the World. Smithsonian Institution Press, Washington, D.C. 313 pp.). On 28 July 2002 we found the intact shell of a female *R. areolata* with a CL of 20.7 cm (CUSC 2124) in the grassy margin between Cohune (*Orbigyna cohune*) forest and a citrus plantation (17°18.188'N; 88°31.213'W) on Tiger Sandy Bay Farm, Mile Marker 31, Western Highway, Cayo District, Belize. The turtle appeared to have been killed by a mowing machine several weeks previously. Large pieces of eggshell were found inside the shell indicating the female was gravid when killed. This specimen was deposited in the Campbell Museum, Clemson University, Clemson, South Carolina, USA.

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TERRAPENE CAROLINA TRIUNGUIS (Three-toed Box Turtle). **POPULATION CHANGES**. *Terrapene carolina* populations often consist of long-term, long-lived resident individuals (Stickel 1978. Copeia 1978:221–225; Williams and Parker 1987. Herpetologica 43:328–335; Schwartz and Schwartz 1991. Copeia 1991:1120–1123; Schwartz 2000. Chel. Conserv. Biol. 3:737–738; Dodd 2002. North American Box Turtles, A Natural History, Univ. Oklahoma Press, 231 pp.). I studied a small suburban population of box turtles in my yard in West Point, Clay County, Mississippi (USA) (33°35'14"N, 88°37'46"W) from 1979 to 2003. The triangular yard was about 0.3 ha, partially wooded with mostly water oaks and some hackberry, sycamore, mimosa, and poplar. Most of the natural ground vegetation was cleared away and the yard fenced in the rear by 1985 and replaced with brick walks, flower gardens, fern beds, and border plants such as *Liriope*. Space under the fence still enabled access by turtles. Mowed lawns characterized the front and backyards of virtually all neighbors. Less-disturbed habitat for box turtles remained behind houses across the street in a horse pasture and adjacent patches of oak-hickory woodland.

Turtles were individually marked by notching marginal scutes of the carapace with a pocket saw, measured for carapace length (CL) to the nearest 0.1 mm with vernier calipers, and weighed to the nearest 0.1 g on an Ohaus mechanical balance. Overall, I marked and released 23 individual box turtles, as follows in 5-

year intervals (number of individuals, total captures): 1979–1983: 14, 21; 1984–1988: 3, 6; 1989–1993: 4, 14; 1994–1998: 3, 4; 1999–2003: 5, 6. None of the individuals captured in the latest group had been captured before 1999. Sex ratio was biased toward females (3:1) from 1979–1983, even (1:1) from 1984–1998, and all females from 1999–2003.

Sixteen of the 23 individuals were captured in only one year and two females in three years. Four individuals were longer-term residents, or at least visited the yard in more than one year over longer intervals: one female over four years (CL 108.0 in 1990, gravid road kill in 1994); one female in six consecutive years (1988–1993, growth below); one adult male captured in 1979 (CL 117.8), 1983 (CL 125.7), and 1988 (CL 125.7); and an older adult male captured in 1983, 1993, 1994, and 1996 (CL 123.5, no change during 13 years). One hatchling was captured in 1993.

One female was captured in six consecutive years (1988–1993) and illustrated growth from about age 7 to age 12 (CL, mm; weight, g): May 1988: 90.1, 138.1; June 1989: 100.0, 236.4; August 1990: 127.1, 400.1; August 1991: 137.2, 515.4; June 1992: 138.0, 545.5; July 1993: 141.0, 569.1 (estimated age based on plastral annuli).

With habitat alteration, road mortality, and possibly removal of box turtles for pets, this sparse population may have have declined. However, only the female in the previous paragraph, among the 23 marked and released, seemed to be a consistent resident. Other recaptured individuals were not seen in the yard for years and probably visited it at only irregular intervals. Transients from 1998–2003 have appeared healthy and included an adult male (CL 128.0), two juveniles (CL 81.4, 79.2), and two adult females (CL 131.0, 135.0), indicating a possibly viable source population.

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LACERTILIA

ANELYTROPSIS PAPILLOSUS **(Mexican Blind Lizard). DEATH FEIGNING AND AUTOTOMY**. Almost nothing is known about the natural history of the distinctive blind lizard, *Anelytropsis papillosus*; the few available data are taxonomic (Campbell 1974. Cat. Amer. Amphib. Rept. 156.1; Greer 1985. J. Herpetol. 19:116–156). Here, we provide a preliminary report on its death feigning and caudal autotomy.

On 21 November 1996, two of us (RJTC and XHI) collected an adult male *A. papillosus* (137 mm SVL, 22 mm tail length, 3.5 g) under an old *Yucca carnerosana* trunk in xerophyll scrub at Rancho Nuevo, municipality of Guadalcázar, San Luis Potosí, México (22°52'0.1"N,100°10'1.1"W; elev. 1200 m). When first picked up, this individual responded by aggressively biting the collector's fingers continuously and intensely for 3–4 min. Immediately afterwards the *A. papillosus* became motionless in the collector's hand. The animal was relaxed, but slightly rigid, with a half open mouth, and adopted any position when manipulated. Engaging in this behavior, it appeared dead. After 2–3 min, it began to move slowly. Similar behavior was exhibited by a second adult male *A. papillosus* (136 mm SVL, 82 mm tail length, 3.8 g) that was collected 19 April 1999, under an old yucca trash log in xerophyll scrub along a road near Presa El Tepetate, also in the municipality of Guadalcázar (22°56'40.7"N, 100°13'52.8"W; elev. 1345 m). However, unlike the first *A. papillosus*, it remained motionless for only 10–15 sec after biting the collector's fingers. It acquired the same relaxed position, but in an S-shape. Subsequently, it made a sudden lash that autotomized almost half its tail (40 mm), and tried to escape the collector.

The Rancho Nuevo (IBH 13926) and Presa El Tepetate (IBH 1327) specimens were deposited in the herpetological collection of the Instituto de Biología, UNAM, and were obtained under collection permit DOO 750.10664/98 from SEMARNAP. We thank the authorities of the region and the local teacher Francisco Ávila-Pineda for help during the fieldwork. CONACYT Project 27618-N and CONABIO Project R045 supported this study.

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ANOLIS EQUESTRIS **(Knight Anole). ENDOPARASITES.** *Anolis equestris* is native to Cuba and has been introduced to Oahu, Hawaii, where it was first noticed in 1981 (McKeown 1996. A Field Guide to Reptiles and Amphibians in the Hawaiian Islands. Diamond Head Publishing, Inc., Los Osos, California. 172 pp.). Helminth parasites of *A. equestris* in Cuba are listed in Schwartz and Henderson (1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History. University of Florida Press, Gainesville. 720 pp.). The purpose of this note is to report two nematode species heretofore unknown in *A. equestris* from Hawaii.

Seven (2 female, 5 males) *A. equestris* (mean SVL = 141 mm ± 26 SD, range: 82–156 mm) collected on Oahu, Hawaii in 1999, 2000, and 2003 were examined for helminths. Lizards were deposited in the University of Michigan Museum of Zoology (UMMZ), Ann Arbor, Michigan, USA: UMMZ 226789–226791 and the Bishop Museum (BPBM), Honolulu, Hawaii, USA: BPBM 14821, 14822, 14998, 61961. The esophagus, stomach, small intestine and large intestine were opened and separately examined for helminths under a dissecting microscope. The body cavity was also searched. Three third-stage nematode larvae (*Physaloptera* sp.) were found in the large intestine of one *A. equestris* (UMMZ 226789). Cysts containing third-stage nematode larvae of *Physocephalus* sp. were found in the stomach wall or mesentery of six *A. equestris*. For *Physocephalus* sp., prevalence (number infected/number examined x 100) was 86% and mean intensity (mean number nematodes/infected lizards) was 99 ± 95 SD, range: 9–269. The nematodes were deposited in the United States National Parasite Collection, Beltsville, Maryland as *Physaloptera* sp. (USNPC 93696) and *Physocephalus* sp. (USNPC 93697).

Neither *Physaloptera* sp. or *Physocephalus* sp. have been reported from *A. equestris* in Cuba (Schwartz and Henderson, *op. cit.).* Third-stage larvae of *Physaloptera* sp. (adults absent) are frequently found in amphibians and reptiles. Their occurrences were summarized in Goldberg et al. (1993. Bull. South. California Acad. Sci. 92:43–51). Hanley et al. (1998. Oecologia 115:196–205) reported *Physaloptera* sp. in *Hemidactylus frenatus* from

Oahu, Hawaii; Goldberg et al. (2003. Bishop Mus. Occas. Pap. Rec. Hawaii Biol. Survey 2001–2002. Pt 2: Notes, 74:72–76) reported them in *Phelsuma guimbeaui* from Oahu and *Phelsuma laticauda* from the Big Island, Hawaii. Encapsulated infective *Physocephalus* sp. larvae are commonly found in tissues of vertebrates that have ingested infected beetles (Anderson 2000. Nematode Parasites of Vertebrates: Their Development and Transmission. CABI Publishing, Wallingford, Oxon, UK. 650 pp.). Cysts containing *Physocephalus* sp. have been reported in a variety of lizards from Hawaii (Goldberg and Bursey 2000. J. Parasitol. 86:750–755; Goldberg et al. 2003, *op. cit.*). *Anolis equestris* is an accidental host for *Physaloptera* sp. since the nematodes would have been voided from the large intestine with the feces. It is a paratenic (= transport host) for *Physocephalus* sp. since no further development occurs. Development to the adult stage occurs when *A. equestris* is eaten. This represents the first report of larvae of *Physaloptera* sp. and *Physocephalus* sp. in *Anolis equestris.*

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ANOLIS LUCIUS (Coronel, Gorrita). **VOCALIZATION.** *Anolis lucius*, a Cuban endemic (Schwartz and Henderson 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History. Florida Univ. Press, Gainesville. 720 pp.), inhabits coastal scrubwoods and semideciduous forests typically in association with limestone soils and outcrops (Rodríguez-Schettino 1999. *In* Rodríguez-Shettino [ed.], The Iguanid Lizards of Cuba, pp. 104–380. Florida Univ. Press, Gainesville, Florida). Some authors have described a sharp squeak when individuals are grasped (Barbour and Ramsden 1916. Mem. Soc. Cubana. Hist. Nat. Felipe Poey 2:124–143; Schwartz and Ogren 1956. Herpetologica 12:91–110; Allen and Neill 1957. Herpetologica 13:246–247; Ruibal 1964. Bull. Mus. Comp. Zool. 130:475–520; Peters 1970. Mitt. Zool. Mus. Berlin 46:197–234; Rodríguez-Schettino, *op, cit.*), but the gender or age of vocalizing animals has not been addressed. Herein we provide a quantitative description of the vocalizations produced by adult male and female *A. lucius*.

We recorded the calls of 11 *Anolis lucius* collected during October 2002 in Sierra de Najasa, Camagüey Province, Cuba. All recordings were made within 12 h of capture. We evoked vocalizations by gently grasping each animal between thumb and forefinger and orienting it within 10 cm of a Sennheiser ME 80 (K30 AV) microphone connected to a Marantz PMD-430 cassette recorder. Sounds were digitized at a sampling frequency of 44.1 KHz and 16 bits resolution, using an IBM Pentium computer fitted with Sound Blaster Live 1024 Sound Card and Batsound 2.1 software. Numerical data, sonograms, oscillograms, and power spectra were also obtained with the Batsound 2.1 sofware. Spectral variables considered were: fundamental frequency (FF), measured as the most intense frequency of the first harmonic on the sonogram; highest frequency (HF), measured at the upper frequency trace of the sonogram; and dominant frequency (DF); the frequency value at peak amplitude in the call's power spectrum. Call duration was measured to the nearest 0.01 s on the oscillograms. Measurements were averaged across individuals. The snout–vent length (SVL) of each individual was measured to the nearest 0.1 mm with Vernier calipers. We recorded air temperature (AT) at the site using a Miller-Weber quick-reading thermometer (± 0.2°C).

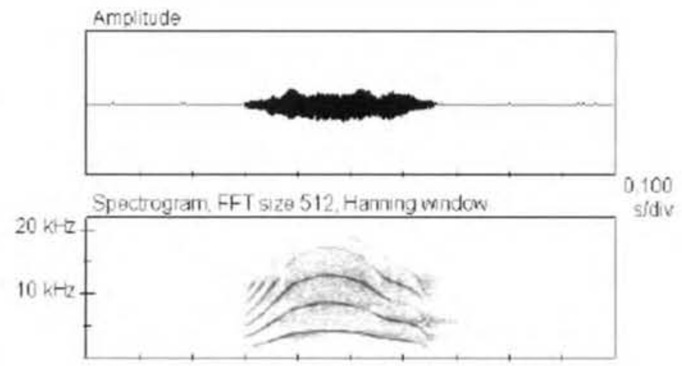

FIG. 1. Oscillogram (top) and sonogram (below) of one call of a male *Anolis lucius* recorded at La Belén, Sierra de Najasa, Camagüey province, Cuba. Air temperature = 26.5°C.

Eleven of 15 (73%) individuals vocalized in response to the procedure by producing short and high-pitched calls or "squeaks" with a clear harmonic structure (3–12 harmonics) distributed over a broad frequency range (Fig. 1). Generally, the first or second harmonic were dominant (mode = 2). Variation in vocalization variables for male and female *A. lucius* are summarized in Table 1. All acoustic properties analyzed varied considerably for the successive calls of a given subject and between different individuals (see Table 1). The air temperature, stable during the recordings (28.5 ± 0.1°C), should not have influenced acoustic feature variability. Despite the 13.2 mm range of variation in body size, acoustic parameters were not significantly correlated with lizard SVL.

The biological significance of these vocalizations is unclear, but we have also observed free-living animals emitting these calls during agonistic encounters with conspecifics. Moreover, the multi-

TABLE 1. Descriptive statistics of the acoustic features measured in vocalizations of *Anolis lucius*. For each parameter the mean, SD, and coefficient of variation (as %; in parens) are shown.

Gender Groups	CD ms	FF kHz	DF kHz	HF kHz	SVL mm
Males	0.33 ± 0.07	2.93 ± 0.75	4.89 ± 0.79	14.87 ± 1.31	58.11 ± 6.08
N = 8	(20.7)	(25.8)	(16.1)	(8.8)	(10.5)
Females	0.20 ± 0.03	2.51 ± 0.76	4.22 ± 0.62	12.95 ± 1.83	55.11 ± 3.57
N = 3	(12.4)	(30.5)	(14.8)	(14.1)	(6.5)

harmonic structure of these signals resembles selected distress or protest calls that have been documented in some mammals (Vencl 1977. Amer. Nat. 111:777–782; August 1985. Southwest. Nat. 30:371–375; Russ et al. 1998. Anim. Behav. 55:705–713), birds (Marler 1957. Behaviour 11:13–39; Neudorf and Sealy 2002. Biotropica 34:118–126), and frogs (Hoff and Moss 1974. Copeia 1974:533–534; Weber 1978. Copeia 1978:354–365; Höld and Gollmann 1986. Amphibia-Reptilia 7:11–21).

Historically, anoline lizards generally have been considered voiceless even though some Caribbean species have been known vocalize when individuals are grasped, as has been reported for several Cuban species: *Anolis isolepis* (Rodríguez-Schettino, *op. cit.*), *A. vermiculatus* (Neill and Allen, *op. cit.*; Ruibal, *op. cit.*; Peters, *op. cit.*), *A. bartschi* (Peters, *op. cit.*), and *A. jubar* (Rodríguez-Schettino, *op. cit.*). Also, *Anolis grahami iodurus* and *A. opalinus* from Jamaica are known to produce a sharp squeak when in distress or when fighting (Grant 1940. The Herpetology of Jamaica. II, Reptiles:88). Sound production in Caribbean *Anolis* does not appear to be restricted to members of an ecomorph class or to any phylogenetic groupings (Jackman et al. 1997. *In* Givnish and Sytsma [eds.], Molecular Evolution and Adaptive Radiation, pp. 535–557, Cambridge University Press, Cambridge). Detailed study will be needed to understand the basis of interspecific variation in anoline vocalization and identify their potential evolutionary significance.

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ANOLIS STRATULUS (Saddle Anole). **EXTRAFLORAL NECTIVORY**. Nectivory or nectivory-like behavior has been recorded in lizards (Dearing and Schall 1992. Ecology 73:845–858; Eifler 1995. Oecologia 101:228–233; Font and Ferrer 1995. Herpetol. Rev. 26:35–36; Sáez and Traveset 1995. Herpetol. Rev. 26:121–123), including polychrotid anoles (*A. stratulus* from flowers: Perry and Lazell 1997. Herpetol. Rev. 28:150–151; *A. carolinensis* from hummingbird feeders: Liner 1996. Herpetol. Rev. 27:78), but extrafloral nectivory is undocumented among lizards. Here, I document extrafloral nectivory in *Anolis stratulus*, a medium-sized anole (48 mm maximum SVL) that frequently occurs in the forest canopy. This species is widely distributed in lowlands and intermediate elevations (up to 500 m) in mountains throughout Puerto Rico (Rivero 1998. The Amphibians and Reptiles of Puerto Rico, 2ed. Editorial de la Universidad de Puerto Rico, San Juan, 510 pp.).

Between 1200 and 1300 h on 20 July 2002, I observed an adult (ca. 40 mm SVL) male *Anolis stratulus* at a height of 1.5 m on a leaf of *Inga vera* (Leguminosae-Mimosoideae), a tree that can reach 15 m or more in height, on a karst hillside in Sabana Seca (18°27'N, 66°12'W), north coastal Puerto Rico. The anole was lapping nectar from the stipitate glands, which are located between opposite leaflets of *I. vera*'s compound leaves (Liogier 1988. Descriptive Flora of Puerto Rico and Adjacent Islands, vol. 2. Editorial de la Universidad de Puerto Rico, San Juan, 481 pp.). The anole lapped each of the four glands in sequence from the base of the leaf to its terminal axis. After 2–3 minutes of lapping nectar, the anole jumped to a nearby tree trunk and began displaying.

Anolis stratulus typically consumes ants (Wolcott 1924. J. Dept. Agric. Porto Rico 7:5–37; Lister 1981. Ecology 62:1548–1560; Reagan 1996. *In* Reagan and Waide [eds.], The Food Web of a Tropical Rain Forest, pp. 321–345. University of Chicago Press, Chicago, Illinois), but the extrafloral nectar of *Inga vera* in Puerto Rico, if similar to that of *I. vera* in Costa Rica, is energy and amino acid rich, and available continuously (i.e., nectar production occurs day and night: Koptur 1994. Biotropica 26:276–284). In general, extrafloral nectaries of *Inga* are visited by several species of ants that protect young leaves from insect herbivores (Koptur, *op. cit.*). In Puerto Rico, the ant, *Myrmelachista ramulorum* (NCN), which is predominantly arboreal, tunnels the stems of its domicile plants, and has a diet based largely on nectar and the exudate of homopterans (J. Torres, pers. comm.; Torres 1984. Biotropica 16:284–295). This ant species also occurs in Sabana Seca and elsewhere (the El Verde rain forest of northern Puerto Rico). *Myrmelachista ramulorum* is the most common ant in the diet of *A. stratulus* taken from understory and canopy strata (Reagan, *op. cit.*). Thus, extrafloral nectivory in *A. stratulus* may have evolved from the anole being exposed to the nectar while predating on ants of *M. ramulorum* which in turn, were feeding on extrafloral nectaries. Such a behavior would be advantageous for the anole at times when ants, its primary prey, were not abundant. Further, presence of *A. stratulus* on *I. vera* could also benefit the plant as anti-herbivore protection when other nectar feeding mutualists are rare or absent. The documentation of extrafloral nectivory deserves attention not only because it addresses a novel feeding behavior in lizards, but also for the possible influences of this behavior on the relationships among anoles, ants, and plants. This behavior might have consequences for plant fitness in islands like Puerto Rico, where anoles are among the most abundant diurnal insectivores (Reagan, *op. cit.*).

I thank Juan A. Torres for life history information on *M. ramulorum* and Frank Axelrod, U.P.R.-Río Piedras Herbarium, for confirmation of *I. vera*'s identity. I am indebted to Marc P. Hayes for valuable comments on an earlier version of the manuscript.

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BRIBA BRASILIANA (Lagartixa). **PREDATION**. Records of predation on Brazilian geckos are scarce. Here, we report predation on *Briba brasiliana* by the burrowing owl *Speotyto cunicularia* (Aves: Strigidae) from central Brazil.

The observation occurred on 14 June 2003 at 2045 h in Parque Estadual do Jalapão (10°19'S, 46°53'W; elev. 400 m), municipality

of Ponte Alta, Estado do Tocantin. *Briba brasiliana* occurs in low densities in open habitats in the park and is sympatric with three other geckos (*Coleodactylus meridionalis*, *Gymnodactylus geckoides* and *Hemidactylus mabouia*). The predation event occurred in an area of cerrado *sensu stricto* (a savanna-like formation). We were conducting a night survey when we encountered a burrowing owl (*Speotyto cunicularia*) resting in an undeveloped roadway track on sandy ground. On approach, we saw that the owl was carrying a lizard in its claws as it flew off. The owl landed ca. 40 m away in the same roadway and then presumably killed the gecko with a bite to its head. On our second approach, we startled the owl and it flew off, leaving the gecko, which was almost intact; only bite marks on its head were evident. The gecko was an adult male *B. brasiliana* (65.5 mm SVL, 42.0 mm tail length).

Lizards are occasional prey of *Speotyto cunicularia*, but predation on *B. brasiliana* has not been previously reported (del Hoyo et al. 1999. Handbook of the Birds of the World. Vol. 5. Barn-owls to Hummingbirds. Lynx Ed., Barcelona, 759 pp.). *Briba braziliana* is a presumptively rare Brazilian gecko known from a handful of sites in northeastern Brazil and little is known of its ecology (Vanzolini et al. 1980. Repteis das Caatingas. Academia Brazileira de Ciencias. 161 pp.). This is the first record of predation on this species.

The gecko was deposited in the Coleção Herpetológica da Universidade de Brasília, Distrito Federal (CHUNB 30911).

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CELESTUS CYANOCHLORIS (NCN). **ARBOREAL BEHAVIOR.** Largely due to inaccessibility, the biology of many vertebrates that inhabit tropical rainforest canopies is poorly known. Some anguid lizards, such as *Celestus hylaius* from the Atlantic lowlands of Costa Rica, are thought to be arboreal (Savage 2002. The Amphibians and Reptiles of Costa Rica, The University of Chicago Press, Chicago. 934 pp.), but, as with most cryptozooic forms, few observations exist. Here we report an observation of the poorly known anguid, *Celestus cyanochloris*, in the rainforest canopy providing preliminary evidence for arboreal behavior.

At 1400 h on 10 July 2003 (first half of rainy season), we encountered an adult *C. cyanochloris* (ca. 200 mm TL; full tail) 26 m above the forest floor in a tree (*Myrsine* sp.) along the Sky Walk tourist complex near Santa Elena, Costa Rica (84°95'N, 10°35'W; elev. 1450 m). The tree crown extended 4 m above the surrounding canopy, and the lizard was perched ca. 1 m from the tip of the branch closest to the Sky Walk bridge. The branch, ca. 75 mm dia, was laden in epiphytes: mosses, young bromeliads (predominantly *Tillandsia* spp.), and orchids. The lizard remained motionless during our observation (25 min). As the tree was ca. 8 m from the bridge, we could not capture the lizard, but we did voucher the observation with a digital photograph.

Celestus cyanochloris is considered as "rare and terrestrial, with the tendency to occasionally climb into low bushes" (Savage, *op. cit.*). Our observation suggests that its "rarity" may be a function of previously unrecognized arboreal behavior.

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CHAMALELEO JACKSONI (Jackson's Chamaeleon). **ENDOPARASITES.** *Chamaeleo jacksoni* is endemic to east Africa (Spawls et al. 2002. A Field Guide to the Reptiles of East Africa. Academic Press, San Diego, California, 543 pp.). It is now well established in Hawaii due to released pet-trade animals (McKeown 1996. A Field Guide to Reptiles and Amphibians in the Hawaiian Islands. Diamond Head Publishing, Inc. Los Osos, California, 172 pp.). To our knowledge, the only species of helminth known from *C. jacksoni* is the nematode *Oswaldocruzia chamaeleonis* collected from an African specimen (Horchner 1963. Zeit. Parasiten. 22:537–544). The purpose of this note is to report three additional species of endoparasites from Hawaiian *C. jacksoni*.

Thirty-one (9 females, 22 males) *C. jacksoni* (mean SVL = 85 mm ± 20 SD, range: 41–117 mm) collected February 2000 in Honolulu, Oahu, were examined for helminths. Lizards were deposited in the herpetology collection of the Bishop Museum (BPBM), Honolulu as BPBM 13998–14028. The esophagus, stomach, small intestine and large intestine were opened and examined separately for helminths under a dissecting microscope. The body cavity was also searched. Five-hundred seventy-four third-stage nematode larvae (*Physaloptera* sp.) were found in the stomachs of 19 *C. jacksoni*. Prevalence (number infected lizards/number examined x 100) was 61%; mean intensity (mean number nematodes/infected lizards) was 30.2 ± 46.4 SD, range: 1–204. Seven-hundred thirty cysts containing third-stage larvae of *Physocephalus* sp. were found in the stomach wall or body cavity. Prevalence was 61%; mean intensity was 38.4 ± 46.1 SD, range: 1–139. Two cysts containing acuariid larvae were found in the body cavity. Prevalence was 6%; mean intensity was 1. The nematodes are deposited in the United States National Parasite Collection, USNPC, Beltsville, Maryland as *Physaloptera* sp. (94133); *Physocephalus sp.* (94134); acuariid larvae (94135).

Third-stage larvae of species of *Physaloptera* infecting mammals are frequently found in amphibians and reptiles (occurrences summarized in Goldberg et al. (1993. Bull. South. California Acad. Sci. 92:43–51). In Hawaii, *Physaloptera* sp. has been reported in *Hemidactylus frenatus* (Hanley et al. 1998. Oecologia 115:196–205), *Phelsuma guimbeaui, Phelsuma laticauda* (Goldberg et al. 2003. Bishop Mus. Occas. Pap. 74:72–76) and *Anolis equestris* Goldberg et al. (2004. Herpetol. Rev. 35:384–385). Species of *Physocephalus* infect mammals, but encapsulated larvae are commonly found in the tissues of vertebrates that have ingested infected beetles (Anderson 2000. Nematode Parasites of Vertebrates: Their Development and Transmission. CABI Publishing, Wallingford, Oxon, UK. 650 pp.). Cysts containing *Physocephalus* sp. have been reported in *Norops sagrei, P. guimbeaui, P. laticauda, H. frenatus, Lepidodactylus lugubris, A. equestris* from

Hawaii (Goldberg and Bursey 2000. J. Parasitol. 86:750–755; Goldberg et al. 2003, *op. cit*; Goldberg et al. 2004, *op. cit.*). Members of the Acuariidae are parasites of terrestrial birds; eggs ingested by insects develop to third-stage infective larvae (Anderson, *op. cit.*). Acuariid larvae have been previously reported from Hawaii in *N. sagrei, P. guimbeaui,* and *P. laticauda* (Goldberg et al. 2002. Amer. Midl. Nat. 148:409–415; Goldberg et al. 2003, *op. cit.).* We know of no reports of larvae of *Physaloptera, Physocephalus,* or the Acuariidae in African chameleons; thus, we consider the occurrence of these species in *C. jacksoni* to represent an instance of an immigrant host capturing local helminths. *Chamaeleo jacksoni* would be a paratenic (= transport host) for these three species.

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COLEONYX BREVIS (Texas Banded Gecko). **TAIL REGENERATON**. Reviewing data on caudal regeneration among lizards, Bellairs and Bryant (1985. *In* Gans and Billett [eds.], Biology of the Reptilia, Vol. 15, Development B, pp. 301–410. John Wiley & Sons, New York, New York) noted that the fastest and slowest regeneration rates were 4.7 mm/day for *Lacerta lepida* and 0.07 mm/day for *Anguis fragilis*, respectively. Yet, except for Mulaik (1935. Copeia 1935:155–156), no study has identified the actual rate of tail regeneration in the gecko, *Coleonyx brevis*. Dial and Fitzpatrick (1981. Oecologia 51:310–317) noted that regeneration is rapid, but gave no exact rate. Here we report an unusually rapid rate of tail regeneration in a free-living *C. brevis*, and discuss its significance.

On the night of 30 May 1998, an adult female *C. brevis* was caught in one of a series of 51 19-L pitfall traps deployed near the headquarters of Indio Mountains Research Station, 40 km SW Van Horn, Hudspeth County, Texas (30°46'35"N, 105°00'55"W; elev. 1215 m). Local vegetation consists of Chihuahuan Desert scrub and the trap site was on a gently sloping alluvial fan composed mostly of smaller rock fragments, sand, and silt. This female lizard (62 mm SVL, 2.6 g) had a 13 mm tail with regenerated tip, was not gravid (no developing eggs upon being backlit), was given a single unique toe clip (method of Tinkle 1967. Misc. Publ. Mus. Zool. Univ. Michigan [132]:1–182), and was released near its capture site. On the night of 12 June 1998, this female recaptured in the adjacent pit-fall trap 10 m away, measured 64 mm SVL, weighed 3.4 g and had a completely regrown tail 55 mm long. Again, no egg development was noted. The tail had grown 42 mm in 13 days, a mean of 3.2 mm/day.

This growth rate is 4 times that of the 0.8 mm/day Mulaik (*op. cit.*) described for the first 12 days of his study. In that time, he had a female *C. brevis* regenerate about 33% (or 9.5 mm) of its final total tail length (29.6 mm). Regenerating the total tail length required 68 days. Although not specified therein, Mulaik's (*op. cit.*) study was probably not performed in a natural setting where lizards could optimize feeding and activity periods; thus, the growth rate he recorded may have been constrained. Our female had a tail regeneration growth rate second only to the 4.7 mm/day maximum previously noted for *L. lepida* (Bellairs and Bryant, *op. cit.*). Dial and Fitzpatrick (*op. cit.*) discussed the factors associated with tail regeneration in *C. brevis*, indicating that temperature, reproductive timing, and life expectancy all affect regeneration rate. Briefly, tails are thought to regenerate faster with warmer temperatures and slower during vitellogenesis, and short-lived species, like *C. brevis* (Dial 1975. MS Thesis, Texas A&M University, College Station, Texas. 211 pp.) put more energy into reproduction versus tail regeneration because the probability of future reproductive success is low. However, we expect that the tradeoff between tail regeneration and vitellogenesis would become important only after females become reproductive. Moreover, as energy shunting from tail reserves for reproduction is a pronounced phenomenon in *C. brevis* (Dial and Fitzpatrick, *op. cit.*), we would expect maximal diversion into tail reserves prior to reproductive maturity. The rapid tail regeneration rate we found in our female *C. brevis*, which was pre-vitellogenic, seems consistent with these hypotheses, but examination of regeneration rates between vitellogenic and pre-vitellogenic females will be needed.

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CYCLURA NUBILA LEWISI (Grand Cayman Blue Rock Iguana). **REPRODUCTION.** All published accounts of the reproductive ecology of West Indian Rock Iguanas (genus *Cyclura*) state or imply that these iguanas lay one clutch per year, typically in June or July (Auffenberg 1976. Bahamas Nat. 2:9–16; Carey 1975. Bull. Florida St. Mus., Biol. Sci. 19:189–233; Christian 1986. Caribbean J. Sci. 22:159–164; Grant 1940. Bull. Inst. Jamaica, Sci. Ser. No. 2; Iverson 1979. Bull. Florida St. Mus., Biol. Sci. 24:175–358; Iverson, Hines, and Valiulis, ms. in review; Wiewandt 1977. Ecology, Behaviour, and Management of the Mona Island Ground Iguana, *Cyclura stejnegeri*. Ph.D. dissertation, Cornell Univ., Ithaca, New York, 338 pp.; and seven papers in Alberts [ed.] 2000. West Indian Iguanas: Status Survey and Conservation Action Plan. IUCN, Gland, Switzerland. 111 pp.). With the exceptions of the genus *Brachylophus* (Gibbons and Watkins 1982. *In* Burghardt and Rand [eds.], Iguanas of the World: Their Behavior, Ecology and Conservation, pp. 418–441. Noyes Publ., Park Ridge, New York) and possibly *Dipsosaurus* (Mayhew 1971. Herpetologica 27:57–77), and a reference to possible multiple nesting by *Iguana delicatissima* in Dominica (Day et al. 2000. pp. 62–67 *in* Alberts, *op. cit.*), annual single clutches are reported as the reproductive strategy common to all iguanids (Wiewandt 1982, pp. 119–141 *In* Burghardt and Rand, *op. cit.*). My own observations of released, free roaming captive bred *Cyclura nubila lewisi* observed in the quasi-natural setting of the Queen Elizabeth II Botanic Park on Grand Cayman, Cayman Islands show these iguanas generally match this pattern, mating from late April through May, and laying eggs in June to early July each year.

In 2002 I observed a female *C. n. lewisi* which had then been living in the wild for 2.5 years, mating on 23 June, 21 days after she had laid her eggs. It is unknown whether she nested a second

time that year. The following year I observed the same female laying a clutch of 9 eggs on 24 May, and she nested a second time 53 days later, producing 7 more eggs. A second female laid 10 eggs on 10 June 2003 and nested a second time 60 days later, producing 6 more eggs: this individual had been living in the wild for 3.5 years. Schettino (1999. The Iguanid Lizards of Cuba. Univ. Florida Press, Gainesville, 428 pp.) reported that a captive *C. n. nubila* in Cuba produced two clutches in one year, and the same has occurred with *C. n. nubila* and *C. n. lewisi* in at least three zoos in the United States (J. Lemm, J. Ramer, and A. Verhey, pers. comm.), but these are the first documented cases of biannual nesting in wild *Cyclura*.

Mean turgid egg weight in the first clutches (87.3 g and 105.8 g) was larger than in the second clutches (41.5 g and 66.8 g respectively). All eggs in the first clutches were viable, whereas two in each of the second clutches were incompletely calcified and died early in incubation.

Male *C. n. lewisi* in the wild are frequently seen attempting to copulate with females some time after they have laid eggs, implying that the incidence of biannual reproduction in the population may be significantly greater than is currently recognized. The fact that this has not been observed in wild *Cyclura* before may reflect the paucity of extended observations on individual females rather than rarity of the phenomenon. If incidence of biannual reproduction in *Cyclura* populations is found to be significant, it may require reassessment of life tables and population projections used in conservation management for the taxa concerned, and scheduling duration and seasons for field studies.

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EGERNIA STRIOLATA (Tree Skink). **REPRODUCTION**. *Egernia*, a genus of large, long-lived viviparous skinks (Greer 1989. The Biology and Evolution of Australian Lizards. Surrey Beatty & Sons, Sydney. 264 pp.), has reliable litter size estimates for only 13 of the 30 currently described species from Australia (Chapple 2003. Herpetol. Monogr. 17:145–180). Here, we help fill this data gap with litter size information on *Egernia striolata*.

In the first week of January 1999, 14 gravid female *E. striolata* were collected along the South Para River in the Para Wirra Conservation Park (34°68'S, 138°50'E), South Australia, and held in individual 70 x 30 x 30 cm glass tanks maintained at 25°C on a 12:12 photoperiod. Each tank had an overturned box (16 x 16 x 8 cm) for refuge. A 60-W lamp, provided temperatures of 35°C on a basking tile (9 x 9 x 2.5 cm) during the light phase of the photoperiod. Tanks were checked twice daily for the presence of new neonates until 25 February, 2 weeks after the last birth. The 14 females produced 46 young over 23 days (18 January–10 February). Mean litter size was 3.3 (SE 0.2; range: 2–4). Six of the litters were each produced in 1 day, whereas the remaining litters took up to 7 days. The mass and snout–vent length (SVL) of each female was measured on 10 January before parturition (mean mass 45.2 g; SE 1.5; range: 36.8–56.1; mean SVL 112.7 mm; SE 1.1; range: 104–118), and for each neonate on its birth date (mean mass 3.0 g; SE < 0.1; range: 2.3–3.7; mean SVL 50.6 mm; SE 0.2; range: 47–54). Relative clutch mass (RCM), total mass of new born juveniles in the litter as a percentage of the post-parturition mass of the mother, averaged 26.0% (SE 1.0; range: 19.2–31.6). No significant correlations were found between female SVL or mass and average SVL or mass of their offspring. However, longer mothers were significantly heavier ($r = 0.66$; $P = 0.011$), had significantly more young in their litters ($r = 0.71$; $P = 0.004$), had significantly higher total litter mass ($r = 0.78$; $P = 0.001$), and had significantly greater RCM ($r = 0.54$; $P = 0.046$).

Egernia striolata is similar to 14 of 15 other *Egernia* species in timing litter production to the middle of the Austral summer, and is in the middle of the range of RCM values (0.10–0.39) recorded from five other *Egernia* species (Chapple, *op. cit.*). Among *Egernia* species, mean clutch size (range: 2–6) increases with maternal SVL (Chapple, *op. cit.*) and *E. striolata,* with mid-range values for both parameters, also conforms to this pattern.

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EULAMPRUS QUOYII (Eastern Water Skink) **PREDATION**. *Eulamprus quoyii* is an opportunistic insectivore also known to eat adult frogs, tadpoles, fish, small skinks (*Ablepharus* sp.) and occasionally carrion (Veron 1969. J. Herpetol. 3:187–189; Daniels 1987. Austral. J. Zool. 35:253–258). Here, I report an observation of predation by *E. quoyii* on one of its sympatric congeners.

On 21 September 2002 at South Mimosa Creek, Blackdown Tableland National Park, central Queensland, Australia (149°04'E, 23°47'S) I caught a female *Eulamprus quoyii* (107 mm SVL, 271 mm tail, 24.5 g) on a cockroach sticky trap baited with live mealworms (*Tenebrio* sp). During handling, the animal regurgitated the two mealworms used as bait and an adult male *Eulamprus sokosoma* (51 mm SVL, 89 mm tail, 3 g). The *E. sokosoma* seemed to have been recently eaten, as minimal digestion appeared to have occurred. Although *Eulamprus* ecology is well studied (e.g., Schwarzkopf 1993. Ecology 74:390–395; Morrison et al. 2002. Molec. Ecol. 11:535–546), this is the first report of interspecific predation within the genus. Both *E. quoyii* and *E. sokosoma* are sympatric in eastern central Queensland, and are also syntopic, as both dwell in rocky habitats. This observation suggests that intrageneric predation may be important for interactions between *Eulamprus* species, and raises the possibility that blood parasites in *Eulamprus quoyii* may be transmitted through predation of sister species (Mackerras 1960. Austral. J. Zool 9:61–134; Smith et al. 1996. Can. J. Zool. 74:1850–1856).

The *Eulamprus sokosoma* specimen has been deposited in the Queensland Museum (QMJ 78447). A Queensland Parks and Wildlife Service Permit (No. F1/000374/00/SAA) was granted to D. J. Salkeld for this work.

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EUROLOPHOSAURUS DIVARICATUS (NCN). **DEATH FEIGNING.** Lizards of the subfamily Tropidurinae are common members of South America fauna (Frost 1992. Amer. Mus. Novit. 3033:1–68), exploiting a variety of habitats (Kohlsdorf et al. 2001. J. Morphol. 248:151–164). In general, Tropidurinae (*sensu stricto*) are heliothermic, territorial, sit-and-wait predators that thermoregulate behaviorally (Rodrigues 1988. *In* Heyer and Vanzolini [eds.], Proceedings of a Workshop on Neotropical Distribution Patterns, pp. 305–315. Academia Brasileira de Ciências, Rio de Janeiro). *Eurolophosaurus divaricatus*, a medium-sized (to 92 mm SVL) Brazilian species found west of Rio São Francisco, Estado da Bahia, Brazil (Rodrigues 1986. Papéis Avulsos de Zoologia, São Paulo 36:171–179), is common on dunes. This species typically relies on sprint speed to escape predators and attempts to reach nearby concealing vegetation or dives into sand when threatened (Rodrigues 1986, *op. cit.*). Presumptive death-feigning behavior in *E. divaricatus* behavior was first observed by one of us (MTR) on collecting trips, but this behavior is unstudied in this species. Here, we describe behavioral observations and experiments on *E. divaricatus* intended to provide insights into this behavior.

Our observations were based on two adult males and two females *E. divaricatus* collected at Alagoado, Estado da Bahia, Brazil (09°29'01"S, 41°22'21"W). Lizards were maintained for two weeks in large plastic boxes (50 x 70 x 40 cm) provided with infrared heating lamps and a vermiculite substrate. We confirmed death feigning in the lab when we first manipulated animals. Over the time interval 1000–1700 h when observations and tests were performed, animals were alert and ready to respond to observer approach. Upon capture, they sometimes struggled and attempted to bite. Struggle, however, ceased very quickly and was followed by relaxation of body, tail and limbs, closing of eyelids (Fig. 1) and deep slow ventilatory movements. This behavior continued even if lizards were released and placed upside down on the boxes. After less than three minutes the lizards recovered and quickly attempted to flee.

We manipulated animals at temperatures of 14, 24, and 42°C to explore whether thermal conditions might alter death feigning. The highest experimental temperature is probably close to field activity temperatures, as these thermophilic lizards select high temperatures in a thermal gradient day or night (day: mean = 36.1°C ± 2.11°C; night: mean = 37.9°C ± 0.56°C; overall range of temperatures selected: 25.6–44.3°C). In their dune habitat, substrate temperatures may reach 60°C between 1300 and 1500 h (Rocha 1998. PhD Dissertation, Depto. de Zoologia, Universidade de São Paulo, Brazil. 108 pp.). After maintaining each individual in a cloth bag at the experimental temperature for 40 min, we seized each lizard firmly by the neck. We recorded the time when death feigning was first performed and measured the animal's cloacal temperature at that time. We randomized the test temperature order and each animal was tested 6 times at each temperature, with intervals of 1 hour between tests.

Death feigning consistently occurred within 2 min following hand capture, and was not necessarily preceded by a struggle. Three individuals feigned death at all three experimental temperatures, but the largest male death-feigned only at 14 and 24°C, although it did not behave aggressively when not feigning death at high temperature. We did not detect differences among individuals either in the lag time to death feigning or temperature (lag time: $F_{3,24}$ = 2.2, P = 0.113; temperature: $F_{1,24}$ = 3.2, P = 0.087). The lag time to death feigning averaged 27 sec (SD = 19 sec; range: 10–96 sec). Death feigning was less frequent at 42°C, but differences were not significant and the result was due to only one animal (c^2 = 5.4, P = 0.067). However, we observed that animals habituated to manipulation so that they exhibited death feigning responses less often after a few days of captivity and manipulation.

Our data suggest that this behavior is analogous to the death feigning observed in other squamates (e.g., Burghardt and Greene 1988. Anim. Behav. 36:1842–1844; Mutoh 1983. Herpetologica 39:78–80). Some species have evolved complicated death feigning behaviors that apparently improve their chances of survival after predator attacks (Schieffelin and de Queiroz 1991. Herpetologica 47:230–237). Among lizards, the most common antipredator behavior is running (Greene 1988. *In* Gans and Huey [eds.], Biology of the Reptilia, vol. 16, pp. 1–52. Alan R. Liss, Inc., New York, New York), but at cold temperatures, when it may be difficult to outrun a predator, some species switch to aggressive behavior such as biting (Hertz et al. 1982. Anim. Behav. 30:676–679). In contrast, death feigning, although generally rare in lizards, may be common in the genus *Eurolophossaurus*. Anecdotal observations suggest that the other two members of this group, *E. amathites* and *E. nanuzae*, exhibit similar death-feigning behavior (MTR, pers. obs.). These observations are interesting because *E. amathites* is the sister species of *E. divaricatus* (Frost et al. 2001. Mol. Phyl. Evol. 21:352–371), and also a dune dweller, but found on the east side of the Rio São Francisco (MTU, pers. comm.). In contrast, *E. nanuzae* is a saxicolous species from campos rupestres in Central Brazil (Rodrigues 1981. Papéis Avulsos de Zoologia, São Paulo 34:145–149).

One could hypothesize that the apparent death-feigning we report is actually a manifestation of stress or exhaustion. However, given that most Tropidurinae do not exhibit such behavior under similar conditions, and that struggling was not a necessary precursor to death feigning, we suggest that the apparent feigning we observed in *E. divaricatus* is ecologically meaningful and related to an escape strategy in free-ranging lizards. This behavior may have evolved in response to predators that do not immediately consume captured prey. The main predators of *E. divaricatus* are *Didelphis albiventris* (a skunk), small hawks, and snakes like *Philodryas nattereri*, *P. offersi*, and *Oxyrhopus trigeminus* (MTR, pers. obs.). Some of these predators frequently wait before eating their prey because they go back to their nests or alternate attention between prey and their surroundings (MTR, pers. obs.). Thus, immobility followed by quick recovery and fleeing may allow these lizards to evade some predators. Field and laboratory tests of this hypothesis will be necessary to understand the functional significance of death feigning in *Eurolophosaurus*.

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FEYLINIA ELEGANS (Elegant Feylinia). **ENDOPARASITES.** *Feylinia elegans* (Scincidae) occurs in Angola, Congo, Gabon, Uganda, and Zaire (Welch 1982. Herpetology of Africa, Krieger Publishing Company, Malabar, Florida. 293 pp.). To our knowledge, this is the first report of helminths from *F. elegans*.

One adult male (105 mm SVL) *F. elegans* (MCN 940) from the Museo de Ciencias Naturales de la Universidad Nacional de Salta, Salta, Provincia de Salta, Argentina that R. F. Laurent collected in Omaniundu (3°21'S, 23°16'E), Republic of the Congo, Africa, on 18 August 1959 was examined. It was fixed in 10% formalin then preserved in 70% ethanol. The abdominal cavity was opened, the gastrointestinal tract removed, slit longitudinally, and examined under a dissecting microscope. Helminths were removed to a drop of undiluted glycerol for identification.

One species of Nematoda, *Africana africana* (Heterakidae) was found in the stomach. The 2 female, 2 male *A. africana* specimens were placed in a vial of 70% ethanol and deposited in the collection of the Fundación Miguel Lillo (FML 01782), San Miguel de Tucumán, Provincia de Tucumán, Argentina.

Hosts of *A. africana* include *Chamaeleo cristatus* of Cameroon (Rasheed 1965. J. Helminthol. 39:67–100), *C. gracilis* of Republic of the Congo (Baylis 1939. Ann. Mag. Nat. Hist. Ser.11. 3:625–629), *Kinixys belliana* of Guinea (Gendre 1909. Actes Soc. Linn. Bordeaux 63:33–41) and Malawi (Fitzsimmons 1961. Ann. Parasit. Hum. Comp. 36:107–112), *K. erosa* of Republic of the Congo (Baylis 1940. Ann. Mag. Nat. Hist. Ser. 11. 5:401–416), *Varanus griseus* of Benin (Gendre 1911. Actes Soc. Linn. Bordeaux 65:68–78), and *V. niloticus* of Republic of the Congo (Graber 1981. Rev. Elev. Med. Vet. Pays Trop. 34:155–167). The life history of *A. africana* apparently has not been studied, but other heterakoids are monoxenous (no intermediate host); eggs containing the infective stage are ingested by the host (Anderson 2000. Nematode Parasites of Vertebrates: Their Development and Transmission 2nd ed. CABI Publishing, Oxon, UK. 650 pp.). *Feylina elegans* represents a new host record for *A. africana*.

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HEMIDACTYLUS MABOUIA (Tropical House Gecko). **COMMUNAL NESTING.** *Hemidactylus mabouia* is an exotic gekkonid presumably introduced via slave ships to Brazil (Vanzolini 1978. Papéis Avulsos Zool., S. Paulo 31:307–343). *H mabouia*, like many other gekkonids, consistently produces two eggs per clutch (Vitt 1986. Copeia 1986:773–786). Although communal nesting is known for a number of gekkonids (Flower 1933. Proc. Zool. Soc. London 1933:735–851; Bustard 1967. Herpetologica 23:276–284; Shanbhag 1999. Herpetol. Rev. 30:166), it has not been reported in *H. mabouia*. Here, we report on oviposition in *H. mabouia* from southern Brazil that suggests communal nesting.

On 27 March 2003, we collected 10 *H. mabouia* eggs on a ca. 50 x 30 cm piece of granite in urban environment in neighborhood to the Parque Jardim Botânico de Porto Alegre (30°04'S, 51°11'W; elev. 47 m), Rio Grande do Sul. The eggs were incubated in vermiculite. The mean volume of the eggs was 472.0 cm^3 (SD = 85.8), and the mean mass was 0.4 g (SD = 0.2). One hatchling emerged on each of 27 and 30 April; 14 May; 25, 27 and 30 June and 9 July. Two eggs did not hatch. The staggered pattern of hatching implies that at least four clutches were represented. Individuals that hatched were released at the location where the eggs were found.

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HEMIDACTYLUS (House Geckos). **ANTI-PREDATOR BEHAVIOR.** Florida, which has experienced a dramatic influx of exotic lizards, now has more non-indigenous than native species (Butterfield et al. 1997. *In* Simberloff et al. [eds.], Strangers in Paradise: Impact and Management of Nonindigenous Species in Florida, pp. 123–138. Island Press, Washington, D.C.). Many of these exotics have remained near their points of initial arrival, but three *Hemidactylus* geckos (*Hemidactylus garnotii*, *H. mabouia*, and *H. turcicus*) have substantially expanded their ranges (Butterfield et al., *op. cit.*). All three species appear to occupy similar niches, being found largely on buildings with external lights. *Hemidactylus turcicus*, native to the Mediterranean, northern Africa, and southwest Asia (Henkel and Schmidt 1995. Geckoes: Biology, Husbandry, and Reproduction, Krieger Publishing Company, Malabar, Florida. 237 pp.), has been recorded in Florida since ca. 1915 (Butterfield et al. 1997, *op. cit.*). *Hemidactylus garnotii*, a parthenogenetic form from southeast Asia and the Pacific region (Kluge and Eckhardt 1969. Copeia 1969:651–664), probably arrived in Florida around 1963 (Butterfield et al., *op. cit.*). Most authors suggest a southern African origin for *Hemidactylus mabouia* (Powell et al. 1998. Cat. Amer. Amphib. Rept. 674:1–11), which was first recorded in Florida in 1991 (Lawson et al. 1991. Herpetol. Rev. 22:11–12) and has been spreading rapidly in mainland Florida (Butterfield et al. 1993. Herpetol. Rev. 24:111–112; Meshaka et al. 1994. Herpetol. Rev. 25:80–81). In southern Florida, reduction in *H. turcicus* populations seem to correspond to the increased presence of congeners (Meshaka et al., *op. cit.*). *Hemidactylus mabouia* has been documented replacing *H. garnotii* (Meshaka and Moody 1996. Florida Sci. 59:115–117), so that *H. mabouia* seems to be currently expanding its range as the other two species are contracting in distribution. In an effort to identify mechanisms that may contribute to the patterns of range expansion and species replacement among these geckos, we undertook a study to compare their anti-predator

behaviors.

During 11–17 March 2000, we surveyed geckos on 55 buildings within Brevard, Okeechobee, Highlands, and Orange counties, Florida. On 52 buildings, only one species was found. Two species were recorded on two buildings. All three species were observed on one building. Surveys were generally conducted in the interval 2015–0115 h. Twenty-eight of the buildings were hotels; the remainder were non-residential structures (banks, churches, stores, and restaurants) that had some kind of external lighting. All but two of the buildings had their exterior lights on during surveys.

At each building, pairs of observers walked the perimeter searching for geckos. When a gecko was sighted, one observer approached the building at a slow steady pace and, upon reaching the wall, attempted to manually catch the lizard. We kept approach speed uniform (ca. 0.25 m/sec) among observers. The second observer remained back from the building, and recorded anti-predator responses: 1) approach distance (A_d) - the distance (cm) between the approaching observer and the gecko, when the latter first fled, and 2) flight distance (F_d) - the distance (cm) the gecko moved on its first escape attempt after being approached. An A_d of 0 was assigned to geckos who allowed observers to reach the wall before fleeing. An F_d of 0 was assigned to geckos who did not flee before the observer reached the wall. Sample sizes for F_d were smaller than for A_d. It was not always possible to see where a flight ended. For geckos that were captured, we recorded whether they tried to bite as a defense, as well as their snout-to-vent length (SVL, mm).

We used nonparametric statistics for analyses. Statistical significance was assigned using an initial rejection criterion of < 0.05. We adjusted for multiple tests using the sequential Bonferroni method (Sokal and Rohlf 1995. Biometry 3rd edition, W. H. Freeman and Company, New York. 887 pp.). All tests were performed using Minitab (3801 Enterprise Drive, State College, Pennsylvania).

Both A_d and F_d varied significantly among the three species (Kruskal-Wallis: H = 15.3, df = 2, $P < 0.001$; H = 13.41, df = 2, $P = 0.001$ respectively). *Hemidactylus mabouia* allowed the closest approach, with the median A_d being 0 cm (range 0–475 cm, N = 63) and had the shortest F_d (median = 5 cm, range 0–130 cm, N = 54). *Hemidactylus garnotii* had the longest A_d (median = 106 cm, range 0–460 cm, N = 42), and a median F_d of 25 cm (range 0–420, N = 39). *Hemidactylus turcicus* displayed a median A_d of 50 cm (range 0–500 cm, N = 19), and F_d of 27 cm (range 0–125 cm, N = 14). Post hoc comparison revealed that the A_d for *H. mabouia* was significantly shorter than that for both *H. garnotti* (Mann Whitney: $P = 0.0003$) and *H. turcicus* (Mann Whitney: $P = 0.044$), whereas A_d did not differ significantly between *H. turcicus* and *H. garnotti* (Mann Whitney: $P = 0.36$). Post hoc comparison also revealed that the F_d for *H. mabouia* was significantly shorter than that for both *H. garnotti* (Mann Whitney: $P = 0.0015$) and *H. turcicus* (Mann Whitney: $P = 0.012$), but F_d did not differ significantly between *H. turcicus* and *H. garnotti* (Mann Whitney: $P = 0.78$).

Approach distance was unrelated to F_d for both *H. garnotii* and *H. turcicus* ($F_{1,34} = 0.0$, $P = 0.95$; $F_{1,12} = 0.8$, $P = 0.38$, respectively), but a significant but weak positive relationship existed between A_d and F_d for *H. mabouia* ($F_{1,51} = 9.25$, $r^2 = 15.4$, $P = 0.004$; $F_d = 7.73 + 0.095\,A_d$). Body size was unrelated to either A_d or F_d in any of the species (Approach Distance: *H. garnotii*: $F_{1,26} = 0.08$, $P = 0.78$; *H. turcicus*: $F_{1,14} = 1.57$, $P = 0.23$; *H. mabouia*: $F_{1,45} = 0.53$, $P = 0.47$; Flight Distance: *H. garnotii*: $F_{1,23} = 1.16$, $P = 0.29$; *H. turcicus*: $F_{1,10} = 0.01$, $P = 0.91$; *H. mabouia*: $F_{1,36} = 2.10$, $P = 0.15$).

Upon capture, interspecific differences existed in the likelihood of using biting as a defense (Chi-square: $c^2 = 27.5$, df = 2, $P < 0.001$). *Hemidactylus mabouia* was much more likely to bite than the other two species. *Hemidactylus mabouia* attempted to bite during 55% of captures (N = 47). Only 5% of captured *H. garnotii* (N = 38) and 16% of *H. turcicus* (N = 19) tried to bite. We observed no indication that the animals that avoided capture were likely to behave differently than the captured geckos. In addition, biting by *H. mabouia* was significantly related to body size; biting individuals (median SVL = 57 mm) were significantly larger than non-biting individuals (median SVL = 41; Mann-Whitney: U = 422, N = 27, 22; $P = 0.01$).

The more aggressive and less flighty behavior we quantified in *H. mabouia* may help explain why this species is expanding its range, while the other two species are contracting in distribution. *Hemidactylus mabouia* may be behaviorally dominant to the other two species. In addition, the tendency of *H. mabouia* to remain stationary upon approach may make it an effective predator of juvenile *H. garnotti* and *H. turcicus*. As behavioral dominance is a documented mechanism contributing to species displacement in some gecko assemblages (Petren et al. 1993. Science 259:354–358; Petren and Case 1996. Ecology 77:118–132), and predation by *H. mabouia* on hemidactyline geckos has been documented (Meshaka 2000. J. Herpetol. 34:163–168), further tests of these hypotheses is warranted.

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LEIOCEPHALUS CARINATUS CORYI (NCN). **NEST LOCATION.** Although among the most conspicuous lizards in the West Indies, curly-tailed lizards (*Leiocephalus* spp.) have few published accounts of their nesting behavior. Smith and Iverson (1993. Can. J. Sci. 71:2147–2151) describe one nesting episode for *L. psammodromus,* where the eggs were deposited ca. 5 cm deep in sand at the base of a small shrub (*Borrichia arborescens*). Here, we report the first observation of the use of a termite mound for nesting by *L. carinatus coryi.*

On 16 August 2003, we discovered two *L. carinatus coryi* eggs adjacent to an active *Nasutitermes rippertii* termite mound during excavation of an Andros Iguana (*Cyclura cychlura cychlura*) nest on Sandy Cay, South Andros, Bahamas (24°05'24"N, 77°41'44"W; elev. 1.5 m). Both *Leiocephalus* eggs were buried in a uni-directional skirt of loose termite carton with mixed loam and leaf litter. The eggs were directly in front of a tunnel entrance excavated and filled by a female iguana on 13 June 2003. The eggs were

deposited at the base of the mound ca. 3 cm in front of the entrance with ca. 5 cm of carton covering them. At the time of excavation, one of the eggs (25.2 x 12.2 mm) was flaccid and appeared lifeless, whereas the other (24.9 mm x 14.2 mm) appeared viable. Egg sizes closely match those Schwartz and Henderson reported (1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History. Univ. Press of Florida. 720 pp.; i.e., 25.1 x 11.5 mm), and two appears to be the typical clutch size for the genus (Smith and Iverson, *op. cit.*; Nelson et al. 2001. Contemp. Herpetol. http://www.cnah.org/ch/ch/2001/1/index.htm). We tried to incubate the eggs in a plastic container filled with termitaria carton, but aborted incubation after two days when it was clear that the eggs were lifeless. The embryo in the flaccid egg was slightly less developed than the other, but both embryos were clearly identifiable as *L. carinatus coryi;* the better developed specimen was deposited in the Florida Museum of Natural History (UF 138902). We estimated the clutch to be a maximum of 64 days old based on our 13 June 2003 observation of oviposition by the female *C. c. cychlura* in the same mound.

South Andros offers little vertical relief and has a substrate composed of jagged karst limestone with scant soil accumulation. The island has a distinct wet season from May to October when high water often results in a raised water table toward the limestone surface. Ovipositing in the loose termitaria media accumulated by nesting female iguanas may be advantageous for *L. carinatus coryi* because mounds are elevated above flood level and remain dry throughout the rainy season. Additionally, the soft, soil-like carton offered by using termitaria, and the constant temperature created by the adjacent termite colony, may provide a convenient incubation site in an environment with little soil and moderately fluctuating temperatures (Magnusson et al. 1985. J. Herpetol. 19:199–207).

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LIALIS BURTONIS (Burton's Snake Lizard). **ENDOPARASITES.** *Lialis burtonis* (Pygopodidae) occurs throughout continental Australia and parts of New Guinea (Cogger 2000. Reptiles and Amphibians of Australia. 6th ed. Ralph Curtis Books, Sanibel Island, Florida, 808 pp.). Previous reports of endoparasites of *Lialis burtonis* include the cestode *Kapsulotaenia tidswelli* (Johnston 1914. Proc. Roy. Soc. Queensland 26:76–84), physalopterid larvae (Jones 1995. J. Wildl. Dis. 31:299–306), and the acanthocephalan *Porrorchis hylae* (Bolette 1996. J. Wildl. Dis. 32:704–706). The purpose of this note is to add an additional nematode to the host list of *L. burtonis.*

We examined one adult (152 mm SVL) female *Lialis burtonis* (FML 06515) from the Herpetological Collection of Fundación Miguel Lillo, San Miguel de Tucumán, Argentina that Simon Oliver collected in Queensland, Australia, 29 March 1993. It had been fixed in 10% formalin and preserved in 70% ethanol. The abdominal cavity was opened, the gastrointestinal tract removed, slit longitudinally, and examined under a dissecting microscope. Helminths were removed to a drop of undiluted glycerol for identification.

One species of Nematoda, *Ophidascaris pyrrhus* (Ascarididae) was found in the stomach. The 3 female, 3 male specimens were placed in a vial of 70% ethanol and deposited in the collection of the Fundación Miguel Lillo (CHFML 07417).

Ophidascaris pyrrhus was originally described from the snake *Pseudechis porphyriacus* collected in New South Wales, Australia (Johnston and Mawson 1942. Rec. Aust. Mus. 21:110–115) and subsequently reported from the snakes *Denisonia punctata, Echiopsis curta, Notechis ater, Pseudechis australis, Pseudonaja nuchalis, P. textilis,* and *P. modesta* from western Australia (Jones 1980. Aust. J. Zool. 28:423–433). The life history of *O. pyrrhus* apparently has not been studied, but other ophidascarids have been found to require an amphibian or mammal intermediate host (Anderson 2000. Nematode Parasites of Vertebrates: Their Development and Transmission. 2nd ed. CABI Publishing, Oxon, UK. 650 pp.). *Lialis burtonis* represents a new host record for *Ophidascaris pyrrhus.*

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MABUYA LONGICAUDATA (Long-tailed Skink). **PREDATION**. Of the four species of the near-pantropical skink genus *Mabuya* that inhabit Taiwan, *M. longicaudata* inhabits lowland areas (< 500 m elev.) in central and southern Taiwan (Lue et al. 2002. The Transition World - Guidebook of Amphibians and Reptiles of Taiwan. SWAN, Taipei, 145 pp. [In Chinese]; Shang and Lin 2001. Natural Portraits of Lizards of Taiwan. Big Trees Publishers, Taipei, 80 pp. [In Chinese]). Here, we report observations relating to predation by *M. longicaudata* on Brown Anoles (*Anolis sagrei*), a species introduced to Taiwan (Norval et al. 2002. Zoological Studies 41:332–336).

At 1018 h on 15 March 2001, a *M. longicaudata* (ca. 120 mm SVL) was observed basking on a piece of black plastic along an irrigation ditch in an agricultural area of Santzepu, Shuisan District, Chiayi County, Taiwan (23°25'45"N, 120°28'59"E). The weather was partially overcast (air temperature = 25.2°C). A young *A. sagrei* (ca. 35 mm SVL, sex undetermined) approached the basking skink. When the *Anolis* was ca. 30 cm away from the *Mabuya*, the skink dashed towards the anole, seizing it by the head. With the neck clamped in the skink's jaws, the anole's body protruded from the left side of the skink's mouth. The anole was held in this position until it stopped struggling. The skink then moved to nearby vegetation where it swallowed the anole.

At 1005 on 27 March 2001, a smaller skink (ca. 85 mm SVL) was seen in the same area attempting to capture another small (ca.

30 mm SVL) Brown Anole at the base of a 17.5-cm diameter Betel Palm (*Areca catechu*). Weather was sunny (air temp. = 27.7°C). When first observed, the skink was ca. 40 cm from the anole. Almost immediately the anole spotted the skink and fled up the trunk of the palm, whereupon the skink discontinued the chase.

As the diet and feeding behavior of *M. longicaudata* is poorly understood, it is not known whether predation on other lizards is common. Cooper and Whiting (2000. Copeia 2000:112–118) reported ambush foraging in *Mabuya acutilabris* and *M. spilogaster*, as well as active foraging in *M. striata sparsa*, *M. sulcata*, and *M. variegata*. Our foraging observations of *M. longicaudata* resemble ambush foraging in the first case and active foraging in the second.

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NOROPS CUPREUS (Copper Anole). **ENDOPARASITES.** *Norops cupreus* occurs in a wide variety of habitats in Costa Rica and Nicaragua (Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas, University of Chicago Press, Chicago, 934 pp.). To our knowledge, no reports exist of endoparasites from this species. The purpose of this note is to report the presence of two nematode species in *N. cupreus* from Costa Rica.

Ten (4 females, 6 males) *N. cupreus* (mean SVL = 41 mm ± 4 SD, range: 33–45 mm) from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles (California, USA): LACM 146707–708, 146710, 146716–146721, 146723 collected in San José and Guanacaste Provinces, Costa Rica in 1973 and 1996, respectively were examined for helminths. The esophagus, stomach, small and large intestines were opened and separately examined for helminths under a dissecting microscope. The body cavity was also searched. Three *Physaloptera retusa* were found in the stomach of LACM 146719 and one *Physocephalus* sp. (larva in cyst) was found in the stomach wall of LACM 146721. Both infected anoles were from Guanacaste Province. Prevalence (infected lizard/lizards examined x 100) was 10% for each nematode species. The nematodes were deposited in the United States National Parasite Collection, Beltsville, Maryland as *Physaloptera retusa* (USNPC 93678) and *Physocephalus* sp. (USNPC 93679).

Physaloptera retusa is known in a variety of lizards from the Western Hemisphere (Goldberg et al., Comp. Parasitol. *in press*). Various insects serve as intermediate hosts (Anderson 2000. Nematode Parasites of Vertebrates: Their Development and Transmission, 2nd ed., CABI Publishing, Wallingford, Oxon, UK. 650 pp.). *Norops cupreus* represents a new host record for *P. retusa*. Costa Rica is a new locality record. Encapsulated larvae of *Physocephalus* commonly occur in gut tissues of terrestrial vertebrates which have ingested infected dung beetles; no further development occurs (Anderson, *op. cit.*). *Norops cupreus* represents a new host record for *Physocephalus* sp. but is most likely only a paratenic (transport) host. Costa Rica is a new locality record for *Physocephalus*.

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PETROSAURUS REPENS (Central Baja California Banded Rock Lizard). **SCALE VARIATION**. According to Grismer (2002. Amphibians and Reptiles of Baja California including its Pacific Islands in the Sea of Cortés. University of California Press, Berkeley, California. 399 pp.), possession of a postorbital stripe and one scale between the nasal and supralabials is diagnostic for the rock lizard species, *Petrosaurus repens*. In contrast, its congener, *P. thalassinus*, lacks the stripe and presents two scales between the nasal and supralabials. Here, we report the occurrence of a *P. repens* with the nasal scale morphology of *P. thalassinus*.

At 1100 h on June 15 2003, one of us (OHG) collected a young female *P. repens* (69.4 mm SVL) near Santa Rosalia, Baja California Sur, México (27°11'17"N, 112°14'41"W; elev. 541 m). This specimen, collected next to a microwave station in rocky desert scrub habitat, had the postorbital stripe characteristic of *P. repens* and was found at least 350 km (straight line distance) outside of the range where *P. thalassinus* has been recorded (Grismer, *op. cit.*). However, this specimen has two scales between the nasal and supralabials (Fig. 1). This find suggests caution regarding field diagnosis of the species of *Petrosaurus* exclusively relying on scale morphology in the nasal region.

The specimen, the identity of which was verified by L.Grismer, was deposited in the Colección Nacional de Anfibios y Reptiles, Instituto de Biología, UNAM (IBH-14608). We thank L. Grismer for the verification and reading a draft of this note.

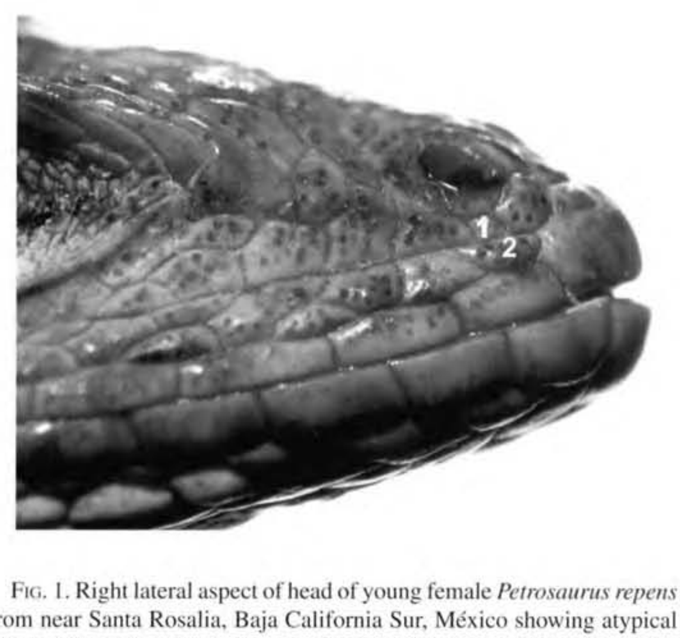

FIG. 1. Right lateral aspect of head of young female *Petrosaurus repens* from near Santa Rosalia, Baja California Sur, México showing atypical nasal scale morphology. Numbers indicate the two scales between the nasals and supralabials.

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PHYLLODACTYLUS REISSII (Peter's Leaf-toed Gecko). **ENDOPARASITES.** *Phyllodactylus reissii* is known from coastal Ecuador and Peru (Peters and Orejas-Miranda 1986. Catalogue of the Neotropical Squamata. Part II Lizards and Amphisbaenians. Smithsonian Institution Press, Washington, D.C. 293 pp.). To our knowledge, no reports exist of its endoparasites. The purpose of this note is to report two species of Nematoda from *P. reissii.*

Ten (8 females, 2 males) *P. reissii* (mean SVL = 58 mm ± 5 SD, range: 49–67 mm) from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California, USA (LACM 123091, 123093–123095, 123097–098, 123117, 123119–123121) were examined for helminths. Geckos were collected in Lambayeque Department, Peru during May–June 1976. The esophagus, stomach, small and large intestines were opened and separately searched for helminths under a dissecting microscope. The body cavity was also examined for helminths. Found were two species of nematodes: in the large intestines, adults of *Spauligodon oxkutzcabiensis* prevalence (infected lizards/lizards examined x 100) = 80%; mean intensity ± 1 SD (mean number nematodes per infected lizard) = 68 ± 42, range: 13–128; in the stomach, one third-stage larva of an unidentified species of *Physaloptera,* prevalence 10%. The nematodes were deposited in the United States National Parasite Collection, Beltsville, Maryland as *Spauligodon oxkutzcabiensis* (USNPC 94032) and *Physaloptera* sp. (USNPC 94033).

Spauligodon oxkutzcabiensis was described from *Thecadactylus rapicauda* from the Yucatan, Mexico (Chitwood 1938. Publ. Carnegie Inst. Washington 491:51–66). It has also been found in sceloporine lizards (*Sceloporus malachiticus*) from Costa Rica (Goldberg 1992. J. Helminth. Soc. Washington 59:125–126) and (*S. formosus, S. grammicus, S. megalepidurus, S. mucronatus*) from Mexico (Goldberg et al. 2003. Southwest. Nat. 48:208–217). Third-stage larvae of *Physaloptera* sp. (adults absent) are commonly found in amphibians and reptiles. Their occurrences were summarized in Goldberg et al. (1993. Bull. South. California Acad. Sci. 92:43–51). *Phyllodactylus reissii* represents new host records for *S. oxkutzcabiensis* and *Physaloptera* sp.

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PHYLLODACTYLUS TUBERCULOSUS (Yellow-bellied Gecko). **ENDOPARASITES.** *Phyllodactylus tuberculosus* occurs from central Sonora, Mexico to central Costa Rica (Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas. Univ. Chicago Press, Chicago, Illinois. 934 pp.). To our knowledge, no reports exist of its endoparasites. The purpose of this note is to report one species of Nematoda from *P. tuberculosus.*

Ten (5 females, 5 males) *P. tuberculosus* (mean SVL = 64 mm ± 6 SD, range: 58–78 mm) from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California, USA (LACM 93818, 19821, 93826, 93828–93830, 93832, 93833, 93838, 93846) were examined for helminths. Geckos were collected in Sonora, Mexico during 1961–1964. The esophagus, stomach, small and large intestines were opened and searched for helminths under a dissecting microscope. The body cavity was also examined for helminths. Found in the large intestines was one species of Nematoda, *Spauligodon giganticus*; prevalence (infected lizards/lizards examined x 100) = 80%; mean intensity ± 1 SD (mean number nematodes per infected lizard) = 19 ± 8, range: 9–32. The nematodes were deposited in the United States National Parasite Collection, Beltsville, Maryland as *Spauligodon giganticus* (USNPC 94034).

Spauligodon giganticus was described from *Sceloporus graciosus* by Read and Amrein (1953. J. Parasitol. 39:365–370). It is a widespread nematode that occurs in a variety of lizards both in the United States and Mexico (Bursey and Goldberg 1992. Amer. Midl. Nat. 127:204–207; Goldberg et al. 1996. Amer. Midl. Nat. 135:299–309; Goldberg et al. 2002. Texas J. Sci. 54:282–285; Goldberg et al. 2003. Southwest. Nat. 48:208–217). *Phyllodactylus tuberculosus* is a new host record for *S. giganticus.*

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PHYLLOPEZUS POLLICARIS (Rock Gecko). **CLUTCH SIZE AND OVIPOSITION SITES.** Knowledge of the reproductive ecology and life history of Brazilian lizards has expanded enormously during the last decade. However, Brazilian geckos have generally remained less studied. Vitt (1986. Copeia 1986:775–786) conducted a quantitative study of four gecko species from northeastern Brazil that included data on *Phyllopezus pollicaris.* Here, we add data on clutch size and oviposition sites for *P. pollicaris* from southeastern Brazil.

During a survey on 2–3 January 2003, we found five groups of eggs of *P. pollicaris* in the municipality of Diamantina (18°14'S, 43°36'W; elev. 1113 m), Estado de Minas Gerais, in the Espinhaço Mountains. The habitat consists of vegetation typical of rocky substrates, termed "campos rupestres," with a predominance of the families Eriocaulaceae, Velloziaceae, and Melastomataceae. The eggs had calcified shells, a characteristic of many gekkonids (Packard et al. 1982. Herpetologica 38:136–155), and were glued to each other as well as to furrows in the rock (we were not able to measure the eggs as we avoided disturbing them). The highly calcified shell and egg microhabitat excluded sympatric teiids, *Ameiva ameiva* and *Kentropyx paulensis,* and tropidurids, *Eurolophosaurus nanuzae* and *Tropidurus montanus.* Egg shape and dimensions excluded the sympatric gecko, *Gymnodactylus guttulatus*, which has smaller eggs with a more spherical shape (unpubl. data). Clutches of *Phyllopezus pollicaris* were exposed to the environment in furrows ca. 4 cm deep on rock surfaces and

found at heights 0.8–4.5 m above ground (mean = 1.96 m ± 1.49). Number of eggs grouped together varied from 2 to 10 (mean = 6.4 ± 4.1).

Gekkonids have small clutches (Sinervo 1994. *In* Vitt and Pianka [eds.], Lizard Ecology, pp. 73–90. Princeton University Press, New Jersey; Dunham and Miles 1985. Amer. Nat. 126:231–257), typically depositing only one or two eggs. The number of eggs on three of the oviposition sites (two with 10 and one with 8) agrees with the finding of Vitt (*op. cit.*) that this species oviposits communally; he found that 1–3 female *P. pollicaris* deposited eggs at oviposition sites in northeastern Brazil. Our data imply that a minimum of 4–5 females comprised the communal clutches we observed in the Diamantina population.

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SCELOPORUS MAGISTER UNIFORMIS (Yellow-backed Spiny Lizard). **FAILED PREDATION**. Few passerine birds are large enough to prey on small vertebrates, shrikes (Passeriformes: Laniidae) are prominent among them. Shrikes kill with blows of their bills to the head or backbone and usually impale their prey on plant thorns or spines or other sharp objects (e.g., barbed wire) for later consumption (Elphick et al. [eds.] 2001. The Silbey Guide to Bird Life & Behavior. Alfred A. Knopf, Inc. New York. 407 pp.). Numerous records exist of squamates as prey of Loggerhead Shrikes (*Lanius ludovicianus*), but most represent relatively small (< 15 g) prey (Miller in Bent 1950. *In* Life Histories of North American Wagtails, Shrikes, Vireos and their Allies, pp. 131–182. Dover Publications, Inc. New York; Chapman and Castro 1978. Wilson Bull. 84:496–497; Judd 1898. *In* Beal and Judd [eds], Cuckoos and Shrikes in their Relation to Agriculture, pp. 15–26. U.S. Dept. Agric., Div. Biol. Surv. Bull. 9; Miller 1932. Univ. California Publ. Zool. 50:531–643; Reid and Fulbright 1981. Southwest. Nat. 26:204–205; Scott and Morrison 1990. Proc. West. Found. Vert. Zoology 4:23–57; 1995. *ibid.* 6:186–193). Loggerhead Shrikes occasionally take prey of a mass that approaches their own (Balda 1965. Condor 67:359; Vaiden in Bent, *op. cit.*), but experiments have shown that where possible, they select smaller prey (Slack 1975. Auk 92:812–814). For the latter reason, we report here an attempt at predation by a Loggerhead Shrike on a relatively large prey, an adult *Sceloporus magister uniformis* from the Mojave Desert, California, USA.

On the relatively warm (air temperature ca.16°C max.), sunny, late afternoon of 26 December 1999, we noted a Loggerhead Shrike hovering above a large (ca. 2 m tall) *Yucca schidigera* along a rocky outcrop ca. 18 km NE Apple Valley, just W of Sidewinder Mountain, San Bernardino County (34°35'N, 117°03'W; elev. ca. 1000 m). As we approached, the shrike dropped into the base of the yucca and began to struggle to remove an object. Closer inspection revealed that the shrike was attempting to extract a large (> 100 mm SVL; ca. 40 g, Vitt et al. 1981. Ecology 62:398–410) male *Sceloporus magister*. When we approached to within 2 m, the shrike flew several meters away and perched on a Creosote Bush (*Larrea tridentata*) while the lizard retreated deep into the yucca. After we retreated several meters, the lizard reappeared within 5 min and the shrike renewed its attack. After struggling with the lizard for several more seconds, the shrike ceased its attack, flew off, and did not return during the ensuing 15 min we were at this site.

Hatchling and juvenile *S. magister* (largely < 20 g.; see Vitt et al., *op. cit.*) appear small enough to fall prey to loggerhead shrikes, but this species has not been reported in the diet of shrikes. Regardless, our observation suggests that adult *S. magister* are unlikely to routinely serve as prey for Loggerhead Shrikes.

We thank Brian Grogan for assistance in the field; Samuel Droege for researching food records of shrikes at Patuxent Wildlife Research Center; Laurie Vitt for literature; Marc Hayes for literature and helpful comments on the manuscript, and Christopher Briand for reviewing an early draft of the manuscript.

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SCELOPORUS OCCIDENTALIS (Western Fence Lizard). **FAILED PREDATION BY SNAKE.** Despite the many adaptations of snakes for swallowing prey large relative to their body size (Cundall and Greene 2000. *In* K. Schwenk [Ed.], Feeding: Form, Function and Evolution on Tetrapod Vertebrates, pp. 293–333. Academic Press, San Diego, California), gape-size places an upper limit on the maximum size of prey that these animals consume (Shine 1991. Funct. Ecol. 5:493–502). However, gape-limitation may more strongly determine the size of prey successfully consumed than that attacked by snakes. Larger prey may still be attacked and even killed without being consumed if gape-limitation prevents ingestion after prey capture and dispatch. Here we report on an observation of failed predation by a snake on a gravid female *Sceloporus occidentalis* in which the egg mass carried by the female lizard prevented an otherwise successful predation event.

This observation took place in a riparian cobble bar habitat along the South Fork (SF) Eel River, Mendocino Co., California, USA. In coordination with an ongoing study of overnight retreat site selection by *S. occidentalis*, we had previously attached (8 June 1999) a 1.3 g radio transmitter (Holohil, Inc., Carp, Ontario,

Canada) to a gravid female lizard (70 mm SVL, 14.7 g). On the morning (0630 h) of 20 June 1999, we found this female dead and fully exposed on the cobble bar surface. This was the second largest *S. occidentalis* marked with a transmitter on the site. The head and thorax of this individual were severely compressed (Fig. 1) and coated with a shiny residue indicating that this animal had been partially swallowed. In addition, dried blood was found in the nostrils, suggesting that the lizard had been crushed in the process of being swallowed. The cylindrical compression of this animal extended posteriorly to ca. 15 mm from the pelvic region where the entire clutch (11 eggs, 3.7 g wet mass) was compressed against the posterior end of the abdomen. The radio transmitter was >15 mm posterior to the point of egg mass constriction.

These observations led us to conclude that this lizard had been captured, partially swallowed but regurgitated by a predator, most likely a gape-limited snake. Moreover, we conclude that the observed predation event was unsuccessful as a direct result of the girth of the gravid female. Snake predators of fence lizards, including Racers (*Coluber constrictor*) and juvenile Northern Pacific Rattlesnakes (*Crotalus oreganus*), are common at the SF Eel River. For example, on the evening prior to our discovery of the dead female lizard, we observed a Racer hunting a male Western Fence Lizard ca. 50 m from the point of discovery of the dead female. This snake continued to hunt after this first pursuit and may have attempted to consume the dead female lizard as well.

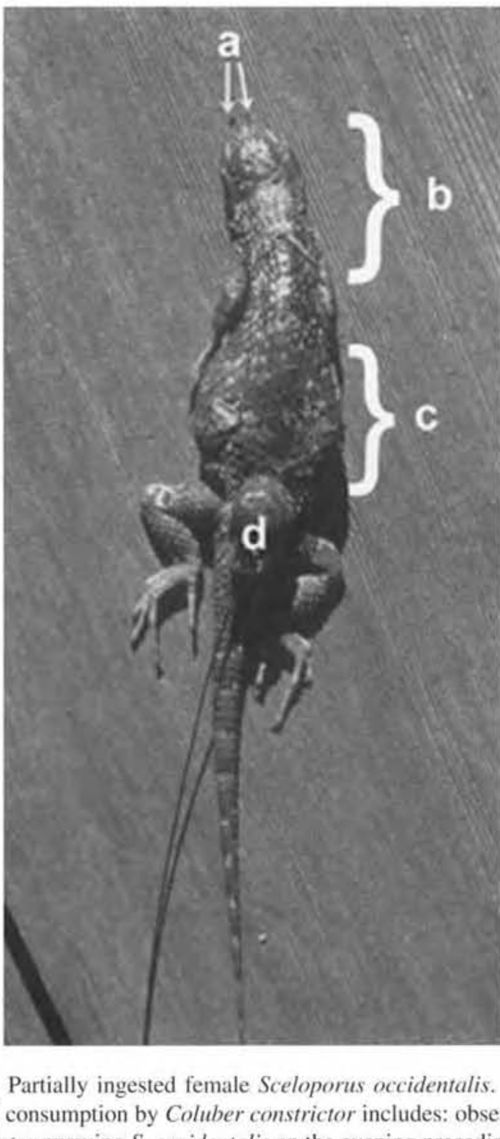

FIG. 1. Partially ingested female *Sceloporus occidentalis*. Evidence for partial consumption by *Coluber constrictor* includes: observation of *C. constrictor* pursuing *S. occidentalis* on the evening preceding the discovery of dead female, blood in nostrils (seen here as nostril accentuation, a), cylindrical anterior compression and glossy coat (b), clutch gathered in swollen posterior end of abdomen (c) but anterior to the radio transmitter (d).

The observation of failed predation is important because it demonstrates that the predation process in gape-limited snakes may involve successful and unsuccessful encounters, both of which may be unsuccessful from the perspective of the attacked prey. Predators may actively choose prey based on size-specific cues (e.g., prey body depth; Hambright 1991. Trans. Am. Fish. Soc. 120:500–508). Alternatively, prey size selection by predators may occur passively, as a result of diminished success in handling larger prey (Jaunes and Conover 1994. Mar. Ecol.-Prog. Ser. 114:59–69). In the latter case, attack may be independent of prey size but large prey may be more likely to escape an attack.

In the case of the observed gravid female lizard, failed predation may have occurred either because cues used by the snake to judge the size of non-gravid individuals (e.g., head width) did not apply to this large, gravid female lizard, or simply because successful handling, rather than attack, of prey was dependent on prey size. In either case, the lizard did not escape the attack as a result of a mistake made by its potential snake predator.

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SCELOPORUS UNDULATUS (Eastern Fence Lizard). **FIRE AVOIDANCE BEHAVIOR**. Few direct observations of reptile response to fire exist (reviewed in Russell et al. 1999. Wild. Soc. Bull. 27:374–384). Here, we report on the behavior of *Sceloporus undulatus* in response to a prescribed burn in northwestern Florida, USA.

At ca. 1130 h on 22 Mar 2003, we observed the behavior of two lizards for 10 min during a prescribed burn of a Longleaf Pine (*Pinus palustris*) – Turkey Oak (*Quercus laevis*) sand hill community at Eglin Air Force Base, Okaloosa County (30°31'N, 86°53'W; elev. 35 m). Prior to the arrival of the flames, lizards were basking on a dirt mound (ca. 0.5 m high) on the shoulder of a recently scraped road serving as a fire break. The low-intensity fire was moving less than 1 m per minute towards their location. As the fire approached, both lizards began digging separate bur-

rows into the side of the dirt mound and were completely buried by the time the flames were within 1 m of their locations. It is unknown what aspect of the fire (sight of the flames, heat, smoke, or sound of the fire) triggered their response. Unfortunately, our work required us to cease observation, and we were unable to determine the duration and effectiveness of the retreat.

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TROPIDURUS HYGOMI (NCN). **CANNIBALISM.** Cannibalism, well known among lizards (e.g., Luiselli et al. 1999. J. Zool. 247:127–131), is described from continental (Kiefer and Sazima 2002. Herpetol. Rev. 33:136) and island (Stone and Snell 2002. Herpetol. Rev. 33:53) populations. In island populations, cannibalism is frequently interpreted as a response to scarcity of space and food resources, whereas in continental populations, it may be triggered by many factors, including group social structure. Here, we add to data on continental populations with an observation of cannibalism in *Tropidurus hygomi* from northeastern Brazil that may arise out of its group social structure.

In August 2002, during a field trip to the sand dunes of Salvador, Estado da Bahia (12°58'16"S, 38°30'39"W; elev. > 1 m), we observed a predatory episode involving an adult (62.3 mm SVL, 12.7 mm head width) male *T. hygomi* eating a conspecific juvenile male (26.5 mm SVL, 5.6 mm head width). The juvenile was in the shade of a small bush near the adult male. The latter quickly caught it by the neck without a chase, and then ate it head first. The adult took less than two minutes to swallow the juvenile. We collected the adult after it had eaten, and sacrificed it to examine its gut contents. Two hours after ingestion, the juvenile was almost intact, only its tail was broken. Both animals were deposited in the University of Bahia, Department of Zoology's museum collection, Salvador, Brazil (LVT collection numbers: adult: PEU-SQ-200201; juvenile: PEU-SQ-200202).

Lizards of the genus *Tropidurus* are territorial sit-and-wait predators (Bergallo and Rocha 1993. Amphibia-Reptilia 14:312–315) that are insectivorous, eating mostly ants (Rocha and Bergallo 1994. Herpetol. Rev. 25:69; Van Sluys 1993. J. Herpetol. 27:347–351). Cannibalism is known in *T. montanus* (Kiefer and Sazima 2002. Herpetol. Rev. 33:136), a saxicolous species from Estado de Minas Gerais, Brazil. Some *Tropidurus* found in rocky environments (e.g., *T. torquatus* and *T. itambere*) are socially organized as harems (TK, pers. obs.), with a dominant male, many females, juveniles, and other males living around the dominant male's territory. *Tropidurus hygomi* seems to exhibit a similar pattern of social organization. In such cases, coexistence of dominant males and juveniles may increase the likelihood of cannibalism.

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TROPIDURUS HYGOMI (NCN). **JUVENILE PREDATION.** The diurnal, heliophilic, terrestrial lizard *Tropidurus hygomi* is a medium-sized (to 80 mm SVL) tropidurid endemic to "restinga" habitats (coastal xeric sand dunes) of northeastern Brazil. Despite its frequent occurrence at high densities, information regarding most aspects of its ecology or natural history is lacking. Only systematic studies and anecdotal observations exist (Vanzolini and Gomes 1979. Papéis Avulsos de Zoologia, São Paulo 21:243–259; Rodrigues 1987. Arquivos de Zoologia, São Paulo 31:105–230). Here, we report two cases of predation on juvenile *T. hygomi*.

On 13 February 2003, during a lizard community study of "restinga" habitat at Dunas do Abaeté (12°57'03"S, 38°22'30"W; elev. 15 m), municipality of Salvador, Estado da Bahia, one of us (EJRD) captured a juvenile *T. hygomi* (27.7 mm SVL) in a pitfall trap. After marking, the juvenile was released; as soon as it started moving away, it was attacked by an adult male *T. hygomi* (61.2 mm SVL) that emerged from nearby vegetation. The adult grabbed the juvenile by the mid-body region and swallowed it tail first. The capture and swallowing process took ca. 5 min. The adult was collected and deposited at the Museu Nacional, Rio de Janeiro (MNRJ 10036).

Occasional cannibalism is reported among other tropidurids, including *Liolaemus lutzae* also from Brazilian restinga habitat (Rocha 1992. Herpetol. Rev. 23:60), an insular *T. torquatus* in the Abrolhos Archipelago, Estado da Bahia (Dutra 1996. Bachelor's Thesis, Departamento de Biologia, Univ. Fed. de Minas Gerais. 48 p.), *T. torquatus* from Corrientes Province, Argentina (Alvarez et al. 1985. Historia Natural, Corrientes 31:281–288) and montane *T. montanus* (Kiefer and Sazima 2002. Herpetol. Rev. 33:136). Opportunistic foraging has been regarded as the main explanation for cannibalism in lizards (e.g., Polis and Myers 1985. J. Herpetol.19:99–107; Zamprogno and Teixeira 1998. Herpetol. Rev. 29:41–42) and might explain this pattern.

During a study of the feeding habits of the whiptail lizard *Cnemidophorus abaetensis* from the Dunas do Abaeté, one of us (EJRD), found a juvenile *T. hygomi* (35 mm SVL) in the stomach of an adult male *C. abaetensis* (65.2 mm SVL) on 4 October 1997. The whiptail is deposited at the Museu Nacional, Rio de Janeiro (MNRJ 8654). In a review of data available on cannibalism for lizard species from eastern Brazil, Rocha et al. (2000. *In* Esteves and Lacerda [eds.], Ecologia de Restingas e Lagoas Costeiras, pp. 117–149. NUPEM/UFRJ, Macaé, Brazil) showed that all cannibalistic events involved juvenile prey and adult predators. These authors suggested that cannibalism should be associated with species having sexual dimorphism in size and that the cannibalistic behavior should be more frequently displayed by individuals of the largest sex, usually males (in the only instance in which the female was the cannibal [the scincid *Mabuya frenata*],

females were the larger sex [Vrcibradic and Rocha 1996. Herpetol. Rev. 27: 201–202]). *Tropidurus hygomi* is sexually dimorphic in body size (Vanzolini and Gomes, *op. cit.*), with males being the largest sex, so our observations reinforce the idea of Rocha et al. 2000 (*op. cit.*). Our finding also indicates that *C. abaetensis* is a source of mortality for juvenile *T. hygomi* in the Abaeté restinga.

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TUPINAMBIS MERIANAE (Tegu). **DIET**. *Tupinambis merianae* is a generalist, but many aspects of its ecology remain unstudied. Even the most complete report on its diet does not specify the identity of most vertebrate species taken. This is especially true for amphibians despite the fact that anurans were recorded from 27% of tegus examined (Mercolli and Yanosky 1994. Herpetol. J. 4:15–19). At least one anuran has been identified from the related *T. teguixin* (Souza 2002. Herpetol. Rev. 33:209), but no anurans in *T. merianae* diet have been identified to species. For this reason, we describe an apparent predation event by *T. merianae* on a leptodactylid frog from southeastern Brazil.

On 16 January 1998 at ca. 1700 h, we encountered a small (ca. 40 cm shoulder height) "vira lata" dog with a dead juvenile male (17.4 cm SVL) *T. merianae* in its mouth at km 116 on road RS 030, Glorinha, Estate of Rio Grande do Sul (50°46'S, 29°52'W; elev. 58 m), in an abandoned horticultural plot in humid lowlands. Upon examination of the *T. merianae* removed from the dog's mouth, we found an adult *Leptodactylus ocellatus* (ca. 65 mm SVL) inside the lizard's mouth with its head in its throat.

During the predation event on this frog, the dog may have surprised the tegu. Because the frog was lodged in the throat of the lizard, it is unclear whether this represented a successful predation attempt by the lizard, or whether the dog took advantage of a lizard already encountering problems with an oversized prey item.

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SERPENTES

CHILOMENISCUS STRAMINEUS (Variable Sandsnake). **PREDATION**. Although some scorpions occasionally prey on small vertebrates including snakes (Polis 1990. The Biology of Scorpions. Stanford University Press, Palo Alto, CA. 587 pp.), a search of the literature revealed no records involving *Chilomeniscus stramineus*. On 20 March 1997 at 1833 h MST in Maricopa County, Arizona, an adult female *Hadrurus arizonensis* (77 mm TL) was discovered under a cover board feeding on the anterior 35 mm of a *C. stramineus* (ASU 30878), which she clasped in her pedipalps. We estimate that the snake was ca. 180 mm TL, based on comparison with conspecific museum specimens.

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CLONOPHIS KIRTLANDII (Kirtland's Snake). **REPRODUCTION**. Eight cover boards placed on a recently burned restored prairie near Allerton Park in Piatt County, Illinois yielded a male *Clonophis kirtlandii* (291 mm SVL, 13 g) on 14 May 2003. On 5 August 2003, a gravid female (415 mm TL, 38.0 g) was found under the same cover board. The female was fed earthworms of an unknown weight on 18 and 19 August 2003. A brood of 8 was born 23 August 2003. Mean length of the brood was 160 ± 77 mm TL (range = 151–171 mm). Mass averaged 1.3 ± 0.1 g (range = 1.421–1.209 g). Post-partum mass of the mother was 21.9 g, while the sum of the brood's mass was 10.7 g. Little is known of the natural history of *C. kirtlandii*, but feeding just prior to parturition appears to be unusual. Tucker (1976. J. Herpetol. 10:53–54) reported a 16-day interval between last acceptance of food and parturition and Conant (1943. Amer. Midl. Nat. 29:313–341) reported food was refused for two to three weeks prior to parturition. Brood size reported here approximates previously reported mean brood sizes of 7.8 (Conant, *op. cit.*) and 7.3 (Tucker, *op. cit.*). The most recent Piatt County record in the Illinois Department of Natural Resources Natural Heritage database is dated 1990.

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CONOPHIS LINEATUS (Road Guarder). **REPRODUCTION.** *Conophis lineatus* is a colubrid that occurs from central Mexico to western Nicaragua (Savage 2002. The Amphibians and Reptiles of Costa Rica; A Herpetofauna Between Two Continents, Between Two Seas. University of Chicago Press, Chicago. 934 pp.). There are previous reports of clutches containing 4–6 eggs (Campbell 1998. Amphibians and Reptiles of Northern Guatemala, The Yucatán, and Belize. University of Oklahoma Press Norman, 380 pp; Savage, *op. cit.*). Here I report on a new maximum clutch record for this species.

One *C. lineatus* from Nicaragua (LACM 67653), 550 mm SVL, was collected January 1969 in León Department. It contained 8 oviductal eggs (mean length = 18.9 mm ± 1.1 SD, range = 17–21 mm), which is a maximum clutch size for *C. lineatus*. The eggs are deposited in the Natural History Museum of Los Angeles County (LACM), Los Angeles, California, USA.

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CROTALUS CERBERUS (Arizona Black Rattlesnake). **ENDOPARASITES.** The endoparasites of the Arizona Black Rattlesnake (*Crotalus cerberus*) have not been reported. Here we report on the presence of larvae (tetrathyridia) of tapeworms (Cestoda) and larvae (cystacanths) of spiny-headed worms (Acanthocephala) in this species.

The body cavities of 64 *C. cerberus* from Arizona from the herpetology collections of Arizona State University (ASU), Tempe, Arizona (N = 29) and the University of Arizona (UAZ), Tucson, Arizona (N = 35) were examined for helminths. A mid-ventral incision was made in the body wall, and organ surfaces and mesenteries in the posterior portion of the body cavity were visually examined. Oblong whitish bodies, ca 1 x 3 mm, were found in six snakes, which proved upon microscopic examination to be tetrathyridia (larvae) of *Mesocestoides* sp. (ASU 7038, UAZ 27860, 27862, 27924–925) or oligacanthorhynchid acanthocephalan cystacanths (UAZ 27922, 27860, 27925). Prevalence of infection (percent of infected snakes in sample) and mean intensity ± SD (mean number parasites per infected snake) and range for *Mesocestoides* sp. was 8%, 9.6 ± 8.2, 1–23; oligacanthorhynchid acanthocephalan cystacanths, 5%, 1. Voucher specimens were deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland as tetrathyridia of *Mesocestoides* sp. (USNPC 94151) and acanthocephalan cystacanths (USNPC 94152).

Mesocestoides sp. and oligacanthorhynchid cystacanths are commonly found in North American rattlesnakes. Their occurrences were summarized in Goldberg and Bursey (2000. Herpetol. Rev. 31:104). Both have since been found in *Crotalus enyo* (Goldberg et al. 2003. Herpetol. Rev. 34:64–65 and oligacanthorhynchid cystacanths in *Crotalus cerastes* (Goldberg and Bursey 2002. Herpetol. Rev. 33:138). Rattlesnakes may serve as paratenic (transport) hosts for species of *Mesocestoides* (Bolette 1997a. J. Parasitol. 83:751–752) and acanthocephalans (Bolette 1997b. Southwest. Nat. 42:232–236). *Crotalus cerberus* is a new host record for both tetrathyridia of *Mesocestoides* sp. and cystacanths of oligacanthorhynchid acanthocephalans.

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CROTALUS MOLOSSUS (Black-tailed Rattlesnake). **FATAL INGESTION**. At 2128 h on 25 July 2003 we collected a dead male *Crotalus molossus* (UTEP 18857, 760 mm SVL, 313.3 g including stomach contents) on the shoulder of State Route 96 in Yavapai Co., Arizona, 26.7 road miles E of the junction with State Route 97 (34°28.023'N, 112°48.178'W, 1190.5 m elev.). Upon dissection, an exceptionally large mid-body bulge yielded a 125.3 g White-throated Woodrat, *Neotoma albigula* (identification by A. H. Harris). Comprehensive examination revealed no signs of externally inflicted blunt trauma. The skin was free of abrasive injuries and free of subcutaneous bleeding. Apart from obvious mid-body distortion, the internal organs, viscera, and major vessels were intact. We also failed to note any fractures in a skeletal preparation of the specimen. In view of the evidence presented we consider death due to injury by automobile or predator unlikely. Ingestion of prey often compromises locomotory performance in snakes, particularly endurance capacities (Garland and Arnold 1983. Copeia 1983:1092–1096). In this case a prey/predator mass ratio of 0.67 may have severely compromised locomotory ability and, along with some other circumstance, resulted in exposure to lethal daytime temperatures. Alternatively, the prey bolus may have constricted vital anatomical structures.

Although the ability to capture and ingest large prey items has obvious adaptive benefits for snakes, large prey/predator size-ratios can also increase vulnerability to predation and exposure to lethal temperatures (Fitch 1949. Amer. Midl. Nat. 41:513–579; Holycross et al. 2001. Southwest. Nat. 46:363–364; Klauber 1972. Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind. 2nd ed. University of California Press, Berkeley. 1533 pp.; Mulcahy et al. 2003. Herpetol. Rev. 34:64; Pauly and Benard 2002. Herpetol. Rev. 33:56–57; Turner 2001. Herpetofauna 31:112–115). Whereas some of the extreme prey/predator weight-ratios are captivating and compelling, less drastic ratios might also result in death. Unfortunately, there has been no attempt to quantify the relationship between variation in prey/predator mass ratios and mortality, let alone locomotory performance.

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FARANCIA ABACURA (Mud Snake). **COURTSHIP BEHAVIOR.** Courtship behavior by *Farancia abacura* is undescribed (Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Institution Press, Washington and London. 680 pp.). Although Meade (1937. Copeia 1:12–15) reported mating, it apparently was not preceded by courtship behavior.

Here we report courtship behavior in *F. abacura* for the first time, on a trail separating a tupelo-gum swamp from annually flooded hardwood bottomlands on Mound Island in the Mobile-Tensaw Delta Wildlife Management Area (Baldwin Co., Alabama, USA). On 19 June 2003 at 1430 h we spotted the movement of the dorsum of what appeared to be a single *F. abacura* at the surface of a pool of rainwater (15 m x 3 m). The snake appeared to be struggling with something underwater. Upon capture with tongs, it became clear that there were two *F. abacura*, intertwined in a loose ball. The male (ca. 1000 mm TL) was biting the female's (ca. 1200 mm TL) neck and attempting cloacal apposition. Hemipenes were not observed, suggesting that intromission had not yet occurred (Seigel et al. 1987. Snakes: Ecology and Evolutionary Biology. McGraw-Hill Inc., 529 pp). Despite handling, the pair appeared oblivious to our presence and continued court-

ship behaviors. The male was forcibly removed from the female's neck three minutes after capture by applying light pressure to the anterior portion of his jaws. Minuscule teeth marks were observed on the female's neck. Although the snakes were released together in the pool, no further courtship behavior was observed. It was partly cloudy with no breeze, the air temperature was 32°C, and water temperature was ca. 25–27°C.

We thank D. H. Nelson, B. Gill, T. Rice, and the Alabama Department of Conservation and Natural Resources.

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HIEROPHIS VIRIDIFLAVUS (European Whip Snake). **COLOR CHANGE**. In heterotherm animals, color change can be physiological or morphological. The former is caused by displacement of melanosomes along the processes of dermal melanophores and occurs over minutes or hours, the latter is due to the change in the number of melanosomes and/or melanophores and occurs over weeks or months; for example during ontogenesis or between different seasons of activity (e.g., Johnston 1994. J. Herpetol. 28:109–112 and citations therein). Morphological changes in color and/or reflectance are seldom reported in snakes, but have been reported in four elapids (Banks 1981. Herpetofauna 13:29–30; Johnston, *op. cit.*; Johnston 1996. J. Zool. 239:187–196; Mirtschin 1982. Herpetofauna 14:97–99) and in one viperid (Rehák 1987. Vest. s. Spole. Zool. 51:300–303; Madsen and Shine 1992. Evolution 47:321–325). To our knowledge, only physiological color changes have been observed in colubrids (natural: Boundy 1994. Herpetol. Rev. 25:126–127, in *Thamnophis rufipunctatus*; induced: Rahn 1941. Biol. Bull. 80:228–237, in five American species).

Two adult *Hierophis viridiflavus* changed their body color during the course of radio-telemetric observations in Groane Natural Park in Lombardy, Italy. In this region, color pattern varies from black-and-yellow patterned dorsum with a pale yellow venter to melanotic (i.e., no yellow markings, with a pale grey or cream belly). During the study, we captured 34 adult snakes and recaptured three. Snakes were individually marked by scale clipping, sexed, measured, and color and pattern were also recorded (usually photographically). A very dark male (940 mm SVL, 1250 mm TL) captured on 4 June 1999 was radio-tagged and released. It was recaptured 21 June 1999 with a head wound, due to a dog bite. Over the course of a month-long recovery in captivity, this snake shed several times. With each shedding episode, the yellow coloration typical of the species became increasingly evident, ultimately attaining typical dorsal coloration and pattern. A female (900 mm SVL, 1160 mm TL) captured and radio-tagged 16 of September 1998 showed a bright black and yellow coloration but when recaptured on 21 October 1998 appeared melanotic. In both cases, the color change appears to be morphological (Johnston 1994, *op. cit.*).

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LAMPROPELTIS GETULA CALIFORNIAE (California Kingsnake). **OVIPOSITION SITE**. Records of reproduction in northern populations of *Lampropeltis getula* are rare (Nussbaum et al. 1983. Amphibians and Reptiles of the Pacific Northwest. University of Idaho Press, Moscow. 332 pp.; St. John 2003. Reptiles of the Northwest: Alaska to California; Rockies to the Coast. Lone Pine Publ., Edmonton, Alberta, Canada. 272 pp.), as they are for most snakes at the northern edge of their distribution (Blem 1981. Brimleyana 5:117–128). At 1800 h on 20 September 2003 near Roseburg, Oregon I found the recently shed skins of nine hatchling *L. getula* surrounding a burrow (within 1 m). A tenth sloughed skin was found in a burrow 4.2 m away. Excavation revealed that the burrows descended vertically and were joined at a depth of ca. 19 cm by a straight tunnel. A recently shed hatchling male *L. getula* (ca. 220 mm SVL) was found basking ca. 1 m from the first burrow. The burrows, skins, and hatchling were below an electric fence separating a gravel driveway from a grass field and ca. 23 m from a small, artificial wetland established 6 years earlier via damming of an intermittent stream. *Lampropeltis getula* shed within 9–13 days of hatching and disperse almost immediately thereafter (Tu et al. 2002. J. Exp. Biol. 205:3019–3030). For this reason I believe the eggs were oviposited and hatched inside the burrow. Although within 20 km of the northern limit of the species' range, this record coincides with most aspects of kingsnake reproduction in other regions. Specifically, oviposition of 2–12 eggs in rodent burrows near wetlands is not atypical (Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Institution Press, Washington, D.C., 680 pp.).

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MASTICOPHIS FLAGELLUM RUDDOCKI (San Joaquin Coachwhip). **CANNIBALISM**. Cannibalism or attempted cannibalism by *Masticophis flagellum* has been reported once in captivity (Cunningham 1959. Herpetologica 15:17–19) and three times in the wild (Guidry 1953. Herpetologica 9:49–56; LaDuc and LaDuc 2003. Herpetol. Rev. 34:252). Watson and Stuart (2003. Bull. Chicago Herpetol. Soc. 38:222) report cannibalistic carrion feeding in *M. flagellum* and suggest cannibalism "does not appear to be common in this species." I found a *M. flagellum ruddocki* (ca. 1.2 m TL) swallowing a slightly smaller conspecific headfirst at ca. 1100 h on 22 April 2001 on the Carrizo Plain National Monument (35°02'45.8"N, 119°36'18.2"W; 696 m elev.), San Luis Obispo County, California, USA. Forty minutes later, neither snake was observed during a brief search of the site. This observation is novel for the subspecies and suggests cannibalism is not uncommon in *M. flagellum*.

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NATRIX NATRIX (European Grass Snake) **MALE COMBAT**. On 1 May 2001 during my field studies in the Stawy Milickie Nature Reserve (51°31'51"N, 17°20'12"E; Wroclaw, Poland) I observed two male (545 and 555 mm SVL) *Natrix natrix* engaged in combat in the presence of a female. Each male attempted to force his rival's anterior body to the ground. The snakes were often completely entwined. After three to five minutes the female moved into high grass, apparently in response to my presence, while the males continued to fight. After half a minute the males rapidly moved 60–70 cm forward, while still wrestling. This sequence was repeated several times before the two males suddenly ceased combat (ca. four minutes after the female left) and both began to follow the female's path while rapidly flicking their tongues. At this point I captured both males and measured and marked them for future identification.

Although *N. natrix* is common across most of Europe, this is the first report of combat in the species. The only previously reported form of male-male competition is tail wrestling (e.g., Madsen 1983. Oikos 40:77–82). Male combat can shape population structure and lead to the evolution of sexual size dimorphism (Shine 1993. *In* Seigel and Collins [eds.], Snakes: Ecology and Behavior, pp. 49–86. McGraw Hill, New York; Shine 1994. Copeia 1994:326–246) and is given much attention in snake studies. It is therefore difficult to conceive how such a conspicuous behavior has remained unreported in this common and widespread species. I believe that male combat is not ubiquitous in *N. natrix*, and expression of the behavior might vary geographically.

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GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 35, Number 1 (March 2004). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extension reports unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA MACULATUM (Spotted Salamander). USA: ILLINOIS: Hardin Co: Shawnee National Forest wildlife pond, 0.8 km N side FR 1726 and 0.3 km E Co. Rd. 700E (N37°33'38", W88°16'29"). 12 July 2004. Kurt J. Regester, Patrick T. McDonald, and Julius A. Frazier. Verified by Ronald A. Brandon. SIUC H-07765. Juvenile, metamorphosed in laboratory. New county record (Philips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, Champaign, Illinois. xii + 282 pp.).

Submitted by **KURT J. REGESTER, PATRICK T. MCDONALD**, and **JULIUS A. FRAZIER**, Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901, USA.

AMBYSTOMA TALPOIDEUM (Mole Salamander) USA: ARKANSAS: Clark Co: Populations of *Ambystoma talpoideum* in southwestern Arkansas appear to be isolated or disjunct from populations in northern Louisiana, northeastern Texas, and eastern Oklahoma (Trauth et al. 1993. Proc. Arkansas Acad. Sci. 47:154–156; Conant and Collins 1998. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. 3rd ed. Houghton Mifflin Co., Boston, Massachusetts, 509 pp; Petranka 1998. Salamanders of the United States and Canada. Smithsonian Inst. Press, Washington, D.C., 587 pp; Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville, 421 pp.), and available information seldom defines whether populations are metamorphic or paedomorphic. Recent records (Caldwell and Tumlison 2003. Herpetol. Rev. 34:379; Tumlison and Campbell 2002. Herpetol. Rev. 33:143–144) prompted a survey for *A. talpoideum* in southwestern Arkansas, outside of its previously known range. Using dipnets and seines, we sampled aquatic habitats because aquatic *A. talpoideum* are more easily captured than the burrowing terrestrial adults (Bishop 1947. Handbook of Salamanders. Comstock Publishing Company, Inc, Ithaca, New York). All specimens are housed in the Henderson State University (HSU) Vertebrate Collections in Arkadelphia, Arkansas. Identifications were verified by Stan Trauth. Metamorphic salamanders were collected from temporary pools. Paedomorphic forms were collected in small, permanent, fishless ponds. Clark Co., 0.8 km NW Gurdon (S27 T9S R21W), 23 February 2002 and 15 March 2002, R. Tumlison, HSU 903–906 paedomorphic larvae, HSU1281 metamorphic form. Other paedomorphic and metamorphic specimens from Clark County locations are catalogued as HSU 1041, 1278, and 1299. Columbia Co., 3 km E McNeil (S16 T16S R20W), 25 April 1992, R. Tumlison, HSU1282, metamorphic larvae. Dallas Co., jct. County Roads 245 and 247 (S6 T9S R17W), 22 April 2003, B. Caldwell and T. Fulmer, HSU 1293, metamorphic larvae. An additional Dallas County specimen is catalogued as HSU 1294. Hempstead Co., County Rd. 32, 0.6 km from jct. with County Rd. 27 (S9 T9S R26W), 26 April 2003, B. Caldwell, HSU 1295, metamorphic larvae. Howard Co., 5 km W jct. Hwys 26 and 369, (S30 T8S R27W), 27 and 28 April 2003, B. Caldwell, HSU 1297, 1302, metamorphic larvae. Pike Co., 3 km SW of Murfreesboro, off Hwy 27 (S14 T8S R26W), 27 April 2002 and 26 April 2003, B. Caldwell and T. Fulmer, HSU 1274, 1300, metamorphic larvae. Additional Pike county vouchers are catalogued as HSU 1275–1277, 1279, 1296, and 1305.

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AMBYSTOMA TIGRINUM (Tiger Salamander). USA: FLORIDA: Calhoun Co: Florida Road 71, 10.1 km S of jct with Florida Road 20 at Blountstown (30°22.17'N, 85°5.75'W). 31 De-

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TECHNIQUES

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Photographic Identification as a Noninvasive Marking Technique for Lacertid Lizards

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Color and body patterns have long been used to identify individual lacertid lizards (Schmidt-Loske 1996), but may be unsuitable for long-term studies because they vary with reproductive condition, age, and other factors (Henle et al. 1997). Elbing and Rykena (1996) found that individual *Lacerta viridis* could be recognized by patterns of head scalation, and although these scales do not vary over time (Fox 1975), Elbing and Rykena (1996) considered this method of identifying individuals to be excessively time consuming and, in some cases, difficult to use because of the small size of the scales. Recently, Steinicke et al. (2000) found photographic identification of the scales of the first four rows of ventrals to be a suitable technique for recognizing individuals of five species of lacertids (*Lacerta agilis*, *L. bilineata*, *L. viridis*, *L. vivipara*, and *Podarcis muralis*). Photographic identification of individuals by means of scale patterns is an emergent technique with a promising future, but it is necessary to examine other species before it can be considered suitable for lacertids, and other lizards generally. The method also must be improved to reduce the time required for identification, especially when many individuals are involved in the study.

We tested the suitability of using ventral scalation to identify individual *Lacerta perspicillata* (SVL = 46.8 ± 0.34, range: 40.5–54.0, N = 99; unpubl. data). From November 2000 to May 2001, we collected 53 individuals on Menorca Island, Spain. We toe clipped and took two pictures of each lizard with a digital camera (Sony Mavica®). Digital photographs (resolution 640 x 480 pixels) were enhanced in the laboratory with Microsoft Photo Editor® (brightness, contrast, and conversion from color to black and white) and printed (600 x 300 dpi). Ninety-three recaptures of the 53 toe-clipped lizards were identified from photographs using ventral characters (i.e., scales of the chin and collar area, arrangement of scales in the chest area and of the longitudinal and transverse scale rows of the trunk, Fig. 1) by two observers. Photographic identification of individuals matched identification based on toe clips in 100% of cases. All individuals were easily identified, and no apparent change in scale pattern was noted.

Our method was subsequently used in a capture-recapture study involving the same population later the same year (June–October 2001). Lizards were photographed and individuals were added to a previously assembled reference collection of pictures. Individuals collected in the field were identified via comparison with the reference file. To reduce time spent on identification, the photographic reference file was organized by sex, and then by natural amputations, scale anomalies (e.g., aberrations, asymmetries), and

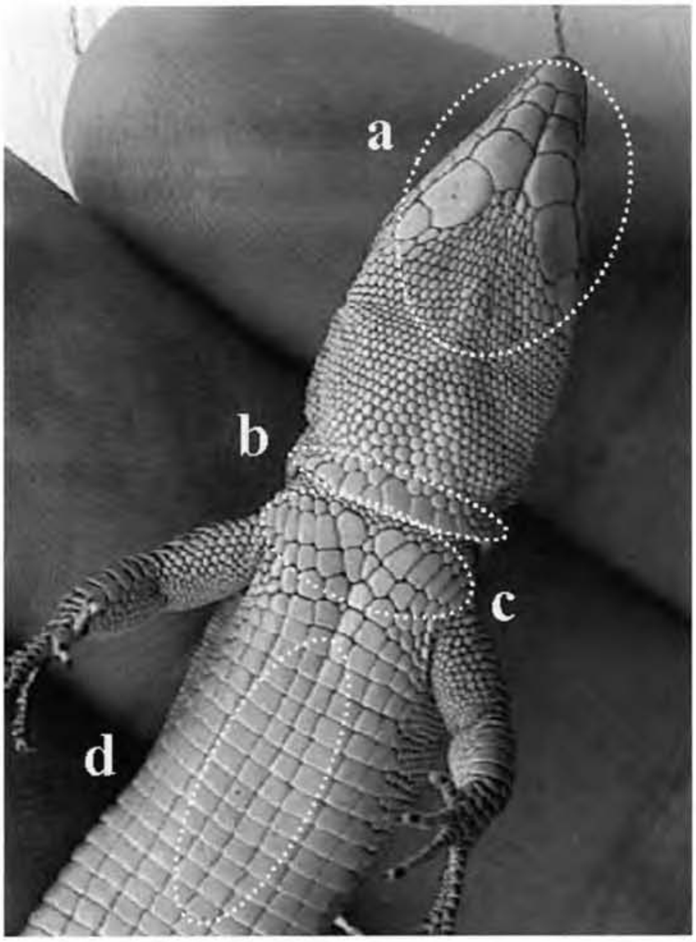

FIG. 1. Ventral characters used in the reference file: (a) chin-scale symmetry, (b) collar scales, (c) scale arrangement in chest area, and (d) position of longitudinal and transverse rows.

the ventral scale characters illustrated in Fig. 1. Consequently, the time needed to identify a lizard was reduced to < 2 min.

Our study corroborates the findings of Elbing and Rikena (1996) and Steinicke et al. (2000) and extends the use of photographic identification of lacertid scalation patterns as a means of permanent specimen identification in field studies. Digital cameras and printers greatly reduce the time and expense required for this technique, making individual recognition by means of photographic identification only slightly more time consuming and expensive than toe clipping. However, photographic identification has the advantage of being both nontraumatic and permanent, making it suitable for field research.

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A Preliminary Test and Report on the Efficiency of a New Funnel Trap for Semi-Aquatic Snakes

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Baited and unbaited glue-traps (Glor et al. 2000; Vargas 2000; Whiting 1998), funnel traps with and without floats (Casazza et al. 2000), drift fences in conjunction with pitfalls, round and square funnel traps (Christiansen and Vandewalle 2000), and habitat traps (Allan et al. 2000) have recently been proposed for the collection of reptiles and amphibians. Several collection techniques, such as collecting by hand, drum nets, fykenets, and funnel traps, have been successfully used for ecological and life history studies of aquatic or semi-aquatic snakes (Casazza et al. 2000; Fitch 1986; Shine 1986). In long-term ecological studies, funnel traps have proven to be an efficient method to systematically collect specimens, not only for aquatic species, but also for terrestrial and arboreal species (Casazza et al. 2000).

From August to October 2002, we conducted a preliminary population study on three sympatric water snakes (*Enhydris chinensis*, *Enhydris plumbea*, and *Xenochrophis piscator*) in Tamsui, Taipei County, Taiwan. Over a period of three months, two funnel trap-types were utilized in this population study to determine their effectiveness. During the three-month test, a total of 20 medium-size shrimp funnel traps (12.5 cm diameter) and 15 small-size (10 cm diameter) funnel traps modified with polyvinyl chloride (PVC) piping (referred to in the text as PVC funnel traps) were set in a private farmland composed of five ponds and adjacent paddy fields. The medium-size (12.5 cm diameter) shrimp funnel trap was 35 cm in length with a single entrance. The first funnel is situated in the entrance of the trap and the second funnel is positioned ca. 11 cm into the trap, with the funnel cones pointing inwards. A container compartment is created by the remaining part of the trap (Fig. 1). These traps were positioned horizontally and half-submerged along the shoreline of the pond and paddy field habitat

with pegs at approximately three-meter intervals.

The new PVC funnel trap is an inverted "T" in design (Fig. 1) and it has two entrances, one at each side of the bottom, with an upright vertical air circulation pipe to prevent the snakes from drowning once they become trapped. Every PVC funnel trap was constructed out of the container compartment and two entrance parts of the small-size shrimp funnel traps (10 cm in diameter). These parts were attached to a 50 cm long PVC pipe (80 mm inside diameter) fitted to a PVC T-piece connector as follows: the PVC pipe was attached to the T-piece connector, the container compartment was fitted to the upright end of the PVC pipe and the two entrance parts, fitted with funnels, were attached to the two open ends of the T-piece. Every PVC trap was kept in an upright position by tying it to a bamboo rod planted in the mud of the pond bottom. The PVC trap can also be tied to the vegetation. When the trap is set in a deep-water trapping site the air circulation pipe can be extended by attaching another pre-manufactured PVC connector. Some semi-aquatic snake studies have indicated that individuals of different gender and size utilize different water depths (Shine 1986). For that reason, every PVC trap is calibrated on the vertical air circulation pipe for measurement of water depth (Fig. 1). The PVC traps were set at approximate equal intervals from each other in the testing pond habitat. Both trap-types were baited with loaches (*Misgurnus anguillicaudatus*) to increase the capture rate.

After three months and 1636 trap-nights, we collected a total of 49 snakes of four species (Table 1) using both trap-types. Snakes were marked and released, and some snakes were trapped more than once, resulting in a total of 70 snake captures. The trap-rate was 3.42 per 100 trap-nights in the PVC traps (33 snakes in 965 trap-nights) and 5.51 per 100 trap-nights in the medium-size shrimp funnel trap (37 snakes in 671 trap-nights). Because of the water depth of the test ponds, the water depth of the PVC funnel traps was between 21 and 97 cm, much deeper than the unmodified shrimp funnel traps (< 12 cm). At this depth *E. chinensis* was more effectively trapped with the PVC funnel traps than *E. plumbea* and *X. piscator*, which might reflect some difference in microhabitat utilization among these species.

The unmodified medium-size shrimp funnel traps were effectively utilized in shallow aquatic conditions (e.g., creeks, ditches, rice paddies, and swamp habitats) in population studies of the two species of *Sinonatrix* snakes in Taiwan by the first author (Mao 2003) and in the present test. Various amphibian and reptile species and individuals of the same species, but in different age classes, might utilize different aquatic environments and depths. In deep pond environments, the PVC funnel trap proposed here allows trapping at greater depths than standard funnel traps and offers great potential for semi-aquatic snake studies.

TABLE 1. Comparison of trap rates (per 100 trap-nights) of unmodified shrimp funnel traps and PVC funnel traps. The PVC traps were used in a pond, and the shrimp funnels in swamp, creek, ditch and paddy field. *Sinonatrix* data from Mao (2003).

Species	PVC funnel trap-rate/100 nights (965 nights)	Shrimp funnel trap-rate/100 Nights (671 nights)
Enhydris chinensis (N = 32)	2.8	0.75
E. plumbea (N = 2)	0.0	0.30
Xenochrophis piscator (N = 35)	0.62	4.32
Bungarus m. multicincintus (N = 1)	0.0	0.15
Sinonatrix spp. (N = 617)	—	2.75

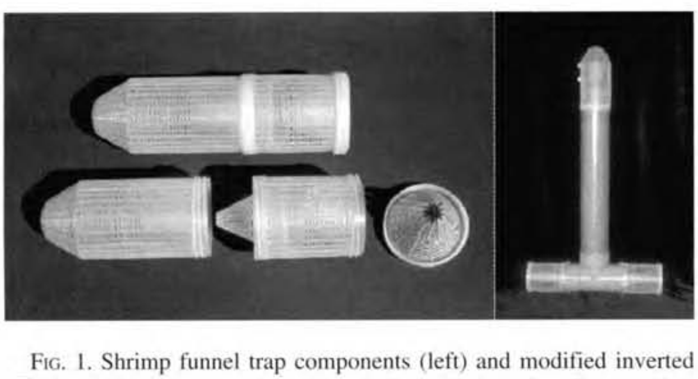

FIG. 1. Shrimp funnel trap components (left) and modified inverted "T" design (right). The upright vertical air circulation pipe allows snakes access to air.

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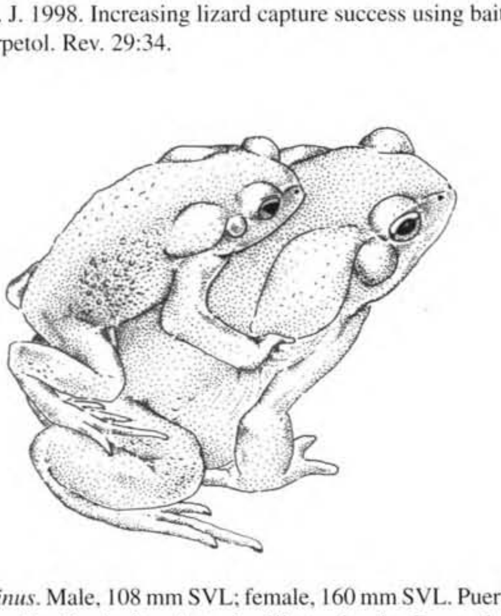

Bufo marinus. Male, 108 mm SVL; female, 160 mm SVL. Puerto Rico: Quebradillas, Región de San Antonio. Illustration by Fernando Vargas Salinas.

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Rates of Tricaine Methanesulfonate (MS-222) Anesthetization in Relation to pH and Concentration in Five Terrestrial Salamanders

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Tricaine methanesulfonate (MS-222) is commonly used to anesthetize fish and amphibians, but while studies have investigated its effects on fish, no studies have been carried out on terrestrial salamanders (e.g., family Plethodontidae). Existing general guidance recommends MS-222 baths of 500 mg/L for anesthetizing adult salamanders (Cooper 2003), however species-specific dose recommendations and pH buffering instructions are nonexistent. Neutralizing the pH of MS-222 solutions is necessary because when dissolved in water with poor buffering ability, such as tap or distilled water, MS-222 lowers the pH (Smit et al. 1977). For example, a 50 mg/L MS-222 solution prepared using distilled water has a spontaneous pH of 3.9, and a 5000 mg/L solution has a spontaneous pH of 2.8 (Ohr 1975a). Such low pH baths induce anesthetization more slowly than neutral solutions (Smit and Hattingh 1979; Ohr 1975a), and low pH solutions injure the epithelial transport systems for sodium chloride and water in leopard frogs (*Rana pipiens*; Ohr 1975b). Crawshaw (1993) recommends neutralizing the pH by adding sodium bicarbonate, but this method is cumbersome because the reaction takes some time to equilibrate, which can cause difficulty in determining the appropriate amounts of sodium bicarbonate required to attain neutrality. For example, adding 3.5 g of sodium bicarbonate to 250 ml of a 2000 mg/L MS-222 solution results in a spontaneous pH of 7.0, however after 4 hours the pH will reach >8.2 (pers. ob.).

I experimented with commercially available aqueous pH buffers consisting of dihydrogen potassium phosphate and sodium hydroxide (Fisher Scientific, catalogue numbers SB112-20, SB108-10, SB104-20) to stabilize the pH of MS-222 (Sigma, catalogue number A-5040) solutions. I investigated the relation of pH and concentration on anesthetization time in five terrestrial salamander species (*Plethodon elongatus, P. cinereus, Ensatina eschscholtzii, Batrachoseps attenuatus, Desmognathus ocoee*). I tested the null-hypotheses that there are no differences in anesthetization time among three pH levels (6, 7, 8), between two concentrations (2000 mg/L, 500 mg/L), or among species.

Materials and Methods.—Twenty salamanders (4 each of the five species) were subjected to six experimental treatments of MS-222 that included two concentrations (2000 mg/L and 500 mg/L) at three pH levels (6, 7, 8). Salamanders were submerged in the aqueous solutions and timed with a stopwatch until they were completely anesthetized. The criterion for complete anesthetization was the inability to right themselves when turned onto their backs. The experiment was stopped if after 30 minutes a salamander was not completely anesthetized. Full submersion of terrestrial salamanders may have caused stress to the animal as vigorous swimming behavior was observed for the first few seconds of anesthetizing. As an alternative method, salamanders could be partially submerged in a more shallow bath that would allow their heads to remain out of the anesthetizing solution. Following anesthetization, salamanders were rinsed with water and aquarium conditioner and allowed to recover. Salamanders were housed in an environmental control chamber at 14°C in plastic containers with clay pot shards and moist paper towels prior to and between experiments. Salamanders were fed fruit flies once per week. Aqueous solutions of MS-222 were at room temperature, and salamanders were acclimated to room temperature for 30 minutes prior to anesthetization. MS-222 solutions were prepared by mixing MS-222 powder with aqueous pH buffers. For a 2000 mg/L concentration, 0.5 g MS-222 was mixed with 250 ml of aqueous buffer. For a 500 mg/L concentration, 0.125 g MS-222 was mixed with 250 ml of aqueous buffer.

I used a three-factor repeated measures experimental design with time to anesthetization as the response variable and factors being species, pH, and concentration. Six repeated measures, representing the six treatment combinations of pH and concentration, were taken on each subject. The washout period (time between treatments) in repeated measures designs is intended to be long enough to allow subjects to fully recover, thereby preventing a previous treatment from affecting the outcome of a following treatment. I observed that after anesthetization with a 2000 mg/L solution of MS-222 at pH 7, salamanders were able to lift their heads and walk within 17 (± 2 SE) minutes. Hormonal effects of acidic (pH 3) MS-222 baths endure at least 5 h after anesthetization of leopard frogs, but these effects were attributed to the acidity of the baths not MS-222 itself (Ohr 1975b). Arterial pH of bullfrogs (*Rana catesbeiana*) exposed to neutralized (pH 7.4) and acidic (pH 3) MS-222 baths return to normal levels after one day (Ohr 1975b). No information exists on long-term physiological recovery or the effect of repeated anesthetizations. Therefore, I chose a washout period of 14 days between treatments. Repeated measures ANOVA requires the assumption of circularity, which is met when treatment effects are independent. When the assumption of circularity is not met, I report Box's epsilon adjusted p-values. A sample size of 4 individuals each of the five species (20 salamanders total) was chosen because only that number was available in the lab. I used the computer program Number Cruncher Statistical Systems™ 2000 (J. Hintz, Kaysville, Utah) to perform two, 2-factor repeated measures ANOVA tests. Factors were species and pH in one test and species and concentration in the other. I used Tukey-Kramer's multiple comparison procedure to differentiate groups of species according to their anesthetization time. The response variable (time in seconds) was normalized by the log transformation. I analyzed the effect of snout-vent length (SVL), weight, and SVL-weight ratio as potential covariates using Pearson's correlation coefficient.

Results.—The time required for treatment solutions of MS-222 to anesthetize salamanders ranged from 1 minute 9 seconds to 30 minutes (mean = 7 minutes 5 seconds) and varied by species, pH, and concentration (Fig. 1). Snout–vent length, weight, and SVL-weight ratio were not significant covariates to anesthetization time ($R = 0.14, 0.01, 0.13$ respectively). Significant differences were found in the ANOVAs among species, among pH levels, and between concentrations (Table 1).

Tukey-Kramer's multiple comparison procedures, which were applied to each ANOVA test separately, produced the same species grouping pattern in the pH ANOVA as in the concentration ANOVA. In both tests the two members of the genus *Plethodon*

took significantly longer to anesthetize than the other species (concentration ANOVA: MSE = 0.02, CV = 4.37; pH ANOVA: MSE = 0.03, CV = 4.37). Tukey-Kramer's multiple comparison procedures used on the pH factor showed that the significant differences among pH were between pH 8, which took less time to anesthetize, and pH 6 and 7, which took more time (MSE = 0.01, CV = 3.51). Significant interaction terms in both ANOVAs (Table 1) indicate that the manner in which species were affected by treatments of a factor were not consistent between treatments of that factor.

TABLE 1. Species, pH, and concentration had significant effects on time to anesthetization (repeated measures ANOVA), but interaction terms were also significant indicating that the degree of change between levels of a factor was not consistent among species. Tukey-Kramer's multiple comparison procedures showed pH 6 and 7 were different than pH 8 (MSE=0.01, CV=3.51) and *Plethodon* species were different than all others (MSE=0.02, CV=4.37).

Response Variable	Source of Variation	DF	MS	F	p
Time (seconds)	A: species	4	0.42	12.37	0.0001
	B(A): individual	15	0.03		
	C: pH	2	0.41	28.76	<0.0001*
	AC	8	0.03	4.63	0.0016*
	BC(A)	26	0.01		
Time (seconds)	A: species	4	0.28	16.41	<0.0001
	B(A): individual	15	0.02		
	C: concentration	1	2.74	176.52	<0.0001
	AC	4	0.11	6.92	0.0023
	BC(A)	15	0.02		

* Box's epsilon adjusted p-value.

Discussion.—Using aqueous pH buffers to prepare MS-222 solutions is a convenient way to keep the solution pH stable. Because neutralizing pH using sodium bicarbonate results in solutions that require up to an hour or more to equilibrate, it is difficult to judge the amount of sodium bicarbonate needed without laboratory tests. Using an aqueous pH buffer simplifies the pH buffering procedure. These results show that using a pH 8 buffer will have a significantly different effect (less time to anesthetization) than using either a pH 6 or 7 buffer. The question of whether to use a pH 7 or pH 8 buffer remains open. Ohr (1975a) recommended adjusting the pH to between 7 and 8 to prevent injury to the skin and prevent stress, and she noted that leopard frogs appeared calm in MS-222 baths at pH 7.4 (Ohr 1975b) and *Necturus* appeared calm when placed in MS-222 solutions at pH 7.7 (Ohr 1975a). My experiment did not quantify levels of stress, and no information exists on amphibian stress responses in solutions of pH 8 or higher. Because MS-222 baths at pH 7 induce anesthetization in a reasonable amount of time and the faster anesthetization times at pH 8 are associated with an unknown level of stress, I recommend using a pH 7 buffer unless species-specific

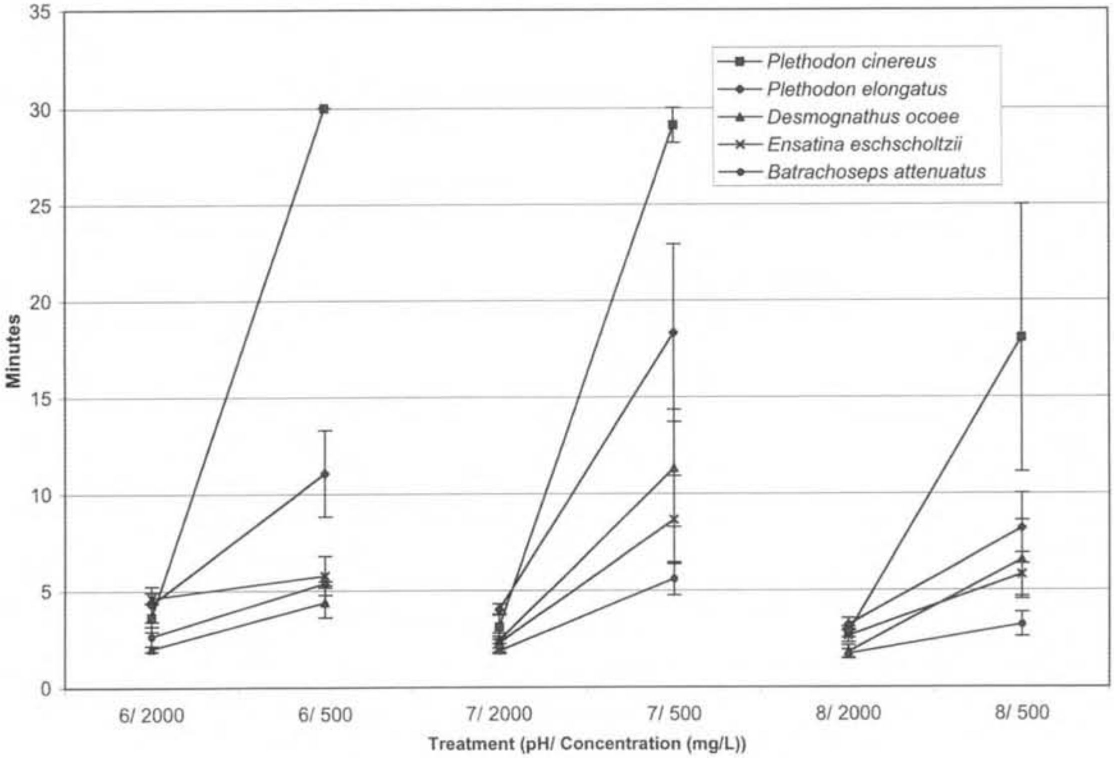

FIG. 1. Mean (± SE, N = 4) times to anesthetization are shown for five terrestrial salamander species under 6 pH/concentration treatments. Treatments consisting of a 2000 mg/L concentration differed from those consisting of a 500 mg/L concentration (ANOVA, p < 0.0001). Treatments made with pH 6 and 7 aqueous buffers differed from those made with pH 8 buffer (ANOVA, p < 0.0001), and *P. cinereus* and *P. elongatus* differed from the other species (ANOVA, p = 0.0001). Standard errors are absent from one treatment because time was cut off at 30 minutes.

stress responses to other pH levels are known. Because increasing pH results in increasing the potency of MS-222, it may be necessary to decrease MS-222 concentrations if one changes their methods from unbuffered to neutral baths. For example, an unbuffered 3500 mg/L MS-222 bath normally used to anesthetize leopard frogs is lethal after being neutralized (Ohr 1975a).

As one would expect, the higher concentration of MS-222 (2000 mg/L) anesthetized salamanders faster than the lower concentration (500 mg/L). At the high concentration, all species were similarly anesthetized in under 5 minutes. At the low concentration, *P. elongatus* and *P. cinereus* took significantly longer (18 and 29 minutes respectively at pH 7) than the other species which took 6–12 minutes at pH 7. These results suggest that while 500 mg/L concentrations of MS-222 work well for some species, 2000 mg/L solutions may be needed for *P. elongatus* and *P. cinereus*. The similarity in response between *P. elongatus* and *P. cinereus* may have a phylogenetic basis due to shared physiological characteristics or may just be a result of random chance. Data on more terrestrial salamanders would be needed to support a phylogenetic hypothesis.

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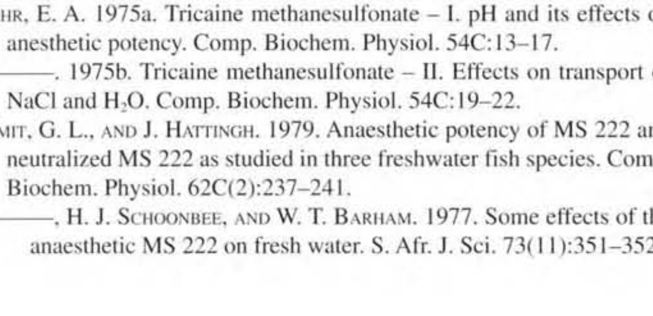

Elaphe vulpina (Fox Snake), juvenile. USA: Indiana: Tippecanoe County. Photolithograph by Will Brown.

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A New Method for Attaching Electronic Devices to Crocodilians

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Despite the potential importance of movement patterns to crocodilian life histories, movement, home range behavior and dispersal have received careful examination only in *Alligator mississippiensis* (Hutton 1989). Data for other species of crocodilian are deficient and stem mostly from mark-recapture studies, which have provided baseline information on many species (e.g., Gorzula 1978; Walsh and Whitehead 1993; Webb and Messel 1978; Tucker et al. 1997). However, telemetry is more suitable for clarifying theories about patterns of movement and advancing our understanding of dynamic activity budgets and seasonal patterns of habitat use by different life-history stages (Tucker et al. 1997).

Radio-telemetry has been successfully used to track *A. mississippiensis* (e.g. Joanen and McNease 1970, 1972; McNease and Joanen 1974; Goodwin and Marion 1979; Rootes and Chabreck 1993), *Crocodylus acutus* (Rodda 1984a), *Crocodylus niloticus* (Hutton 1989; Hocutt et al. 1992), *Crocodylus intermedius* (Muñoz and Thorbjarnarson 2000), *Paleosuchus trigonatus* (Magnusson and Lima 1991), and *Melanosuchus niger* (Martin and da Silva 1998). Attachment configurations for radio tags have included neck collars (e.g. ,Joanen and McNease 1970), tethering (Rodda 1984a; Rodda 1984b; Martin and da Silva 1998; Muñoz and Thorbjarnarson 2000), ingestion (Magnusson and Lima 1991), and surgical implantation (Magnusson and Lima 1991; Hocutt et al. 1992). The most successful methods in terms of longevity have been neck collars (Taylor 1984) and surgical implantation (Hocutt et al. 1992), which have enabled animals to be radio located for periods in excess of 3 and 2 years, respectively. This paper describes a new method used for attaching VHF radio tags to *Crocodylus porosus* that could easily be modified to attach other electronic devices such as satellite tags, GPS data loggers or time-depth recorders.

Captured crocodiles were physically restrained during the attachment procedure by binding the front and rear legs alongside the body with nylon webbing, and tying the animal to an aluminium ladder padded with burlap sacks. Subject animals were blindfolded with eye pads and electrical tape to reduce visual stimulation. Once restrained, the animals rarely struggled during the procedure unless provoked by loud human voices or the sound of an approaching boat. Anesthesia was not used, partly because of difficulty finding an appropriate treatment regimen that effectively and reliably sedated the animals for the intended procedure, but more importantly because of the lengthy recovery periods involved (see Loveridge and Blake 1987; Bennett 1996). Priority was given to returning the animals to the water as quickly as possible at the end of the procedure. The procedure was performed near the site of capture either onboard a small (4.5 m) boat or on the riverbank. Animals were released as close as possible to the site of capture.

Tags were attached to the enlarged nuchal scales on the dorsal

surface of the neck because the pronounced keel of these scales was conducive to the use of bone pins (Fig. 1). The tags fit between the central nuchal scales of large animals (> 3.5 m) and sat above these scales on smaller individuals. One animal had a large gash on its throat and a necrotic wound festering beneath the nuchal scales. Therefore, the tag was attached to the dorsal scales midway between the front legs.

An aluminium angle bracket was pop-riveted to the tag (Fig. 1A), which was then placed over the central nuchal scales to assess the fit (Fig. 1C). Depending on the size of the nuchal scales, the bracket could be trimmed with tin snips as required to minimize the height of the tag above the dorsal surface. The ventral surface of the tag and the bracket were sanded with emery paper to roughen the surface to aid bonding with the glue. The tag was then sprayed with 70% ethanol and allowed to dry.

Two brands of equally satisfactory glue were used: Loctite Fixmaster Underwater Repair Epoxy (<http://www.loctite.com>) or Selleys Knead It Aqua (<http://www.selleys.com.au>). Both are hand kneadable, fast setting, co-extruded epoxy repair systems that come in roll form, with the hardener encapsulated in the resin. They harden 5–10 min. after mixing to a white solid material and cure fully within an hour. Both will adhere to damp or wet surfaces and cure underwater. The glues are slightly exothermic while curing but were tested on human skin and temperatures generated were mild.

The nuchal scales were scrubbed clean with a disposable chlorhexidine scrub, rinsed with river water and dried with a clean cloth. The area was sprayed with 70% ethanol, which was allowed to evaporate. A lump of glue was placed on the ventral surface of the tag, which was then placed between the central nuchal scales. The tag and glue were molded to remove any air pockets and minimize the tag's profile above the dorsal surface while leaving the outside lateral edges of the central nuchal scales exposed to enable the placement of bone pins (Fig. 1B).

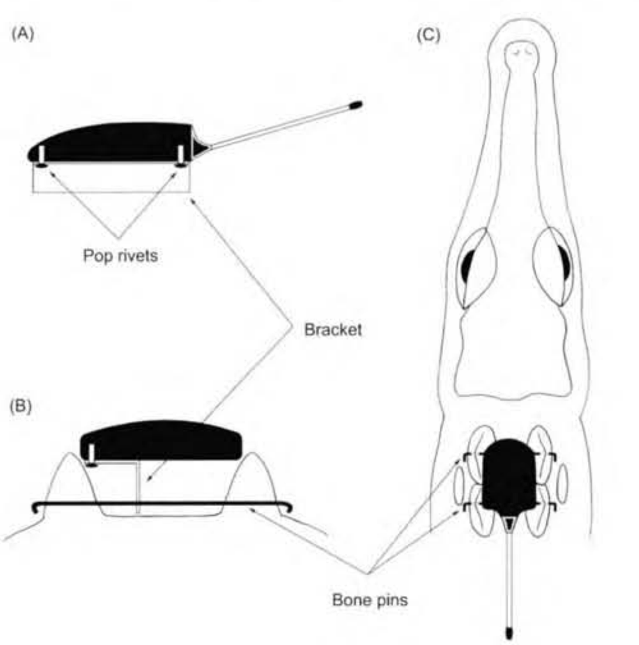

FIG. 1. Placement and orientation of the radio tag, bracket and bone pins on the nuchal scales. The attachment was further augmented with glue, which bonded sufficiently well to the tag and bone pins that the bracket is now considered redundant.

The bone pins used were 31 cm, 1.6 mm diameter, stainless steel Kirschner wires (K-wires), which were cut in half and secured directly into the chuck of a cordless drill. They were then sprayed with 70% ethanol for sterilization. Two pins were used, one through the anterior central nuchal scales and a second through the posterior central nuchal scales (Fig. 1C). The K-wires had a trocar spike at each end, which enabled them to drill directly through the osteoderms and bracket without pre-drilling any holes, but the process was fairly slow. Care was required to ensure the orientation of the bone pins was horizontal and that they penetrated only the raised keel of the scales and the bracket (Fig. 1B). Once the bone pins protruded through the osteoderms they were bent with pliers, to stop them from pulling through, and trimmed with wire cutters (Fig. 1B, C). The area was sprayed again with 70% ethanol, which was allowed to evaporate. Additional glue was then placed around the tag and molded to provide smooth contouring, and totally encase and seal the central nuchal scales, bone pins and the lower half of the tag.

Ten tags were attached using brackets but, because it was thought that the glue bonded sufficiently well to the tag alone, no bracket was used for 6 other attachments (Table 1). The length of time a tag stayed attached to a crocodile was similar, irrespective of whether a bracket was used (15– > 412 days) or not (132– > 370 days), and I now consider the bracket to be superfluous. Elimination of the bracket not only reduced the materials required but also the time taken to attach a tag. Time taken to attach a tag ranged from 60 min. (bracket and inexperience) to about 30 min. (no bracket and experience).

Tag attachment without a bracket was a much simpler procedure. The nuchal area was prepared as before. Holes for the bone pins were pre-drilled through the keel of the nuchal scales with a sterilized drill bit, which was much faster than trying to drill holes using the trocar spike at the end of the K-wires. Also, aligning the bone pins was much easier. After the bone pins were placed through the scales, they were bent and trimmed as before, and the area was then sterilized with 70% ethanol. Once the ethanol evaporated, the glue and tag were placed over the central nuchal scales and molded into place so that the glue enclosed and sealed the bone pins and scales, and held the tag in place.

Every effort was made to use as sterile a procedure as possible, given the limitations of working under field conditions. Because bone pins were used, a single phrophylactic dose of a broad-spectrum antibiotic, oxytetracycline hydrochloride (OTC), was administered by intramuscular injection as a precaution prior to commencement of the attachment procedure. Dose rates were calculated by allometrically scaling the therapeutic dose recommended by the manufacturer for placental mammals, to that for a generic reptile, using the methods described by Pokras et al. (1992) or Sedgwick and Borkowski (1996). OTC has the added advantage of being a suitable biomarker (see Coles et al. 2001). It is worth noting that crocodiles, in common with other reptiles and non-mammalian vertebrates, have a renal portal system. Therefore, it is prudent to inject any medications, especially nephrotoxic drugs, into the anterior half of the animal to avoid the renal portal system (Jenkins 1996).

Tags weighed 140 g but, when combined with glue, pins and bracket, the mass of the assembly increased to about 500 g. In

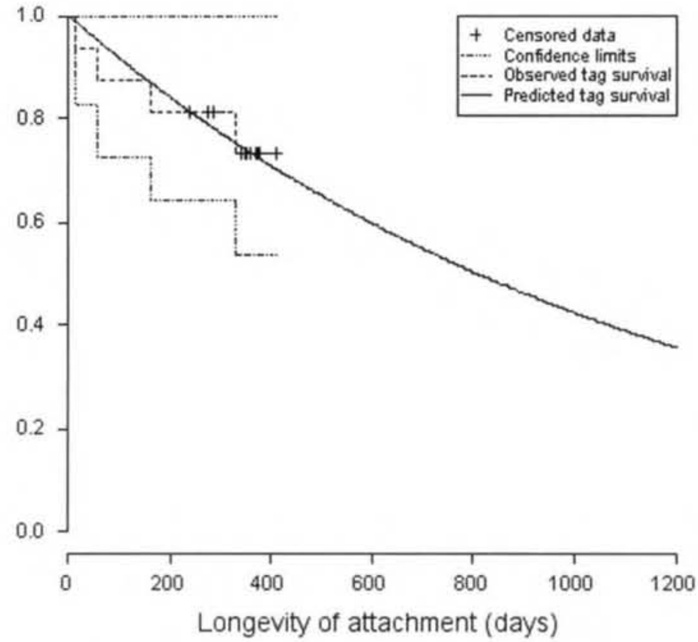

FIG. 2. Exponential survival function fitted to longevity of attachment data. The dashed line is the observed tag attachment time with each step down representing a detachment event. The crosses represent censored data, that is, individuals where the tag was still attached and operational at the final observation. The solid line is the tag attachment time predicted by fitting an exponential function to the observed data.

general, tags should weigh < 3–5 % of body mass to avoid adverse effects (Kenward 2001). Therefore, using this method with current tag specifications, animals would need to be > 17 kg or about 1.8 m total length. The greatest confirmed longevity of attachment (LOA) achieved during the study was > 412 days and most tags remained attached for > 340 days (Table 1). The study ended in May 2003, however, aerial crocodile surveys flown in July 2003 sighted three tagged animals, confirming one tag had remained attached for > 637 days and two others for > 420 days. Four tags (25%) are known to have detached during the study: three detached naturally in submerged snags and one when an animal escaped from a cage trap (Table 1). Dislodgement of a tag is most likely during a flight response when an animal is startled, especially when it is among thick or fallen vegetation, whether submerged or on the bank.

A simple mean LOA would not provide a meaningful estimate of expected attachment time because most tags were still attached and operational at the end of the study (= censored data, see McCallum 2000; Crawley 2002). Therefore, survival analysis on LOA was performed to estimate the mean time to failure using the survival package within R statistical software (ver. 1.6.2, Ihaka and Gentleman 1996). No evidence was found that the risk of detachment increased with attachment time (Weibull distribution, scale = 1.33, $P = 0.5$ for H_0 scale = 1). Therefore, it was assumed that the risk of detachment was constant throughout life, and an exponential survival function was fitted to the data using parametric regression (McCallum 2000; Crawley 2002). The mean time to failure was estimated to be 1164 days. The precision of the estimate was low, having a 95% CI of between 437 and 3103 days, because most of the data were censored with few failures occurring during the study period (Fig. 2).

Crocodile 185 was re-captured after 370 days and the tag removed to evaluate possible deleterious effects of the attachment procedure. The skin appeared healthy with only a slight loss of pigmentation (see Kirshner 1985) and there was no infection or necrosis visible in the underlying tissue. Skull dimensions, total length and body mass had all increased suggesting the attachment

TABLE 1. Longevity of attachment (LOA) achieved for 16 animals tagged during the study.

Crocodile	Sex	Total length (m)	Body mass (kg)	Date attached (dd/mm/yy)	Bracket (Y/N)	LOA at last fix (days)	Comments
146	M	2.65	59	15/10/2001	Y	15	Tag detached escaping trap
147	M	2.09	26	22/10/2001	Y	241 +	
350	M	2.13	32	23/10/2001	Y	277 +	
164	F	2.72	76	25/10/2001	Y	412 +	
183	F	3.08	103	11/04/2002	Y	281–384	Tag detached in snag
184	M	3.25	91	22/04/2002	Y	377 +	
186	M	3.27	141	24/04/2002	Y	375 +	
188	M	3.53	151	07/05/2002	Y	361 +	
189	F	2.72	82	07/05/2002	Y	360 +	
190	M	2.63	62	09/05/2002	Y	49–67	Tag detached in snag
185	F	2.74	76	24/04/2002	N	370	Tag removed 29/04/2003
191	M	4.34	337	12/05/2002	N	287 +	
192	M	3.12	111	16/05/2002	N	352 +	
193	M	3.17	116	21/05/2002	N	348 +	
194	M	3.07	103	25/05/2002	N	132–195	Tag detached in snag
195	M	2.53	62	26/05/2002	N	341 +	

+ Tag still attached and operational at last fix

had not adversely affected growth or body condition. Furthermore, all females tagged during the study moved to nesting habitat during the wet season and one was detected near a recently constructed nest. Therefore, attachment of the tags did not appear to have interfered with courtship, mating or nesting behavior. On the basis of this evidence, I consider the technique to be relatively benign.

In summary, this technique provides a reliable medium to long-term method for attaching small electronic devices to crocodilians. It has some advantages over other successful methods of tag attachment. First, it does not constrict an animal's neck as would a collar and it is not as invasive as surgical implantation. Also, signal propagation is better than with an implanted tag, which improves detectability. Examination of underlying tissue on one animal 370 days after attachment suggests that the method is relatively benign. There are a number of ways the technique could be refined. Ideally, the tag should have as low a profile as possible above the dorsal surface of the animal. In hindsight, it would have been preferable to design a narrower tag that would fit between the central nuchal scales on a greater size range of animals to reduce the overall profile of the tag assembly above the dorsal surface. However, there is a compromise in that the tag itself would have a higher profile. Additionally, the flexible whip antenna could be orientated vertically without greatly increasing the risk of detachment, which may improve signal propagation and reception (see Kenward 2001). The use of alternative materials may also be advantageous. For example, bone pins made from titanium or Delrin plastic (<http://plastics.dupont.com>) are probably more inert than stainless steel. It would be well worth testing the use of a less dense, flexible polyurethane glue such as Sikaflex-291 (<http://www.sika-industry.com>), which would reduce the overall weight of the tag assembly. However, curing times for this product are lengthy and would need to be accelerated to be of practical use in the field.

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A Novel Technique for Capturing Arboreal Geckos

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When conducting research on lizards it is often necessary to capture individuals unharmed. Popular methods for the capture of arboreal lizards include hand capture, noosing, using rubber bands as projectiles (Simmons 1987), chasing lizards into mesh barriers (Patterson 1998), attracting individuals to baited traps (Durden et al. 1995; Zani and Vitt 1995), or fishing for them with baited lines (Krysko 2000; Strong et al. 1993). Other methods include using wire hooks to pull lizards from refugia (Bedford et al. 1995), glue boards for passive capture (Bauer and Sadlier 1992), or sticky poles for active capture (Durtsche 1996).

Any capture technique has inherent problems (Krysko 2000), but for the capture of small, skittish, and fast-moving lizard species, such as geckos that perch high on building walls, the techniques listed above make capture without harm extremely difficult and, in many cases, inappropriate. The most suitable of these techniques is noosing, but often the lizard flees at the sight of the approaching pole, evades the noose, or bites the noose pulling it closed (pers. obs.). Furthermore, the thread of the noose has to be thin, making it difficult to see more than 3-m away and difficult to keep steady. Using a baited line poses similar problems to using a noose.

To overcome the problems of safely catching arboreal geckos from buildings, I describe a novel technique I developed to capture native and introduced geckos in Mauritius using a laser pointer.

All geckos rely on their vision to capture predominantly insectivorous prey and are, in general, opportunistic feeders, attacking any small moving object within range. A small dot projected onto a wall from a laser pointer within view of a gecko will entice the lizard to give chase and repeatedly lunge and bite at the dot. The dot can then be moved down the wall to a point permitting capture, generally at chest height, close to an awaiting hand. To keep the gecko moving it is necessary to keep the laser dot within 5–10 cm of the gecko's head.

Lasers are grouped into seven classes (1, 1M, 2, 2M, 3R, 3B, and 4), the higher the class the greater risk of laser radiation hazard. Most commercially available laser pointers belong to Class 1 or 2. The output power of a Class 1 laser is such that exposure of the eye to the beam will not cause damage and is, therefore, considered eye safe. The output power of a Class 2 laser is higher and prolonged eye exposure is potentially harmful, although a person's natural involuntary response, such as the blink reflex and/or head aversion is quicker than the maximum permissible exposure time, therefore avoiding damage to the eye. The International Electrotechnical Commission (IEC 60825–1 2001) and British Standards (BS EN 60825–1 1994) state that only Class 1 or 2 devices should be used in unsupervised areas. Of course, when using any type of laser pointer, do not shine the laser beam into the eyes of any person or animal. The risk of shining the beam of the laser into the eyes of a gecko is easily avoided by continually moving the laser away from the target animal. Catching geckos from reflective surfaces, such as glass windows, should be avoided. Researchers, should consult regional laws and regulations before undertaking fieldwork using laser pointers because some countries have laws associated with possession and use of laser pointers.

The efficiency of the technique is illustrated for four species of nocturnal gecko and the daytime capture of two diurnal species (Table 1). The laser pointer was only used for geckos that could not be caught by noose or by hand. Individual geckos were not captured more than once for this trial. The utility of this method, therefore, is untested for experimental designs requiring multiple captures of the same individual. More than 90% of all geckos pursued the laser dot and almost 80% of these were brought to a point of capture. Five geckos were so intent on eating the laser dot that they chased the dot down onto the ground (up to 11 m) and two were coaxed onto the palm of my hand. Of the 19 geckos that were not brought to a point of capture, seven showed no response to the laser dot, one ran off, six terminated their pursuit after chasing the laser dot (one after pursuing it for 8 m), and five either encountered and ate an insect or were chased off by another gecko whilst following the laser dot.

Nocturnal geckos responded similarly in chasing the laser dot over unlit (51%) and lit (49%) walls and over smooth (cemented/bricked [58%)]) and rough (old stone [42%]) walls. All diurnal geckos were found on shaded walls. It is doubtful whether geckos would be able to see the laser dot in full sunlight. Eighty six percent of diurnal geckos were found on smooth surfaces, so it is difficult to determine whether wall texture had an effect on efficiency of laser use.

This technique is quick to use, inexpensive, requires minimal equipment, and aids in the capture of individuals from high, unreachable places without harm. The use of the laser pointer has also been successful in enticing adult *Phelsuma ornata* down the trunks of coconut trees (data not included here), indicating that its use may not be restricted to relatively flat surfaces, such as walls.

TABLE 1. Number of each lizard species indicating the percentage of adults (rounded to nearest whole digit), the efficiencies of the laser technique, and distances they moved.

Species	N	Geckos chasing laser dot (%)	Brought to hand capture (%)	Mean distance (m) moved by responsive geckos (SD, maximum)
Gehyra mutilata	9	78	78	4.3 (1.1, 6)
Hemidactylus brookii	7	100	86	6.1 (2.3, 9)
Hemidactylus frenatus	58	97	85	4.4 (2.2, 11)
Hemiphyllodactylus typus	3	67	33	3.5 (0.7, 4)
Phelsuma cepediana	3	67	67	3.5 (0.7, 4)
Phelsuma ornata	14	86	71	3.3 (1.7, 6)
Total or Mean (%)	94	92	80	4.3 (2.1, 11)

This method is also likely useful in facilitating the capture of other small insectivorous lizards. Another potential use could be in social experiments wherein an individual is enticed into the territory of another to test behavioral interactions.

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A New Method for Preparing Preserved Hemipenes of Lizards for Scanning Electron Microscopy

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Lizard hemipenis morphology has a long history of use in taxonomy (e.g., Arnold 1986a, b; Branch 1982; Cope 1895, 1896). In other taxa the morphology of intromittent organs has also provided valuable insight into the mating strategies of a species (Arnqvist 1997; Arnqvist et al. 1997; Dixson 1987; Eberhard 1985; Patterson and Thaeler 1982). Thus, detailed studies of hemipenis morphology can be useful in a number of research fields.

Investigations of hemipenis morphology are best made on freshly prepared material, as this minimizes the potential for artifacts and allows the natural shape of the organ to be studied. Unfortunately, fresh material is not always readily available and researchers often must rely on material from museum specimens.

Squamate hemipenes are particularly difficult to study once preserved, as they lie in an inverted state within the base of the tail when not erect. Consequently, to observe their structure and surface features, it is necessary to evert these organs. This is best done at the time of preservation because fixation tends to harden tissue, making it difficult to evert fixed hemipenes without causing damage to their structure. As a result, it is common for researchers to dissect inverted organs of preserved specimens *in situ* to investigate their surface features (e.g., Arnold 1973; 1986a; Böhme 1988; Dowling and Savage 1960). The disadvantage of this method is that it provides little insight into the overall structure of the everted organ.

More recently, Pesantes (1994) described a method for softening fixed snake hemipenes by soaking the material in a 2% solution of potassium hydroxide (KOH) for 3 d. We tested this technique on eight species of New Zealand geckos but found that it led to tissue damage. In this paper we report these results and describe a new technique for softening fixed hemipenes that is easy to use and causes little tissue damage.

As part of a comparative study on interspecific variation in hemipenis morphology of New Zealand geckos (Gekkonidae), we initially followed Pesantes' (1994) method to soften the inverted hemipenes of 16 museum specimens belonging to eight gecko species that had been fixed in formalin. The condition of the fixed specimens was compared with the hemipenes of six *Hoplodactylus maculatus* that had been preserved in ethanol and did not require any treatment prior to eversion because the hemipenial tissue had remained soft and pliable.

The preparation history of the 16 museum specimens used in our study was uncertain, but all had been fixed in formalin (concentration and duration unknown) and stored in 70% ethanol. The specimens had been stored for 19–35 yr. Hemipenes were first dissected in their entirety from the base of the tail (following Arnold 1986a). Samples were rehydrated from 70% ethanol to distilled water in decreasing concentrations of ethanol (50 and 30%), by soaking the tissues for a minimum of 1 h at each concentration. The hemipenes were then softened using KOH (Pesantes 1994). We found that samples ($N = 6$) that had been soaked in a 2% solution of KOH for 3 d either partially or totally disintegrated. Therefore, we modified this method and obtained best results when the hemipenes were soaked in a 1% solution of KOH for 5–11 h. Following softening, hemipenes were rinsed in 0.05N HCl for 10 min and soaked overnight in distilled water. Specimens were then everted in distilled water using round-tipped forceps and a blunt probe to push the lobes inside out. It is usual for researchers to inflate everted hemipenes to obtain maximal turgidity (e.g., Böhme 1988; Glaw et al. 1999; Myers and Cadle 2003; Zaher and Prudente 2003). However, the degree of inflation that naturally occurs is unknown and it is thought that organs are often over-inflated (Arnold 1986a). In addition, it is difficult to standardize the amount that an organ is inflated. Consequently, for interspecific comparisons in which the surface features rather than the size of the organ are of primary interest, it is preferable to avoid this procedure if possible. Because the hemipenes of the species studied were very small, the organs could be fully everted with relative ease, allowing the surface features to be observed without inflation.

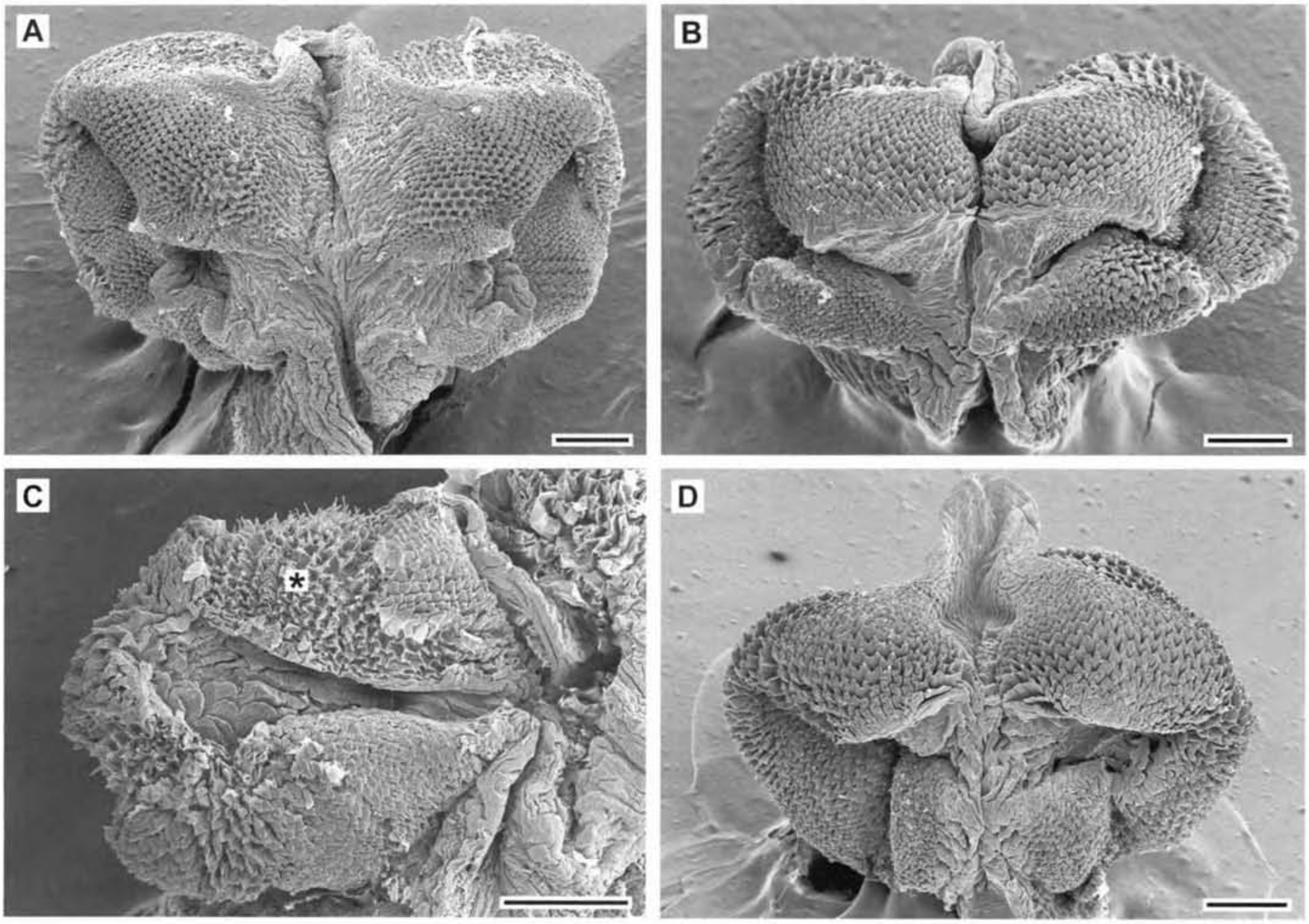

FIG. 1. SEM micrographs of the sulcal surface of hemipenes of *Hoplodactylus maculatus* (Gekkonidae) prepared using different treatments: (A) specimen softened in 1% KOH; (B) untreated ethanol-stored sample; (C) single lobe of hemipenis damaged when softened in 1% KOH, note loss of calyces (*); (D) saponin-prepared sample. Scale bars = 500 µm.

Following eversion, the hemipenes were fixed in 2.5% glutaraldehyde and 1% paraformaldehyde in 0.1M sodium cacodylate for 3 d. Samples were then prepared for scanning electron microscopy (SEM) using the following procedure: washed overnight in 0.1M sodium cacodylate buffer, stained in 2% osmium tetroxide (OsO_4) in distilled water for 2 d, soaked in distilled water for 2 h, dehydrated through an ethanol series (30, 50, 70, 80, 90, 95, and 100%) for a minimum of 2 h at each concentration, left overnight in fresh absolute ethanol, placed in a four-step increasing concentration gradient of amyl acetate in ethanol (25, 50, 75, and 100%) for a minimum of 2 h at each concentration, left overnight in pure amyl acetate, critical point dried with liquid CO_2, mounted on aluminium SEM stubs using conductive carbon paint, and sputter-coated with ca. 40 nm gold/palladium. Hemipenes were viewed using a LEICA S440 scanning electron microscope at accelerating voltages of 10–20 kV.

The use of KOH to evert fixed hemipenes gave variable results. Of the 16 samples, four were everted in excellent condition (Fig. 1A), equal to that of unfixed specimens that had been stored in ethanol and did not require any treatment prior to eversion (Fig. 1B). However, for the remaining samples the KOH treatment resulted in partial or complete loss of the surface layer of calyces (Fig. 1C). Glaw et al. (1999) also found that KOH was sometimes too harsh for delicate organs. Accordingly, we concluded that a milder softening agent was required.

Detergents have been used previously to partially recover formalin-fixed material (Humason 1962). Maupin and Pollard (1982) demonstrated that the permeability of cell membranes to fixatives and stains could be improved by soaking the tissue in saponin, a plant glycoside with detergent-like properties that is extracted from the bark of *Quillaja*. We tested whether saponin (Sigma Cat. # S4521) could soften formalin-fixed hemipenes and enable us to evert them more easily and with less damage than we experienced with the KOH treatment.

We dissected and rehydrated hemipenes from 22 specimens belonging to 10 gecko species using the methods described previously and then soaked them in a 1% solution of saponin in distilled water. The samples were checked at 15-min intervals to detect the best time for eversion using a blunt probe to test the material for optimal softness and pliability. We found that the organs regained sufficient flexibility for eversion after 1–2 h in the saponin solution. The hemipenes were then everted, rinsed 3–5 times in distilled water over a 30-min period and prepared for SEM as described above.

Saponin treatment yielded excellent results in 16 out of 22 samples (Fig. 1D), comparable to the most successful KOH-pre-

pared specimens and the ethanol-stored samples. Although the minimum soaking time required to sufficiently soften the material varied between samples (presumably a function of their original collection/storage regime), there appeared to be no risk of over softening the tissue and thus losing delicate surface features. Only in six samples did saponin fail to soften the organs sufficiently to evert them. In these instances the tissue had been left in the solution for 2.5 h and appeared to have regained sufficient flexibility for eversion. However, upon attempting eversion we found that the material crumbled, as the tissue inside was still hard and brittle. Longer soaking times may have been required for these samples, or some samples simply may not be reclaimable using this method.

The use of fixed material to investigate the surface features of squamate hemipenes may always be, at best, a salvage operation. This is often necessary because of the lack of suitably preserved specimens. We found that saponin is a highly effective softening agent of formalin-fixed material, as not only are preparation times relatively short, but the treatment is also very mild to the tissue. Consequently delicate structures on the surface of the organ are retained throughout processing. It is possible that other solutions with detergent-like properties may prove successful in salvaging similarly preserved tissues.

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HERPETOLOGICAL HUSBANDRY

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A Comparison of Vitamin D-Synthesizing Ability of Different Light Sources to Irradiances Measured with a Solarmeter Model 6.2 UVB Meter

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Recognition of nutritional metabolic bone disease (= nutritional secondary hyperparathyroidism) in herpetocultural collections in recent decades has led to an interest in measuring ultraviolet B (UVB) radiation (280–315 nm) in natural light and in vivaria illuminated with artificial lamps. UVB facilitates photoisomerization of 7- dehydrocholesterol (pro D_3) to previtamin D_3 (preD_3) which in turn is thermally isomerized to vitamin D_3 (vitD_3) (Chen 1999;

TABLE 1. Demonstration of reciprocity between the UVB dose and the percent of product formation in ampules of 7-dehydrocholesterol between 30 minutes and 120 minutes. The UVB source was a Westinghouse FS 20/T12 fluorescent lamp. Irradiance was measured with a Solartech 6.2 meter.

IRRADIANCE ($\mu W/cm^2$)	EXPOSURE TIME (min) (mJ/cm^2)	DOSE	% PRODUCT SYNTHESIZED
142	30	255	34.42
70	60	252	34.20
35	120	252	34.14

TABLE 2. Various characteristics of natural light in Boston, Massachusetts (USA) (42°N) at different seasons and different times of the day. Irradiances were measured with a Solarmeter 6.2 radiometer (Solartech, Inc., Harrison Township, Michigan 48045). The regression equation relating the % of photoproducts formed to the dose is presented for each season. Ampules used to assess vitamin D-synthesizing ability of the light were exposed for 1 hour.

DATE; TIME (EST)	IRRADIANCE ($\mu W/cm^2$)	DOSE (mJ/ cm^2)	% PRODUCT SYNTHESIZED
21-Jan-2003			
1100	42	151	0.17
1200	56	202	0.19
1300	52	187	0.25
1400	37	133	0.15
1500	20	72	0.06
%Prod = 0.001 (Dose) - 0.020 ($r^2 = 0.8322$)			
3-Mar-2003			
1130	120	432	0.66
1230	132	475	0.98
1330	124	446	0.85
1430	97	349	0.48
1530	50	180	0.16
%Prod = 0.003 (Dose) - 0.351 ($r^2 = 0.9249$)			
26-Jul-2003			
1100	260	936	5.2
1200	262	943	6.8
1300	275	990	7.4
1400	240	864	6.8
1500	215	774	6.5
1600	130	468	2.0
%Prod = 0.009 (Dose) - 1.730 ($r^2 = 0.7650$)			
24-Sep-2003			
1100	140	504	2.0
1200	180	648	2.7
1300	215	774	3.5
1400	185	666	3.2
1500	160	576	2.0
1600	95	342	1.2
%Prod = 0.006 (Dose) - 0.803 ($r^2 = 0.9274$)			

TABLE 3. Characteristics of four UVB emitters. Irradiances were measured with a Solarmeter model 6.2 radiometer (Solartech, Inc., Harrison Township, Michigan 48045). The regression equation relating the % of photoproducts formed to the dose is presented for each source. Ampules used to assess vitamin D-synthesizing ability of the UVB sources were exposed for 2 hours. The temperatures adjacent to the distances listed for the Westron 160 W spot were those measured after 2 hours.

LAMP DISTANCE (cm)	IRRADIANCE ($\mu W/cm^2$)	DOSE (mJ/cm^2)	% PRODUCT SYNTHESIZED
BLACKLIGHT 350 BL			
11	25	180	3.37
23	13	94	1.34
34	7	50	0.91
46	4	29	0.45
%Prod = 0.019 (Dose) - 0.162 (r^2 = 0.9775)			
REPTISUN 5.0			
11	36	259	1.39
23	16	115	0.54
34	9	65	0.27
46	5	43	<LD*
%Prod = 0.006 (Dose) - 0.116 (r^2 = 0.9997)			
ESU REPTILE DESERT 7% UVB			
11	53	382	1.79
23	25	180	0.68
34	14	101	0.35
46	8	58	<LD*
%Prod = 0.005 (Dose) - 0.209 (r^2 = 0.9969)			
WESTRON 160 W SPOT			
30 (45°C)	173	1246	4.39
42 (38°C)	92	662	2.68
88 (29°C)	24	173	1.07
127 (26°C)	12	86	0.82
%Prod = 0.003 (Dose) + 0.562 (r^2 = 0.9992)			

* less than lower limit of detection

Holick 2004). The irradiance of UVB is related to the rate of $preD_3$ production and hence indirectly to the rate of $vitD_3$ synthesis.

Spectroradiometers can accurately measure the irradiance of UVB from a light source. However, they are expensive and relatively difficult to work with. Hand-held broadband radiometers are less expensive and easy to use but may indicate irradiances that are significantly different from the actual values. Gehrmann et al. (2004) examined three types of broadband radiometers and showed that the meters indicated different levels of irradiance from the same light source. The determination of the vitamin D_3-photosynthesizing ability of a light source can serve as an independent measure of UVB irradiance. Thus, the percentage of photoproducts formed from $proD_3$ after exposure to the light for a specified time period allows for the comparison of irradiances from the different meters.

We recently became aware of an inexpensive broadband UVB meter manufactured by Solartech, Inc. (Harrison Township, Michigan 48045) as model no. 6.2, reading UVB between 280 and 320 nm and with a resolution of 1 $\mu W/cm^2$. In order to facilitate comparisons with the three meters described by Gehrmann et al. (2004) (Gigahertz-Optik, Inc. [Newburyport, Massachusetts 01950], UVP, Inc. [Upland, California 91786], and Spectronics Corp. [Westbury, New York 11590]) we correlated irradiances and associated doses from natural sunlight and various lamps with in vitro $vitD_3$-synthesizing ability.

Measurements of UVB in natural light at different times of the day were made in Boston, Massachusetts during the four seasons of 2003. UVB irradiance readings for the 1 hour during which $proD_3$-containing ampules were exposed were recorded at the start, middle, and end of the hour and then averaged. Readings were made at a solar angle of 80°. Irradiances from the three 20-watt fluorescent lamps were recorded at various distances below the midpoint of the lamp length; the meter was slowly moved about at this location to achieve the maximum reading. Irradiances were recorded at various distances below the center of the light circle produced by the Westron mercury vapor lamp. $ProD_3$ ampules were placed at these positions and exposed for 2 h to maximize conversion.

After exposure to the light source, the boron-silicate ampules that had contained 50 µg of $proD_3$ dissolved in one ml of ethanol

were analyzed by High Performance Liquid Chromatography (HPLC) for proD_3 and UVB-induced photoproducts (preD_3, tachysterol, and lumisterol) and vitD_3. A Waters 501 HPLC pump was used in conjunction with a Waters 490E multiwave detector set at 260 nm. The column was Econosphere silica, 5 µm, 250 x 4.6 mm (Alltech Associates, Inc, Deerfield, Illinois). The mobile phase was 8% ethyl acetate in hexane with a flow rate of 1.8 ml/min. Three replicates per ampule were analyzed and the percent of photoproducts and vitD_3 synthesized was calculated (see Gehrmann et al. 2004 and Webb et al. 1988 for details of the HPLC procedure).

We wished to verify that comparisons of photoproduct formation between the natural light ampules exposed for one hour and those exposed to the lamps for two hours were valid. The reciprocity law (Parrish et al. 1978) states that the UVB effect on photoproduct formation is not from irradiance *per se* (i.e., rate of energy delivery as watts), but rather the total energy (joules) delivered during a given time period which is the dose [dose (mJ/cm^2) = irradiance (µW/cm^2) x time (seconds) ÷ 1000]. We selected three different exposure times (30, 60, and 120 minutes) and adjusted the irradiance from a lamp, by changing the distance, such that the delivery dose was the same for all three periods. If the law was applicable to this study, the percent of photoproducts formed in the ampules should be the same for the three exposure times.

Results (Table 1) demonstrate the validity of the reciprocity law and justify comparisons of doses and associated photoproduct synthesis between ampules exposed to natural light for one hour with those exposed to various lamps for two hours. This idea is embodied in the regression equations relating the percent of photoproduct formed to the UVB dose (not the irradiance) that are given in Tables 2 and 3. Table 2 shows the irradiances of UVB in natural light in Boston measured with a Solartech 6.2 meter, and the associated doses, and relates them to the percent of photoproducts formed in ampules after one hour of exposure. Daily and seasonal trends are evident. Table 3 contrasts the UVB irradiances at different distances from four lamp types commonly used in herpetoculture and indicates their ability to produce vitD_3 photoproducts in ampules exposed for two hours. It is evident that the same irradiance and associated dose from different lamps can produce different quantities of photoproducts. Not all wavelengths within the UVB band are equally effective in producing preD_3 from proD_3. The greater the percent photoproduct formed at a given dose, the greater the concentration of UVB energy clustered around the most effective wavelength of 295 nm. This is clearly demonstrated by the Westinghouse FS 20 UVB lamp in Table 1. The percent of photoproducts formed is considerably higher than for the other light sources described in this article because of the high concentration of UVB close to 295 nm.

Evaluating the significance of vitD_3-synthesizing potential for herpetocultural purposes remains largely unexplored. Systematic studies showing the effect of latitude on the ability of natural light to form photoproducts in ampules could serve as an estimate of UVB requirements for various species in captivity taken in the context of their natural history and habitat preferences. Scattered reports indicate significant latitudinal effects on vitD_3-synthesizing ability. Webb et al. (1988) reported ampule conversions of 3% in Los Angeles, California (34°N) and 10% for Puerto Rico (18°N), both in January. Gehrmann et al. (2004) report conversion at about 11% at noon in Boyd, Texas (32°N) in September. Conversion at Iquitos, Peru (3°S) was about 15% in February (Gehrmann, unpubl. data). Ampule photoproduct formation was characterized throughout the year in Edmonton, Canada (52°N) by Webb et al. (1988). Additional examples can be found in Chen (1999) and Holick (2004).

Knowing the UVB requirements for a species studied in captivity allows for more specific recommendations. For example, Ferguson et al. (2002) reported that lamps that produce conversions from 0.52% to 1.32% after a 2 h exposure when used for 12 h per day, facilitate the production of viable hatchlings in the panther chameleon. Conversion percentages above or below these values resulted in reduced hatchability of viable eggs. Referring to Table 3 and using the regression equations, we see that a blacklight with an irradiance of between 5 and 11 µW/cm^2, a Reptisun 5.0 between 15 and 33 µW/cm^2, an ESU Desert 7% between 20 and 42 µW/cm^2 and a Westron spot between 8 and 35 µW/cm^2 will produce conversions within the 0.52% to 1.32% range. It is suggested that further studies relating UVB irradiance to husbandry and reproduction in reptile species, especially lizards, will contribute to their captive welfare.

The percent of photoproduct formation in ampules can serve as a reference to doses and associated irradiances measured with other meters. For example, from Table 3 we see that for a Sylvania 350 blacklight the amount of photoproduct formed is 1.34% when the irradiance is 13 µW/cm^2. Using the data in Gehrmann et al. (2004) it can be calculated that 1.34% is associated with an irradiance of 7 µW/cm^2 measured with a Gigahertz-Optik meter, 80 µW/cm^2 measured with a UVX meter, and 17 µW/cm^2 measured with a Spectroline DM 300N meter.

The Solarmeter sensor and processor are combined as a single unit. Because the sensor is located about 10.5 cm above the meter bottom, it cannot be used to directly measure the irradiance at the substrate level in an enclosure. Nevertheless, this meter will be useful for many purposes, including monitoring the UVB output of various lamps or checking the attenuation of UVB by various materials.

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Society for the Study of Amphibians and Reptiles

www.ssarherps.org

The Society for the Study of Amphibians and Reptiles, the largest international herpetological society, is a not-for-profit organization established to advance research, conservation, and education concerning amphibians and reptiles. Founded in 1958, SSAR is widely recognized today as having the most diverse society-sponsored program of services and publications for herpetologists. Membership is open to anyone with an interest in herpetology—professionals and serious amateurs alike—who wish to join with us to advance the goals of the Society.

All members of the SSAR are entitled to vote by mail ballot for Society officers, which allows overseas members to participate in determining the Society's activities; also, many international members attend the annual meetings and serve on editorial boards and committees.

ANNUAL DUES AND SUBSCRIPTIONS: Annual membership dues for the year 2004 in the Society for the Study of Amphibians and Reptiles are as follows: **REGULAR** membership US$60 (Student $30)—includes *Journal of Herpetology* and *Herpetological Review*; **PLENARY** membership US$80 (Student $45)—includes *JH*, *HR*, and annual subscription to the *Catalogue of American Amphibians and Reptiles*; **INSTITUTIONAL SUBSCRIPTION** $115—includes JH and HR. Additional fee for airmail postage outside USA $35 for one year. Additional membership categories available on the SSAR webpage: http://www.ssarherps.org/pages/membership.html.

All members and institutions receive the Society's primary technical publication, the *Journal of Herpetology*, and its news-journal, *Herpetological Review*; both are published four times per year. Members also receive pre-publication discounts on other Society publications, which are advertised in *Herpetological Review*.

Payment must be made in USA funds, payable to "SSAR," or by International Money Order, or with VISA or MasterCard (account number and expiration date must be provided). Payment should be sent to: Theodora Pinou, SSAR Treasurer, Department of Biological & Environmental Sciences, Western Connecticut State University, 181 White Street, Danbury, Connecticut 06810, USA. Fax: (203) 837-8769; e-mail: PinouT@wcsu.edu.

Future Annual Meetings

2005 — University of South Florida, Tampa, Florida, 6–11 July (with ASIH, HL)
2006 — New Orleans, Louisiana, 12–17 July (with ASIH, HL)

About Our Cover: *Phyllomedusa tomopterna*

Phyllomedusine frogs comprise six genera and 52 species that range, collectively, from Mexico through Argentina (Frost 2004. Amphibian Species of the World: an Online Reference. Version 3.0 [22 August, 2004]. Electronic database accessible at http://research.amnh.org/herpetology/amphibia/index.php. American Museum of Natural History, New York). All but one species (*Phyllomedusa atelopoides*) are arboreal. These frogs usually resemble some shade of green foliage, and are adapted to highly desiccating canopy environments in tropical climes. Most conserve moisture by wiping themselves with dorsal lipid secretions and passing the day sleeping, with limbs pressed to the body. Some phyllomedusines such as *Pachymedusa dacnicolor*, *Phyllomedusa hypocondrialis*, and *P. sauvagii* have exploited seasonally dry thornscrub and savanna habitats. The genus *Agalychnis* (Leaf Frogs) includes the Red-eyed Leaf Frog (*A. callidryas*), perhaps the most photographed amphibian in the world. The genus *Phyllomedusa* (Monkey Frogs) includes the Giant Monkey Frog (*Phyllomedusa bicolor*), that secretes peptides sequestered by Matses Indians and used to enhance their vision and hearing while hunting game (Daly et al. 1992. Proc. Nat. Acad. Sci. USA 89:10960–10963). Leaf and Monkey frogs are unusual in that they hop and crawl slowly as opposed to leaping. Their habit of grasping at perches is more reminiscent of chameleons than frogs. When molested, most phyllomedusines simply tuck their limbs, close their eyes, and remain motionless. A distinctive odor is given off by several species, but its function has not been demonstrated.

Breeding aggregations of some species (*Agalychnis spurrelli*, *Phyllomedusa bicolor*) may involve dozens of raucous individuals. By contrast, the Amazon Leaf Frog (*A. craspedopus*) is nearly silent and visits water-filled stumps and tree holes to reproduce. Phyllomedusine eggs are laid in gelatinous masses on vegetation overhanging water. Tadpoles fall from the ooze into the water to complete development. Eggless capsules and rolled-leaf nests serve to provide metabolic water and impede desiccation, respectively, for *P. hypocondrialis* eggs (Pyburn 1980. Proc. Biol. Soc. Washington 93:153–167). Populations of *P. tomopterna* in Brazil suffered 67% egg mortality from predation by phorid flies and staphylinid beetles (S. Neckel-Oliveira and M. Wachlevski 2004. J. Herpetol. 38:244–248).

The Barred Monkey Frog (*Phyllomedusa tomopterna*) on the cover was photographed at night in primary rainforest at the Allpahuayo-Mishana Reserve in Loreto, Peru, not far from the type locality (Cope 1868. Proc. Acad. Nat. Sci. Philadelphia 20:112). This species is found throughout Amazonian and Guianan South America. It is distinctive owing to the pronounced calcars (dermal heel appendages) and brightly colored flanks. **William W. Lamar** took the picture with a Pentax LX camera, Vivitar Series 1 105mm macro lens set at f22, Vivitar Series 1 flash, using Fujichrome Velvia film rated at ISO 80 and pushed 1 stop during processing. Lamar spends much of his time in the tropics, guiding groups for GreenTracks, Inc. (www.greentracks.com), or coordinating film work for the Discovery Channel, Animal Planet, and the BBC.

PHOTO BY ED GEORGE

SSAR BUSINESS

Dean E. Metter Memorial Award Winner 2004

Sixteen very well written proposals were submitted for the first Dean E. Metter Memorial Award. Committee members (Joseph Beatty, Anne Maglia, and Brian Miller) were extremely impressed with all of the proposals, but had to choose a single awardee. We have chosen Alison Hamilton Jennings to be the second recipient of the Metter Award. Her proposal was titled: "Comparative Phylogeography of Two Lizard Families with Differing Life Histories, Ecologies, and Reproductive Modes."

Ms. Jennings earned a B.A. in Ecology from Simon's Rock College (Great Barrington, Massachusetts) in 1993. Her undergraduate thesis work dealt with *Chrysemys picta* and *Chelydra serpentina* and was supervised by Robert Schmidt and David Meyers. In 2001, she earned an M.S. in Wildlife Ecology & Conservation with Kenneth Dodd at the University of Florida. Her thesis was entitled: Evidence for Ontogenetic Shifts in Box Turtles: Activity Patterns, Movements, and Use of Microenvironments and Habitats by Juvenile *Terrapene carolina bauri* on Egmont Key. Alison is well into her doctoral work with Christopher Austin at Louisiana State University in Baton Rouge with the completion of two successful field seasons. Her thesis work compares the phylogeography of geckos (*Nactus pelagicus*) and skinks (*Emoia sanfordi*) in the Vanuatu Archipelago.

2005 Dean E. Metter Memorial Award Application Deadline 28 February 2005

The Dean E. Metter Memorial Award is given annually by SSAR to a herpetology student. Its purpose is to encourage students to pursue field research in herpetology and to facilitate field research by providing funds for relevant expenses. Proposals must be submitted (post-marked) no later than 28 February to be considered; 2005 SSAR dues must be paid by 31 December 2004. Failure to meet these guidelines may result in elimination of a proposal from consideration. Awards will be announced on or around 1 April. Successful applicants are encouraged to submit the results of their research for publication in the *Journal of Herpetology* or *Herpetological Review*, or to present their findings at the annual meeting of the SSAR. Full proposal guidelines, submission instructions and background information are available on the SSAR website (http://www.ssarherps.org/pages/metter.html).

Proposals should be submitted electronically as e-mail attachments or by regular mail. Submit proposals or questions regarding application procedures to the Chair of the Metter Award Committee, Dr. Joseph J. Beatty (beattyj@science.oregonstate.edu). Awards will be announced on or around 1 April 2005.

2004 Annual Meeting, Norman, Oklahoma

The 47th annual meeting of SSAR took place from 26–31 May 2004 at the National Center for Employee Development (NCED)/ Marriott Conference Center in Norman, Oklahoma. SSAR members joined with members of the American Elasmobranch Society (AES), the American Society of Ichthyologists and Herpetologists (ASIH), and The Herpetologists' League (HL). The meeting was hosted by the University of Oklahoma with local organizers from the Sam Noble Oklahoma Museum of Natural History, the Department of Zoology, and the Oklahoma Biological Survey.

Almost 1100 herpetologists (including the amazing 94-year-old Henry Fitch) and ichthyologists from 21 countries attended the meeting; 43% of the attendees were students. Papers and posters were presented by 610 individuals. Although the number of symposia was down this year (only four compared to 11 in 2003), they were well attended. The very successful symposium honoring Eric Pianka was standing room only at times.

A great deal of thanks is due to Janalee Caldwell (Chair) and other members of the Local Committee for their dedication and hard work. Manaus was always going to be a hard act to follow, but they rose to the challenge! Special thanks are due to Sharon Brookshire, Jan Hudzicki, and their staff from the Kansas State University Division of Continuing Education for their superb organizational skills.

Social Programs and Resolutions

On the evening of 26 May, President Janalee Caldwell introduced Dr. Rafe Brown (Berkeley and University of Kansas) who gave this year's SSAR President's Travelogue "Oceanic Islands, Cloud Forests, Marcos' Ghost, and Herpetology in the Philippines." As has become the tradition, the room was full and an appreciative audience enjoyed hearing about the biology of the diverse herpetofauna in this biologically rich area, as well as stories about the trials of field work in a tropical region.

President Caldwell opened the Plenary Session on 27 May by welcoming meeting participants to Norman. Ellen Censky (Director, Sam Noble Oklahoma Museum of Natural History) and T.H. Lee Williams (Dean of Graduate College and Vice President for Research, University of Oklahoma) reiterated the welcome and gave informative presentations about the Museum and the University. This was followed by the ASIH Past-Presidential Address from Larry Page, "Egg-clustering and Diversification in Darters." Eric Pianka was this year's Distinguished Herpetologist for The Herpetologists' League and gave a presentation entitled "Can We Read the Vanishing Book of Life?" The AES Plenary Address "Life After Jaws: The American Elasmobranch Society, 20 Years and Counting," given by Samuel Gruber and John Morrissey, completed the Plenary Session.

The Annual Group Photograph followed the morning Plenary Session and many meeting attendees dutifully assembled outside. However, this year, thanks to modern technology and some creative editing, showing up for the photograph didn't necessarily guarantee that your face would appear once, twice, or even at all! The General Reception was held that evening in the Sam Noble Oklahoma Museum of Natural History. Many enjoyed viewing an exhibit of stunning photographs of Brazilian herpetofauna taken by herpetology curators Janalee Caldwell and Laurie Vitt, entitled "Amazonian Biodiversity: Through the Eyes of Amphibians and Reptiles."

Tornado warnings and predictions of wild weather drove the Annual Picnic indoors. Although we were spared, some 92 tornadoes touched down in a band to the north and east that evening, as Oklahoma and Kansas lived up to their reputations. We enjoyed plenty of good Oklahoma barbeque and some great music from "Harvey and the Wallbangers." The Annual SSAR/HL Live Auction held on Sunday evening was, as usual, well attended. John Moriarty's skill as an auctioneer successfully pushed up the bidding on a number of items. Particularly frenzied was bidding on a bottle of 10-year-old beer from the First World Congress of Herpetology and a 5-liter bottle of chardonnay wine donated by Toad Hollow Winery.

The Annual Banquet was held on 31 May at the Sam Noble Museum with Dave Hillis serving as the Master of Ceremonies. Dave warmed up the crowd with a presentation of an impressive collection of photographs amassed throughout the meeting. Who knew that James Dean and Marilyn Monroe would one day attend the Joint Meeting? Winners of the Henri Seibert and Kennedy Awards were acknowledged at the banquet.

The following resolutions were read by Linda Ford (Chair, SSAR Resolutions Committee) and David Green (Chair, ASIH Resolutions Committee) at the banquet:

Resolution on the SSAR Presidents' Travelogue speaker:
Whereas, SSAR President Janalee Caldwell invited Dr. Rafe Brown to present the 2004 SSAR Presidents' Travelogue, and,
Whereas, despite the presence of Marcos' ghost, nothing went awry with the equipment nor facilities, and,
Whereas, Dr. Brown tragically revealed that the exciting new species just discovered are already in danger of extinction from habitat destruction,
Therefore be it resolved that Dr. Brown presented an insightful, fact-filled, but none-the-less enthralling performance despite the fact that he is not on the job market.

Resolution on the SSAR Conservation Committee:
Whereas, the April issue of The Ecological Society of America's publication *Frontiers in Ecology and the Environment* describes SSAR as "the largest international herpetological conservation society", and,
Whereas, the article describes the informative and exciting features of the Conservation committee's new website,
Therefore be it resolved that the society thanks Stephen Richter, chair of the committee, and all members of the conservation committee for their excellent work and for bringing recognition to SSAR.

Resolution on Outgoing SSAR Officers, Editors, and Others:
Whereas, the following individuals have given freely of their time, energy, and expertise to SSAR, and,
Whereas, because of their hard work and dedication, SSAR programs, projects, and goals have been advanced, and,
Whereas, SSAR is dependent on the generosity and tremendous efforts of its members and is grateful for their willingness to serve,
Therefore be it resolved that the Society for the Study of Amphibians and Reptiles offers its gratitude and sincere thanks for jobs well done to the following individuals: Lee Fitzgerald, Board of

Pat Gregory, Dave Cundall, and Julian Lee at the Annual Picnic. Photo by Marion Preest.

Directors; Linda Ford, Board of Directors; Robert Powell, Editor, *CAAR*; Hinrich Kaiser, Section Editor (Anura), *CAAR*; Gordon Schuett, Section Editor (Natural History Notes, Snakes), *Herpetological Review*; Omar Torres-Carvajal (Current Research Section Editor), *Herpetological Review*; Sharon Downes, Associate Editor, *Journal of Herpetology*; P. Stephen Corn, Series Editor, *Herpetological Conservation*; Dennis Desmond, SSAR Webmaster; Dawn Wilson, Resolutions Committee Chair.

Joint Resolution on the Sam Noble Oklahoma Museum of Natural History:

Whereas, the ichthyologists and herpetologists appreciate the warm welcome extended by the Sam Noble Oklahoma Museum of Natural History and its director Ellen Censky, and, Whereas, the state-of-the-art Integrated Pest Management kept us confined to the lobby, we suspect based on some members' reputation for their eating and drinking habits, and, Whereas, the state-of-the-art Security kept the collection tours to a controllable number, we suspect based on some members' reputation for running amok, and,

Whereas, we truly enjoyed the wonders of Brazil through the photo exhibit and the eye-to-eye view of the *Apadosaurus* via the "dinovator,"

Therefore be it resolved that the societies wish to express our sincere gratitude and appreciation for the wonderful times we have had at the Oklahoma Museum of Natural History.

Joint Resolution about the Kansas State University conference planners:

Whereas, ichthyologists and herpetologists have changed the way they organize and operate annual meetings, and,

Whereas, the professional leadership, expertise, congeniality, watchful eyes and unflagging sense of humor provided by our conference planners is key to our success, and,

Whereas, we are now able to offer ichthyologists and herpetologists a well planned and organized meeting,

Therefore be it resolved that we extend our heartfelt thanks and gratitude to Sharon Brookshire, Jan Hudzucki, and their associates at Kansas State University Division of Continuing Education.

Joint Resolution on our Hosts:

Whereas, the University of Oklahoma hosted the joint meetings of the American Society of Ichthyologists and Herpetologists, Society for the Study of Amphibians and Reptiles, Herpetologists' League and American Elasmobranch Society (a.k.a. Jimmy) at the United States Postal Service National Center for Employee Development and Marriott Conference Center in Norman, Oklahoma, and,

Whereas, two social events, including this memorable banquet, were also held at the Sam Noble Oklahoma Museum of Natural History, and,

Whereas, the efforts of the Local Committee and sponsoring institutions have made this a marvelous, if slightly claustrophobic, meeting and,

Whereas, the meeting breaks were provided with soft drinks and coffee to our heart's content, even though there were no goodies to go along with it but that's okay because,

Whereas, popcorn *ad libitum* was freely available in the dining hall and lounge, and,

Whereas, excellent papers and posters were presented concerning the study of amphibians, reptiles and fishes, both bony and cartilaginous, and

Whereas, an atmosphere fostering scientific advancement and camaraderie among old and new friends was created and maintained,

Therefore be it resolved that the societies thank the Sam Noble Oklahoma Museum of Natural History and the Department of Zoology of the University of Oklahoma for sponsoring the meeting, and,

Be it further and most decidedly resolved that we express our sincerest gratitude to the Local Committee chaired by Janalee Caldwell and consisting also of Charles Carpenter, Vic Hutchison, Edith Marsh-Matthews, William Matthews, Laurie Vitt, Ellen Censky, Richard Broughton, Sara Cartwright, Amy Estep, and a host of University of Oklahoma students in ichthyology and herpetology.

David Green, ASIH Resolutions Chair, also read some interesting resolutions regarding the weather, the "pleasure shuttles" to WalMart, the spelling of "ichthyology," and the pronunciation of JMIH. Meeting attendees appeared particularly appreciative of the Local Committee arranging opening of the bar at the NCED 4 hours earlier than normal every day. The Banquet closed with

Linda Ford and Dave Hillis enjoying the music of "Harvey and the Wallbangers" after the SSAR Bar-B-Q. Photo by Marion Preest.

Ernie Liner and Norm Scott compare tee shirts during the Annual Picnic. Photo by Erik Wild.

thanks to the Local Committee and Conference Organizers and an enthusiastic invitation from Henry Mushinsky to attend to 2005 Joint Meeting in Tampa, Florida (6–11 July).

Board Meeting and Business Meeting Summaries

Society President Janalee Caldwell called the Annual SSAR Board Meeting to order at 0800 hrs on 26 May 2004 at the NCED/Marriott Conference Center in Norman, Oklahoma. In attendance were 10 members of the Board of Directors and 9 Editors, Committee Chairs, or members of the Society.

Minutes of the 2003 Board of Directors Meeting were approved. President Caldwell presented summaries of reports made by SSAR Officers, Editors, Committee Chairs, and Coordinators. President Caldwell reported that sites for the joint meeting have been finalized for the next four years (2005 in Tampa, Florida; 2006 in New Orleans, Louisiana; 2007 in Ithaca, New York; and 2008 in Montréal, Canada). The 2008 meeting will be held in conjunction with the 6th World Congress of Herpetology (WCH). David Green (Member, WCH Local Planning Committee) made a number of comments about the location of the meeting, accommodation, and amenities available. A letter of invitation was received from Patrick Gregory (President, ASIH) to hold the 2009 Joint Annual Meeting in Vancouver, British Columbia. Approval was received from the Board to accept this invitation. Henry Mushinsky indicated that, rather than simply accepting invitations, an attempt was being made to distribute meetings around the U.S. Aaron Bauer (Member, 5th WCH Local Planning Committee) presented information on the 5th WCH to be held in Stellenbosch, South Africa (20–24 June 2005). Information about the meeting can be found on the website of the Herpetological Association of Africa (http://www.wits.ac.za/haa).

President Caldwell proposed and received approval from the Board (by email) to form a Web Oversight Committee. This committee would examine the Society website regularly, review new material submitted for posting to the site, and suggest material to be added to the site. A document describing the duties of Committee Chairs and Coordinators was rewritten and posted to the SSAR website. Committee Chairs are now responsible for updating relevant material on the website. A description of SSAR and the *Journal of Herpetology* was written to be included in the 2004 Buyer's Guide for Allen Press.

New appointments made by President Caldwell during the past year include Kirsten Nicholson as Chair of the Nominations Committee, Stephen Richter as Chair of the Conservation Committee, and Richard Durtsche as Symposium Coordinator. President Caldwell noted that SSAR was referred to as "the largest international herpetological conservation society" in the ESA publication *Frontiers in Ecology and the Environment* 2:164 (2004).

Letters of congratulation were sent to the six winners of the 2003 Grants-in-Herpetology Awards and to the winner of the 2003 Dean Metter Memorial Award. Letters of thanks were sent to Drs. Richard Vogt and Ning Labbish Chao for their organization of the 2003 Joint Meeting in Brazil, to Dr. Joseph R. Bidwell and colleagues for their contributions to the SSAR Grants-in-Herpetology program in memory of Dr. James N. Dumont, and to Dr. Toad of Toad Hollow Winery for a donation made to the SSAR live auction. Following tradition, President Caldwell has contributed to the President's Challenge Fund.

Theodora Pinou (Treasurer) reported that the Society made a profit of \$64,438 for calendar year 2003 (\$8,026 in operating income, \$43,826 in donations, and \$12,586 of realized investment income). All investment funds experienced positive returns in 2003. As a result the unrealized loss of \$75,404 in 2002 has been

Eager bidders, Brad Moon, Ali Rabatsky, and Meredith Mahoney, at the SSAR/HL Auction. Photo by Marion Preest.

reduced to $34,597. As this is still just a "paper" loss it will only be realized if assets are sold. Dora made a number of suggestions regarding society funds. She suggested employing a professional portfolio manager to provide advice (but without having trading capacity) on investments. The Board approved President Caldwell's suggestion that a financial advisory committee be formed.

The decline in membership numbers noted in last year's report continues this year. It can be attributed partly to late membership renewals; however, some of the decline might be due to the launch of BioOne and the online availability of Society publications. Dora recommended transferring the duties of the Membership Office to the Treasurer's Office after our contract with Schmidt and Associates ends in December, 2004. She suggested that this change will permit a more focused management of finances, reduce annual service charges, and ensure follow up on returned deposit checks, etc. President Caldwell reminded Board members that the decision to split the duties of the Treasurer's and Membership Offices was made quite recently when Bob Aldridge was Treasurer in order to reduce the amount of work involved as Treasurer. A number of officers expressed satisfaction in their dealings with the current Membership Office. The Board approved non-renewal of the contract with Schmidt and Associates and consolidation of the Membership and Treasurer's Offices.

Breck Bartholomew (Publications Secretary) reported that income from sales of the Society's publications totaled $35,516. Sales were down somewhat compared with recent years, likely reflecting the economy, lack of advertising, and the fact that there were no sales of SSAR publications at the 2003 meeting in Brazil (this will also happen at the two upcoming meetings in Canada in 2008 and 2009).

A reduction in the overrun of journals (from 500 to 250 copies) will help reduce accumulation of inventory. Breck proposed that journal issues be kept for 5 years. After this time, excess journals should be brought to annual meetings and heavily discounted or given away.

Breck made a number of proposals to deal with the bulk of the SSAR inventory currently located in St. Louis (2,100 sq. ft.). Some of this material will be transported to Salt Lake City. However, because of significant transportation and storage costs, a reduction in the volume of material to be sent to Utah is desirable. Breck proposed a "firesale" on much of the inventory. He will send announcements to museums, libraries, collections facilities, and international herpetological societies. He will also notify SSAR members regarding publications that are about to go out of print. Rafael de Sá will work with Aaron Bauer and Breck and contact WCH organizers to locate international scientists and institutions that may be interested in purchasing copies of SSAR publications (especially journals).

Breck proposed taking a number of older *Herpetological Circulars* out of print. He suggested an initial sale on these items followed by distribution/sale at annual meetings. Several *Standard Common and Current Scientific Names for North American Amphibians and Reptiles* circulars may be recycled to avoid adding to confusion over names. Sales on a number of books in the *Contributions to Herpetology* series have dropped to a point where Breck suggests making them available at reduced prices to members, regional societies, and book dealers. Sales of a number of

Steven Whitfield, Corinne Richards, Melissa Pilgrim, and Mizuki Takahashi. Four of the five recipients of the 2004 Grants in Herpetology Awards made at the Annual Business Meeting (Franklin Enrique Castañeda Menéndez not present). Photo by Eric Wild.

Facsimile Reprints in Herpetology have slowed and these issues could be taken out of print and liquidated. There was some discussion of the future of *Catalogue of Amphibians and Reptiles (CAAR)*. Given that many members may not be familiar with *CAAR*, the Board approved a suggestion that a copy of *CAAR* be sent to all members. The Board gave general approval for Breck to implement the above proposals.

Archiving of SSAR publications and Society records was discussed. The Society would need to identify someone able to determine what material is archiveable and also locate a suitable site.

Breck proposed implementing a fee of $10 for all late membership renewals. This will cover the extra costs of packaging and postage. Concern was expressed that a fee may cause some members to not renew their membership. An explanation of this fee will be made in the membership renewal notices. This proposal was approved by the Board.

Robert Powell, Editor of *CAAR*, reported on the status of this publication effort. He thanked Hinrich Kaiser for his service as Section Editor for Anura. Bob noted that the 2003 contributions to *CAAR* consisted of 20 accounts (Nos. 761–780; 3 salamander, 4 frog, 2 turtle, 3 lizard, and 8 snake accounts) for a total of 103 printed pages. Color plates were included in 16 of the accounts. The 2004 subscription is scheduled for publication on June 30 (20 accounts) and Bob has tentative plans for another 20 accounts for 2005. Bob requested a slight increase in the budget for 2005 to allow for typical page costs (including continued use of color plates) and acquisition of software upgrades. From 2004, printing of *CAAR* will occur in Salt Lake City, thus obviating the need for shipping archived copies to the Publications Secretary. A number of personnel changes are anticipated. Bob plans to resign in 2004, Andy Price will serve as Editor and continue as Section Editor for lizards, and Gregory Watkins-Colwell (Index Editor) will become Associate Editor.

Kraig Adler (Editor) reported on the publication activities of *Contributions to Herpetology*. A recent publication in this series

was "*Islands and the Sea: Herpetological Explorations in the West Indies*" edited by Robert Henderson and Robert Powell. "*Field Guide to Amphibians and Reptiles of the West Indies*," by S. Blair Hedges is expected in July of 2004 and although most manuscripts have not yet been received, formatting has begun on "*Biology of the Reptilia*, Volume 20 (Morphology)," edited by Carl Gans and Abbot Gaunt. Beyond next year, publications will include "*Herpetological Time Travel Through the Zoo and Aquarium World*," by James B. Murphy, "*Tasks and Problems Studying the Life of Reptiles in Zoos*," by Hans-Günter Petzold, and "*Lizards of Southern Africa*," edited by William R. Branch and Aaron Bauer.

Editor of *Facsimile Reprints in Herpetology*, Aaron Bauer, reported that publication of "*Les Tortues de l'Indochine*," by René Bourret has been delayed because of new Vietnamese copyright laws. "*The Herpetological Contributions of Mario Giancinto Peracca*," edited by Franco Andreone and Elena Gavetti (with an English translation of the introduction) will be published in late-mid 2005. "*The Shorter Herpetological Contributions of Andrew Smith*" will be released in conjunction with the 5th WCH in Stellenbosch, South Africa. "*The Herpetological Contributions of John Edward Gray*" is anticipated beyond 2004. A number of other titles are under consideration for the future.

Herpetological Circulars Editor, John Moriarty, reported that HC 33, "*Johann von Fischer and His Chameleons: The History of the Common Chameleon*" is planned for early 2005. A grant from the Smithsonian Institution has been requested to cover printing costs. "*A Review of Marking Techniques for Amphibians and Reptiles*" is anticipated in late 2005. Robin Jung and Joe Mitchell, Co-Editors of *Herpetological Conservation* reported that Volume 2 in this series, "*Ecology, Conservation, and Status of Reptiles in Canada*," is expected in summer, 2004. They provided a detailed summary of plans for Volume 3 "*Urban Herpetology: Ecology, Conservation and Management of Amphibians and Reptiles in Urban and Suburban Environments*" including a mission statement, a long list of potential chapters and authors (some of whom have already agreed to contribute), and a tentative timetable. Further information about Volume 3 is available on the SSAR website. Robert Hansen (Editor) reported a 21% increase in the number of pages in *Herpetological Review* Volume 34 compared with Volume 33. He expects Volume 35 to be approximately the same size as Volume 34. This increase in page numbers has not entailed an increase in costs because the production of *Herpetological Review* is now completely electronic. A special effort was made to deal with a backlog of natural history notes (rate of publication increased by nearly two-fold). Rate of rejection of manuscripts has increased over recent years as competition for page space in *Herpetological Review* has become more intense. A number of authors have been referred to the new SSAR author assistance program and an increasing number of manuscripts are being submitted and handled electronically with an associated decrease in labor and costs. Brian Bowen (Associate Editor) has requested that he be replaced. Gordon Schuett (Section Editor for Natural History Notes) was replaced by Andrew Holycross, Omar Torres-Carvajal was replaced by María del Rosario Castañeda, and David McLeod was added as Copy Editor.

Journal of Herpetology Editor, Brian K. Sullivan, submitted a report indicating that the number of submissions in 2003 was similar to that in 2002. The acceptance rate in 2003 was comparable with that in recent years (50–60%). The postacceptance time lag has been reduced and is now 3–4 months. A preacceptance time lag still exists, although this has been addressed partly by the appointment of new Associate Editors and increased electronic submission of manuscripts. Sharon Downes was replaced by David Holzman as an Associate Editor. Brian continues to search for new Associate Editors.

Reports were received from Chairs of the following standing committees and Coordinators: Conservation Committee, Dean Metter Memorial Committee, Henri Seibert Awards Committee, Kennedy Student Award Committee, Meeting Planning Committee, Nominations Committee, Resolutions Committee, Standard English and Scientific Names Committee, and Student Travel Awards Committee, Elector, Symposium Coordinator, and SSAR Representative to AIBS.

Stephen Richter (Conservation Committee) reported that a new committee composed of 10 individuals was formed. This committee has updated the conservation material on the SSAR website and provided new links from this site. A tentative list of initiatives for the coming year includes development of a pamphlet describing the role of humans in the spread of amphibian diseases, updating state conservation links, and developing associations with other conservation organizations.

Chair of the Dean Metter Memorial Award Committee, Joseph Beatty, reported that the screening committee received four proposals this past year. An award was made to Dean Croshaw for his proposal "Evaluating the fitness consequences of polyandry in marbled salamanders." In 2004, proposals are being accepted through 15 July and the committee hopes to make two awards by 15 August. Beginning in 2005, all proposals must be post-marked by 28 February (with SSAR dues being paid by the end of the previous December).

Marion Preest reported that five Henri Seibert Student Awards were made at the 2002 Kansas City meeting. This past year the (recently very large) Ecology/Evolution Category was split in two. The Board discussed retaining five categories (Ecology, Evolution, Conservation, Systematics, and Morphology/Physiology). Given the usually low numbers of participants in the Systematics category, a motion was made and approved by the Board to combine the Systematics and Evolution categories. This change will be implemented in 2005. Bob Gatten reported that the winner of the 2004 Kennedy Student Award is Cynthia P. de A. Prado for her paper:

Prado, C.P. de A. and C.F.B. Haddad. 2003. Testes size in leptodactlylid frogs and occurrence of multiplemale spawning in the genus *Leptodactlyus* in Brazil. *Journal of Herpetology* 37(2):354–362.

Henry Mushinsky (Chair, Meeting Planning Committee) reported on the development of plans for the 2005 JMIH meeting in Tampa. A meeting will be held in Norman with representatives from SSAR, HL, and ASIH to continue the discussion of sharing the costs/profits of the joint meetings. A comment was made that the joint meetings are now sufficiently large that professional conference organizers are essential for the smooth running of these meetings.

Kirsten Nicholson (Chair, Nominations Committee) noted that four new Directors (three regular member and one non-US member, class of 2008) and a President-Elect are needed this year. Rafe

Brown, Brad Hollingsworth, Meredith Mahoney, Jim McGuire, Greg Pregill, and Tod Reeder have agreed to run for regular Board member positions and Oscar Flores-Villela and Rick Shine have agreed to run for the non-US Board member position. Roy McDiarmid and Joe Mendelson, III will run for the President-Elect position. A secretary and treasurer also need to be elected. Dora Pinou (current Treasurer) and Marion Preest (current Secretary) are willing to run for reelection.

Resolutions were read by Dawn Wilson at the 2003 meeting in Manaus thanking retiring members of SSAR for their service and acknowledging Walter Hödl for his presentation of the SSAR President's Travelogue. Linda Ford has replaced Dawn Wilson as Chair of the Resolutions Committee. Brian Crother reported that an update of the Standard English and Scientific Names List was published in *Herpetological Review* 34:196-203. Although successful in standardizing usage of most names, the list has also generated some controversy. The committee will begin work on a new volume in late 2004 and publication is expected in 2007. Brian commended the members of the committee for their service. Twenty-two applications were received for the Student Travel Award and ten awards were presented by Dawn Wilson at the Annual Banquet in Manaus.

Maureen Kearney (Elector) reported the election of two Board members, class of 2006 (David Hardy—Regional Society Representative and Richard Wassersug—Regular Member) in Fall, 2003. In his report, Ruston Hartdegen presented the mission statement, general goals, and goals for 2003 for the Relations with Herpetologists at Zoological Parks Committee. Specific goals for 2004 include the distribution of a survey to explore the willingness of some North American zoological organizations to work with outside researchers, the development of a website linked to the SSAR site, the development of a database of papers on zoo/academic collaborations, and discussion of a symposium on Zoo Research to be held at an annual meeting.

Al Savitzky submitted a thorough report detailing his activities as representative to the American Institute of Biological Sciences (AIBS). He attended the 2004 AIBS and BioOne annual meetings. A number of issues discussed at the AIBS meeting were of concern to SSAR. The Public Policy Office of AIBS continues to expand, and congressional action by the society remains a major initiative. Concern was expressed about stagnant funding levels from federal agencies and the proposal to move science education from NSF to the Department of Education. Representatives of member societies and organizations were given time to provide input into the future direction of AIBS, particularly regarding services and actions.

The BioOne meeting and teleconference gave publishers and librarians an opportunity to discuss concerns about future policies of BioOne, the status of legacy journals, the impact of electronic publishing on not-for-profit publishers, and the current status of BioOne. The Assistant Dean of Libraries of the University of Kansas described studies detailing an overwhelming preference by faculty and students for direct delivery of electronic copy. As a consequence, libraries are being redesigned as places for electronic access to journals and sites for study groups rather than locations where paper copies can be obtained. In a recent survey, 75% of libraries at major research universities report that they are prepared to stop subscribing to journals to which they have electronic access. Information was provided in the report on online delivery of legacy journals and "open access" or free delivery of online information. All societies, including SSAR, must consider the consequences to societies of the shift from print-primary to electronic-primary publication. It was agreed that BioOne must provide sustained and substantial income to society publishers, rather than supplementary income.

Dick Durtsche provided a comprehensive report on his activities as Symposium Coordinator. He received a proposal from Robert Henderson (Robert Powell and Gordon Schuett, co-organizers) for SSAR to sponsor "The Biology, of Boas, Pythons, and Related Taxa" at the 2005 Annual Meeting in Tampa. A motion to accept this proposal was made and approved by Board members. The Board supports the recommendation that symposia be restricted to morning and afternoon sessions and stressed the importance of setting aside time for group discussions during and after symposia to distinguish them from regular paper sessions. The Board asked for acknowledgement of SSAR in any publications resulting from symposia sponsored by the society.

Kraig Adler and Breck Bartholomew provided a report on the sales (by auction) of the Sherman A. Minton and Robert E. Gordon libraries. The proceeds from these sales will go to into "The Sherman A. Minton, M.D., Endowment" and "The Robert E. Gordon Endowment" and interest used to support student travel to SSAR meetings and book-length publications by SSAR respectively. Totals of $13,456 (Minton Endowment) and $22,505 (Gordon Endowment) were raised.

Some time was spent discussing annual elections. No election will be held in 2005 and biennial elections will commence in 2006. A member of the Society recently expressed concern over the lack of confidentiality of ballots. A possible solution would be to include envelopes with the ballot. This, however, would increase costs substantially. The Secretary and Nominations Committee Chair will devise a mechanical solution to the lack of confidentiality (e.g. provide a tear-off portion with name of sender). Ballots will be sent to international members in July/August this year to ensure their receipt well before the election deadline.

The Board discussed the formation of an Education Committee proposed by President Caldwell to, for example, handle requests from the public on information about herpetology, provide mentors to those interested in careers in herpetology, establish connections with regional and national science fairs, and interact with the AIBS Education Committee. Suggestions were made that SSAR form a joint Education Committee with The Herpetologists' League and that this Committee establish ties with regional herpetological societies. The Board approved the formation of an Education Committee to exist independently or with the involvement of The Herpetologists' League.

The formation of a Web Oversight Committee (WOC) received Board approval via an email ballot earlier this year. There was some discussion of the proposed composition and duties of this committee.

The Board discussed the issue of providing members with access to SSAR journals via a relatively new program in BioOne. Discussion ensued about why members should support a Society if access to hard copies of journals is no longer available. Suggestions ranged from participating in annual meetings, access to various awards, discounts on society publications, involvement in po-

President Janalee Caldwell passes the SSAR gavel to President-Elect Robin Andrews at the Business Meeting. Photo by Erik Wild.

litical issues and outreach programs, to support of conservation concerns. Board members were charged with continuing to think about these issues.

A report was received from the Chair of the Grants-in-Herpetology Committee (Erik Wild) after the Board Meeting. Fifty proposals were received in 2004 and awards were made in each of five categories (Conservation, Field Research, Laboratory Research, Travel, International). No applications were received in the Herpetological Education and Bibliographic Research categories. Erik expressed satisfaction in changes implemented last year in the application process, particularly electronic submission of proposals, and thanked the members of the Committee.

The Board approved the SSAR 2005 budget. There being no further business President Caldwell adjourned the meeting at 1545 hrs.

The Annual SSAR Business Meeting was called to order by President Caldwell at 1703 hrs on 29 May. Approximately 75 SSAR members were in attendance. President Caldwell summarized a number of reports presented at the Annual Board Meeting by Officers, Editors, and Committee Chairs. There was discussion of the venues of upcoming meetings. David Green extended an invitation to attend the 2008 Joint Annual Meeting in Montréal, Canada and Aaron Bauer encouraged attendance at the 5th WCH in Stellenbosch in June, 2005.

Plans for the Web Oversight and Education Committees were described and there was brief discussion of the roles of these committees. Members, especially graduate students, are encouraged to volunteer for SSAR committees. The LINNE Initiative (Legacy Infrastructure Network for Natural Environments), a project to increase federal funding for promoting systematics and biological collections and linking biological collections, research facilities, and experts with the goal of making biological diversity information easily accessible, was discussed and information pamphlets were distributed to those present.

Kirsten Nicholson presented the slate of nominees for the 2004 annual election. President Caldwell asked for the names of additional nominees; however, none was received. Marion Preest announced the winners of the 2004 Dean Metter Memorial Award, the Kennedy Award, and the Henri Seibert Student Awards. The Grants-in-Herpetology Awards were presented by Erik Wild. President Caldwell then passed the SSAR gavel to President-Elect Robin Andrews and the meeting was adjourned at 1747 hrs.

— Respectfully submitted by
Marion Preest, SSAR Secretary

NEWSNOTES

Slowinski Award Announced for 2004

The Center for North American Herpetology is pleased to announce that the recipient of The Joseph B. Slowinski Award for Excellence in Snake Systematics for 2004 is Simon Creer, a researcher in the School of Biological Sciences at the University of Wales, Bangor, Gwynedd, United Kingdom.

On September 12th 2001, the world lost one of its premier biologists, a loss that went virtually unnoticed in the wake of the tragedy that befell the United States the previous day. Joseph Bruno Slowinski, the 39-year old curator of amphibians, turtles, reptiles, and crocodilians at the California Academy of Sciences in San Francisco, died in the jungles of Burma from the bite of a venomous snake. Joe was bitten on September 11th and, despite heroic efforts to save his life by expedition companions and colleagues, succumbed to the effects of the bite the next day. Eventually, the world took notice, and numerous media outlets across the nation and throughout the world chronicled Joe Slowinski's exemplary career, cut so tragically short.

A distinguished committee, comprised of Frank Burbrink (City University of New York, Staten Island), Brian Crother (committee chair, Southeastern Louisiana University, Hammond), and Robin Lawson (California Academy of Sciences, San Francisco), have deemed the paper entitled "Assessing the Phylogenetic Utility of Four Mitochondrial Genes and a Nuclear Intron in the Asian Pit Viper Genus *Trimeresurus*: Separate, Simultaneous, and Conditional Data Combination Analyses," (2003. Molecular Biology and Evolution 20[8]) , as the most distinguished paper on snake systematics to appear worldwide during 2003. The paper was co-authored by Anita Malhotra and Roger S. Thorpe (all of the University of Wales).

As senior author of the paper, Simon Creer becomes the second recipient of The Slowinski Award, and will receive a check from The Center for North American Herpetology for US $500 along with a commemorative memento in recognition of his achievement.

LACM Herpetology is Open

As many of you know, in June of 2003 the herpetology staff of the Natural History Museum of Los Angeles County (LACM) were laid off due to a budgetary shortfall. Since then, the section of Herpetology has been overseen by Ichthyology staff comprising Dr. Christine Thacker (curator), and Jeff Seigel and Rick Feeney (collection managers). Many herpetologists have asked about the status and activities of the Herpetology section and, in particular,

whether Herpetology is still open for business and what care is being taken of the excellent collection of nearly 180,000 specimens of amphibians and reptiles. We in Ichthyology want to assure the herpetological community that we are committed to the preservation and maintenance of our herpetology collection, and that the collection is open for your use. We are continuing to process loans and data requests, and provide access and assistance for visitors wishing to examine specimens. The collection is housed in compactors in a secure, climate-controlled facility, and the storage conditions are excellent. We remain hopeful that Herpetology staff positions will be restored at some time in the future; until that happens, we encourage those seeking to use the collection to contact one of us at (213) 763-3374, or to e-mail us at the addresses given on our website: http://www.nhm.org/research/fishes/index.html.

LizardChasers.Org

LizardChasers.org is a new web site which offers opportunities for students, interns, and volunteers interested in herpetology. Some research projects are carried out in the southwestern U.S. desert. Topics of study include conservation, behavioral, and evolutionary ecology. Several opportunities for the summer of 2005 will include fire ecology of the Bunch Grass Lizard (*Sceloporus slevini*) in southeastern Arizona. Photo galleries of herps and study sites throughout the southwest U.S. are also on display on the site: http://www.lizardchasers.org. For additional information, contact Paul Hamilton (e-mail: info@lizardchasers.org or phamilton@asu.edu), Arizona State University, West Campus, Department of Integrated Natural Sciences, PO Box 37100, Phoenix, Arizona 85069-7100, USA.

MEETINGS

Meetings Calendar

Meeting announcement information should be sent directly to the Editor (rwh13@csufresno.edu) well in advance of the event.

16–18 January 2005—Biology of the Rattlesnakes conference, Loma Linda, California, USA. Information: www.BiologyoftheRattlesnakes.org.

19–24 June 2005—Fifth World Congress of Herpetology, Stellenbosch University Campus, Stellenbosch, South Africa. Information: http://www.wits.ac.za/haa/5wch.htm.

6–11 July 2005—48th Annual Meeting, Society for the Study of Amphibians and Reptiles, together with The Herpetologists' League and the American Society of Ichthyologists and Herpetologists. University of South Florida, Tampa (USA). Information: http://www.dce.ksu.edu/jointmeeting/.

CURRENT RESEARCH

The purpose of **Current Research** is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, **Eli Greenbaum** or **María del Rosario Castañeda**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can be found at: http://www.herplit.com/contents.

Perch Height and Habitat Preference in Anoles of Grenada

Two species of anoles coexist in Grenada (Lesser Antilles): *Anolis richardii* and *A. aeneus*. The authors tested the previously proposed hypotheses that (1) *A. richardii* is more abundant in densely shaded areas, and (2) adult males of *A. richardii* perch higher than smaller conspecifics and *A. aeneus* of all age classes. Also, they studied the structural niche breadth and degree of niche overlap between the two species based on perch height and diameter, lizard orientation, and degree of insolation. Four different habitats were considered: mangrove forest (dominated by *Rhizophora mangle*), dry scrubland (dominated by *Acacia nilotica*), dry woodland (recently cleared), and streamside broadleaf forest (mixed agriculture). Results agreed with previous hypotheses in that higher densities of *A. richardii* were found in more densely shaded areas whereas higher densities of *A. aeneus* were found in more open, sunny areas. However, differences in perch height were found among the habitats, with *A. aeneus* perching higher that *A. richardii* in the streamside forest. The structural niche breadth analysis classified both species as habitat generalists, and the niche overlap values indicated syntopy in some habitats. This study highlights the effect of environmental characteristics on habitat utilization by anoles.

Harris, B. R., D. T. Yorks, C. A. Bohnert, J. S. Parmerlee, Jr., and R. Powell. 2004. Population densities and structural habitats in lowland populations of *Anolis* lizards on Grenada. Caribbean Journal of Science 40:31–40.

Correspondence to: Robert Powell, Department of Biology, Avila University, Kansas City, Missouri 64145, USA; e-mail: powellr@mail.avila.edu.

Circadian Cycles, Environmental Conditions and Daily Activity Patterns of Whiptail Lizards

Circadian clocks and environmental conditions seem to be the main factors influencing animal activity patterns. Field studies on reptiles suggest that environmental temperature is the main determinant of initiation and cessation of activity; however, environmental stimuli can also obscure endogenous rhythms. The authors

tested the effect of soil temperature, hunger, rates of water evaporation and endogenous rhythms in the early cessation of activity in *Aspidoscelis gularis* and *A. inornata*. Lizards were kept in activity chambers with a stable temperature gradient and a permanent source of water. Different trials to test the effects of feeding on activity were performed on normal and reversed photoperiod regimes. No relationship between high temperatures and cessation of activity was found, although a critical soil temperature was required for initiation of activity. In addition, no effect of food and water availability was found on activity patterns. The results support the primary role played by circadian cycles in the initiation and cessation of activity, and the persistence of the cycle in the absence of limiting environmental factors.

WINNE, C. T., AND M. B. KECK. 2004. Daily activity patterns of whiptail lizards (Squamata: Teiidae: *Aspidoscelis*): a proximate response to environmental conditions or an endogenous rhythm? Functional Ecology 18:314–321.

Correspondence to: Chris T. Winne, Savannah River Ecology Laboratory, Drawer E. Aiken, South Carolina 29802, USA; e-mail: winne@srel.edu.

Temporal Partitioning of Calling Activity in Amphibians

Most species of amphibians in the tropical region of South America breed only during the rainy season. This strict timing might lead to temporal and spatial competition for oviposition and calling sites. The authors studied the temporal partitioning of calling activity and its correlation with rainfall, temperature, and pond water level in a French Guianan frog community during the rainy season. All 31 species observed, representing different reproductive modes, increased their calling activity with increased rainfall. Explosive breeders, species laying eggs in terrestrial foam nests and on vegetation above water, species with terrestrial oviposition, and species with direct development or with non-feeding larvae showed different calling activity patterns throughout the rainy season. The results support the strong influence of abiotic factors on amphibian reproduction, and the adjustment of calling and reproductive activity according to the requirements of different reproductive modes.

GOTTSBERGER, B., AND E. GRUBER. 2004. Temporal partitioning of reproductive activity in a neotropical anuran community. Journal of Tropical Ecology 20:271–280.

Correspondence to: Brigitte Gottsberger, Institute of Zoology II, Friedrich-Alexander University Erlangen-Nürnberg, Staudtstr. 5, 91058 Erlangen, Germany; e-mail: bgottsbe@biologie.uni-erlangen.de.

Behavioral Response of *Rana* and *Bufo* Tadpoles to Trematode Parasites

In recent years, there has been an increase in parasite-induced developmental malformations in tadpoles as a result of echinostomatoid infections. Previous hypotheses suggest that this rise could be explained by the increase in host densities because of normal environmental fluctuations and/or changes in the landscape caused by human activity, or by the weakening of the immune system of tadpoles due to pesticides. This study tested an alternate hypothesis, in which the behavioral response to contact with parasites influences trematode infection. Using high-speed video, the authors recorded the response of *Rana silvatica* and *Bufo americanus* tadpoles to larval stages of trematode parasites (cercariae) of the genus *Echinostoma*. Fast starts and sudden changes in position were observed after exposure to the cercariae in both species, though *Bufo* tadpoles exhibited more diverse and violent movements than *Rana* tadpoles. The authors conclude that behavioral response is important for shedding parasites and that factors reducing locomotion in tadpoles, such as the presence of predators or pesticides, increase the risk of parasite infection.

TAYLOR, C. N., K. L. OSEEN, AND R. J. WASSERSUG. 2004. On the behavioural response of *Rana* and *Bufo* tadpoles to echinostomatoid cercariae: implications to synergistic factors influencing trematode infections in anurans. Canadian Journal of Zoology 82:701–706.

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Dietary Component of the Fossorial Snake *Atractaspis*

An adult caecilian (*Scolecomorphus kirkii*) was found among the gut contents of a burrowing snake *Atractaspis aterrima*. Natural history information on *Atractaspis* snakes is scarce, especially with regard to their diet, probably as a result of their fossorial lifestyle. Feeding habits of *Atractaspis* are particularly interesting because of their highly modified dentition (teeth mostly reduced with the exception of very long maxillary fangs) and the ambiguous phylogenetic position of Atractaspidae. The authors report the characteristics of prey and predator (size, size ratio, and position of prey in gut). Also, references and comparisons with previously reported *Atractaspis* gut contents and *Scolecomorphus* predation data are described.

GOWER, D. J., J. B. RASMUSSEN, S. P. LOADER, AND M. WILKINSON. 2004. The caecilian amphibian *Scolecomorphus kirkii* Boulenger as prey of the burrowing asp *Atractaspis aterrima* Günther: trophic relationships of fossorial vertebrates. African Journal of Ecology 42:83–87.

Correspondence to: David J. Gower, Department of Zoology, The Natural History Museum, London SW7 5BD, UK; e-mail: d.gower@nhm.ac.uk.

Evolution of Color Variation in *Ctenophorus* Lizards

In theory, animal color patterns represent a compromise between signaling effectiveness and protective crypsis for visually oriented predators. The authors used chromatic (hue) and achromatic (brightness) spectrum measurements and information on predator visual sensitivities to evaluate the role of crypsis in the evolution of color in *Ctenophorus* lizards (*C. decresii, C. fionni,* and *C. vadnappa*). Differences in conspicuousness among populations, between sexes, and between body regions ('exposed' or 'hidden'

from predators), and evidence for local adaptation to different substrates through crypsis were investigated. The authors found differences in crypsis between populations and between sexes, especially in body regions used by males during social and sexual displays. Also, 'exposed' regions were more cryptic than 'hidden' regions in both sexes. These results add evidence supporting the necessary compromise involved in the evolution of color pattern between signaling and cryptic functions.

STUART-FOX, D. M., A. MOUSSALLI, G. R. JOHNSTON, AND I. P. F. OWENS. 2004. Evolution of color variation in dragon lizards: quantitative tests of the role of crypsis and local adaptation. Evolution 58:1549–1559.

Correspondence to: Devi M. Stuart-Fox, School of Animal, Plant and Environmental Science, University of Witwatersrand, Private Bag 3, Wits 2050, South Africa; e-mail: devi@gecko.biol.wits.ac.za.

Ecological and Genetic Components of Behavior in *Desmognathus* Salamanders

Species interactions and dispersal capabilities describe major patterns of community structure, which in turn, has an effect on speciation patterns. The authors studied the influence of species interactions on behavior and population genetics by comparing two populations of *Desmognathus monticola*, one allopatric and the other sympatric with *D. quadramaculatus*. The latter species has more aquatic habits than *D. monticola*, which has been observed to reduce its aquatic habits in the presence of *D. quadramaculatus*. Data regarding behavior (more/less aquatic habits) and individual condition (body mass and length) in allopatric and sympatric settings were recorded in natural environments and laboratory enclosures. Also, sequence data (portion of COI and 12S rRNA genes) were collected. Results indicate that *D. monticola* from areas of overlap with *D. quadramaculatus* have more terrestrial habits than allopatric populations, even in experimental enclosures were *D. quadramaculatus* was excluded. Genetic analyses indicate a recent range expansion of *D. monticola* into areas where it can interact with *D. quadramaculatus*. This paper emphasizes the importance of combining ecology with genetics to study species distributions and behavioral patterns.

RISSLER, L. J., H. M. WILBUR, AND D. R. TAYLOR. 2004. The influence of ecology and genetics on behavioral variation in salamander populations across the Eastern Continental Divide. The American Naturalist 164:201–213.

Correspondence to: Leslie J. Rissler, Department of Biological Sciences, University of Alabama, 307 Mary Harmon Bryant Hall, Box 870345, Tuscaloosa, Alabama 35487, USA; e-mail: rissler@bama.ua.edu.

Phylogeny of Gymnophthalmid Lizards: Multiple Genes and Model Testing

Recent incorporation of multiple genes to estimate phylogenetic relationships has led to the need for simultaneous modeling of sequence evolution of different genes. The authors evaluated the effects of partitioning among-site rate variation and among-site rate autocorrelation on tree topology and Bayesian posterior probability estimates in a phylogenetic analysis of gymnophthalmid lizards. The data set included sequences of protein-coding nuclear c-mos, mitochondrial ND4, and fragments of the mitochondrial 12S and 16S rRNA genes. Five data partitions were evaluated: (1) all genes combined, (2) protein-coding versus rRNA genes, (3) nuclear versus mitochondrial, (4) nuclear versus ND4 versus rRNA genes, and (5) all individual genes. ModelTest v3.0 was used to determine the best-fit model of evolution for each partition. The General Time Reversible (GTR) substitution rate model was applied to all partitions using Mr. Bayes v2.01, with alternative incorporation of among-site rate autocorrelation (each partition with and without autocorrelated gamma). The three-way gamma partition (c-mos vs. ND4 vs. rRNA) was found to produce significantly higher and less variable posterior probabilities. The resulting phylogenetic hypothesis was used to reevaluate the higher-level taxonomy of Gymnophthalmidae.

CASTOE, T. A., T. M. DOAN, AND C. L. PARKINSON. 2004. Data partitions and complex models in Bayesian analysis: the phylogeny of gymnophthalmid lizards. Systematic Biology 53:448–469.

Correspondence to: Todd A. Castoe, Department of Biology, University of Central Florida, 4000 Central Florida Boulevard, Orlando, Florida 32816-2368, USA; e-mail: tcastoe@mail.ucf.edu.

Population Structure of *Chrysemys picta* in a Developing Landscape

Fragmentation, habitat loss and disturbance of wetlands affect populations of aquatic turtles. Similarly, disturbance of upland habitats is also detrimental, since these areas are used for nesting and migration between ponds. The authors studied population structure of *Chrysemys picta*, as well as pond and landscape characteristics of 37 ponds distributed along a gradient of urbanization in southeastern New Hampshire. Pond substrate and herbaceous vegetation were negatively associated with turtle abundance, while year of sampling, forest coverage and potential nesting area were positively associated. Higher proportions of males were associated with high forest coverage, high density of roads and high nest predation. Females were found in upland habitats more often than males and showed a higher proportion of injuries related to human encounters. This paper highlights the importance of studies on early stages of turtle declines to recognize population responses to disturbance in human dominated landscapes. The results would allow the identification of early key interventions to prevent local extinction.

MARCHAND, M. N., AND J. A. LITVAITIS. 2004. Effects of habitat features and landscape composition on the population structure of a common aquatic turtle in a region undergoing rapid development. Conservation Biology 18:758–767.

Correspondence to: John A. Litvaitis, Department of Natural Resources, 215 James Hall, University of New Hampshire, Durham, New Hampshire 03824, USA.; e-mail: john@christa.unh.edu.

ZOO VIEW

". . . In a few years come down and see if anything has happened. A good idea, I believe."—C. B. Perkins, describing in his diary why Galápago Land Iguanas were translocated (*In* Campbell 1978).

In 1932, San Diego Zoo Curator of Reptiles C. B. "Si" Perkins joined a local businessman, G. Allan Hancock, on a trip to the Galápagos Islands to study and collect animals for the Zoo. Hancock's ship was named Valero III, an impressive vessel nearly 200 feet in length and outfitted with the most luxurious trappings; it was perfectly suited for the voyage.

When they reached the islands, Hancock and Perkins decided to move 40 Galápagos Land Iguanas (*Conolophus subcristatus*) from Baltra Island, also known as South Seymour Island, to North Seymour Island which contained no iguanas. On their next trip a year later, they translocated 20 more lizards.

Baltra was an American airbase during World War II in the 1940s. Several thousand military and support personnel were stationed there, in part to guard the Panama Canal. The Baltra lizards disappeared during that period because of habitat destruction, introduction of feral animals, and direct killing by humans.

For 47 years, there appeared to be virtually no successful reproduction or recruitment in the translocated population on North Seymour so a pair of adults was brought to the Charles Darwin Research Center on Santa Cruz Island where they successfully reproduced (Cayot et al. 1994). Populations of feral cats and dogs were reduced on Baltra. In June 1991, 35 five-year-old iguanas were repatriated to Baltra and 24 more were released the next year. This head-starting program was truly an accomplishment deserving praise. If Perkins and Hancock had not intervened years earlier, the land iguana population on Baltra would be extinct.

The situation faced by the Baltra iguanas mirrors the plight of large iguanids throughout the world. Because many species are found on islands, they are particularly vulnerable. For the past several decades, West Indian iguanas of the genera *Cyclura* and *Iguana* have been the focus of many researchers in zoos and aquariums. To underscore this fact, consider the list of authors in the 1982 book *Iguanas of the World*, edited by Gordon Burghardt and A. Stanley Rand; there was not a single one from the zoo and aquarium community! Contrast this with the list of authors in the new 2004 book *Iguanas: Biology and Conservation* edited by Allison Alberts et al.—there are a dozen. In the earlier book, only two iguanines are mentioned in detail in the "Conservation and Management" section—green iguanas (*Iguana*) and banded iguanas (*Brachylophus*). In the new book, Richard D. Hudson and Alberts outline the role of zoos in the conservation of West Indian iguanas (p. 274), a sobering list of 17 taxa requiring attention.

This chapter on the role of zoos was bittersweet reading for me. On the one hand, I am proud of the efforts by my colleagues to save these lizards through genetic research, headstart release programs, training and technology, population recovery and monitoring, and *ex-situ* captive breeding. For the Jamaican Iguana Recovery Program alone, nearly two dozen US institutions provide logistical and financial support. Worldwide, over two dozen institutions support conservation activities on behalf of West Indian iguanas. The sorrow is that these dramatic interventions are needed because so many taxa are at risk.

Alberts, Head of Applied Conservation at the San Diego Zoo, and her coeditors Ronald Carter, William Hayes, and Emília Martins have published a fabulous contribution covering evolution, behavioral ecology, and conservation. One striking feature is that many of the chapters are jointly written by museum, academic, and zoo and aquarium workers, demonstrating increased collaboration. This book will surely stand as the definitive work on this topic for many years to come.

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— James B. Murphy, Section Editor

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Carl and His Rattlesnakes: Herpetology at the Staten Island Zoo

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"The Reptile House was the first large building erected in the Zoological Park," noted Dr. William T. Hornaday, director and general curator of the New York Zoological Park, commonly known as the Bronx Zoo (Hornaday 1918). It is remarkable that this prestigious institution which was opened in 1899 placed an emphasis on reptiles. However, in early days these animals were not considered an important component of a zoo animal collection in this country.

Decades after the opening of the Bronx Zoo, George P. Vierheller, director of Saint Louis Zoo, Missouri, planned a reptile house but members of the zoo control board were concerned about the acceptance of such an exhibit by the public. To convince them, a temporary reptile exhibit was built in a small portion of an old ostrich barn. Soon, several employees were needed for crowd control as a block-long line of visitors waited to view the reptiles (Perkins 1982). After arriving at the Toledo Zoo, Ohio, in 1929, Roger Conant collected reptiles and constructed exhibits in the lobby of an old elephant house, which became instantly popular (Conant 1997). Such a crowd-drawing power may not have been readily recognized. A glance at data from 1930 reveals a relative

scarcity of reptiles and amphibians in American zoos.

Doolittle (1932) listed a total of 61 institutions including three in Canada; of these, eight submitted no statistical data on animals. Eighteen out of the remaining 53 had no reptiles or amphibians, leaving 35 holding institutions. Eleven of them had fewer than 10 reptiles and amphibians. As for mammals and birds, most zoos indicated the numbers of species and specimens by the so-called S-S count, yet only 22 zoos reported the S-S counts on reptiles and amphibians. Others simply noted the number of individual animals in their holdings. Most puzzling is the list from the Philadelphia Zoo, Pennsylvania; 1,268 reptiles and 63 amphibians with no indication of the number of species. In some zoos, exhibits were only seasonal. Typically, snakes were placed in huge numbers in a "snake pit" and most perished before the winter; frogs met a similar fate.

Exceptionally, five zoos in the United States maintained more than 400 specimens in more than 70 species. At the top was the National Zoo in Washington, D.C. with 600 reptiles and amphibians in 150 species followed by Saint Louis Zoo (581 reptiles in 116 species; 86 amphibians and fish), Toledo Zoo (473 reptiles and amphibians in 70 species), San Diego Zoo, California (408 reptiles and amphibians in 107 species), and Bronx Zoo (401 reptiles and amphibians in 84 species). Behind the statistics lay prominent herpetologists who assembled the collections such as Marlin Perkins (Saint Louis), Roger Conant (Toledo), Charles Shaw (San Diego), and Raymond Ditmars (Bronx).

A Small Zoo on an Island

On the list of American zoo herpetologists, another name appears regularly: Carl Kauffeld of the Staten Island Zoo. A close examination of the history of this zoo reveals that the zoo was intimately tied to snakes even before Kauffeld came into the picture (Kawata 2003). In the early 1930s a group of leading naturalists of the community including Harold O'Connell, Carol Stryker and Robert Mathewson, planned a zoo in the eight-acre municipal Barrett Park. They were advocates of snakes and dreamed of a zoo with emphasis on reptiles especially snakes. The zoo was to be built with labor by the Works Progress Administration (WPA), a federal government program created during the Great Depression.

Staten Island is the southernmost and least populated of the five boroughs in New York City (1930 population: 158,346). Yet the small zoo was to become a pioneer in other areas in addition to reptiles. Dr. Patricia O'Connor, the first full-time (most likely the very first) woman zoo veterinarian in the country, worked here (1942–1970), leaving a legacy of many accomplishments. Also, at a time when few zoos emphasized education, it became the prime mission of this institution.

Educational Programs

Even before the zoo opened, aforementioned Stryker and O'Connell conducted programs for civic organizations using snakes, demonstrating force feeding and venom extraction. One day in 1935, Dr. Clifford Pope, a noted herpetologist at the American Museum of Natural History in Manhattan, New York, joined the two men in the venom extraction at the Staten Island Club; "milking," as it was known, was a common practice by zoo herpetologists. In May of 1936 the First International Snake Exposition was held in Grand Central Palace, Manhattan, under the auspices of the Staten Island Zoological Society, the operator of the zoo. Its purpose: To stimulate interest in snakes, and through educational methods, to overcome some of the widespread public fear of them. Ross Allen of Silver Springs, Florida, Frank Buck of the *Bring' Em Back Alive* fame and Raymond Ditmars were among those who attended the event.

Carl Kauffeld, the legendary reptile curator of the Staten Island Zoo, giving a lecture using live snakes at the zoo's auditorium. With colorful theatrics, his presentation marked the annual highlight of the series of natural history talks for members of the Staten Island Zoological Society. Undated photo by Staten Island Zoo.

On 10 June 1936 the zoo opened, consisting of one building in a shape of a large T. Several weeks later Carl Kauffeld, then on the staff of the American Museum of Natural History, arrived as the curator of reptiles. The zoo building had three "wings" for mammals, birds, and reptiles in addition to an aquarium section. The reptile wing, often called the Serpentarium, measures roughly 31 m (104 ft) long and 16 m (54 ft) wide including service areas, with a series of glass-fronted cages and an alligator pool. Highly unusual for any zoo, this new zoo was equipped with a large auditorium, classrooms, and a laboratory.

The staff conducted a variety of educational programs ranging from regularly scheduled lectures for children and young people, high school biology classes, monthly lectures for the Zoological Society members to special lectures on request by various groups, and tours for elementary school children. Within three years after the programs began, more than 15,000 children in elementary school groups visited the zoo; another 600 attended the biology and laboratory classes for high school and college students, and more than 10,000 attended the lectures and club meetings for children and young people. Those programs were conducted primarily by the zoo director, staff veterinarian and the reptile curator (the zoo did not have paid staff for education until the 1970s). The annual highlight of the programs at the auditorium was Carl Kauffeld's lecture on snakes. Throughout their efforts, the staff tried to dispel the popular myths concerning snakes, and to explain interesting facts about them.

"The fear of snakes is not instinctive," Carol Stryker, the first zoo director, noted, adding: "We are interested in obliterating as many of the superstitions concerning snakes as possible." In 1942

Field work was a passion with Carl Kauffeld. For this annual event he often took protégés such as Robert Zappalorti (left, with a Black Racer). In Okeetee, South Carolina, April 1968. Photo by Robert Zappalorti.

the staff inaugurated the "acquaintance program" with the assistance by the members of the Staten Island Herpetological Society. Each Sunday afternoon, some non-venomous snakes were taken out of the cages and handed out from a roped off area for the public to touch. The staff hoped that if the average person could learn to appreciate the snakes they would not kill snakes, and would try to dispel the ignorance and fear of others. "Closely associated with the 'acquaintance program' is the still more fundamental objective of developing a tolerance for snakes which will lead to extensive snake conservation." (Anon. 1942)

Innovative activities by the staff in the pre-WWII period included radio broadcasting of snake venom extraction and a rattlesnake rattle as Stryker held the snake before a microphone. At the zoo, an exhibit was placed in front of a rattlesnake cage with a rattlesnake rattle in a case, attached to a clapper arm of an electric doorbell. As a visitor pressed a push-button at the guardrail the rattle would produce a sound, simulating that of a snake. This prototype was prone to breakdowns due to a relatively crude mechanism. In the late 1950s Kauffeld rehabilitated the device, which was copied by other institutions. This Staten Island original was a forerunner of the participatory and interactive exhibits that blossomed in zoos decades later.

The zoo was a pioneer. Like any pioneers, however, the staff faced challenges. One such example involved television, a rapidly emerging media in 1949. The National Broadcasting Company (NBC) canceled a snake presentation by noted naturalist Ivan T. Sanderson and Carl Kauffeld. This was after an assurance was given that the audience would be warned five minutes prior to the appearance of a live snake. The director of the broadcasting station defended his position stating that some viewers might find a snake disagreeable, particularly during dinner hours. "Apparently NBC wants to force its own prejudice on the public by suppressing an educational show aimed especially at dispelling medieval fears and superstition," Kauffeld commented in response.

Husbandry Highlights

With a group of trained animal care personnel, the zoo established a sound basis for a husbandry program during its infancy. Snakes began to breed; September 1936 saw births of rattlesnakes, including 20 Eastern Diamondback Rattlesnakes (*Crotalus adamanteus*). Captive breeding of any rattlesnake species remained sufficiently unusual in a northern zoo to be worthy of note even in the 1960s. A pair of Canebrake Rattlesnakes (*Crotalus horridus atricaudatus*), collected in the wild in 1956, became the parents of 10 young in 1961. During the same year a captive-bred and reared pair of Indian Cobras (*Naja n. naja*) mated and the female laid a clutch of 10 eggs. However only one hatched, and the hatchling lived a day or so. Multi-generation breeding was still a challenge then. Rattlesnakes continued to reproduce in the following years.

Over the years the zoo accumulated longevity records in captivity. Snider and Bowler (1992) compiled reptilian longevity records in North American collections as of 1990. Records on nine genera of snakes including *Epicrates, Eryx, Pituophis, Rhinocheilus, Spalerosophis, Naja, Agkistrodon, Crotalus* (two species), and *Sistrurus* (two species) were noted at the Staten Island Zoo. Additionally, previously unpublished data were recently found in the zoo's archives which could potentially be longevity records in North America. Of the six Arizona Black Rattlesnakes (*Crotalus viridis cerberus*) born here on 13 September 1967, three were kept at this zoo; the last one died on 3 September 1983, or after 15 years, 11 months, and 20 days. A Great Basin Rattlesnake (*C. v. lutosus*) was received on 1 July 1971 and was euthanized due to anorexia caused by a huge swelling anterior to mid-body on 5 March 1998, or after 26 years, eight months, and four days. Another possible record holder is a male Black Mamba (*Dendroaspis polylepis*) which arrived on 21 October 1970 and died on 19 February 1995, or after 24 years, three months and 28 days.

Conservation and Research

Aside from educational programs to promote reptile conservation, the staff was engaged in various activities. Among the notable was the work in the Pine Barrens region in neighboring New Jersey. Local people routinely harvested snake eggs, primarily of the Pine Snake (*Pituophis melanoleucus*) and also the Corn Snake (*Elaphe guttata*) and the Black Racer (*Coluber constrictor*) for commercial purposes. Some species also became a target by the pet trade. The staff collected eggs, hatched them in the zoo, and returned them into the wild. This release program continued from the 1960s into the 1980s. In later years zoo-hatched corn snakes were released in South Carolina.

Of medical interest, in 1981 malignant fibro-sarcoma was diagnosed, located between the head and left shoulder in a Galapagos Tortoise (*Geochelone elephantopus*); this type of tumor had not been found in a reptile before. Despite advanced treatments she died in 1983. As for more organized research, senior reptile keeper Charles Hackenbrock studied the morphology of the pituitary gland of snake embryos in the late 1950s, utilizing the Corn Snake and the Timber Rattlesnake (*Crotalus horridus*). Embryos were removed at various stages of development; in the case of the rattlesnake they were surgically taken from gravid females. Histological sections of the head were then cut and stained, and the development of the gland was traced from the earliest to the latest stages.

Regarding *in situ* research, in the 1970s Robert Zappalorti, associate curator of herpetology and education, and coworkers conducted a study on the natural history of the Bog Turtle (*Clemmys muhlenbergii*) in southwestern North Carolina. With three-year

grants from various organizations, they broke new ground including the documentation of a previously unknown breeding population of the species.

A Man of Legend

Three decades after his death Kauffeld continues to appear in reptile-related publications and to stir up lively conversations in zoo and herpetological circles. A native of Philadelphia, Carl Frederick Kauffeld (1911–1974) held the title of curator of reptiles beginning in 1936, and the dual title of director and curator of reptiles from 1963 to 1973 at the zoo. He held no college degree. Interestingly, Card and Murphy (2000) reviewed American zoo herpetologists and observed, "Some persons with limited formal education have been some of the most productive zoo professionals." Wemmer (1991) noted, ". . . on the average, herpetologists are more inspired practitioners of their discipline than most bird and mammal curators." He added that their intellectual commitment resulted in a higher publication rate, more collaboration with non-zoo biologists, and more field experience.

Kauffeld typifies this breed. Dr. Wemmer lists 21 scholars in "a gallery of zoo research and zoo biologists" which includes Kauffeld along with well-respected Europeans. Roy Pinney (1984) remarked, "Because of his involvement, no one since Raymond L. Ditmars of the Bronx Zoo and Ross Allen in Florida did more to popularize herpetology by personal contact, by lectures with live snakes, and by writing." Kauffeld authored three books (one of them with C. H. Curran) and more than 200 articles, and enjoyed an international reputation. Also, Kauffeld served as a mentor and helped promote the zoo as a fertile training ground for younger herpetologists.

The name Carl Kauffeld has been inspirational for persons interested in reptiles. Directly influenced by him young employees, volunteers, and ardent zoo fans later became prominent in zoo, medical, and biological fields. A selected list includes (in alphabetical order; in parenthesis are positions held, past or present) Charles Hackenbrock (Chair, Department of Cell Biology, School of Medicine, University of North Carolina), Robert Mathewson (Director, Lermer Marine Laboratory of the American Museum of Natural History), Louis Pistoia (Curator of Reptiles, Columbus Zoo), Manny Rubio (photographer and author), Wade Sherbrooke (Director, Southwestern Research Station of the American Museum of Natural History), Harold Wahlquist (certified fisheries biologist, United States Fish and Wildlife Service), John Werler (Director, Houston Zoo), Robert Zappalorti (President, Herpetological Associates, Inc., New Jersey), and Dave Zucconi (Director, Tulsa Zoo).

Rattlesnakes Making History

"I don't want you to think that we have any idea of trying to compete with other zoos," commented Carol Stryker to a reporter in 1935 regarding the zoo under construction. Snakes represented the highlight, and at the opening of the zoo, rattlesnakes were featured in a simulated desert scene with cacti, sand, and a bovine skull. Taking on this pursuit, Carl Kauffeld "wisely realized that a smaller zoo could not directly compete with larger zoological gardens such as the nearby Bronx Zoo; his solution was to specialize in snakes, especially rattlesnakes" (James Murphy, pers. comm.). "The urge to hunt and collect is strong in most of us, but never stronger in any one group of people than in naturalists—the zoologists and botanists," asserted Kauffeld (1957), and collect he did. By 1964 a total of 42 species and subspecies of rattlesnakes had been exhibited at the zoo, a number exceeded only by the San Diego Zoo.

Of particular importance, the staff attained the major goal in the same year: For the first time in the history of zoos, they harbored all 32 rattlesnake species and subspecies known to occur in the United States. Among other rattlesnake "firsts" were the arrival of a pair of Aruba Island Rattlesnakes (*Crotalus unicolor*) in 1937, the first to be exhibited in the country; a pair of the Arizona Ridge-nosed Rattlesnakes (*C. w. willardi*), the first of their kind to be exhibited in any zoo, in 1941; the Chihuahua Ridge-nosed Rattlesnakes (*C. w. silus*), the first to reach a zoo, in 1961, and the Southwestern Speckled Rattlesnake (*C. mitchelli pyrrhus*) bred in the zoo for the first time in captivity anywhere in 1962.

Most surprising, a rattlesnake from Mexico arriving in January of 1940 turned out to be new to zoology. It was recognized as a new species and given description under the name *Crotalus totonacus*, the Totonacan Rattlesnake, by Dr. Howard K. Gloyd and Kauffeld.

By the late 1960s the scene of the zoo industry had changed. Larger and modern reptile houses were springing up nation-wide, and the animal collection at the Staten Island Zoo was falling behind in terms of sheer numbers of reptile species and specimens. Nevertheless, the rattlesnake collection continued unsurpassed. With 39 species and subspecies the collection reached its all-time high in 1968 (Staten Island Zoological Society 1969). The 1970s proved to be a difficult period for the zoo, beginning with retirement of Dr. Patricia O'Connor, staff veterinarian, and Carl Kauffeld's declining health.

The waning years of Kauffeld also marked the beginning of rapid changes that were to sweep the zoos of the world. Zoos no longer take pride in the size of animal collections or the number of species in particular taxonomic groups. Long gone are the days of collectors, a remarkable and memorable moment in history. Today, this zoo's rattlesnake collection has dwindled to about one-third of its heyday. "However, there is no doubt the Staten Island Zoo will always be identified with Carl Kauffeld and his rattlesnakes" (Gattullo 2001). His legacy represents a tribute to the bygone era of unmistakably unique characters and great collectors, a monument in the global zoo history.

Acknowledgments.—I would like to express my sincere appreciation to the late Dr. Roger Conant, America's senior herpetologist, for providing insightful and informative comments concerning the status of reptiles and amphibians in zoos during early years.

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POINTS OF VIEW

Herpetological Review, 2004, 35(4), 320–328.

On the Structure of Snake Hemipenes with Comments on their Proper Preparation for Analysis: A Reply to Cadle, Myers, Prudente, and Zaher

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I was greatly surprised at the lengthy responses (12+ pages) by four authors (Myers and Cadle 2003 [M&C]; Zaher and Prudente 2003 [Z&P] to my brief note (Dowling 2002; 2-pages) on hemipenis preparation and illustration. Both of the response papers emphasized that my note was based upon "entrenched opinions" (M&C) and or "authoritative knowledge instead of a search for answers by empirical observation and test of hypotheses" (Z&P).

Actually, none of the applied terms is correct. The operative term is "prior knowledge." Having prepared more than 400 "fresh" hemipenes in the last half-century, I am well acquainted with the varied difficulties in their preparation—and their appearance when something has gone wrong.

When I began my work on hemipenis morphology as an indicator (AN indicator; not THE indicator!) of snake relationships in 1948, I was testing the opinions and the data of some of the workers on snake relationships who preceded me: Cope (1893, 1895), Ortenburger (1923, 1928), Dunn (1928), Bogert (1940), Malcolm Smith (1943), and others. Also, I did not know where the phyletic value of hemipenes fell as indicators of relationships among the many morphological characters used by various workers. Dunn (1928), for example, after summarizing the classifications of Boulenger and Cope, proposed a simplified system for American snakes, with differences in hemipenes as the primary divisions, vertebrae as the secondary, and the dentary as the tertiary. Bogert (1940) used characters of vertebrae for his primary division of Ethiopian clades, hemipenial morphology as the secondary, and dentition as the tertiary, with his 18 (unnamed) "Groups" not further defined, although indicated by additional morphological description. In contrast, Bourgeois (1969) only used skull characters to distinguish the Ethiopian clades. She also applied subfamilial names to them. She was wrong, unfortunately, in her allocation of members of Bogert's Groups I, III, and IV to Colubrinae, but her identification of Bogert's Group II as Lycophidinae, Group IX as Philothamninae, his Groups XIII and XIV as Boiginae, Group XV as Dispholidinae, Group XVI as Psammophinae, and Group XVII as Aparallactinae have not been greatly modified since that time, and the "Subfamilies" appear to be valid taxa at some level. [The true Colubrinae (*s.s.*) were in Bogert's Group VIII, which she did not examine.]

Malcolm Smith (1943) used skull morphology and dentition as major elements, with supplementary information on head and vertebral morphology, in his familial descriptions of Oriental snakes, with subfamilies identified mainly by scale characters.

It appeared, nevertheless, that dentition, skull morphology, vertebral morphology, and hemipenis morphology all were considered to be prime characters in the identification of snake relationships. I later decided to use them generally in the order of: vertebrae, hemipenis, skull, dentition, and details of scutellation. Biochemical analyses (electrophoresis and immunology) and genomic analyses have more recently been added to the morphological data examined.

SOME CRITICAL REMARKS

First, on the Response by Myers and Cadle

On *Psomophis*.—Apparently hemipenis distortion is in the eye of the beholder. I consider a hemipenis that is bowed over so far that the apex appears to be in the middle of the main lobe (Fig.1) to be "badly distorted." M&C and Z&P apparently think otherwise. A comparison of the original figure (M&C 1994) with their (2003) Fig.1 appear so unlike that they might represent different genera of snakes. These figures also show the advantage of a good drawing over what might have been an excellent photograph. Incidentally, I suspected, as did M&C, that the "bowing-over" of the lobes of the hemipenis was caused by the shrinking of the retractor muscle during preservation, as that I described for *Siphlophis* (Dowling 2002).

M&C complain that I "inexplicably failed to notice that Zaher [1999] had corroborated the general physiognomy of the *Psomophis* hemipenis." This is true, because I saw (and see) little correspondence between the organ as drawn by Edmund Malnate (M&C 1994) [my Fig. 1.] and the photographs published by Zaher (Figs. 74, Upper and Lower)—except in their basal regions—which are also similar to those of, for example, *Saphenophis boursieri* (Zaher's Fig. 76, Upper) and several other genera. It may be noted also that the hemipenis in Zaher's Fig. 74 is tied so far distal to the true base as to obscure the proximal structure of the hemipenis and the point of division of the sulcus.

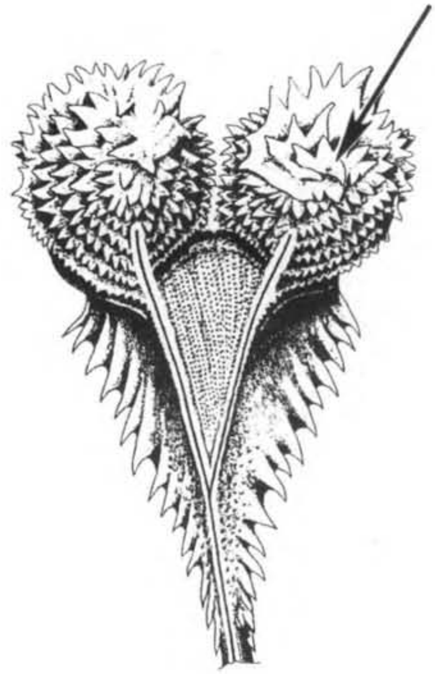

FIG. 1. The hemipenis of *Psomophis genimaculatus* [Xenodontidae; subfamily *incertae sedis*], showing the apex in the center of the apical lobes. [From Myers and Cadle 1994: Fig. 3: pointer added.]

On hemipenis structure and preparation.—M&C complain about "pseudocalyces" that disappear when flattened by "micromanipulation..." which were also found by Z&P. This appears to be a suggestion that none of the responders appreciates that the hemipenis is a double-walled structure, as clearly shown by us, with the aid of Frances Waite's art (see Dowling and Savage (1960: Pl. 1, Fig. 2) [shown here as my Fig. 2.] This is in spite of the quoted "Waite Gibson's" recommendations (M&C 2003: 299), which state in part, "A better specimen is obtained if the needle can be inserted into the lymph sinus and this inflated also."

A hemipenis cannot be merely inflated "like a balloon." As indicated by Ms. Waite, the blood sinus (or the central cavity) of the hemipenis should be filled to fully evert the body of the organ (including the lobes)—and then the outer "lymph sinus" must be filled to fully evert the calyces and flounces. I suggest, therefore, that the disappearing calyces reported by M&C and Z&P are an artifact of incomplete specimen preparation.

M&C have a long discussion (pp. 297–300) on hemipenis preparation, which seems irrelevant in view of the statements of one of Myers' own AMNH postdoctoral fellows, H. Zaher, who writes (Z&P 2003:302): "...hemipenial features are surprisingly variable at all taxonomic levels within colubroids" and "Highly complex transformation series as well as homoplastic occurrences of hemipenial structures at low taxonomic levels do not support the hypothesis of hemipenes being inherently stable morphological complexes...." On this basis, therefore, people are wasting their time in making hemipenis preparations for systematic work. [See my Appendix for another explanation. See also Fig. 3.]

I will comment only briefly on M&C's directions on "Field (Fresh) Eversions." I differ from them in three important respects. 1) I have found that, for a good everted preparation it is necessary to cut the retractor muscles near their connection with the apex of the hemipenis. I first learned this the hard way—by losing the lobes of a *Phyllorhynchus* hemipenis through omitting this procedure. I had injected the hemipenis (both the central cavity and the lymph sinus) with water, tied the base with thread, and cut it off the specimen. It was a good preparation, showing a pair of large apical lobes, and after it had remained in water for 3–4 h, I placed it in formalin, and then, without further observation, asked my current artist to draw it on the following day. To my great surprise and dismay, the finished drawing had no lobes! Placing the hemipenis in formalin, even after several hours, had caused the uncut retractor muscle(s) to shrink and re-invert the lobes (Fig. 4).

Thus, I believe that it is the fixing in formalin that contracts the muscles; the time prior to that is not an important factor. 2) Therefore, the "completely relaxed" hemipenial muscles emphasized by M&C are not important—particularly if they have been previously cut! 3) M&C also suggest that the everted hemipenes "may be left on the snake," which I believe to be in error. Much of Ms. Waite's time at HISS was spent in reconstituting hemipenes that had been pressed flat or ruptured by bottling them with the entire snake, and I have spent considerable time on such work, myself. I emphasize, however, that I have never considered using hemipenes alone in my identifications and determinations of snake relationships, nor would I recommend such a procedure. In a recent paper (Dowling and Pinou 2003), I listed eight morphological characters (one of them hemipenial) that might be used to identify a member of the snake family Xenodermatidae. At various times I have used elements of head scutellation (e.g., Dowling and Price 1988: Fig. 3), mode of dorsal scale reduction (Dowling 1958a), dorsal scale ultrastructure (Dowling and Price 1988: Fig. 4-13), and vertebral morphology (Dowling 1958b, 1988), among others, to aid in the determination of relationships. I have also used data such as chromosome morphology (Cole and Dowling 1970), immunology (Dowling et al. 1983) and

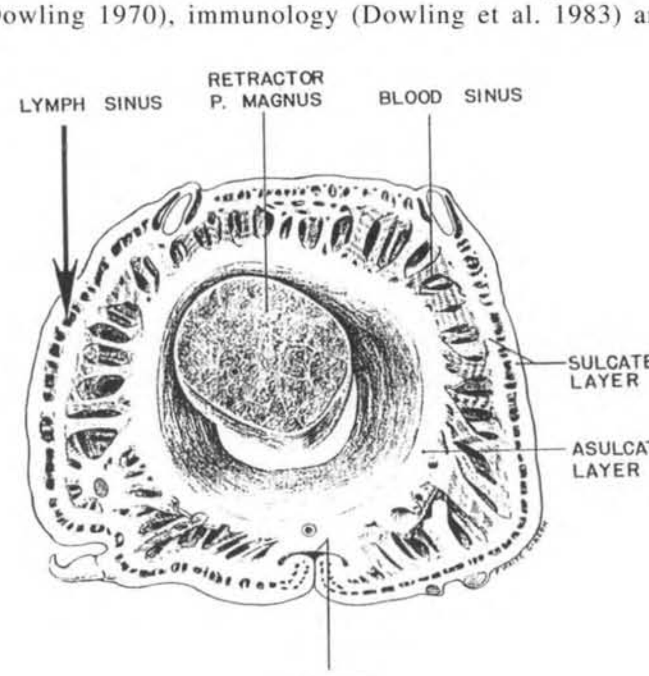

FIG. 2. The cross-section of a hemipenis, showing the two-layered wall; the arrow to the lymph sinus is emphasized. [From Dowling and Savage 1960: Pl. 1, Fig. 2.]

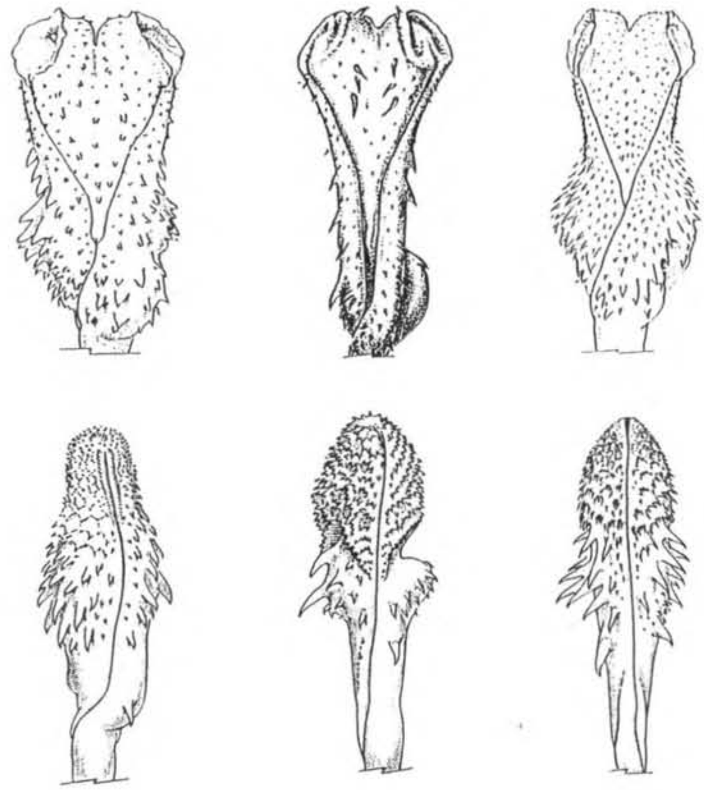

FIG. 3. Top row: Hemipenes of the type species of the genera "*Leimadophis*," "*Lygophis*," and *Liophis* [HISS Collection]. All were placed in the genus *Liophis* [Xenodontidae: Xenodontinae] by Dixon (1980) [cf. my Fig. 10]. In spite of the differences in the expansion of the body, all have the same major characters (e.g., disks) with minor differences in the size and distribution of spines. Bottom row: Hemipenes of three species of the genus *Tantilla* [Dipsadidae: Leptodeirinae: *T. coronata*, *T. atriceps*, and *T. nigriceps*]. Other than differences in the number, size, and distribution of spines, most differences are due to different degrees of expansion of the body during specimen preparation. Only *T. atriceps* clearly shows the degree of capitation, which is common to all [HISS Collection].

FIG. 4. The partly-everted hemipenis of *Phyllorhynchus*. The outline of the originally-observed lobes is dotted in. [Drawn by Brook Fehrenbach: HISS Collection.]

electrophoresis (Dowling et al. 1996) for this purpose.

Having watched mammalogists and ornithologists carefully prepare their specimens in the field (even at midnight), I am struck by the fact that herpetologists still tend to be in the "catch-em, kill-em, fill-em full of formalin, and throw-em in the can" mind-set. The world (including the herpetological world) has changed in the last half-century. It is clear from Zaher's (1999) paper that re-inversion from poorly prepared "field" specimens is never fully successful (see below) and that the proper preparation of everted hemipenes in the field is of major importance. We also need to photograph important specimens alive—to record their colors as well as patterns—and perhaps even record the shape of the pupils of their eyes, anything unusual about their head structures (e.g., nostril shapes and positions), and determine whether their dorsal body scales are juxtaposed or imbricate before preservation. [Immersion in formalin often shrinks the skin, making juxtaposed scales appear imbricate.] Of course we also should take tissue samples for genetic analysis, and perhaps blood samples for electrophoretic and cytogenetic studies.

While working with us at HISS (Herpetological Information Search Systems) Ms. Waite both processed and drew the Museum specimens utilized. Because we had no other everted hemipenes to compare for many of the exotic genera, it was not until after our five-year period at HISS had abruptly ended that we realized that many of the AMNH specimens processed (as described in her note) were still incompletely everted. Apparently, Myers did not recognize this either, resulting in their semi-everted states assumed to be "complete" in Zaher's (1999) extensive study—and my possession of many beautiful drawings—of incompletely-everted hemipenes.

One, of many objectives of ours at HISS was to provide figures of "important morphological characters" of the type species of every snake genus. We decided on a minimal approach: the scutellation of the head, a vertebra from the third quarter of the body, a hemipenis, and a skull or maxilla. To make this possible in the time projected: ten years [later reduced to five when a "restructuring" of National Science Foundation programs left us (and several other similar projects) without a sponsor], we had to restrict each of the figures to a single view. [The complete illustration of a vertebra, for example, requires five views.] Thus, we had only lateral views of the head, vertebra, and maxilla, and only a sulcate view of the hemipenis (*v.* Figs. 5 and 6). [Figs.10 and 11 also have this format.]

On the Response by Zaher and Prudente (2003)

Z&P comment (in part) as follows (p. 302): "...a more careful examination of the arguments and examples used by Dowling shows that his criticisms are founded upon two fallacious ideas: 1) that science is a matter of authoritative knowledge instead of a search for answers by empirical observation and test of hypotheses; [It has been a long time since I have had "science" explained to me!] and 2) that hemipenial morphology shows some special value

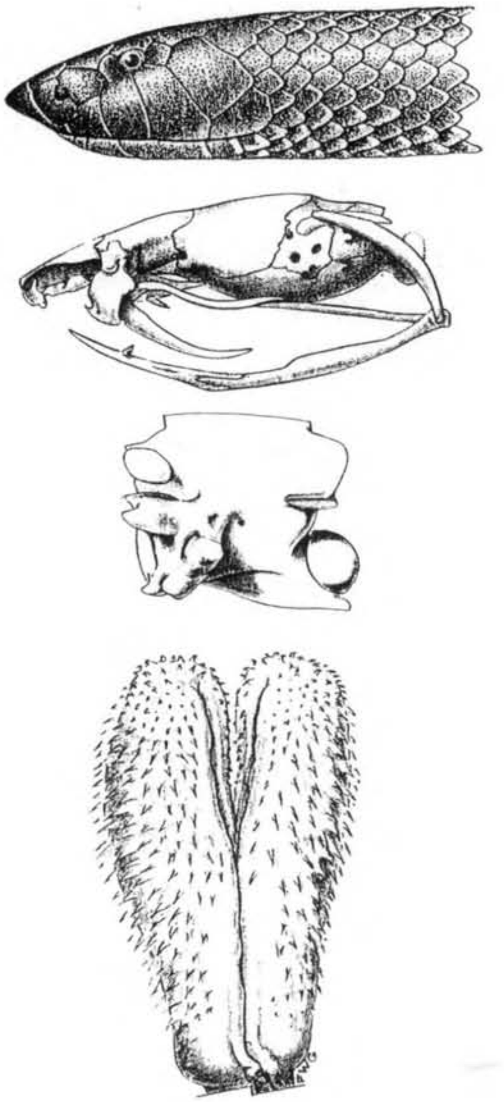

FIG. 5. HISS format [head, skull, posterior vertebra, and hemipenis] of *Atractaspis* ("Atractaspididae"). The apical lobes of the hemipenis are slightly inverted, but the forked centripetal sulcus and the change in size of the spines near the apex are visible. The head drawing is from Witte (1962), other figures are from the HISS Collection. (cf. Zaher 1999: Fig. 4U)

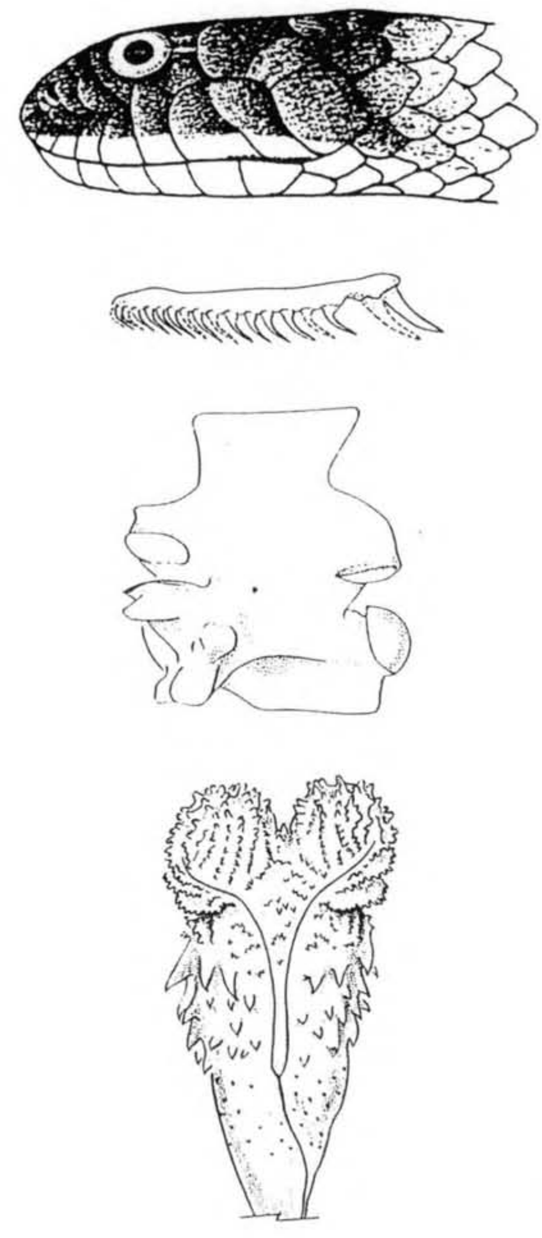

FIG. 6. HISS format of *Helicops* (Xenodontidae: "?Alsophiinae"). The hemipenis is slightly under-everted. The head drawing is from Miranda et al. 1982; other figures are from the HISS Collection (cf. Zaher 1999: Figs. 47–50U).

as a source of information at the detriment of other morphological complexes."

I believe that here, the shoe is on the wrong foot. Rather than arguing about whether my criticisms are valid or not, Z&P should be dissecting the uneverted hemipenis of *Conophis* (*v.* Zaher 1999: Figs. 40, 41) to see whether or not the members of this genus have apical disks—as reported by Wellman (1963) and Auth et al. (1998).

Their objection in reference to *Hydrops* is due to a misreading of my (2002) comment. I referred to Zaher's (1999) Fig. 52, which, although distorted, was a **correction** of my drawing of AMNH 36161, which was incompletely everted and failed to show the apex of the hemipenis.

Their second point, "2) That hemipenial morphology shows some special value as a source of information […] at the detriment of other morphological complexes," I believe to be half-true. I do believe that hemipenial morphology has especial value in establishing relationships among snake taxa (see below), but I do not see any "detriment" of other morphological characters thereby. Z&P are highly critical of my assessment of incomplete eversion and distortion in hemipenes that I have not personally examined. They also have another long segment on hemipenis preparation, much of which is similar to that by M&C. Again, if hemipenial morphology is so variable "at all taxonomic levels," why place so much importance on their preparation? Incidentally, the method employed in their reexamination of previously preserved hemipenes of *Siphlophis* hemipenes (Z&P 2003) is inappropriate. The tissues of the organs had already been fixed, so their overall shapes were unchanged by subsequent treatments. How about cutting the retractor muscles and everting a fresh specimen, or examining an uneverted organ? It is unfortunate that Zaher (1999)

was not encouraged to compare the everted hemipenes that he used in his major work with some inverted specimens—or to have them examined by some other knowledgeable herpetologist.

The value of hemipenes as indicators of relationships is primarily that they all have the same purpose and are used in the same fashion: to introduce sperm into the oviducts of the females of the same species. Thus, they are generally not affected by modes of locomotion, adaptations of sensory organs to changing conditions, or adaptations concerned with prey capture and handling.

The only adaptive change in hemipenes that I have discovered is in the Old World Sand-racers (Psamophiidae), which inhabit open desert grassland and sandy habitats. These snakes, unlike most, remain alert to possible predation during copulation, both male and female looking around in all directions (Fig. 7.). The members of this group (some seven genera with about 73 species) have lost all forms of hemipenis ornamentation, apparently as an adaptation to rapid withdrawal of that organ when the copulating pair is threatened (Fig. 8).

FIG. 7. A sketch, showing the alert postures of copulating psammophiids. [HISS Collection.]

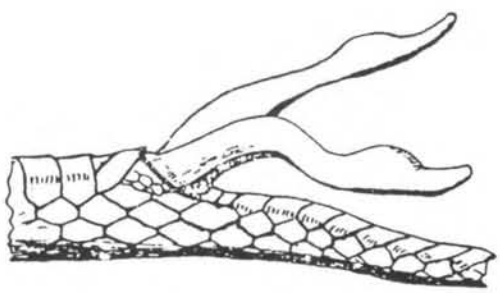

FIG. 8. Hemipenis of *Mimophis* [Psammophiidae] (From Domergue, 1962). Note the length of ~10 subcaudals; the *Psammophis* hemipenis in Bogert (1940: Fig. 14, ~3 subcaudals) is incompletely everted.

Thus, the evolution of hemipenial morphology differs from that of dental and skull characters, which are highly responsive to food adaptations, burrowing or habitat (e.g., the premaxilla in burrowing and other specialized snakes: Bogert 1947 (see my Fig. 9); or terrestrial vs. aquatic snakes: Malcolm Smith 1943:379, 439). It also differs from that of vertebrae, which are responsive to changes in locomotion and food handling (e.g., constrictors, racers, treesnakes, seasnakes).

On the question of my ability to recognize an incompletely-everted or poorly prepared hemipenis, I can only say that it is due to long experience and careful observation. Like a good auto mechanic (of the "old school"), who can tell you what is wrong with the car's motor by listening to it run for a minute or two, or a professional "birder," who can identify an almost invisible bird by a faint call or the flash of a wing—in the last several decades of study I have acquired an "eye" for details that suggest problems in the preparation of hemipenis specimens. These include having: 1) the apex (or apices) bowed over, 2) apical lobes of unequal length, 3) flattened or depressed apices, 4) the "end" of a sulcus spermaticus entering an apical depression, 5) a crooked sulcus, 6) a corrugated base, and 7) jagged or irregular margins of the organ.

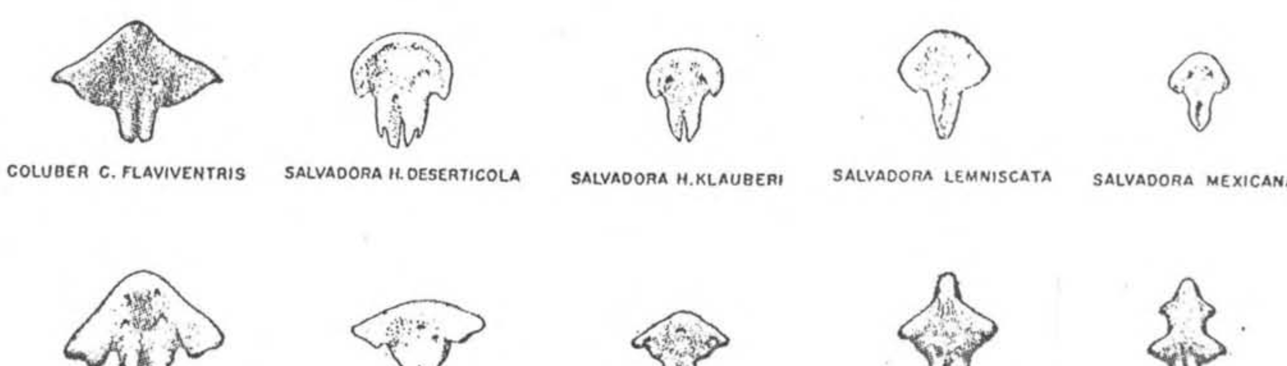

FIG. 9. Differences are shown in the adaptations of premaxillae within a subfamily: (Colubrinae), within genera (*Salvadora; Pituophis*), and in response to burrowing *(Pituophis c. sayi; Rhinocheilus).* [Abstracted from Bogert 1947.]

There are probably other indications as well, but these are a start. I am also suspicious when the members of a genus have vastly different hemipenial structure, or even if the members of a clade have unlike hemipenes.

With this background, when I obtained a copy of Zaher's (1999) photographic study of hemipenes, I immediately recognized that some of his illustrations were of misshapen and/or incompletely everted organs. After finding a significant number, I did a page-by-page survey of the entire study. [I had no idea of publishing this list, but under the present situation, with four herpetologists questioning my ability, I have decided to do so.]

There are five figures that I believe to be so inaccurate as to place the taxa in the wrong family. These are *Nothopsis* (Fig. 88, Upper), *Synophis* (Figs. 88, Lower, and 89, Upper), and *Xenopholis* (Fig. 95, Upper and Lower), genera which T. Pinou and I have recently recognized, on other than hemipenial bases, to be members of the vastly different family, Xenodermatidae (Dowling and Pinou 2003). The Philippine *Oxyrhabdium* (Fig. 6, Upper) belongs here also (*cf.* Leviton 1964, and my Fig. 10).

There have been no descriptions of the hemipenes of American xenodermatids, but Pope (1935:185) has a brief description of the hemipenis of the Chinese xenodermatid, *Achalinus spinalis*: "The hemipenis is excessively long and slender, extending to the sixteenth to seventeenth subcaudal plates, but is forked opposite the sixth." Malcolm Smith (1943:128) has a more detailed description of the allied Indian *A. rufescens*, giving a length of 24 subcaudals and forking opposite the 4th, with a brief statement on the hemipenis in *Fimbrios klossi,* indicating a similar structure in that xenodermatid. Both Brain (1959) and Broadley (1983:109) have photographs of the hemipenis of the Ethiopian xenodermatid, *Pseudaspis,* [Brain was mistaken in thinking that both hemipenes were everted.] and I have examined the hemipenis of another Ethiopian xenodermatid genus, *Mehelya* (Fig. 10). All of these xenodermatids have a pair of long, very slender apical lobes that are 2x or more longer than the hemipenial "body."

I anticipate that the hemipenes of the American representatives noted above will be found to have similarly elongated lobes when properly prepared and examined. [This might also be tested now by carefully slitting the asulcate side of the hemipenis, and looking closely for the slender apical lobes.]

Originally, I had intended to include minor inaccuracies (misshapen body, corrugated basal region, short or unequal apical lobes, incomplete expansion, crooked sulcus, etc., in this list of Zaher's (1999) illustrations, but found that this would include the majority of the figures in the paper. When I cut this to "moderate to significant inaccuracies, I still had 107 figures to list. As pointed out by Yuki (1997), "Unfortunately, a semi-everted hemipenis, prepared with Pesantes' [1994] technique [Similar to that described by Ms. Waite] will not produce a general shape similar to that of organs that are completely everted…." I must agree.

My final count is + 70 "significantly inaccurate" figures [e.g., those that omit significant structures or give erroneous information on the structure of the hemipenis depicted] of Zaher's (1999) total of about 165 illustrations of snake hemipenes (Appendix I). Thus, I find that more than 40% of Zaher's photographic representations of snake hemipenes are significantly inaccurate or misleading. Many others are far from good representations of the hemipenial morphology of the species depicted.

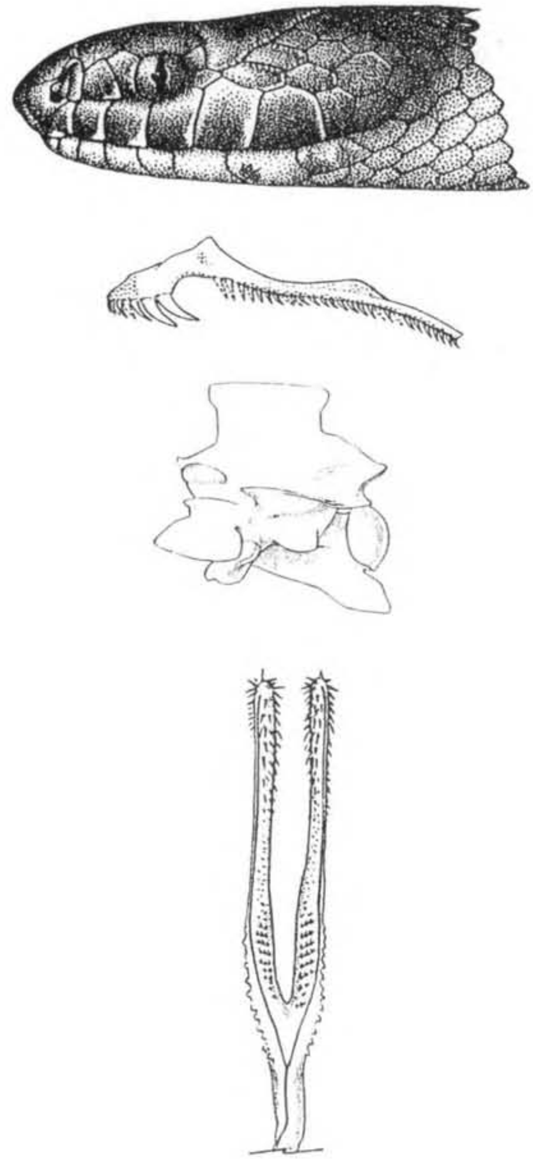

FIG. 10. HISS format of *Mehelya* (Xenodermatidae: subfamily *incertae sedis*). The enlarged, front-facing nostrils, the vertically elliptical pupil of the eye, the expanded zygapophyses of the vertebra, and especially the long, slender paired lobes of the hemipenis (which may not be completely everted) are typical of xenodermatids. The highly specialized maxilla is not typical of all xenodermatid genera, and the size and shape of the vertebral hypapophyses vary between genera. The head drawing is from Witte 1962; other figures are from the HISS Collection.

It is probably for this reason that Zaher failed to discover the several clades of xenodontids that were briefly described and named on the basis of morphology (with major emphasis on hemipenis structure) by Jenner (1981), and later further defined and allocated (but not named) on the basis of immunology by Cadle (1984 *et seq.*). The large proportion of poorly prepared specimens in Zaher (1999) obviously obscured the major hemipenial differences between clades. As a result, rather than his study resulting in a clearer view of xenodontid clades and their interrelations, he was forced to resort to an alphabetical arrangement of presentation!

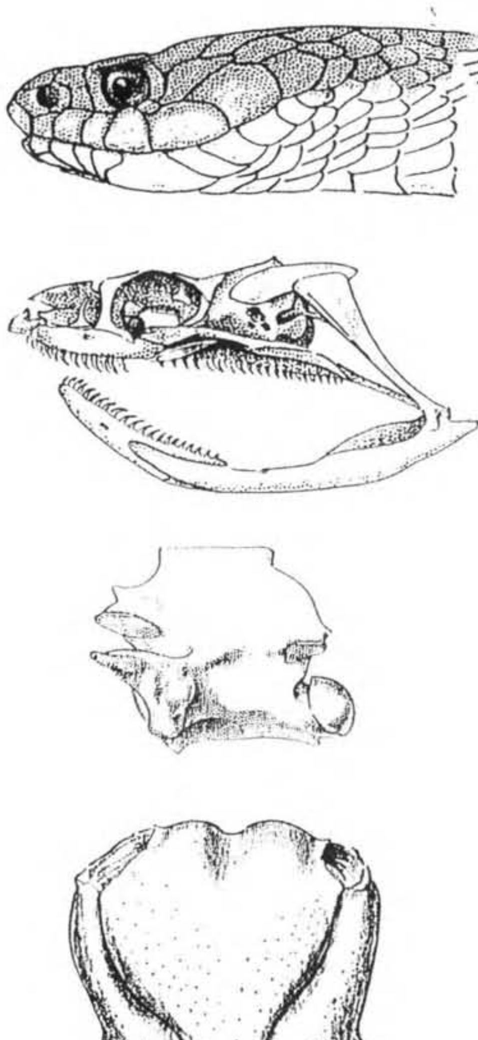

FIG. 11. HISS format of *Xenodon* (Xenodontidae: Xenodontinae). Note the semi-nude apical portion of the hemipenis with the pair of disks. The hemipenis is slightly[?] over-expanded. The dagger-like rear tooth of the maxilla is barely visible. [HISS Collection]

SUMMARY AND CONCLUSIONS

This review began as a reply to the two responses that were elicited by my brief review of Z&P's (1999) note on "Infraspecific variation of the hemipenis...." It has evolved into comments on hemipenis preparation, adequacy of photographic depiction, a brief review of Zaher's (1999) major work, and a brief history of my work on hemipenes and snake relationships. Much of the "sound and fury" could have been avoided if the various responders had made a re-examination of the contested hemipenial morphology [e.g., by dissection], rather than writing confrontational papers. I had previous experience with the apparently different conditions in snakes reported by Z&P (1999) with similar deeply-bilobate hemipenes (e.g., *Agkistrodon*), and pointed out (Dowling 2002) that the "folded-over" condition was caused by the shrinking of the (uncut) retractor muscles during hemipenial preparation.

Z&P did not believe me, but rather than making the pertinent observations—preparing other hemipenes after cutting the retractor muscles, or dissecting one of the "folded-over" specimens to see if the retractor muscles were, indeed, tightly-stretched between the base and the lobes (and between the lobes) of the hemipenis—they contested it in print (Z&P 2003). They cited Zaher (1999) as the authority who demonstrated that "hemipenial features are surprisingly variable at all taxonomic levels within colubroids." [Incidentally, it seems strange that Zaher failed to illustrate the hemipenis of the type genus of xenodontine snakes (*Xenodon*) (*v.* my Fig. 11).]

This view presented us with only two alternatives: (1) either Zaher (1999) is correct in his findings that hemipenis morphology is highly variable within genera and clades—and thus hemipenes cannot be used in the recognition of these taxa [in opposition to the views of Cope (1893, 1895), Bogert (1940 *et seq.*), and many others, including mine], or (2) there is something else that has obscured his view of hemipenial morphology.

As I show in this brief review of Zaher (1999), the apparently significant variation between hemipenes within a genus, or within a clade, as shown by Zaher, is primarily caused by improper preparation of the organs for study.

His illustrations of the hemipenes of seven species of *Arrhyton* (Fig. 33-37U) are a prime object-lesson. They appear to be highly variable in all respects. Whereas *A. vittatum* and *A. landoi* (Fig. 33) have a pair of fairly elongate apical lobes, only *A. taeniatum* (Fig. 34L) otherwise shows a (slightly distorted) similar configuration. *Arrhyton exiguum* (Fig. 37U) obviously has paired lobes, but the entire hemipenis is so distorted that it appears unlike the previous three. *Arrhyton callilaemum* (Fig. 34U) has a pair of tiny apical projections, but no lobes, whereas *A. funereum* (Fig. 35) and *A. polylepis* (Fig. 36) have no trace of paired lobes. In my opinion, all species of *Arrhyton* have paired apical lobes much like those seen in Figs. 33 and Fig. 34L. The lobes possessed by *A. callilaemum, A. funereum,* and *A. polylepis* were not everted in the preparation of these hemipenes. A curator at "MPMH" [?: not listed in Leviton et al. 1985] should split the asulcate side of hemipenis numbers 22703, 22707, and 22789, and carefully look for the inverted apical lobes that I am sure lie inside.

The situation with the genus *Conophis* is another illuminating section. Although Zaher's figures 40U&L, and 41U [*C. vittatus*] vary considerably, none shows the apical disks recently reported by Auth et al. (1998) for *C. vittatus* (the type species), or those previously reported and illustrated by Wellman (1963) in his revision of the genus, who also stated (p. 289), "There are no apparent hemipenial differences among the species of the genus *Conophis*." Zaher (1999) listed this reference, but apparently ignored the description of disks—as well as their illustration.

Similarly, curators at the AMNH and other museums should check for uneverted hemipenes among their specimens that I list in Appendix I. I am confident that inverted lobes (and/or disks) will be found. Further, I would hope that herpetologists working in the field would take the time to properly prepare at least one fully everted and expanded hemipenis of the unusual snakes (and

lizards) that they find. Zaher's (1999) paper convincingly demonstrates that half-everted "field preparations" cannot be "repaired" and successfully utilized for systematic analysis.

Acknowledgments.—All drawings are by Frances Waite [HISS Collection] unless otherwise indicated.

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Appendix

A review of the photographic figures in Zaher's (1999) paper that I found to be "significantly inaccurate" as I paged through [U = upper; L = lower]. They are here placed into categories for brevity. As indicated, the major problems are due to incomplete eversion of the hemipenis.

APEX (usually meaning apical lobes) INCOMPLETE (partly or fully inverted)

Fig. 3: *Aparallactus* (distal parts); Fig. 4U: *Atractaspis* (also, sulcus hidden). [See my Fig. 5.]; Fig. 4L: *Amblyodipsas*?; Fig. 5L: *Macrelaps*;

Fig. 6U: *Oxyrhabdion*; Fig. 7L: *Macrocalamus* (also, sulcus hidden); Fig. 9U: *Lamprophis* (also distorted); Fig. 9L: *Lycodonomorphus*; Fig.12L: *Geodipsas*; Fig.14L: *Dinodon* [?]; *Sibynophis* [?]; Fig. 32U&L: *Apostolepis* (also distorted); Fig. 34U, 35, 36: *Arrhyton*; Fig. 40U&L, 41U: *Conophis* [See text.]; Fig. 41L: *Manolepis*; Fig. 42L: *Ditaxodon*; Fig. 46U&L: *Farancia*; Fig. 47U, 48U, 50U: *Helicops*; Fig. 56U: *Lystrophis* (and distorted); Fig. 63L: *Phalotris*; Fig. 65U, 67, 69L: *Philodryas*; Fig. 69U: *Pseudablabes*; Fig. 72U: *Pseudoboa* (also, base distorted); Fig. 73U: *Pseudoeryx*; Fig. 79U: *Tropidodryas* (also distorted); Fig. 81U: *Uromacerina*; Fig. 86L: *Echinanthera*; Fig. 87U: *Gomesophis*; Fig. 87L: *Ptycophis*; Fig. 88U: *Nothopsis* [See text.] Fig. 88L, 89U: *Synophis* [See text.]; Fig. 89L: *Sordellina* Fig. 90U, 91U: *Tachymenis*; Fig. 92U&L: *Taeniophallus* (also, distorted); Fig. 94U&L: *Thamnodynastes*; Fig. 95U&L: *Xenopholis* [See text.]

BODY and /or LOBES DISTORTED

Fig. 8: *Fordonia* (also, sulcus hidden); Fig.18L: *Hydraethiops*; Fig. 20: *Arrhyton, Darlingtonia*; Fig. 29L: *Alsophis* (and over-inflated); Fig. 34L, 37U: *Arrhyton*; Fig. 37L: *Darlingtonia*; Fig. 52U: *Hydrops* (lobes); Fig. 53L: *Ialtris* (sulcus not visible); Fig. 57 *Oxyrhopus* (and over-inflated); Fig. 58L: *Oxyrhopus*; Fig. 60U: *Oxyrhopus* (and base omitted); Fig. 70U: *Phimophis*; Fig. 74L: *Psomophis* (base not visible); Fig. 76L: *Saphenophis* (and body incomplete); Fig. 77U&L: *Siphlophis* [See Dowling 2002]; Fig. 85U: *Diadophis* (and incompletely everted); Fig. 93U&L: *Taeniophallus* (also incompletely everted?).

ARTICLES

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Long-term Sperm Storage and Plasma Steroid Profile of Pregnancy in a Western Diamond-backed Rattlesnake (*Crotalus atrox*)

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Sophisticated information on reproduction and mating systems of non-avian reptiles is growing rapidly, and important advancements span a wide range of disciplines (Campbell and Brodie, 1992; Duvall et al. 1992, 1993; Gans and Crews 1992; Gibbs and Weatherhead 2001; Schuett et al. 2002 a, b; Shine 2003). Notwithstanding this growth there are obvious and significant deficiencies in knowledge of certain taxa, especially in snakes. Studies of endocrine patterns in this group involve only a limited number of species, and most of them are New World natricines (Moore and Lindzey 1992; Whittier and Tokarz 1992). Consequently, diversity of proximate mechanisms is lacking which seriously impedes our ability to develop robust evolutionary models (Drickamer and Gillie 1998). Many important research questions regarding proximate regulation of reproduction need to be addressed, and these include seasonal patterns of plasma sex steroids, differential functions of steroids on development and activation of behavior, and the dynamics of free- and bound steroids (and their binding globulins) with respect to receptor function (Bonnet et al. 1994, 2001, 2002; Breuner and Orchinik 2002; Jennings et al. 2000; Moore and Lindzey 1992; Schuett et al. 2002a; Seigel and Ford 1987; Whittier and Tokarz 1992).

There are, for instance, few studies of steroid profiles of pregnancy in snakes (Whittier and Tokarz 1992), and no studies of sex steroid profiles in cases where females are unequivocally utilizing sperm from long-term (over winter) storage, referred to as long-term sperm storage (LTSS; Schuett 1992). In numerous species of viperids, LTSS is an important (or even obligate) component of reproduction (overviewed by Schuett 1992; Sever and Hamlett 2002). Although there are no *a priori* data to suggest that there are causal connections between LTSS, ovarian activity, and sex steroid profiles during pregnancy, we cannot assume they do not exist (see Ameida-Santos et al. in press). For example, if females that mate in spring ovulate earlier, perhaps due to the act of coitus itself (e.g., Mendonça and Crews 1990), development and birth of offspring might be accelerated compared to females with LTSS and no sexual activity in spring.

While conducting field behavioral endocrinological studies on the Western Diamond-backed Rattlesnake (*Crotalus atrox*) in the area of the White Tank Mountains (39 km W of central Phoenix, Maricopa County, Arizona), an adult female was collected by one of us (GWS) on 17 September 1999, 2110 h, on Sun Valley Parkway, 15.2 km W of the McMicken Dam Spillway. Due to her good state of health and high body mass, she had not likely produced a litter that summer. Thus, she was a good candidate for having been mated in late summer (cf. Bonnet et al. 1994, 2002; G. Schuett and R. Repp, unpubl. data) and to test for LTSS (Schuett 1992). It is not established that female *C. atrox* show LTSS, and it is important to know whether or not copulations restricted to the first mating season (late summer and autumn) are sufficient for the initiation of pregnancy the following spring (Schuett 1982, 1992).

In south-central and southern Arizona and other areas of its expansive distribution, *C. atrox* shows sexual behavior (i.e., courtship, coitus, male-male aggression) in two distinct calendar periods. Based on the events of the male's reproductive cycle (e.g., peak spermatogenesis and levels of plasma sex steroids in late summer; meiotic regression in autumn) and timing of ovulation and fertilization in late spring, the first mating season is from late August to at least mid October, which includes the monsoon season (mid July to mid September). Following hibernation (mid November to late February), the second mating season is from early March to mid May, and sexual activity can occur at or near traditional communal dens during emergence (Repp 1998; Schuett et al. 2001). This bimodal pattern of mating seasons in *C. atrox* was established by long-term studies using radiotelemetry, observations in the field, published accounts, and personal communication (e.g., Klauber 1972; Schuett et al. 2001, in press; Taylor et al. 2004; G. Schuett and R. Repp, unpubl. data; S. Beaupre, pers. comm.; E. Nowak, pers. comm). Detailed information on the tim-

ing of mating seasons of pitvipers is reviewed in Schuett (1992), Aldridge and Duvall (2002), and Schuett et al. (2002a).

The goal of this paper is to report for the first time unequivocal LTSS in a female Western Diamond-backed Rattlesnake (*Crotalus atrox*), and to describe the profile of several important circulating steroid hormones (testosterone [T], 17β-estradiol [E2], progesterone [P4], and corticosterone [CORT]) during her pregnancy.

Methods

Subject.—At the time of capture, the subject was 740 mm SVL, 50 mm TL, and 435.0 g. Her identification number was CA-149. She was maintained in strict isolation in a glass enclosure (91 cm L x 30 cm W x 25 cm H) with a screen cover, supplied with newsprint as a floor covering and heat tape (8 cm wide) was situated beneath and across the front end of the cage (35°C). Artificial lighting (eight 40 W fluorescent tubes) positioned 3 m above the cage was electronic timer-controlled to simulate natural (Arizona time) photoperiod year round. Laboratory rodents (hamsters and rats) were offered as food every 10 days until 15 November 1999, and water was available in a glass bowl *ad libitum*. From 15 November 1999 to 1 March 2000, CA-149 was maintained under conditions to simulate hibernation (Schuett et al. 1997b).

Collection of blood and plasma.—Sampling periods (N = 11) occurred in September 1999, and from April to August 2000 (Fig. 1). In the laboratory, the subject was gently removed from her individual enclosure using a hook and/or grabber tongs, and secured in a standard squeeze-box. This procedure was done quickly (1–3 min) to avoid handling stress and possible effects on sex steroid levels (Schuett et al. 2004). Once secured, 1.0 ml of blood was collected from tail vessels, generally within 1 min, using a 1.0 ml sterile tuberculin syringe (25-G5/8") treated with porcine-derived heparin sodium (1,000 units/ml). The subject was returned to her enclosure immediately following this procedure. Blood was transferred to a 1.5 ml centrifuge tube and immediately placed on ice for several minutes until it could be centrifuged (Taylor and Schuett 2004). All blood samples were centrifuged for 4 min at 6000 rpm, and plasma was collected and transferred to 1.5 ml Nalgene® centrifuge tubes for storage in an ultra-low freezer (-80ºC) until radioimmunoassays (RIAs) could be performed (<1 year).

Radioimmunoassay of plasma.—The general procedures for conducting RIAs for measuring concentration of plasma T and CORT (Schuett and Grober 2000; Schuett et al. 1996, 1997b, 2002a, in press; Taylor and Schuett 2004) and E2 (Schuett et al., *in press*; Taylor and Schuett 2004) are published, and those for P4 will be discussed in detail below. Briefly, RIAs of T, CORT, and E2 included validation (quantitative recovery and parallelism), and samples were analyzed in duplicate (N = 22 for each steroid). Two RIAs were performed for T; the intra-assay coefficients of variation (CV) were 9.1% and 11.1%, and the inter-assay CV was 11.9%. One RIA was performed for CORT, and the intra-assay CV was 2.4%. Two RIAs were performed for E2; the intra-assay CVs were 7.9% and 12.5 %, and the inter-assay CV was 11.9% Values for T, CORT, and E2 are presented as arithmetic means ± 1 SE (ng/ml).

For RIAs of P4, antibody-coated tubes and radiolabeled P4 were purchased from Diagnostic Products Corporation, Los Angeles, CA (catalog numbers TPG1 and TPG2). Standards were prepared be serial dilutions of a stock solution in phosphate buffered saline (PBS) containing 0.1% gelatin. Snake plasma (50 μl) plus 350 μl of PBS were extracted in 5.0 ml of diethyl ether (Fisher Scientific). After removing and drying the ether layer, the sample was re-suspended in 200 μl of PBS-0.1% gelatin. Extraction recovery of H^3-progestestrone (New England Nuclear, Boston, MA, NET-381) was 69%. The entire 200 μl of extract plus an additional 100 μl of PBS-0.1% gelatin was dispensed into the antibody tubes. Following addition of 1.0 ml of tracer, the tubes were incubated at room temperature (21°C) for 4 hr. Quantitative recovery of P4 added to *C. atrox* plasma was 100%. Parallelism was demonstrated between the inhibition curve for the standards and dilutions of *C. atrox* plasma for plasma volumes > 12.5 μl. A single RIA was performed and assay samples were run in duplicate (N = 22). The intra-assay coefficient of variation was 8.7%. Values for P4 are presented as arithmetic means ± 1 SE (ng/ml).

Ultrasonography.—To determine size of follicles, the approximate time of ovulation, and presence of embryos, ultrasound imaging (Dynamic Imaging, Concept/MC) was performed multiple times from the time of capture through July 2000. Size of follicles was determined as best as possible to the nearest millimeter, and numbers were estimated. Embryos were counted but not measured.

Results

The reproductive pattern and plasma steroid profiles of CA-149 at the time of her capture to 5 days post-partum are shown in Fig. 1.

On 17 September 1999, at the time of capture, the concentration of T and P4 was relatively higher than E2; CORT was relatively high (67.28 ng/ml). Ultrasound revealed multiple follicles (> 5) that were ≤ 3 mm in width, and thus not in the process of primary follicular growth, i.e., yolk deposition (Aldridge 1979; Schuett 1992).

On 3 April 2000, the first post-hibernation measurement, E2 was elevated (highest level measured), CORT levels were similar to the value obtained on 17 September, and both T and P4 were relatively low. Ultrasound revealed growth of the follicles since 17 September, presumably occurring from 1 March to 3 April. Multiple clustered follicles of ≥ 35 mm in width were detected. On 10 May 2000, E2 had decreased, and on 10 June E2 was at its lowest concentration remained near (or at) that 1.0 ng/ml throughout gestation and five days following parturition. From 10 May and following parturition, the profile of T tracked that of E2. Ultrasound revealed that ovulation had occurred by 10 May (i.e., multiple ova ≥ 55 mm were arranged linearly), and seven embryos were detectable by 1 July. The concentration of P4 increased sharply following10 May, and its highest concentration was on 1 July. Subsequently, P4 decreased sharply up to and several days beyond the date of parturition (22 August). CORT increased after 3 April, and reached its highest spring concentration on 10 May (263.89 ng/ml). Following ovulation, CORT sharply declined to baseline by 10 June, and levels subsequently increased a second time, peaking from 29 July to 12 August, and decreasing by 18 August. On 22 August, levels of CORT rose to the highest concentration at the time of parturition. Seven offspring (4 males, 3 females) were of healthy appearance and normal size, and no infertile masses were present.

Discussion

This is the first account to unequivocally demonstrate LTSS in female *C. atrox* (Schuett 1992), and among the few descriptions of steroid patterns of pregnancy in a viperid snake (Bonnet et al. 2001, 2002; Saint Girons et al. 1993; Taylor et al. 2004; Tsai and Tu 2002). We suggest that the present female mated in late summer or fall of 1999, showed LTSS during winter, ovulated in May, and the stored sperm had normal fertilizing capacity. Because there are no reliable data to support the view that LTSS extends beyond a single reproductive season, mating in late summer or autumn is the most parsimonious conclusion. Moreover, there is little evidence to support a spontaneous parthenogenetic event because such rare cases of reproduction in captive snakes have never resulted in healthy litters composed of both sexes (Schuett et al. 1997 a). In the present case, timing of reproductive events, such as follicular growth and ovulation, as well as patterns of plasma sex steroids, were indistinguishable from wild female *C. atrox* that have the opportunity to mate in spring (Taylor et al. 2004). In most North American viperids, vitellogenesis and follicular development appear to be largely confined to summer and autumn, and females thus enter hibernation with large, yolked follicles and subsequent growth of follicles may occur in spring (Aldridge 1979; Aldridge and Duvall 2002; Schuett 1992). In low elevation regions of south-central and southern Arizona, these follicular events in *C. atrox* appear to be confined to spring on a biennial basis (Taylor et al. 2004; G. Schuett and R. Repp, unpubl. data; S. Beaupre, pers. comm.; but see Rosen and Goldberg 2002). Although Tinkle (1962) reported that female *C. atrox* from northwestern Texas had enlarged follicles in autumn, the observations by Fitch and Pisani (1993) of *C. atrox* from Oklahoma are similar to our findings and indicate that the majority of follicular yolking occurs in spring. Based on these incongruent data, further studies will be required to better understand the role of environmental factors and geographic location in the timing of follicular development in this species (Rosen and Goldberg 2002).

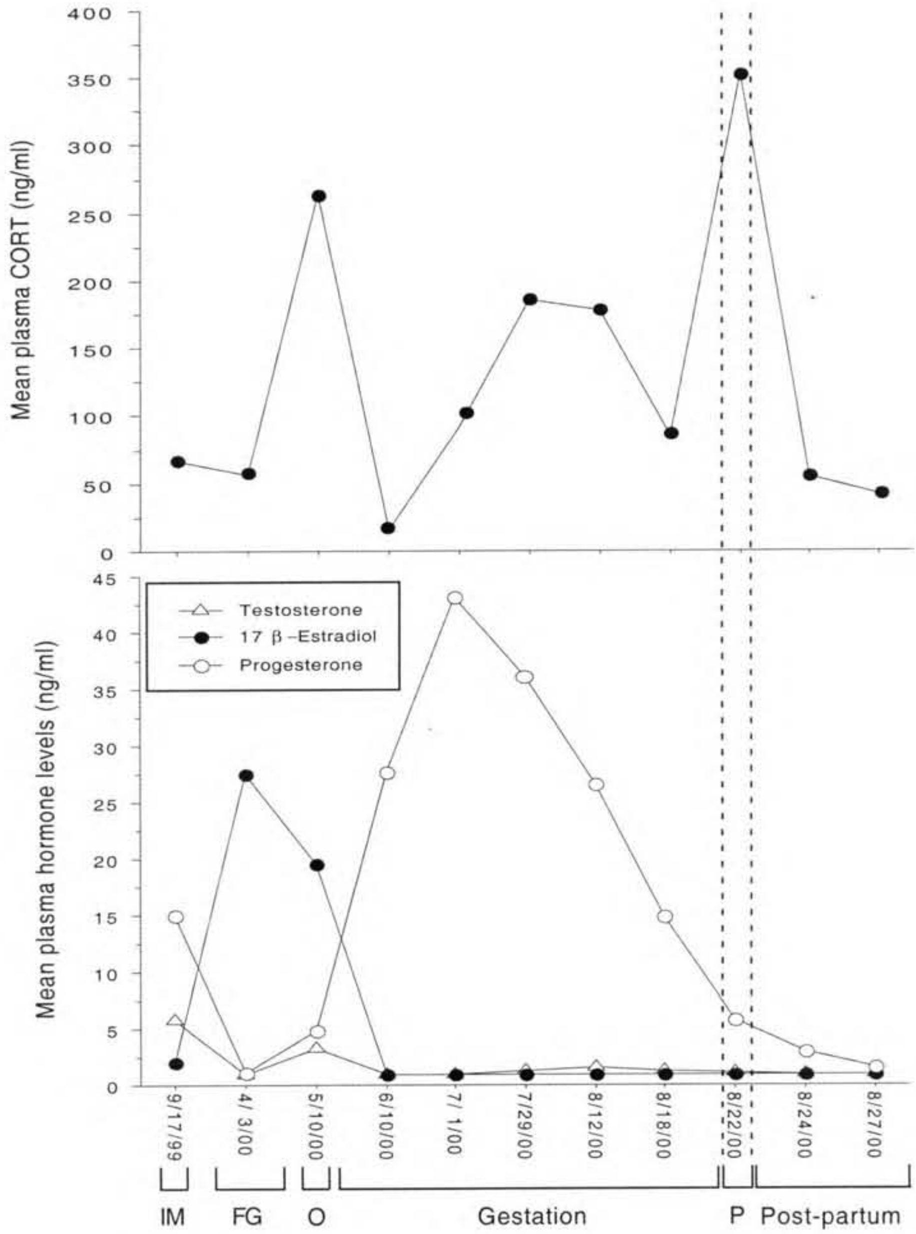

Fig. 1. Reproductive events and mean plasma sex steroid profile of the female *Crotalus atrox* (CA-149) described herein. CORT = corticosterone. IM = immature follicles. FG = follicular growth. O = ovulation. P = parturition.

There are few studies on female snakes regarding patterns of circulating steroids related to sexual activity and pregnancy to make robust comparisons (Chan et al. 1973; Highfill and Mead 1975 a, b; Kleis-San Francisco and Callard 1986; Whittier et al. 1987); data on vipers are very limited (Bonnet et al. 1994, 2001, 2002; Saint Girons et al. 1993; Taylor et al. 2004; Tsai and Tu 2001). Taylor et al. (2004) investigated plasma steroids in free-ranging pregnant *C. atrox* in south-central Arizona, and plasma steroid profiles of the present female did not deviate from free-ranging individuals that have a second opportunity to mate in spring. Furthermore, the steroid data of the present female are, in general, similar to those reported for other viperids (Bonnet et al. 2001, 2002; Tsai and Tu 2001), as well as other viviparous squamates (Edwards and Jones 2001; Martínez-Torres et al. 2003; Xavier 1987).

Most authors report elevated E2 levels during follicular growth, and subsequent declines during gestation (Bonnet et al. 2001; Taylor et al. 2002), and it is suggested that high post-ovulatory P4 levels suppress E2 levels during pregnancy (Bonnet et al. 1994; Edward and Jones 2001). The high P4 levels during autumn in the present female may have been associated with sexual receptivity

and/or ovarian function (Whittier and Tokarz 1992). There was, however, no evidence of follicular growth at that time based on ultrasound results. It is doubtful that yolk deposition occurred from 15 Nov.–1 Mar.; nonetheless, it is a possibility because the next ultrasound measurement was not taken until 3 April. Although few authors have reported on androgen levels in female snakes (Saint Girons et al. 1993), these are also generally low during gestation. Comparison of CORT levels at the time of birth to other viperid species is not possibly due to lack of information; the pattern of CORT levels in *C. atrox* reported by Taylor et al. (2004) were essentially identical to those we report here.

The functional roles of estrogens (e.g., 17β–estradiol), progestins (e.g., progesterone), and androgens (e.g., testosterone) in female reptiles have been reviewed (Whittier and Tokarz 1992). Despite the fact that a robust understanding of the functions of steroids is lacking for female snakes, estrogens and progestins can have relatively straightforward effects on behavioral processes related to sexual receptivity (McNicol and Crews 1979; Whittier and Tokarz 1992; Whittier et al. 1987; Wu et al. 1985), vitellogenesis and yolk deposition (Garstka et al. 1985; Ho 1987; Ho et al. 1982; Wilson and Wingfield 1992), and maintenance of pregnancy (Bonnet et al. 1994, 2001; Chan et al. 1973; Custodia-Lora and Callard 2002; Edward and Jones 2001; Tsai and Tu 2001; Xavier 1987).

Reproductive tissues of females can produce androgens (testosterone, 5α-dihydrotestosterone), but little information concerns their function(s) (Edwards and Jones 2001). There is, however, increasing evidence that androgens might play a role in follicular maturation and oviductal maintenance (Staub and DeBeer 1997). Androgens in females (and males) can be converted in the central nervous system (and other regions) to estrogens (i.e., aromatization) and other steroids (Callard et al. 1977, 1978); nonetheless, they also might have direct involvement in normal organization-activation processes (Staub and DeBeer 1997).

The significance of plasma corticosterone (CORT) in reproduction is not well known in female reptiles, and results are equivocal (Girling and Cree 1995; Wilson and Wingfield 1992). But several studies show its positive association with seasonal timing of sexual behavior, vitellogenesis and yolk deposition, mid-pregnancy anorexia, and extreme (i.e., peak) levels during parturition (Taylor et al. 2004; Wilson and Wingfield 1992; this study). The function of CORT and corticotropin-releasing hormone (CRH) during pregnancy and parturition has been studied rather extensively in humans and sheep models; the sharp spike in plasma CORT at parturition in humans, sheep, and snakes (this study) may derive from multiple origins (Bell et al. 1997; Petershack et al. 1999). Because the source of plasma CORT in pregnant snakes is not understood (i.e., it is probably not limited to strict adrenal involvement), fetal, placental, and other sources should be considered based on results of mammalian systems (Smith 1999; Weiss 2000). In *C. atrox*, plasma CORT levels are highly elevated during parturition (see Fig. 1), exceeding by two-fold the levels observed in male *C. atrox* that have been exposed to moderate handling stress (Schuett et al. 2004). Nonetheless, unlike stressed males which appear agitated and assume defensive postures, female *C. atrox* are unremarkable and calm prior to and during parturition. Therefore, the role of CORT in both physiological and behavioral processes in snakes, as in other vertebrates, appears to be complex and multi-functional.

In conclusion, we demonstrated that LTSS operates effectively in *C. atrox* resulting in pregnancy and normal offspring. In a laboratory setting, LTSS and lack of spring mating did not modify timing of reproductive events such as vitellogenesis, yolk deposition, ovulation and fertilization, and parturition. Furthermore, levels of plasma sex steroids in the present female were comparable to those of free-living pregnant female *C. atrox* that had the opportunity to mate in spring (Taylor et al. 2004).

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Radio Telemetry and Post-emergent Habitat Selection of Neonate Box Turtles (Emydidae: *Terrapene carolina*) in Central Illinois

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Although factors influencing turtle offspring prior to nest emergence have received considerable attention by researchers (Gutzke and Crews 1988; Janzen et al. 2000; Packard and Packard 1987), the activity of neonates following their emergence from the nest is poorly understood (but see Burger 1976; Butler and Graham 1995; Keller et al. 1997). Previous field research has produced valuable information on several aspects of neonate ecology for several species (Brewster and Brewster 1991; Butler and Sowell 1996; Janzen 1993). A thorough understanding of life history patterns for many species is absent, however, and some existing information is conflicting (e.g., Congdon et al. 1999; Janzen et al. 2000). The lack of knowledge is primarily due to the cryptic nature of neonates and various logistical problems associated with studying small animals in the field. Recent advances in radio telemetry technology such as decreased transmitter size and increased battery life facilitate tracking small neonate turtles for a longer duration.

We studied nest dispersal and habitat use in neonate box turtles using a relatively new, very small radio transmitter. Few studies have been conducted using telemetry on neonate turtles (e.g., Butler et al. 1995), and none has focused on nest dispersal and habitat use of neonate box turtles.

The study was conducted at Rhodes-France Boy Scout Reservation (RFBSR) located in western Shelby County, Illinois, USA (39°19'N; 89°02'W), from March to April 2002. Two nests were located by radio tracking gravid female turtles during summer 2001 (Flitz 2003). The nests were sited in relatively open areas next to a tree stump in a grassy field and at the edge of a fire trail (see Flitz 2003 for more description). Nest disturbance was prevented by using excluder devices, made of hardware cloth of 0.6 cm^2 mesh and 30 cm diameter with walls buried 15 cm into the ground, around the nest until the end of the 2001 activity season. Upon hatching and emergence, neonate turtles from both nests (clutch sizes were 4 and 5, respectively) were collected, brought to our laboratory and allowed to overwinter in an outdoor enclosure (1.5 x 1.5 m) under ambient conditions. Each turtle was marked with a unique series of notches in the marginal scutes. This facilitated identification and placement back at the proper nest site the following spring.

After overwintering, single-stage radio transmitters (model LTM, Titley Electronics, Australia; 0.95 g) were attached to the carapace of six randomly chosen neonates (three from each clutch) using a non-toxic silicon adhesive (Fig. 1). Each transmitter cost approximately US $170, had an average lifespan of 28 days (pers. obs.; D. Titley, pers. comm.), and did not contain a thermistor. We relocated the subjects using a Telonics TR2 receiver (159.000-160.000 MHz) and a 6-element Yagi antenna. On average, the transmitter represented 13.4% of individual body mass (mean ± 1 S.E. mass of neonates = 7.11 ± 0.10 g). At the time we designed this study, the LTM model was the smallest transmitter of this longevity being manufactured for attachment on turtles. We concede that this mass exceeds normal guidelines for relative mass of transmitters (usually 5–8%, and rarely up to 10%; Cochran 1980; Richards et al. 1994); however, we did not observe differences in the mobility of neonates outfitted with these transmitters (discussed below).

On 30 March 2002, all neonates were returned to their respective nest sites at RFBSR and allowed to disperse. Each neonate was located 15 times between 0900 and 1700 h on an alternate day cycle (study duration = 32 days), and locations were marked with forestry flags. Upon relocation, air temperature at 1 m above ground (±1° C), and distance (±1 cm) and compass bearing from the previous location were recorded. Many movements were of small magnitude and were within the margin of error of most handheld Global Positioning System units, so we did not take GPS readings. If the turtle moved less than 30 cm from the previous

TABLE 1. Mean distances moved between relocations (m ± 1 S.E.) and microhabitat characteristics (of a 1 m^2 plot centered at point of relocation) for telemetered neonate box turtles (*Terrapene carolina*) at Rhodes-France Boy Scout Reservation (RFBSR), Shelby County, Illinois, between 30 March and 27 April 2002. Means are based on values recorded at 15 relocation points per subject and 75 randomly-selected sites at RFBSR.

	Feature of microhabitat							
Subject #	Distance moved (m)	% bare ground	% leaf litter	% herbaceous vegetation	% woody vegetation	% canopy closure	vegetation height (cm)	light intensity (lux)
202	1.14 ± 1.40	11.9	58.4	28.6	1.3	41.6	5.6	504.9
203	1.14 ± 1.39	48.3	34.5	12.2	5.0	61.3	7.7	442.9
204	2.35 ± 1.37	22.0	39.7	33.0	6.0	31.0	7.0	512.1
random	n/a	15.5	26.6	47.2	10.9	71.3	37.4	138.7

location, the exact distance was recorded but we did not mark the new position with another flag to minimize the physical obstructions within the immediate vicinity. We also recorded the following parameters in discrete categories at each relocation: sky condition (full sun, some clouds, mostly cloudy, overcase), amount of subject exposure (full exposure, partially concealed, fully concealed, buried), and subject activity (stationary, walking, eating, other).

On 30 April 2002, we revisited all relocation points and completed an analysis of the habitat within a 1-m area centered around each point (methodology follows Flitz 2003; Wilson 1998). The following measurements were recorded: % bare ground, % leaf litter, % herbaceous cover, % woody vegetation, % canopy cover (recorded using a densiometer), maximum vegetation height (± 1 cm), and light intensity at the ground surface (in lux; Extech Instruments light meter). Values for these parameters were compared to those measured at 75 randomly chosen sites within RFBSR recorded in April 2001 (Flitz 2003). Between 2001 and 2002, we did not observe drastic changes in vegetation characteristics and the pattern of human use of RFBSR remained the same.

Three turtles from the same clutch had moved less than 0.5 m in

FIG. 1. Neonate (36 days post-emergence) box turtle, *Terrapene c. carolina*, with 0.95 g transmitter. Glossy area on turtle's left dorsolateral surface is area where transmitter had been attached with silicone adhesive.

the first five days following their release. On the sixth day, the transmitters were discovered without the turtles within 0.5 m of their last locations. The presence of marks resembling tooth impressions on the resin casing of the transmitters suggests that a mammalian predator had eaten these subjects. Because of this, we discarded all data from the depredated subjects and base the remainder of our results on the remaining three neonates. The remaining telemetered turtles survived the duration of the study, and one of the non-telemetered turtles was observed 18 days into the telemetry period within 10 m of its nest location.

The total distance moved by our subjects during the study averaged 21.94 ± 5.46 m. Distances moved between relocations ranged from 0 to nearly 7.5 m, although the mean distance moved was on the lower end of that scale (Table 1). Minimum convex polygon estimates of home ranges averaged 39.96 ± 27.00 m^2 (Jennrich and Turner 1969). These home range areas are based on a limited sample (15 relocations per individual) and thus should be interpreted with caution. Subjects moved within the area around the nest site and were most often encountered motionless underneath a layer of leaf litter (36 of 43 observations). Air temperature at the time of relocation ranged from 9 to 27°C. The relationship between temperature and distance moved was not determined because subjects could have moved at any time between two relocations.

Sites where we relocated our subjects had less canopy closure ($\chi^2 = 44.8$, $p < 0.001$) and higher light intensity ($\chi^2 = 41.6$, $p < 0.001$) than randomly-chosen locations within RFBSR (Kolmogorov-Smirnov tests; Table 1). Light intensity was inversely correlated with canopy closure ($r^2 = 0.22$, $p = 0.001$) and we recorded higher air temperatures at the time of relocation at sites with higher light intensity ($r^2 = 0.11$, $p = 0.03$). Of the measured microhabitat characteristics, subjects were found in sites that had more leaf litter ($\chi^2 = 11.2$, $p = 0.007$), less herbaceous cover ($\chi^2 = 16.7$, $p < 0.001$), and shorter vegetation height ($\chi^2 = 28.1$, $p < 0.001$) than random sites. Relocation sites did not differ from random locations in the percent bare ground or percent woody vegetation available.

Following their emergence from the nest, neonate box turtles at RFBSR used habitats having characteristics that differed from randomly-selected areas. In the days immediately following emergence from the nest, this pattern of use was likely influenced by

the nest site itself. As elsewhere (Congello 1978; Messinger and Patton 1995), female box turtles at RFBSR tend to excavate their nests in relatively open habitat (see Flitz 2003 for quantified habitat parameters). Regardless of the structure of emergent vegetation, we relocated the neonates most often within the leaf litter layer. We observed one neonate in the entrance of a mole burrow, and found another occupying a shallow depression under the leaves. Similar postures, occasionally termed "forms," have been recorded in neonate semi-aquatic turtles (Butler and Graham 1995) and adult *T. carolina* (Flitz 2003; Stickel 1950). In the early part of the activity season (e.g., April), leaf litter might provide some insulation from cool air currents above the leaves or concealment from predators.

Radio telemetry of amphibians and reptiles historically has been constrained by the size and mass of the transmitter. Whether implanted or affixed to the animal's surface, the concern has been that the subject mobility would be impaired by the transmitter's bulk (Fitch 1987; Richards et al. 1994). In spite of losing half of our test animals, we do not think that the LTM transmitters impaired the movements of neonate box turtles. We observed each of the neonates moving within the leaf litter layer without hindrance from the transmitter or its antenna. Transmitters of this size and style would probably be suitable for other small turtle species. Construction of a similar transmitter with a longer battery life would be most useful to better assess microhabitat selection and activity of neonate turtles without undue disturbance.

Our data represent only three individuals of a single *T. carolina* clutch. Nevertheless, they provide information on the activity of a poorly-studied life history stage of a turtle species that is encountered across much of the eastern United States. As the survival of pre-adolescent individuals is essential to ensure the persistence of any species, we hope to encourage further study of early life history stages with the technology that has recently become available and affordable. Furthermore, as neonate turtles might utilize habitat that differs from juvenile and adult areas of activity (Butler and Graham 1995; Dodd 2001), conservation efforts for some turtle populations may be overlooking habitat types that are critical to the species' survival.

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Cyclura nubila nubila (Cuban Rock Iguana), adult male, from the translocated Puerto Rican population on Magueyes Island). Illustration by John Bendon (lizardwizard@btinternet.com).

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Notes on the Diet of the Rare Gymnophthalmid Lizard *Ecpleopus gaudichaudii* from Southeastern Brazil

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Gymnophthalmids are small-bodied lizards (SVL up to 10 cm) that inhabit the leaflitter of tropical and subtropical forests and herbaceous vegetation of open formations from southern Central America to Argentina and some islands of the Caribbean (Ávila-Pires 1995; Pellegrino et al. 2001; Vitt and Zani 1996). They eat insects and other small invertebrates and are oviparous, typically laying a clutch of two eggs (Pellegrino et al. 2001; Vitt 1982).

Ecpleopus is a monotypic genus endemic to the Atlantic rainforest of southeastern Brazil (Peters et al. 1986). The diets of several gymnophthalmids from various regions of Brazilian Amazonian have been reported (Caldwell and Vitt 1999; Colli et al. 1998; Rocha 1991; Vitt 1991, 1995; Vitt and Caldwell 1994; Vitt and Carvalho 1995; Vitt and Zani, 1998; Vitt et al. 1998a,b). However, *Ecpleopus gaudichaudii* is poorly known, in fact no data are available on any aspect of its biology. Here we report information on the diet of *E. gaudichaudii* based on specimens collected in two Atlantic rainforest sites of southeastern Brazil.

The Estação Ecológica da Universidade Federal de Minas Gerais (EEUFMG) (19°25'S, 43°58'W) is a 102-ha urban-disturbed reserve located at Belo Horizonte, state of Minas Gerais. Fieldwork was conducted sporadically from 1999 to 2001. Specimens were captured in five, 20-L pitfall traps provided with drift fences in secondary growth forest.

The Reserva Particular do Patrimônio Natural Feliciano Miguel Abdala (RFMA) (19°43'53"S, 41°49'00"W) is a fragment of Atlantic forest located in the city of Caratinga of southeastern Minas Gerais. Fieldwork was conducted from July 2000 through July 2001 by JC. Specimens were obtained by a combination of opportunistic collection, targeted visual searching, and 20-L pitfall traps, which were monitored from December 2000 to April 2001.

Preserved lizards were dissected and their stomach contents were analyzed under stereosmicroscope (10–40x). Food items were determined to order or family. The snout-vent length (SVL) of the lizards was measured with a vernier caliper to the nearest 0.1 mm. Similarity of prey utilization among the two populations was estimated with the symmetric niche overlap coefficient (Pianka 1986): $O_{ij} = \sum p_{ij} p_{ik} / (\sum p_{ij}^2 \sum p_{ik}^2)^{-2}$, where *i* is the resource category, *p* is the proportion of resource category *i* and, in this case, *j* and *k* represent the two populations. Voucher specimens of the lizards were deposited in the herpetological collection of the Universidade Federal de Minas Gerais (UFMG 323, 796, 810, 870, 987, 1094–1105).

At EEUFMG, we collected five individuals in a secondary growth forest and at RFMA we collected 12 individuals in areas of primary forest. At RFMA one individual was observed active at night, two individuals were found active by day, three individuals were found under logs by day, and the remaining specimens were captured in the pitfall traps.

Mean SVL of the lizards was 31.5 ± 4.7 mm (N = 11). The diet was numerically dominated by termites (32.6%) and spiders (18.3%) (Table 1). More frequent items in the stomachs (N = 17) were spiders (0.36), orthopterans (0.24), and isopods (0.24). The stomachs of six individuals (35.3%) were empty. The diet differed in the two areas ($O = 0.11$).

Ecpleopus gaudichaudii seems to be a diet generalist, like other gymnophthalmids (e.g., *Neusticurus ecpleopus* and *Prionodactylus eigenmanni*, Vitt et al. 1998a,b). It is not clear if the apparent differences in prey between these sites reflect differences in prey choice, availability, or the small number of individuals examined.

TABLE 1. Diet summaries for two populations of the gymnophthalmid lizard *Ecpleopus gaudichaudii* from the Atlantic forest of southeastern Brazil. EEUFMG = Estação Ecológica da Universidade Federal de Minas Gerais; RFMA = Reserva Particular do Patrimônio Natural Feliciano Miguel Abdala.

Prey Type	EEUFMG		RFMA		Total		Frequency
	N	%	N	%	N	%	(N = 17)
Araneae	—	—	1	3.1	1	2.2	0.06
Salticidae	—	—	1	3.1	1	2.2	0.06
Scytopidae	1	7.1	—	—	1	2.2	0.06
Theridiidae	—	—	7	21.9	7	11.7	0.18
Opiliones	1	7.1	1	3.1	2	4.4	0.12
Collembola	1	7.1	—	—	1	2.2	0.06
Dictyoptera	—	—	1	3.1	1	2.2	0.06
Diptera	—	—	1	3.1	1	2.2	0.06
Hemiptera	1	7.1	—	—	1	2.2	0.06
Homoptera	1	7.1	—	—	1	2.2	0.06
Fulguroidae	3	21.4	—	—	3	6.5	0.06
Isoptera	—	—	15	47.0	15	32.6	0.06
Orthoptera	1	7.1	3	9.4	4	8.8	0.24
Psocoptera (Psocidae)	2	14.6	—	—	2	4.4	0.06
Isopoda	3	21.4	2	6.2	5	11.0	0.24
Totals	14	100	32	100	46	100	

The higher proportion of sedentary prey in the diet of *E. gaudichaudii* supports the idea that active foragers feed primarily on small, clumped prey (Colli et al. 1997; Huey and Pianka 1981). At the taxonomic level of the prey reported here, the diet of *E. gaudichaudii* is similar to that of the closely related cercosaurine gymnophthalmids (Pellegrino et al. 2001) *Neusticurus ecpleopus* (Rocha 1991; Vitt et al. 1998a) and *Prionodactylus eigenmanni* (Vitt et al. 1998b), and the gymnophthalmine *Vanzosaura rubricauda* (Vitt 1995).

The elongate and streamline body and tail of *E. gaudichaudii*, together with its relatively narrow mouth and the presence of a chemosensory-sensitive tongue, are suggestive of an active forager (Colli et al. 1997; Cooper 1994). However, we are not able to define the activity period of *E. gaudichaudii* because of the three individuals found active, two were apparently active by day and the other at night.

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Cajun-French Common Names for Louisiana Amphibians and Reptiles

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The use of common names for organisms has long plagued biologists and others because there are often multiple names for the same species or similar names for different species. This problem certainly exists for amphibians and reptiles, and efforts sanctioned by the Society for the Study of Amphibians and Reptiles, the American Society of Ichthyologists and Herpetologists, and The Herpetologists' League, have resulted in a list of standardized English common names. Many previous authors were instrumental in laying the groundwork for this list (Crother et al. 2000, and references therein). However, some areas of North America have an extensive cultural history that has resulted in a unique and widespread collection of local common names. Because of the heavy French influence that has persisted in southern Louisiana at least since the 1700s, there is a collection of Cajun-French common names used ubiquitously throughout southern Louisiana, particularly within the Acadian Parishes. Given that many species of amphibians and reptiles in southern Louisiana are known locally by different names than the standard list for North America (Crother et al. 2000), it would seem useful to have a parallel list of Cajun-French names for southern Louisiana. I have compiled such a list below, primarily to facilitate fieldwork and communication about these species with local people, but also to document a unique set of common names represented by a unique local culture. Such documentation also serves as a resource for interpreting these common names as they have often appeared in the herpetological literature. This list is not exhaustive, as not every species in the area has a French common name applied. The names given here are from the "prairie" dialect spoken in the Ville Platte/Opelousas area, and there may be some variation among other areas of the Acadian Parishes. This list is also not intended to replace any of the existing Standard English names, but rather, to serve as a complement to those names. The Standard English Name according to Crother et al. (2000) is presented first, followed by the Cajun-French name, with an English translation or explanation in parentheses.

Cajun-French Common Names for Louisiana Amphibians and Reptiles

FROGS – Grenouilles (frogs)

American Bullfrog (*Rana catesbeiana)* – Ouaouaron (the name mimics the male's call)

Treefrogs (*Hyla*) – Rainette (little rain frog)

Chorus Frogs (*Pseudacris*) - Rain Frogs (refers to their activity association with rain)

Toads (*Bufo*) – Crapauds (toads)

SALAMANDERS

Three-toed Amphiuma (*Amphiuma tridactylum*) – Anguille (eel), Congre (refers to Congo Eel)

CROCODILIANS

American Alligator (*Alligator mississippiensis*) – Cocodrie (likely derived as a variation of the French pronunciation of crocodile)

American Crocodile (*Crocodylus acutus*)– Crocodile

LIZARDS – lizards (lizards)

Little Brown Skink (*Scincella lateralis*) – Chien de Terre (ground dog), Soudèe

SNAKES – Serpents (snakes)

Copperhead (*Agkistrodon contortrix*) – Sonnette de Canne (cane rattler; shaking the tail against sugar cane leaves produces the sound of a rattlesnake)

Cottonmouth (*Agkistrodon piscivorous*) – Serpent Congo (Congo snake)

Timber Rattlesnake (*Crotalus horridus*) – Serpent *à* Sonnette (rattle snake)

North American Watersnakes (*Nerodia*) – Serpent d'Eau (water snake)

North American Gartersnakes (*Thamnophis*) – Serpent d'Arbre (tree snake, referring primarily to *T. proximus*)

DeKay's Brownsnake (*Storeria dekayi*) – Vipère (also called ground rattler in English, both of which are probably derived by misidentification, referring originally to the Pygmy Rattlesnake (*Sistrurus*))

Texas Ratsnake (*Elaphe obsoleta*) – Serpent *à* Rat (rat snake), Serpent *à* Z-oeufs (egg-eating snake)

Rough Greensnake (*Opheodrys aestivus*) – Couleuvre (snake)

Common Kingsnake (*Lampropeltis getula*) – Serpent Roi (king snake)

Eastern Racer (*Coluber constrictor*) – Serpent Noir (black snake), Fouetteuse (whipping snake)

Red-bellied Mudsnake (*Farancia abacura*) – Pointe, Aspique, Aspic (ice pick, referring to pointed tail)

TURTLES – Tortues (turtle)

Alligator Snapping Turtle *(Macrochelys temminckii*) – Trois rangs (Three-Row), Caouane (tortoise/turtle)

Common Snapper (*Chelydra serpentina*) – Cailleux (rough, ugly skin), Caouane

North American Softshells (*Apalone* sp.) – Caille molle (soft shell), Caouane de Mer (slough turtle)

Pond Slider (*Trachemys scripta*) – Tête Verte (green head)

Mobile Cooter (*Pseudemys concinna mobiliensis*) - Mobilien

All other sliders (*Trachemys*), Cooters (*Pseudemys*), Map Turtles (*Graptemys*) - Ventre Jaune (yellow belly)

Razor-backed Musk Turtle (*Sternotherus carinatus*) – Caouane de Saule (willow turtle)

Stinkpot (*Sternotherus odorata*) – Caouane Puante (stinking turtle)

Eastern Box turtle (*Terrapene carolina*) – Caouane de Rosée (dew turtle)

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'Snake Talks' in the Classroom: Do They Influence Children's Attitudes?

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Human fear and dislike of snakes has been extensively studied and publicized (Cavendish 1994; Morgan 1996; Morris and Morris 1965). Indeed, the persecution of snakes by humans, both in the past and present, is one reason that many snake species and populations now are threatened (Greene 1997). Public opinion often influences the effectiveness of conservation initiatives; therefore, influencing and educating the public is seen as one way that managers can ensure that their decisions are respected, implemented and maintained (Jacobson 1995). Altering public opinions towards snakes will be particularly challenging because of the widespread animosity and fear shown towards these animals.

Well-conducted interpretive programs generally are considered an important mechanism for shifting public opinion. Many professionals and amateurs spend countless hours delivering interpretive programs on animals such as snakes. Many of these programs target children, who often display a pronounced dislike towards snakes similar to that shown by adults. Positively influencing children's attitudes towards snakes today is seen as a proactive step towards future snake conservation initiatives. Surveys collected by ourselves and others consistently place snakes

among children's most feared animals (see Table 1). Furthermore, previous work has indicated that it is between the ages of 4 and 9 that children tend to develop fears, affections or other emotional concerns towards certain animals (Kellert 1985; Ost 1987). This age bracket also represents that time when children are first able to start perceiving the concept of endangered species (Hungerford 1996).

Because of the time, effort and cost invested in interpretive work, it is crucial to determine the effectiveness of such programs. Carlson (1995) cautions that interpreters should not simply rely on intuition to confirm that their message has been effectively transmitted, and many studies have been conducted to analyze the effectiveness of interpretive programs (Barrie and Knapp 1998; Beckmann 1999; Morgan 1989; Morgan et al. 1997). To this end, we conducted an experiment to address two important questions: (1) Does the delivery of one short, informative and interactive presentation to children affect their attitudes towards snakes, and (2) if a change in attitude is observed, how long does it last?

We conducted this study using Grade 2 public-school classes in Kamloops, British Columbia, Canada, during the 2001–2002 academic year. We designed an instrument for assessing attitudes towards snakes (following Alreck and Settle 1995 and Henerson et al. 1987). This instrument consisted of a series of questions concerning snakes, followed by a series of faces depicting a range of emotions (Fig. 1). The children were asked to respond by circling the face below the appropriate adverb that best reflected their feelings in response to each question. Student responses were ranked from 1 to 5, with 5 representing the most positive attitude and 1 the least positive attitude. In addition to separately analyzing the responses to each question, we generated a grand mean attitude score. This score represented the students' overall attitude towards snakes (Henerson et al. 1987). Several other general questions were asked, including a request for students to list their most feared animals (see Table 1). In order to verify that our assessment instrument was indeed measuring children's attitudes towards snakes, we ensured the instrument had face validity (Henerson et al. 1987).

Eight Control classes of students were involved in this study, along with six 'Presentation' classes that received a snake-interpretive talk (overall mean = 17 students/class, SD = 5.9). The Control classes received a total of three attitude assessments: an initial assessment, followed by a second assessment one week later, and a third and final assessment two months later. The Presentation classes completed the same attitude assessment instrument a total of four times: one day before the snake-interpretive talk, followed by three more assessments occurring one day, one week, and two months after the talk. In order to participate in this study, all students were required to submit signed parental consent forms. We initially were concerned that this provision would significantly bias the composition of students allowed to attend the snake presentations; although we were unable to determine precisely how many children were not allowed to participate, we estimate it was quite small, constituting no more than 5% of the total student body, and never exceeding more than one student per class.

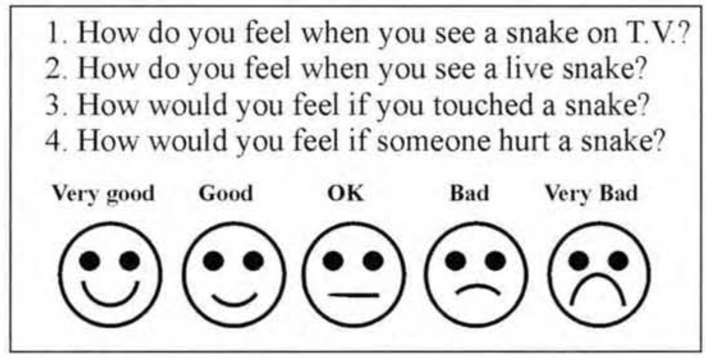

FIG. 1. Attitude assessment instrument consisting of four core questions and the semantic differential scale used to quantify the childrens' reactions. Students were asked to circle the face that best represented how each snake-related question made them feel. Student responses were ranked from 1 to 5, with 5 representing the most positive attitude and 1 the least positive attitude.

The classroom presentations consisted of 20-minute, interactive talks delivered by the senior author. Our previous experiences, coupled with feedback from teachers during pilot presentations, were used to design the presentation at a level suitable for Grade 2 children. Because presentations that incorporate modeling and provide direct contact opportunities can be more effective at influencing attitudes (Morgan 1996), we supplemented our factual information with the opportunity to touch local, non-venomous snake specimens (live Rubber Boa [*Charina bottae*] and Gopher Snake [*Pituophis catenifer catenifer*]). These contact opportunities were brief as students were allowed to touch the snakes with only one finger for a few seconds. Reluctant individuals were not pressured to participate in the contact, as other research has shown that in order for an interpreter's message to be conveyed effectively, individuals must want to touch the snake and must feel in control of the situation (Carlson 1995).

These presentations were followed by a maximum 10-minute question period, where students were allowed to inquire about anything related to snakes; however, storytelling was discouraged. All teachers agreed not to incorporate any snake, reptile, or related units into their class's curriculum during the academic year of the study in order to eliminate this potential source of bias. Furthermore, Presentation classes were not intentionally made aware of the forthcoming 'snake talk' during the first assessment period; however, because advance parental consent forms were mandatory, there is the possibility that some students had been informed of the upcoming event by their parents. We used Pearson's *r* test for reliability because the identical assessment was delivered

TABLE 1. Comparison of the top three animals feared by schoolchildren from: Kamloops, Canada (this study); Victoria, Canada (Bowd 1983); Australia (Bowd 1984); and British Isles (Morris and Morris 1965).

Location	Age	N	Top 3 Feared Animals (% of total response)
Kamloops, Canada	6–8	152	Bear (14), Lion (12), Snake (10)
Victoria, Canada	5	37	Bear (18), Tiger (12), Snake (12)
Australia	10	104	Snake (43), Lion (26), Spider (19)
British Isles	4–14	11,960	Snake (27), Spider (9), Crocodile (4)

to the same individuals multiple times. The results of these tests indicated that the instrument was reliable, displaying a weak to moderate correlation between responses obtained from repeated application of the assessment instrument to the Control classes (all $rs > 0.51$, all $Ps < 0.001$).

Our initial results showed surprisingly high positive mean-attitude scores towards snakes (Fig. 2), despite the fact that numerous students also cited snakes as one of their most feared animals (see Table 1). Although improvement might be difficult if the audience already tends towards a positive attitude (Morgan 1997), the Presentation classes still showed a significant increase in their attitude scores immediately after the snake-interpretive talk ($t_5 = 2.62$, $P = 0.05$; Fig. 2). However, results from the post-attitude assessments indicated that attitudes had returned to pre-presentation levels over the course of only one week, and remained there up to the final two-month assessment period. The effects of time, treatment, and their interaction on the students' attitudes towards snakes all were insignificant (MANOVA, all $Ps \geq 0.17$). Repeated-measures ANOVA was used to compare the responses to each individual question between assessments. Only one of the four attitude questions ("How would you feel if you touched a snake?") elicited a significant positive attitude change that was maintained up until one week after the presentation ($F_{1,1} = 5.27$, $P = 0.02$; all other P values > 0.1). After two months, this change was still evident, albeit weaker ($F_{1,1} = 3.54$, $P = 0.06$).

It is interesting that the only question to which attitudes remained significantly altered was the one that referred to actually touching a snake, rather than just visualizing it. Some studies have found that including a hands-on component in programs directed at improving attitudes towards snakes can actually have negative impacts (Morgan 1996). Students without previous hands-on snake experience would have had to generate an attitude towards touching snakes without ever having done so. Unfortunately, we did not collect data on previous snake encounters and so cannot examine the effects of these encounters on the children's attitudes. After receiving our snake-interpretive talk, these students would have been able to base their attitudes towards touching snakes on a direct, hands-on experience. Although this positive attitude change did not influence the students' over-all attitudes towards snakes, it still may have helped shape their 'mental picture' of them (Meredith et al. 1995). It is this internal "picture" made-up of the students' past experiences, thoughts and feelings that must be influenced before attitudes towards seeing these reptiles can be changed.

As noted, the senior author conducted all of the interpretive talks in order to standardize the experiment. The effectiveness of interpretive talks likely will vary depending on the presenter's ability to effectively communicate information. However, during informal discussions with the teachers following our talks, all of them indicated they believed the talks were conducted at a level appropriate for educating (and entertaining) Grade 2 children. The attitude assessment instrument is another potential source of variability that should be considered in future studies. Because of the short time frame imposed on this study, face validity was the most feasible method for measuring the strength of our attitude assessment instrument. Time permitting, it would be in the best interest of future researchers to conduct a more thorough analysis of the assessment instrument in order to enhance its credibility (Henerson et al. 1987).

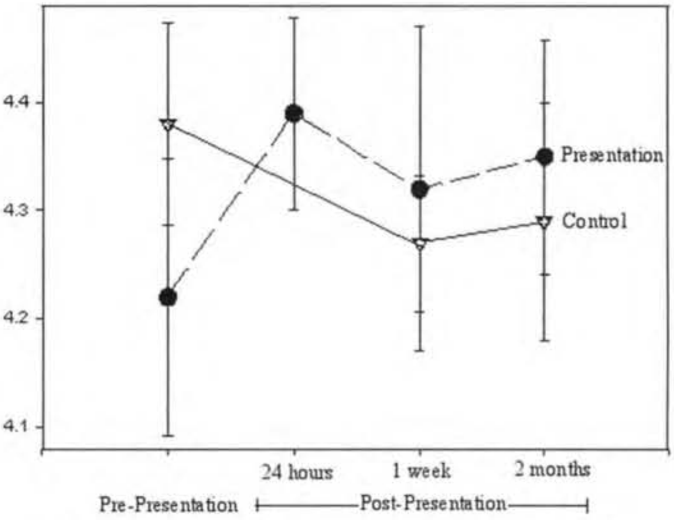

FIG. 2. Grand mean attitude scores in relation to presentation date of Presentation and Control grade two classes (N = 14) from school district #73 in Kamloops, British Columbia. An attitude score simply refers to the students' general feelings towards snakes. A score of five reflects a most positive attitude, while a score of one reflects a most negative attitude. Here, each point represents the mean of all class average attitude scores. Those students that received the presentation (Presentation students) adopted, on average, a more positive attitude towards snakes immediately after the presentation occurred.

Previous studies show that interpretive programs can be effective at influencing children's attitudes towards snakes, at least in the short term (Morgan 1996). In our study, these changes appeared to decline somewhere between 1 and 7 days after the interpretive talk. Without some quantification of the long-term influence of such presentations, this failure to induce permanent attitude changes in the audience (the students) would have gone undetected. Based on our results, we caution interpreters and educators that snake presentations, similar to those conducted in our study, should not automatically be assumed to cause a permanent improvement in the attitude of young children towards snakes. At the same time, our results should not deter the implementation of snake-interpretive programs, or those based on any other animal, as a large amount of in-school animal education is completely devoid of direct contact opportunities (Kellert 1985). Instead, we argue that further study on the effectiveness of snake interpretive work is imperative, particularly so that maximum gains can be made from the efforts of those involved. For instance, periodically revisiting the "snake topic" with the audience (the students) might be required to maintain long-term, positive attitudes towards snakes. In fact, extensive research opportunities exist for those determined to influence public perception of snakes; we urge biologists with an interest in snakes and other maligned animals to consider bridging out into this critical component of conservation.

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Notes on the Second Specimens of *Geophis damiani* Wilson, McCranie, and Williams and *Rhadinaea tolpanorum* Holm and Cruz D. (Colubridae)

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We collected from 2–6 September 2003 in the Cerro Texíguat Wildlife Refuge (15°25'49"N, 87°18'32"W), northern Yoro, Honduras, in the vicinity of the type localities for two species of snakes (*Geophis damiani* Wilson, McCranie, and Williams, 1998, and *Rhadinaea tolpanorum* Holm and Cruz D., 1994). Both of these species were known only from their holotypes until we collected the second specimens of each. We herein provide information on variation in scalation, tail length, and color pattern based on these new specimens.

The second specimen of *Geophis damiani* (USNM 559598) is an adult female (total length 303 mm) that agrees in most details with the adult male holotype. Variation in scutellational features is as follows (data for the holotype in parentheses): ventrals 143 (136); subcaudals 34 (41); and temporals 0+1–0+2 (0+1). The tail length is 15.5% of the total length (18.3%). Color in life was similar to that of the holotype. The new specimen was crawling in leaf litter in moderately disturbed cloud forest at 1950 h (about 1 h after dark) and 1680 m elevation.

The second specimen of *Rhadinaea tolpanorum* (USNM 559600) is an adult female (total length 419 mm) that agrees in most features with the adult female holotype. Variation in scutellational features is as follows (data for the holotype in parentheses): ventrals 157 (164); subcaudals 73 (68); and infralabials 8–7 (8–8). The tail length is 26.0% of the total length (25.7%). Color in life was also similar in most details to that provided for the holotype by Holm and Cruz D. (1994), differing only in that the narrow vertebral dark stripe in the new specimen is present only anteriorly and posteriorly on the body and the pale stripe above the dark dorsolateral stripe is only slightly paler than the remaining dorsal color (shown to be white in the holotype in these authors' Fig. 2). The second specimen was crawling on the ground at 1140 h and 1690 m elevation in second growth forest with low vegetation (ca. 1.5 m high) associated with a landslide. The weather was clear and sunny at the time of capture.

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Observations of Boreal Toad (*Bufo boreas*) Breeding Populations in Northwestern Utah

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From 1999 to 2003, the Utah Division of Wildlife Resources studied Boreal Toad (Western Toad; *Bufo boreas*) breeding populations in northwestern Utah. I report several apparently unique characteristics related to movement, elevation, habitat, and timing of breeding.

Six breeding ponds were monitored in the Grouse Creek Mountains, elevation 1690–2070 m, Great Salt Lake Desert Drainage Basin (mean annual precipitation of 23 cm), in Utah (Fig. 1). Boreal Toad breeding occurred in springs which had been dredged and bermed in the 1950s to create small ponds (surface area 30–900 m^2; maximum depth 0.5–2.5 m) for livestock watering. Emergent vegetation was dominated by rushes (*Juncus* spp.), sedges (*Carex* spp.), Hardstem Bullrush (*Scirpus acutus*), Cattail (*Typha latifolia*), and Teasel (*Dipsacus fullonum*). The upland vegetation community was Single-leaf Pinyon (*Pinus monophylla*)-juniper (*Juniperus* spp.)/sagebrush (*Artemisia* spp.).

Visual searching and dipnetting was conducted at breeding sites once a week during a six to eight week period (Thomas et al. 1997). New eggs strands were counted, and if not distinguishable, the minimum number of egg strands was estimated. An egg strand was considered a pair of egg strings in a gelatinous strand, so counts likely approximated the number of clutches. Small, fragmented egg strands were not counted, as these strands were a result of strands that were not continuously deposited. Adults were caught by hand or dip net from breeding aggregations. Passive Integrated Transponder (PIT) tags (10 x 2.1 mm) were used to individually mark toads (Corn et al. 1997; Muths et al. 2003). A small incision was made with sterile scissors horizontal to the mid-dorsal line, a sterilized PIT tag was implanted subcutaneously, and the tag was worked to the posterior of the toad to prevent it from being expelled before the small wound healed. Only *B. boreas* $\geq$ 50 mm snout–vent length were tagged. For two consecutive years per site, population sizes with 95% confidence limits were estimated with the closed captures model from the Program MARK (White and Burnham 1999). This model assumes no births, deaths, immigration, or emigration.

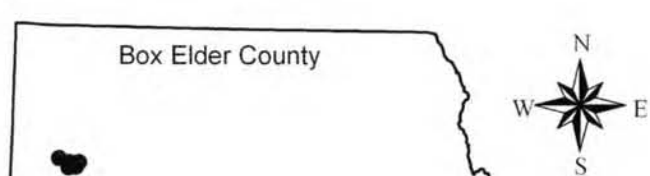

FIG. 1. Locations of six *Bufo boreas* breeding sites monitored in northwestern Utah.

Breeding consistently occurred in late March at two sites and in early May at the remaining four ponds. The earlier sites were fed by 12 and 17ºC warm springs, while the other four breeding ponds were 6–8ºC in early April. Boreal Toads did not breed synchronously; the breeding period ranged from two to six weeks, likely due to variable spring weather, and averaged four weeks per site. Initiation of *B. boreas* breeding appears to be correlated with the onset of warming weather and snowmelt (Blaustein et al. 2001; Blaustein et al. 2003; Campbell 1972; Corn 2003; Corn and Muths 2002; Olson 1988; Olson et al. 1986), however, breeding at the two warm springs was initiated when as much as 0.5 m of snow remained on the ground and the breeding ponds at the other four sites typically were frozen. Boreal Toads remained active year round at one warm spring. A covered spring box kept the water temperature in the box near 15°C during the winter of 2003 and a site visit in January 2003 resulted in the capture of 35 active adult toads.

During the five breeding seasons, tadpoles were observed on three occasions when egg strands had not been detected during prior visits; a minimum of one egg strand was assigned in these cases. Dense emergent vegetation likely hampered detection of egg strands at the two sites where egg strands were missed. During the five-year period, the total number of egg strands observed per year at all six breeding sites ranged from 28 to 45, with the largest number at a single site being 14 (Table 1). Variation among years in egg strand production was observed at all sites. Olson (1991) observed that half of female *B. boreas* skipped one year between breeding and 30% of them skipped 2–3 years, which might explain some of this variation. Another explanation might be loss of breeding habitat, a result of a drought that northwestern Utah experienced during 2000–2003. Sites 4 and 6 experienced an apparent decline in breeding activity (Table 1) and the breeding habitat at these sites was reduced by 50–100% compared to the available habitat in 1999.

PIT-tags were implanted in 981 toads. High recapture rates at breeding ponds indicated that few tags were expelled; 39–84% of the *B. boreas* tagged were encountered on at least one subsequent visit. Population estimates were obtained for two years at five of six sites; a population estimate was not obtained at one site because too few *B. boreas* were captured during that year. Breeding population estimates ranged from 40 to 243 adult toads and, in general, the estimates remained consistent between the two years (Table 2). Although the populations may not have been closed, I feel that little movement occurred at these sites while *B. boreas* were breeding. Toads tended to aggregate 1–2 weeks prior to breeding and tagging was discontinued 1–2 weeks following the last egg strand deposition. In general, sex ratios of breeding adult *B. boreas* were male biased (Table 2), with similar ratios to those

TABLE 1. Number of egg strands per breeding site.

Site	Year 1999	2000	2001	2002	2003
1	12	10	12	8	12
2	5	5	1	5	7
3	3	7	4	4	0
4	6	1	1	0	0
5	5	8	15	11	8
6	14	0	4	5	1
Total	45	31	37	33	28

observed at breeding sites in Oregon (Olson et al. 1986; Olson 1988; Samollow 1980).

Fifteen toads (5 females, 10 males) moved between breeding ponds during the mark-recapture study. The movements were between 0.9 and 5.0 km. Male *B. boreas* are not believed to travel long distances from a breeding site (Loeffler 1998). Muths (2003) and Bartelt (2000) observed post-breeding movements by male *B. boreas* of up to 1 km. I observed two male *B. boreas* that moved longer distances following breeding. One male toad moved 5.0 km between two springs in the summer/fall of 2002 during a severe drought. A wet corridor does not exist between the two springs. This toad was initially tagged in June of 2002 and recaptured in January of 2003 at a warm spring. Another male toad moved 1.3 km between May 2000 and May 2001. In June 2002, this toad was found back at the original breeding locality.

Boreal Toads in the southern Rocky Mountains (New Mexico, Colorado, Utah, southeastern Wyoming, and southeastern Idaho) generally occur above 2500 m in elevation and are restricted to mountain habitats (Hammerson 1999). Campbell (1970) and Livo and Yeakely (1997) describe *B. boreas* populations in Colorado at elevations ranging from 2164 to 3640 m. I found that the population of *B. boreas* in northwestern Utah occupied habitats at considerably lower elevations in a desert environment with pinyon-juniper/sagebrush upland habitats. The six breeding populations in this study were at elevations ranging from 1690 to 2070 m and another breeding location in this region was documented at 1570 m. The lowest elevation of any other known *B. boreas* breeding location in Utah is 2010 m. The dredging and berming habitat alterations in the 1950s may have improved breeding habitat quality for boreal toads in northwestern Utah low elevation areas by increasing water permanency. Continued monitoring of these locations is warranted given their apparently unique characteristics and potential regional instability.

TABLE 2. Population structure of six Boreal Toad breeding populations in northwestern Utah.

Site	Year	Population Estimate	(95% CI)	Standard Error	Sex Ratio (Male/Female)
1	1999	243	(185–347)	40.04	3.8
	2000	110	(102–125)	5.57	2.0
2	1999	141	(126–167)	10.23	4.7
	2000	81	(71–102)	7.61	2.4
3	1999	124	(116–141)	5.97	3.4
	2000	173	(168–183)	3.63	4.0
4	1999	116	(105–137)	7.74	4.1
	2000	N/A		N/A	1.2
5	2001	63	(61–72)	2.40	1.4
	2002	110	(109–116)	1.24	3.1
6	2001	53	(49–63)	3.14	1.6
	2002	40	(39–46)	1.30	1.3

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Overwintering California Tiger Salamander (*Ambystoma californiense*) Larvae

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In California, overwintering in larval salamanders is known for three ambystomatid species. Northwestern Salamander (*Ambystoma gracile*) and Long-toed Salamander (*A. macrodactylum*) larvae overwinter in areas where ambient and water temperatures are cold (Stebbins 1985; Stebbins and Cohen 1995; Zug 1993). Introduced Tiger Salamanders (*A. tigrinum*) also may overwinter as larvae (Sexton and Bizer 1978; Riley et al., *in press*). Stebbins and Cohen (1995) and Storer (1925) reported that larvae of a fourth ambystomatid, the California Tiger Salamander (*A. californiense*), do not overwinter; however, B. Shaffer (Univ. California, Davis; pers. comm.) found one larval *A. californiense* in late fall 1993, in Monterey County. I report observations of *A. californiense* larvae overwintering in the Los Vaqueros Watershed, Contra Costa County, California.

Of the 90 managed stock ponds in the Los Vaqueros Watershed, 63 are perennial and 27 seasonal. California tiger salamanders were observed in 66 ponds (45 perennial, 21 seasonal) between 1998 and 2002. Within three perennial stock ponds in the upper Kellogg Creek drainage (eastern Contra Costa County, California), *A. californiese* larvae were recorded through the late fall and winter. On 5 November 1998, a perennial stock pond was drained for maintenance and adult and larval *A. californiese* were found at the bottom of the pond. The three larvae captured ranged in size from 71 to 77 mm SVL, and 125 to 135 mm TL. The pond was located in a heavily grazed grassland at the headwaters of Kellogg Creek (533 m elevation). With the exception of a small stand of cattails (*Typha* sp.), the banks of the pond were devoid of emergent vegetation. Tadpoles of *Rana aurora draytonii* also were observed to be overwintering at this location (Fellers et al. 2001).

During October 1998, a second perennial pond was found with *A. californiense* larvae. The pond was located in an area of grazed annual grassland/oak woodland (300 m elevation) and was devoid of emergent vegetation. Salamanders in this pond were monitored through the winter of 1998/1999. During January 1999, 15 adult and 37 larval salamanders were observed. Larvae ranged in size from 58 to 84 mm SVL, and 114 to 144 mm TL (average = 77.6 mm and 127.3 mm, respectively). Freshly laid eggs also were present in the pond. This pond was monitored weekly until 12 March 1999. During that period, young of the year hatched and developed at a rate that was consistent with other ponds in the watershed.

At a third pond in the Los Vaqueros Watershed (440 m elevation), a single *A. californiense* larva was found in mid-January of 2001. This animal measured 97 mm SVL, 126 mm TL. Again the pond was perennial, associated with cattle grazing, and devoid of emergent vegetation.

Tails tips were collected for genetic analysis from *Ambystoma* larvae overwintering in the Los Vaqueros Watershed. Results confirmed that samples came from *A. californiense* with no detectable level of hybridization (H. B. Shaffer, Univ. California, Davis; 3 genes analyzed: 1 mtDNA, 2 nuclear DNA, 20 specimens, 2 sites, August 2003, pers. comm.).

This report is important because the introduced *A. tigrinum* is being recorded in many areas across California. *Ambystoma tigrinum* is known to overwinter and therefore may be incorrectly identified if the presence of overwintering larvae is the sole characteristic used to determine species. In addition, some authors have suggested that *A. californiense* may not occur regularly in perennial pools (Jennings and Hayes 1994; Storer 1925), yet my findings show 45 of 66 (68%) occupied sites were perennial. Finally, management considerations for perennial ponds may need to be re-evaluated if *A. californiense* larvae are found to overwinter throughout their range. The proper management of *A. californiense* should provide for thoughtful consideration of the implications of overwintering in the species.

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Is There an Antipredator Blood-Squirting Defense in the Bull Horned Lizard, *Phrynosoma taurus*?

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Understanding of the phenomenon of the squirting of blood from orbital sinuses of horned lizards has been slow in unfolding since its early historic (Spanish Empire 1651 and 1767; Manaster 1997) and scientific reports (Middendorf and Sherbrooke 1992; Wallace 1871). Only infrequently do conditions during capture by humans result in blood squirting. In contrast, this defensive behavior is elicited with much greater frequency by exposure of the lizards to native canid predators such as Coyotes, *Canis latrans* (Sherbrooke and Mason, *in press*) and Kit Foxes, *Vulpes macrotis*; (Sherbrooke and Middendorf 2004), or a Dog (*Canis familiaris*) model (*P. cornutum*: 70–100%, *P. hernandesi*: 50%, and *P. solare*: 60% of trials; Middendorf and Sherbrooke 1992; Sherbrooke and Middendorf 2001). Indeed, this defensive behavior may be elicited by only a subset of would-be predators. For example, *P. cornutum* did not squirt blood in response to a variety of non-canid predators including Greater Roadrunner (*Geococcyx californianus*), Southern Grasshopper Mouse (*Onychomys torridus*), Long-nosed Leopard Lizard (*Gambelia wislizenii*), Western Diamondback Rattlesnake (*Crotalus atrox*), or whipsnakes (*Masticophis* spp.) (Sherbrooke 1990, 1991, 2003, unpubl. data). Anecdotal field observations of human encounters with a specific species of horned lizards can be useful for determining the presence of the behavior if the results are positive, but negative reports leave doubt as to the ability of the species to squirt blood under more appropriate conditions. Nevertheless, negative records under controlled conditions are useful for comparing the relative frequency of occurrence of blood squirting among species.

Recently, field encounters with humans and several species of *Phrynosoma* were combined with controlled encounters with dogs and literature records to identify which of the 13 currently recognized species of horned lizards exhibit antipredator blood-squirting behavior (Sherbrooke and Middendorf 2001). These studies concluded that a clade of three species—*Phrynosoma mcallii*, *P. modestum*, and *P. platyrhinos*—does not use antipredator blood squirting. Individuals of those three species (N = 10–15 for each) failed to squirt blood in controlled trials with a dog as a model canid and had a remarkably low frequency of blood-squirting events in encounters with humans (0.07%, compared to ~5% for *P. solare* and *P. cornutum*; Sherbrooke and Middendorf 2001). The blood-squirting proclivity of several other species in the genus remains in doubt pending tests with appropriate predators or predator models such as dogs. Therefore, Sherbrooke and Middendorf (2001) reported that the propensity to squirt blood in *P. douglasii* and *P. braconnieri* was unknown although expected because of the phylogenetic affinities of the two species with others in the genus that also appear not to squirt blood. Based on reports of human encounters in the literature, these researchers accepted that *P. asio*, *P. coronatum*, *P. orbiculare*, and *P. taurus* squirt blood when approached by predators for which the defense has evolved (i.e., canids). For these species the frequency of these responses in human encounters is unknown, but any positive response to humans apparently indicates the capacity of the species to utilize this defense during encounters with appropriate predators.

Recently one of us (BB) noted that the only literature report of blood squirting in *P. taurus* (Ruthling 1919) was apparently based on a misidentification of the species. Ruthling's (1919) reports of blood squirting for two species of horned lizards, *P. orbiculare* and *P. taurus*, in México were not based on personal observations, but on experiences reportedly made by Carlos Cuesta Terrón, a Mexican herpetologist (see Cuesta Terrón 1932). In recounting Cuesta Terrón's observations, Ruthling (1919) stated that both species were "abundant in the Valley of Mexico." Current information indicates that *P. taurus* does not occur in the Valley of México, where only *P. orbiculare* occurs (Baur and Montanucci 1998; Gonzáles et al. 1996; Sherbrooke 2003; Zamudio and Parra-Olea 2000), bringing into doubt the identification of a species known primarily from Oaxaca, Puebla, and Guerrero (additional reports place *P. taurus* in southeastern Morelos; Castro Franco 1987; Castro-Franco and Busto Zagal 2004). The uncertainty, in 1919, of Ruthling's report stems also from the dubious taxonomic designation and identification of some Mexican species of horned lizards. Cuesta Terrón (1932) failed to mention *P. taurus* in his "Los Camaleones Mexicanos," and Martín del Campo (1934), who included *P. taurus* in his additions, did not mention blood squirting for the species. Therefore, we conclude that Ruthling's report of blood squirting by *P. taurus* is erroneous and should be rejected. This casts doubt on the ability of this species to squirt blood defensively in response to a predator. Here we attempt to resolve this question by presenting data from (1) numerous human field encounters with *P. taurus*, and (2) trials with a dog model of a native canid predator.

Between 1996 and 2003 one of us (EBS) made repeated observations of individuals of *Phrynosoma asio* and *P. taurus* at Cerro Tepelayo, Zumpango del Río, Municipio de Eduardo Neri, Guerrero, México (17°83'09"N, 99°31'31"W; 1280 m). Between 28 March and 16 September there were 35 human field encounters with individual *P. taurus;* of these 7 lizards were males, 21 females, and 7 juveniles. None of the Bull Horned Lizards squirted blood

when captured by hand. Because juvenile *P. cornutum* and *P. hernandesi* squirt blood in response to a dog (Sherbrooke and Middendorf 2001), we expect age is not a critical determinant. Thus, if *P. taurus* has a similar blood-squirting reaction rate to humans as that recorded for Texas horned lizards (*P. cornutum*; 5.9%, Lambert and Ferguson 1985) and Regal Horned Lizards (*P. solare*; 4.6%, Parker 1971), we might predict that 1–2 (~5%) of the 35 *P. taurus* encountered would have squirted blood. However, not all horned lizard species have the same frequency of this defensive behavior when tested with canids (Sherbrooke and Middendorf 2001).

Ten *P. taurus* (9 females, 1 male; mean mass = 15.3 g, range = 8.0–30.5 g; mean SVL = 65.1 mm, range = 53–84 mm) were collected between 18 May and 16 June 2003, and were held in captivity in indoor terraria under natural lighting and fed ants and other insects. Tests for dog-elicited bloodsquirting were conducted on 16 June (N = 9: air temperature 22°C) and 17 June (N = 1; air temperature 26°C) in late afternoon. The dog, a Cocker Spaniel-mix, was held on a leash during the 3-min trials while one of us (WCS) handled the Bull Horned Lizards. During trials, the dog vigorously pawed and barked at the lizards, and in most trials (60%) the dog briefly took the lizard into its mouth, from which it was quickly removed. All lizards repeatedly ran from the dog, but were immediately returned to the study arena. None of the lizards closed their eyelids or engorged them with blood, a precursor to blood squirting (Middendorf and Sherbrooke 1992; Sherbrooke and Middendorf 2001; Sherbrooke and Middendorf 2004), or squirted blood. Immediately following the trials with *P. taurus*, we conducted a single trial with a large (SVL = 110 mm) male *P. asio* (a species known to squirt blood; Alvarez del Toro 1960; Hodges 2004) to confirm the appropriateness of the experimental conditions for eliciting blood squirting. This trial was terminated after 50 s when the horned lizard squirted blood from one orbital sinus onto the dog's muzzle (for comparable times with *P. cornutum*, see Middendorf and Sherbrooke 1992). Both of this lizard's eyelids were engorged with blood prior to squirting.

The negative results with *P. taurus* are similar to those for three other species of horned lizards, *P. mcallii*, *P. modestum*, and *P. platyrhinos* (Sherbrooke and Middendorf 2001). Combined with our negative encounters for blood squirting with humans (N = 35) and those of Hodges (N = 20; Hodges 2004), these data suggest that *P. taurus* either does not squirt or is not easily induced into a blood-squirting defensive behavior. In this sense, *P. taurus* resembles the *P. mcallii-modestum-platyrhinos* clade of "nonsquirting" species of *Phrynosoma* (Sherbrooke and Middendorf 2001). If blood-squirting is not a defensive strategy of *P. taurus*, based on the cladogram presented by Sherbrooke and Middendorf (2001), there may be more than one lineage of *Phrynosoma* that lacks or nearly lacks blood-squirting as a defense response. If *P. taurus* is a nonsquirting species, in contradiction to Ruthling's (1919) report, this calls for reinterpretation (Sherbrooke and Middendorf 2001) of this characteristic in the sister taxon to *P. taurus*, *P. braconnieri* (Hodges and Zamudio 2004).

No published data on blood squirting exist for *P. braconnieri*, but it was suggested that the species might exhibit a blood-squirting defense because of its putative close relationship with *P. taurus* and *P. asio* (Sherbrooke and Middendorf 2001). Recently collected data on blood squirting in *P. braconnieri* suggest that this species may not respond, or displays a reduced frequency of defensive blood squirting (Sherbrooke and Mendoza, *in press*). Thus, there may be two or three clades—*P. douglasii* (Sherbrooke and Middendorf 2001; Zamudio, unpubl. data), *P. mcallii-modestum-platyrhinos* (Sherbrooke and Middendorf 2001), and *P. braconnieri-taurus* (this paper; Sherbrooke and Mendoza, *in press*)—of species in which the frequency of blood squirting is absent or significantly reduced. Although these groupings are interesting, because the phylogenetic relationships among *Phrynosoma* species are not completely resolved (Hodges and Zamudio 2004; Reeder and Montanucci 2001; Zamudio et al. 1997), the determination of the number of times blood squirting has been acquired or lost during the evolution of the genus remains in question.

As was noted with the *P. mcallii-modestum-platyrhinos* clade and *P. douglasii* (Sherbrooke and Middendorf 2001), *P. braconnieri* and *P. taurus* are relatively small bodied. The species best known for blood squirting (*P. asio*, *P. cornutum*, *P. coronatum*, *P. hernandesi*, *P. orbiculare*, and *P. solare*) are the six largest species in the genus (Baur and Montanucci 1998; Sherbrooke 2003). The large robust species *P. asio* seems to have the highest frequency (12%) of blood squirting toward humans (Hodges 2004). This suggests that the size and armament of larger *Phrynosoma* species narrows the range of potential predators to include canids and possibly others, where blood squirting is an effective defense.

Currently there are two methods for determining the blood-squirting response of horned lizards—human encounters and canid trials. Negative results in either case do not prove that a species is incapable of a positive response under other experimental or natural conditions. Even non-*Phrynosoma* iguanian lizards may occasionally exude blood from the orbital sinus, a condition that may have led to the evolution of blood squirting (Sherbrooke 2000). Consequently it is difficult to assign a "nonsquirting" status to a species of horned lizards. Indeed, Sherbrooke and Middendorf (2001) recorded infrequent human-encounter blood squirting within the *P. mcallii-modestum-platyrhinos* "nonsquirting" clade (0.07% of encounters), although the three species did not squirt when tested with dogs. Nevertheless, the dramatic differences in responses among *Phrynosoma* species, to both human and canid predators, suggests that the 13 species in the genus, and perhaps populations thereof, do not employ a blood-squirting defense to the same extent or under the same conditions. Our growing understanding of the circumstances that elicit blood squirting may lead to an appreciation of the selective pressures that fostered its development and diversification of use in species of *Phrynosoma*.

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Dryadophis Versus *Mastigodryas* (Ophidia: Colubridae): A Proposed Solution

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The nomenclatural history of the Neotropical colubrid snake genera *Mastigodryas* and *Dryadophis* is convoluted. The oldest specific name in either of these genera is *Coluber boddaerti* Sentzen, 1796. Fitzinger (1843) assigned the generic name *Eudryas* to *C. boddaerti*. Brongersma (1937) pointed out that *Eudryas* Boisduval, 1836 predated Fitzinger's name. Stuart (1939) proposed *Dryadophis* as a replacement name for all of the species in the group. Dunn (1944), in his report on the amphibians and reptiles of Colombia, suggested that *Mastigodryas danieli* Amaral, 1935a is a synonym of *Dryadophis boddaerti*. Dunn (1944) apparently thought *Dryadophis* was the older name and included *M. danieli* as *Dryadophis* in his discussion (p. 202) of the latter genus. Inadvertently, Dunn's synonymy made *Mastigodryas* the oldest available name for the species recognized in the genus *Dryadophis*. Romer (1956) also suggested that the two genera were congeneric. Smith (1963), prompted by Romer's suggestion, proposed the validation of *Dryadophis* as the accepted name and the suppression of *Mastigodryas* as a senior synonym to the International Code of Zoological Nomenclature (ICZN). Amaral (1964) commented to the ICZN that Smith's request should not be granted because *Mastigodryas* is distinguished from *Dryadophis* by the absence of apical scale pits and a relatively shorter tail in the former. Amaral (1964) concluded that on taxonomic grounds both genera should be recognized. Peters and Orejas-Miranda (1970) placed *Dryadophis* as a synonym of *Mastigodryas* because Peters had examined the holotype of *M. danieli* and concluded that the two genera are not separable. However, Peters did not discuss the characters of *Mastigodryas* presented by Amaral, leaving the subject open for further comment. Smith and Larsen (1973) argued that it was premature to replace *Dryadophis* with *Mastigodryas*, based on Amaral's (1964) comments. Apparently, the aforementioned discussions rekindled the ICZN members to vote on Smith's (1963) proposal. ICZN Opinion 1035 was published in 1975, wherein the commission rejected suppressing the generic name *Mastigodryas*, based on Amaral's (1964) comments.

Between 1935 and 1969 *Mastigodryas* is used as a valid generic name six times, whereas *Dryadophis* was reported in the literature 67 times during nearly the same time frame (1939–1969). The rare use of *Mastigodryas* is likely due to the absence of specimens in collections and/or its recognition as a valid genus.

Despite Peters and Orejas-Miranda's (1970) synonymy of *Dryadophis* with *Mastigodryas*, *Dryadophis* continued to be used as a valid generic name by some herpetologists (Hidalgo 1981; Köhler 1999, 2003; McCoy et al. 1986; Smith and Larsen 1973; Wilson 1979; Wilson and Meyer 1982; Wilson et al. 1976), but others used *Mastigodryas* (Amaral 1976; Boos 2001; Cei 1993; Chippaux 1986; Cunha and Nascimento 1978; de Lema 1994;

Emsley 1977; Giraudo 2001; ICZN Opinion 1975; Murphy 1997; Pérez-Santos and Moreno 1988, 1991; Savage 2002). We approached H. M. Smith (electronic mail) about the possibility of suppressing *Mastigodryas* once again. His comment was

> "The ICZN put the name *Mastigodryas* on the official list of generic names. It did so with the understanding that the genus is different from *Dryadophis* and therefore need not to be suppressed to protect *Dryadophis*. It did nothing with *Dryadophis*, it was not allocated to either the lists (conserved) or indices (suppressed)… had *Dryadophis* been suppressed, there would be no chance of its revival. I think the ICZN nevertheless would never suppress a name already placed on the official list, even though it was placed there on erroneous bases. Furthermore, *Mastigodryas* has been used several decades and appeal for its suppression now in the interest of stability, would be questionable."

In an effort to resolve this long-standing taxonomic controversy, we undertook a study to characterize the variation of *Dryadophis* relative to that found in *Mastigodryas*. In addition to having the holotype of *M. danieli* examined and photographed by Francisco Franco, Curator of Herpetology, Instituto Butantan, we examined four additional specimens of *M. danieli* from Colombia in the collections of the Field Museum of Natural History (FMNH), the Natural History Museum of Los Angeles County (LACM), and the University of Kansas Natural History Museum (KU). We compared the salient features of the genus *Dryadophis* presented by Stuart (1941), with similar characters of five specimens of *M. danieli*. The characters representing the genus *Dryadophis* are presented first, followed by those of *Mastigodryas* in brackets. If the two genera are equal in a particular character, the bracket contains an equal sign. The dorsal scales are smooth [=], in 15–15–15 or 17–17–15 rows [17–17–15] (rows around the body counted 10 ventrals posterior to the gulars, at midbody, and 10 ventrals anterior to the anal plate), with two apical scale pits [=]. The ventrals number 159–206 [171–187], subcaudals 79–136 [71–107], and maxillary teeth 18–26 [19–21]. The supralabials are variable, but usually 8–8 [=]. The infralabials are also variable and usually 10–10 [=]. The preoculars are 1–1 [=], postoculars 2–2 [=], and the loreal 1–1 [=]. Supralabials entering the orbit are 4+5 or 4+5+6 [4+5+6]. The temporals are variable, usually 2+2 [=], and the anal plate is divided [=]. Given these similarities and broadly overlapping characteristics, we recommend that *Mastigodryas* and *Dryadophis* be relegated to the single genus, *Mastigodryas* because of seniority.

A redescription of the holotype of *M. danieli* and other specimens follow. If scales differ on opposite sides of the head, the right side is recorded first. If our data differ from Amaral's (1935a) description, his differences are in italics, and any additional data are in bold print.

The holotype of *M. danieli* (IB 8694) is an adult female with a total length of 895 mm. The tail length is 190 mm (tip possibly missing) and the tail/total length ratio is 0.212. The dorsal scale rows are smooth, and in 17–17–15 rows. Scales contain **two small apical pits** (*none*). Ventrals number 183, with two preventrals (*187*), whereas the subcaudals number 70 (**+tip**?). Supralabials are 9/9, infralabials 11/12, with the fifth and sixth in contact with the anterior chin shields. Preoculars are 1/1, postoculars 2/2, temporals 2+2, and the supralabials entering the orbit are the fourth, fifth and sixth. The loreal is 1/1 and the anal shield is divided. Maxillary teeth are **19/19** and dentary teeth **21/22**. The color has changed after 67 years in preservative. The anterior two thirds of the body is bluish black, whereas the posterior third is brownish blue. There is no indication of a pattern on any part of the body. The ventral surface is bluish black.

The only additional female examined (FMNH 63783) has an incomplete tail and contained five eggs. It differed from the holotype of *M. danieli* in having 177 ventrals, 1+2/2+2 temporals, and 21 maxillary teeth. The three males examined (LACM 72750, 114654; KU 169953) respectively have ventrals numbering 171, 187, 172, and subcaudals, 98, incomplete, 107. The supralabials are 9/9 in all. The infralabials are 10/10, 11/11, 9/9, and the maxillary teeth number 19, 19, 20. The tail length/total length ratios vary from 0.26, —, 0.29. The reduction site of all four individuals occurred with the fusion of scale rows 3 and 4 over ventrals 107/107 for the female, and 89/93, 113/113, 102/— for the males.

The color of these specimens is similar to that of the holotype. The venter is bluish brown with an indistinct white line on the outer margin of the ventrals. The white line is discontinuous from the fifty-seventh ventral to the anal plate in KU 169953. The throat is bluish brown with a few white spots on the chin and throat in all four specimens. The above summarizes the known variation in *Mastigodryas*.

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TECHNIQUES

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Photographic Identification as a Noninvasive Marking Technique for Lacertid Lizards

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Color and body patterns have long been used to identify individual lacertid lizards (Schmidt-Loske 1996), but may be unsuitable for long-term studies because they vary with reproductive condition, age, and other factors (Henle et al. 1997). Elbing and Rykena (1996) found that individual *Lacerta viridis* could be recognized by patterns of head scalation, and although these scales do not vary over time (Fox 1975), Elbing and Rykena (1996) considered this method of identifying individuals to be excessively time consuming and, in some cases, difficult to use because of the small size of the scales. Recently, Steinicke et al. (2000) found photographic identification of the scales of the first four rows of ventrals to be a suitable technique for recognizing individuals of five species of lacertids (*Lacerta agilis*, *L. bilineata*, *L. viridis*, *L. vivipara*, and *Podarcis muralis*). Photographic identification of individuals by means of scale patterns is an emergent technique with a promising future, but it is necessary to examine other species before it can be considered suitable for lacertids, and other lizards generally. The method also must be improved to reduce the time required for identification, especially when many individuals are involved in the study.

We tested the suitability of using ventral scalation to identify individual *Lacerta perspicillata* (SVL = 46.8 ± 0.34, range: 40.5–54.0, N = 99; unpubl. data). From November 2000 to May 2001, we collected 53 individuals on Menorca Island, Spain. We toe clipped and took two pictures of each lizard with a digital camera (Sony Mavica®). Digital photographs (resolution 640 x 480 pixels) were enhanced in the laboratory with Microsoft Photo Editor® (brightness, contrast, and conversion from color to black and white) and printed (600 x 300 dpi). Ninety-three recaptures of the 53 toe-clipped lizards were identified from photographs using ventral characters (i.e., scales of the chin and collar area, arrangement of scales in the chest area and of the longitudinal and transverse scale rows of the trunk, Fig. 1) by two observers. Photographic identification of individuals matched identification based on toe clips in 100% of cases. All individuals were easily identified, and no apparent change in scale pattern was noted.

Our method was subsequently used in a capture-recapture study involving the same population later the same year (June–October 2001). Lizards were photographed and individuals were added to a previously assembled reference collection of pictures. Individuals collected in the field were identified via comparison with the reference file. To reduce time spent on identification, the photographic reference file was organized by sex, and then by natural amputations, scale anomalies (e.g., aberrations, asymmetries), and

GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 35, Number 1 (March 2004). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extension reports unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA TALPOIDEUM (Mole Salamander). USA: INDIANA: Posey Co: Pike Township (UTM: zone 16 0412376, 4187414, NAD 83), in a permanent bald cypress (*Taxodium distichum*) swamp. 20 March 2004. Rod N. Williams, Brian J. MacGowan, and Mark Pochon. Verified by Ray Semlitsch, Zack Walker, Robert Brodman and Mike Lodato. Field Museum of Natural History (FMNH 262651–652) and Purdue University Department of Forestry and Natural Resources (PUFNR 10032). First verified record for this species in Indiana. The Indiana Department of Natural Resources is considering the conservation status (endangered or special concern) of this species. Twenty-three individuals (22 in breeding condition; see Semlitsch 1985. Oecologia 65:305–313) were caught on 24 March 2004. Morphological measurements were taken on all individuals and data are available from the authors upon request.

Submitted by **ROD N. WILLIAMS** (e-mail: horse@purdue.edu) and **BRIAN J. MacGOWAN,** Department of Forestry and Natural Resources, Purdue University, West Lafayette, Indiana 47907, USA (e-mail: macgowan@purdue.edu).

AMPHIUMA TRIDACTYLUM (Three-toed Amphiuma). USA: ALABAMA: Macon Co.: Beaver pond in Tuskegee National Forest (32.4305°N, 85.6470°W [WGS84/NAD83]) 10 June 2004. Verified by Robert Mount, George Folkerts, and Craig Guyer. Auburn Museum of Natural History, AUM 36393. First county record. This record represents a range extension of ca. 150 km and is the easternmost locality for the species (Mount 1996. The Amphibians and Reptiles of Alabama. University of Alabama Press. xi + 347 pp.). Specimen (a male) was found dead at ca. 2200 h lying outstretched on mud under *Juncus* sp. and *Numphar lutea*, less than 30 cm from the water's edge. The water level in the pond had dropped steadily over the previous weeks. Two injuries on the dorsal surface of the head and tail could not be attributed to a specific predator (i.e., no tooth or claw marks) nor were predator tracks visible in the mud. They could be the result of male-male aggression (Cagle 1948. Ecology 29:479–491). Condition of the specimen indicated that it had not been out of the water long; however fire ants (*Solenopsis invicta*) had begun feeding on the carcass and could also have caused the injuries observed. Our record suggests that *A. tridactylum* is widespread throughout the Mobile Drainage and is similar in distribution to the Diamond-backed Watersnake (*Nerodia rhombifer*) and the Southern Painted Turtle (*Chrysemys picta dorsalis*), two species that also prefer similar shallow, sluggish, vegetated aquatic habitats. Additional surveys for this species within the Alabama and Tallapoosa Rivers are needed to confirm this distribution.

Submitted by **ROGER D. BIRKHEAD, VALERIE M. JOHNSON, SCOTT M. BOBACK**, and **MICHELLE L. BOBACK**, Department of Biological Sciences, Auburn University, Alabama 36849-5414, USA; e-mail: birkhrd@auburn.edu.

BOLITOGLOSSA RUFESCENS (Northern Banana Salamander). MÉXICO: QUINTANA ROO: Municipality of Felipe Carrillo Puerto, 17 km SE of Andrés (19°08'51.3"N, 88°02'24.7"W). 12 February 2003. Alejandro Franco. Colección Herpetológica, Museo de Zoología, El Colegio de la Frontera Sur, Unida Chetumal, Quintana Roo (ECO-CH-H-2022). Verified by Luis Canseco and Oscar Flores-Villela. First record for Quintana Roo and a ca. 300 km range extension from the closest previous record in the Cockscomb Basin Jaguar Preserve, Stann Creek, Belize (Lee 1996. The Amphibians and Reptiles from the Yucatan Peninsula. Cornell Univ. Press, Ithaca, New York. 500 pp.). The specimen was found in a dead tree in secondary, semi-deciduous forest.

Submitted by **RENE CALDERON-MANDUJANO, ALEJANDRO FRANCO,** and **MARISOL MEDINA**, Museo de Zoología, El Colegio de la Frontera Sur, Unidad Chetumal. A.P. 424. C.P. 77059, Chetumal, Quintana Roo, México; e-mail: rcalderon@ecosur-qroo.mx

ENSATINA ESCHSCHOLTZII ESCHSCHOLTZII (Monterey Ensatina). MÉXICO: BAJA CALIFORNIA: Ejido Antonio Meléndrez, ca. 22 km S of Ensenada (31°38.990'N, 116°33.279'W), 371 m elev. 9 February 2003 and 15 February 2004. Francisco Casillas-Figueroa and Anny Peralta-García and Jorge H. Valdez-Villavicencio, respectively. Herpetological collection of Facultad de Ciencias, Universidad Autónoma de Baja California (UABC 1138–39). Verified by Bradford D. Hollingsworth.

Southernmost locality for the species on the Baja California Peninsula and extends the range 58 km S from La Misión (Grismer 2002. Amphibians and Reptiles of Baja California, Including its Pacific Islands, and the Islands in the Sea of Cortés, Univ. of California Press, Berkeley and Los Angeles, California. xiii + 399 pp.). The two specimens were collected during the day in a canyon on the north facing slope of Cerro Buenavista, in chaparral, including ferns and mosses; UABC 1138 was found dead in a pond and UABC 1139 was found alive under a small rock at 1150 h.

Submitted by **ANNY PERALTA-GARCÍA** and **JORGE H. VALDEZ-VILLAVICENCIO**, Facultad de Ciencias, Universidad Autónoma de Baja California, Km. 103 Carretera Tijuana-Ensenada, A.P. 1653, C.P. 22800, Ensenada, B.C., México; e-mail: j_h_valdez@yahoo.com.mx.

HEMIDACTYLIUM SCUTATUM (Four-toed Salamander). USA: ALABAMA: Cleburne Co: Talladega National Forest, Shoal Creek Ranger District, Dugger Mountain, 6.4 km SSE Piedmont (35°52'02.1"N, 85°33'58.8"W). 24 February 2004. Jeffrey L. Gardner and Eric C. Soehren. Verified by Craig Guyer. Auburn University Museum, Alabama Herpetological Atlas Project database (AHAP-D-0001a–d [digital photographs]). One adult specimen captured while swimming on surface of vernal pond within Dugger Mountain Wilderness Area; photographed and released. New county record. (Mount 1975, Reptiles and Amphibians of Alabama. Agricultural Experiment Station, Auburn University. 347 pp.).

Submitted by **JEFFREY L. GARDNER**, Shoal Creek Ranger District, Talladega National Forest, 2309 Hwy 46, Heflin, Ala-

bama 36264, USA, and **ERIC C. SOEHREN**, Alabama Department of Conservation and Natural Resources, State Lands Division, Natural Heritage Section, 64 North Union Street, Montgomery, Alabama 36130, USA; e-mail: jeffgardner@fs.fed.us.

PLETHODON GLUTINOSUS (Northern Slimy Salamander). USA: TENNESSEE: HICKMAN CO.: Just W of Carothers Cemetery, ca 2.0 air mi W of Grinders Switch (35°47'40"N,87°30'36"W). 03 April 2004. David Anderson. Austin Peay State University Museum of Zoology (APSU 17499, 2 color photos). Verified by A. Floyd Scott. One adult observed under rotting pine log in forested area. New county record in Duck River drainage (Redmond and Scott. 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, Center for Field Biology, Austin Peay State University, Clarksville, Tennessee and web version at http://www.apsu.edu/amatlas/ which includes links to information on records published since 1996; accessed 4 June 2004).

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ANURA

BUFO CALIFORNICUS (California Arroyo Toad). MEXICO: BAJA CALIFORNIA NORTE: Rio Santo Tomas, 16 air km E Santo Tomas near Rancho Las Aguillas (31.54913°N, 116.22174°W), 400 m elev., 26 May 2004. Los Angeles County Museum of Natural History voucher photograph (LACM-PC 1400). Observed by Robert Lovich, Barry Downer, and Clark Mahrdt. Photos verified by Edward L. Ervin. This species is distributed disjunctly in several river drainages west from the Sierra Juarez and Sierra San Pedro Martir peninsular range to the foothills and coastal drainages south to San Quintin in northwestern Baja California (see Mahrdt et al. 2002. Herpetol. Rev. 33:123–125; Mahrdt et al. 2003. Herpetol. Rev. 34:256–257). Three juvenile and three adult *Bufo californicus* were observed in sparse oak woodland and riparian habitat on sandy soil substrate. The Rio Santo Tomas record fills a 40 km gap between the Rio Zorrillo and Rio San Vicente and represents a new river drainage for *B. californicus* in Baja California.

Submitted by **CLARK R. MAHRDT**, Herpetology Department, San Diego Natural History Museum, P.O. Box 1390, San Diego, California 92112, USA and **ROBERT E. LOVICH**, AC/S Environmental Security, Box 555008, Marine Corps Base, Camp Pendleton, California 92055-5008, USA.

COCHRANELLA ROSADA. COLOMBIA: ANTIOQUIA: Anorí municipality: Chaquiral forest (6°58'44.3"N, 75°7'53.0"W) 1750 m elev. 14 February 2003. S. P. Galeano and J. C. Urbina. Museo de Herpetología Universidad de Antioquia, Medellín, Colombia (MHUA 2474). Adult male found on the leaf litter at the edge of a stream in the forest. Verified by J. D. Lynch. First department record. Previously known only from Samaná and Pensilvania municipalities of Caldas, Colombia (Ruiz and Lynch 1997. Rev. Acad. Colomb. Cienc. 21[81]:541–553). This record extends the known distribution in 184 km NW from Samaná, and 187 km N from Pensilvania including the northern part of the Colombian Central Mountain.

Submitted by **SANDRA P. GALEANO** (e-mail spgaleano@yahoo.com) and **JENNY C. URBINA**, Instituto de Biología, Universidad de Antioquia, AA. 1226 Medellín, Colombia; e-mail jennyurbina@yahoo.com.

CYCLORAMPHUS MIGUELI (Miguel's Button Frog). BRAZIL: BAHIA: Uruçuca Municipality (14°33'45"S, 39°18'45"W). 06 April 2002. M. Dixo. Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil (MZUSP 128254–255). Verified by M. Trefaut Rodrigues. Species previously known only from the type locality, Fazenda Unacau, São José da Vitória Municipality, Bahia, Brazil (15°09'S, 39°18'W) (Heyer 1988. Proc. Biol. Soc. Washington 101:151). This new record extends range 66.4 km northward from the type locality.

Submitted by **MARIANNA DIXO** and **VANESSA K. VERDADE**, Universidade de São Paulo, Instituto de Biociências, Departamento de Ecologia, Departamento de Zoologia· CEP 05508-901, São Paulo, SP, Brazil (e-mail [MD]: maridixo@ib.usp.br).

ELEUTHERODACTYLUS FACTIOSUS. COLOMBIA: ANTIOQUIA: Anorí municipality: Chaquiral forest (6°58'44.3"N, 75°7'53.0"W). 13 November 2002. Museo de Herpetología Universidad de Antioquia, Medellín, Colombia (MHUA 3091, female). Amalfi municipality: Costa Rica forest (6°52'8.8"N, 75°6'12.5"W). 29 November 2002. MHUA 2442, 2448, females. La Secreta forest (6°49'33.7"N, 75°6'22.8"W). November 2002 and February 2003. MHUA 2452 (male), MHUA 2423 (female). El Edén forest (6°51'31.0"N, 75°5'16.1"W). 26 February 2003. MHUA 2438, male. All localities between 1750 and 1950 m elev. S. P. Galeano and J. C. Urbina. Verified by J. D. Lynch. First department record. Previously known only from Samaná and Pensilvania municipalities of Caldas department, Colombia (Lynch et al. 1998. Rev. Acad. Colomb. Cienc. 22[83]:287–298). These records extend the known distribution ca. 162 km NW from Samaná and ca. 167 km N from Pensilvania including the northern part of the Colombian Cordillera Central.

Submitted by **SANDRA P. GALEANO** (e-mail: spgaleano@yahoo.com) and **JENNY C. URBINA** (e-mail: jennyurbina@yahoo.com), Instituto de Biología, Universidad de Antioquia, AA. 1226 Medellín, Colombia.

ELEUTHERODACTYLUS GALDI (Espada's Robber Frog). PERÚ: PIURA: Provincia Huancabamba: Distrito Carmen de la Frontera: Santuario Nacional Tabaconas-Namballe (05°06'50.7"S, 79°21'16.3"W, 2200 m elev.). 24 April 2003. C. Aguilar. Museo de Historia Nacional, Universidad Mayor de San Marcos, Lima, Perú (MHNSM 19919–21), Museum fuer Tierkunde Dresden, Dresden, Germany (MTD 45969–64). Verified by J. M. Guayasamin. Specimens were caught in a primary forest, adults in vegetation 0.9–1.0 m above ground at night, juveniles on ground during day. Second record for Perú, northernmost distribution in Perú, first record for Departamento de Piura, and extension of altitudinal distribution (Duellman and Pramuk 1999. Sci. Pap., Nat. Hist. Mus. Univ. Kansas 13:1–78). First Peruvian record was based on a single juvenile specimen from 12 km E of La Peca in Departamento de Amazonas (Duellman and Pramuk, *op. cit.*). Our record extends the distribution within Peru ca. 130 air km NW from La Peca and extends the altitudinal distribution 225 m. Previously known high-

est altitudinal distribution was 1975 m (Duellman and Lynch, *op. cit.*). In comparison to Peru, *E. galdi* is well known from Ecuador where it is found at elevations of 1000–1740 m on the eastern face of the Cordillera Oriental (Lynch and Duellman 1980. Misc. Publ. Mus. Nat. Hist. Univ. Kansas 69:1–86), 1700–1975 m in the Cordillera de Cutucú (Duellman and Lynch 1988. Proc. Acad. Nat. Sci. Phil. 140:125–142), and 1500–1550 m in the Cordillera del Cóndor (Almendáriz 1997. *In* Schulenberg and Awbrey [eds], RAP Working Papers No. 7, pp. 199–201, Washington, D.C., Conservation International; Lynch and Duellman, *op. cit.*).

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ELEUTHERODACTYLUS SUETUS (Small Rain Frog). COLOMBIA: ANTIOQUIA: Anorí municipality: La Forzosa forest (6°58'54.1"N, 75°8'41.6"W). 08 February 2003. Museo de Herpetología Universidad de Antioquia, Medellín, Colombia (MHUA 2478, female). Amalfi municipality: Costa Rica forest (6°52'8.8"N, 75°6'12.5"W). 27 November 2002. MHUA 2434, female. Los Canales forest (6°49'46.1"N, 75°5'18.8"W). MHUA 2458, male. All localities between 1750 and 1970 m elev. Individuals found in forest fragments on the leaf litter during the day or on herbaceous vegetation up to 1 m at night. S. P. Galeano and J. C. Urbina. Verified by J. D. Lynch. First department record. Previously known only from Samaná and Pensilvania municipalities of Caldas, Colombia (Lynch and Rueda 1998. Rev. Acad. Colomb. Cienc. 22[85]: 561–579). This record extends the known distribution ca.162 m NW from Samaná and ca. 167 km N from Pensilvania, including the northern part of the Colombian Cordillera Central.

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HYALINOBATRACHIUM EURYGNATHUM (Rio Glass Frog). BRAZIL: BAHIA: Municipality of Itapebi, Palmeira farm (15°57'03"S, 39°37'40"W). 5 November 2002. M. A. de Freitas, C. R. Moura, and T. Figueiredo Santos Silva. Museu Nacional do Rio de Janeiro, Brazil (MNRJ 35557). Collected in the morning on the ground within forest. Verified by J. Perez Pombal, Jr.. Previously known from southeastern Brazil (Frost 1985. Amphibian Species of the World. Allen Press, Lawrence, Kansas. 732 pp.). First record of the family Centrolenidae in northeastern Brazil; extends range ca. 450 km N of Santa Teresa municipality (19°56'S, 40°36'W), state of Espirito Santo (Heyer 1985. Pap. Avul. Zool. 36:1–21), the previous northernmost limit of the species.

Submitted by **MARCO ANTÔNIO DE FREITAS** (e-mail: philodryas@hotmail.com) and **THAÍS FIGUEIREDO SANTOS SILVA,** Rua E quadra D lote 11, Jardim Aeroporto, CEP 42700-000, Lauro de Freitas, Bahia, Brazil, and **ANTÔNIO JORGE SUZART ARGÔLO**, Universidade Estadual de Santa Cruz – UESC, Km 16 Rodovia Ilhéus-Itabuna, CEP 45650-000, Ilhéus, Bahia, Brazil (e-mail: lachesis@uesc.br).

HYLA CINEREA (Green Treefrog). USA: ARKANSAS: Little River Co: off St. Hwy 32, 3.2 km E Ashdown. 13 June 2004. Z. D. Ramsey. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28588). Verified by Stanley E. Trauth. New county record filling small distributional gap in southwestern Arkansas between records for Miller and Sevier counties (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **ZACHARY D. RAMSEY**, **STEPHANIE F. BARCLAY,** and **CHRIS T. McALLISTER,** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA (e-mail: chris.mcallister@tamut.edu).

HYLA CINEREA (Green Treefrog). USA: INDIANA: Vanderburgh Co: Howell Slough at Howell Wetlands. NW1/2, NW1/4, Sec. 35, T6S, R11W. Scott Kramer and Michael J. Lodato 16 June 2003. Verified by Greg Schneider. University of Michigan Museum of Zoology, UMMZ 230109–110. First vouchered record for county and first vouchered record for Indiana. (Minton 2001. Amphibians and Reptiles of Indiana. 2nd ed., revised. Indiana Acad. Sci. 404 pp.).

Green treefrogs were first located at this site by Scott Kramer, who heard chorusing males on various dates in May 2003. Specimens were first collected by Scott Kramer and James Horton on 14 June 2003 and kept in living collection of J. Horton. This new locality is about 7 km NW of a previously reported colony of *H. cinerea* in adjacent Henderson County, Kentucky (Lodato and Grannan 1990. Herpetol. Rev. 21:37). The origin of this newly reported population is unknown, i.e., previously overlooked resident, recent colonization, or introduction. However, this species has, in recent years, rapidly expanded its range and has shown to be a successful colonizer in adjacent southern Illinois (Redmer et al. 1999. Illinois Nat. Hist. Surv. Bull. Vol. 36, Art. 2, 66 pp.) and in adjacent western Kentucky (J. MacGregor, pers. comm.; B. Palmer-Ball, pers. comm.).

Submitted by **MICHAEL J. LODATO**, 925 Park Plaza Drive, Evansville, Indiana 47715, USA (e-mail: mlodato229@aol.com), **SCOTT KRAMER**, Wesselman Woods Nature Preserve, 551 North Boeke Road, Evansville, Indiana 47711, USA, and **JAMES HORTON**, 7601 Placing Road, Indianapolis, Indiana 46226, USA (e-mail: Stardali84@hotmail.com).

HYLA CRUZI. BRAZIL: MATO GROSSO DO SUL. Municipality of Cassilândia (19°08'S, 51°38'W), 471 m elev. 31 October 1996. I. A. Martins, J. Jim, E. F. Spirandeli-Cruz, and B. R. Cardana. Coleção Científica de Vertebrados do Laboratório de Zoologia da Universidade de Taubaté, São Paulo; (IAM/CCLZU 1402–11 males); 29 December 2002. I. A. Martins and S. C. Almeida. (IAM/CCLZU - males, 1037–65 and females, 1066–67), calling in permanent and temporary ponds. Verified by J. P. Pombal, Jr. Species previously known from type locality (Municipality Silvânia, Goiás, Brazil; Pombal and Bastos 1998. Bol. Mus. Nac. N.S. Zool., Rio de Janeiro, 309:1–14; Frost 2002. Amphibian Species of the World: An online reference V2.21 http://research.amnh.org/herpetology/amphibia/index.html.), and recently from Bolivia (Parque Noel

Kempff Mercado; Köhler 2003. Herpetol. Rev. 34:381). First state record extends known distribution ca. 500 km SSW from type locality (Pombal and Bastos, *op.cit.*) and ca. 1500 km SE from its known occurrence in Bolivia. This new record, in the State of Mato Grosso do Sul, confirms the wide distribution of this member of the *Hyla microcephala* group.

Submitted by **ITAMAR ALVES MARTINS,** Departamento de Biologia, Lab. de Zoologia da Universidade de Taubaté, 12030-010, Taubaté, SP, Brazil (e-mail: istama@uol.com.br.), and **SILVIO CESAR ALMEIDA**, **JORGE JIM**, **ELIETH FLORET SPIRANDELI CRUZ**, and **BENEDITO RINALDO CARDANA**, Departamento de Zoologia, Universidade Estadual Paulista, 18618-000, Botucatu, SP, Brazil.

HYLA PUNCTATA (Polka-dot Treefrog). VENEZUELA: ESTADO APURE: MUNICIPIO MUÑOZ: Hato El Frío. 65 m elev. 24 August 1981. R. Roca. Museo de la Estación Biológica de Rancho Grande, Maracay, Venezuela (EBRG 4425–4427). ESTADO YARACUY: MUNICIPIO SAN FELIPE: Parroquia Albarico, Parque Nacional Yurubí, Mayorica, Granja El Renacer. 260 m elev. 24 November 2000. E. Camargo-Siliet and F. Garcia (EBRG 4573–4575). 28 July 2000. E. Camargo-Siliet (EBRG 3680); 24 November 2000 (EBRG 3838–3839); 28 December 2000 (EBRG 3840–3842). Specimens, verified by Marco Natera, constitute first records for Apure and Yaracuy states. *Hyla punctata* is found from Trinidad and Guyanas south to Brazilian, Colombian, Ecuadorian and Peruvian Amazon, as well as Paraguay and Argentina (Frost 1985. Amphibian Species of the World: p. 149; La Marca 1992. Catálogo Taxonómico, Biogeográfico y Bibliográfico de las Ranas de Venezuela, Cuadernos Geográficos, Univ. Los Andes, 9:56, and map 29). The Yaracuy state record represents the northernmost locality for the species in continental South America, with the exception of a neglected Colombian specimen (holotype of *Hylella pearsei;* Ruthven 1922. Misc. Publ. Mus. Zool. Univ. Michigan 8:57) from Fundación, Sierra Nevada de Santa Marta, Colombia, collected more than 500 km W of the localities reported here, and considered by Cochran and Goin (1970. Frogs of Colombia, U.S. Nat. Mus. Bull. 288:224) as a synonym of *Hyla punctata*. The Yaracuy record extends the species range more than 800 km W and 450 km N from closest localities previously documented in Venezuela. Regionally, the species has been reported from eastern Venezuela (states of Delta Amacuro and Bolívar) and the upper Orinoco basin (Amazonas State) in the southern part of the country (Frost, *op. cit.*; La Marca, *op. cit.*; Barrio 1998. Acta Biol. Venezuel. 18[2]:33), as well as from Barinas State (Barrio et al. 2000. Herpetol. Rev. 31:50) and Táchira State (Chacón et al. 2002 Herpetol. Rev. 33:145).

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HYLA SQUIRELLA (Squirrel Treefrog). USA: TEXAS: CAMERON Co. South Padre Island (26°5'8.29"N, 97°9'48.89"W). 14–16 May 2004. Collected by Rebecca M. Calisi. Verified by Jonathan A. Campbell and John H. Malone. A series of 28 juveniles were sampled from landscaped, grassy area along Bridgepoint Luxury Condos driveway, 334 Padre Boulevard, South Padre Island, Texas, 78597 (UTA A-56636–663). Numerous juveniles observed, and adults were calling south of the condo parking lot in conjunction with *Hyla cinerea*. First confirmed county record. Nearest occurrence documented in Kleberg Co., two counties north of Cameron Co. (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Press, College Station, Texas. 182 pp.).

Submitted by **REBECCA M. CALISI**, Department of Biology, University of Texas at Arlington, 501 South Nedderman, Life Science Building 337, Arlington, Texas 76019, USA; e-mail: calisiB@aol.com.

LEPIDOBATRACHUS LLANENSIS. BOLIVIA: DEPARTAMENTO TARIJA: Provincia Gran Chaco: ca. 50 km from Villamontes towards Paraguayan border (21°29'28"S; 63°3'7"W). 2 January 2004. S. Reichle and D. Embert. Museo Historia Natural Noel Kempff Mercado, Santa Cruz, Bolivia (MNKR 7600). First country record. Previously known from Argentina and Paraguay. The new record extends the known distribution 100 km N from the nearest locality—"Hickman"—in the Salta Province in Argentina (23°12'S; 63°34'W) (Faivovich 1994. Acta Zool. Lilloana 43[1]:105–115).

Submitted by **STEFFEN REICHLE**, The Nature Conservancy – Bolivia Program, Edificio Multicentro Torre B, piso 4 ofc. 402, La Paz, Bolivia; **DIRK EMBERT,** Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany; and **JULIAN FAIVOVICH**, Department of Herpetology, American Museum of Natural History, New York, New York 10024, USA.

LEPTODACTYLUS STENODEMA (San José White-lipped Frog). PERÚ: MADRE DE DIOS: Manu: Río Los Amigos Conservation Concession, Río Los Amigos Research Center (12°34' S, 70°06' W, 270 m elev.). 7 April 2003. E. Chulla, M. Medina, N. Carrillo, R. von May. Verified by W. R. Heyer. Museo de Historia Natural Universidad San Marcos, Lima, Perú (MUSM 21069, juvenile, 62.3 mm SVL collected at 2000 h on leaf litter, near a burrow between tree roots in an old-growth tierra firme forest ca. 2.6 km NW from research center). First record for Madre de Dios Department and extension of southern limit of its range in Perú and in South America (Rodríguez et al. 1993. Publ. Mus. Hist. Nat. UNMSM [A] 45:1–22; Duellman and Thomas 1996. Occas. Pap. Mus. Nat. Hist. Univ. Kansas 180:1–34; Heyer 1979. Smithson. Contr. Zool. 301:1–43). The nearest known locality is Balta, Ucayali Department, Perú (ca. 300 km NW) (Duellman and Thomas 1996, *op cit.),* which was the southernmost record (10°08' S) within the known range for this species that includes part of the Amazon Basin in Ecuador, Colombia, Perú, Brazil, and part of the Guianas (Heyer 1979, *op cit.).*

Submitted by **RUDOLF VON MAY**, Asociación para la Conservación de la Cuenca Amazónica (ACCA), Calle Cuzco 499, Puerto Maldonado, Madre de Dios, Perú; e-mail: vonmay@terra.com.

NYCTIXALUS PICTUS (White-spotted Tree Frog). THAILAND. NAKHON SI THAMMARAT PROVINCE: KHAO LUANG NATIONAL PARK: Khao Luang (ca. 8°27'N, 99°37'E). No date. M. Matsui. Graduate School of Human and Environmental Studies, Kyoto University (KUHE 19435). Verified by J. Nabhitabhata. Single adult. RANONG PROVINCE: Muang District: forest stream near Klong Hat Som Paen (ca. 9°57'N, 98°41'E). 9 January 2003. C. Chimsunchart, M. Sumontha, and O.S.G. Pauwels. Institut Royal des Sciences naturelles de Belgique, Brussels (IRSNB 13241). Verified by C. Chimsunchart. Single adult, found at 2235 h on a shrub along the water, 1.5 m above the ground. First records for both provinces. The closest records in Thailand are from Raman Forest Park (Pauwels et al. 2000. Abstracts. Fourth Asian Herpetological Conference. 16–20 July 2000, Chengdu, China: 137; voucher specimen in Muséum National d'Histoire Naturelle, Paris) and Laem Hin Chang (Grossmann and Tillack 2000. Sauria 22[4]: 23–38), Phang-Nga Province, southern Thailand. The locality in Ranong Province is situated at ca. 145 air km N of the previous northernmost locality for *N. pictus* in mainland Southeast Asia, and less than 20 air km from Myanmar, where the species has not yet been recorded.

We thank C. Chimsunchart (Phetchaburi), A. Aowphol and K. Thirakhupt (Chulalongkorn University, Bangkok), and G. Coulon and G. Lenglet (IRSNB) for help and working facilities.

Submitted by **OLIVIER S. G. PAUWELS**, Department of Recent Vertebrates, Institut Royal des Sciences naturelles de Belgique, Rue Vautier 29, 1000 Brussels, Belgium (e-mail: osgpauwels@hotmail.com), **MONTRI SUMONTHA**, Ranong Marine Fisheries Station, 157 M. 1, Saphan-Pla Rd., Paknam, Muang, Ranong 85000, Thailand (e-mail: montri_sumontha@hotmail.com), and **MASAFUMI MATSUI**, Graduate School of Human and Environmental Studies, Kyoto University, Sakyo, Kyoto 606-8501, Japan (e-mail: fumi@zoo.zool.kyoto-u.ac.jp).

OSTEOCEPHALUS BUCKLEYI (Buckley's Slender-legged Treefrog). PERÚ: MADRE DE DIOS: Manu: Río Los Amigos Conservation Concession, Río Los Amigos Research Center (12°34'S, 70°06'W, 270 m elev.). 14 February 2002, 10 March 2003, 1 April 2003. R. von May, N. Carrillo. Museo de Historia Natural Universidad San Marcos, Lima, Perú (MHNSM 19225, male 39.8 mm SVL; MHNSM 19226, male 38.6 mm SVL; MHNSM 19227, female 50.9 mm SVL. Collected between 2000 and 2400 h, on understory vegetation 0.6–1.4 m above ground, in an old-growth tierra firme forest ca. 2.5 km N and 3.5 km NW from research center.). Verified by K.H. Jungfer. First record for Madre de Dios Department and second record for southern Perú (Rodríguez et al. 1993. Publ. Mus. Hist. Nat. UNMSM [A] 45:1–22; Duellman and Thomas 1996. Occas. Pap. Mus. Nat. Hist. Univ. Kansas 180:1–34; Trueb and Duellman. 1971. Occas. Pap. Mus. Nat. Hist. Univ. Kansas 1:1–47). The nearest known localities in Perú are: Balta, Ucayali Department (ca. 300 km NW) (Duellman and Thomas 1996, *op. cit.*) and Yahuaramayo, Puno Department (ca. 150 km S) (Trueb and Duellman 1971, *op. cit.*). This record fills a hiatus of ca. 450 km in the southwestern region of the known range for this species. This includes the periphery of the Amazon Basin in the Guianas and northeastern Brazil, as well as part of the Amazon Basin in southern Colombia, Ecuador, Perú, and east-central Bolivia (Trueb and Duellman 1971, *op. cit.*).

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OSTEOPILUS SEPTENTRIONALIS (Cuban Treefrog). USA: FLORIDA: SEMINOLE CO: 2.2 km E of Interstate 4 on Lake Mary Road (UF 87342). 19 April 1993. Central Florida Zoological Park grounds, 0.3 km S of Interstate 4 on US 17/92 (UF 87341 and 87344). 0.9 km S of Volusia Co. line on US 17/92 (UF 87343). 25 May 1993. Douglas Mehaffey and Michael E. Welker. Verified by David L. Auth and Kenneth L. Krysko, Florida Museum of Natural History. New county records (Meshaka 2001. The Cuban Treefrog in Florida: Life History of a Successful Colonizing Species. University Press of Florida, Gainesville, Florida, 208 pp.).

Submitted by **MICHAEL E. WELKER**, 1911 NW 55th Terrace, Gainesville, Florida 32605, USA; e-mail: herpconservation69@yahoo.com.

PHYLLONASTES MYRMECOIDES. BOLIVIA: DEPARTAMENTO LA PAZ: Provincia Iturralde: Candelaria (13°35'12.5"S; 68°40'48"W). 29 August 2001. C. Cortez. Colección Boliviana de Fauna, La Paz, Bolivia (CBF 5222). DEPARTAMENTO COCHABAMBA: Provincia Chapare: Santa Anita (16°38'56"; 65°47'36"). 6 September 2002. A. Romero. CBF 1007. Verified by J. Aparicio and A. Muñoz. First country records. Previously known from Peru and Brazil. De la Riva et al. (Rev. Esp. Herpetol. 2000. 14:19–164), expected that this species would be found in the Amazonian part of Bolivia. These records extend the known distribution 567 km (airline) SE from the nearest locality at Explorer's Inn in Peru (Doan and Arizábal 2002. Biotropica 34:101–117).

Submitted by **STEFFEN REICHLE**, The Nature Conservancy – Bolivia Program, Edificio Multicentro Torre B, piso 4 ofc. 402, La Paz, Bolivia; **RODRIGO AGUAYO,** Centro de Biodiversidad y Genética, Universidad Mayor de San Simón, C/Sucre esq. Parque La Torre, Casilla 538, La Paz, Bolivia; and **CLAUDIA CORTEZ**, Colección Boliviana de Fauna, Calle 26 de Cota Cota, La Paz, Bolivia.

RANA AREOLATA (Crawfish Frog). USA: OKLAHOMA: WASHINGTON CO.: ca. 2.1 km W of Hwy 75 at Ramona on W3350 Road (UTM zone 15; 233905E, 4047104N, NAD 83.). 04 March 2004. Stephen C. Richter and Donald B. Shepard. Verified by Janalee P. Caldwell. Sam Noble Oklahoma Museum of Natural History Collection (OMNH 39878). First county record. (Bragg 1953. Wasmann J. Biol. 11:273–318). AOR male, 96.5 mm SVL, 102.9 g mass; air temperature was 13.9°C; rainfall during the previous two days was 8.9–10.2 cm. Crawfish Frogs were chorusing in three wetlands in a cattle pasture just S of W3350 Road.

Submitted by **STEPHEN C. RICHTER** and **DONALD B. SHEPARD**, Department of Zoology, University of Oklahoma, 730 Van Vleet Oval, Norman, Oklahoma 73019, USA; e-mail richter@ou.edu.

RHAMPHOPHRYNE MACRORHINA (Billed Toad, Trumpeted Toad). COLOMBIA: ANTIOQUIA: Anorí Municipality: La Forzosa Forest (6°58'54.1"N, 75°8'41.6"W). 11 November 2002.

Museo de Herpetología Universidad de Antioquia, Medellín, Colombia (MHUA) 2343, a male; Chaquiral Forest (6°58'44.3"N, 75°7'53.0"W). 15 November 2002. A male (MHUA 2344). Amalfi Municipality: Costa Rica Forest (6°52'8.8"N, 75°6'12.5"W). November and February 2002. A female (MHUA 2445) and two males (MHUA 2446–47). Los Canales Forest (6°49'46.1"N, 75°5'18.8"W). November 2002. A female (MHUA 2345) and a male (MHUA 2346). All localities between 1800 and 1980 m elev. Individuals found on leaf litter during the day and on terrestrial bromeliads at night, within interior forest. S. P. Galeano and J. C. Urbina. Verified by J. D. Lynch. Previously known from the Guatapé Municipality in Antioquia (Trueb 1971. Los Angeles Co. Mus. Contr. Sci. 216:1–40) and from Samaná Municipality in Caldas, Colombia (Rueda et al. [eds.] 2004. Libro Rojo de Anfibios de Colombia. Serie Libros Rojos de Especies Amenazadas de Colombia. C I Colombia, ICN – UNAL Colombia, Ministerio del Medio Ambiente. Bogotá, Colombia). This record extends the known distribution 75 km NE from Guatapé and ca. 162 km NW from Samaná including the northern part of the Colombian Cordillera Central.

Submitted by **SANDRA P. GALEANO** (e-mail spgaleano@yahoo.com) and **JENNY C. URBINA,** Instituto de Biología, Universidad de Antioquia, AA. 1226 Medellín, Colombia (e-mail: jennyurbina@yahoo.com).

XENOHYLA EUGENIOI (NCN). BRAZIL: BAHIA: Ipirá (12°09'S, 39°44'W). 328 m elev. 4 April 1995. Amphibian Collection, Museu de Zoologia, Universidade Federal da Bahia, Salvador, Bahia, Brazil (UFBA 050). Verified by U. Caramaschi. This new record is the northernmost for the species, and extends its range 161.5 km N from the type locality, Maracás, Bahia, Brazil (13°25'S, 40°25'W, 964 m elev.) (Caramaschi 1998. Amphibia-Reptilia 19:377–384). Only two other localities are known for this species: Poções, Bahia (14°32'S, 40°22'W), and Planalto Baiano, Bahia (14°40'S, 40°28'W).

Submitted by **MARCELO FELGUEIRAS NAPOLI** (e-mail: napoli@ufba.br) and **FERNANDA BRANDÃO**, AMPHIBIA – Laboratório de Taxonomia e História Natural de Anfíbios, Departamento de Zoologia, Instituto de Biologia, Universidade Federal da Bahia, Campus Universitário de Ondina, Rua Barão de Geremoabo, 40170-290 Salvador, Bahia, Brazil.

TESTUDINES

BATAGUR BASKA (River Terrapin). CAMBODIA: KOH KONG: Botum Sakor District: Stung Proat River (11°19'52"N 103°27'57"E), 24 October 2003. Juvenile (BW 1900 g, CL 246 mm). Photographic collection, Museum of Vertebrate Zoology (MVZ 241558). Verified by J. F. Parham. First district record and westward extension of known range of the species within Cambodia, although this endangered terrapin is known from neighboring Sre Ambel District (Platt et al. 2003. Chelonian Conserv. Biol. 4:691–694). This individual was handed to the Sre Ambel District Fisheries officer. It was speared with a four-pronged spear by Mr. Tuong of Chiphat Village while he was fishing for shrimp 31.5 km from the river mouth, at a salinity 20% of sea water. It was maintained in captivity for a week before it was released where Mr. Tuong caught it.

Submitted by **ROHAN H. P. HOLLOWAY**, Applied Ecology Research Group, University of Canberra, Canberra, ACT 2601 Australia (e-mail: rohanholloway@online.com.kh), and **HENG SOVANNARA**, Wildlife Conservation Society, PO Box 1620, Phnom Penh, and Department of Fisheries, P.O. Box 582, Chamcar Mon, Phnom Penh, Cambodia (e-mail: sovannara_2000@yahoo.com).

CHELYDRA SERPENTINA SERPENTINA (Eastern Snapping Turtle). USA: TEXAS: SAN AUGUSTINE CO: 12.9 km SE San Augustine, off US 96 Hwy. 16 June 2004. M. L. Cameron. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28626). Verified by Stanley E. Trauth. New county record filling distributional gap between Jasper and Shelby counties in far east/central Texas (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M University Press, College Station, Texas. 421 pp.). Juvenile specimen found DOR.

Submitted by **MICHELLE L. CAMERON** and **CHRIS T. MCALLISTER,** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA; e-mail: chris.mcallister@tamut.edu.

GOPHERUS AGASSIZII (Desert Tortoise). MÉXICO: CHIHUAHUA: 6 km SW Chínipas (27°20'55.4"N, 108°33'1.8"W), 800 m elev. 17 September 2003. Julio A. Lemos-Espinal. Herpetological Collection Photograph, Laboratorio de Ecología, Unidad de Biología, Tecnología y Prototipos (LE-UBIPROo-00001). Verified by Luis Oliver-López. First specimens reported from the state of Chihuahua and a range extension of about 75 km E Alamos, Sonora (Bogert and Oliver 1945. Bull. Am. Mus. Nat. Hist. 83:398).

Submitted by **HOBART M. SMITH** and **DAVID CHISZAR**, Department of Ecology and Evolutionary Biology, and Museum, University of Colorado, Boulder, Colorado 80309, USA (e-mail: hsmith@colorado.edu; chiszar@clipr.colorado.edu), and **JULIO A. LEMOS-ESPINAL** (e-mail: lemos@servidor.unam.mx) and **GUILLERMO WOOLRICH-PIÑA**, Laboratorio de Ecología, Unidad de Biología, Tecnología y Prototipos, Facultad de Estudios Superiores Iztacala, Universidad Nacional Autónoma de México, Apartado Postal 314, Avenida de los Barrios #1, Los Reyes Iztacala, Tlalnepantla, Estado de México, México 54090 (e-mail: woolrich@correo.unam.mx).

PELTOCEPHALUS DUMERILIANUS (Big-headed Amazon River Turtle). BRAZIL: PARÁ: Município de Prainha (1°48'S, 53°29'W). Amazonas River. 10 June 2002. Linha de Pesquisa em Herpetologia da Amazônia, Laboratório de Pesquisas Zoológicas, Faculdades Integradas do Tapajós, Santarém, Pará State (LPHA 2434–5, both juvenile females). Verified by Rubens N. Yuki. These specimens represent the first records in Prainha, extending the known distribution by 557 km from Belém (01°27'S, 48°29'W) (Pritchard and Trebbau. 1984. The Turtles of Venezuela. SSAR Contr. Herpetol. 2, 403 pp.) and by 100 km from Curuá-Una (02°24'S, 54°05'W) (Iverson et al. 2002. Turtles of the World (http://emys.geo.orst.edu).

Submitted by **MARCELO ERICK BATISTA DEZINCOURT** (e-mail: sextuberculata@hotmail.com) and **AUGUSTO RODRIGUES MAIA**, Linha de Pesquisa em Herpetologia da Amazônia, Faculdades Integradas do Tapajós, 335, Caixa Postal

81, CEP: 68.110-200, Santarém, Pará, Brazil (e-mail: auromaia@hotmail.com).

PSEUDEMYS CONCINNA (Eastern River Cooter). USA: ARKANSAS: Miller Co: 10.2 km WSW Fouke off AR St. Hwy 237 at Sulphur River Bridge. 25 March 2004. N. E. Solley. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28309). Verified by Stanley E. Trauth. New county record (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville. 421 pp.) filling a distributional hiatus in extreme SW part of state. Also reported previously to the west in nearby Bowie (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station. 421 pp.) and Cass (McAllister 2001. Herpetol. Rev. 32:117) counties, Texas.

Submitted by **NANCY E. SOLLEY** and **CHRIS T. McALLISTER,** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA; e-mail: chris.mcallister@tamut.edu.

RHINOCLEMMYS PULCHERRIMA ROGERBARBOURI (Western Mexican Wood Turtle). MÉXICO: CHIHUAHUA: Municipality of Chínipas, La Cienaga (27°27'27.5"N, 108°34'50.9"W), 600 m elev. 22 September 2003. Julio A. Lemos-Espinal. Herpetological Collection Photograph, Laboratorio de Ecología, Unidad de Biología, Tecnología y Prototipos (UBIPROo-00002). Verified by Luis Oliver-López. First valid record from Chihuahua, and a range extension of about 75 km E of Guirocoba, Sonora (Bogert and Oliver 1945. Bull. Am. Mus. Nat. Hist. 83:396). Another record reported from the state was invalidated by Ernst (1981. Cat. Am. Amph. Rept. [275]:1), who determined it to be a released or escaped animal that undoubtedly came from another locality.

Submitted by **HOBART M. SMITH** (e-mail: hsmith@colorado.edu) and **DAVID CHISZAR**, Department of Ecology and Evolutionary Biology, and Museum, University of Colorado, Boulder, Colorado 80309, USA (e-mail: chiszar@clipr.colorado.edu), and **JULIO A. LEMOS-ESPINAL** (e-mail: lemos@servidor.unam.mx) and **GUILLERMO WOOLRICH-PIÑA**, Laboratorio de Ecología, Unidad de Biología, Tecnología y Prototipos, Facultad de Estudios Superiores Iztacala, Universidad Nacional Autónoma de México, Apartado Postal 314, Avenida de los Barrios #1, Los Reyes Iztacala, Tlalnepantla, Estado de México, México 54090 (e-mail: woolrich@correo.unam.mx).

TERRAPENE CAROLINA TRIUNGUIS (Three-toed Box Turtle). USA: ARKANSAS: Little River Co: off St. Hwy 108, 3.2 km SE Alleene. 13 June 2004. M. L. Cameron. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28589). Verified by Stanley E. Trauth. New county record filling hiatus in southwestern Arkansas between records for Miller and Sevier counties (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville. 421 pp.). We anticipate that *T. c. triunguis* will be documented in adjacent Hempstead County thus placing this species in all counties of western Arkansas.

Submitted by **MICHELLE L. CAMERON** and **CHRIS T. McALLISTER,** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA (e-mail: chris.mcallister@tamut.edu).

LACERTILIA

ANOLIS CAROLINENSIS CAROLINENSIS (Northern Green Anole). USA: ARKANSAS: Little River Co: 1.6 km SE Wilton off U.S. 71 on County Rd. 201. 28 March 2004. A. R. Shoemake. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28310). Verified by Stanley E. Trauth. New county record completely filling small distributional gap in southwestern Arkansas (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **ALICIA R. SHOEMAKE** and **CHRIS T. McALLISTER,** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA (e-mail: chris.mcallister@tamut.edu).

ANOLIS CAROLINENSIS CAROLINENSIS. (Northern Green Anole). USA: TENNESSEE: Hickman Co.: Sulpher Creek Road ca. 1.0 road mi NW of Beaverdam Springs (Camp Nocome) (35°41'31"N,87°36'30"W). 23 March 2004. David Anderson. Austin Peay State University Museum of Zoology (APSU 17487, 2 color photos). Verified by A. Floyd Scott. One adult observed on south-facing bank of roadside ditch near 3rd-order stream (Sulphur Creek) in beech-maple forest. New county record and northernmost documented locality for the species in middle Tennessee (Conant and Collins 1998. A Field Guide to Reptiles and Amphibians. Eastern and Central North America. Houghton Mifflin, Boston, Massachusetts. 616 pp.). Previously reported from the following central Tennessee counties: Hardin (Truett 1993. M.S. Thesis, University of Tennessee, Knoxville, 55 pp; Cahn 1939. Copeia 1939:169), Wayne (Cochran 1938. Copeia 1938:90; Gentry 1956. J. Tennessee Acad. Sci. 31:242–251); Lawrence, Giles, Lincoln, Franklin (Gentry 1956, *op. cit.*).

Submitted by **DAVID ANDERSON**, 1150 Riverview Road, Centerville, Tennessee, 37033, USA; e-mail: dandm5@bellsouth.net.

CYRTODACTYLUS IRREGULARIS (Irregular Bent-Toed Gecko). VIETNAM: THUA THIEN HUE: Bach Ma (16°05–16'N, 107°43–53'E). Collected before August 1998. Hoang Xuan Quang and students. Verified by Wolfgang Böhme. Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany (ZFMK 80080). *Cyrtodactylus irregularis* was previously only known from the northern part of southern Vietnam and the southern part of central Vietnam (Smith 1935. The Fauna of British India, including Ceylon and Burma. Reptilia and Amphibia. Vol. II. Sauria. Taylor & Francis Ltd., London; Bobrov 1993. Zoologicheskii Zhurnal 72:70–79), in particular the provinces Lam Dong, Dac Lac, and Gia Lai (Nguyen Van Sang and Ho Thu Cuc 1996. Danh luc bo sat va ech nhai Viet Nam. Nha xuat ban khoa hoc va ky thuat, Ha Noi). The new finding represents the first record for the northern part of central Vietnam (compare www.wing-wbsj.or.jp/~vietnam/source_book/index.htm for geographical zones) and thus is the northernmost record of the species in Vietnam and in general. The specimen of Bach Ma is most likely a female (SVL 51.0 mm; head length 14.0 mm; head width 8.7 mm; head height 6.2 mm; tail incomplete); its stomach and gut contained remains of a cricket or grasshopper (Saltatoria) of

about 15 mm head–body length. ZFMK 80080 differs from the original description (Smith 1921. Proc. Zool. Soc. London 1921:423–440) in pattern. However, the neck and back pattern of the present specimen corresponds well with that of another specimen (BM 1931.6.12.3 from Sui Kat) tentatively placed in *C. irregularis* by Smith (1935). The scalation features of the specimen of Bach Ma (12 supralabials; 8 sublabials; 4 nasals; 1 internasal; 2 postmentals; 6 scales behind postmentals; 20 rows of dorsal tubercles; ca. 47 ventrals between lateral folds at midbody; ca. 9 enlarged preanal scales, situated in an angle, and followed up with two rows of distinctly enlarged, smooth scales; 21–23 subdigital lamellae below fourth toe; subcaudals larger than dorsal tail scales but not in a longitudinal, medial row) largely correspond with the characters given in Smith (1935), except for the lack of enlarged femoral scales. Apparently, *Cyrtodactylus irregularis* is a rarely collected and therefore barely known bent-toed gecko species.

Submitted by **THOMAS ZIEGLER**, Zoologischer Garten Köln, Riehler Str. 173, D-50735 Köln, Germany (e-mail: tziegler@zoo-koeln.de), **HERBERT RÖSLER**, Staatliche Naturhistorische Sammlungen Dresden, Museum für Tierkunde, Forschungsstelle A. B. Meyer Bau, Königsbrücker Landstr. 159, D-01109 Dresden, Germany (address for correspondence: Ferdinand-Freiligrath-Str. 51, D-06502 Thale am Harz, Germany), and **HOANG XUAN QUANG**, University of Vinh, Nguyen Du Str., Vinh - Nghe An, S. R. Vietnam.

COLEONYX ELEGANS (Yucatán Banded Gecko). MÉXICO: PUEBLA: Municipality of Huehuetlán El Chico, Mixteca Poblana (18°21'19"N, 98°41'27.1"W), 1055 m elev. 8 September 2000. Demian Solis Cuautle. Laboratorio de Herpetología, Escuela de Biología, Benemérita, Universidad Autónoma de Puebla (EBUAP 2046). Verified by Edmundo Perez Ramos. First record for the state and a ca. 58 km range extension from the nearest locality in Morelos (Castro-Franco and Bustos-Zagal 2003. Acta Zool. Mex. 88:123–142). The specimen was caught in tropical deciduous forest.

Submitted by **LUIS CANSECO-MÁRQUEZ**, Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, A.P. 70-399, México, D.F. 04510, México (e-mail: lcm@correo.unam.mx); **GUADALUPE GUTIÉRREZ MAYÉN**, Laboratorio de Herpetología, Escuela de Biología, Benemérita Universidad Autónoma de Puebla, C.P. 72570, Puebla, México; **URI OMAR GARCÍA-VÁZQUEZ** and **CARLOS HERNÁNDEZ-JIMËNEZ**, Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, A.P. 70-399, México, D.F. 04510, México.

EUGONGYLUS RUFESCENS. INDONESIA: EAST SUMATRA: Jambi Province: Kersic Tui District. Rainforest in the Sangaranaguna River Valley, near a volcanic lake, Danan Gunung Tujnh (1900 m elev.). 19 November 1999. Nikolai Orlov. Zoological Institute, Russian Academy of Sciences (ZISP 22613). Verified by Natalia Ananjeva. Adult male, 110 mm SVL, 31 rows of scales at mid-body, 69 mid-dosal scales between parietal scales and a point above vent, 15 smooth lamellae under 4th toe. New island record. Known localities of this relatively large skink (reaching 150 mm SVL at maximum) range from the islands of Timor, Ambona, Ceram, Aru, and Molluccas, through New Guinea and some adjacent islands including those in the Torres Strait, to northern Cape York of Australia and the Solomon Islands (Rooij 1915. The Reptiles of Indo-Australian Archipelago 1. Lacertilia, Chelonia, Emidosauria. Brill, Leiden; Greer 1974. Austral. J. Zool., Suppl. Ser. 31; Welch et al. 1990. Lizards of the Orient: A Checklist. Krieger Publ. Co., Malabar, Florida). This very unexpected discovery of *E. rufescens* from Sumatra extends the species' range, as well as generic range, westward by more than 2500 km. Because the present specimen was collected at a high altitude, it seems unlikely that it had originated from recent migration to Sumatra by means of rafting or of artificial transportation. We suspect that the specimen represents a relict population of the species, which should once have exhibited a continuous distribution, but then disappeared from islands located between Sumatra and eastern Indonesia.

Submitted by **ILYA DAREVSKY** (e-mail: lacerta@zin.ru) and **NIKOLAI ORLOV,** Zoological Institute, Russian Academy of Sciences, 199034 St. Petersburg, Russia.

GEKKO MONARCHUS (Spotted House Gecko). WEST MALAYSIA: PAHANG: Pulau Sembilan. 22 July 2003. Cindy M. Valdivia, Linda Escobar, Nicole Padilla, Jonathan Wheatley, Steven Wright, Siewyeen Teen, and Robert Rosser. Forest Research Institute, Malaysia (FRIM) 0620. Verified by Jesse L. Grismer. Two males were collected, of which one (87 mm SVL) was found at ca. 2000 h on a large boulder in a dry streambed, and the other (86 mm SVL) at ca. 2100 h, ca. 1 m above ground on a small dipterocarp tree along the same dry streambed. Only one of these was deposited as a voucher specimen (see above); the other was released after examination and identification. The current distribution of *G. monarchus* ranges throughout southern Thailand, West Malaysia, Singapore, Borneo, Sumatra, Java, Sulawesi, New Guinea, and the Philippines (Manthey and Grossman 1997. Amphibien und Reptilien Südostasiens. Natur und Tier-Verlag, Münster, Germany. 233 pp.). Within the Seribuat Archipelago, West Malaysia, *G. monarchus* occurs in Pulau Aur, Pulau Dayang, Pulau Pemanggil, Pulau Seribuat, Pulau Tinggi, and Pulau Tioman (Escobar et al. 2003. Hamadryad 27:259–262; Grismer et al. 2001. Hamadryad 26:322–325; Wood et al. 2003. Hamadryad 27:281–284; Wood et al. 2004. Hamadryad, *in press*; Youmans et al. 2002. Hamadryad 27:148–149). It is not surprising to find *G. monarchus* on Pulau Sembilan because of its proximity (0.7 km W) to Pulau Seribuat, where *G. monarchus* occurs (Wood et al. 2003, *op. cit.*).

Submitted by **CINDY M. VALDIVIA, LINDA ESCOBAR, NICOLE PADILLA, JONATHAN WHEATLEY, STEVEN WRIGHT, SEWYEEN TEEN,** and **ROBERT ROSSER**, Department of Biology, La Sierra University, Riverside California 92515-8247, USA; e-mail: cm_valdivia@yahoo.com.

GERRHONOTUS LIOCEPHALUS (Texas Alligator Lizard). MÉXICO: ZACATECAS: Municipality of Valparaíso, El Romerillo, 4 km N, 1.5 km W Valparaíso (22°46.2'N, 103°34'W), 1980 m elev. 27 September 2002. Lesley Chambert. Verified by Adrián Nieto-Montes de Oca. Herpetological Collection of the Escuela Nacional de Ciencias Biológicas (IPN. ENCB-17383). First record for Zacatecas and extends range ca. 139.5 airline km SE from Llano Grande, Durango (Good 1994. Herpetol. Monogr.

8:180–202) and ca. 146 airline km NW from Sierra del Laurel, Aguascalientes (Ramírez-Bautista 1998. Herpetol. Rev. 29:110. The specimen was collected in a transition zone between dry pine-oak forest and xerophytic shrubs.

Submitted by **JOSÉ ISMAEL CAMPOS-RODRÍGUEZ** (e-mail: ismaelcampos@msn.com), **LESLEY CHAMBERT,** and **MARÍA DEL CARMEN DÍAZ**, Laboratorio de Cordados Terrestres, Departamento de Zoología, Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional, Apdo. Post. 42-186, Carpio y Plan de Ayala s/n. Santo Tomás, México D.F., 11340, México; and **FERNANDO MENDOZA-QUIJANO,** Instituto Tecnológico Agropecuario de Hidalgo, km 5. 5. Carr. Huejutla-Chalahuiyapa, Apdo. Post. 94, C.P. 43000, Huejutla de Reyes Hidalgo, México.

GYMNOPHTHALMUS UNDERWOODI (Smooth-scaled Worm Lizard). ST. VINCENT: The Grenadines: Mustique Island, intersection of the road connecting Macaroni Beach with Pasture Bay and the road leading to Britannia Bay (250 m inland from the eastern coast), 50 m elev. 2 February 2002 and 3 February 2003. M. R. Paice. Verified by Robert Powell. MPM Herpetology Photographic Collection 711–12. Photographed midday in partially shaded roadside leaf-litter near xeric woodland. First record for Mustique Island (Schwartz and Henderson 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History. Univ. Florida Press, Gainesville. xvi + 720 pp.).

Submitted by **MICHAEL R. PAICE**, 8D Rochdale Way, London SE8 4LY, UK (e-mail: mrpaice@yahoo.co.uk), and **ROBERT W. HENDERSON**, Section of Vertebrate Zoology, Milwaukee Public Museum, Milwaukee, Wisconsin 53233-1478, USA (e-mail: rh@mpm.edu).

HEMIDACTYLUS AGRIUS. BRAZIL: MARANHÃO: Urbano Santos Municipality: Fazenda Bonfim (3°21'14"S, 43°09'05"W; ca. 40 m elev.). 23 July 2002. J. O. Gomes, L. D. Cruz, and P. C. Freire. Museu de Zoologia da Universidade de São Paulo, São Paulo, São Paulo, Brazil (MZUSP 93079, adult). 31 May 2003. J. O. Gomes, P. C. Freire. (MZUSP 93078, adult). Verified by M. T. Rodrigues. Published distribution is restricted to the caatinga of Ceará and Piauí states (Vanzolini et al. 1980. Répteis das Caatingas. Academia Brasileira de Ciências, Rio de Janeiro, 161 pp.; Rodrigues 1986. Pap. Av. Zool. 36:237–250), in northeastern Brazil, including open areas of the relic forest in semiarid caatingas in the state of Ceará (Borges and Caramaschi 2003. *In* Ecologia e Conservação da Caatinga. Recife: UFPE, v. 01, pp. 489–540). New state records, extends range ca. 270 km W in northeastern Brazil, and extend the distribution of this species to the domain of the Cerrado.

Submitted by **GILDA V. ANDRADE** (e-mail: gandrade@ufma.br), **JERRIANE O. GOMES** (e-mail: jerrianegomes@yahoo.com.br), **PEDRO C. FREIRE**, and **LEONARDO D. CRUZ**, Universidade Federal do Maranhão, Departamento de Biologia, Campus do Bacanga, CEP 65080-040, São Luís, Maranhão, Brazil.

HEMIDACTYLUS GARNOTII (Indo-Pacific Gecko). USA: FLORIDA: SUWANNEE COUNTY: Live Oak, jct. of US 129 and 2nd Street N.E. (30°18'15"N, 82°58'50"W). 11 June 2004. Cory R. Lindsay and Josiah H. Townsend. Verified by Kenneth L. Krysko. Florida Museum of Natural History (UF 141645). New county record (Townsend and Krysko 2003. Florida Sci. 66:204–208). Juvenile, active on a concrete wall at SuperTest service station at 2300 h. This specimen extends the range of the non-native *H. garnotii* ca. 88.5 km W of the nearest locality in Maclenny, Baker Co., and ca. 104.6 km NNW of the next nearest locality in Gainesville, Alachua Co. (Townsend and Krysko, *op. cit.*).

Submitted by **JOSIAH H. TOWNSEND**, Division of Herpetology, Florida Museum of Natural History, and Center for Latin American Studies, University of Florida, Gainesville, Florida 32611, USA (e-mail: jtownsend@flmnh.ufl.edu), and **CORY R. LINDSAY**, Department of Anatomy and Cell Biology, College of Medicine, University of Florida, Gainesville, Florida 32610, USA (e-mail: clindsay@ufl.edu).

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). USA: ARKANSAS: JEFFERSON CO: 2700 East Harding Ave., Pine Bluff, (34°12.669'N, 91°58.456'W). 4 June 2004. Coleman M. Sheehy III. Verified by Kenneth L. Krysko. Florida Museum of Natural History, University of Florida, Gainesville (UF 141606–08). New county record. Collected three (53.4, 50.7, and 43.8 mm SVL, respectively) and observed ca. 10 additional individuals on walls of building at 0500 h. *Hemidactylus turcicus* was first reported in Arkansas from Sebastian County in the early 1970s (Paulissen and Buchanan 1990. Herpetol. Rev. 21:22). This species subsequently has been found in six additional counties, and remains the only established exotic herpetofaunal species in Arkansas (Trauth et al. 2004, The Amphibians and Reptiles of Arkansas. Univ. Arkansas Press. 421 pp.).

Submitted by **COLEMAN M. SHEEHY III**, Division of Herpetology, Florida Museum of Natural History, University of Florida, Gainesville, Florida 32611, USA; e-mail: csheehy@flmnh.ufl.edu.

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). USA: TEXAS: HARDIN CO: Village Creek State Park, 0.8 km E Lumberton. 15 June 2004. C. T. McAllister. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28625). Verified by Stanley E. Trauth. New county record falling between records for Jasper and Jefferson counties (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M University Press, College Station, Texas. 421 pp.). Thriving population, including juveniles, gravid females, and adult males found dispersed among wood crevices of state park restroom. This introduced species has now been reported from at least 71 of 254 counties of the state.

Submitted by **CHRIS T. McALLISTER,** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA; e-mail: chris.mcallister@tamut.edu.

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). USA: TEXAS: LUBBOCK CO: Commercial business building (Blue Star Candles) at UTM Easting 0236269, Northing 3717543 (33°33'54"N, 96°09'32"W), eastern Lubbock city limits. Collected by Waymouth Roberts, 20 February 2003, verified by J. Baldwin. University of Texas at Arlington (UTACV R-52460). This juvenile specimen represents the first official county record, although this species has inhabited the city of Lubbock for at least a decade

(L. Densmore, pers. comm.). This extends the range ca. 354 km NW in Texas from Taylor Co. (Landwer and Lee 2001. Herpetol. Rev. 32:119). Perhaps because this is an introduced species with a rapidly expanding distribution (as explained by Bauer 2000. Herpetol. Rev. 31:72–73), especially in Texas, the effort to report its official occurrence in Lubbock County has until now been neglected. This may represent Texas' most northwestern county to have long-term established populations of this species.

Submitted by **ANDREW S. BALDWIN**, Mesa Community College, Department of Life Science, 1833 West Southern Avenue, Mesa, Arizona 85202, USA.

LIOLAEMUS CYANOGASTER CYANOGASTER (Blue Belly Lizard, Lagartija de Vientre Azul). CHILE: VII REGIÓN DEL MAULE, Cauquenes Province, Tregualemu, pine (*Pinus radiata*) plantations surrounding Reserva Nacional Los Queules (35°59'19"S, 72°41'15"W, 180 m elev.). 17 January (adult male, 57 mm SVL; MNHN 3785) and 20 March 2004 (adult male, 61.7 mm SVL; MNHN 3786). A. Rubio and F. Zorondo-Rodríguez. Herpetological collection, Museo Nacional de Historia Natural de Chile, Santiago, Chile. Verified by A. Veloso. This species ranges from Concepción (37°00'S, 70°00'W), VIII Region, to Puerto Montt (41°28'S, 72°57'W), X Region (Donoso-Barros 1966. Reptiles de Chile. Ediciones Universidad de Chile, Santiago, Chile; Veloso and Navarro 1988. Bollettino del Museo Regionale di Scienze Naturali Torino 6:481–539). The record reported herein extend its known range two degrees north (over 200 km). Another individual was observed nearby on 23 April 2004 (35°58'26"S, 72°38'38"W, 473 m elev.), in a reduced remnant of Maulino forest comprised of *Nothofagus obliqua* and *N. glauca*. The northward extension in the species range adds to changes in the known distribution of several species usually regarded as typical of the more southernValdivian forest, such as the microbiotherid *Dromiciops gliroides*, the rodents *Irenomys tarsalis* and *Geoxus valdivianus* (Saavedra and Simonetti 2000. Mammal. Biol. 65:243–245; Saavedra and Simonetti 2001. Mammalia 65:96–100), the short-tailed snake *Tachymenis chilensis chilensis* (Simonetti 2001. Gayana 65:219–220), and several ground beetles (Grez et al. 2003. Rev. Chil. Entomol. 29:9–18), reinforcing the "Valdivian forest" type attributes of the Maulino forest fauna. This new locality has been recorded with the partial support of grant Fondecyt 1010852.

Submitted by **ANDRÉ RUBIO** (e-mail: tranebird@yahoo.com), **FRANCISCO ZORONDO-RODRÍGUEZ** (e-mail: panchozr@esfera.cl), and **JAVIER A. SIMONETTI** (e-mail: jsimonet@uchile.cl), Departamento de Ciencias Ecológicas, Facultad de Ciencias, Universidad de Chile, Casilla 653, Santiago, Chile.

LEIOLEPIS REEVESII RUBRITAENIATA. VIETNAM: GIALAI PROVINCE: Chu Prong District, 15 km E of the Vietnam-Campuchia border. In the primary tropical forest on the Iamo River bank, predominated by dipterocarpasean trees, floored with sandy and stony soil. April 2000. Nguyen Van Sung. Institute of Ecology and Biological Resources (IEBR S 0401–0404). Verified by Natalia Ananjeva. First country record. This subspecies was originally described from northern Thailand (Paktjong, 160 km NE of Bangkok) under the name *Leiolepis belliana rubritaeniana* (Mertens 1961. Senckenbergiana biologica 42:507–510), and later from other localities in the western and central parts of northern Thailand (Taylor 1963. Univ. Kansas Sci. Bull. 44:687–1077). In his revision of the genus *Leiolepis*, Peters (1971. Zool. Jb. 98:11–130), while moving this subspecies to *L. reevesii,* argued that its range is confined to the Khorat Plateau in northeastern Thailand and the southwestern extremity of Laos. Our discovery extends the known range of *L. reevesii rubritaeniata* southeastward by at least 500 km. It also predicts occurrence of this subspecies in Campuchia, because it intervenes between southern Vietnam and other parts of previously known range of the subspecies. It is interesting to note that the range of this butterfly lizard in Vietnam is remote (ca. 200 km) from sea, because all other Vietnamese congeners *(L. r. reevesii, L. guttata, L. belliana,* and *L. guntherpetersi)* chiefly inhabit sandy dunes with sparse xerophilic vegetation near the coast (usually within 1–3 km from the coastline: Darevsky and Kuprijanova 1993. Herpetozoa 6:3–20). Gonads of three sexually mature specimens (two males and one female) of the present sample looked much depressed, suggesting that reproduction had taken place earlier. This is of interest because the reproductive season of *L. r. reevesii* in Vietnam includes April (Darevsky and Kuprijanova, unpubl.). This, along with differences in a few meristic characters in pholidosis, body coloration, and degree of sexual dimorphism between *L. reevesii rubritaeniata* and the nominotypical subspecies (to be published elswhere), suggests that the former may actually deserve recognition as an independent species. Definitive determination of taxonomic status will require molecular analysis sensu Schmitz et al. (2001. Zool. Abh. Staatliches Mus. Tierkunde Dresden 51:355–360).

Submitted by **ILYA DAREVSKY**, Zoological Institute, Russian Academy of Sciences (e-mail: lacerta@zin.ru), and **NGUYEN VAN SUNG**, Institute of Ecology and Biological Resources, National Center for Natural Science and Technology of Vietnam, Hanoi, Vietnam (e-mail: nguyen@iebr.nc.vn).

LEPIDODACTYLUS LUGUBRIS (Mourning Gecko). FRENCH POLYNESIA: TUBUAI (AUSTRAL) ISLANDS: Raivavae Island: Hotuatua, a small islet W of Raivavae (23.85709°S, 147.61591°W), at sea level in a *Hibiscus tiliaceus* forest. MNHN 2002.0984. Triploid specimen belonging to clone B. 25 November 2002. Olivier Gargominy and Benoît Fontaine. Verified by Roger Bour. First island record. This unisexual-bisexual complex was previously only known from Rurutu, Tubuai, and Rapa in the Tubuai Islands. It may also be present on the main island of Raivavae (= Vavitao). Its occurrence on Rimatara remains undocumented (Ineich and Blanc 1988. Atoll Res. Bull. 318:1–75).

Submitted by **IVAN INEICH,** Muséum national d'Histoire naturelle, Département d'Ecologie et de Gestion de la Biodiversité - Conservation des Espèces, Restauration et Suivi des populations, 25 rue Cuvier, F-75005 Paris, France, **OLIVIER GARGOMINY,** and **BENOIT FONTAINE**, Muséum national d'Histoire naturelle, Département Systématique et Evolution – Taxonomie et collections (Mollusques), 55 rue Buffon, F-75005 Paris, France; e-mail: ineich@mnhn.fr.

LEPIDOPHYMA OCCULOR (Jalpan Tropical Night Lizard). MÉXICO: GUANAJUATO: Municipality of San Luis de la Paz; El Aguacate, 1 km N, 0.5 km E Mineral del Realito (100°14'N, 21°36'W), ca.1040 m elev. 29 June 2003. Cinthya Elizalde. Her-

petology Collection of the Escuela Nacional de Ciencias Biológicas (IPN. ENCB-17532). Verified by Luis Canseco-Márquez. First record for Guanajuato, extending its range ca. 59.2 airline km NW of the closest record at 2.5 mi S Concá, Querétaro (Bezy and Camarillo 2002. Contrib. Sci. Nat. Hist. Mus. Los Angeles Co. 493:1–41). In Guanajuato the range of this species is apparently limited to northeastern portion of the Sierra Gorda at low and moderate elevations, on the western slope of the Sierra Madre Oriental. The specimen was collected near a stream on a limestone outcrop in tropical deciduous forest.

Submitted by **JOSÉ ISMAEL CAMPOS-RODRÍGUEZ** (e-mail: ismaelcampos@msn.com), **LESLEY CHAMBERT**, **MARIA DEL CARMEN DÍAZ,** and **JUAN CARLOS LOPEZ-VIDAL**, Laboratorio de Cordados Terrestres, Departamento de Zoología, Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional, Apdo. Post. 42-186, Carpio y Plan de Ayala s/n. Santo Tomás, México D.F. 11340, México; **RAUL HERNÁNDEZ-ARCIGA**, Dirección de Fomento y Desarrollo Económico de Municipio de San Luis de la Paz and CERCA-Celaya, Guanajuato; and **FERNANDO MENDOZA-QUIJANO,** Instituto Tecnológico Agropecuario de Hidalgo, km 5. 5. Carr. Huejutla-Chalahuiyapa, Apdo. Post. 94, C.P. 43000, Huejutla de Reyes Hidalgo, México.

LEPIDOPHYMA SMITHII (Smith's Tropical Night Lizard) MEXICO: GUERRERO: Municipality of Juan R. Escudero: Cerro Alto del Tepehuaje, western Omitlán (17°07'06.8"N, 99°31'18.5"W), 220 m elev. 30 June and 2 August 2003. MZFC-16183–184. Verified by Edmundo Pérez Ramos. These records extend the known range ca. 49 km from Puerto Marqués, Guerrero (Bezy and Camarillo 2002. Contr. Sci. Nat. Hist. Mus. Los Angeles Co. 493:1–41). Both individuals were found in rock crevices surrounded by tropical semi-deciduous forest.

Submitted by **ANDRÉS A. MENDOZA-HERNÁNDEZ** and **GEORGINA SANTOS- BARRERA**, Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, Apartado Postal 70-399, México Distrito Federal 04510, México; e-mail: gsantos@miranda.ecologia.unam.mx.

PHRYNOSOMA ASIO (Giant Horned Lizard). MEXICO: PUEBLA: Municipality of Jolalpan, Mitepec (18°14'N, 98°56' W), 1020 m elev. 18 June 2003. Jonathan Maceda-Cruz. Escuela de Biología, Benemérita Universidad Autónoma de Puebla (EBUAP 2062). Verified by Edmundo Pérez Ramos. First state record. Extends range ca. 70 km (airline) NE from Mezcala, Guerrero (Reeve 1952. Univ. Kansas Sci. Bull. 34:817–960), and ca. 24.5 km (airline) SE from Huautla, Morelos (Aguilar et al. 2003. Anfibios y Reptiles de la Sierra de Huautla Estado de Morelos. Centro de Educación Ambiental e Investigación Sierra de Huautla, Universidad Autónoma del Estado de Morelos. México, D.F., México. 32 pp.). The new locality is located in the southeastern portion of the Balsas Basin.

Submitted by **ROLANDO JONATHAN MACEDA-CRUZ**, **HÉCTOR ELIOSA-LEÓN** (e-mail: heliosa@siu.baup.mx), and **GONZALO YANES-GÓMEZ**, Escuela de Biología, Benemérita Universidad Autónoma de Puebla, Edificio 76, Ciudad Universitaria Blvd. Valsequillo y Av. San Claudio, C.P. 72570, Puebla, Puebla, México, and **ADRIÁN NIETO-MONTES DE OCA**, Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, A.P. 70-399, México 04510, D.F., México.

PODARCIS MURALIS (Common Wall Lizard). CANADA: BRITISH COLUMBIA: West Saanich, Durrance & Rudy Road. On 1 October 2002, GD observed four adults and 20 juveniles at the site of a former zoo which is now a private garden. The following day GD observed three juveniles on a power line road 250 m farther west.

In an interview with Mrs. Brigitte Wolff, she stated that in 1970 her father, Rudy Bauersachs, now deceased, released a dozen *P. muralis* on his land on Durrance Road after the closing of Rudy's Petpark Zoo. In addition, six lizards were released in each of the gardens of two of Mrs. Wolff's sons in Summerland, BC in 1983 and another six lizards on Triangle Mountain near Sooke, BC (Greater Victoria area) in 1986 by her third son. The Summerland group did not survive. The Triangle Mountain group became established, and according to Mrs. Wolff, "expelled the brown native lizards there" (*Elgaria coerulea*). This statement contradicts Allan et. al. who in a March 1993 report to the British Columbia Ministry of Environment report ("The Ecology of Introduced Common Wall Lizards [*Podarcis muralis*] in Saanich, Vancouver Island") concluded that there is no compelling evidence of *Podarcis* threatening *Elgaria* on Vancouver Island. As of 2000, the Vancouver Island population was still growing (Allan et. al. 2000. Herpetol. Rev 31:160–161).

We extracted total DNA from two samples (Russell L. Burke personal collections, RLB902 and RLB904) following standard proteinase K and phenol chloroform protocols. A segment of 1039 bp including parts of the cytochrome b gene and the threonin t-RNA gene was amplified by PCR (primers: "sicnt-L" 5'-TTTGGATCCCTGTTAGGCCTCTGTT-3' and "H15906" 5'-GGTTTACAAGACCAGTGCTTT-3') and sequenced (primers "sicnt-L" and "HPOD" 5'-GGTGGAATGGGATTTTGTCTG-3') by MWG-BIOTECH (Ebersberg, Germany) sequencing service. A part of the cytochrome b gene consisting of 887 bp was used for analysis. The sequences from both specimens were identical. These were compared with homologous regions from samples collected over most of the native range of *P. muralis* (Schweiger and Mayer, unpubl.). Sequences from individuals from the northern slopes of the Emilian Apennine, from Friuli (Northern Italy), as well as from the Island of Cres in northwestern Croatia were identical to the sequences of the Vancouver Island samples. Because green-colored individuals are common in the Apenninian populations but completely absent in the northern part of the distribution area of this haplotype group, and because green individuals are commonly observed among the BC lizards (Gregory, in litt.), we conclude the founding individuals of the BC population originated in the Emilian Apennine, Italy. Because Common Wall Lizards from there are usually referred to as *Podarcis muralis maculiventris,* we attribute the population on Vancouver Island to this subspecies. This conflicts with Gregory and Gregory (1999. The Reptiles of British Columbia: A Taxonomic Calalogue. Wildlife Bulletin No. B-88, British Columbia Ministry of Environment, Lands and Parks. Victoria, BC), who consider the lizards as *P. m. brueggemanni.*

Sequences were deposited at GenBank under the accession num-

ber AY374256. We thank Patrick T. Gregory for very helpful comments improving the quality of this manuscript, Nadine Bertram for local guidance in West Saanich, and Russell Burke for providing tissue samples from specimens collected by David Cunnington and Kathy Paige.

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SCINCELLA SILVICOLA CAUDAEQUINAE (Horsetail Falls Ground Skink). MÉXICO: HIDALGO: Municipality of Tepehuacán de Guerrero: Cerro Acuecuello, on road to Teyahuala, ca 2 Km NW of Tepehuacán de Guerrero (21°03'33"N, 98°50'09"W), ca. 1500 m elev. 12 November 2003. Fernando Mendoza Quijano. Colección Herpetológica, Instituto Tecnológico Agropecuario de Hidalgo (ITAH 998). El Coyol, San Juan Ahuehueco (21°02'15"N, 98°53'48"W), ca. 975 m elev. 4 April 2004. Edith Hernández Medellín and Griselda Quijano Manilla. ITAH 1062. Tlahuiltepa. 29 November 1982. José Luis Camarillo Rangel. Colección Herpetologica, Museo de Zoología, Facultad de Ciencias, UNAM (MZFC 7586). All verified by Edmundo Pérez Ramos. First records for Hidalgo, extending its known range ca. 35 km SE from El Lobo, Querétaro (Dixon et al. 1972. Southwest. Nat. 16:225–237).

Submitted by **URI OMAR GARCÍA-VÁZQUEZ**, Museo de Zoología, Facultad de Ciencias, UNAM, A.P. 70-399, México D.F. 04510, México (e-mail: urigarcia@hotmail.com); **FERNANDO MENDOZA-QUIJANO**, Instituto Tecnológico Agropecuario de Hidalgo, Km 5.5 Carr. Huejutla-Chalahuiyapa, A.P. 94, C.P. 43000, Huejutla de Reyes Hidalgo, México (e-mail: mendozaq2000@yahoo.com.mx); and **LUIS CANSECO-MARQUEZ**, Museo de Zoología, Facultad de Ciencias, UNAM, A.P. 70-399, México, D.F. 04510, México (e-mail: lcm@correo.unam.mx).

SERPENTES

AGKISTRODON PISCIVORUS LEUCOSTOMA (Western Cottonmouth). USA: TEXAS: Lee Co. / Burleson Co.: Yegua Creek above Lake Summerville. Collected in March, 2003. Natural History Museum, University of Kansas color slide (KU CT-11922). Verified by John E. Simmons. This specimen was collected in the middle of Yegua Creek. This species has not been previously recorded from Lee County, (Dixon 2000. Amphibians and Reptiles of Texas, 2nd ed. Texas A&M Univ. Press, College Station, Texas, 421 pp.). Yegua Creek represents the border between the two counties.

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AMPHIESMA SANGUINEA (Smedley's Keelback). MALAYSIA: PENINSULAR MALAYSIA: Johor: Bekok Forest, on forest floor, beside small pool along bank of Sungei Bantang (1°20'N, 103°10'E, ca. 125 m elev.). 7 March 2004. Arvin C. Diesmos. Raffles Museum of Biodiversity Research: Zoological Reference Collection (ZRC) 2.6023. Verified by Kelvin K. P. Lim. Sub-adult (262 mm in total length, 65 mm in tail length), exhibiting diagnostic character of the species (e.g., two preocular scales, instead of one: Tweedie 1983. The Snakes of Malaya, 3rd Edition. Singapore National Printers. 167 pp.). New state record and southerly range extension. Confirmed records of this species have been confined to Cameron Highlands (type locality) and the foothills in Selangor of the peninsula (Tweedie 1983, *op. cit.*).

Submitted by **TZI MING LEONG** (e-mail: scip0132@nus.edu.sg), and **ARVIN C. DIESMOS** (e-mail: g0304912@nus.edu.sg), Department of Biological Sciences, National University of Singapore, Singapore 119260.

BOULENGERINA ANNULATA ANNULATA (Banded Water Cobra). GABON: NGOUNIÉ PROVINCE: Onoy River at Bandi (1°50'S, 11°15'E; 136 m elev.). 19 July 2001. S. Lavoué. Institut Royal des Sciences Naturelles de Belgique (IRSNB 16326). NYANGA PROVINCE: Basse-Banio District, Doumvou River at Doumvou (3°21'S, 10°45'E; 20 m elev.). 25 July 2001. S. Lavoué. Direction de la Faune et de la Chasse, Libreville (DFC; field number P607). Verified by V. Mamonekene. Both specimens collected by fishing nets during an ichthyological survey. New records for the two provinces, making the number of Gabonese provinces having this species seven, i.e., all but Ogooué-Maritime and Haut-Ogooué Provinces (Villiers 1954. Bull. IFAN, sér. A, Sc. nat. 16[3]:1234–1247; Knoepffler 1966. Biol. Gabonica 2[1]:3–23; Blanc and Frétey 2000. Bull. Soc. Zool. France 125[4]:281–292; Pauwels et al. 2002a,b. Bull. Inst. Roy. Sc. Nat. Belg., Biol. 72:47–57, 59–66). The new records are a part of the results of field surveys organized by the WWF Ecoregion Program as a part of its Central Africa Biodiversity Assessment Program. We thank Emile Mamfoumbi Kombila and Marc Mpami (Direction de la Faune et de la Chasse, Libreville) for collecting permits.

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CALAMARIA LOWI GIMLETTI (Gimlett's Reed Snake). SINGAPORE: PULAU PAWAI (part of the Southern Islands) (1°12'N, 103°43'E). November 1933. M. W. F. Tweedie. Raffles Museum of Biodiversity Research: Zoological Reference Collection (ZRC) 2.5896. Total length 226 mm, tail length 16 mm. Verified by Kelvin K. P. Lim. New country record and fifth representative of the genus *Calamaria* for Singapore (Lim and Lim 1992. A Guide to the Amphibians and Reptiles of Singapore. Singapore Science Centre. 160 pp.). This species is otherwise known from Peninsular Malaysia, Aur Island (South China Sea), and the Riau Archipelago (Indonesia) (Inger and Marx 1965. Fieldiana: Zoology 49:1–304; Tweedie 1983. The Snakes of Malaya, 3rd Edition. Singapore National Printers. 167 pp.).

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COLUBER CONSTRICTOR (Racer). USA: TEXAS: Lee Co.: County Road 125, 2.1 rd mi NE FM 1697. 13 October 2003. 311 + 113 mm; juvenile male collected DOR at 1754 h. TNHC 62939 (TJL 1192). Motley Co.: FM 2009, 5.4 rd mi S TX Hwy 97 (SE of Flomot). 29 May 2004. 362 + 104 mm; 14.25 g; juvenile female collected AOR at 0900 h. TNHC 62942 (TNHC-FS 2812). Verified by Jessica Rosales. Both specimens represent county records, and fill gaps within known distribution (Dixon 2000, Amphibians and Reptiles of Texas, 2nd edition, Texas A&M University Press, 421 pp.).

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CROTALUS ATROX (Western Diamond-backed Rattlesnake). USA: TEXAS: Lee Co.: County Road 311, 2.4 rd mi SW County Road 308; 30°21.687'N, 97°11.469'W. 31 May 2004. 502 + 44 mm; 85.3 g; young female collected AOR at 2154 h. TNHC 62941 (TJL 1179). Verified by Jessica Rosales. First county record, fills in gap along easternmost distribution (Dixon 2000. Amphibians and Reptiles of Texas, 2nd edition, Texas A&M University Press, 421 pp.).

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CROTALUS RAVUS (Mexican Pygmy Rattlesnake). MÉXICO: HIDALGO: Municipality of Tepeapulco: Texcatzongo, 0.8 km N, 5 km E Tepeapulco (19°47'22"N, 98°30'20"W), 2580 m elev. 21 April and 31 May 1992. A. Hernández. Herpetological Collection of the Escuela Nacional de Ciencias Biológicas (IPN. ENCB 15308–09). Verified by Luis Canseco-Márquez. First vouchered record for Hidalgo and a range extension of ca. 32.4 airline km NE from nearest record at San Juan Teotihuacán, state of México (Gloyd 1940. Spec. Publ. Chicago Acad. Sci. 4:1–266). An unsubstantiated record for this species in Hidalgo was mentioned by Martin Del Campo (1937. Folletos Divulg. Cient. Inst. Biol., México 27:1–18) and depicted on a map in Gloyd (*op. cit.*), a record that presumably was referenced by Smith and Taylor (1945. United States Nat. Mus. Bull. 187:1–239), but Campbell and Armstrong (1979. Herpetologica 35:304–317) found no evidence that it occurred in that state. The two specimens reported here were collected in xerophytic scrub vegetation.

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DRYMOBIUS MARGARITIFERUS FISTULOSUS (Northwestern Speckled Racer). MÉXICO: CHIHUAHUA: Guamachulito, Municipality of Chínipas, near Agua Salada (27°23'21.9"N, 108°29'5.5"W), 510 m elev. 2 September 2003. Chínipas (27°23'39.9"N, 108°32'9.7"W), 469 m elev. 19 June 2003. Julio A. Lemos-Espinal. Herpetological Collection of Unidad de Biología, Tecnología y Prototipos, UNAM (UBIPRO 11693 and 11720, respectively). Verified by Richard L. Holland. First records for Chihuahua, and a range extension of ca. 75 km from presumably near Guirocoba, Sonora (extrapolating from pp. 405–407 in Bogert and Oliver 1945. Bull. Am. Mus. Nat. Hist. 83:297–426).

Submitted by **JULIO A. LEMOS-ESPINAL**, under CONABIO Projects L103, U003, X004, AE003 and BE002, Laboratorio de Ecología, UBIPRO, Facultad de Estudios Superiores Iztacala, UNAM, Apartado Postal 314, Avenida de Los Barrios No. 1, Los Reyes Iztacala, Tlalnepantla, Estado de México, C.P. 54090 (e-mail: lemos@servidor.unam.mx), **DAVID CHISZAR** and **HOBART M. SMITH** (e-mail: hsmith@colorado.edu), University of Colorado Museum, Boulder, Colorado 80309-0334, USA.

ELAPHE TAENIURA RIDLEYI (Cave Dwelling Ratsnake). THAILAND: PHETCHABURI PROVINCE: Tha Yang District, Kratluang Subdistrict. 18 September 2003. C. Chimsunchart and O. S. G. Pauwels. Institut Royal des Sciences Naturelles de Belgique, Brussels (IRSNB 16681). Verified by Montri Sumontha. This adult male (SVL 1193 mm, tail L 319 mm) was found in a cave on a limestone hill, at ca 150 m from the cave entrance, coiled around a stalactite 3 m above the ground. In another cave, also inhabited by numerous bats, on the same hill and on the same day we caught and released an adult female (TL ca. 1900 mm) that was ca. 7 m from the cave entrance. First provincial record (Pauwels et al. 2003. Nat. Hist. J. Chulalongkorn Univ. 3[1]:23–53). This records extends the known range by about 480 airline km N from the two previous northernmost localities, situated either in the hills of northern Nakhon Si Thammarat Province (Schulz 1996. A Monograph of the Colubrid Snakes of the Genus *Elaphe* Fitzinger. Koeltz Scientific Books, Havlickuv Brod. iii + 439 pp.) or in Phang-Nga Province, without exact locality (voucher Queen Saovabha Memorial Institute, Bangkok [QSMI] 131; Pauwels et al. 2000. Dumerilia 4[2]:123–154). The above mentioned specimens are typical *E. t. ridleyi*, distinct from the other subspecies from Phetchaburi Province mentioned and illustrated by Schulz (*op. cit.*). We thank Chucheep Chimsunchart (Phetchaburi), Alanna Maltby (Imperial College, London), and Edwin Wiek (Khao Look Chang) for their help in the fieldwork.

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EUPREPIOPHIS MANDARINUS (Mandarin Ratsnake). VIETNAM: TUYEN QUANG: Na Hang district. March 2003. Photo-

graphed by Le Khac Quyet. Verified by Wolfgang Böhme. Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany (ZFMK color slide catalog numbers 0331 – 0333). *Euprepiophis mandarinus* (formerly *Elaphe mandarina*, see Utiger et al. 2002. Russ. J. Herpetol. 9:105–124) was previously known from a few provinces in northern Vietnam (Lai Chau, Lao Cai, Vinh Phu, and Lang Son: Nguyen Van Sang and Ho Thu Cuc 1996. Danh luc bo sat va ech nhai Viet Nam. Nha xuat ban khoa hoc va ky thuat, Ha Noi; Schulz 1996. A Monograph of the Colubrid Snakes of the Genus *Elaphe* Fitzinger. Koeltz Scientific Books, Havlickuv Brod; Gumprecht 2002. Sauria Suppl. Berlin 24: 565–568). The new location in Tuyen Quang Province, northern Vietnam, closes the distribution gap between Lai Chau and Lao Cai in the west, Lang Son in the east and Vinh Phu in the south. The former Vinh Phu Province is currently represented by the provinces of Phu Tho and Vinh Phuc, and the locality Tam Dao, provided by Nguyen and Ho (1996), refers to Vinh Phuc Province. The new finding is located in the northern part of Tuyen Quang Province, more than 100 km N of Tam Dao. This area (Sinh Long commune, Na Hang district) is proposed as an extension of Na Hang Nature Reserve. *Euprepiophis mandarinus* was not previously included in the list of amphibians and reptiles recorded for Na Hang (Boonratana 1998. Na Hang Rainforest Conservation Project. FFI-Indochina Programme, Hanoi).

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LAMPROPELTIS ALTERNA (Gray-banded Kingsnake) MEXICO: NUEVO LEON: Municipio La Fama: Cerro de las Mitras at Gruta Gatos Monteses, 1000 m elev. 2 May 1967. Carlos H. Garcia. Universidad Autonoma de Nuevo Leon Herpetological Collection (UANL 459). Verified by Hobart M. Smith. Municipio Guadalupe: western slope of Cerro de la Silla, ca. 1200 m elev. Caught by unknown local resident. UANL 5018. Verified by Dennis J. Miller. First records for Nuevo Leon and the Sierra Madre Oriental, and a range extension of ca. 75 km ENE and 90 km E, respectively, from near Saltillo, Coahuila (Smith 1941. Copeia 1941:112). Two earlier records of *L. alterna* in Nuevo Leon (Liner 1964. Southwest. Nat. 8:221–227; Liner et al. 1976. Herpetol. Rev. 7:177) were reported in error, as both specimens were actually *Lampropeltis mexicana*, with habitats located in pine-oak associations. The localities reported herein are in the foothills of the Sierra Madre Oriental that contain Chihuahuan Desert vegetation.

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LAMPROPELTIS CALLIGASTER CALLIGASTER (Prairie Kingsnake). USA: ARKANSAS: Scott Co: off U.S. 71, 8.0 km SW Y-City. 9 June 2004. S. F. Barclay. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28587). Verified by Stanley E. Trauth. New county record filling hiatus between records for Polk and Sebastian counties (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville. 421 pp.). Adult specimen found under trash pile at dump site.

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LAMPROPELTIS GETULA HOLBROOKI (Speckled Kingsnake). USA: ARKANSAS: Miller Co: off AR Hwy. 237, at Carl Gallion Waterfowl Rest Area, Sulphur River. 1 June 2004. S. F. Barclay and M. L. Cameron. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28578). Verified by Stanley E. Trauth. New county record completely filling distributional gap in far southwestern Arkansas; only four (5%) of the 75 counties of the state remain without vouchers of *L. g. holbrooki* (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville. 421 pp.).

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LAMPROPELTIS TRIANGULUM ANNULATA (Mexican Milksnake). USA: TEXAS: Willacy Co.: Found DOR in agricultural fields (26°27.201'N, 97°37.649'W). 16 March 2004. Jacquelyn A. Cavazos. Verified by Frank W. Judd. University of Texas - Pan American Vertebrate Museum (UTPA) 03042. First county record. Previously reported in surrounding Hidalgo, Cameron, and Kenedy counties (Dixon 2000. Amphibians and Reptiles of Texas. 2nd Ed. Univ. of Texas A&M Press, viii + 421 pp.).

Submitted by **JACQUELYN A. CAVAZOS** and **FREDERIC ZAIDAN III**, Department of Biology, University of Texas – Pan American, Edinburg, Texas 78541, USA; e-mail: fzaidan@panam.edu.

LEPTODEIRA SEPTENTRIONALIS SEPTENTRIONALIS (Northern Cat-eyed Snake). MÉXICO: GUANAJUATO: Municipality of San Luis de la Paz; 3.85 km N, 5.1 km E Mesa de Jesús (21°27'30"N, 100°20'30"W), 1680 m elev. 6 April 2003. José Ismael Campos. Herpetological Collection of the Escuela Nacional de Ciencias Biológicas (IPN. ENCB-17531) . Near Ojo de Agua, 2.25 km S, 8 km W Mineral El Realito (21°34'48"N, 100°17'42"W), 1360 m elev. 6 October 2003. Lesley Chambert. IPN. ENCB 17533. Both verified by Luis Canseco-Márquez. First records for Guanajuato, extending the range ca. 66 airline km SW of the closest record at Media Luna, San Luis Potosí (Duellman 1958. Bull. Amer. Nat. Hist. Mus. 158:1–151). Although this subspecies is known from numerous localities in the Sierra Madre Oriental and Gulf Coastal Plain in Hidalgo, Nuevo León, San Luis Potosí, Tamaulipas, and Veracruz (Duellman 1958. Bull. Amer. Mus. Nat. Hist. 114:1–152; Willard 1972. An Analysis of Variation within some Mexican Taxa of the Colubrid Snake Genus *Leptodeira*. Unpubl. M.S. Thesis, Univ. Kansas, 138 pp.), its range in Guanajuato is apparently limited to the northeastern portion at low

and moderate elevations of Sierra Gorda on the western slope of the Sierra Madre Oriental. IPN. ENCB 17533 was caught near a small stream in dry oak-cedar forest and IPN. ENCB 17531 was found in tropical deciduous forest.

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MICRUROIDES EURYXANTHUS (Sonoran Coralsnake). USA: ARIZONA: MOHAVE CO: Cerbat Mountains, near the community of "So-Hi" on a S-facing hillside (35.2511°N, 114.1223°W). 28 April 2004. William Cobb. ASU 34681. Verified by Andrew T. Holycross. Extends documented range 98 km NNW of the nearest specimen (USNM 38044, collected in 1907 from Signal, Mohave County, Arizona). USNM 38044 is an isolated specimen, falling ca. 80 km NW of a cluster of specimens in the vicinity of Wickenburg (Maricopa County, Arizona) and Hillside (Yavapai County, Arizona). Distributional data are based on a search of ca. 70 institutional collections with specimens from Arizona (A. T. Holycross, pers. comm.).

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NERODIA ERYTHROGASTER FLAVIGASTER (Yellow-bellied Watersnake). USA: ALABAMA: LAMAR CO.: wetland adjacent to Hwy 35, ca. 10.0 km S of junction with U.S. Hwy 78 (34°01'39"N, 88°03'46"W). 14 April 2004. Christopher T. Winne and J. Whitfield Gibbons. Verified by Craig Guyer. Auburn University Museum (AUM 35906). County record. Previously reported in adjacent Marion, Fayette, and Pickens counties (Mount 1975. Reptiles and Amphibians of Alabama. Auburn Printing Company, Auburn, Alabama; Gibbons and Dorcas 2004. North American Watersnakes. A Natural History. University of Oklahoma Press. Norman, Oklahoma). Collection was made under permit 2399 issued to Ken Marion by the state of Alabama Department of Conservation and Natural Resources.

Submitted by **CHRISTOPHER T. WINNE** and **J. WHITFIELD GIBBONS**, University of Georgia, Savannah River Ecology Laboratory, Aiken, South Carolina 29802, USA.

OPHEODRYS AESTIVUS (Rough Green Snake). USA: TEXAS: LEE CO.: CR 316, 2 mi N of FM 696, 10 mi W of Lexington. Hugh Brown Wildlife Sanctuary. Collected in May 2003. Natural History Museum, University of Kansas color slide (KU CT-11921). Verified by John E. Simmons. This species has not been recorded previously from Lee County (Dixon 2000. Amphibians and Reptiles of Texas, 2nd ed. Texas A&M Univ. Press, College Station, Texas, 421 pp.).

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PORTHIDIUM NASUTUM (Rainforest Hognosed Pitviper). ECUADOR: PROVINCIA DE MANABI: 11 km W of Bahía de Caráquez, on Chone - Sto. Domingo de Los Colorados Road (ca. 00°40'S, 80°23'W, 50 m elev.). 17 July 1991. H. Pedroban and E. Palacios. Laboratorio de Anfibios & Reptiles, Universidad San Francisco de Quito & Fund. G. Orcés (FHGO-USFQ 698). Verified by Jean-Marc Touzet. This species inhabits the humid lowlands of Middle America and adjacent northwestern South America from Chiapas (Mexico) southward to Pichincha (Ecuador) (Porras et al. 1981. Tulane Stud. Zool. Bot. 22:85–107; Schatti and Kramer 1993. Rev. Suisse Zool. 100[2]: 235–278). First province record and the southernmost for the species, extending the range ca. 130 km WSW from closest known localities (surroundings of Santo Domingo de Los Colorados, Pichincha Province, Porras et al., *op. cit.*). Schatti and Kramer (*op. cit.*) erroneously cited the species from Carchi Province based on specimens from "Paramba;" however, this locality is in Imbabura Province (Lynch and Duellman 1997. Univ. Kansas Nat. Hist. Mus. Spec. Publ. 23:1–236).

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RAMPHOTYPHLOPS BRAMINUS (Brahminy Blind Snake). USA: FLORDA: BREVARD CO. : West Melbourne, garden at 605 Sugar Pine Drive (28°5'10.1"N, 80°41' 20.4"W). 13 March 2004. Michael S. Grace. Florida Museum of Natural History (UF141405). Verified by K. Krysko. New county record. Found under decaying pine needles, the specimen was 0.7 g body weight and 12.3 cm total length. *Ramphotyphlops braminus* is considered the most geographically widespread reptile on Earth, spread through the trade in potted tropical plants. In the United States, it has been reported as far north as Massachusetts (Wallach et al. 1991. Herpetol. Rev. 22:68) and Virginia (Savitsky et al. 2002, Herpetol. Rev. 33:150), but such northern locales are likely beyond climatic zones where this snake could survive winter conditions and become established. In the southernmost U.S., however, *R. braminus* is almost certainly established. The specimen noted here was found in a garden that had not had plants introduced for at least two years, and represents the northernmost discovery of the species on Florida's Atlantic Coast. In Florida, this snake was reported previously from Key West (Ehrig 1990. Herpetol. Rev. 21:41) and Stock Island (Collins and Collins 2002. J. Kansas Herpetol. 2:11) in the south to as far north as Pinellas County (Crawford and Somma 1993. Herpetol. Rev. 24:68) and Hillsborough County (Hennessy and Michalak 2004. Herpetol. Rev. 35:193) on the western coast, Alachua County in inland Florida (Townsend et al. 2002: Herpetol. Rev. 33:75), and Palm Beach County on the east coast (Delorey and Mushinsky 1987. Herpetol. Rev. 18:56). These records and the new discovery reported here (152 km N of the Palm Beach County location, 88 km SE of nearest known locality in Seminole County; Owen 1998. Herpetol. Rev. 29:115) support the idea that *R. braminus* is is established in tropical and sub-

tropical Florida.

Submitted by **MICHAEL S. GRACE** and **JAMES U. VAN DYKE**, Department of Biological Sciences, Florida Institute of Technology, 150 West University Boulevard, Melbourne, Florida 32901 USA (e-mail: mgrace@fit.edu).

REGINA GRAHAMII (Graham's Crayfish Snake). USA: ARKANSAS: Miller Co: 10.3 km SE Fouke off AR St. Hwy 134 on county rd. 8. 8 April 2004. Z. D. Ramsey. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28358). Verified by Stanley E. Trauth. New county record adding a second locale in far southwestern Arkansas near previous record in Little River Co.; three distinct allopatric populations occur in the state (Trauth et al. 2004. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville). Also reported previously from adjacent Caddo Parish, Louisiana (Dundee and Rossman 1989. The Amphibians and Reptiles of Louisiana. Louisiana State University Press, Baton Rouge. 300 pp.) and Bowie County, Texas (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station. 421 pp.). Adult female specimen collected from bar ditch using minnow trap baited with sliced ham and crayfish.

Submitted by **ZACHARY D. RAMSEY** and **CHRIS T. McALLISTER,** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA; e-mail: chris.mcallister@tamut.edu.

RHADINAEA DECORATA. HONDURAS: GRACIAS A DIOS: Urus Tingni Kiamp, along a tributary of the Río Warunta (14°54.639'N, 84°40.829'W), 180 m elev. 25 November 2003. J. R. McCranie. USNM 560000. Verified by L. D. Wilson. First record of this snake from Honduras, and fills a gap from ca. 490 km NNW at Finca Semuc, Izabal, Guatemala (Campbell 1998. Amphibians and Reptiles of Northern Guatemala, the Yucatán, and Belize. Univ. Oklahoma Press, Norman, 380 pp.) and ca. 120 km SSE at Cupitna Camp, Atlántico Norte, Nicaragua (Myers 1974. Bull. Amer. Mus. Nat. Hist.153:1–262), a locality misplotted in Köhler (2001. Anfibios y Reptiles de Nicaragua. Herpeton, Offenbach, 208 pp.).

Submitted by **JAMES R. McCRANIE**, 10770 SW 164th Street, Miami, Florida 33157-2933, USA; e-mail: jmccrani@bellsouth.net.

SIBYNOMORPHUS TURGIDUS (Slug-eating Snake). ARGENTINA: CÓRDOBA: Departamento Marcos Juárez: Marcos Juárez city (32°42'S, 62°06'W). 6 December 2001. Herpetological collection, Fundación Miguel Lillo, Tucumán, Argentina (FML 12522). Verified by G. Scrocchi. Species known from northern and central Argentina, Bolivia, Paraguay, south of Mato Grosso in Brazil, and Uruguay (Franco 1994. O gênero *Sibynomorphus* Fitzinger 1843, no Brasil [Colubridae; Xenodontinae; Dipsadini], Dissertação de Mestrado em Zoologia, Pontifícia Universidade Católica do Rio Grande do Sul, Brasil, 148 pp.; Achával and Olmos 1997. Anfibios y Reptiles del Uruguay, Montevideo, Uruguay, 128 pp.; Giraudo and Scrocchi 2002. Smithson. Herpetol. Inf. Serv. 132, 53 pp.). Second record for the province (205 km S airline from previous citation: Cabrera and Merlini 1989. Iheringia Ser. Zool. 69:151 –153), extends known distribution in Argentina 180 km (airline) SW from previous southernmost record (Scrocchi et al. 1993. Rev. Brasil. Biol. 53[2]:197–208).

Submitted by **GERARDO C. LEYNAUD** and **RAQUEL SILMARA CERVANTES**, Centro de Zoología Aplicada, Universidad Nacional de Córdoba, Casilla de Correo 122, Córdoba (5000), Argentina; e-mail: gleynaud@efn.uncor.edu.

TANTILLA GRACILIS (Flat-headed Snake). USA: TEXAS: Willacy Co.: Under mesquite branch in open field (26°22.497'N, 97°32.015'W). 10 March 2004. Jacquelyn A. Cavazos. Verified by Frank W. Judd. University of Texas – Pan American Vertebrate Museum (UTPA) 03041. New county record. Previously reported in adjacent Hidalgo and Kenedy counties (Dixon. 2000. Amphibians and Reptiles of Texas. 2nd Univ. of Texas A&M Press, viii + 421 pp.). However, Werler and Dixon (2000. Texas Snakes: Identification, Distribution, and Natural History. University of Texas Press, xv + 437 pp.) reported this species in Willacy County, as well as in Hidalgo and Kenedy counties. Our record confirms the presence of *T. gracilis* in Willacy County.

Submitted by **JACQUELYN A. CAVAZOS** and **FREDERIC ZAIDAN III**, Department of Biology, University of Texas – Pan American, Edinburg, Texas 78541, USA; e-mail: fzaidan@panam.edu.

TELESCOPUS FALLAX (Cat Snake). GREECE: EASTERN AEGEAN: Lesvos Island: Vassilika Village. 31 May 2003. Maria Dimaki. Verified by Efstratios D. Valakos. Goulandris Natural History Museum (GNHM 5035). First island record (Dimitropoulos and Ioannidis. 2002. Reptiles of Greece and Cyprus. Goulandris Natural History Museum, 275 pp.).

Submitted by **MARIA DIMAKI**, Department of Terrestrial Zoology, The Goulandris Natural History Museum, 100 Othonos St., Kifissia, Greece; e-mail: mdim@gnhm.gr.

XENOCHROPHIS PUNCTULATUS (Spotted Keelback Water Snake). THAILAND: RANONG PROVINCE: Kraburi District, mangrove surrounding Tham (Cave) Phrakhayang. 18 May 2003. M. Sumontha. Queen Saovabha Memorial Institute, Bangkok (QSMI 767). This adult female (SVL 465 mm, tail L 165 mm) was found at 0035 h asleep on a mangrove palm tree 20 cm above high tide level. Verified by Lawan Chanhome (QSMI). Another adult female had been previously observed in the same locality on 5 December 2002, while it was swimming at 1500 h in brackish water between mangrove palm trees. Other snake species found in syntopy include *Cerberus rynchops*, *Enhydris plumbea*, *Fordonia leucobalia*, *Bungarus fasciatus*, and *Trimeresurus purpureomaculatus*. These records represent the first for the province and the second for the country, and a 660 km range extension southwards for the species from its former southernmost locality in southern Myanmar (Pauwels et al. 2001, Hamadryad 26[2]:259–264).

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New Distributional Records and Comments on Amphibians and Reptiles from Quintana Roo, México

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During the course of fieldwork on amphibians and reptiles, between March and November 2002, on the Sian Ka'an Biosphere Reserve and adjacent areas of Quintana Roo, México, three new state records and eight significant range extensions were recorded. All specimens were collected by the authors and deposited in the Herpetological Collection of the Museum of Zoology, Colegio de la Frontera Sur, Chetumal, Quintana Roo, México (ECO-CH-H). All species were verified by Oscar Flores-Villela. The new distributional records are based on Campbell (1998), Calderon et al. (2003), Cedeño-Vaquez et al. (2003), Köhler (2000), and Lee (1996).

New State Records

Gastrophryne elegans (Elegant Narrowmouth Toad). 50 km S, 15 km E of Felipe Carrillo Puerto (19°08'16.3'N, 88°02'49.7"W). 27 May 2002. ECO-CH-H-1935, 1911. This new state record is from about 135 km NW of the closest reported locality on Albion Island, Orange Walk, Belize.

Ctenosaura defensor (Yucatan Spinytail Iguana). 3 km E of Santa Teresa Station (19°44'03"N, 87°47'46.7"W). 23 April 2002. ECO-CH-H 1782. Based on Kohler (2000) and Cedeño-Vazquez et al. (2003), this is the first record for Quintana Roo, and extends the known range ca. 200 km NE from the closest reported locality at Dzibalchen, Campeche.

Norops biporcatus (Neotropical Green Anole). 17 km SE of Andrés, Quintana Roo (19°08'51.3"N, 88°02'24.7"W). 28 September 2002. ECHO-CH-H-2022. This new state record is from ca. 150 km NNW of the closest locality within the Calakmul Biosphere Reserve, Campeche. The specimen was found in secondary semideciduous forest.

Range Extensions

Eleutherodactylus yucatanensis (Yucatan Rainfrog). 3 km E of checkpoint entrance on road to Sian ka' Biosphere Reserve (19°08'51.3"N, 88°02'24.7"W). 28 July 2002. ECO-CH-H 1883, 1909, 1949). Zascabera, 7 km E of Santa Teresa Station (19°45'29.3"N, 87°45'58.1"W). 28 July and 2 August 2002. ECO-CH – H 1883, 1909, 1932. 50 km S, 16 km E of Felipe Carrillo Puerto (19°08'08"N, 88°02'34.7"W). 27 September 2002. ECO-CH-H 2014-16. Breach Pemex (19°13'26.7"N, 88°01'32.6"W). 2 October 2002. ECO-CH-H 2042. These records extend the range of the species ca. 70 km S of the nearest record from 25 km NE of Felipe Carrillo Puerto. All the specimens were collected on bushes, branches, and tree trunks, which are in contrast to Lee's (1996) account that this poorly known species is a ground dweller.

Sphaerodactylus glaucus (Dwarf Gecko). Pulticup (19°05'22.3"N, 87°33'06.4"W). 3 June 2002. ECO-CH-1912, 1941. These records close the distributional gap between previously reported specimens in the northern and southern ends of Quintana Roo.

Hemidactylus frenatus (Common House Gecko). Pulticup (19°05'22.3"N, 87°33'06.4"W). 3 June and 5 October 2002. ECO-CH-H 1933, 2046). The records are a ca. 150 km range extension from the nearest known locality at Punta Chiqeros, on Cozumel Island (Lee 1996).

Thecadactylus rapicauda (Turniptail Gecko). Near checkpoint at entrance to Sian ka' Biosphere Reserve, 48 km N of Felipe Carrillo Puerto (19°55'46"N, 87°46'57.3"W). 30 April 2002. ECO-CH-H 1965. Ponud road to Cafetal (19°06'48.3"N, 88°03'19.3"W). 28 September 2002. ECO-CH-H 2019. These records close a distributional gap between the closest reported localities on the northern (ca. 50 km N in Quintana Roo) and southern (ca. 200 km S in Belize) portions of the Yucatán Peninsula.

Sceloporus lundelli (Lundell's Spiny Lizard). Santa Teresa Station (19°44'37.6"N, 87°47'01.1"W). 24 April and 27 June 2002. ECO-CH-H 1818, 1839, 1961. These specimens represent the third locality for the species in Quintana Roo and extend the range ca. 120 km N of the closest locality at Bahía de Chetumal (Cedeño-Vásquez et al. 2003).

Eumeces sumichrasti (Sumichrast's Skink). 50 km E of Felipe Carrillo Puerto, on road to Playon (19°47'19.3"N, 87°37'42.2"W). 26 April 2002). ECO-CH-H 1850. 50 km S, 16 km E of Felipe Carrillo Puerto (19°08'08"N, 88°02'34.7"W). 27 May 2002. ECO-CH-H 1913. These records bridge a distributional gap between previously perceived disjunct populations of this species on the northeastern (100 km extension SW) and southern parts (200 km extension N) of the Yucatán Peninsula as depicted by Lee (1996).

Mabuya unimarginata (Central American Mabuya). Playon (19°49'17.4"N, 87°29'40.1"W). 1 August 2002. ECO-CH-H 1968. This record bridges the gap between the documented populations on the northern, western, and southern portions of the Yucatán Peninsula.

Aspidoscelis cozumelae (Cozumel Racerunner). Pulticup (19°05'22.3"N, 87°33'06.4"W). 5 October 2002. ECO-CH-H 2047. Dunes in front of Mosquitero Lagoon (19°12'27.8"N, 87°32'17.1"W). 4 June 2002. ECO-CH-H 1871. This record extends the range of this species on the mainland ca. 80 km N of the closest locality in southern Quintana Roo at Lake Bacalar (LSUMZ 33387). It is also known from northeastern Quintana Roo on Isla Cozumel and Isla Mujeres.

Acknowledgments.—We are indebted to Oscar Flores-Villela for verifying specimen identifications and for helpful comments on an earlier version of this manuscript. We are grateful to Alejandro Tuz, Alejandro Franco, and the staff of the Sian ka' Biosphere Reserve.

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Smilisca baudinii (Anura: Hylidae) in Baja California Sur, México

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Smilisca baudinii (Duméril et Bibron, 1841) is a widely distributed hylid frog, ranging from Costa Rica (Savage 2002) to the border between Texas and Mexico (Duellman 2001). The species is present along a broad altitudinal range from the Pacific Coast up to elevations of 2000 m in cloud forests (Duellman 2001). Its distribution in Mexico covers a wide area from Chiapas and Yucatán (Lee 1996) to Tamaulipas and southern Sonora (Duellman 2001) including the Isla María Madre (Tres Marías Islands) along the coast of Nayarit (Casas-Andreu 1990, 1992). It has not been recorded from the Baja California peninsula (Grismer 2002; Grismer and McGuire 1993; McPeak 2000).

During a field trip along the Baja California peninsula on 13 April 2003 we found two active specimens of *Smilisca baudinii* in a flooded grass field among palm trees near the village of Todos Santos (Baja California Sur, México) (23°27'N, 110°13'W, 28 m above sea level). The two specimens were found at night (collectors: ER-G, IM-S, GP-O and MG-P), jumping on the flooded grass, around 2130 h, in company of active *Bufo punctatus*. There was no sign of reproductive activity of either species. One specimen of *Leptotyphlops humilis* was found under stones in the drier area of the field, and *Hemidactylus frenatus* was present in nearby buildings. The two specimens of *S. baudinii* (IBH 14078–79) have been deposited in the CNAR collection (UNAM, México).

Smilisca baudinii aggregates in large numbers during the breeding season (Duellman 2001), and accidental transport from any of the ferry ports near which the species occurs seems possible. Alternately, this population might represent an old relict isolated from the main distribution range of the species. The presence of *S. baudinii* in Tres Marías Islands (Casas-Andreu 1990), apparently isolated from the continent since the Middle Pliocene (Casas-Andreu 1992), does not shed light on this issue, as both possibilities are equally plausible. Molecular studies to detect the precise origins of these populations are underway.

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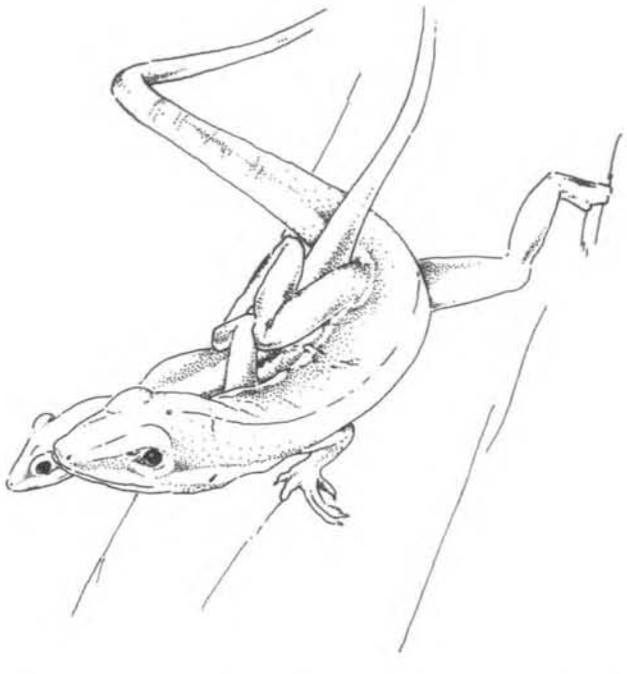

Anolis pulchellus. USA: Puerto Rico: Quebradillas, Región de San Antonio. Illustration by Fernando Vargas Salinas.

BOOK REVIEWS

Herpetological Review, 2004, 35(3), 297–299.

Multiple Stressor Effects in Relation to Declining Amphibian Populations, edited by G. L. Linder, S. Krest, D. Sparling, and E. E. Little. 2003. American Society for Testing and Materials (ASTM) International, 100 Bar Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania 19428-2959, USA. 282 pp. Hardcover. US $109.00. ISBN 0-8031-034640-9.

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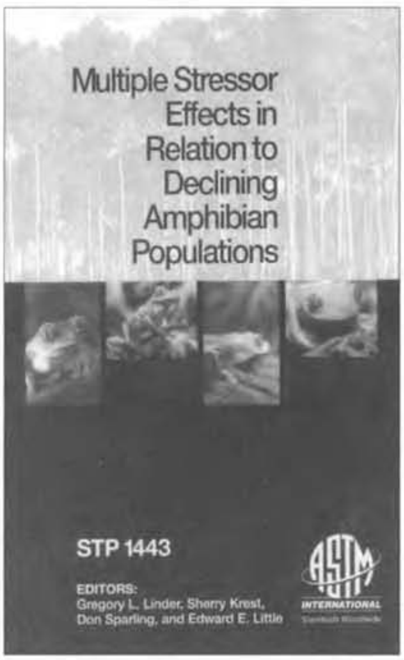

This book is a collection of papers constituting the proceedings of a symposium on Multiple Stressor Effects in Relation to Declining Amphibian Populations held 16–17 April 2002 in Pittsburgh, Pennsylvania and sponsored by the American Society for Testing and Materials (ASTM) International. The three main goals of the symposium, as stated in the published proceedings, are: 1) To highlight the historic role that the ASTM has in providing a forum for standardization of amphibian toxicity test methods and the characterization of adverse effects potentially associated with chemical stressors, 2) to demonstrate, via case studies, the current state of technical 'tools' available to biologists, ecologists, environmental scientists, and natural resources professionals for assessing amphibian populations exposed to various environmental stressors, and 3) to characterize a process that brings together a range of interdisciplinary technical and management tools to causal analysis, especially those that related to a multiple stressor risk assessment "mind-set". I think the book achieves these stated goals.

The book is divided into three sections, reflecting the major themes of the symposium: 1) toxicity assessment, 2) field and lab studies, and 3) causal analysis. The toxicity section consists of three chapters mostly focused on the development and use of toxicity tests for amphibians. These include FETAX (Frog Embryo Teratogenesis Assay-*Xenopus*) to assess developmental effects of potential teratogens, and the somewhat competing Amphitox, a toxicity test using *Bufo* embryos. Each of these approaches has advantages and disadvantages. Overall, this section was very convincing in demonstrating teratogenetic/toxicological assay methods that require relatively little technical expertise. As a developmental biologist familiar with the vagaries of amphibian development, however, I am a little leery of such standardized tests. The validity of the FETAX method in particular has recently been questioned because of the sensitivity of amphibian embryos to variation in essential cations (Tietge et al. 2000).

The section on field and laboratory studies includes nine chapters that get down to the nitty-gritty of real data collected from the field and/or laboratory. I was particularly interested in a chapter on frog abnormalities in National Wildlife refuges in the Northeastern US by Eaton-Poole et al. This study seemed to be a rigorous example of how to go about trying to understand abnormalities in natural populations of amphibians, a good model for future studies. The authors report an analysis of over 3643 frogs and toads over a three-year period from a total of 35 sites, representing a tremendous amount of work. The objectives of this study were to 1) identify "hotspots" where high levels of abnormalities occur, 2) determine the temporal patterns of occurrence of abnormalities at those spots, and 3) try to pinpoint possible causes. Visual assessment using x-ray radiographs was used to score and classify abnormalities into one of five possible categories: malformation, trauma, infectious disease, nutritional deficiency, and "unknown." The abnormal specimens were also used to identify viral, fungal, or parasitic infection using visual inspection, dissection, tissue culture, and/or histology. The prevalence of abnormalities ranged from zero to approximately 15% and was highly variable from year to year and site to site. As in many other such studies, the most common abnormality observed was frogs with a partially or completely missing hind limb, and supernumerary limbs were relatively rare. The study demonstrated the importance of radiographs in detecting internal abnormalities that are misdiagnosed or not detected at all by superficial examination. In trying to pinpoint causes in a sample of 89 abnormal frogs, 62% had abnormalities apparently caused by trauma, and 25% were judged to carry "true malformations." Cyst infection by trematodes of the genus *Ribeiroia* is the only firmly established cause of limb deformities/malformation in natural populations of frogs (Johnson et al. 1999; Sessions et al. 1999; Stopper et al. 2002). Recognizing this, the authors took special pains to try to eliminate *Ribeiroia* as the cause of abnormalities in their frogs. Consistent with other studies (e.g., Meteyer et al. 2000), *Ribeiroia* cysts were not found at every hotspot, but when they were, they were associated with supernumerary limb structures. The authors correctly conclude that an investigation into possible causes of abnormalities in natural populations of amphibians probably requires an integrated, interdisciplinary approach including surveys, experimental exposures, radiography, microbiology, parasitology, endocrinology, immunology, and toxicity analyses, to name a few.

The last section, Causal Analysis, contains four chapters and, in my opinion, is the most important part of the book. Here we find a series of papers illustrating the range of tools currently available for evaluating cause and effect relationships between environmental stressors and declining and deformed amphibian populations. Emphasis is on identifying the kind of research needed to find solutions for these problems. My own research interests led me to focus particular attention on the chapter by Lanoo et al. on "Multiple Causes for the Malformed Frog Phenomenon." Malformed/deformed frogs is a contentious issue that has been well-publi-

cized in the media (including the internet), and some have considered it a "scientific nightmare." Even the terms "malformation" and "deformation" are loaded with controversy! The medical definition of malformation is "an abnormality of structure resulting from an *intrinsic* defect in the formation of that structure [my italics]," while a deformity is defined as "variation in structure resulting from the response of normal tissues to mechanical forces" (Winter et al. 1988). I have come to learn that people who believe that the frog abnormalities may be caused by chemical pollutants tend to describe the abnormalities as malformations, since the pollutants, acting as teratogens, are likely to interfere in cellular interactions at the molecular level. On the other hand, those who work on parasite-induced abnormalities tend to call them deformities, since the mechanical effects of cysts have been shown to be sufficient to cause the specific limb deformities (Sessions and Ruth 1990; Stopper et al. 2002). For this reason, I find it wise to side-step the issue and simply use the term "abnormalities".

Although the "abnormal frog phenomenon" encompasses a wide range of different kinds of morphological abnormalities, the vast majority of cases involve the limbs (mostly the hind limbs). These limb abnormalities fall into two major categories (or "syndromes"): 1) frogs with too many limbs (and a host of associated gross abnormalities, such as mirror-image duplications, truncated limbs, and badly distorted limbs) and 2) frogs with too few limbs (usually a completely or partially missing hind limb or foot). Category 1 abnormalities are now known to be directly caused by infection by *Ribeiroia* cysts but the cause of category 2 deformities remains uncertain, although predation has been implicated in some studies, and heavy parasite infection can also cause limblessness (Sessions and Ruth 1990; Sessions et al. 1999; Stopper et al. 2002). Multilegged category 1 frogs were used early on as the "poster child" for the entire "malformed frogs" issue and, once the parasite connection was established, this caused some confusion and (in my opinion) wasted effort. As of this writing, parasites (*Ribeiroia* sp) remain the only documented cause of supernumerary limbs in natural populations of frogs (Blaustein and Johnson 2003; Sessions 2003). Likewise, the evidence presented in this chapter points to parasites as the only identified cause of any of the morphological abnormalities, although the absence of parasites from some of the "hotspots" indicates that something else may be going on at those sites. Unfortunately, our knowledge of *Ribeiroia* natural history is still very rudimentary.

I was a little dismayed that this chapter still mentions retinoids as a possible cause for limb abnormalities in frogs even though there is little or no evidence (and at best only very weak theoretical basis) that retinoids are playing a role in any of the naturally occurring morphological abnormalities (Sessions 2003). Morphological evidence excluding retinoids as a cause of limb abnormalities in natural populations of frogs was presented by Sessions et al. (1999), but this paper was not cited by the authors (even though they discuss the problem of inferring cause from morphological pattern!). The morphological consequences of retinoid exposure to limb development and regeneration in frogs have been very thoroughly studied and characterized, and neither the observed abnormalities nor the required (high) retinoid concentrations fit what is observed in nature. I suppose one could argue that examining the possible role of retinoids is nevertheless worthwhile since it is difficult to imagine a more serious environmental catastrophe, if ground water at hotspots contains enough retinoids to cause limb malformations in frogs (and certainly a considerable amount of money has been thrown at the problem), but it's probably time to get realistic and move on.

Probably the most useful conclusion from this chapter is that hotspots of frogs showing abnormalities are usually associated with altered wetlands, suggesting that a good approach to solving the problem should involve restoration of these ecosystems. A particularly likely scenario is that cultural eutrophication of wetlands encourages increases in snail populations which in turn provide an expanded substrate for parasites, since they serve as the first intermediate host (Sessions 2003). Since trematodes undergo a kind of "embryonic amplification" in snails, whereby a single egg can give rise to hundreds if not thousands of infectious cercariae (Noble and Noble 1982), small changes in the snail population could have very large impacts on the production of cercariae in a particular pond (Sessions and Ruth 1990; Stopper et al. 2002; Sessions 2003). I was a little surprised, however, that the authors did not spend more time examining another component of parasite-caused deformities, namely birds, which serve as the primary host in the trematode's life cycle (Pratt and McCauley 1961). Birds could be a primary determiner of the unusual distribution of *Ribeiroia*-infected snails in Minnesota.

One of the big take-home messages from this collection of papers is that if we want to understand amphibian declines and deformities, we need to examine multiple stressors. This may be true, and is certainly not a novel conclusion (cf. Semlitsch 2003), but it does beg the question: is there ever a case of amphibian decline or abnormalities that has been caused by just a single major stressor? For example, if someone emptied a barrel of pesticide into a pond, or if over-collecting depleted the population. Or, similarly, are there single stressors whose presence allows us to exclude others? For example, if small organisms (such as free-swimming cercariae) are more vulnerable to toxic chemical pollutants than larger organisms, then finding that parasites are associated with deformed amphibians at a particular site may allow one to exclude the presence of toxic chemicals (I call this the "perverse hypothesis"). This possibility needs to be tested. Overall, although it makes intuitive sense that chemical pollution is contributing to amphibian decline and deformities, and some effects can be demonstrated experimentally, there is surprisingly little evidence of this being a major cause, especially in regard to deformed amphibians. Perhaps this will change as the intensity of research increases. Despite the price of the book which, at $109.00, seems a little high, it is the best symposium volume on this topic that I have seen, and anyone interested in the problem of declining and deformed amphibians will want to have it on their bookshelf.

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Herpetological Review, 2004, 35(3), 299–300.

King of the Crocodylians: The Paleobiology of *Deinosuchus*, by David R. Schwimmer. 2002. Indiana University Press, Indianapolis, Indiana (http://www.indiana.edu/~iupress/). xii + 220 pp. Hardcover. US $45.00. ISBN 0-253-34087-X.

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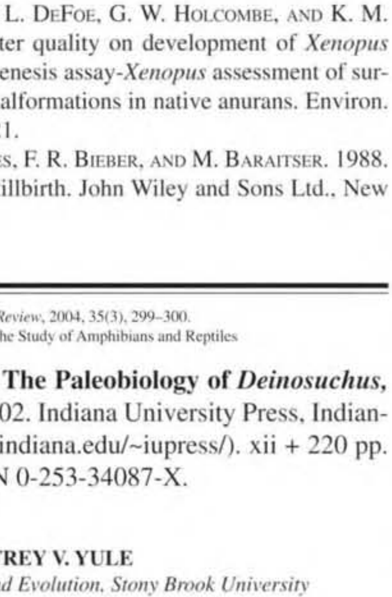

David R. Schwimmer's preface promises a paleoautoecology of *Deinosuchus rugosus*—that is, a study of the life, times, and habitat of what was probably the largest land carnivore of late Cretaceous North America and is certainly the continent's largest known crocodylian. The project is broad in scope, engaging, and successful — even admirable. In addition to offering an overview of the coastal plains of the Western Interior Seaway that *Deinosuchus* inhabited, Schwimmer also contextualizes current knowledge of the species while carefully interpreting fossil evidence, taking care to point out which of his conclusions are well corroborated and which are more speculative. The analysis is impressive and demonstrates just how much we can infer about vanished species and ecosystems on the basis of fairly undramatic fossil evidence.

And make no mistake: the fossil evidence on which Schwimmer relies is not dramatic. While other vertebrate paleontologists seeking to reconstruct the lives and habitats of extinct North American species have access to abundant materials, Schwimmer must rely on a very limited array of specimens. Fossil remains of *Deinosuchus* consist of skulls, jaws, teeth, and a variety of postcranial bones but, so far, no substantially complete individuals. Because the fossils that have been found indicate that *Deinosuchus* was generally typical of eusuchians (i.e., those derived lineages that include all modern crocodylians), Schwimmer reconstructs missing elements based on eusuchian models. Consistently, though, Schwimmer specifies when he bases his reconstructions, or his conclusions, on best guesses rather than actual *Deinosuchus* remains. Fossils bearing likely evidence of *Deinosuchus* predation also prove helpful in Schwimmer's effort to ascertain the crocodylian's diet. Here, too, Schwimmer carefully differentiates between informed, evidence-based speculation and hunches.

The study's tone is conversational but not at the expense of necessary detail, whether offering context on broad topics (e.g., taxonomy, anatomy, paleontological methods) or elaboration within particular subtopics (e.g., crocodylian taxonomy and anatomy, methods for estimating the size of *Deinosuchus*). Chapter 1, "The Life and Times of a Giant Crocodylian," opens with a hypothetical predation event by a *Deinosuchus* on a 600-kilogram, 6-meter long theropod along with a preliminary overview of the animal's habitat along the southern coast of the Western Interior Seaway, a body of salt water that bisected the North American landmass during the Cretaceous. Schwimmer's discussion of the crocodylian is clear, concise, and thorough, as is his coverage of the animal's habitat, both briefly here and at greater length in Chapter 5, "*Deinosuchus* Localities and Their Ancient Environments." The paleoecological groundwork Schwimmer provides is surprisingly thorough, carefully chosen, and very clearly presented, with the result that readers develop an appreciation for an extensive coastal habitat of a sort that no longer exists. While Schwimmer returns at greater length to the subject of what *Deinosuchus* preyed upon (both dinosaurs and turtles) in Chapter 8, he first devotes chapters to the early paleontology of the species, offering an historical overview of its discovery and the confusion surrounding its generic and species names (Chapter 2) and discussions of the techniques used to determine the animal's size (Chapter 3) and the age during which it lived (Chapter 4). Schwimmer's thorough treatment of the animal also tackles the question of how many species of *Deinosuchus* existed (Chapter 6), concluding that despite the wide range in sizes between eastern and western specimens, only one species occurred on both sides of the Western Interior Seaway. Before returning to the subject of the animal's diet, Schwimmer provides a primer on crocodylian taxonomy and the place of *Deinosuchus* in that taxonomy (Chapter 7). Additional background and context are provided in three appendices: one on the details of the geologic time scale (including subdivisions of the late Cretaceous); the second a glossary of anatomical and cladistic terminology; and the third a list of known *Deinosuchus* localities including details about the materials collected at each location. Throughout, Schwimmer makes thorough use of available evi-

dence while recognizing that new fossil finds and recently recovered materials currently under preparation might well support different conclusions.

The result is an in-depth introduction to a species whose largest known representatives were roughly 12 meters in length and at least 8.5 tons in weight. By way of context, that would have made them at least as large as their dinosaur contemporaries and capable of hunting both dinosaurs and any other species in their range —except, possibly, for the larger mosasaurs, plesiosaurs, and pliosaurs. Schwimmer estimates that, in life, even the smaller eastern *Deinosuchus* specimens would have been 8.0 meters long and about 2.3 tons in weight—far larger and more massive than any contemporary crocodylians. While the first and last chapters emphasize the size of the animal and the likelihood that it preyed upon dinosaurs, quite clearly with the intention of attracting readers, *King of the Crocodylians* offers far more substance than sensationalism, and the ecological and evolutionary context Schwimmer provides allows readers to appreciate both *Deinosuchus* and, through their contrast with it, its extant cousins.

The study's main shortcoming, the low quality of a few of its illustrations, is minor. Most of Ron Hirzel's line drawings are at least effective in revealing necessary information about the crocodylian's anatomy and appearance, and a few are exceptionally well rendered (e.g., the *Deinosuchus* pursuing a marine turtle in Figure 8.1). In some instances, probably because of the relatively small size at which fairly large illustrations are reproduced, the thickness and abundance of lines result in images whose individual elements are difficult to resolve. This is true of Figure 8.4, where the play of line and shadow makes it difficult to determine how the jaws and teeth of the pictured *Deinosuchus* are closing on a turtle. A few photographs also reproduce poorly, particularly those of South American museum specimens, tending to be out of focus, dark, or both. The shortcoming is certainly not significant given the study's many strengths, but it is regrettable.

This engaging study is a popularization in the most positive sense of that term—and a rigorous one at that. Schwimmer does not dispense with discussions of anatomical and taxonomic detail; instead, he covers all the relevant ground, taking care to explain the terminology as he goes. The result is admirable: a study that will be of interest and value to many students of herpetology, paleontology, and natural history — and, quite possibly, a welcome addition to courses in herpetology, paleontology, or paleoecology, where it could serve as an excellent case study of the methods used in making inferences about extinct creatures and their environments. Interested readers, and there will be many, will appreciate and benefit from the volume's thoughtfulness, thoroughness, and accessible tone.

PUBLICATIONS RECEIVED

Atlas Plazów I Gadów Polski, Status – Rozmieszczenie – Ochrona (Atlas of the Amphibians and Reptiles of Poland, Status – Distribution – Conservation), edited by Zbigniew Glowacinski and Jan Rafinski. 2003. Biblioteka Monitoringu Srodowiska, Warszawa – Kraków, Poland. 152 pp., 4 pls. Softcover. Distributed free. ISBN 83-7217-208-0.

This volume provides up-to-date information about the distribution and conservation status of the 18 species of amphibians and nine species of reptiles inhabiting Poland. The distribution of each species is plotted, in color, in cells of approximately 100 km^2 on grid maps of Poland, providing a fine scale picture of species ranges. These differentially plot historical records, introductions, and questionable localities. For each species a text overview of distribution pattern and population status is provided (in Polish with an English summary) as is a list of sources of the plotted records. Short sections in Polish cover hybridization and taxonomic problems as well as conservation and protection of the Polish herpetofauna. A comprehensive bibliography of more than 750 references, including many unpublished theses and reports, is also provided, as are keys (in Polish and English) to the amphibians and reptiles of the country. The book concludes with four pages of color plates illustrating 11 of the species covered as well as several habitats. It will be of particular interest to those working on the European herpetofauna or interested in the conservation biology or biogeography of temperate herpetofaunas.

Predicting Extinction: Fundamental Flaws in IUCN's Red List System, Exemplified by the Case of Sea Turtles, by N. Mrosovsky. 2004. N. Mrosovsky, Toronto, Canada (available from the author: Department of Zoology, University of Toronto, Toronto, Ontario, Canada M5S 3G5). [4] + 70 pp. Softcover. ISBN 0-9734777-0-9.

This small book is the hard copy version of an earlier (2003) electronic document (http://members.seaturtle.org/mrosovsky/) outlining the author's arguments regarding the inappropriateness of current IUCN Red List categories for certain long-lived and widespread species, such as sea turtles. Mrosovsky raises concerns about a number of problems including: inconsistencies in the application of IUCN criteria, the assignment of Red List status based on strict application of IUCN criteria even when contradicted by common sense, and the primacy of precautionary approaches over evidentiary ones in the designation of IUCN categories. Evidence is presented that the status of green, hawksbill, olive ridley, and leatherback turtle populations is better than is reflected by current IUCN listings for these species. Suggestions for improvements to the existing system of assessing risks of extinction are provided. The arguments presented are supported by a reference list of 80 citations. This publication is of direct relevance to both sea turtle biologists and those more broadly involved with the assessment of conservation status of reptiles and amphibians.

Venomous Snakes of North Carolina, by Alvin L. Braswell, William M. Palmer, and Jeffrey C. Beane. North Carolina State Museum of Natural Sciences, 11 West Jones Street, Raleigh, North Carolina 27601, USA (also available free in electronic format at www.naturalsciences.org/research/herpetology/Venomous_Snakes_of_NC.pdf). 31 pp. Softcover. US $3.00. ISBN 0-917134-24-9.

This booklet is a basic guide to the six species of venomous snakes inhabiting North Carolina. It includes a short introduction, followed by an illustrated key to species, and a series of species accounts, each occupying two pages. The accounts include a short, non-technical description, natural history notes, and a section on distribution in North Carolina. Accounts also include a point locality county map of North Carolina and one or two color photos. A "Resources" section at the end of the accounts guides readers to selected books and websites, as well as seven sources cited in the text. One page is devoted to "Snake Safety," which provides advice on how to avoid being bitten by venomous snakes, and another alerts readers to the several options for animal identification provided by the North Carolina State Museum of Natural Sciences. The back cover outlines basic snakebite treatment as recommended by the Carolinas Poison Center. This small guide will be especially useful for amateur naturalists and visitors to North Carolina who want to be able to identify (and possibly avoid) the snakes they encounter.

Introducción a los Anfibios y Reptiles del Estado de Chihuahua/ Introduction to the Amphibians and Reptiles of the Stae of Chihuahua, Mexico, by Julio A. Lemos Espinal, Hobart M. Smith, and David Chiszar. 2004. Universidad Nacional Autónoma de México and Comisión Nacional para el Conocimiento y Uso de la Biodiversidad – México D.F., México (distributed by Bibliomania!, P.O. Box 58355, Salt Lake City, Utah 84158-0355; www.herplit.com). [7] + 128 pp. Softcover. US $24.95. ISBN 970-9000-21-7.

This book provides an overview, in both Spanish and English, of the herpetofauna of Mexico's largest northern state and represents a summary of an ongoing project by the authors. A short history of herpetological exploration in Chihuahua is given and a list of the 186 taxa of Chihuahuan amphibians and reptiles (including six new species and 14 new state taxon records documented since 1995) and their general distributions within the state is presented. The bulk of the volume comprises identically illustrated Spanish and English keys to the species and subspecies. A key to the genera of anuran larvae is also provided. The illustrations accompanying the keys are derived from a number of older sources and vary in their style and quality. Many of the species are also depicted in series of 136 small color photographs distributed on 23 pages separating the two different language sections of the book. A literature cited section of approximately 300 references completes the volume, which will be of greatest utility to herpetologists working in northern Mexico and the adjacent areas of west Texas and New Mexico.

Fauna of the Socotra Archipelago – Field Guide, by Wolfgang Wranik, with contributions by Omar Al-Saghier, Simon Aspinall, Richard Porter, and Herbert Rösler. 2004. Universität Rostock, Universitätsdruckerei Rostock, Zum Laakkanal 20, D-18109 Rostock, Germany (e-mail: uni-druckerei@verwaltung.uni-rostock.de). 542 pp. Hardcover. ¤79.00 (approx. US $96). ISBN 3-86009-263-4.

This large volume is the first comprehensive treatment of the Socotran Archipelago, the series of four islands belonging to the Republic of Yemen and lying east of the Horn of Africa and south of the Arabian Peninsula. Socotra has long been known for its high number of endemic taxa (especially plants) and its role as a biogeographic enigma. The book covers the terrestrial fauna in detail and marine forms rather superficially. Of interest to herpetologists are background chapters on the geology, biogeography, vegetation, and climate of the islands, as well as reviews of conservation on Sokotra and the history of biological exploration there. The reptile chapter (there are no amphibians), authored by Rösler and Wranik, covers the 32 species (21 lizards, 1 amphisbaenian, 6 snakes, 4 marine turtles) in 31 pages of text and line drawings plus 30 pages of color plates with more than 110 large format images. Basic identifying features, distribution, and natural history information are provided for each species. The book concludes with a section on animal names in Socotri, a glossary, literature cited, and an index. While few herpetologists may actually visit Socotra, this volume will appeal more broadly to those with an interest in the fauna of Africa, the Middle East, or the Palearctic region, or in biogeography in general.

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ods. That afternoon the trap was moved and set at another nest site. When checked on the morning of 1 August 2002, the water was calm and clear and the bait appeared minimally disturbed. When we began to pull up the anchoring stakes, we realized the trap contained a female alligator with a total length of 248.9 cm.

The trap was not set again until 7 August 2002, at a new nest site. When checked on 8 August, we found the bait had fallen off the suspending cable. It was rebaited and checked the next day. The door had fallen closed (perhaps bumped by the alligator or as a result of gusty winds), and the bait appeared untouched. The trap was moved and next set on 21 August 2002. The female was observed when placing the trap at the nest site, and despite minor disturbance (photography) for some 20 minutes, the female (201.9 cm) was captured overnight, again caught apparently without injury.

The trap was moved to a new nest site on a floating marsh, with an unstable foundation. When checked on 23 August we found it had fallen over slightly sideways, having been inadequately anchored into position on the unstable marsh or bumped by the alligator at the site. This was the final opportunity to test the trap for this nesting season.

Of note, in Joanen's study (1969) of alligator nesting, data from movement recorders placed at four nests indicated over half of 66 nest visits recorded occurred in the first three weeks of incubation (approximately mid-June through first week of July). Nest visits were rare until the ninth/final week of incubation in late August, when 27.3% of nest visits occurred (Joanen 1969). We believe our trap was very successful, in that the first two alligators were captured during the 6th-7th week of incubation, when only one nest visit of 66 was noted in the four nests Joanen (1969) monitored.

We also measured plasma corticosterone levels from the blood sample we took after removing the alligators from the trap. These measured 5.07, 5.03, and 3.29 ng/ml for the three alligators captured. The second alligator trapped (for which we were unable to check the trap until the second day after it was set) had no higher stress hormone level than the first one, caught and bled the next day after the trap was set. We do not know however when the alligator entered the trap after it was set. For comparison, five adult alligators bled immediately upon capture had average plasma corticosterone levels of 0.8 ng/ml, which rose to an average of 12.6 ng/ml after four hours of restraint stress (Elsey et al. 1991). The slightly elevated corticosterone levels in our trapped alligators may have resulted from being contained within the trap, or due to the acute stress of being removed from the trap prior to blood sampling. It took ca. 10–15 minutes to remove the anchoring stakes, move the trap to a relatively dry spot in the marsh (Fig. 2), remove the alligator from the cage, secure the jaws, and obtain the blood sample. Our normal procedure of snaring aggressive females generally takes about 5 minutes from initiation of capture until the blood sample is obtained.

We believe this prototype trap was very successful in our limited testing. In every case when we caught an alligator, the alligator was extremely calm resting on the bottom beneath the water, and did not appear to have struggled within the trap. This trap is advantageous in that it allows for capture of wary adults, and although preferred, does not have to be checked on a daily basis as the alligator does not have a snare around its neck (possibly causing injury/drowning). Trapped alligators are also protected from fighting/cannibalism from other alligators that might attack an alligator caught in a "walk-in" snare system. The trap could be very useful in situations where nuisance alligators need to be live captured and removed, as it may be socially problematic to harvest the alligator in question. We also did not capture any non-target species. A disadvantage is hormone analyses may be altered due to restraint time/mild stress effects (Elsey et al. 1991), as we prefer to collect blood samples immediately after capture, with minimal disturbance.

FIG. 2. Captured alligator (201.9 cm total length) within trap, being moved to high ground for processing. Note door in closed position and trap transported with reasonable ease by two persons.

Improvements could be made by designing an easier way to remove a captured alligator from the trap (we had to open the door, noose the alligator by the neck, and physically pull it out of the entrance). Also, if large male alligators are targeted, the trap may need to be enlarged.

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RECENT POPULATION CHANGES

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Distribution of *Bufo boreas* in Utah

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The Western Toad (*Bufo boreas*) has undergone severe reductions in population sizes and distribution in much of its geographic range (Carey 1993; Colorado Division of Wildlife 1997; Corn et al. 1989; Livo and Yeakley 1997). In the southern Rocky Mountains, which include portions of the states of Colorado, Wyoming, and New Mexico, *B. boreas* is a candidate species for federal listing under the United States Endangered Species Act. Federal listing is "warranted but precluded," however, because there are other species presently in greater need (Federal Register 2002). Because of declining populations, the states of New Mexico and Colorado listed *B. boreas* as endangered in 1976 and 1993, respectively (Colorado Division of Wildlife 1997). In Utah, *B. boreas* is considered a species of special concern because of declining populations (State of Utah Rule R657-48) and lack of knowledge on current distribution (Ross et al. 1995).

Only 70 *B. boreas* localities were documented in Utah prior to 1995 (Fig. 1). These localities were based on museum records, various databases, and survey efforts, however, it was not known how many historical sites still supported *B. boreas* or how well these sites represented the distribution of the species in the State of Utah. Ross et al. (1995) reported that the majority of the historical records for *B. boreas* in Utah were concentrated in northern Utah and a large number of these locations were in the Wasatch Mountains between Salt Lake City and Provo (Fig. 1). This distribution pattern may reflect increased survey effort in this part of the state. Between 1980 and 1994, *B. boreas* records were scattered and typically consisted of the presence of one to several adults. Twenty-six localities were documented during this timeframe and reproduction was observed at only five of these localities (Ross et al. 1995).

We report the results of surveys since 1995 by the Utah Division of Wildlife Resources (UDWR) to better determine the current distribution of *B. boreas* in Utah and determine the extent of occupancy in areas with detections. This effort has consisted primarily of daytime visual encounter surveys (Crump and Scott 1994) during the breeding season. Surveys were generally systematic as initial surveys were completed statewide at or near pre-1995 localities and expanded to suitable habitat near detection points to

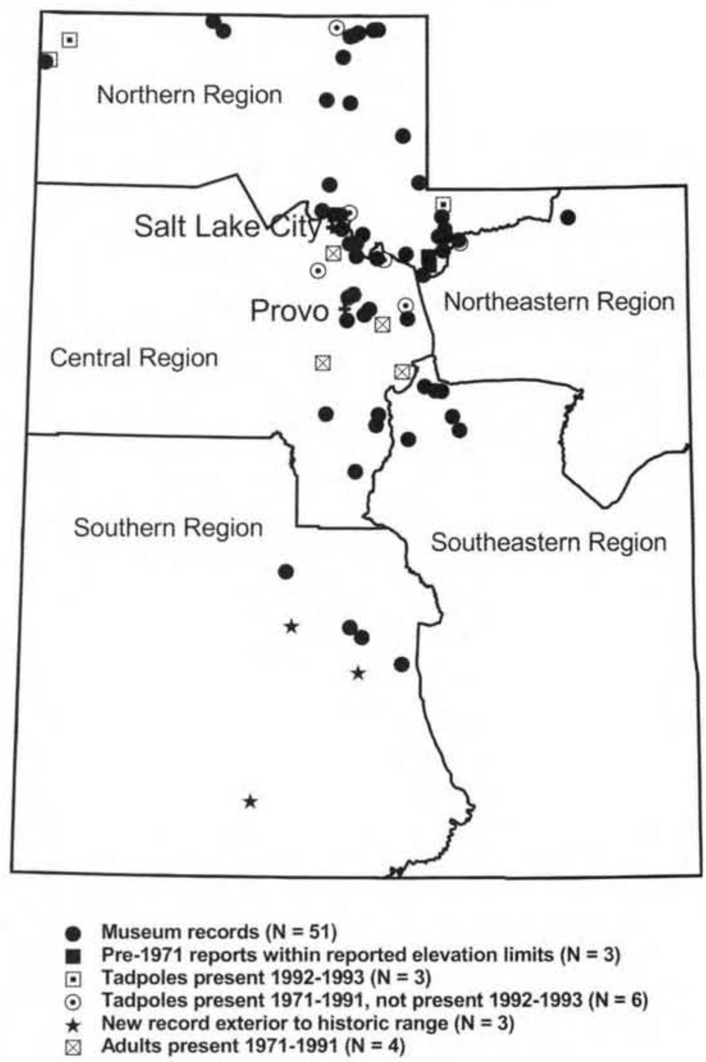

FIG. 1. Pre-1994 distribution of *Bufo boreas* in Utah (adapted from Ross et al. 1995).

delineate local populations. Fifty-eight of the 70 pre-1995 localities were revisited and surveyed. Survey effort varied because of the complexity of *B. boreas* habitat in Utah. In dry regions of the state, surveys were completed at springs as small as 10 m^2, while some surveys encompassed all habitats within portions of drainages (more than 0.5 km^2). Multiple visits were made in areas with detections, while areas where *B. boreas* were not observed generally were not revisited. No detections are not reported as one survey is not adequate to determine occupancy due to the temporal variability in amphibian populations.

Springs, streams, ponds, small lakes, and reservoirs were targeted for surveys. Effort was concentrated in springs, beaver (*Castor canadensis*) dam complexes, areas of shallow (less than 30 cm) open water with emergent and submerged vegetation, wet meadows adjacent to wetland habitat, and small mammal burrows upland from wetland sites. Surveys were conducted by searching the perimeter of all streams, ponds, and lakes, and conducting parallel transects to achieve 100% coverage of wet meadows and shallow ponds and marshes (Fridell et al. 2000). Some locality information, however, was collected from detection of single individuals in non-breeding habitat. Date, locality, observer, county, Universe Transverse Mercator (UTM) coordinates, and the number of each life stage (juvenile/adult, metamorph, tadpole, and egg strand) were recorded for all detection points. *Bufo boreas* captured during surveys were examined for clinical signs (e.g., loss of righting reflex, leg extension, failure to flee, skin tags, and subcutaneous hemorrhages) of infection of chytrid fungus (*Batrachochytrium dendrobatidis*).

Between 1995 and 2003, *B. boreas* were observed at 102 localities (Fig. 2) in more than 1100 discrete surveys. *Bufo boreas* were found at 84 previously undocumented localities and were present at 18 of 58 pre-1995 localities. Sites with *B. boreas* were clustered in 12 geographically distinct areas, likely representing discrete populations (Fig. 2). The majority of the *B. boreas* populations were found in two of the five UDWR management regions (Fig. 2).

Breeding (presence of egg strands and/or tadpoles) was observed in 54 locations within nine of 12 geographic areas (Fig. 2). Limited distributional information has been gathered on the three geographic areas (Strawberry Reservoir, Cottonwood Canyons, and North Horn Mountain) where *B. boreas* breeding has not been documented. In Cottonwood Canyons and North Horn Mountain, few adult *B. boreas* have been encountered, while 30 adults were encountered during 2003 surveys in the Strawberry Reservoir geographic area. Areas used by *B. boreas* for breeding are highly variable from year to year with spatial shifts corresponding to changes in habitat quality, water level, and vegetation. Since 1995, *B. boreas* breeding habitat has disappeared at one isolated breeding pond in northern Utah due to drying associated with drought. Additional breeding localities seemed to have shifted to more suitable habitat, when breeding habitats changed.

Consistent with Ross et al. (1995), we found *B. boreas* to primarily occupy montane habitats. In northwestern Utah, *B. boreas* were found primarily in lower elevation springs, which had been dredged and bermed to create small ponds for livestock watering; no fish were present in these habitats. The upland vegetation community varied from pinion-juniper/sage brush to aspen/mountain fir/mountain shrub. In higher elevations, *B. boreas* were found in wetlands and streams. *Bufo boreas* were found in eight streams containing native Bonneville cutthroat trout (*Oncorhynchus clarki utah*) and one stream containing brook trout (*Salvelinus fontinalis*). The upland vegetation community consisted of aspen/lodgepole pine. *Bufo boreas* were observed in northern Utah at elevations ranging from 1570 to 2800 m. In southern Utah, most *B. boreas* were found in wetlands associated with flowing streams, particularly in areas with recent *C. canadensis* activity (4 of 4 geographic areas). *Bufo boreas* were found in one stream containing brown trout (*Salmo trutta*), four streams with rainbow trout (*Oncorhynchus mykiss*), two streams with *S. fontinalis*, and four streams with *O. c. utah*. *Bufo boreas* were occasionally observed in off-channel wetlands, lakes, and ponds. The upland vegetation community varied from spruce fir/aspen to mountain fir/ponderosa pine. Populations were located at slightly higher elevations in southern Utah, ranging from 2390 to 3220 m.

FIG. 2. Distribution of *Bufo boreas* in Utah based on observations between 1995 and 2003.

Chytrid fungus was detected in one of 12 geographic areas during the survey effort. The diagnosis was confirmed when two *B. boreas* from the Paunsagunt Plateau tested positive according to the National Wildlife Health Center in August 2001. No other populations have been tested for chytrid fungus, however, no clinical symptoms have been observed to date.

Surveys between 1995 and 2003 have better defined the current distribution of *B. boreas* in Utah (Fig. 1). Ross et al. (1995) reported that very few recent localities, specifically breeding localities, were known to exist in Utah. Between 1995 and 2003, the UDWR documented the presence of *B. boreas* at 102 localities and 54 breeding areas within 12 geographically isolated populations (Fig. 2). *Bufo boreas* are widely distributed in Utah with populations persisting in northern and southern Utah (Fig. 2). Even though *B. boreas* were not detected in more than 1000 discrete surveys, temporal variability in amphibian populations coupled with the variability in survey effort among habitats does not indicate absence. Few *B. boreas* were found in the Wasatch Mountains between Salt Lake City and Provo, which could be attributed to the expanding human population along the Wasatch Front. Survey efforts in this part of the state, however, have not been as intensive. More surveys are needed to determine the distribution, population status, and factors influencing *B. boreas* distribution in these mountains. Future surveys may document *B. boreas* in additional geographic areas in Utah.

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HERPETOLOGICAL HUSBANDRY

Herpetological Review, 2004, 35(3), 257–259.

Captive Breeding of *Notophthalmus viridescens* Through Hormonal Manipulation

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Model organisms such as *Notophthalmus viridescens*, which possess regenerative ability, can offer great insight into the mechanisms of regeneration. Improved techniques for increasing the availability of embryos under laboratory conditions will allow comparative studies between development and regeneration and enable the manipulation of embryos to determine which genes are necessary for regenerative ability.

The effect of the environment, including temperature and photoperiod, on amphibian reproduction has been well documented. Photoperiod has proven to significantly affect spermatogenic cycles and ovarian development. It has also been shown that inappropriate temperatures can decrease gametogenesis (Duellman and Trueb 1986). Under laboratory conditions, inadequacies in environmental, social or nutritional cues necessitate the use of hormonal manipulation for the successful generation of large numbers of embryos (Whitaker 2001). A variety of hormones have been used in amphibian reproduction. These include Human Chorionic Gonadotropin (HCG), Luteinizing Hormone-Releasing Hormone (LH-RH), Follicle Stimulating Hormone (FSH), and Gonadotropin-Releasing Hormone (Gn-RH) (Whitaker 2001). Most of these studies have been done with anurans and there is very little information on urodeles.

Khan and Liversage (1995) developed a technique for spawning and rearing *Notophthalmus viridescens* embryos under laboratory conditions. Their method uses a combination of manipulation of photoperiod, temperature and hormones. Our current communication improves and simplifies the method for obtaining embryos by eliminating the need for manipulation of temperature and photoperiod or the selection of pre-conditioned animals.

Adult maintenance.—Adults in our colony are maintained under standard conditions (Foty and Liversage 1993) with some modifications. A bed of oak leaves (sterilized by autoclaving) is layered on the bottom of the tubs. The oak leaves provide shelter for the newts, and anecdotal evidence suggests that degradation products such as fulvic acid provide anti-bacterial and anti-microbial properties and help in the absorption of nutrients and minerals (www.fulvic.com). Pine or cedar products should not be used, as the compounds they release are harmful to many amphibian species (Barnett et al. 2001). Newts are fed twice weekly with live blackworms (*Lumbriculus variegates*), which are high in protein and live in the enclosure until they are eaten. The use of live prey decreases the amount of husbandry time by eliminating the need

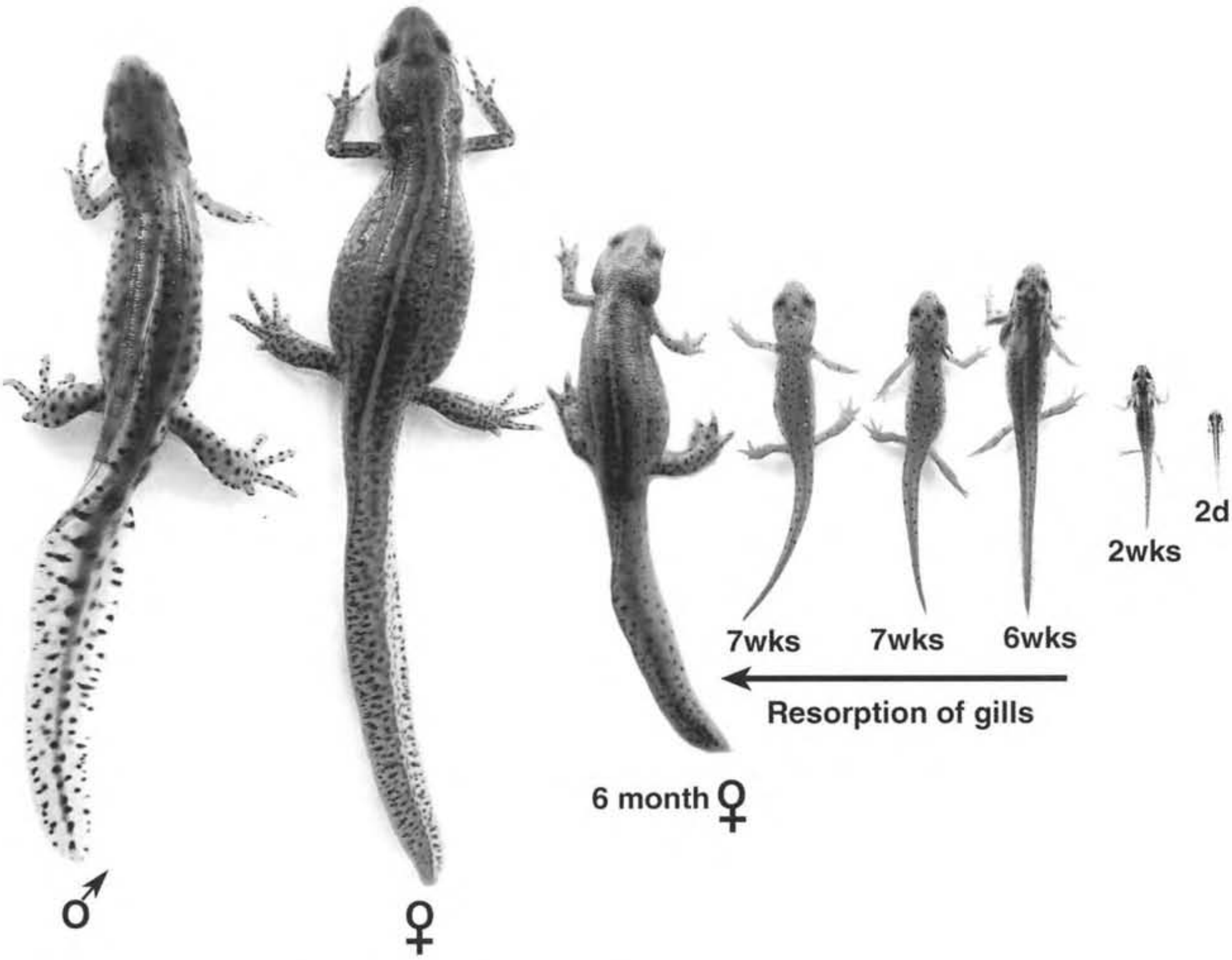

FIG. 1. Time (post-hatching) of development in our captive-bred population.

to clean out decaying uneaten food.

Hormonal manipulation.—Adult *Notophthalmus* chosen for spawning are moved to alternate containers for ease of identifying injected individuals and for ease of embryo collection. Plastic containers with adequate height to accommodate a minimum water depth of 15 cm are suitable. Aquatic plants (e.g., *Elodea* sp.) or plastic plants fixed by silicone rubber to large stones are placed on the bottom of the enclosure as egg laying locales.

The injection procedure is as follows:

1. Male and female animals are mildly anesthetized by submersion for 5–10 minutes in 0.05% MS-222 (buffered to pH 7.0 with $NaHCO_3$).
2. An intraperitoneal (IP) injection of 30 international units (IU) of prolactin (PRL – Sigma, Cat. # L6520) is administered.
3. Animals are re-treated after 72 h and again after another 72 h for a total of three injections.
4. Forty-eight hours after the last PRL injection, females are re-anesthetized and injected IP with 100 IU of human chorionic gonadotropin (HCG – Sigma, #CG-5; see Khan and Liversage 1995). We have found that males do not require an HCG injection for successful captive breeding using our method.
5. A second injection of HCG is administered to the females after 24 h.

Typically, eggs begin to appear within 72 h after the last HCG injection, and females will continue depositing eggs for several weeks, usually resulting in 150–200 viable embryos per female. Eggs are generally attached to submerged aquatic plants. Priming with PRL eliminates the need for using animals that already display secondary sexual characteristics such as nuptial pads on the hindlimbs in males and the prominent distension of the cloacal region in females. In several urodele species, PRL has been shown to induce migration to water, and to promote courtship behavior and development of secondary sexual characteristics (Iwata et al. 2000). We have found that the use of PRL injections prior to HCG has also improved the viability of our embryos. PRL is pivotal in the female's production and secretion of oviducal jelly (Duellman and Trueb 1986), and HCG alone might not produce this jelly effectively. The oviducal jelly secretions, which ultimately become the mucoid capsules, encase the embryo and are responsible for prevention of fungal infections and other defensive strategies (Duellman and Trueb 1986).

Embryos and larvae.—Once eggs are deposited, they can be removed delicately from the plants with the use of tweezers and a disposable transfer pipette. Eggs should be removed daily, if possible, to prevent them from being eaten by the adults. Eggs are then housed in petri dishes, and non-viable embryos are removed immediately so that degradation and the subsequent fungal growth that may ensue does not contaminate the remaining embryos. The eggs should always be totally submerged in water and the lid should be kept on the petri dish to prevent water evaporation and desicca-

tion of embryos. Once the eggs have hatched the tiny larvae can be placed in plastic containers with aerated water. Submerged oak leaves in the larval enclosures provide shelter but also promote growth of algae from the nutrients leached by the slowly decaying leaves. Cultures of *Daphnia* sp., *Cyclops* sp., and other minute aquatic organisms (Aquatic Foods, Inc. or Carolina Biological Supply Co.) are introduced into the enclosures. These organisms will feed on the algae and will in turn provide food for the larvae. Once the larvae are about 1.5 cm long, they can be fed on blackworms like the adults. Powerful filters should not be used in the enclosures as the larvae will be drawn into the filter. Aeration with weekly partial water changes should be adequate in most cases. Approximately 30 larvae can be housed in a container 40 cm x 27 cm x 15 cm. Overcrowding the larvae will increase the likelihood of cannibalism and increase the amount of waste build-up between cleanings.

Efts.—Typically, *Notophthalmus viridescens* goes through a terrestrial eft stage which lasts from 3 to 7 years (Healy 1974). In captivity the terrestrial stage can be bypassed by keeping the newts in a shallow aquatic environment with the same set up used for the adults but with a water depth of only 5 cm and either rocks or plastic plants to break the water surface. This allows the newts to adjust more easily to the aquatic environment. Young newts are fed predominantly on blackworms like the adults. Although faster growing rates than 3–7 years have been observed with aquatic juveniles under natural conditions (Healy 1974), we have been able to attain sexual maturity in our offspring in as few as six months by using the conditions outlined above (see Fig. 1 for developmental staging). Although these animals are smaller in stature than the full-grown adults, we have obtained viable embryos from their matings. In nature, the development of terrestrial efts is restricted by availability of food, rainfall, and the number of suitable days for hunting (Healy 1974). Our juveniles are fed three times a week on blackworms, which provide sufficient caloric intake to accelerate maturation rates.

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NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 35, Number 1 (March 2004).

ANURA

BUFO GRANULOSUS (NCN). **PREDATION**. On 24 Oct 2002 at Lagoa Grande, 30 km from the municipality of Pontalina (17°31'23"S, 49°26'49"W; 642 m elev.), in the southern portion of the State of Goiás, central Brazil, we observed an individual *Leptodactylus podicipinus* (33.9 mm SVL) predating an individual *Bufo granulosus* (19.8 mm SVL) at 2050 h. This interaction was observed in a soil cavity ca. 5 cm deep in a humid pasture. Although the right rear leg and part of the abdomen of *B. granulosus* had already been swallowed by *L. podicipinus*, it continued to struggle. These specimens were collected, and immediately after capture, *L. podicipinus* released the *B. granulosus*, which died within a few minutes. These specimens are deposited in the collection of the Laboratory of Animal Behavior of the University Federal of the State of Goiás, Goiânia (ZUFG 1846 *B. granulosus*; ZUFG 1847 *L. pocidipinus*). This observation suggests that *L. pocidipinus* is a predator of *B. granulosus*, and that the skin toxins of *B. granulosus* might not be an effective defense against *L. podicipinus*.

Submitted by **LORENA DALL´ARA GUIMARÃES**, **RICARCO MARQUES PINTO**, and **RAFAEL DE FREITAS JULIANO**, Depto. de Biologia Geral - ICB – UFG, Campus II, Caixa Postal 131, 74001-970, Goiânia, Goiás, Brazil; e-mail (LDG): dallaraelm@uol.com.br.

LEIOPELMA HAMILTONI (NCN). **HOMING**. Translocations of frog species are likely to become more prevalent in future years as researchers and conservationists attempt to be more proactive in halting the global demise of many frog species (Waldman and Tocher 1998. Behavioral Ecology, Genetic Diversity, and Declining Amphibian Populations. *In* T. Caro (ed.), Behavioural Ecology and Conservation Biology. Oxford University Press, Oxford.). It is possible that animals attempting to return home will hinder translocation efforts for some species. For rare or threatened amphibian species, the loss to the total population of individuals that unsuccessfully home may significantly jeopardize the long-term persistence of the species. Animals that attempt to home also compromise successful establishment of the translocated population.

The primitive leiopelmatid frogs of New Zealand comprise four extant species, two of which (*Leiopelma pakeka* and *L. hamiltoni*) are now restricted to offshore predator-free islands in the Marlborough Sounds. *Leiopelma hamiltoni* is present only on Stephens Island and has an estimated population size of 169–318 individuals (Brown 1994. New Zealand J. Zool. 21:425–430; Thomson 1996. B.Sc. [Hons.] Thesis, Victoria University of Wellington, Wellington), all living in a rock tumble ca. 300 m^2. *Leiopelma hamiltoni* is the most threatened of New Zealand's endemic frogs.

All New Zealand *Leiopelma* spp. are subject to a formal Recov-

ery Plan (Newman 1996. Native Frog (*Leiopelma* spp.) Recovery Plan. Threatened Species Recovery Plan No. 18, Dept. Conservation, Threatened Species Unit, Wellington, New Zealand), which is administered by a Recovery Group, under the auspices of the Department of Conservation. The Recovery Plan proposed the establishment of two additional populations of *L. hamiltoni*: a second population on Stephens Island, and another on a different, predator-free island in the Marlborough Sounds.

On Stephens Island, clearing, browsing, and subsequent wind-damage to the remaining forest early this century destroyed much of the forest cover. *Leiopelma hamiltoni* were likely to have been more widely distributed on Stephens Island and have become restricted to the rock tumble since the forest was cleared (Brown 1994. *op. cit.*). Tuataras are present in high numbers on Stephens Island, and may have benefited from the clearing of the forest and subsequent patchy regeneration of vegetation. It is likely that tuatara play a significant role in restricting *L. hamiltoni* to the rock tumble (Newman 1977. Proc. New Zealand Ecol. Soc. 24:43–47; Brown 1994, *op. cit.*).

In 1991 a new habitat was built for *L. hamiltoni* on Stephens Island (Cree 1990. Habitat restoration for Hamilton's frog. Unpubl. Rept., Dept. Conservation, Wellington, New Zealand; Brown 1994. *op. cit.*). A rock pit ("frog pit") was built ca. 70 m from the existing frog habitat in an exposed rock tumble ("frog bank"), and was fenced to exclude tuatara. The frog pit was located within a forest remnant. Twelve frogs were transferred to the pit in May 1992. Of these transferees, five were presumed to be adult females, and seven were adult or subadult males or subadult females (Bell 1978. Herpetologica 34:340–354; Brown 1994. *op. cit.*). Frogs were toe-clipped prior to their release into the frog pit.

During the year following the translocation, 50 searches yielded 27 recaptures of 7 of the 12 translocated frogs (Brown 1994. *op. cit.*). As the years have passed, fewer of these frogs have been recaptured, and now only 3 of the translocated frogs are known to remain at the frog pit (Tocher and Brown *unpubl. data*).

Newman (1990. Herpetologica 46:319–330) found that *L. hamiltoni* could home accurately over 10 m, and homing was seen as a potential confounding problem in the translocation of *L. hamiltoni* (Brown 1994, *op. cit.*). The apparent success of the *L. pakeka* translocation on Maud Island (Bell 1994. New Zealand J. Zool. 21:341–349) provided evidence that new populations could be established, and the Recovery Group decided the "risk" of perhaps losing a number of *L. hamiltoni* through homing was worth taking to potentially establish a second population. Herein we provide data on two homing events (from the frog pit back to the frog bank).

Stephens Island is located at one of the northern-most points of South Island, New Zealand and is exposed to Cook Strait. In 1989 planting of wind-tolerant species such as ngaio (*Myoporum laetum*), taupata (*Coprosma repens*), and akiraho (*Olearia paniculata*) was begun between the frog bank and frog pit. Now, the frog bank is effectively linked to the original forest remnant and the frog pit by vigorous growth of plantings and the seedlings that are establishing beneath them.

Searches of the frog bank, and later the frog pit (from 1992) for toe-clipped animals were made intermittently between 1990 and 1996 (Thomson 1996, *op. cit.*). Since July 1997, searches have been conducted at least four times per year, and each search usually takes place over a period of six or more days. Up to June 2000, there have been 61 captures of 8 of the 12 translocated frogs. Four of the frogs have never been seen since release into the frog pit. Three others have not been seen since 1992, 1993, or 1994. Of the three adult frogs remaining in the frog pit, two are females and one is likely to be a male (based on SVL remaining constant at 39 mm over the last few years; Bell 1978, *op. cit.*; Brown 1994, *op. cit.*).

Two frogs have homed back to the frog bank and another may have attempted to home. A male *L. hamiltoni* (Frog B) was last seen in the frog pit in October 1994 and was recaptured on the frog bank in April 1995. The capture site for this frog in April 1995 was 0.2 m from the site where it was originally captured prior to translocation in May 1992. Since arriving back at the frog bank, the frog has been recaptured on two other occasions, both times in the vicinity of the original capture site. The distance between the last capture site in the frog pit and the site Frog B was captured in the frog bank is ca. 76 m.

Brown (1994, *op. cit.*) reported that two frogs (Frog B and C) seemed to be moving away from the release site in the frog pit, towards the frog bank, several months after the release (based on capture locations). Frog B did eventually home back to the frog bank, but Frog C has not been seen since February 1993.

The second frog to home was a female *L. hamiltoni* (Frog I) that was last seen in the frog pit in Feb 1993, nine months after the release, and was recaptured on the frog bank in June 1999. The capture site in June 1999 was 3.1 m from its original capture site in May 1992, and 89 m in a straight line from the site the frog was last seen at in the frog pit.

The translocation of *L. hamiltoni* has highlighted the need for a thorough consideration of life history and behavioral attributes of species prior to the initiation of translocations. A high mortality rate is expected in amphibians that attempt to home across modified or otherwise inhospitable habitats. The habitat between the frog pit and frog bank is relatively inhospitable to *L. hamiltoni*. The presence of tuatara and burrowing seabirds, sparse vegetation and the relative paucity of deep rock piles all combine to deter colonization of this habitat by *L. hamiltoni*. Over the period that the *L. hamiltoni* population on Stephens Island has been studied (from 1975) frogs have never been observed in the area between the frog pit and frog bank. Even in recent years as the forest between the two habitats has regenerated, no sightings have been recorded (although no thorough and systematic searches have been made).

It is unlikely that there are any adult frogs in the frog pit, other than the three known to be resident. These 3, plus the 2 frogs known to have returned to the frog bank, account for 42% of the translocated frogs, meaning that 58% are unaccounted for, eight years after the translocation. By way of comparison, 53% of frogs marked between 1990 and 1991 are "unaccounted for" in the frog bank, after a similar period of time.

Some of the "missing" frog pit frogs may still be in the process of homing back to the frog bank. The habitat surrounding the frog pit may be more suitable for *L. hamiltoni* than it seems, and some of the transferees may have taken up residence in the habitat between the frog bank and frog pit. Alternately, they could have succumbed to natural mortality, or unsuitable habitat (e.g., drying conditions), or been predated. It is also possible that they have re-

mained undetected at either the frog bank or frog pit (19% of frogs marked at the frog bank between 1990 and 1991 were not seen again for over nine years despite repeated searches).

Threatened frog species, such as *L. hamiltoni*, do not exist in high enough numbers to sustain regular cropping to establish other populations, and even a single cropping may be cause for concern. The likelihood of translocated frogs returning home may be minimized by translocating young animals that have not yet fully established a home range. Also, frogs may be more likely to home when they are not involved in breeding.

We advocate that for any future translocations, strong consideration be given to the transfer of subadult frogs. The three frogs that have remained in the frog pit had yet to attain full size when transferred, while the two that "homed" were at full size. Subadults may have fewer tendencies to attempt homing, and their removal from the founding population does not immediately compromise breeding and population recovery potential.

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MELANOPHRYNISCUS MONTEVIDENSIS (Darwin's Toad). **ALBINO LARVAE**. Published reports of albino amphibians and reptiles have become more common in the last years. However, these records are mainly based on reptiles rather than amphibians. Albinism in amphibians in Uruguay has not been reported previously.

During a field trip to Cabo Polonio, Rocha Department, Uruguay (34°24'S, 53°47'W), several male *Melanophryniscus montevidensis* were observed calling in a temporary pond (1 m diam, 0.5 m max depth, stone bottom) on 13 Feb 2003, 24 h after an intense rainfall. On 20 Feb 2003, when the pond was nearly dry, several tadpoles were collected and placed in a glass container. We noted that twelve tadpoles were complete albinos, whereas the other individuals showed normal pigmentation. Nine albino larvae died before reaching Gosner stage 30 (Gosner 1960. Herpetologica 16:183–190), the others were fixed in formalin at Gosner stage 35. All normal tadpoles survived. Specimens were deposited in the Zoología Vertebrados Batracios Collection, Facultad de Ciencias, ZVCB 10505). On 24 Feb 2003, after another rainfall, three amplectant pairs of *M. montevidensis* were observed. They were collected and placed in a glass container. Twenty-four hours later, six small egg clutches (two clutches by each pair) were found in the container; the toads were released at the same place where they had been collected. After a week, no albino tadpoles were observed in the container.

Whereas other reports of albinism in tadpoles indicate that albinos had neither different mortality nor developmental rates (Nijs 2002. Herpetol. Rev. 33:131), we observed the normally colored tadpoles survived better than albinos. Differential features between albino and normal tadpoles were not observed in the tooth row formula or in the general body shape.

We thank Axel Kwet for helpful suggestions on the manuscript.

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PROBREVICEPS LOVERIDGEI, P. ULUGURUENSIS, and ***P. MACRODACTYLUS*** (Loveridge's Forest Frog, Uluguru Forest Frog, Long-fingered Forest Frog). **ADVERTISEMENT CALLS**. The forest frogs are robust, short-limbed, burrowing microhylids that are found in some old mountain forests in Africa. Five species are known, of which four are found in the high Eastern Arc mountain forests of Tanzania, and one, *Probreviceps broadleyi*, is found in the mountains between Mozambique and Zimbabwe. Not one of the calls of these species has been described.

Probreviceps loveridgei is known only from the Uluguru Mountains in Tanzania, where it occurs between 1200 and 1500 m elevation. *Probreviceps uluguruensis* is also confined to the Uluguru Mountains, where it occurs at altitudes of 2000 m and above. *Probreviceps macrodactylus* is known only from the Usambara Mountains of northern Tanzania. We report the advertisement calls of the above three species (Fig. 1). Recordings were made in the field, using a Sony TC-D5M cassette recorder, or a Sony Microcassette Corder M-730V. The calls were analyzed using CANARY 1.2.4 (Cornell Laboratory of Ornithology). Voucher specimens are in the collection of the Zoology and Marine Biology Department, University of Dar es Salaam.

Probreviceps loveridgei was recorded on 22 Aug 2002 by FJM at Shikurufumi Catchment Forest (Southern Uluguru Mountains) at an altitude of 1500 m. Air temperature was 14°C. Males call from burrows or leaf litter after rain. Calls from a single typical male consist of 3–6 notes at an emphasized frequency of 1.67 kHz. The mean call duration is 457 ms (range 332–697, N = 10). Each note consists of 1–5 pulses with a pulse rate of 43–91/sec.

Probreviceps uluguruensis was recorded on 1 Sept 2002, Uluguru South Forest Reserve at an altitude of 2000 m by FJM, and 30 Nov 2002 on the Lukwangule Plateau, Uluguru Mountains at an altitude of 2450 m by WN. Air temperature was 9.7°C and 12°C. Males call from grass tussocks along wetlands or under leaf litter in forest. The call is a low-pitched chirp. Typical calls from two males, one at an altitude of 2000 m in the Uluguru South

FIG. 1. Typical calls of *Probreviceps loveridgei* (L), *Probreviceps macrodactylus* (M), and *Probreviceps uluguruensis* (U).

Forest Reserve, and the other at 2440 m on the Lukwangule plateau, consist of 6–8 notes at a frequency of 1.41kHz, and 3–6 notes at a frequency of 1.37 kHz. The mean call duration for both samples is 269.3 ms (range 107–349, N = 11). The mean note rate is 20.4 notes/sec (range 18.6–22.0).

Probreviceps macrodactylus was recorded at Amani in the East Usambaras, on 13 March 2000. Air temperature was 22°C. Males call from burrows or concealed beneath vegetation after rain. The call is a low-pitched chirp. The calls of a single typical male consist of 12–13 notes at a dominant frequency of 1.87 kHz. The mean call duration is 308 ms (N = 4). The mean note rate is 38 /sec (range 37.8–38.2).

We thank the local authorities for permission to work in these areas. AC acknowledges a research permit issued by COSTECH.

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RANA BLAIRI **(Plains Leopard Frog). PREY.** Although there are accounts of the distribution, habitat, and zoogeography of *Rana blairi*, specific studies that refer to their feeding habits are scarce (Collins 1993. Amphibians and Reptiles in Kansas. 3rd ed., rev. Univ. Kansas Nat. Hist. Mus. 397 pp.; Minton 2001. Amphibians and Reptiles of Indiana. 2nd ed. Indiana Acad. Sci., Indianapolis. 404 pp.). During the spring of 2001 and 2002, we collected *R. blairi* for studies on parasite ecology (Bolek et al. 2003 J. Parasitol. 89:522–528) and to document examples of predation on the Western Chorus Frog, *Pseudacris triseriata*. During the nights of 30–31 March and 2 April 2001 individual male *R. blairi* were observed among choruses of *P. triseriata* in an overflow temporary pond located on the North East side of Pawnee Lake, Lancaster County Nebraska (40°51.18'N, 96°53.11'W). None of these male *R. blairi* at this or two other locations around Pawnee Lake was heard calling on these dates, although we spent 2–4 h/night at this location. Observations on these male *R. blairi* indicated that they were fully submerged with only the eyes and nostrils exposed above the water and facing calling male chorus frogs. It appeared as if the male *R. blairi* were homing in on the calls of the male *P. triseriata*. Although no predation attempts were observed in the field, all 3 male *R. blairi* collected from this site on 30-31 March and 2 April 2001 and 3 of 10 male *R. blairi* collected from an overflow temporary pond on the western side of Pawnee Lake on 14 April 2002 contained undigested frogs or bones of *P. triseriata* in their stomachs. Additionally, a single female Bullfrog, *R. catesbeiana,* collected at this location on 10 April 2001 contained a *P. triseriata* in its stomach. Recently McCallum et al. (2003. Herpetol. Rev. 34:54) observed a similar phonotactic stalking behavior in Wood Frogs, *R. sylvatica*, preying on Spring Peepers, *P. crucifer*, in Arkansas. Our observations suggest that numerous *Rana* species that overlap during their breeding season or location with *Pseudacris* sp. may commonly prey on these frogs, suggesting that calling by male *Pseudacris* sp. may be costly. Our observations suggest another hypothesis for the presence of non-calling or "satellite " males in close proximity to calling conspecific males of *P. triseriata* and other *Pseudacris* sp. (Robel 1985. J. Herpetol. 19:432–436; McCallum et al. 2003. Herpetol. Rev. 34:53).

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***RANA* SPP.** (Multiple Ranid Species). **HIBERNACULA.** Overwintering locales for adult Green Frog (*Rana clamitans*), Pickerel Frog (*R. palustris*), and American Bullfrog (*R. catesbeiana*) have been documented, though these species are primarily known to hibernate either singly or with conspecifics. We present here what we believe to be the first account of a shared hibernaculum of multiple species of ranid frogs of different age classes.

On 12 March 2003, we observed 16 individuals representing three species of ranid frogs under a sandstone rock (73 x 75 x 12 cm) at the edge of a small (15.4 x 7.3 m) pond on US Department of Agriculture property in Beltsville, Maryland (39°02'00.9"N, 76°51'27.9"W). The rock was partially submerged at the northwestern edge of the pond basin, at a maximum depth of ca. 18 cm. Air temperature was 13.7°C, and water temperature at the edge of the pond basin was 11.5°C. Water temperature under the rock where we found the ranid frogs was 5.2°C. The species, age class, sex (if it could be determined), and SVL were as follows: 3 *R. palustris* adult males (40, 45, 52 mm SVL), 6 *R. clamitans* juveniles (mean 36 mm SVL, range 28–46 mm), and 7 *R. catesbeiana* juveniles (mean 34 mm SVL, range 30–40 mm).

Individuals retrieved from under the rock were extremely sluggish, and we presumed that they were hibernating. In addition, a single adult *R. catesbeiana* was discovered under an artificial plywood cover board (61 x 122 cm) adjacent to the pond, suggesting that the individuals discovered under the rock were not simply seeking cover, as there were many other cover boards located near the pond's edge which were unoccupied.

Comparisons of photographs from this site taken in 2001 and 2002 indicate that the water level was higher in 2003 than in the previous two years, and that this hibernaculum was not adjacent to the water or inundated in the previous two years.

Although the hydroperiod of this pool was not observed during the winter months, the large amount of precipitation and snowmelt in late 2002 and early 2003 suggests that the water level was high enough to reach and inundate the hibernaculum during the hibernation period. These ranid frogs typically move to hibernation sites in October and November in Missouri and Pennsylvania (Willis et al. 1956. Copeia 1956:30–41; Hulse et al. 2001. Am-

phibians and Reptiles of Pennsylvania. Cornell University Press, Ithaca, New York, 419 pp.).

This hibernaculum was discovered while conducting work associated with the U.S. Geological Survey's Amphibian Research and Monitoring Initiative, Northeast Region.

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SCAPHIOPUS COUCHII (Couch's Spadefoot). **PREDATION.** *Scaphiopus couchii* is an explosive, opportunistic breeder that congregates around ephemeral pools following heavy rains. After a short larval period, tadpoles emerge in high densities over short periods (Stebbins and Cohen 1995. A Natural History of Amphibians. Princeton University Press, New Jersey, p. 86). *Masticophis flagellum* is an active foraging, diurnal predator whose diet includes small mammals, birds and their eggs, snakes, lizards, small turtles, frogs, and occasionally grasshoppers (Reams and Aucone 2001. Herpetol. Rev. 32:108; Werler and Dixon 2000. Texas Snakes. Texas A&M Univ. Press, Texas, p.182; Tabor and Germano 1997. Herpetol. Rev. 28:90; Ward and Clark 1988. Herpetol. Rev. 19:36–37; Tyler 1986. Oklahoma Ornithol. Soc. Bull.19:14–15). On 19 July 2002, we found an adult *M. flagellum* (162 cm TL; 141 cm SVL) foraging ca. 1 m from the edge of an ephemeral pool in Big Bend National Park, Brewster County, Texas (Zone 13R 3239700N, 646820E) where hundreds of *S. couchii* metamorphs were emerging. Although no predation events were observed, palpation yielded four *S. couchii* metamorphs with tails (mean 14.3 mm SVL). Opportunistic foraging upon recently metamorphosed toadlets can undoubtedly provide a tremendous amount of energy for a given snake. While, to the best of our knowledge, predation upon *S. couchii* by *M. flagellum* has not been documented, it is likely that these snakes utilize this food source on a regular basis during the summer months when numbers of metamorphosing amphibians are often greater than 10,000 individuals per night (Gray 2002. Effects of Anthropogenic Disturbance on Body Size, Demographics, and Chaotic Dynamics of Southern High Plains Amphibians. Ph.D. Thesis, Texas Tech University).

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TESTUDINES

ACANTHOCHELYS MACROCEPHALA (Pantanal Swamp Turtle). **HABITAT**. *Acanthochelys macrocephala* is a poorly known South American chelid turtle with a geographical distribution restricted to the Paraguay River basin in western parts of central Brazil, Paraguay, and possibly Bolivia (Rhodin et al. 1984, Herpetologica 40:38–46). This range encompasses mainly flooded lands and cerrados (savanna-like vegetation) known as Chaco and Pantanal, and at a local scale this habitat is quite diverse. Marshes, slow-flowing streams, and pastures are defined as *A. macrocephala* habitat in Brazil (Rhodin et al. 1984, *op. cit.*; Cintra and Yamashita 1989. Herpetol. Rev. 20:65–66). During intensive field work conducted in Mato Grosso do Sul State in recent years it was possible to collect turtle skeletal remains and to capture and observe living turtles. Collections were made in two areas of Nhecolândia Pantanal (18°57'S, 56°37'W and 19°34'S, 56°14'W). The region is characterized by the presence of hundreds of ponds, regionally known as "baías" (shallow bays) and brackish ponds called "salinas" (salt lagoons), in lowland areas within a matrix of distinct cerrado physiognomies on higher ground (± 2 m). Turtle shell remains are frequently found associated with intermittent streams ca. 3 km from the salinas. During the rainy season the bays (excepting the salt lagoons) connect through small intermittent streams creating a shallow waterway that is utilized by migrating *A. macrocephala*. Individuals that fail to reach a waterway can die while traversing the dry cerrado uplands.

Baías and salinas are distinct. While bays can harbor several species of vertebrates (i.e., caiman, fish, frog) and plants (water lily, cattail), vertebrates are poorly represented in salinas, although occasionally caimans and a frog species (*Pseudis paradoxa*) can be found in these water bodies. In the salt lagoons, alkaline conditions (pH 10–12) promote diatomaceous algae and a rich invertebrate community, including crabs, dragonflies, and other aquatic insects. The ponds can be permanent or temporary. Soil composition, such as the relative amounts of silt or sand, influences the presence of aquatic plants in the lagoon and herbaceous plants at the edges. A grass, *Axonopus purpusii* (Poaceae), dominates the edges of the lagoons.

During the dry season (July–September), salinas can become partially or totally dry. In this period, distinct physiognomies from salt lagoon beach to the closest vegetation can be detected. A variably wide strip of beach in salt lagoons is destitute of vegetation. Instead, only decomposed algal remains are visible. Turtle bones are very common around these beaches. From this vegetation-free beach to the upland cerrado edge, a succession of grasses, shrubs, and trees is well distinguished. A predominant strip of *Digitaria* (Poaceae) grass with few herbaceous species is the first vegetation band. Next appears a tall grass, *Paspalum vaginatum* (Poaceae), together with *Digitaria* and few *Scirpus* (Cyperaceae). Reaching the upland, the vegetation around the salt lagoons is dominated by cerrado and semi-deciduous forests. Bordering the forest edge there are patches of dense bromeliads (*Bromelia balansae*).

The habitat of *A. macrocephala* in Brazil is subject to a pronounced wet-dry season rhythm. Interesting behavioral responses to such environmental stochasticity might be expected in these populations.

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CHELYDRA SERPENTINA (Common Snapping Turtle). **REPRODUCTION.** On the morning of 7 June 2001, we observed a 2.9 kg female *Chelydra serpentina* digging a nest at the edge of a gravel road in Utica Marsh, an urban wetland next to the Mohawk River and lying partially within the city limits of Utica, New York, USA. The nest site was 53 m from the water on a direct line and within a ca. 30 x 60 m cleared area with a gravel road running along one margin. On closer inspection of the nesting activity, we found several damaged *C. serpentina* eggs from a prior nest in the soil being dug up by the female. As she continued digging, additional eggs surfaced. Palpation of the pelvic region of the laying female indicated that she had a full load of shelled eggs ready for oviposition. We left the animal undisturbed for an hour, and upon return, found the female covering the nest. We found numerous additional broken eggs around the nest site. Palpation indicated that no eggs remained in her body cavity. Twenty-three eggs were recovered from this nest and collected for hatching in the lab. Three undamaged eggs were salvaged from the previous nest of an estimated 15–20 eggs total.

To our knowledge, this represents a rare instance of *C. serpentina* using a previously excavated nest for her own, thus destroying the eggs of the first female. Anecdotal evidence provided by others suggests that this phenomenon has been observed in several species, including *C. serpentina, Glyptemys insculpta*, and seaturtles. One published study of nesting in *Malaclemys terrapin* reported that females would occasionally dig up other nests in high density nesting areas, but such incidents represented less than 2% of total nesting events (Burger 1977. Am. Midl. Nat. 97:444–464). We have been unable to find published reports of this type of nest destruction by *C. serpentina*, and such activity was not documented by Congdon et al. (1987. Herpetologica 43:39–54) in their thorough study of nesting ecology of *C. serpentina*.

Although predation of *C. serpentina* nests by other species is well established, it remains puzzling as to what mechanism other than chance led to this observed nest destruction by *C. serpentina* in a low-density nesting area containing only six nest sites within this 1800 m^2 nesting area. Difference in soil structure does not seem to be a factor nor does relative openness of each nest site in the area. One could speculate whether olfactory cues may have contributed to selecting the first nest as the site to excavate.

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DERMOCHELYS CORIACEA (Leatherback Sea Turtle). **MIGRATION AND DISPERSAL.** While relatively large numbers of *Dermochelys coriacea* forage seasonally in temperate waters off Atlantic Canada (Bleakney 1965. Can. Field Nat. 79:120–128; Goff and Lien 1988. Can. Field Nat. 102:1–5; James and Herman 2001. Chelon. Cons. Biol. 4:202–205), the nesting origins of these animals are generally unknown. Until now, the only direct evidence of the nesting origins of leatherbacks found off eastern Canada came from a single animal bearing a flipper tag applied in French Guiana that was in Placentia Bay, Newfoundland, on 17 September 1987 (Goff et al. 1994. Can. Field Nat. 108:72–73). Here we report on the discovery of two previously marked female *D. coriacea* captured while conducting field research off the coast of Cape Breton Island, Nova Scotia, in the summer of 2002.

The first turtle, measuring 162 cm curved carapace length (CCL), was captured at 1500 h on 30 August 2002 at 46°49.891'N, 60°03.139'W. During examination, an Avid IV Multi-tag reader detected a Passive Integrated Transponder (Trovan #00-061D-4876) implanted in the turtle's right shoulder muscle. A small amount of scar tissue on the epidermis (approximately 2 cm^2) corresponded to the area above the implantation site. It was later established that the turtle had been tagged on 6 July 2001 at Kolukumbo Beach, at the eastern end of the Galibi Nature Reserve in Suriname (approx. 05°51.384'N, 54°07.813'W).

The second turtle (157 cm CCL) was captured at 0930 h on 7 September 2002 at 46°47.290'N, 60°11.180'W. Monel flipper tags (V1260, V1261) were discovered on the margins of both rear flippers. It was later confirmed that the turtle had been tagged on 12 May 2000 at Gandoca Beach (9°34.991'N, 82°35.091'W), on the southern end of the Caribbean coast of Costa Rica. At that time, the animal measured 156 cm CCL. She was observed nesting a second time at the same beach on 20 May 2000.

Although *D. coriacea* demonstrates a high degree of fidelity for island nesting sites, mainland nesters frequently nest across broad areas of coastline. This is true of the assemblage of *D. coriacea* in French Guiana and Suriname—now considered the world's largest nesting colony—where there is regular shifting of nesting activity between these countries in alternate nesting seasons and even in the same nesting season (Spotila et al. 1996. Chel. Cons. Biol. 2:209–222). The tag recovery from Suriname and the earlier flipper tag recovery from French Guiana, therefore, likely represent a common nesting origin. In fact, these two animals were tagged at sites that are less than 50 km apart.

The discovery of the turtle tagged in Costa Rica provides the first evidence of representation of an insular Caribbean nesting colony in the Canadian foraging population of *D. coriacea*.

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DERMOCHELYS CORIACEA (Leatherback Sea Turtle). **PENIS DISPLAY.** *Dermochelys coriacea* males spend their entire lives at sea, where they are rarely encountered by researchers. Basic morphometric data on males is thus very limited, as it is typically only available from stranded turtles. Collaboration with commercial fishers has enabled us to examine and tag male and female *D. coriacea* in temperate waters off Nova Scotia, Canada. Sexual dimorphism in mature animals may be most evident in tail length, with males possessing a tail a minimum of two to three times longer than that of females of a comparable curved carapace length. However, penis display during handling can also readily identify a male

turtle. Penis extrusion has been observed in snapping turtles (*Chelydra serpentina*) (de Solla et al. 2001. Chelon. Cons. Biol. 4:187–189), however, only in animals held off the ground. We observed partial, or complete penis extrusion in five of seven male *D. coriacea* that were captured at sea as part of a satellite telemetry study. Penis display was in all cases associated with full plastron contact with a tagging platform mounted on a boat. Penis display by leatherbacks in this context likely represents a displacement behaviour associated with handling (deSolla et al, *op. cit.*), rather than a sexual or defensive response. As sexual dimorphism in tail length is more apparent in mature and large subadult turtles, penis display may be of greatest utility in the identification of juvenile males.

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GLYPTEMYS MUHLENBERGII (Bog Turtle). **DIET**. Bog Turtles are omnivorous, opportunistic feeders that apparently eat whatever acceptable food source is most abundant and easiest to obtain (Ernst and Barbour 1989. Turtles of the World. Smithsonian Institution Press, Washington, D.C. 313 pp.). In Virginia, Bog Turtles have been observed eating tent caterpillars (*Malacosoma* sp.), earthworms (Annelida), and unidentified berries (Mitchell 1994. Reptiles of Virginia. Smithsonian Institution Press, Washington, D.C. 352 pp; Carter 1997. M.S. Thesis. Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 79 pp.).

In the summer of 1999, Virginia Department of Game and Inland Fisheries (VDGIF) biologists gathered additional information on *G. muhlenbergii* diet in Virginia during a mark-recapture population study in Floyd County. On 11 August 1999, a 9+ year-old, adult female *G. muhlenbergii* (max CL: 92 mm, max PL: 82 mm, mass: 122.5 g) deposited a fecal pellet in a holding bucket. Initial study of the scat revealed beetle exoskeleton parts which Richard Hoffman of the Virginia Natural History Museum in Martinsville, Virginia, identified as the remains of a Japanese Beetle (*Popillia japonica*), a common, exotic pest species.

On 18 August 1999, a 10+ year-old, adult female turtle (max CL: 95 mm, max PL: 86 mm, mass: 126.0 g) from a different location in Floyd County, also deposited a fecal pellet while being held for data collection. Initial study of this scat sample revealed over 30 small dark and light brown seeds. On average, the larger, dark brown seeds were 0.035 mm long and 0.016 mm wide and were considered mature. The smaller, lighter brown seeds on average were 0.020 mm long and 0.014 mm wide and were considered immature. Tom Wieboldt, Assistant Curator of the Virginia Tech Herbarium in Blacksburg, Virginia, identified the source for both types as low-bush blueberries (*Vaccinium vacillans*), a common woodland shrub species.

Based on the amount of these food items in the two scat samples, both Japanese beetles and low-bush blueberries can be considered components of *G. muhlenbergii* diet in Virginia.

Special thanks go to Michael Pinder of VDIGF and Eric Wilhelm of USDA-APHIS (formerly of VDIGF) for their assistance and to Richard Hoffman and Tom Wieboldt for their time and expertise.

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MALACLEMYS TERRAPIN TERRAPIN (Northern Diamond-back Terrapin) **DIET.** *Malaclemys terrapin* is an inhabitant of salt marshes, tidal creeks, and estuaries ranging from Cape Cod, Massachusetts south to the Florida Keys and as far west as Texas. This species is especially well adapted for crushing mollusk shells, gastropods, and crabs (*Littorina*, *Mytilus*, *Uca*, and *Callinectes*) (Ernst et al. 1994 Turtles of the United States and Canada, Smithsonian Inst. Press, 578 pp.) but is a generalist that will also eat plant material, fish, and insects. Here we report a possible new prey item for the northern subspecies, *Malaclemys t. terrapin*, which suggests scavenging tendencies

In July 2000, a gravid female Diamondback Terrapin was found on Stone Harbor Boulevard, Stone Harbor, New Jersey (39°03'N, 74°46'W) and was taken to the nearby Wetlands Institute of Stone Harbor, New Jersey. The mortally wounded individual was euthanized and necropsied for parasite analysis (Werner et al. 2002 Bull. New Jersey Acad. Sci. 47[2]:21–24). Upon gross analysis of the large intestine, two live black larder beetle larvae (Dermestidae: *Dermestes ater*) were discovered. During the 2000 nesting season, 66 mortally wounded females were euthanized and necropsied but this was the only individual that showed evidence of predation on dermestid beetle larvae. Because dermestid beetles feed on carrion, we speculate that these individual larvae were feeding on carrion in the salt marsh at the time of ingestion by the terrapin. It is thus possible that the female *Malaclemys* had been recently feeding on carrion and ingested the two larvae. The carrion may have been floating on surface waters or perhaps the female was feeding on land before nesting. It is unknown whether or not *Malaclemys* will feed on land (R. Wood, pers. comm.). It is also unknown how these larvae survived the digestion process.

We thank Roger Wood for insight on feeding habits, and Michael Thomas and John Kingsalver for larvae identification.

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TERRAPENE CAROLINA TRIUNGUIS (Three-toed Box Turtle). **AQUATIC BEHAVIOR**. *Terrapene carolina triunguis* is primarily terrestrial, although there have been reports of aquatic behavior, such as moving into water during the heat of summer and entering water to drink (Dodd 2001. North American Box Turtles: A Natural History. Univ. Oklahoma Press, Norman, Oklahoma. 231 pp.). We observed four instances of aquatic behavior in

this species during the summer and fall of 2002.

The first observation occurred on 4 June 2002, on the Current River (Carter County, Missouri, USA). A box turtle was swimming at the surface of the river. The turtle was ca. 5 m from the east bank, in 2–3 m of water and was swimming toward the west bank. The east bank was a bluff bank ca. 10–15 m in height. It is unknown if the turtle had fallen from the bluff or had entered the river at a point upstream. The turtle was kept as a voucher specimen for a herpetofaunal inventory for the National Park Service (NPS, ASUMZ 27039) and was later measured with calipers (height = H, 70 mm; bridge width = BW, 97 mm, and carapace length = CL, 134 mm).

A second observation of aquatic behavior occurred at Wilson's Creek National Battlefield (Greene County, Missouri) on 23 June 2002. During a dip net survey of an ephemeral woodland pond (ca. 10 m diam), we found a box turtle in 23 cm of water. The turtle did not appear to be foraging, as the water was stagnant and did not contain any invertebrates or other vertebrates. The turtle was partially submerged in the water. When we approached, the turtle moved into a head-down position and began "swimming" to the bottom. Once there, it began to wedge itself into the mud and held this position on the bottom. Shortly thereafter, we began timing the duration of the submergence. After 13 min and 17 sec, the turtle extended its neck to the surface of the water to breathe. The turtle was also kept as a voucher specimen for the NPS herpetofaunal inventory (ASUMZ 27076) and later measured (H = 74 mm; BW = 93 mm; CL = 131 mm).

A third observation was on 23 July 2002 on the Current River (Shannon County, Missouri). A box turtle was retrieved from the bottom of the Current River. The turtle was "sitting" on large cobble substrate and was ca. 10 m from the bank at a depth of ca. 2 m. This turtle was retained as a NPS herpetofaunal inventory voucher specimen (ASUMZ 27169) and later measured (H = 75 mm; BW = 107 mm; CL = 144 mm).

A fourth observation was on 21 October 2002, on the North Fork of the White River (Ozark County, Missouri). The turtle was moving along the edge of the river, ca. 1–2 m from the bank. The turtle was photographed and released back into the water. Upon release the turtle sought refuge within a root wad at the edge of the shoreline. The turtle remained on the surface of the water hidden beneath the vegetation until we left the area.

We thank the Department of Biological Sciences, Arkansas State University, for use of facilities and equipment. The National Park Service provided funding to SET for the field research. The Missouri Department of Conservation authorized the scientific collection permit (MDC 11419, Wildlife Collector's Permit, 2002). Malcolm L. McCallum reviewed the manuscript and offered helpful editorial comments on this manuscript.

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LACERTILIA

AMEIVA FESTIVA (Central American Racerunner). **PREDATION**. Species of the lizard genus *Ameiva* typically are among the most important terrestrial carnivorous lizards in Neotropical assemblages as they eat both invertebrates and vertebrates (Vitt and Zani 1996. J. Herpetol. 30:110–117). Orthopterans (crickets, katydids, and roaches) and arachnids (spiders) dominate *A. festiva* diet, but they also eat small amphibians and other lizards may be consumed (Savage 2002. The Herpetofauna of Costa Rica: A land between two continents, between two seas. The University of Chicago Press, 510 pp.; Vitt and Zani, *op. cit.*). Savage (*op. cit.*) noted that *A. festiva* feeds on small amphibians, but did not state which species are consumed. Here I augment observations of predation on anurans with the first report of an adult of *A. festiva* eating a juvenile Turbo White-lipped Frog, *Leptodactylus poecilochilus*.

I made the observation over a 15-min period ca. 0830 h on 20 June 2002, while conducting an amphibian census at the La Selva Biological Station (La Guaria Annex), Heredia, Costa Rica (10°26'N, 83°59'W) in a pasture 2 m from the edge of secondary forest. I encountered an adult *A. festiva* (ca. 105 mm SVL) swallowing a juvenile (ca. 20 mm SVL) *L. poecilochilus,* which already had its head in the lizard's mouth. Upon approach, the lizard ran toward the forest edge, were it sat for ca. 10 min on leaf litter and continued to swallow the frog up to its groin. At that point, I was able to see clearly the white stripe on the frog's posterior thigh, an unequivocal trait that distinguishes *L. poecilochilus* (Savage, *op. cit.*). The lizard then disappeared into the forest, and I was unable to find it again.

Juveniles of *L. poecilochilus* are common in the small puddles that form in the pastures as a result of livestock activity. Thus, the edge between pastures and forests in this region might be important foraging grounds for *A. festiva*, especially when recruitment of juvenile *L. poecilochilus* is at its peak.

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DIPLOGLOSSUS LEGNOTUS (NCN). **REPRODUCTION.** No reproductive data are available for the recently described anguid lizard, *Diploglossus legnotus* (Campbell and Camarillo 1994. Herpetologica 50:193–209). Here we provide the first data on reproduction for *D. legnotus*.

On 2 August 1998, LCM collected a gravid female (96.4 mm SVL, 105.4 mm tail length, 17.5 g; upper head, body and tail were brown, distinct black markings were arranged in irregulars vertical bars on sides, a distinct red ventrolateral band extended from axilla to groin hence onto basal third of tail; sides of neck between posterior infralabials and insertion of forelimb were yellowish). The lizard was collected 3.5 km W Xocoyolo, Municipality of Cuetzalan del Progreso, Puebla (19°59.432'N, 97°33.325'W; elev. 1355 m). The locality is a cattle ranch bordered by cloud forest, and a stream runs along the cloud forest margin. The female was collected under a fallen tree trunk on a slope with abundant fallen trees. On 23 September 1998, the female gave birth to seven young (mean SVL 32.5 mm, SD 1.7 mm, range: 29.4–34.2 mm; mean tail length 37.8 mm, SD 2.3 mm, range 35.8–42.5 mm; mean mass 0.55 g, SD 0.07 g, range: 0.46–0.64 g). After parturition, the female weighed 12.2 g. All seven neonates were bright green with nine white dorsal stripes, a red ventrolateral band, and a blue tail.

Reproductive data on Mexican *Diploglossus* species are scarce, but available information indicates that the three recognized species are viviparous. *Diploglossus rozellae* gives birth to 3–5 young during the interval May–July (Alvarez del Toro 1982. Los Reptiles de Chiapas. 3rd ed. Instituto de Historia Natural, Tuxtla Gutiérrez, Chiapas. 248 pp.), but the clutch size we report for *D. legnotus* is at the high end of the range for *D. enneagrammus*, which has 3–7 young in June (Canseco-Márquez 1996. Estudio Preliminar de la Herpetofauna en la Cañada de Cuicatlán y Cerro Piedra Larga, Oaxaca. Unpublished Thesis. Universidad Autónoma de Puebla. 180 pp.; P. Heimes, pers. obs.).

The female *D. legnotus* (EBUAP 1655) was deposited in the herpetological collection of Benemérita Universidad Autónoma de Puebla, México. Support for field work was provided by grant from CONABIO (number FB444/L283/97) to G. Gutiérrez-Mayén, and SEMARNAT provided the necessary collecting permits.

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ELGARIA PAUCICARINATA (San Lucan Alligator Lizard). **ENDOPARASITES.** *Elgaria paucicarinata* is restricted to the Cape Region of Baja California Sur (Grismer 2002. Amphibians and Reptiles of Baja California Including its Pacific Islands and the Islands in the Sea of Cortés. University of California Press, Berkeley. 399 pp.). To our knowledge, no reports exist of endoparasites from this species. The purpose of this note is to report the presence of four nematode species from *E. paucicarinata*.

Seven *E. paucicarinata*, 4 males and 3 females (mean SVL = 92 mm ± 9 SD, range: 82–105 mm) from the herpetology collection of the Natural History Museum of Los Angeles County (LACM 92711–12, 92714, 92718–19, 99441, 109371) were examined for helminths. The esophagus, stomach, small and large intestines were opened and separately examined for helminths under a dissecting microscope. The body cavity was also examined. Except for LACM 109371, all lizards were infected. Four species of nematodes, *Cosmocercoides variabilis* (infection site: small and large intestines); *Physaloptera retusa* (stomach); *Oswaldocruzia* sp. (small intestine); and *Rhabdias* sp. (lung) were found. Prevalence (infected lizards/lizards examined X 100), mean intensity (mean helminth number/infected lizards) and range are as follows: *Cosmocercoides variabilis* (57%, 6.0 ± 3.1 SD, range: 1–11), *Physaloptera retusa* (57%, 4.8 ± 4.1 SD, range: 1–10), *Oswaldocruzia* sp. (29%, 1.5 ± 0.71 SD, range: 1–2), and *Rhabdias* sp. (14%, 1.0). Helminths were deposited in the United States National Parasite Collection, Beltsville, Maryland as: *Cosmocercoides variabilis* (USNPC 93511); *Physaloptera retusa* (USNPC 93509); *Oswaldocruzia* sp. (USNPC 93512); *Rhabdias* sp. (USNPC 93510).

Cosmocercoides variabilis is known from various amphibians and reptiles of North America (Baker 1987. Mem. Univ. Newfoundland, Occas. Pap. Biol. 11:1–325; Goldberg et al. 2000. Southwest. Nat. 45:362–366; Goldberg and Bursey 2002. Bull. South. California Acad. Sci. 101:118–130) and *Physaloptera retusa* is known from amphibians and reptiles of North and South America (Goldberg et al. 2004. Comp. Parasitol. *in press*). *Elgaria paucicarinata* represents a new host record for *C. variabilis* and *P. retusa* and Baja California a new locality record. The numerous species of *Oswaldocruzia* and *Rhabdias* have more limited distributions (see Baker, *op. cit*). This is the first report of *Oswaldocruzia* and *Rhabdias* in *Elgaria paucicarinata* and may represent undescribed species.

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GEKKO SUBPALMATUS (NCN). **REGIONAL INTEGUMENTARY LOSS**. An adult male *Gekko subpalmatus* (Yale Peabody Museum of Natural History, slide collection YPM.M.01007) was collected by Dustin Sigler on 27 July 2000 from a stone wall at Tai Zhu Ao, Nan Ao Island, Guandong Province, Peoples Republic of China (23°26'00"N, 117°03'00"E). When handled, the specimen's skin tore easily in a manner consistent with regional integumentary loss (RIL), an anti-predator escape strategy employed by geckos in at least 9 different lineages (Bauer et al. 1989. J. Exp. Biol. 145:79–102). The resulting wound extended over ca. 10% of the back and was associated with little or no bleeding, as is typical in defensive integumentary loss. The animal survived without special care or obvious distress at least 6 days, until euthanized. This is the first record of this anti-predator defense in the species, and in the genus *Gekko*, which includes at least some species (e.g., *G. gecko*) with mechanically strong, tough skins (Bauer et al. 1989, *op. cit.*). Similar intrageneric variation in this ability has been noted in the African geckos of the genus *Pachydactylus* (Bauer et al. 1993. S. Afr. J. Zool. 28:192–197). Although *G. subpalmatus* has a broad range within southern China, RIL has only been documented on Nan Ao, a small island (106 km^2) in the South China Sea. This is consistent with the general trend among geckos for this strategy to evolve chiefly in insular contexts (Bauer and Russell. 1992. Ecol. Ethol. Evol. 4:343–358). In at least one other species of gekkonid, *Thecadactylus rapicauda*, some evidence of notable intraspecific variation in skin fragility exists, with insular populations more prone to RIL than those from continental regions (Bauer et al. 1989, *op. cit.*). Possibility of a parallel situation in *G. subpalmatus* needs investigation.

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LEPIDOBLEPHARIS XANTHOSTIGMA (Orange-tailed Gecko). **ENDOPARASITES.** *Lepidoblepharis xanthostigma* is a small diurnal gecko that inhabits leaf litter and occurs from southeastern Nicaragua, northwestern Costa Rica to northern Colombia (Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas, University of Chicago Press, Chicago, 934 pp.). To our knowledge, no reports exist of endoparasites from this species. The purpose of this note is to report the presence of a larval acanthocephalan in a *L. xanthostigma* from Costa Rica.

Ten female *L. xanthostigma* (mean SVL = 33 mm ± 4 SD, range: 28-40 mm) from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles (LACM 148083–084, 148092, 148105, 148107, 148109–113), collected in Guanacaste and Puntarenas provinces, Costa Rica in 1964, 1965, and 1973 were examined for helminths. The esophagus, stomach, small and large intestines were opened and separately examined for helminths under a dissecting microscope. The body cavity was also examined. One acanthocephalan cystacanth was found in the stomach of LACM 148083. The cystacanth was cleared in a drop of undiluted glycerol on a glass slide, examined with a compound microscope and assigned to the family Oligacathorhynchidae. Prevalence (infected lizard/lizards examined X 100) was 10%. The cystacanth was deposited in the United States National Parasite Collection, Beltsville, Maryland as (USNPC 93433).

Lizards are known as paratenic (transport) hosts of species of the acanthocephalan family Oligacathorhynchidae (Schmidt 1985. *In* Crompton and Nickol [eds.], Biology of the Acathocephala, pp. 273–305. Cambridge University Press, Cambridge, UK). Development to the adult acanthocephalan occurs when the lizard is eaten by a predator. A list of lizards serving as paratenic hosts for oligacanthorhynchid cystacanths is in Bolette (1997. Southwest. Nat. 42:232–236). *Lepidoblepharis xanthostigma* feeds primarily on spiders as well as isopods and mites (Lieberman 1986. Acta Zool. Mex. 15:1–72). Infection likely occurs when *L. xanthostigma* ingests prey containing acanthocephalan larvae. An oligacanthorhynchid cystacanth in *L. xanthostigma* is a new host record.

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LEPIDOPHYMA SYLVATICUM (Madrean Tropical Night Lizard). **REPRODUCTION.** Tropical night lizards (genus *Lepidophyma*) are rarely seen, so data on their natural history is sparse. Available information indicates that members of this genus are viviparous, have litters of 1–8, display peak reproductive activity in winter, carry developing young during winter and spring, and give birth in early summer (Bezy and Camarillo 2002. Contrib. Sci. Los Angeles County Mus. Nat. Hist. 493:1–41). Here, we augment the few reproductive data on *Lepidophyma* with the first report for *L. sylvaticum.*

On 28 April 1998, LCM collected a gravid female *L. sylvaticum* (98.7 mm SVL, tail 62.0 mm [40.0 mm regenerated]) in the Sierra Norte de Puebla, ca. 2 km S of San Miguel Tzinacapan, Municipality of Cuetzalan del Progreso, Puebla, Mexico (20°00.603'N, 97°32.485'W; elev. 1140 m). The female was collected under large rocks in an open area on a hill within disturbed cloud forest. After being maintained in captivity, this female gave birth to five young on 24 June 1998. These averaged 33.4 mm SVL (SD 0.5 mm, range: 33.0–34.2) and 0.64 g (SD 0.02 g, range: 0.62–0.66). Despite the nearly two-month captive interval, the parturition date and litter size are within the known range of variation for other species of *Lepidophyma*.

The female (EBUAP 2061) was deposited in the herpetological collection of Benemérita Universidad Autónoma de Puebla, México. Support for field work was provided by grant from CONABIO (number FB444/L283/97) to G. Gutiérrez-Mayén, and SEMARNAT provided the necessary collecting permits.

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NANNOSCINCUS GRACILIS (New Caledonian Gracile Dwarf Skink). **VOCALIZATION**. Among lizards, complex vocalizations including distinctive advertisement and distress calls are largely restricted to gekkotans (Gans and Maderson 1973. Amer. Zool. 13:1195–1203; Frankenberg and Werner 1992. Acta Zool. Lilloana 41:45–62). Among autarchoglossan families, vocalization has been reported for scattered representatives in several families, and in the case of certain lacertids, it may be used in territorial interactions (Böhme et al. 1985. Bonn. Zool. Beitr. 36:337–354). In the family Scincidae, only defensive vocalizations have been reported. Loud emphatic vocalizations have been reported for the New Guinea crocodile skink *Tribolonotus gracilis* (Cogger 1972. Zool. Meded. 47:202–210; O'Shea 1991. Brit. Herpetol. Soc. Bull. 37:15–17) and have been linked to parental defense of young (Hartdegen et al. 2001. Contemp. Herpetol. 2001[2] [http://dataserver.calacademy.org/herpetology/herpdocs/ch/2001/2/index.htm]). Less dramatic defensive squeaks have been reported in a few other skink species (e.g., *Euprepes* [formerly *Mabuya*] *bensonii*; Barbour and Loveridge 1930. *In* Strong [ed.], The African Republic of Liberia and the Belgian Congo, pp. 769–785. Harvard University, Cambridge, Massachusetts), although the validity of some records has been questioned (Mertens 1946. Abh. Senckenberg. Naturf. 471:1–108) and in other species, distress vocalizations appear to be rare (e.g., *Chalcides ocellatus;* Frankenberg and Werner 1992, *op. cit.*). Most records of skink vocalization, however, derive from Pacific region lygosomines, including representatives of the Australian genera *Ctenotus*, *Egernia*, *Eremiascincus*, *Eulamprus*, *Gnypetoscincus*, and *Saproscincus* (Greer 1976. Aust. Nat. Hist. 18:428–433; Covacevich and McDonald 1980. Mem. Qld. Mus. 20:95–101; Annable 1983. Herpetofauna 14:80–82) and the New Zealand genus *Oligosoma* (Werner 1973. Israel J. Zool. 22:204–205; Thomas 1985. *In* Grigg et al. [eds.], Biology of Australasian Frogs and Reptiles, pp. 17–22. Surrey Beatty, Chipping Norton). We here report another in-

stance of scincid defensive vocalization in a New Caledonian endemic, *Nannoscincus gracilis*.

Nannoscincus gracilis, the largest species (to 49 mm SVL) in a genus of small skinks, is a cryptic form found in humid forests up to 1100 m elevation in central New Caledonia (Bauer and Sadlier 2000. The Herpetofauna of New Caledonia. Society for the Study of Amphibians and Reptiles, Ithaca. xii + 310 pp.). Thirteen *N. gracilis* were collected underneath logs and stones in montane forest at 950-1040 m on Pic Ningua, 17.0 km south of Nakaré, Province Sud, New Caledonia (21°44'S, 166°09'E) on 26–27 September 2002. Specimens from this locality are morphologically distinctive and may be specifically distinct from other populations. All specimens made faint but distinctive squeaks when handled. Vocalizations were elicited by grasping or handling the body and were accompanied by writhing and occasional biting, both typical in the genus. Squeaking was noted both at initial capture and subsequently when specimens were handled in the laboratory.

Whether vocalizations are employed to deter potential predators (large arthropods, birds, larger skinks and geckos) or they function in intraspecific interactions is unclear. That most skinks known to vocalize are lygosomines occurring in Australia or on Pacific islands implies some underlying phylogenetic and/or ecological commonality. However, the species for which vocalization has been documented do not form a monophyletic group, and this behavior has been too poorly documented to attribute any special meaning to this apparent geographical bias.

Nannoscincus specimens were collected under permit 6034-2075/DRN issued by the Direction des Ressources Naturelles of the Province Sud, New Caledonia and exported under permit 6034-2330/DRN of the same authority. Specimens (Field numbers AMB 7338–7344, 7373–7378) will be deposited in the California Academy of Sciences and Australian Museum collections.

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NOROPS PENTAPRION (Lichen Anole). **ENDOPARASITES.** *Norops pentaprion* is a small to moderate-sized anole (adult males 70–79 mm standard length, adult females 57–63 mm standard length) found in lowland forest zones from the Isthmus of Tehuantepec, Mexico to Colombia (Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas, University of Chicago Press, Chicago. 934 pp.). To our knowledge, no reports exist of endoparasites from this species. The purpose of this note is to report the presence of two species of nematodes in *N. pentaprion* from Costa Rica.

Four (1 female, 3 males) *N. pentaprion* (mean SVL = 66 mm ± 3 SD, range: 63–70 mm) were examined for helminths from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles: LACM 148382–383, 148392–393, collected in Puntarenas and Guanacaste provinces, Costa Rica in 1967, 1980, 1973, and 1974, respectively. The esophagus, stomach, small and large intestines were opened and separately examined for helminths under a dissecting microscope. The body cavity was examined as well. The only infected anole was LACM 148383. Four *Skrjabinelazia intermedia* were found in the stomach; 32 *Cyrtosomum longicaudatum* were found in the large intestine. Prevalence (infected lizard/lizards examined X 100) was 25%. The nematodes were deposited in the United States National Parasite Collection, Beltsville, Maryland as *Skrjabinelazia intermedia* (USNPC 93507) and *Cyrtosomum longicaudatum* (USNPC 93508).

Skrjabinelazia intermedia is previously known from *Tropidurus spinulosus* and *T. torquatus* from Brazil (Vicente 1981. Atas Soc. Biol. Rio de Janeiro 22:7–18). *Norops pentaprion* represents a new host record for *S. intermedia.* Costa Rica is a new locality record. *Cyrtosomum longicaudatum* is previously known from *Ctenosaura similis* from Costa Rica (Brenes and Bravo-Hollis 1960. Sobretiro del Libro Homenaje al Dr. Eduardo Caballero y Caballero, pp. 451–464, Mexico, D.F.) and from Honduras and Mexico (Caballero Deloya 1971. An. Inst. Biol. Univ. Nac. Autón. México 42:29–33). It has also been found in *Anolis equestris, A. luteogularis, A. baracoae, Chamaeleolis chamaeleonides, C. porcus, Leiocephalus cubensis, L. stictigaster, L. carinatus,* and *Hemidactylus brooki* from Cuba (Barus and Coy Otero 1968. Folia Parasit. 15:41–45; Barus and Coy Otero 1969. Helminthologia 10:329–346; Coy Otero and Barus 1973. Folia Parasit. 20:297–305; Coy Otero and Barus 1979. Acta Sci. Nat. Brno 13:1–3) and *Anolis garmani* from Jamaica (Bundy et al. 1987. J. Helminthol. 61:77–83). *Norops pentaprion* represents a new host record for *C. longicaudatum*.

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SCINCELLA LATERALIS (Ground Skink). **PREDATION**. Accounts of spiders preying on vertebrates are infrequent. However, some spiders are known to take lizards. For example, Cokendolpher (1977. J. Arachnol. 5:184) observed an *Argiope aurantia* eating a *Eumeces laticeps*, and Corey (1988. J. Arachnol. 16:392–393) found an *Anolis carolinensis* in the chelicerae of a *Lycosa ammophila*. This note details the first observation of a wolf spider feeding on the Ground Skink, *Scincella lateralis*.

At 1330 h on 15 March 2003, we encountered a small (ca. 4 cm SVL) *S. lateralis* struggling with a *Hogna carolinensis* (ca. 3 cm head–abdomen length) under a piece of tin at the Old Sabine Wildlife Management Area, Smith County, Texas (32°35'33"N, 95°21'26"W). The spider held the skink by the neck with its fangs. The two animals wrestled for ca. 5 min before the skink stopped moving. When the spider released the skink, we discontinued observations. About 30 min later, we returned to the site and the spider was still near the dead skink.

Don Killebrew verified the identity of the spider.

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STENOCERCUS AZUREUS (NCN). **REPRODUCTION.** Reproductive data on *Stenocercus azureus* are sparse (Cei 1993. Mus. Reg. Sci. Nat. Torino, Monogr. 14:1–949) and data are lacking for Uruguay. Here, we provide preliminary information on clutch size and egg dimensions for Uruguayan *S. azureus*.

We report data on three adult females in the Colección Zoología Vertebrados, Reptiles (ZVC-R), Facultad de Ciencias, Montevideo. External measurements were obtained after preservation; data on eggs were obtained by dissection. Calixto Fuques collected ZVC-R 176 at Tres Cruces, Departamento Artigas (30°27'S, 56°48'W; elev. 150 m) in January 1955; Alejandro Olmos collected ZVC-R 4656 at Potrero "La Invernada," Estancia de Castro "El Tapado," Arerunguá, Departamento Salto (31°38'S, 56°44'W; elev. 250 m) on 9 January 1990; and ZVC-R 1619 has a collection locality of Uruguay without further data.

Female ZVC-R 176, 79.4 mm SVL (112.6 mm tail, 21.4 g), has 8 eggs (mean dimensions = 14.2 x 8.0 mm, ranges: 13.8–14.8 x 6.2–10.1 mm; mean mass: 0.47 g, ranges: 0.43–0.50 g); female ZVC-R 1619, 69.6 mm SVL (115.4 mm tail, 12.9 g), has 6 eggs (mean dimensions = 15.7 x 8.9 mm, ranges: 15.20–16.05 x 8.6–9.4 mm; mean mass: 0.62 g, ranges: 0.52–0.69 g); and female ZVC-R 4656, 80.2 SVL (121.8 mm tail, 24.8 g), has 9 eggs (mean dimensions = 15.2 x 8.5 mm, ranges: 15.30–18.60 mm x 7.1–9.6 mm; mean mass: 0.69 g, ranges: 0.49–1.01 g).

Torres-Carvajal (2004. Herpetol. Rev. 35:172) recently reported a clutch size of 6 for one *S. azureus*. Although the locality was not indicated, that individual was also from Uruguay but lacked specific locality data (O. Torres-Carvajal, pers. comm.). Clutch sizes of 6–9 in *S. azureus* based on Uruguayan specimens are larger than known clutches sizes for all other species of *Stenocercus*, which range from 2 to 4 (Torres-Carvajal 2000. Univ. Kansas Mus. Nat. Hist. Sci. Pap. [15]:1–38). The two available collection dates are for January, which might indicate summer reproduction.

We thank Melitta Meneghel for assistance in dissection.

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TROPIDURUS TORQUATUS (Calango). **PREDATION.** Many reptiles are bird prey (e.g., Terres 1991. The Audubon Society Encyclopedia of North American Birds. Wing Books, New York, New York. 1109 pp.). Although broadly distributed across Cerrado and Atlantic Forest domains in Brazil (Rodrigues 1987. Arq. Zool. São Paulo 31:105–230), records of predators on *Tropidurus torquatus* are lacking. Here, I report an instance of Burrowing Owl predation on *T. torquatus* from central Brazil.

On 26 September 2002 in the municipality of Caldas Novas (17°50'S, 48°36'W), Estado do Goiás, Brazil, Ariovaldo A. Giaretta found a gravid female *T. torquatus* (66 mm SVL) inside the nest chamber of a Burrowing Owl, *Speotyto cunicularia*. The *T. torquatus* was found dead with a small gash on its throat, but was otherwise intact. We presume that the owl made the throat gash during the predation episode.

Bird predation on lizards is common (e.g., Palacios et al. 1997. Herpetol. Rev. 28:204–205; Franz 2001. Herpetol. Rev. 32:253). As *T. torquatus* is both abundant and widespread, we would expect it to be prey for at least some birds. Although many aspects of the biology of *T. torquatus* have been studied (e.g., diet—Bergallo and Rocha 1994. Austral. J. Ecol. 19:72–75; thermal ecology—Bergallo and Rocha 1993. Amphibia-Reptilia 14:312–315; spatial patterns—Giaretta 1996. Herpetol. Rev. 27:80–81), a lack of records of predation seems peculiar. This observation represents the first record of predation on *T. torquatus*.

The female *T. torquatus* (AAG-UFU 1196) is deposited at the Museu de Biodiversidade do Cerrado in the Universidade Federal de Uberlândia, Estado do Minas Gerais, Brazil. We thank Ariovaldo A. Giaretta for critically reading the manuscript.

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TROPIDURUS TORQUATUS (Calango). **SAUROPHAGY.** *Tropidurus torquatus*, a tropidurid lizard ranging from Brazil to Argentina (Rodrigues 1987. Arq. Zool. 31:205–230), has been reported to have an insect-dominated diet (Bergallo and Rocha 1994. Austral. J. Ecol. 19:72–75; Fialho et al. 2000. J. Herpetol. 34:325–330; Juliano et al. 2002. Herpetol. Rev. 33:54–55). Frugivory (Figueira et al. 1994. Biotropica 26:295–301), herbivory (Fialho et al., *op cit.*), and cannibalism of adults on juveniles has also been reported (Kiefer and Sazima 2002. Herpetol. Rev. 33:136), but predation on other lizards is unrecorded. Hence, we describe an instance of predation by *T. torquatus* on the teiid *Cnemidophorus ocellifer* from central Brazil.

At 1000 h on 13 September 2002, we found an adult *Tropidurus torquatus* (ca. 220 mm total length [TL]) consuming an adult (ca. 100 mm TL) *C. ocellifer* (Teiidae) at Fazenda Limoeiro, municipality of Cumari, Estado de Goiás (18°03'S, 48°03'W). When first seen, the *C. ocellifer* was alive in the mouth of the predator, immobile, and was being held by the posterior part of the body; 6 minutes after we first saw the encounter, the *C. ocellifer* was swallowed. During this time, the *C. ocellifer* twice attempted to escape twice and continued to struggle until the *T. torquatus* bit it, and it stopped moving.

Cnemidophorus ocellifer is an active forager, whereas *T. torquatus* is a territorial sit-and-wait predator (Gandolfi and Rocha 1998. Amphibia-Reptilia 19:319–323; Giaretta 1996. Herpetol. Rev. 27: 80–81). The movement of a small lizard within the territory of an adult *T. torquatus* may elicit a predatory act. This observation indicates that *T. torquatus* has a broader trophic niche than previously thought.

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ZONOSAURUS LATICAUDATUS (NCN). **PREDATION**. The genus *Zonosaurus* (Gerrhosauridae) consists of rather large, diurnal lizards endemic to Madagascar. Although members of the genus typically feed on invertebrates (unpubl. data), here I report several cases of *Z. laticaudatus* feeding on frogs.

On 3 April 2000, at the Kirindy forest station 60 km N of Morondava in western Madagascar, I found a large *Z. laticaudatus* biting the neck of a large (ca. 45 mm SVL) adult *Laliostoma labrosum* (Mantellidae) in an open area of the forest station. It shook the frog until it went limp and started to swallow it head first. On 4 January 2000, similar behavior was observed for another individual of *Z. laticaudatus* with an adult (ca. 35 mm SVL) *Boophis doulioti* (Mantellidae) on the forest floor near a breeding pond. Lastly, on 21 January 1999, a *Z. laticaudatus* was observed successfully preying on several recently metamorphosed froglets (ca. 10 mm SVL) of *Aglyptodactylus laticeps* (Mantellidae) at the edge of a breeding pond. All events occurred on sunlit gaps not covered by canopy. These observations suggest that frogs may form a significant part of the prey base for *Z. laticaudatus*.

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SERPENTES

AGKISTRODON CONTORTRIX (Copperhead). **PREDATION**. On 6 September 2003, an adult male Copperhead (*Agkistrodon contortrix*) fitted with a Holohil Ltd. SB-2 transmitter was radiotracked by one of us (NEH) at the Madison County Wildlife Management Area, Ozark Natural Science Center, in northwest Arkansas as part of an ongoing study. The tracker, however, was lead to an adult Speckled Kingsnake (*Lampropeltis getula holbrooki*) rather than the expected Copperhead. The male kingsnake was captured and measured (108.0 cm TL; 621.6 g) at the time of capture. The Copperhead was located alive on 4 September 2003 by one of us (SJB), and captured on 15 July 2003; it measured (70.0 cm TL; 216.1 g, including the 5.0 g transmitter). Therefore, by subtraction the Copperhead was ca. 53.3% of the kingsnake's body mass, and 64.8% of the kingsnake's total length. The kingsnake was held in captivity at 27°C. The copperhead's PIT-tag and scales were defecated on 18 September 2003, and we presumed that two weeks after defecation digestion was complete. The post-defecation mass of the kingsnake was 463.8 g. Based on this measurement the Copperhead represented a meal that was ca. 46.6% of the final body mass of the kingsnake. The actual relative prey mass for the kingsnake probably falls somewhere between the two estimates (46.6–53.3%).

The Common Kingsnake (*Lampropeltis getula*) is a well-known predator of snakes, including Copperheads (Fitch 1960. Autecology of the Copperhead. Univ. Kansas Publ. Mus. Nat. Hist., 13). Previous reports of predation on Copperheads by snakes in the wild have included Racers (*Coluber constrictor*), Common Kingsnakes (*Lampropeltis getula*), and Eastern Coral Snakes (*Micrurus fulvius*) (summarized in Gloyd and Conant 1990. Snakes of the *Agkistrodon* Complex. Soc. Stud. Amphib. Reptil., Contrib. Herpetol. 6, 614 pp.). Few reports of Common Kingsnake predation on snakes have supplied the relative prey size. A juvenile Black Kingsnake (*Lampropeltis getula nigra*) consumed a Brown Snake (*Storeria dekayi*) and an Eastern Wormsnake (*Carphophis amoenus*), which combined represented 112% of the length of the kingsnake (Byrd and Jenkins 1996. Herpetol. Rev. 27:204). Additionally, a juvenile Desert Kingsnake (*Lampropeltis getula splendida*) consumed a Plains Black-headed Snake (*Tantilla nigriceps*) that was estimated to be 82% of the kingsnake's length (LaDuc et al., 1996. Herpetol. Rev. 27:25). Three Rough Greensnakes (*Opheodrys aestivus*) greater than 500 mm SVL were consumed by *L. g. holbrooki*, which each represented a conservative 58%, 69%, and 75% of the Kingsnake's length (Plummer 1990. J. Herpetol. 24:327–328). The Copperhead in this note represents the largest reported relative ophidian meal size by mass for a *Lampropeltis getula* as far as we could determine from the literature.

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AGKISTRODON PISCIVORUS (Cottonmouth). **DIET**. The reported diet of *A. piscivorus* consists mainly of vertebrate prey including occasional vertebrate carrion (Burkett 1966. Univ. Kansas Pub. Mus. Nat. Hist. 17:435–491). Previous accounts have described parts of birds in Cottonmouth stomachs, including feathers of large birds, unidentified bird bones, the head and neck of an adult egret, and intact waterbirds (egret and ibis) (Gloyd and Conant 1990. Snakes of the *Agkistrodon* Complex. Contributions to Herpetology, No. 6, SSAR. 620 pp.). Here we report the identification of the shoulder girdle and wing of a Blue-winged Teal (*Anas discors*) ingested by a female *A. piscivorus*.

On 16 May 2002, 2103 h, a female *A. piscivorus* (64 cm SVL, 10.9 cm TL, 348.8 g) was captured in the Tuskegee National Forest, Macon County, Alabama, USA, and held overnight for measurements and additional processing. Upon closer inspection the following morning, it was noted that the snake had a series of protruding bulges at its mid-body. The specimen was radiographed after attempts to palpate the prey item were unsuccessful. The radiograph (deposited in the Herpetology Collection at Auburn University; AUM 4566) shows a complete right shoulder girdle (coracoid and scapula) and wing (humerus, ulna, radius, carpometacarpus, carpels) that was compared against skeletal specimens in the ornithological collections of the Florida Museum of Natural History of 30 species that occur in the capture area. Based on relative length and thickness of the humerus and ulna,

the wing was identified to the family Anatidae. Within Anatidae, fine level osteological comparison allowed us to identify the wing as a Blue-winged Teal (UF 23494, UF 23497 - Coracoid: distal end [especially processus procoracoideus]; Humerus: proximal head [esp. fossa pneumotricipitalis, crista bicipitalis, and crista pectoralis], distal head [esp. condylus ventralis and condylus dorsalis]; Ulna: proximal head). Terminology follows Baumel et al. (1979. Nomina Anatomica Avium, Academic Press).

Because of the strength of avian shoulder girdles, it is unlikely that the snake was able to remove the wing from a carcass by pulling. We presume that the present specimen scavenged the wing that had been separated from the rest of the carcass and dropped by another predator. We were unable to locate additional evidence of the *A. discors* carcass near the capture area.

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AGKISTRODON PISCIVORUS PISCIVORUS (Eastern Cottonmouth). **DIET**. The Cottonmouth (*Agkistrodon piscivorus*) is an opportunistic predator that feeds on invertebrates, fish, amphibians, reptiles, birds and small mammals (Gloyd and Conant 1990. Snakes of the *Agkistrodon* Complex. SSAR, Oxford, Ohio. 614 pp.; Mitchell 1994. The Reptiles of Virginia. Smithsonian Institution Press, Washington. 368 pp.). Lepidopteran larvae, cicadas, grasshoppers, and damselflies, have been reported as insect prey (Gloyd and Conant 1990, *op. cit.*; Ernst et al. 2003. Snakes of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 668 pp.). Here we describe the first reported incidence of *A. piscivorus* consuming a moth cocoon. On 31 July 2003, in Gum Swamp, Beech Island, South Carolina, USA, an *A. piscivorus* (533 mm SVL) was collected by one of us (XG). It was left in a snake bag overnight, and during that time regurgitated a Southern Leopard Frog (*Rana sphenocephala*) and an intact lepidopteran cocoon that was identified by one of us (DLW) as a Luna Moth (*Actias luna*, Saturniidae). The cocoon was possibly ingested secondarily, via the frog. However, because movement is important in releasing feeding behavior in anurans (Borchers et al. 1978. J. Comp. Physiol. 152:241–249; Freed 1988. Herpetologica 44:18–24), the frog likely did not feed on a non-motile cocoon. Interestingly, Smith (1997. Herpetol. Rev. 28:153) reported an instance of *A. contortrix* regurgitating a moth cocoon (*A. luna*) seven days after being caught, suggesting that the cocoon was not digestible. The moth was deposited in the Savannah River Ecology Laboratory Museum.

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BOA CONSTRICTOR (Boa Constrictor). **KLEPTOPARASITISM**. On 7 August 2002, at about 1000 h, within the compound at the Man O'War Bay Cottages, Charlotteville, Tobago, an adult Ameiva (*Ameiva ameiva*, ~25 cm SVL) was observed tugging at something that was caught in a tuft of grass adjacent to the beach. One of us (TM) approached within 1 m of the lizard and saw that it had a dead anole (Richard's Anole, *Anolis richardii*, ~15 cm SVL) in its mouth. Presumably, the *A. ameiva* captured the *A. richardii*, but we did not observe this. After a few seconds, the Ameiva pulled the anole from the grass and carried it by the neck beneath a small ornamental bush in the center of the compound. As the Ameiva darted under an overhang in the bush, a juvenile *Boa constrictor* (~91 cm SVL) that was hidden in the leaf litter struck and snatched the anole from its mouth. The Ameiva briefly tugged at the anole but eventually released it and scurried away. The boa then constricted the anole and began to swallow it head-first.

Intra- and interspecific kleptoparasitism, defined as stealing food from another (Ruxton and Moody 1997. J. Theor. Biol. 186:449–458), is well documented among certain predatory birds and mammals. Intraspecific kleptoparasitism among captive squamate reptiles at high densities is documented in controlled environments but rarely in the field (Cooper and Pérez-Mellado 2003. Amphibia-Reptilia 24:219–224). Boa Constrictors are moderately abundant in the upland forest surrounding Charlotteville, but are rarely seen along the coastal areas where *A. ameiva* and *A. richardii* are very abundant (J. D. Hardy, pers. comm.). This observation is possibly the first interspecific record of opportunistic kleptoparasitism in squamate reptiles.

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BOTHRIECHIS SCHLEGELII (Eyelash Viper). **PREY/PREDATOR WEIGHT RATIO** and **DIET.** Viperid snakes feed on exceptionally large prey items relative to their body size (Cundall and Greene 2000 *In* K. Schwenk [ed]. Feeding: Form, Function, and Evolution in Tetrapod Vertebrates, pp. 293–333. Academic Press, San Diego, California). Data collected from pitvipers include the largest prey/predator ratios reported for snakes, with two examples exceeding 1.5 (Greene 1983. Amer. Zool. 23:431–441; Mulcahy et. al. 2003. Herpetol. Rev. 34:64). In this account we report a prey/predator ratio for *Bothriechis schlegelii* that rivals the largest published values, and documents a previously

undescribed prey item. Greene (1989 *In* F. Almeda and C. M. Pringle [eds.], Tropical Rainforests: Diversity and Conservation, pp. 259–274. California Academy of Sciences, San Francisco) characterizes *B. schlegelii* as an "extreme diet generalist" which is known to take frogs, lizards, birds, bats, and small mammals (rodents and mouse opossums). Other authors have published similar information describing the diet of *B. schlegelii* in general terms (Campbell 1998. The Amphibians and Reptiles of Northern Guatemala, the Yucatan, and Belize.Univ. of Oklahoma Press. 380 pp; Lee 2000. A Field Guide to the Amphibians and Reptiles of the Mayan World. Cornell Univ. Press. 402 pp; Savage 2002. The Amphibians and Reptiles of Costa Rica. The Univ. of Chicago Press. 934 pp.). An anecdotal account published by Hardy (1994. Sonoran Herpetol. 7:108–113) provides the only instance where prey item (*Norops limifrons*) was identified to species.

On 29 June 2003, 1215 h, a subadult female *B. schlegelii* (360 mm SVL, 423 mm TL, 19 g), was located outstretched along a woody vine (~0.75 m above ground level). The snake was noticeably distended from a recent feeding; it was captured and palped about 7 h post-capture. The prey item was a male *Thecadactylus rapicaudus* (SVL 118 mm SVL, 125 mm TL, 28 g), which results in a prey/predator ratio of 1.47. This snake was captured about 20 m elev. in Atlantic Lowland Tropical Moist Forest (Holdridge et.al. 1967. Life Zone Ecology. Tropical Science Center, San José, Costa Rica. 206 pp.) at a mainland site in Bocas del Toro Province, Panamá. The snake was released at the site of capture the following day, and the prey item was preserved and housed in the collection of the Institute for Tropical Ecology and Conservation, Bocas del Toro Biological Station, Panamá.

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BOTHRIOPSIS TAENIATA or ***BOTHROPS TAENIATUS*** (Speckled Forest Pitviper). **JUVENILE SIZE**. The Speckled Forest Pitviper (see taxonomic comment below) is a geographically variable, arboreal species with a wide distribution in South America east of the Andes (Campbell and Lamar 1989. The Venomous Reptiles of Latin America. Ithaca, New York, Cornell University Press, 425 pp.). We are unaware of reports on juveniles from populations in Ecuador. Five individuals were collected in the vicinity of Tena, Province of Napo, Ecuador (~ 1°S, 77°50'W; 300–900 m elev.) in February and April 1978, months with the highest precipitation: Instituto Nacional de Higiene y Medicina Tropical [INHMT] 219 (collected by Antonio Tapiry on 10 February 1978; 30 cm TL), 328 (collected by Anibal Rodríguez on 18 April 1978; 25 cm total length), 330 (collected by Antonio Freire L. on 19 April 1978; 30 cm TL), 335 (collected by Agusto Tanguinde on 22 April 1978; 30 cm TL), 337 (collected by Manuel Shigmango on 23 April 1978; 25 cm total length). Three additional juveniles of similar size were collected in the same area on 23 April 1982 (INHMT 1003–05, collected at El Napo by Antonio Freire L.). The largest adults out of a series of 30 specimens received by the Instituto Nacional de Higiene y Medicina Tropical were two snakes from Tena, which measured 150 cm total length each (INHMT 226–27).

Because generic assignment of this pitviper species is controversial (see papers in Schuett et al. [eds.] 2002. Biology of the Vipers, Eagle Mountain Publishing, Eagle Mountain, Utah, 580 pp.), we present the two most widely recognized combinations to facilitate information retrieval.

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BOTHROPS ASPER (Terciopelo or Equis). **DIET**. This large species of pitviper inhabits a variety of habitats from northeastern Mexico through Central America to northwestern South America, where its range along the Pacific Coast extends into northernmost Peru (Campbell and Lamar 2004. The Venomous Reptiles of the Western Hemisphere. Cornell University Press, Ithaca, New York; Tello 1998. *In* Wust [ed.], La Zona Reservada de Tumbes. Lima, Australis South America, pp. 81–87). Published records of prey types characterize this species as opportunistic. Prey is primarily ectothermic in juvenile stages, whereas endothermic prey is consumed as they reach a sufficient size to swallow large and bulky animals. Considering its extensive geographical distribution and common occurrence, specific records of prey items of *B. asper* are relatively rare. They include orthopterans, centipedes, crayfish, frogs, anoles, geckos, skinks, snakes (including conspecifics), birds, marsupials, rodents, and rabbits (reviewed in Campbell and Lamar, *op cit.*). Here we report on the stomach contents of four *B. asper* from the coastal lowlands and the Pacific versant of the Andes in Ecuador, where this species is widely distributed. The specimens are deposited in the herpetological collections of the Instituto Nacional de Higiene y Medicina Tropical, Guayaquil (INHMT) and the Museo de Zoología de la Pontificia Universidad Católica del Ecuador, Quito (QCAZ). On 23 January 1998, a subadult *B. asper* (631 mm SVL, 88 mm TL, INHMT, uncatalogued) collected by Cesar Morán at Finca Escorpión, Puerto Inca 2, Province of Guayas, Ecuador, contained a cotton rat (*Sigmodon peruanus*, 173 mm SVL, 83 mm TL; QCAZ 3669). Body mass of the ethanol preserved snake was 200 g before dissection; after dissection, wet mass of the snake and its prey were 100 g and 75 g, respectively (prey/predator mass ratio ~ 0.75). A subadult *B. asper* (620 mm SVL, 116 mm TL; INHMT 4095) collected in La Maná, Province of Cotopaxi, Ecuador (ca. 79°13'W, 0°57'S), contained an unidentified, partly digested Muridae species (> 73 mm SVL, 99 mm TL; QCAZ 3670). Wet mass after dissection of the ethanol preserved specimens were 75 g and 20 g, respectively (prey/predator mass ratio > 0.25). On 18 April 1991, an adult male *B. asper* (1054 mm SVL, 170 mm TL; INHMT 2336) collected by José Lema in Sacramento, Cantón Pallatanga, Province of Chimborazo, Ecuador (ca. 79°02'W, 2°10'S, 1200–1500 m elev.), contained an unidentified, rat-sized rodent. A juvenile *B. asper* (ca. 35 cm TL; INHMT 4083) from Las Naves, Province of Bolívar, Ecuador (ca. 79°15'W, 1°17'S), had mammalian hair in its stomach;

thus, endothermic prey is confirmed in juveniles. Prey/predator mass ratios are within the limits reported for other species of *Bothrops*, from which ratios of up to 1.3–1.6 are recorded (Greene 1992. *In* Campbell and Brodie [eds.], Biology of the Pitvipers, pp. 107–118. Selva, Tyler, Texas; Sazima 1992. *In* Campbell and Brodie [eds.], Biology of the Pitvipers, pp.199–216. Selva, Tyler, Texas).

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BOTHROPS LOJANUS (Lojan Lancehead). **DIET**. This poorly known pitviper species inhabits arid, temperate regions of the Andes in southern Ecuador, and has been found primarily at its type locality, the vicinity of Loja (Provincia de Loja and adjacent parts of the Provincia de Zamora-Chinchipe, Ecuador); however, a record exists from Saraguro (Provincia de Loja), 40 km N of Loja. The known vertical distribution of *B. lojanus* is 2100–2500 m elevation, and its preferred habitat is apparently montane dry forest (Campbell and Lamar 2004. The Venomous Reptiles of the Western Hemisphere. Cornell University Press, Ithaca, New York). Here we present for the first time data on the diet of *B. lojanus*. On 19 July 2002, 1245 h, we found an adult male *B. lojanus* (272 mm SVL, 35 mm TL, ca. 16 g) dead on the Pan-American Highway, about 3 km N of Loja (Cantón Loja, Provincia de Loja, Ecuador; 79°15'11.2"W, 3°56'22.5"S, 2340 m elev.). An adult female microteiid lizard (*Pholidobolus annectens*; 64 mm SVL, 50 mm TL, ca. 1.9 g) was protruding from various parts of the damaged anterior body of the snake. The *P. annectens* appeared to be essentially undigested, but its position indicated that it had been completely swallowed before the snake was killed. Road construction workers informed us that they had encountered the snake when removing bunch grass locally known as "sigse" (*Cortaderia* sp., according to them the preferred shelter of *B. lojanus*), and killed and thrown it onto the highway just before our arrival. The surrounding disturbed habitat of rocky grassland and pastures dominated by bunch grasses suggested a potential natural vegetation of montane dry forest. Surface temperature of sun-exposed rocks, soil, and asphalt highway was 30.5°C; air temperature 1 m above the ground was 20°C in full sun with a brisk wind. The *B. lojanus* and the *P. annectens* are deposited in the herpetological collection of the Museo de Zoología de la Pontificia Universidad Católica del Ecuador, Quito (QCAZ 6018 and 6019, respectively).

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BUNGARUS CANDIDUS (Malayan Krait). **DIET**. The Malayan Krait (*Bungarus candidus* Linnaeus, 1758) is a nocturnal elapid that is widely distributed in mainland Southeast Asia, the Malayan Peninsula, Sumatra, Java, and Bali. Captive *B. candidus* are reported to prefer snakes as prey, especially freshwater species (Van Hoesel 1959. Ophidia Javanica. Bogor, Mus. Zool. Bogoriense, Pertjetakan Archip., 188 pp.; Campden-Main 1970. A Field Guide to the Snakes of South Vietnam. Washington, D.C., Division of Amphibians and Reptiles, U.S. National Museum, Smithsonian Institution, 114 pp.). Many captive specimens readily accept synbranchid eels (*Monopterus albus*), laboratory mice, and rats (Kuch 2001. Herpetol. Bull. 75:10–14; Kuch and Schneyer 1991. Sauria [E] 1:7–14). Specific records on the diet of wild specimens are rare; they include skinks (*Mabuya* sp. and unidentified remains; N = 3: Lim in Tweedie 1983. The Snakes of Malaya. Singapore, Singapore Natl. Printers, 167 pp.; Slowinski. 1994. Herpetol. Rev. 25:51–53), caecilians (*Ichthyophis* sp.; N = 1: Grossmann and Schäfer. 2000. Sauria 22:45–46), and adult, mouse-size rodents (hair and incisors; N = 2: Kuch, *loc. cit.*), but snakes are not reported.

Here we report a colubrid snake (*Elaphe radiata*) as a natural prey item for *B. candidus*. Both prey and predator are deposited in the herpetological collection of the National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA (USNM). All measurements were taken from the ethanol-preserved specimens. An adult male *B. candidus* (960 mm SVL, 132 mm TL; USNM 167595) was collected at "Ca Lu, Vietnam", in January 1969 by William T. McBighan. This locality name most likely refers to the village of Ca Lu, prior to 1971 located at 16°41'N, 106°55'E on the main road from Quang Tri City to Khe Sanh, at the base of Dong Ca Lu mountain ridge, a predominantly limestone part of the Annamese Cordillera (R. I. Crombie, pers. comm.).

The specimen of *B. candidus* was captured while eating the juvenile *E. radiata* (414 mm SVL, 89 mm TL; USNM 167596). The maximum diameter of the head of the *B. candidus* and the *E. radiata* (head width at the posterior angle of the jaw) was 19.3 mm and 9.1 mm, and the greatest diameter of the body (in both snakes midbody in dorsoventral axis) was 19.7 and 11.1 mm, respectively. Body mass of the ethanol-preserved snakes was determined to be 241.5 g for the *B. candidus* and 19.7 g for the *E. radiata* (prey/predator mass ratio ~ 0.08).

We thank Ronald I. Crombie of USNM for documenting the collection site of these snakes and reviewing the manuscript.

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DENDROASPIS POLYLEPIS (Black Mamba). **DEFENSIVE BEHAVIOR**. The Black Mamba (*Dendroaspis polylepis*) is well known to show defensive behavior, such as raising the front part of the body and spreading a narrow hood (Ionides 1969. Mambas and Man-Eaters: A Hunter's Story. Postscript by Dennis Holman, Mayflower, London, pp. 1–236). On 27 February 2002, while conducting field studies in Botswana, we observed an unusual defensive behavior by a female *D. polylepis* that, to our knowledge, has not been recorded in this species. On 26 February at ca. 2100 h as we spotlighted, we sighted the snake climbing an acacia tree (5 m) at a private game ranch situated in the southeastern part of the country. Nocturnal activity by mambas is poorly understood and rarely recorded; this is the first individual we encountered active at night. After a minor chase the snake was captured, measured (ca. 2.5 m TL), and sexed, whereupon it was placed into a cloth bag to be photographed the next day. On 27 February, at about 0800 h, the snake was removed from the bag and allowed to climb another small tree where it was to be photographed. The snake moved in the tree and after about 15 minutes it descended to the ground. Because we also wanted photographs of it on the ground we approached it to within a distance of ca. 2 m whereupon it displayed its typical defensive behavior (i.e., raising of the front part of the body off the ground and spreading of a narrow hood). We remained still and the snake lost interest in us and moved into an open area. One of us investigated how the snake would react if it were constantly cornered (it was not allowed to approach any of the nearby thickets, which were ca. 10 m away). The snake again reacted by raising the front part of the body and spreading a hood. However, walking around the snake at a distance of about 2 m for 5–10 min made it impossible for it to reach the thickets. At the end of this exercise, the snake displayed a very peculiar defensive behavior. It coiled up and hid its head under the coils and raised the tail tip about 20–30 cm above the ground. The tail was constantly moving in the middle of the coiled snake, a behavior very similar to what has been described as defensive behavior in the garter snake *Thamnophis radix* (Arnold and Bennett 1984. Anim. Behav. 32:1108–1118). We are certain that this behavior was not caused by heat stress. Such tail displays have been suggested to divert attacks to a more 'disposable' part of the body compared to attacks directed to the head, which is common among several avian and mammalian predators (Jackson 1979. Copeia 1979:169–172). It is interesting to note that in a very thorough study of temporal and spatial ecology of *D. polylepis* in South Africa, individual identity of the specimens studied was based upon on scarring and bits of tail missing (Phelps 2002. Herpetol. Bull 80:7–19). Thus, perhaps the latter injuries might have been due to predator attacks on individuals displaying behavior similar to tail-raising observed by us.

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ENULIOPHIS SCLATERI (Colombian Long-tailed Snake). **REPRODUCTION.** *Enuliophis sclateri* is a colubrid snake that occurs in evergreen forests from Nicaragua to central Colombia and in southwestern Costa Rica to eastern Panama; it is diurnal and fossorial (Savage 2002. The Amphibians and Reptiles of Costa Rica; A Herpetofauna Between Two Continents, Between Two Seas. The University of Chicago Press, Chicago. 934 pp.). There is, to my knowledge, no information on its clutch sizes. Herein I present information on ovarian activity from *E. sclateri* from Costa Rica deposited in the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California.

A female *E. sclateri* (LACM 150616) collected in 1991 (month unknown) in Puntarenas Province, Costa Rica (270 mm SVL) contained two oviductal eggs (mean egg length: 15.0 mm). The above represents the first reported data on potential clutch size for *E. sclateri*.

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ENULIUS FLAVITORQUES (Pacific Long-tailed Snake). **REPRODUCTION**. *Enulius flavitorques* is a colubrid that occurs from Jalisco, Mexico to Colombia; it is diurnal and fossorial (Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas. The University of Chicago Press, Chicago. 934 pp.). There is, to my knowledge, no information on its clutch size. Herein I present information on ovarian activity in *E. flavitorques* from Costa Rica deposited in the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California.

A female *E. flavitorques* (LACM 150628; 280 mm SVL) collected in the summer of 1961 from San José Province, Costa Rica, contained three enlarged ovarian follicles (mean follicle length: 14.7 mm ± 1.5 SD, range: 13.0–16.0 mm) which would have presumably ovulated. The above represents the first reported information on potential clutch size in *E. flavitorques*.

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LAMPROPELTIS ALTERNA (Gray-banded Kingsnake). **DIET.** Although *Lampropeltis alterna* has been documented to feed on iguanids, teiids, anurans, and small rodents (Miller 1979. A Life History of the Gray-banded Kingsnake, *Lampropeltis mexicana alterna* in Texas. Master's thesis. Sul Ross State University, Texas. 91 pp.; Tennant et al. 1998. A Field Guide to Texas Snakes. Gulf Publ. Co., Houston, Texas. 211 pp.), detailed knowledge of its natural diet is lacking. Here, we report bird eggs in the diet of *L. alterna* for the first time. On 13 June 1997, at ca. 0100 h we found an adult female *L. alterna* crossing FM-170 (Presidio County, Texas, USA) 1 mi. W of the bridge in Panther Canyon. A row of five bulges, each approximately the size of a small ping-pong ball, were evident mid-body. The specimen was placed in a bag and several hours later five eggs were regurgitated. Although two eggs were slightly digested (as evidenced by their flaking shell casings) the outer membrane remained undamaged. The other three eggs

were in perfect condition, indicating that the clutch was consumed very recently. Dissection of one egg revealed a nearly fully developed Scaled Quail (*Callipepla squamata*). We thank Alan Tennant for identifying the bird.

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MASTICOPHIS FLAGELLUM PICEUS (Red Racer). **CARRION FEEDING.** DeVault and Krochmal (2002. Herpetologica 58:429–436) summarized 35 literature reports of natural snake scavenging (spanning at least 24 snake species and assorted carrion) to show that snakes utilize carrion more often than commonly believed. Not unexpectedly, these reports reveal that snakes generally use olfaction to locate carrion, and they suggest that some snake species forage specifically for carrion.

On 24 July 1974 between 0700 and 1030 h I observed three unusual instances of opportunistic carrion feeding by two or three *Masticophis flagellum piceus* at a field collectors' campsite in Whitewater Canyon, Riverside County, California (33°57.422'N, 116°38.650'W, 536 m elev.). During the previous evening (23 July 1974) researchers at the camp prepared about a dozen museum study skins of local rodent specimens including field mice (*Peromyscus*) and pocket mice (*Perognathus* and *Chaetodipus*), all < 35g live mass. We skinned the animals, removed the heads, opened the abdominal cavities to evaluate reproductive condition, and discarded the carcasses randomly in sparse desert vegetation along a nearby road embankment. During the night the skinless carcasses desiccated rapidly in the high temperatures and extremely low humidity. They were also contaminated with desert gravel and the hardwood sawdust used during preparation.

The next morning (24 July 1974) at 0700 h, a *M. f. piceus* (ca. 1200 mm TL) was outstretched in open view in full sunlight along the above embankment, rapidly engulfing one of the desiccated mouse carcasses. An attempt to catch the snake failed and it escaped rapidly, still grasping the mouse carcass. Air temperature at 0700 h was 28°C, and ground temperature in direct sun was ca. 40°C. Three hours later we noticed a second *M. f. piceus* (1175mm TL) engulfing a very dry mouse carcass at the same spot on the embankment where the first snake had been. The ground temperature (determined later) at the site was 44°C, and the shaded-bulb air temperature was 42°C. About 20 minutes later we saw a third *M. f. piceus* (1180 mm TL) outstretched and engulfing a mouse carcass < 2 m from the spot where the first snakes were seen. I collected the second and third specimens with dust shot and deposited them in the UC Davis Museum of Zoology (cat nos. 5331–5332). The stomachs of both specimens were empty, but I cannot be certain that either collected snake was not the specimen seen at 0700 h.

Cowles (1946, Herpetologica 3:121–122) and Small et al. (1994. Herpetol. Rev. 25:28) reported natural carrion feeding by *M. f. piceus*, respectively, on a poorwill (*Phaelaenoptilus nuttali*) in an advanced state of putrefaction and on a road-killed Glossy Snake (*Arizona elegans*). Our observations and others support DeVault and Krochmal's (2002) contention that carrion is normal forage for some snake species, and they underscore the role of olfaction in foraging even in snakes thought to rely primarily on prey movement and other visual cues.

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MICRURUS DISTANS (West Mexican Coral Snake). **TREE CLIMBING**. Snakes of the genus *Micrurus* are secretive and largely fossorial, and are often found under cover objects such as leaves, stones, and logs (Roze 1996. Coral Snakes of the Americas: Biology, Identification, and Venoms. Krieger Publ., Malabar, Florida). To our knowledge, there are no records of arboreality for this species. On 24 September 2001, at 1230 h, while conducting a survey on the herpetofauna of the Cuixmala-Chamela Biosphere Reserve on the coast of Jalisco, México, we observed a *M. distans* (790 mm TL) climbing a mature tree at ca. 4.5 m above the ground. The tree was part of a small patch of remnant dry forest immersed in a matrix of livestock grazing plots in different stages of regeneration. Air temperature was 29.1°C and humidity was 84.6%. Upon discovery the snake climbed down the tree and disappeared under the ground litter (specimen was photographed while climbing down). This observation suggests that this typically ground-dwelling species of coral snake may occasionally climb trees, perhaps to hunt prey not readily available on the ground. Two previous publications report the presence of *M. distans* in the area we describe herein but make no reference to arboreal habits (García and Ceballos 1994. Guia de Campo de los Reptiles y Anfibios de la Costa de Jalisco, Mexico, Fundación Ecologica de Cuxmala and IB UNAM, Mexico:184 pp.; and Ramírez-Bautista 1994. Manual y Claves Ilustradas de los Anfibios y Reptiles de la Región de Chamela, Jalisco, México. Cuadernos IB UNAM [23]:1–127).

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NINIA PSEPHOTA (Cope's Coffee Snake). **REPRODUCTION.** *Ninia psephota* is a colubrid that occurs in evergreen forests in Costa Rica and Panama (Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas. University of Chicago Press, Chicago. 934 pp.). There is, to my knowledge, no information on clutch size in *N. psephota*. Herein I present information on two egg clutches

from *N. psephota* deposited in the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California.

One *N. psephota* (LACM 153772; 315 mm SVL) collected 16 March 1959 in Cartago Province, Costa Rica, contained 4 oviductal eggs (mean egg length: 11.9 mm ± 1.4 SD, range: 10.4–13.7 mm). A second *N. psephota* (LACM 153766; 321 mm SVL) collected 20 November 1963 in Cartago Province, Costa Rica, contained 4 oviductal eggs (mean egg length: 12.8 mm ± 0.6 SD, range: 12.2–13.4 mm).

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PSEUSTES POECILONOTUS (Puffing Snake). **REPRODUCTION.** *Pseustes poecilonotus* is a common, diurnal colubrid that ranges from San Luis Potosí, Mexico to Amazonian Peru, Bolivia, and Brazil (Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas. The University of Chicago Press, Chicago. 934 pp.). There is, to my knowledge, no information on clutch size. Information on an egg clutch from *P. poecilonotus* from Costa Rica is presented herein, based on material deposited in the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California.

A female *P. poecilonotus* (1429 mm SVL; LACM 153978) collected 25 July 1963, San José Province, Costa Rica, contained seven enlarged follicles (mean follicle length: 33.4 ± 4.8 mm SD, range: 25–40 mm), which presumably would have been ovulated. These data are the first reported on female reproduction in *P. poecilonotus.*

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PHILODRYAS VIRIDISSIMUS (Green Palm Snake). **FEEDING ATTEMPT**. Members of the genus *Philodryas* (Colubridae) consume a wide variety of prey including amphibians, snakes, lizards, birds, and mammals (Silva and Filho 1999. Herpetol. Rev. 30:170). However, the specific predation habits of the arboreal *Philodryas viridissimus* are not thoroughly known. Herein we describe an instance of predation by *P. viridissimus* on a bat.

On 1 January 2003, at 1235 h, an adult *Philodryas viridissimus* (140 cm SVL; 36 cm TL; 350 g) was observed attempting to consume a bat (Phyllostomatidae; 98 mm total body length, 15 mm tip of ear to base of skull, 66 mm length of forearm, 16 mm length of hind-foot), on a forest trail within the 10,000-ha rainforest of Reserva Amazonica. This reserve exists on the north bank of the Rio Madre de Dios, 15 km ENE of Puerto Maldonado, Departamento de Madre de Dios, Peru (12°32.295'S, 69°03.211'W; 200 m elev.). The snake was on the ground not moving, with the bat approximately one-third in its mouth. The bat appeared too large for the snake to consume; red irritations present along the jaw of the snake suggested it was being overstretched. Many flies and wasps were present around the exposed part of the carcass, indicating that the bat had been dead for several hours. Using the coils of its body the snake attempted to force the bat further into its mouth, however this produced no visible progress. A portion of the bat's forelimb was pressing outward conspicuously from inside of the snake's throat and appeared as if it could easily puncture the skin. After 40 minutes of observation and no visible sign of progress by the snake, it was captured. The snake immediately released the bat and coiled into a strike position. The mouth of the snake was mangled and bloody from trying to swallow a prey item that was seemingly much too large.

Upon examining the bat carcass a strong odor of decay was noticed and the joints of the bat were very stiff. The skin around the abdominal region of the bat was open, exposing the abdominal muscles. The body of the bat was too decomposed to make confident identification beyond family in the field. The alignment of the snake's lower jaw was slightly out of place and remained that way until its release near the site of capture on 3 January 2003, at 1300 h. A photographic voucher of the specimen was deposited in the Herpetology Collection of the Department of Biology, University of Wisconsin-Stevens Point.

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SIBON ANTHRACOPS (Cope's Snail Sucker). **REPRODUCTION.** *Sibon anthracops* is a colubrid snake that occurs in lowlands from Guatemala to Costa Rica (Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas. The University of Chicago Press, Chicago. 934 pp.). Kofron (1987. J. Herpetol. 21:210–225) reported three females (locality not given) each containing three enlarged yolked follicles indicating clutches of three eggs. One female from El Salvador had follicles 17.9–19.8 mm (length) on 2 July and presumably would have ovulated later that month (Kofron, *op. cit.*). The purpose of this note is to present additional information on egg clutches from *S. anthracops.*

Four female *S. anthracops* from Guanacaste Province, Costa Rica were examined from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California, USA. One female (LACM 154110, 386 mm SVL) collected 2 July 1964 contained three enlarged ovarian follicles (mean length = 18.4 mm ± 0.72 SD, range: 18–19 mm). One female (LACM 154116, 400 mm SVL) collected August-October 1973 contained five oviductal eggs (mean length = 23.4 mm ± 2.6 SD, range: 21–27 mm) which represents the largest reported egg clutch for *S. anthracops.* Histological examination of ovarian tissue revealed that LACM 154123 (365 mm SVL) collected 31 May 1974 was not undergoing yolk deposition (= secondary yolk deposition *sensu* Aldridge 1979. Herpetologica 35:256–261) while LACM 154126 (355 mm SVL) collected 29 October 1973 was undergoing yolk deposition and represents the smallest reported reproductively active *S. anthracops* female.

Submitted by **STEPHEN R. GOLDBERG,** Department of

Biology, Whittier College, Whittier, California 90608, USA; e-mail: sgoldberg@whittier.edu.

SIBON ARGUS (NCN). **DIET**. Snakes of the Neotropical genus *Sibon* are described as mollusk and gastropod specialists (Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas. The University of Chicago Press, Chicago. 934 pp.), although Greene (1997. Snakes: The Evolution of Mystery in Nature. University of California Press, Berkeley, 351 pp.) refers to them as "goo-eaters." Kofron (1987. J. Herpetol. 1987:210–225) dissected 151 specimens of three species of *Sibon*, and found 4.6% of specimens with gut contents of slugs and an earthworm. Herein we describe the first report of *Sibon argus* feeding on eggs from an arboreal species of anuran, and provide further evidence that the vernacular name goo-eater is suitable.

Sibon argus is patchily distributed in lowland evergreen rainforests from southeastern Costa Rica to eastern Panama (Savage and McDiarmid 1992. Copeia 1992:421–432). While conducting herpetological surveys at Parque Nacional Omar Torríjos, El Copé, Coclé Province, Panama (8°40'N, 80°37'17"W), we observed an adult *S. argus* (360 mm SVL) wrapped around a branch, 1.5 m above a small headwater stream at 2000 h on 5 June 2002. The snake's head was hidden within a clump of moss on a lower branch ca. 10 cm below the snake's body. When we gently pulled the snake away from the moss, we saw it was in the process of swallowing several *Centrolenella prosoblepon* eggs, and had five Gosner Stage 18 (Gosner 1960. Herpetologica 1960:183–190) eggs clinging to the sides of its mouth. We saw ca. 10 additional eggs in the moss clump. We identified the snake as *S. argus* (Savage and Villa 1986. Herpetofauna of Costa Rica. Society for the Study of Amphibians and Reptiles, Ithaca, New York. 207 pp.) and then released it at the point of capture.

Sibon argus is a common snake at this site and is often seen along streams. In nine months of survey work at El Copé during 1999–2002, all *S. argus* we captured (N = 71) were alongside stream habitats. At night these snakes are often seen slowly moving along branches while tongue flicking moss clumps and leaf undersides, apparently foraging. We hypothesize that the snakes are searching for arboreal frog eggs. Nine species of stream breeding centrolenids and one leaf breeding hylid (*Phyllomedusa lemur*) occur at this site, and were actively breeding during our survey work.

On 19 May 2001, one of us (MJR) found unidentifiable green jelly in stomachs of 4 of 12 dissected *Sibon nebulatus* 14 km NE of Dominical, Puntarenas Province, Costa Rica. These snakes were collected DOR 15 m from a breeding pond of *Agalychnis callidryas* following an explosive breeding episode in which hundreds of frogs were calling and depositing eggs. We suspect that the distinctive green jelly was the remains of the green eggs typical of *Agalychnis* egg masses. Near the Dominical area, 26 other *S. nebulatus* gut contents did not contain the green jelly, including 11 collected from the above-mentioned pond on other nights. This suggests that *S. nebulatus* may opportunistically feed on these eggs when they are abundant. *Sibon* may feed on frog eggs more than has been previously recognized, but because eggs are delicate and become unrecognizable when ingested they may be under represented in gut contents.

Submitted by **MASON J. RYAN** and **KAREN R. LIPS**, Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901-6501, USA; e-mail (MJR): barleymoe@yahoo.com.

THAMNOPHIS ELEGANS (Western Terrestrial Garter Snake) **PREDATION.** On 12 July 2003, at 1330 h, while at Umtanum Creek in southern Kittitas County, Washington, I observed a female *Thamnophis elegans* (585.1 mm SVL, 67.7g) actively foraging along the creek bed. Within several minutes, the snake began to writhe and thrash in the water. I discovered that a large adult crayfish (*Orconectes virilis*) grabbed it with its first pereiopod (chela). Later that day I collected the snake (CWU 1238) after a small portion of skin, associated muscles, and some viscera had been consumed. The length of the crayfish was 135.1 mm TL; no other measurements were taken. Although other species of invertebrates (scorpions, spiders, and centipedes) are predators on snakes (Greene 1994. Biology of the Reptilia, Vol. 16 Ecology B, Defense and Life History, pp. 1–153), I believe this to be the first report of a crayfish capturing and killing a species of snake in the field. In laboratory experiments, Fernandez and Rosen (1996. Effects of the Introduced Crayfish *Orconectes virilis* on Native Aquatic Herpetofauna in Arizona. Arizona Game and Fish Department, Heritage Fund Report IIPAM Project No. I94054, Phoenix, Arizona. 56 pp.) reported that a 60 g crayfish (*O. virilis*) killed and consumed a juvenile *T. elegans* (175 mm SVL, 2.68 g).

I thank D. M. Darda for commenting on this manuscript

Submitted by **ROBERT E. WEAVER**, Department of Biological Sciences, Central Washington University, 400 E. 8th Avenue, Ellensburg Washington 98926-7537, USA; e-mail: weaverr@cwu.edu.

VIPERA ASPIS (Asp Viper). **REPRODUCTION**. Although the reproductive biology of *Vipera aspis* is well described, recent reviews suggest that the form found in Italy represents a distinct lineage, and possibly a separate taxon (Zuffi 2002. Amph. Rept. 23:191–213; Zuffi and Bonnet 1999. Ital. J. Zool. 66:87–95). We captured a female *V. aspis* (588 mm SVL; pre-parturition 330 g; post-parturition 144 g) in Bosco della Fontana (a woodland near Mantua, northern Italy) that gave birth to 17 live neonates on 28 August 2002. Male neonates averaged 196.8 ± 3.8 mm SVL and 6.7 ± 0.5 g (N = 12). Females averaged 200.2 ± 3.0 mm SVL and 6.8 ± 0.2 g (N = 5). This exceeds previously reported litter sizes for Italian populations (Luiselli and Rugiero 1990. Herpetozoa 2:107–115; Luiselli and Zuffi 2002. *In* Schuett et al. [eds.], Biology of the Vipers, pp. 279–284. Eagle Mountain Publishing, Eagle Mountain, Utah; Zuffi et al. 1999. Acta Oecologica 20:633–638). Maximum litter size for French populations of *V. aspis* is 22 neonates born to a female that weighed 375 g pre-parturition and measured 760 mm TL (Naulleau 1976. Ann. Soc. Sc. Nat. Charente Maritime – La Rochelle 6:201–202).

Submitted by **AUGUSTO GENTILLI** (e-mail: augusto.gentilli@unipv.it), **FABIO PUPIN**, and **MAURO FASOLA**, Dipartimento di Biologia Animale, Università di Pavia, Piazza Botta, 9-10, 27100 Pavia, Italy.

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SOCIETY FOR THE STUDY OF AMPHIBIANS AND REPTILES

www.ssarherps.org

The Society for the Study of Amphibians and Reptiles, the largest international herpetological society, is a not-for-profit organization established to advance research, conservation, and education concerning amphibians and reptiles. Founded in 1958, SSAR is widely recognized today as having the most diverse society-sponsored program of services and publications for herpetologists. Membership is open to anyone with an interest in herpetology—professionals and serious amateurs alike—who wish to join with us to advance the goals of the Society.

All members of the SSAR are entitled to vote by mail ballot for Society officers, which allows overseas members to participate in determining the Society's activities; also, many international members attend the annual meetings and serve on editorial boards and committees.

ANNUAL DUES AND SUBSCRIPTIONS: Annual membership dues for the year 2004 in the Society for the Study of Amphibians and Reptiles are as follows: **REGULAR** membership US$60 (Student $30)—includes *Journal of Herpetology* and *Herpetological Review*; **PLENARY** membership US$80 (Student $45)—includes *JH*, *HR*, and annual subscription to the *Catalogue of American Amphibians and Reptiles*; **INSTITUTIONAL SUBSCRIPTION** $115—includes JH and HR. Additional fee for airmail postage outside USA $35 for one year. Additional membership categories available on the SSAR webpage: http://www.ssarherps.org/pages/membership.html.

All members and institutions receive the Society's primary technical publication, the *Journal of Herpetology*, and its news-journal, *Herpetological Review*; both are published four times per year. Members also receive pre-publication discounts on other Society publications, which are advertised in *Herpetological Review*.

Payment must be made in USA funds, payable to "SSAR," or by International Money Order, or with VISA or MasterCard (account number and expiration date must be provided). Payment should be sent to: Theodora Pinou, SSAR Treasurer, Department of Biological & Environmental Sciences, Western Connecticut State University, 181 White Street, Danbury, Connecticut 06810, USA. Fax: (203) 837-8769; e-mail: PinouT@wcsu.edu.

Future Annual Meetings

2005 — University of South Florida, Tampa, Florida, 6–11 July (with ASIH, HL)
2006 — New Orleans, Louisiana, 12–17 July (with ASIH, HL)

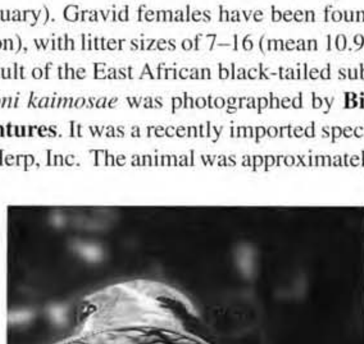
About Our Cover: *Dendroaspis jamesoni*

Mambas (*Dendroaspis*, Elapidae) comprise four species occurring in sub-Saharan Africa. The most notorious of these, the savannah-dwelling Black Mamba (*D. polylepis*), is also the most studied. As a group, mambas possess a powerful venom with strongly neurotoxic properties (Van Aswegen et al. 1996. Wilderness and Environmental Medicine 7:115–121).

Jameson's Green Mamba *(D. jamesoni)* may be the least known. It ranges widely across central African forests to elevations of ~2100 m, from southern Nigeria east to the southern half of Uganda and western Kenya, south to Angola, but also ranges to Togo and Ghana in the northwest, and extends to the Imatong Mountains in the southern part of the Sudan (Spawls and Branch 1995. Dangerous Snakes of Africa. Krieger Publ., Malabar, Florida, 192 pp.).

Although reported to attain a maximum length of 3.66 m (Pitman 1974. A Guide to the Snakes of Uganda, revised edition. Wheldon & Wesley, xxii + 290 pp.), a more reasonable estimate of maximum size is perhaps 2.64 m (Spawls et al. 2002. A Field Guide to the Reptiles of East Africa. Academic Press, San Diego, 543 pp.). In the most detailed field investigation to date of this species, Luiselli et al. (2000. Contributions to Zoology 69[3]:147–155; online at <http://dpc.uba.uva.nl/ctz/vol69/nr03/a01>) studied *D. jamesoni* in southern Nigeria. Their work confirmed this species' strongly arboreal habits and generally secretive, inoffensive behavior. Notably, these snakes are able to persist in patches of remnant forest, often surprisingly near human settlements. Adults are mostly sedentary, favoring retreats in specific trees or bushes, and capture arboreal prey—mainly birds, with some rodents eaten. Juveniles are more likely to consume ectothermic prey such as toads and lizards. Males attain a larger size than females, and male-male combat has been observed during the dry season (December–February). Gravid females have been found during April–June (wet season), with litter sizes of 7–16 (mean 10.9).

The cover image of an adult of the East African black-tailed subspecies *Dendroaspis jamesoni kaimosae* was photographed by **Bill Love / Blue Chameleon Ventures**. It was a recently imported specimen borrowed from Glades Herp, Inc. The animal was approximately 5.5 feet (1.68 m) long and surprisingly (and thankfully) cooperative for the studio session lit by three Novatron lights. A Nikon 60 mm macro lens and F90X body recorded the image on Fujichrome Velvia (ASA 50) slide film. The odd pose was contrived specifically to show most of the snake's color variation along its attenuated body in a vertical close-up format.



SSAR BUSINESS

Seibert Award Winners for 2004 Announced

The thirteenth annual Seibert Awards were presented at the 47th Annual Meeting of the SSAR in Norman, Oklahoma 26–31 May 2004. These awards are named in honor of Henri C. Seibert, an early and tireless supporter of SSAR (having served as an officer for over 20 years). In recognition of outstanding student presentations at the annual meeting, a single award was given in each of the following categories: Systematics (3 eligible presentations), Physiology/Morphology (5 eligible presentations), Evolution (7 eligible presentations), Ecology (8 eligible presentations), and Conservation (11 eligible presentations). All five awardees received a check for US $200 and a book from Chuck Crumly at the University of California Press.

The Winners—Systematics: Adam Leache and Charles Cole, University of California, Berkeley, "Secondary Contact Between Two Putative Species of *Sceloporus* Lizards in Arizona." Physiology/Morphology: Christopher Leary, University of Oklahoma, Norman, "Influence of Individual Physiological Condition on Reproductive Tactic Expression in Toads: Implications for Behavioral Studies." Ecology: Stephen Spear and Charles Peterson, Idaho State University, Pocatello "Spatial Analysis of Tiger Salamanders (*Ambystoma tigrinum*) Gene Flow Across the Northern Range of Yellowstone National Park." Conservation: Nicole Thurgate, University of New Orleans, "Have Canopy Closure and Competition Contributed to the Decline of Endangered Dusky Gopher Frogs (*Rana sevosa*)?" Evolution: Catherine Darst, Pablo Menendez, Luis Coloma, and David Cannatella, University of Texas, Austin, "The Evolution of Toxicity and Diet-Specialization in Poison Frogs: A Comparative Analysis."

Honorable Mention—Ecology: Jason Hoverman, Rick Relyea, and Nancy Schoeppner, University of Pittsburgh, "Direct and Indirect Impacts of Insecticides and Herbicides on Aquatic Communities," Mizuki Takahashi and Matthew Parris, University of Memphis, "Effect of Hydroperiod on Developmental Polymorphisms of the Eastern Spotted Newt, *Notophthalmus viridescens*." Conservation: Carol Strojny and Malcolm Hunter, University of Maine, "A Comparison of Amphibian Abundance in Harvest-Created and Natural Canopy Gaps in a Northeastern Forest." Evolution: Erin Myers, Fred Janzen, and Dean Adams, Iowa State University, Ames, "Quantitative Genetics of Plastron Shape in Slider Turtles (*Trachemys scripta*)."

The judges were Brian Crother (Southeastern Louisiana University), David Bickford (University of Texas, Austin), Robert Espinoza (California State University, Northridge), Stanley Fox (Oklahoma State University, Stillwater), David Hardy, Sr. (Tucson, AZ), Joe Mendelson, III (Utah State University, Logan), Meredith Mahoney (UC Berkeley), Kirsten Nicholson (Washington University), Marion Preest (The Claremont Colleges), and Paul Stone (University of Central Oklahoma).

SSAR Grants-in-Herpetology Committee Annual Report (2004)

An award in the amount of US $500 was made to each of the following individuals:

Field Research.—**Steven M. Whitfield**, Florida International University. Project title: "Costs and benefits of male versus female parental investment in *Eleutherodactylus johnstonei*, a frog with amphisexual parental behavior."

International.—**Franklin Enrique Castañeda Menéndez**, Universidad de Costa Rica. Project title: "Movement, activity pattern and habitat use of *Kinosternon scorpioides* (Testudines: Kinosternidae), in a dry tropical forest in Costa Rica."

Conservation.—**Corinne L. Richards**, University of Michigan. Project title: "Elucidating factors integral to the conservation of endangered Panamanian Golden Frogs (*Atelopus varius* and *Atelopus zeteki*)."

Laboratory Research.—**Melissa A. Pilgrim**, University of Arkansas. Project title: "Assessing the impact of diet composition on Pygmy Rattlesnake (*Sisturus miliarius*) life history and demography: a stable isotope approach."

Travel.—**Mizuki Takahashi**, University of Memphis. Project title: "Phylogeography and population differentiation of the Eastern Newt, *Notophthalmus viridescens*."

2004 Grants-in-Herpetology Committee.—Chair: Erik R. Wild. Reviewers: Jeffrey Parmelee, Karen Lips, Daniel Meinhardt, David Kizirian, Christopher Beachy.

SSAR congratulates the 2004 GIH recipients and thanks the committee members for their efforts.

Grants-in-Herpetology 2005 Proposals

Proposals are now being accepted for the 2005 SSAR Grants-in-Herpetology Program. This program is intended to provide financial support for deserving individuals or organizations involved in herpetological research, education, or conservation. Application deadline is 31 December 2005. Grant application details are available at:

<http://www.ssarherps.org/pages/GIH.html>

SSAR Special Award in Herpetology at the New Haven City Wide Science Fair

In an effort to promote herpetological education among children in grades K–12, the SSAR Board of Directors agreed to support a Special Award in Herpetology for the 2004 New Haven (Connecticut) City Wide Science Fair. The New Haven Science Fair is an important part of the City's K–12 science program because the New Haven science curriculum requires every school in the district to enter projects. Many of these go on to compete on the state level (www.nhsciencefair.org/html/home.html).

The winner of the SSAR 2004 Special Award in Herpetology is fifth grader Adam Hallet, from Sheridan Middle School. Adam exposed lizards to different colored light (white, red, blue, and green) and measured their respiratory response. He found that they consistently breathed slowest under green light and fastest under white light. Adam used the change in the rate of rhythmic expanding and contracting of the rib cage to measure breathing rate. Although he wasn't sure why colored light affected rates of breathing he did remember reading about the pineal organ and felt that it might somehow be involved in controlling lizard respiration.

Adam Hallet in front of his project poster and trophy.

In interviewing Adam I learned that he loves lizards and reads about them all the time. He told me he developed his project alone after trying to decide how to best calm his pet Forest Armadillo Lizards in their cage. Now that he has completed this Science Fair project he wants to examine skulls of different lizard species. When asked where he was going to get these skulls he replied in a very matter of fact manner that "everyone knows that drawings of skulls are published in the literature."

On behalf of the Society for the Study of Amphibians and Reptiles and its Board of Directors I would like to extend our warmest congratulations to Adam, his family, and his science teacher Huan Ngo, and wish Adam all the best in his future scientific inquiries. I would also like to thank SSAR member Gregory J. Watkins-Colwell of the Peabody Museum of Natural History, who kindly agreed to judge the award.

Anyone serving on a local Science Fair Board who would like to facilitate this type of award should contact the SSAR Treasurer at theodora.pinou@yale.edu for more information.

—*Theodora Pinou, SSAR Treasurer*

NEWSNOTES

Biology of Sea Snakes Workshop: The Nha Trang Declaration

A workshop on the Biology of Sea Snakes (elapids with a flat paddle-like tail), was held at the Institute of Oceanography, Nha Trang, Vietnam, 9–12 March 2004, jointly organized by the DANIDA Research Council, the Royal Danish Academy of Fine Arts, School of Conservation, and the Institute of Oceanography, Nha Trang. The following scientists, representing eight countries, participated: Touch Seang Tana (Cambodia); Jesper Norup Nielsen, Peter Gravlund, Jens Boedtker Rasmussen, Arne Redsted Rasmussen (Denmark); Medy Ompi (Indonesia); Indraneil Das (Malaysia); Filipina B. Sotto (Philippines); Anslem de Silva (Sri Lanka); Somchai Bussarawit, Lawan Chanhome, Visith Sitprija, Sansareeya Wangkulangkul (Thailand); Chu Anh Khanh, Nguyen Thi My Ngan, Cao Van Nguyen (Vietnam).

The following resolution—the Nha Trang Declaration—was adopted:

1) Sea snakes contribute significantly to the biological diversity of marine, coastal and freshwater ecosystems of the Indo-Pacific region.
2) The natural habitats of sea snakes are rapidly being degraded through pollution, use by humans and their impact, and thus require immediate assessment. Appropriate management options may need to be adopted in order to stem the decline of sea snake populations as a result of habitat destruction.
3) Intensive fishing activities, especially the use of trawlers, result in the incidental capture of a large number of sea snakes, a large proportion of which perish. This is a senseless loss of a valuable biological resource, the ecological implications of which are not well understood at present.
4) Systematic knowledge of the group, in addition to knowledge of biology and conservation status, remains poor.
5) For effective species conservation, more research is needed on these and other aspects of the natural history of sea snakes and of their habitat requirements.
6) Efforts to enhance conservation of sea snakes should include: Institutional capacity building, training, especially of students, husbandry, development of databases on trade, and other forms of use, bites, a general exchange of information between sea snake workers and others interested in their management and conservation, a review of legislation, and finally a public awareness programme.
7) Many fishermen and some tourists get bitten by sea snakes every year throughout the region. A number of these bites result in death. Thus, the status of bites by sea snakes and preventive methods need to be ascertained.
8) Where bites from sea snakes are a problem, specific anti-venom needs to be developed where it is not currently available.
9) Sea snakes are a shared common resource. The migratory habits and wide distribution of some species make them ideal candidates for regional cooperation in studies of biology and conservation. Such cooperation between institutions and individuals, representing many countries of the Indo-Pacific region, has been ongoing for the past decade. These collaborative ventures need to be carried on in the future.

—*Arne Redsted Rasmussen (e-mail: arr@kons.dk)*

MEETINGS

Meetings Calendar

Meeting announcement information should be sent directly to the Editor (rwh13@csufresno.edu) well in advance of the event.

15–20 November 2004—VI Symposium of Zoology, Topes de Collantes, Sancti Spiritus, Cuba. Information: www.geocities.com/zoologiacubana/simposio or by e-mail: zoologia.ies@ama.cu.

16–18 January 2005—Biology of the Rattlesnakes conference, Loma Linda, California, USA. Information: www.BiologyoftheRattlesnakes.org.

OBITUARIES

Herpetological Review, 2004, 35(3), 211–212.

C. Robert Shoop (1935–2003)

C. KENNETH DODD, JR.
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Bob Shoop (often affectionately known simply as "Shoop") was born in Cicero, Illinois in 1935. He attended Southern Illinois University for his Bachelor's degree (1957), then migrated south to Tulane University for his Master's (1959) and Doctoral degrees (1963). At Tulane, two important events helped shaped Bob's life: he studied the biology of *Ambystoma* and *Necturus* under Fred Cagle, and he developed a connoisseur's appreciation for barbeque, a taste which came in handy during later years of preparing mystery meat dinners for friends and visitors at the University of Rhode Island and on Cumberland Island. After graduating, he briefly worked at Oak Ridge before taking a position at Wellesley College, where he taught for 7 years. Wellesley had no graduate program, so in 1969 he accepted a position in the Zoology Department at URI where he remained until his retirement in 1998.

By all accounts, Bob was an enthusiastic teacher as he instilled an excitement and curiosity about the natural world in serious Yankee students. His zeal and sense of humor punctuated long winters of teaching undergraduate and graduate courses. At URI, he led numerous "road trips" to the southeast to expand the horizons of his students and to show them the diverse world of amphibians and reptiles. Bob served as major professor to 8 Doctoral students and 18 Master's students who worked on a wide variety of research projects, although most had herpetological interests. In addition, he served as committee member to nearly 50 additional graduate students, all at URI. The warm remembrances from colleagues, students, and friends at the university present a picture of the man many of us were privileged to know: knowledgeable; warm and friendly; possessed of a great love of life and sense of humor, even among those with whom he disagreed or in adverse situations.

He never stopped being a teacher, either to students or to colleagues. For example, Bob was vexed by sea turtle measurements, and expressed concern about their accuracy and the growth claims made by some researchers based on mark-recapture measurements. At one Sea Turtle Workshop, he brought a loggerhead carapace to the meeting and placed it near the registration desk with a set of calipers and a measuring tape (but no other instructions) and a sign: "Measure this Turtle." As he predicted, the variance in the measurements exceeded anything that could possibly be meaningful, even though taken by experienced researchers using "standardized" techniques on a stationary carapace. I later adopted this exercise on occasion to illustrate the potential for observer bias in taking measurements.

During his career, Bob published more than 65 papers, most of them dealing with the ecology and life history of amphibians and reptiles. Although his dissertation focused on *Necturus*, he quickly became interested in the orientation, migration, movement patterns, and survivorship of *Ambystoma* salamanders, publishing some of the earliest and most important papers on these topics. In fitting tribute, a plaque in his honor will be placed at the URI Alton Jones Research Center, where he did much of his amphibian work. In the late 1970's, Bob's interests shifted to marine turtles, a passion he pursued until his death. Indeed, he had just finished a revision of his *Sea Turtles of the Georgia Coast* with Carol Ruckdeschel shortly before the stroke that ended his life. And although salamanders and sea turtles came to dominate his publication list, Bob was keenly interested in everything concerning the natural world. This is particularly true of Cumberland Island, Georgia, a place he often visited and retired to in 1998. Shoop never really retired, he just had more time to work on turtles and the biology of Cumberland Island (29 papers beginning in 1982).

While at Cumberland, Bob became increasingly concerned about the conservation of marine turtles in offshore waters. He was fiercely dedicated to finding a solution to the problem of "incidental" mortality due to shrimp trawling and other commercial fishing, and he was not afraid to challenge authority, especially when he had the data to show that half-way technology and agency-espoused "solutions" simply were not effective. I remember many discussions with him and Carol, where they convincingly argued that the regulations imposed did not address the root cause of the sea turtle strandings. Bob was not fond of bureaucratic intransigence.

On Cumberland Island, Bob lived out his dream with Carol Ruckdeschel at their home at The Settlement; he especially loved his mule and taking buggy rides in an Amish carriage. Bob was a pilot, a writer for *Special Edition of The Mullet Wrapper*, a recipient of the ASIH Stoye Award (1960), Vice President of the Cumberland Island Museum (1985–2003), auctioneer at sea turtle meetings, teacher, researcher, conservationist, chef, mentor, and distinguished naturalist. I will very much miss our talks of turtles, wine, herpetology books, food, and southeastern life. Bob is survived by his life-mate, Carol, his sons John and Michael, 3 grandchildren (Cassandra, Jack, Alexis), a brother (Steven), and a whole lot of friends. Memorial celebrations of his life were held at Cumberland Island and the University of Rhode Island.

Herpetological Review, 2004, 35(3), 212–213.

Richard L. Wallace (1933–2003)

LOWELL V. DILLER
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Richard ("Dick") L. Wallace, 70, Professor Emeritus of Zoology, University of Idaho, died on November 13, 2003 in Moscow, Idaho. He had a long and productive career and made important contributions to the fields of ichthyology and herpetology, but to his former colleagues, graduate students and friends, his greatest contribution was the friendships they shared. Working in an academic world where self-promotion is common, he was direct, completely unpretentious, sought no recognition for himself and was willing to devote long hours assisting his graduate students and colleagues. As one former graduate student said: "They don't make'em like him anymore. I consider myself very lucky to have known him … I would have never finished my Master's thesis if it weren't for Dick's guidance and expertise." Another former graduate student remarked, "Dick didn't just adopt me, but my entire family as well. He was concerned with our welfare in addition to my progress as a scientist. He was one of the most generous people I've known in academia."

I know I can never capture the essence of a man for whom I had

such love and respect, but my personal testament to his special qualities is all the years he supported our field studies on rattlesnakes out of his personal income. We were unable to get more than small grants to conduct our fieldwork, but his interest in nature and devotion to science did not allow this to deter our work. Largely through his personal support, we continued the work from 1978–1990. As he would be the first to say, the studies on rattlesnakes may not have been "profound," but they were done with a genuine and pure interest in science that is not always evident in today's scientific studies. We conducted fieldwork mostly on weekends during the spring and summer, and in the winter we would use the weekends to catch up on laboratory work and data analysis. Although Dick had a deep love and respect for the animals he studied, he was definitely from the old school that believed in the scientific value of "sackin' up" some specimens. One of my favorite memories was our tradition of going to the lab on Saturdays to do dissections. The work was tedious, but allowed for hours of lively, mostly scientific discussions, with coffee and a donut for our snack. Dick would be dissecting a rattlesnake with all manner of unmentionable "uck-puck" (his favorite term) on his fingers, and if he needed to record something on the data form or took a bite of his donut, he simply licked his fingers and proceeded. He agreed with my admonishments that he probably shouldn't do that, but in a short time, he was right back to using the most natural of cleaning methods. Another memorable occasion was one Saturday when we were dissecting some gravid female rattlesnakes and Dick kept insisting that the mature ova looked "real tasty." We must have forgotten the donuts that day, because we decided that science would be no worse off if we cooked up a couple of the ova. It probably is no surprise that they were terrible and we were never tempted to eat any of our specimens again.

Dick was born August 22, 1933 in Tacoma, Washington and grew up in the same town. He earned his Bachelor of Science degree in conservation from Washington State College in 1956. Following two years in the U.S. Army Signal Corps, he began graduate studies in fisheries science at Oregon State College in 1958 where he received Master of Science and Doctoral degrees in 1960 and 1969. He began his academic career in 1960 at Oregon State University and accepted a position as acting Assistant Professor of Zoology at the University of Idaho in September 1967. At the University of Idaho, Dick taught ichthyology, general zoology, herpetology and biological science courses. He was tenured in 1972 and was promoted to Professor of Zoology in 1984. During his academic career at the University of Idaho, he had graduate students in both fisheries science and herpetology. He retired from the University of Idaho in 1991.

Dick's professional memberships included the American Fisheries Society, American Society of Ichthyologists and Herpetologists, Society for the Study of Amphibians and Reptiles, The Herpetologists' League, Idaho Chapter American Fisheries Society, Oregon Chapter American Fisheries Society (charter member), Pacific Fishery Biologists, Sigma Xi, Phi Sigma and Phi Kappa Phi. During his career, he authored or contributed to four books, and over 60 refereed publications and papers. One of Dick's most notable publications was the *Fishes of Idaho*, which he co-authored with James Simpson in 1978. This text was the first that described Idaho fish species, their biology and distribution.

After retiring, Dick stayed active pursuing his life-long passion for fishing and hunting, but he also did consulting work that included both fish and amphibian studies. Most of the herpetological work was done for Simpson Timber Company in northern California, where true to his style, he insisted that he work for only modest compensation. However, his efforts were instrumental in developing a research and monitoring program for forest amphibians that may well set the standard for the forest products industry. Upon his death, Dick was working on a field guide to the native fishes of Idaho, and the morphological variation and distribution of Idaho sculpins. He is survived by his wife Margaret, son John Wallace, daughters Kate Mecham and Liz Branter, and grandchildren Meredith Wallace, Megan Mecham, and Zachary and Nicholas Branter.

For many of us that knew him during his active post-retirement years, he was simply "Wallace," and on any gathering with two or more of his friends, a favorite pastime was telling Wallace stories. One of my favorites was related to his life-long nemesis, elk. On a particularly cold elk hunting expedition, he got a late start hunting in the morning, and was once again unsuccessful, because he had put his dentures in a glass of water before going to bed and awoke to have them frozen solid in a block of ice. He delighted in telling fishing and hunting stories, but in keeping with his self-deprecating style, he was just as likely to tell you about his "screw ups" as his successes, of which he had plenty. Although he commonly told these stories in greater detail than anyone needed to know, his obvious enjoyment and passion for being in the outdoors made every story worth the wait. We have truly lost a great champion of science, and to all those that knew him, a great friend. We can only hope that he is now where the trout and white-tailed bucks are big and on the move.

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John E. Werler (1922–2004)

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John E. Werler was born on 11 June 1922 in Oldenburg, Germany, and immigrated to Weehawken, New Jersey in 1926. He "cut his teeth" in herpetology and the zoo field in Staten Island, New York City. His father was not pleased with his nascent interest in natural history so he burned his animal books. His recollections: "During my early teens I developed a keen interest in reptiles, a passion that inevitably led me to Staten Island Zoo's reptile study society." The group's monthly meetings were held at the Staten Island Zoo, which maintained one of the nation's premier reptile collections. Carl Kauffeld, the zoo's charismatic reptile curator, usually conducted the meetings. According to John, "it was an opportunity to mingle with others, both amateur and professional, who shared the same interest."

From Weehawken it was a tedious journey by bus and ferry to Manhattan, trudging several blocks to a subway station, then on to another ferry terminal for Staten Island, a long ferry ride and then yet another bus to the zoo.

However, John did not mind the two-and-a-half hour one-way trip because "for the next couple of hours I would share a common passion with others," and "to a budding young herpetologist, this was the ultimate experience." "Becoming a member of the Staten Island Zoo reptile study society was one of the most important events of my young life," he reminisced decades later. A year after he had joined the group, a keeper position became available and he applied. Fortunately for him and the herpetological world, Carol Striker, the zoo director, sent him a memo, dated 18 October 1940: "This letter will serve to notify you that you have been appointed to the position of Reptile Keeper, Second Class, salary \$1200.00 per year, effective October 1st, 1940." Thus John Werler, at the age of eighteen, began a productive and successful zoo career, which spanned half a century until his retirement as the Houston Zoo director in 1992.

His new boss, the legendary Carl Kauffeld, continued to be a willing mentor. "It was not unusual for him to spend an hour or two explaining to a keeper or a curious novice the basics of taxonomy, the secrets of captive reptile maintenance, or the historical background of herpetology." John's duties ranged far beyond the maintenance of exhibits and caring for reptiles. Ahead of his time, Kauffeld was aware of the need for accurate record keeping on each specimen under his care. Application of computer chips on live animals was but science fiction then; the task required manual markings on animals as a permanent identification. John's job was to assist the curator with individually marking rattlesnakes. And the zoo had a large number of rattlesnakes.

"It involved pinning each snake to the floor with a snake stick, then grasping the reptile behind the head with the other hand," John noted. He was to hand-hold each specimen while Kauffeld clipped certain scales under the snake's tail. "Picking up the first two snakes went according to plan; the third did not. It jerked its body backward violently just as the snake stick was being lifted

John E. Werler, then-curator at the San Antonio Zoo, and rattlesnake friend. A variation of this photograph was used on the cover of his bulletin on the venomous snakes of Texas. Photo courtesy of John E. Werler.

from its head. When the sudden, unexpected snap loosened my hold, the rattler instantly turned its head to one side, sinking one of its fangs deep into my right thumb. The bite was serious enough to keep me in a local hospital for five days, and in ten days I was back at the zoo. In spite of the accident I was able to perform my usual routine duties upon my return."

"But I faced a nagging question: would I be mentally prepared to once again pick up and hand-hold a venomous snake?" The painful experience was fresh in the young man's mind as he confronted a momentary, paralyzing doubt. However, "I was determined not to let that fear destroy my confidence."

After returning to work, one day he used a snake stick to pull a large cottonmouth from its cage, placing it on the service aisle floor before him. "Almost reluctantly—remembering vividly the circumstances of my first snake bite—I pinned the reptile's head with the stick. But for a brief attempt to pull itself free from the restraining device, the snake remained calm as I picked it up. When it was over, there was perspiration on my forehead, but the deed was done, the challenge met, and my confidence regained. I was back in the business of reptile keeping." [The foregoing is from a four-page note he sent to KK, dated 10 June 1999]

In 1946 John became curator of reptiles at the San Antonio Zoo and was promoted to assistant director in 1952. He moved to the Houston Zoo and served as general curator from 1954 to 1963, when he became the director. As part of the ceremonial opening of the zoo's Reptile House in 1964, Werler demonstrated proper handling of a cobra. He majored in biology at William & Mary College and served four years in the U. S. Coast Guard.

Following the turbulent 1960s, the American zoo world faced formidable challenges in the next decade. The precarious financial status of municipalities caused difficulty for many urban zoos. Moreover in the era of awakening environmental awareness, zoos became a target of criticism from increasingly vocal animal advocate groups. As federal laws, regulations and an international treaty on wild animal trade became stricter, wholesale importation of wild animals was coming to a screeching halt. Soon, it became vitally important for zoos to maintain self-sustaining populations by effectively managing captive wild animals in a more scientific manner.

As the Houston Zoo director, John Werler hosted the 1973 annual conference of the American Association of Zoological Parks and Aquariums (AAZPA, now American Zoo and Aquarium Association, or AZA). It was an unusual conference with a heavy dose of technical paper sessions on breeding and small population management of zoo animals. It was at this conference that the future direction for zoo animal management was laid out, based on biological principles, especially genetics. Later, the National Academy of Sciences (1975) published the conference proceedings.

One of the critical animal management issues surfacing in the forefront of the AAZPA was that of surplus animals. While some species were not reproducing sufficiently, on the other hand offspring of certain species were "flooding" the market, causing a serious dilemma for zoos. Contemplating the issue John alerted his colleagues eloquently (1974): "We are well aware that a major factor in the reduction of wildlife is vanishing habitat. A related problem, unique to our profession, is becoming increasingly evident — that of vanishing space. We have become extremely suc-

cessful in breeding certain species." He continued, "Even when occasional rare species are successfully bred in captivity, there remains the nagging problems of finding space to properly accommodate the expanding captive groups." Ahead of his time, he then suggested a need for a collective animal management program. As zoos faced more rapid changes, John Werler took the AAZPA presidency for the period 1975 to 1976 and made every effort to resolve difficult issues. [He told KK around that time that after he had made a critical decision, a prominent Texas zoo director did not speak to him for a year.]

Houston Zoo director John E. Werler (right) with reptile curator Tommy Logan during the mid-1960s. Photo courtesy of John E. Werler.

Gary K. Clarke, retired director of the Topeka Zoo, Kansas and a former AAZPA president (1971–1972) comments (pers. comm.): "John was one of the all-round zoo professionals who emerged from initial interest in herpetology." Speaking of herpetology, Chris Wemmer of the Smithsonian National Zoological Park wondered (1991), "How come herpetologists tend to be more committed biologists than bird and mammal curators?" He also observed, "Their intellectual commitment is manifested by higher individual publication rates, more collaboration with non-zoo biologists, more field experience, and probably higher per capita membership in professional societies." John Werler typifies this particular breed of zoo professional. Dr. Wemmer then revealed a list of 21 scholars worldwide in "A Gallery of Zoo Researchers and Zoo Biologists." Included in this impressive roster were highly respected European scholars, along with John Werler and his mentor Carl Kauffeld.

In Werler's honor, Roger Conant described the Tabasco Watersnake *Natrix* (= *Nerodia*) *rhombifera werleri* in 1953. Two amphibians from Veracruz, Mexico were named after Werler: Werler's False Brook Salamander (*Pseudoeurycea werleri*) and the leptodactylid frog *Eleutherodactylus werleri* [now *E. laticeps*]. Later this year, a paper by Jonathan Campbell and Werler will appear in *Southwestern Naturalist* describing a new species of lizard (*Diploglossus* sp.) named after Werler's beloved late wife.

Werler died of cancer on 21 March 2004. He and his wife Ingrid had one son, John H. Werler.

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Werler, J. E., and J. R. Dixon. 2000. Texas Snakes. Identification, Distribution, and Natural History. University of Texas Press, Austin. 437 pp.

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Walter Auffenberg (1928–2004)

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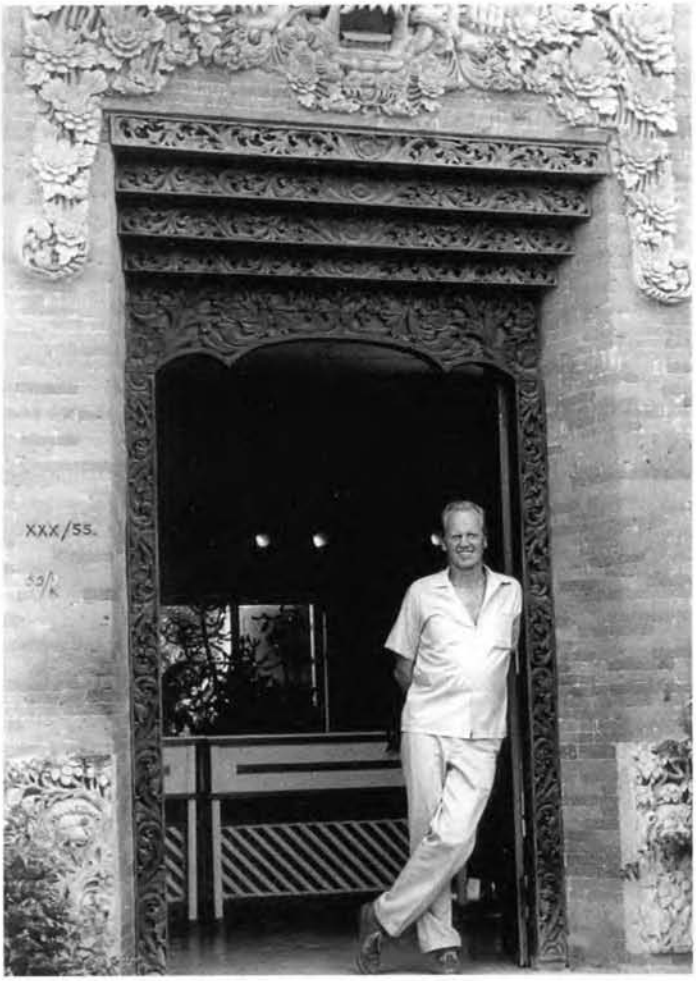
Walt Auffenberg passed away on 17 January 2004 at the age of 75 after a long illness following a stroke in December 1995. He is survived by two sons, Kurt and Troy, six grandchildren, and two great-grandchildren. Walt was born in Detroit, Michigan, on 6 February 1928, the only child of Walter and Ida Auffenberg. He developed a passion for herpetology early in his childhood, and by the time he graduated from Denby High School Walt had amassed a sizable collection of preserved snakes. If he made good grades in school, Walt was allowed to take the bus or hitchhike to far off places, such as Florida and Mexico, to collect herps. His parents had purchased two small orange groves and a fernery near Deland, Florida, for their eventual retirement, and after graduation from high school, Walt tended these small plots of land. Walt enlisted in the Medical Corps of the United States Navy near the end of World



Walter Auffenberg, December 1969, Arya Hotel, Denpasar, Bali, Indonesia, about midway through his field study of the Komodo Monitor.

War II and was stationed in Corpus Christi, Texas. When not playing piano for the officers' entertainment, he would travel to Houston to play where he eventually met and in 1947 married Elinor Ann Wright. The Auffenbergs would have four sons (two deceased) and share a very special relationship over the next 45 years until Elinor's death in 1992. Walt married Katalin Vienne in 1993, but she too passed away in 1999.

In the late 1940s, Walt found employment as a draftsman for Sinclair Oil Company in Houston. However, his supervisor at the time urged him to follow his dream of becoming a herpetologist. So, Elinor and Walt (and one son) moved to Deland, Florida, where he attended Stetson University on the G.I. Bill. He received his B.S. in 1951. The family moved to Gainesville so Walt could pursue his graduate studies in the Department of Biology at the University of Florida. He received his master's degree in 1953. Prior to finishing his Ph.D., Walt took a job as Associate Curator of Vertebrate Paleontology at The Charleston Museum during 1954–1955, and then moved to Harvard University in Fall 1955 to become a student assistant with Ernest Williams. Walt finished his doctoral degree at the University of Florida under the direction of Arnold Grobman in 1956. His dissertation on the fossil snakes of Florida became a benchmark study for all later studies in snake paleontology. Grobman recruited Walt to become Associate Director of the Biological Sciences Curriculum Study (BSCS) program at the University of Colorado at Boulder in 1959. There, Walt helped guide the development of the green, yellow, and blue versions of the innovative high school biology texts that provided many of us with our initial exposure to biological principles. It was during this time that Walt first traveled to Asia where he promoted the BSCS program and taught in India. Following Grobman's departure from BSCS, Walt returned to the Florida State Museum (now Florida Museum of Natural History) in 1963 as Chairman of Natural Sciences and Curator of Herpetology. This allowed Walt to continue his research on fossil and living amphibians and reptiles and raise his family in Florida. Walt stepped away from his Chairman responsibilities in 1973 to devote full attention to his duties in Herpetology until his retirement in 1991. During his 27-year career at the University of Florida, he was the graduate advisor of Dave Auth, John Iverson, Dale Jackson, Peter Meylan, Bob Taylor, and Bill Weaver, guiding them through their doctoral programs and inspiring numerous master's students.

Walt published more than 130 scientific papers and books on fossil amphibians and reptiles, the musculature of snakes, recent and fossil tortoises, and the systematics, evolution, and ecology of reptiles. His foray into the ecology and behavior of the varanid (monitor) lizards began in 1968 when F. Wayne King, then of the New York Zoological Society, recruited him to take on a project that would change his life forever. Along with Elinor and his three youngest children, Walt journeyed to the island of Komodo where he and his family lived for 11 months (1969–1970) to study dragons. This culminated in his landmark book on this species published in 1981. Two more books followed to complete his famous trilogy on varanid lizards. Walt received the Wildlife Society's Best Wildlife Book Award for his Komodo dragon book. Walt also investigated the ecology and conservation of gopher tortoises and West Indian rock iguanas. He inspired the formation of the Gopher Tortoise Council in 1978, a sister organization to the Desert Tortoise Council, both of which continue today as important advocates for the conservation of these turtles. At the time of his stroke, Walt was involved in a major study on the amphibians and reptiles of Pakistan, which his son, Kurt, and numerous colleagues around the world plan to complete. Walt lamented numerous times during his prolonged illness that he would never be able to conduct his dream study on the ecology and behavior of the Bornean lizard *Lanthanotus*.

Walt was much more than a great herpetologist, paleontologist, teacher, and family man. He was a remarkable pianist, guitar player, motorcyclist, and roller skater. He was also a fabulous artist, producing virtually all of the scientific illustrations used in his publications. Walt Auffenberg was a dynamic teacher, mentor, colleague, and friend to me. He will be missed.

Editor's note.—A complete list of Walter Auffenberg's publications can be found at:

http://www.flmnh.ufl.edu/natsci/herpetology/uf-herp/alumni/Auffenbergbiblio.htm#auffenbergbiblio

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Sherm Ketcham (1926–2004)

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Family and friends are deeply grieved by the passing and loss of friend, mentor, and associate Sherm Ketcham, who passed away on 1 February 2004. He had been battling cancer for years and died peacefully. He was 78.

He will be remembered for his passion for conservation and education, his interest in herpetology, and many contributions to the zoo profession through his work at the Detroit Zoological Park (now Detroit Zoological Institute) and Milwaukee County Zoological Gardens.

His childhood love of animals led him to a lead zookeeper position at the Detroit Zoological Park after serving in WWII and the Korean War. Sherm worked there from 1961 to 1970 and was promoted to supervisor of reptiles. He was instrumental in the opening of Holden Museum of Living Reptiles.

From 1970 to 1983, Sherm was employed as Curator of Reptiles at the Milwaukee County Zoo. He developed many of the naturalistic reptile exhibits, improved husbandry techniques and bred many reptiles, especially pythons. Throughout his career, Sherm held firmly to the idea that everyone should have the opportunity to view reptiles up close and in naturalistic exhibits. He designed many exhibits that were innovative and state of the art for the time. Sherm's reptile handling ability is still considered extraordinary by some. Sherm was instrumental in developing "Animal in Action," a hands-on educational program in which zookeepers presented reptile talks to zoo visitors. He also implemented public feeding of snakes so that zoo visitors had the opportunity to view these interesting feeding behaviors.

Sherm was quite the reptile collector, and spent a considerable amount of time in the field collecting and observing reptiles. He was one of the first to utilize early radio telemetry in tropical snakes in Peru and Costa Rica. Sherm assisted with many reptile field projects and is mentioned in numerous reptile publications.

Perhaps his greatest contribution to herpetology was his devotion to educating, training, and motivating young people interested in working with reptiles, a task he accomplished with great ease. During his free time, Sherm presented reptile talks to nursing homes and scouts groups, as well as other organizations. He possessed a contagious enthusiasm that inspired so many around him to excel and achieve, and it is in this capacity as a mentor to aspiring herpetologists that he will be missed the most.

Those wishing to express their appreciation for Sherm Ketcham and his work may direct memorial contributions to Marje Ketcham at 57 Midway Rd, Eldon, Missouri 65026, USA. Contributions will be used for a memorial at the Detroit Zoological Institute.

CURRENT RESEARCH

The purpose of **Current Research** is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, **Eli Greenbaum** or **María del Rosario Castañeda**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can be found at: http://www.herplit.com/contents.

12S and 16S Mitochondrial Genes in Frog Systematics

Although fragments of the 12S and 16S mitochondrial genes have been used extensively in studies of amphibian phylogenies, the usefulness of these genes at different hierarchical levels has not been examined in detail. The authors sequenced 400-bp segments of 12S and 500-bp segments of 16S in Discoglossidae (to examine recent splitting events) and several archaeobatrachians (to examine basal splitting events); additional sequences of other amphibian and reptile taxa were obtained from GenBank. Phylogenetic trees were constructed with maximum parsimony (PAUP 4.0b8), maximum likelihood (Tree-Puzzle 5.0), Bayesian analysis (Mr Bayes 2.01), and one-step analyses (POY). Results indicated that secondary structure of rRNA is not fixed in taxa with highly divergent primary sequences. Moreover, different alignment methods (e.g., POY, CLUSTAL X) resulted in disparate hypotheses of positional homology, number of variable characters, and number of parsimony-informative characters. In all analyses, recent splitting events received universal support, whereas conflicting hypotheses were identified regarding the major anuran clades. The authors suggest noise in the data and uncertain primary homology statements produced conflicting results, and 12S and 16S ribosomal genes should be used with considerable caution to infer the "early phylogeny" of frogs.

HERTWIG, S., R. O. DE SÁ, AND A. HAAS. 2004. Phylogenetic signal and the utility of 12S and 16S mtDNA in frog phylogeny. Journal of Zoological Systematics and Evolutionary Research 42:2–18.

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Ambush Strategies of *Crotalus horridus*

To be effective ambush predators, vipers use chemoreceptive

stimuli to identify ambush sites near suitable prey. Clark tested the behavioral reactions of 24 juvenile *Crotalus horridus* to tap water (control) and aqueous extracts of the integument of a frog, a lizard, and six species of mammals. Snakes directed most tongue flicks toward integuments from white-footed mice and chipmunks; stereotypical ambush posture was initiated by snakes most often when these prey-item scents were encountered. Snakes directed the fewest tongue flicks toward scents from animals that are either allopatric with the Pennsylvanian population of tested snakes, or species that are not usually preyed upon by *Crotalus horridus* (e.g., dogs). The results of this study complement previous studies that documented a link between prey scent and snake ambush strategies.

CLARK, R. W. 2004. Timber rattlesnakes (*Crotalus horridus*) use chemical cues to select ambush sites. Journal of Chemical Ecology 30:607–617.

Correspondence to: Rulon W. Clark, Department of Neurobiology and Behavior, Cornell University, Ithaca, New York 14853, USA; e-mail: rwc13@cornell.edu.

Vocal Communication in *Xenopus laevis*

Anuran calls have been associated with reproduction and intrasexual communication in many species. The authors examined the effects of gender and gonadotropin injections on calling behavior of *Xenopus laevis* in captivity. Field recordings of wild animals were made near Cape Town, South Africa for comparison. Analysis of field recordings identified eight call types, including one call (chirping) that had not been described in previous studies. In lab experiments, males vocalized to both sexes, but females vocalized only to males. Male-male interactions involved more calls and clasping when one or both of the males were injected with gonadotropin; dominance in clasping behavior was closely associated with dominance in calling. The authors suggest *X. laevis* establishes a vocal hierarchy in which dominant males emit advertisement calls, and vocally suppressed males (subordinates) rarely advertise.

TOBIAS, M. L., C. BARNARD, R. O'HAGAN, S. H. HORNG, M. RAND, AND D. B. KELLEY. 2004. Vocal communication between male *Xenopus laevis*. Animal Behaviour 67:353–365.

Correspondence to: Martha L. Tobias, 909 Fairchild Building, MC 2430, Department of Biological Sciences, Columbia University, New York, NY 10027, USA; e-mail: mt18@columbia.edu.

A Molecular Phylogeny of *Bolitoglossa*

The Neotropical salamander genus *Bolitoglossa* includes more than 80 species from a diversity of habitats between Mexico and central Bolivia. The authors conducted a phylogenetic analysis on numerous species of *Bolitoglossa* to address hypotheses regarding multiple colonization of tropical lowlands and the invasion of South America. Data used for this study included 1196 bp of 16S and cyt *b* genes from 55 species (including 7 unnamed taxa); outgroups included *Batrachoseps, Thorius,* and *Pseudoeurycea.* Phylogenetic analyses included maximum parsimony, maximum likelihood, and Bayesian analysis. Results supported a monophyletic *Bolitoglossa* and seven clades that are consistent with previously recognized groups within the genus. Taxonomic implications of the results are discussed in detail. The authors suggest members of one clade (*Eladinea*) invaded South America before the establishment of the Isthmian link.

PARRA-OLEA, G., M. GARCÍA-PARÍS, AND D. B. WAKE. 2004. Molecular diversification of salamanders of the tropical American genus *Bolitoglossa* (Caudata: Plethodontidae) and its evolutionary and biogeographical implications. Biological Journal of the Linnean Society 81:325–346.

Correspondence to: David B. Wake, Museum of Vertebrate Zoology, University of California, Berkeley, California 94720-3160, USA; e-mail: wakelab@uclink.berkeley.edu.

Intraspecific Communication with Chemical Cues in *Leiopelma*

Although bioacoustic communication is widespread among frogs, the earliest anurans probably never evolved this ability. *Leiopelma hamiltoni* belongs to an ancient lineage of frogs dating back to the Jurassic. This species has many morphological and behavioral similarities to salamanders, including well-developed vomeronasal and olfactory senses. The authors tested the ability of *L. hamiltoni* to communicate with chemosignals in captivity. Sixty wild-caught frogs were placed in plastic boxes with two paper towels (one on each side) containing either no scent or conspecific integumentary scents. Movements of test subjects toward either side of boxes were recorded. Results indicated strong preference for a given test subject's own scent to an unscented paper towel or a conspecific's scent if the conspecific was collected more than 5 meters away from the test subject (i.e., unfamiliar individual) in the wild. When limited to a choice between an unscented paper towel and one marked by an unfamiliar conspecific, test subjects spent more time near the unscented paper towel. This is the first study to demonstrate that adult anurans use chemical cues for intraspecific communication.

WALDMAN, B., AND P. J. BISHOP. 2004. Chemical communication in an archaic anuran amphibian. Behavioral Ecology 15:88–93.

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A Molecular Phylogeny of *Iberolacerta*

To identify "meaningful conservation units" and explore the history of the genus *Iberolacerta,* the authors sequenced a 460 bp segment of the control region and right domain region, and a 1033 bp segment of cytochrome *b*. Distances between haplotypes were computed in MEGA, and trees were constructed using maximum parsimony (MP) and maximum likelihood (ML) in PAUP*. Divergence-time estimates were obtained from previous substitution rates for reptilian cytochrome *b*. Both methods of tree construction produced four well-supported clades within the monophyletic genus, but the MP and ML trees differed in the position of some taxa. The authors suggest isolation of the four main clades occurred in the northwestern Iberian mountains, the Central Ibe-

rian mountains, the Pyrenees, and the eastern Alps. *Iberolacerta martinezricai* is considered to be a valid taxon in need of urgent conservation action—the total population size is estimated to be less than 50 individuals.

CROCHET, P. -A., O. CHALINE, Y. SURGET-GROBA, C. DEBAIN, AND M. CHEYLAN. 2004. Speciation in mountains: phylogeography and phylogeny of the rock lizards genus *Iberolacerta* (Reptilia: Lacertidae). Molecular Phylogenetics and Evolution 30:860–866.

Correspondence to: P. -A. Crochet, Laboratoire de Biogéographie et Ecologie des Vertébrés, EPHE, box 94, Université Montpellier cedex, France; e-mail: crochet@cefe.cnrs-mop.fr.

Translocation of Gila Monsters in Arizona

Previous studies of translocation in snakes have reported low success rates. Several agencies currently translocate Gila Monsters (*Heloderma suspectum*) from large cities in Arizona, but the effects of this process are unknown. The authors responded to calls for nuisance animals, implanted passive integrated transponders and radio transmitters into the animals, and either translocated them (N = 15) or released them 200 m from the site of capture (N = 9). Test subjects were located every 2–5 days, and their location and behavior were recorded. All lizards released less than 1000 m from the site of capture returned within 30 days. However, all translocated lizards that failed to return were lost (presumably dead) or died, suggesting that translocation may have detrimental effects on some individuals. Moreover, translocated individuals had nearly five times higher mean daily movements compared to non-translocated individuals, which may have contributed to higher predation rates in translocated lizards. The authors conclude that translocation is not a satisfactory solution to the problem of "nuisance" animals.

SULLIVAN, B. K., M. A. KWIATKOWSKI, AND G. W. SCHUETT. 2004. Translocation of urban Gila Monsters: a problematic conservation tool. Biological Conservation 117:235–242.

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Multiple Paternity in *Lacerta vivipara*

Several studies have suggested multiple paternity in lizard mating systems based on behavioral observations, but few researchers have demonstrated this phenomenon with molecular evidence. The authors used six polymorphic microsatellite markers to examine paternity in six populations (four captive, one highland, one lowland) of *Lacerta vivipara*. Considering all loci, none of the six populations differed from Hardy-Weinberg equilibrium. The number of multiply sired clutches was 50% or greater in all populations, and the mating system was not affected by environmental or population factors. The authors suggest multiple paternity is related to conflicting male-mate strategies in territorial species, but because *L. vivipara* males are not territorial, additional hypotheses should be explored in future studies.

LALOI, D., M. RICHARD, J. LECOMTE, M. MASSOT, AND J. CLOBERT. 2004. Multiple paternity in clutches of common lizard *Lacerta vivipara*: data from microsatellite markers. Molecular Ecology 13:719–723.

Correspondence to: D. Laloi, Laboratoire d'Ecologie, UMR 7625, Université Pierre et Marie Curie, 7 quai Saint Bernard, case 237, 75252 Paris cedex 05, France; e-mail: dlaloi@snv.jussieu.fr.

Life-History Variation of *Sceloporus undulatus*

Studies of life-history evolution have been advanced by phylogenetic comparative analyses in recent years. However, few of these analyses have been attempted at the intraspecific level. The authors used a previously published molecular phylogeny of *Sceloporus undulatus* to examine intraspecific life-history variation. Fourteen populations of *S. undulatus* with good life-history information were examined along with one population each of *S. occidentalis, S. virgatus,* and *S. woodi.* Data were analyzed with independent contrasts and phylogenetic autocorrelation. The data indicated body size is an important correlate of life-history variation, but there are no important phylogenetic effects on life-history variation in *S. undulatus*. The authors suggest future studies of life-history variation are likely to vary by taxon and traits that are analyzed.

NIEWIAROWSKI, P. H., M. J. ANGILLETTA JR., AND A. D. LEACHÉ. 2004. Phylogenetic comparative analysis of life-history variation among populations of the lizard *Sceloporus undulatus*: an example and prognosis. Evolution 58:619–633.

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Conservation of Honduran Amphibians and Reptiles

Although the greatest diversity of life exists in the tropics, this region also has the greatest rate of human population growth. As currently understood, Honduras contains 334 species of amphibians and reptiles, and an additional 20 species are likely to occur there. Forty-one species of amphibians are endemic to Honduras, of which seven have "disappeared" and another 13 are declining; less than half of the amphibian taxa known from Honduras are stable. The authors used a set of gauges (e.g., extent of geographic range and ecological distribution) to establish a set of conservation priorities for the remaining Honduran herpetofauna. The authors classified 103 species of amphibians and reptiles as high priority, 154 species as intermediate priority, and 71 species as low priority. To offset the threats to the herpetofauna, the authors suggest expanding and improving the system of biotic reserves in Honduras as soon as possible.

WILSON, L. D., AND J. R. MCCRANIE. 2004. The conservation status of the herpetofauna of Honduras. Amphibian and Reptile Conservation 3:6–33.

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ZOO VIEW

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Count de Lacepède: Renaissance Zoo Man

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"If destiny brings you to the far end of the globe, nature will surround you constantly with its production, its Phenomenon, and marvels. Do not ever renounce going to the purest of all sources."

"When science will have spread its domain, man will interrogate nature in the name of time and time in the name of nature. So many fertile comparisons will come to mind."

Bernard-Germain-Étienne de la Ville-sur-Illon, Compte de Lacepède (1798 and 1800)

"The cube, indeed a straight line of any kind, is unbiological."

Heini Hediger (1970:21) on artificial shapes such as cubical cages in zoos

Carl Hagenbeck (1844–1913) opened his Tierpark at Stellingen, Germany in 1907 and developed the first exhibits without bars for zoos (Kreger 2001; Reichenbach 1996). He served as a design consultant for zoos throughout the world and his philosophies are incorporated even today when new animal displays are planned. In the zoo and aquarium community, the Hagenbeck name is associated with naturalistic exhibitry and there is a perception that he was the first to envision a zoo without bars, nestled in a naturalistic setting. In reality, over a century earlier, Bernard-Germain-Étienne de la Ville-sur-Illon, Compte de Lacepède[1] (1756–1825; Fig. 1), the French naturalist known for his herpetological work, published several seminal papers on zoo history, philosophy, and design that discussed open exhibits and spaces. These publications are virtually unknown. To give Count de Lacepède the recognition he deserves, we have translated portions of his papers from French to show how enlightened he was at the beginning of the nineteenth century. It is interesting that zoo managers struggle today to grasp and implement concepts identified by Lacepède so long ago.

Fig. 1. Portrait of Count de Lacepède. Courtesy of Kraig Adler.

Lacepède was disturbed by the way animals had been treated in the past and how little proper care had improved. He wrote, "It is only very recently that liberty and reason have started to reign over a part of Europe; almost all the menageries that we see on that portion of the globe are still similar to those of the Roman despots. . . . They counted among the attributes of the empire, those narrow edifices, those tight lodges where they are kept, mutilated, degraded, denatured."

Lacepède had a clear idea of the proper mission of zoos and the three roles that these institutions should play: "Three objects are the principal aim of an establishment. The first is to satisfy the curiosity of the public by giving an easy and durable instruction without seeming so to show the habits of animals, to portray the species that Pliny, Linné, and Buffon transmitted to us, to substitute the attitudes of constraint to movements with a sort of independence. The second of those three objectives is to give to the naturalist the true means to perfect zoology by means of the menageries, and the third, to serve society most directly by acclimatizing wild animals reclaimed from the wild." An important point here is that Lacepède understood that zoo visitors could have a pleasant experience and learn something about animals in a nonthreatening way. The choice of the words ". . . to serve society most directly by acclimatizing wild animals reclaimed from the wild" and "greatest utility for man" used below suggests that he was an early thinker about the notion that zoos could be used as acclimatization facilities for wild species that might be domesticated or tamed and be of some "utilitarian" use for humans. The world's first acclimatization society was the Société Zoologique d'Acclimatation, founded in Paris in 1854 (Gillbank 1996). The founding president was Isidore Geoffroy Saint-Hilaire, professor of zoology at the Muséum national d'histoire naturelle and director of the Ménagerie (created in 1793). In 1860 Isidore and his son, Albert Geoffroy Saint-Hilaire, opened Jardin Zoologique d'Acclimatation, west of Paris (Osborne 1996). With reptiles, Henry Fitch (1980) warned captive managers about changes induced by captivity: "Thus, captivity will result in intensive selection, molding the animal in a manner quite different from that followed in its natural environment. The final product will be an animal much better adapted to live in close association with humans, in the home or laboratory, but less well adapted for life under natural conditions." Clearly, the effects of captivity on amphibians and reptiles, especially when reintroductions or other interventions are considered, need to be carefully investigated beforehand (see Chiszar et al. 1993; Dodd and Seigel 1991).

Lacepède was associated with La Ménagerie at the Muséum. Most herpetologists are familiar with Lacepède's name through his monumental tome which was the first to cover amphibians and reptiles of the world, "Histoire Naturelle des Quadrupèdes Ovipares et des Serpens," published in 1788–1789. Based in part on his experiences at the Ménagerie, he formulated a plan for the ideal menagerie: "One will be able to compare this enormous menagerie with the outdoors where the different animal species enjoy all the liberty that it is possible to give them without danger for the numerous spectators, who are also often imprudent, where

they will find a roof and care and where living among plants and trees of their country, shaded at least by vegetation as similar as that that can be found in their country, where they can play and their movement unimpeded, where they do not feel the exile nor the lack of their independence, where they will present to the observer the true picture of what they are like in their environment in the most remote countries of the globe."

Lacepède understood the integration of scientific inquiry into the operations of a zoo, as made clear by several selected passages in his 1801 publications: "It is through the help of such menageries that we will be able to create the science of animal physiognomy more real than that of human physiognomy because their pantomime does not express ideas and only depicts sensation and not ever being altered by pretenses is simpler, stronger, and truer." He continues. . ."The more or less great sensibility to the climatic conditions, to the different elements, the odor, the color, the sonorous impression, the mode of breeding, the time of the pregnancy, the duration of incubation, etc. . ." It is important to remember that the science of ethology did not exist at that time. What is also remarkable is that he understood how observations on behavior, reproduction, nutritional needs, and longevity could be accomplished in a zoo, for he said ". . . Let us keep species which can be of the greatest utility for man and let us give them wide living quarters, durable and best suited for their habits so that they can be observed fruitfully so that one can find the most adaptable nourishment which is most suited to their organs. Also, so that one can find their breeding habits, the number of their litter, the nature of their affection, the violence of their appetite, the length of their life span." Interestingly, Nobel laureate Konrad Lorenz reinforced Lacepède's vision a century and a half later (1952:73): "By keeping a living thing in the scientific sense we understand the attempt to let its whole life cycle be performed before our eyes within the narrower or wider confines of captivity."

Zoo workers should maximize the utility of their living collections by preserving specimens upon death and placing them in a suitable depository. Lacepède addresses this issue: "When an animal dies, it is immediately brought to the laboratory of anatomy. There the skin is taken and sent to the laboratory of zoology where the professor has it mounted if it is not yet on exhibit. Then we prepare the pan, and we put in one pan all the fleshy parts which one intends to preserve. We do not even neglect to look if there is not in the body of the animal some intestinal worms, which could lead to new observations." In this passage, Lacepède offers suggestions to the zoo pathologist as well. According to Kirchshofer (1968:288), Max Schmidt, a veterinarian and director of the Frankfurt Zoo from 1859 to 1885, "initiated the post mortems (sic) on zoo animals."

FIG. 4. Cover of "Le Monde Illustré" published 24 October 1874 showing reptile display and inhabitants at La Ménagerie Jardin des Plantes in Paris. Courtesy of Jean-Luc Berthier, Jardin des Plantes Archives.

FIG. 2. Undated illustration, possibly around mid-1870s, of interior of reptile building at La Ménagerie Jardin des Plantes in Paris. Credit: provided by Jean-Luc Berthier, Jardin des Plantes Archives.

Consider how stunning Lacepède's ideal zoo would be if it were ever actualized in totality: "The garden spreads over a surface which is rectangular and measures more or less thirty-six acres and offers a few elevations. Two little artificial rivers cross the terrain for all its length and end in a series of little lakes of irregular contours. Between the two sinuous little rivers an elevated path is used by the visitors; on each side of the bed of the double river the terrain rises slightly and irregularly and is provided with small hills and rocks. The park is planted with trees and appropriate bushes. Some parts are covered with sand. The slopes are divided in several enclosures of irregular dimensions surrounded by fences which go down to the water and are hidden by vegetation. The river is enlarged in front of those enclosures to allow animals to bathe and the edge is a little inclined in order to facilitate their access to the water. The night lodges for carnivores are hidden by rocks. For most of the species shelters are provided. The bird cages

are spacious and contain small trees and artificial rocks. There are lakes for fishes, aquatic turtles, sea lions, and especially aquatic birds, which are also allowed on certain parts of the rivers. Place is even provided for the breeding of worms and mollusks.

The zoological park so conceived is not an accumulation of buildings or birdcages or cages with bars but it constitutes a true scenery. The plantations offer plenty of natural habitats of most of these exhibited animals. As much as possible one will use as enclosures natural obstacles, among others, a combination of water surface and of different levels, for instance, an elevated path. Thanks to the sloping terrain the animals are not in moats but are the same level or almost the same level as the spectators." The Count identified an important issue relevant to zoo herpetologists. Presently, many zoo administrators are enamored with the rare and expensive – the so-called charismatic mega-vertebrates – so places for breeding worms and mollusks are rarely incorporated into master plans; amphibians and reptiles suffer the same fate. To prove this point, consider how few new herpetological facilities are being planned or significant resources directed into herpetological programs. Accordingly, there is a disturbing trend for building unimaginative and uninspiring zoogeographic exhibits with an occasional python, crocodilian, giant tortoise, or large lizard added as an afterthought. Retired director William Conway from the Wildlife Conservation Society in New York published a thought-provoking paper (1968, 1973) suggesting that the common bullfrog–widespread, small, inexpensive and ectothermic– can enlighten and educate the visitor very effectively. Today, a bullfrog display could be used as the perfect example to highlight amphibian biology, decline of amphibian populations worldwide, and the danger of introducing alien species. Unfortunately, zoo herpetologists have been rather ineffective in convincing their superiors that amphibians and reptiles are incredibly interesting and deserve a *prominent* place within the zoological garden or aquarium.

Lacep de was unable to implement his ideas, owing to the unstable political climate during the French Revolution and the lack of funds (Van den bergh 1962). His plans for outdoor displays at the M nagerie in Paris would have been suitable for some Temperate Zone animals, including amphibians and reptiles, but exotic taxa require indoor exhibits with stable temperatures. During 1870—1874, a reptile building with a pavilion and two lage center exhibition halls was constructed (Figs. 2—3).This beautiful edifice exists today, still used as a reptile building.

Biographies of Lacepède, appointed the Grand Chancellor of the Legion of Honor by Napoleon, are available (Adler 1989; Van den bergh 1962).

Acknowledgments.—This publication is dedicated to Warren Iliff, who throughout his professional career has strived to build the ideal zoo and aquarium. Kraig Adler, Judith Block, Jon Coote, Lucian Heichler, Robert Hoage, and Ken Kawata reviewed early drafts of the manuscript. Jean-Luc Berthier provided illustrations from the Archives of the Ménagerie Jardin des Plantes. Smithsonian National Zoological Park Librarian Alvin Hutchinson was instrumental in locating important historical documents. Leslie Overstreet and Daria Wingreen from the Joseph F. Cullman 3rd Library of Natural History (Smithsonian Institution Special Collections Department) allowed access to the extensive Lacepède collection. Our interest in the Count's life was stimulated by reading the excellent article by H. K. Van den bergh.

Footnote: [1]We follow Adler (1989) in spelling Lacepède without the acute accent on the first *e*.

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ARTICLES

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A Note on the Identity of Chuckwallas Inhabiting Isla Danzante, Baja California Sur

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There is disagreement concerning the taxonomic identity of chuckwallas inhabiting Isla Danzante, Baja California Sur. Isla Danzante is a land bridge island situated at 25°47'07"N latitude, and 111°14'59"W longitude, 2.61 km from the coastline of the Baja California peninsula and south of Isla Carmen. It has an area of about 4.64 km^2 (Murphy et al. 2002). In a systematic revision of the genus *Sauromalus*, Hollingsworth (1998) placed the continental *S. obesus* and the peninsular *S. australus* in the synonymy of *Sauromalus ater*. He also classified the chuckwallas from the southern gulf islands, including Isla Danzante, as *S. ater.* In a study of body size evolution and biogeography of chuckwallas, Petren and Case (1997) sequenced the cytochrome *b* gene from a number of continental and insular populations of chuckwallas. Their analysis revealed that a single chuckwalla from Isla Danzante was genetically similar to their samples of *S. slevini* from Islas Carmen and Monserrate (*S. slevini* also occurs on Isla Coronados, but that island was not sampled by the authors).

Grismer (1999, 2002) listed Isla Danzante among the islands inhabited by *S. ater.* Murphy and Aguirre-Leon (2002) called attention to the discrepancy between Grismer's classification of the chuckwallas from Isla Danzante and the molecular genetic evidence from Petren and Case (1997), and chose to recognize this insular population as *S. slevini*. The purpose of my study is to compare nuchal scalation and other characteristics in a limited number of specimens to determine whether the Isla Danzante population is more similar to *S. ater* or *S. slevini.*

Sauromalus slevini is considered to be generally intermediate in scalation between the spiny chuckwalla, *S. hispidus,* and the smaller-scaled *S. ater* from the southern gulf islands (Shaw 1945). In *S. slevini*, the nuchal scales are much larger than the median dorsal scales and are conical to strongly spinose (Grismer 2002; Shaw 1945). Also, above and slightly forward of the shoulder, there is a skin fold bearing a patch of enlarged, subconical scales (Hollingsworth 1998; Shaw 1945). In contrast, the nuchal scales in *S. ater* are usually tuberculate, flattened, or spinose, but only slightly larger than the largest median dorsal scales. Also, the antehumeral fold lacks a group of enlarged, subconical scales; instead the scales are subequal.

Sauromalus slevini and *S. ater* cannot be distinguished on the basis of meristic scale characters. The range limits of eight meristic characters overlap substantially between the two taxa (compare Tables 13 and 19 in Hollingsworth 1998). Discriminant functions analysis (based on these eight meristic characters) did not separate chuckwallas from Isla Danzante from the insular samples of *S. ater*. The sample from Isla Danzante fell within the dispersion polygon of the sample from Isla San Francisco (see Fig. 51 in Hollingsworth 1998).

I examined two specimens from Isla Danzante (BYU 34494–95, female and male respectively), and compared them with a series of seven *S. slevini* from Isla Carmen, and eight *S. ater* from Isla San Francisco. The two specimens from Isla Danzante are very similar to specimens of *S. slevini*, having nuchal scales that are conical to strongly spinose, especially in the male (Fig. 1). However, many of the nuchal scales in the male specimen show damage, and examination under a dissecting microscope revealed that they were abraded. During life, the lizard may have frequently used a rock crevice with abrasive surfaces, perhaps for predator escape. The scales on the antehumeral fold are conical in the male specimen, and merge with more spinose scales in adjacent areas of the dorsum. The female specimen lacks differentiated scales on the antehumeral fold of the left side, and the scales are only feebly enlarged on the right side.

The male specimen from Isla Danzante has a snout–vent length of 193 mm, which greatly exceeds maximum SVL of *S. ater* from the southern gulf islands, and falls within the upper decile SVL of *S. slevini.* Hollingsworth (1998, Table 4) provides maximum SVLs for these insular samples as follows: Isla Espiritu Santo (169 mm), Isla Partida Sur (171 mm), Isla San Diego (134 mm), Isla San Francisco (145 mm), Isla San Jose (156 mm), Isla San Marcos (164 mm), and Isla Santa Cruz (166 mm). Hollingsworth (1998) gives maximum SVLs for three populations of *S. slevini* as follows: Isla Carmen (188 mm), Isla Los Coronados (202 mm), and Isla Monserrate (209 mm). Petren and Case (1997, Table 2) provide upper decile SVLs for these populations as follows: *S. ater* from the southern gulf islands (163 mm; N = 111) and *S. slevini* from Isla Carmen (181 mm; N = 22).

There appears to be ontogenetic as well as sexually dimorphic variation in the development of the enlarged, spinose nuchal scales in *S. slevini*. The largest male examined (CAS 16127; 190 mm SVL) has greatly enlarged, spinose nuchal scales giving the lizard a more bristly appearance compared with smaller males (143–179 mm SVL). Three females examined (127–154 mm SVL) also have

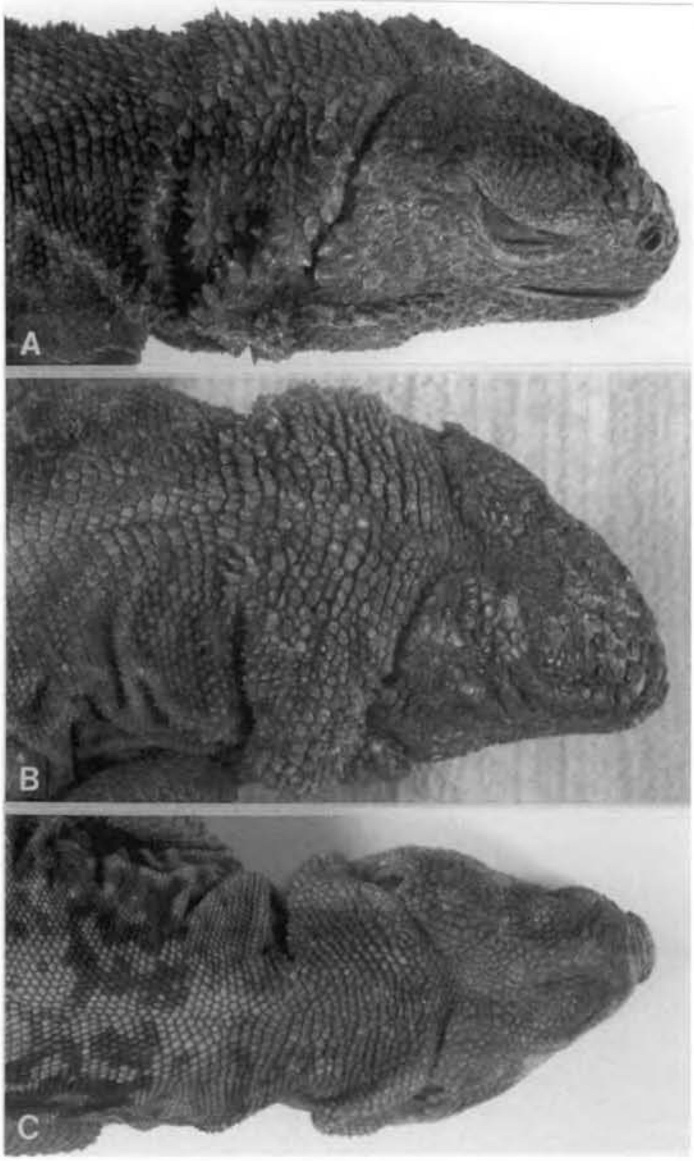

FIG. 1. Comparison of the nuchal scales of (A) *Sauromalus slevini* (CAS-SU 16127), male, from Isla Carmen; (B) *Sauromalus* (BYU 34495), male, from Isla Danzante, and (C) *Sauromalus ater*, (CAS 52708) from Isla San Francisco.

spinose nuchal scales that are less developed when compared with males.

There is also variation in the development of enlarged subconical scales on the antehumeral fold. In the largest male *S. slevini* examined, the scales on the antehumeral fold are spinose and merge with those on the nuchal area. In smaller males, and in females, slightly enlarged, rounded to subconical scales may be present on the antehumeral fold as a discrete group, surrounded by smaller scales. However, the degree of development of the scales on the antehumeral fold is variable among individuals, and may also differ between the left and right antehumeral folds on the same individual. The ontogenetic and sexually dimorphic variations in these characters have not been previously reported.

Hollingsworth (1998) recognized *S. slevini* and *S. klauberi* as sister taxa on the basis of three synapomorphies: enlarged scales on the antehumeral fold, spinous lateral fold scales, and absence of caudal bands throughout ontogeny. The group of differentiated scales on the antehumeral fold of *S. slevini* seems to foreshadow the further enlargement of these scales in *S. klauberi,* but except in the largest specimens, they lack the more spinose shape seen in the latter species.

In conclusion, the chuckwallas from Isla Danzante agree with *S. slevini* in terms of the relative size and shape of the nuchal scales, the presence of enlarged scales on the antehumeral fold, and the snout–vent length. The morphological evidence is therefore consistent with the gene sequence data from Petren and Case (1997), and this insular population should be regarded as *Sauromalus slevini.*

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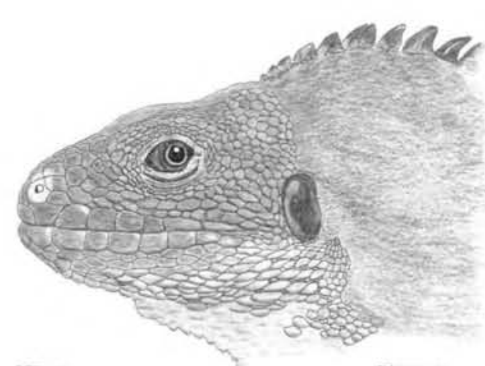

Brachylophus vitiensis (Fiji Crested Iguana), adult female. Illustration by John Bendon (Lizardwizard@btinternet.com).

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First Record for the Genus *Antaresia* (Squamata: Pythonidae) from Papua New Guinea

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On 11 August 2000, during the filming of a documentary in Western Province, Papua New Guinea (PNG), the authors flew from Daru Island to the disused airstrip at Weam (141°07'E, 08°37'S), ca. 33 km E of the Indonesian border (Fig. 1). While searching among discarded metal sheeting on the edge of the Weam runway, we found a small *Antaresia* and two skin sloughs, likely to have come from the same snake, between two upright layers of corrugated sheeting (Fig. 2). The specimen is the first representative of the genus to be found in New Guinea and the first recorded outside Australia.

We tentatively identify this specimen as *Antaresia maculosa* (Fig. 3). It is a female measuring 480 mm snout–vent length, 525 mm total length. Characters of scalation were recorded according to Smith (1985) (Table 1). There are 253 ventrals, 48 subcaudals, and dorsal scale rows are 33-41-25. The scalation of the head is as follows: there are 10/10 supralabials with the fifth and sixth in contact with the lower margin of the orbit; 12/12 infralabials; two pairs of prefrontals with one smaller azygous scale on the midline; 4/5 loreals; 1/1 preocular; 3/3 postoculars; and 2/2 anterior temporals. The scale counts fall within the ranges reported for *A. maculosa* (Smith 1985). Barker and Barker (1994) report an average ventral+subcaudal count of 317.5 in northern Australian populations and an average of 301.3 in southern populations. The ventral+subcaudal count for the Weam specimen is 301, which unexpectedly associates it with the more southern populations in Australia. According to David Barker (pers. comm.), the pattern of the specimen discovered at Weam resembles the inheritable appearance seen in some captive-bred spotted pythons known as the "granite phase." We are not aware that this pattern type occurs in natural Australian populations of *A. maculosa*.

The presence of *Antaresia* in southwestern PNG provides further proof of the strong herpetofaunal links that exist between the southern Trans-Fly region of New Guinea and northern Australia. As recently as 10,000 years b.p. the two land masses were broadly joined by land, the Sahul Shelf, now submerged under the Torres Strait, allowing considerable interchange of floras and faunas. The overlap in reptile species has been well documented (Cogger 2000; De Rooij 1915; O'Shea 1996). Although the new specimen superficially differs in appearance from wild Australian *Antaresia maculosa*, presently there is insufficient reason to describe it as a new taxon because a) only one specimen was found and b) there

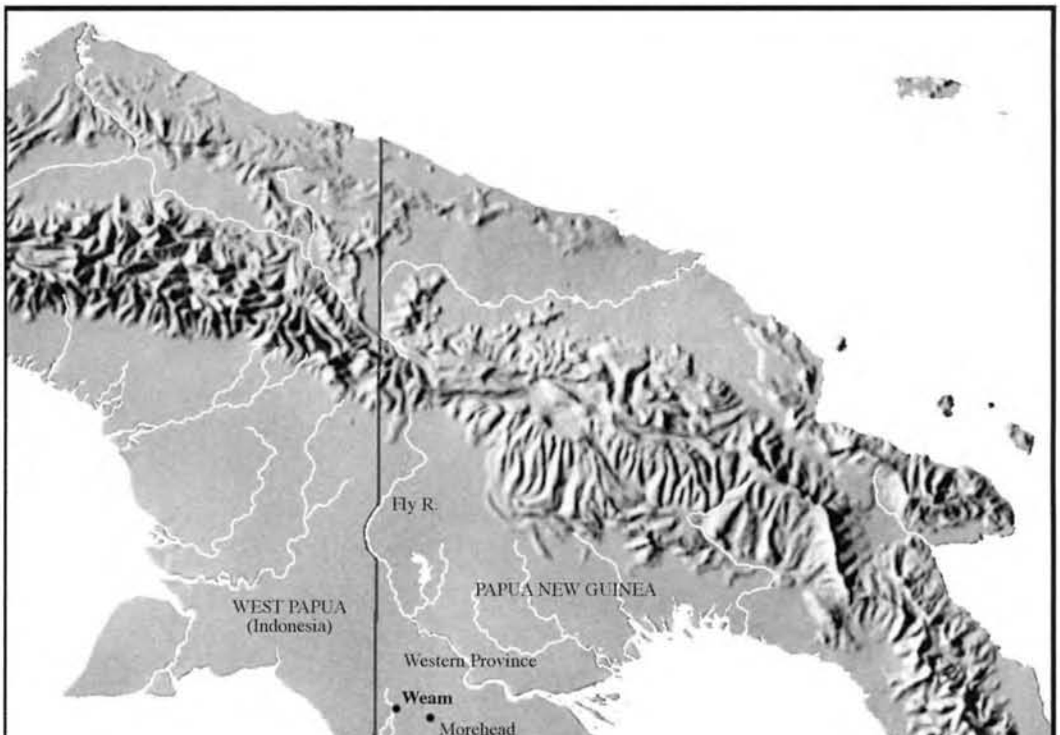

FIG. 1. Map of Papua New Guinea showing Weam (in bold) located in Western Province.

FIG. 2. Collection site of *Antaresia maculosa* at Weam Airstrip, Weam, Morehead District, Western Province, Papua New Guinea.

are strong zoogeographic links between Western Province, PNG and far northern Queensland. However this does not rule out the possibility that this New Guinea snake might represent a new species. Further fieldwork and DNA comparisons are needed to determine relationships of our specimen to those occurring in Queensland.

Many of the more remote areas of the Western Province of PNG remain poorly explored. The terrain is flat, heavily forested, and largely swampland or floodplain with numerous termite mounds, which makes fieldwork difficult. Weam is along the far western border of Papua New Guinea, near the Indonesian border and on the Bensbach River (Fig. 1). We were told that the airstrip has been closed for 10 years and had only been opened to facilitate our arrival and departure. Though August is generally dry season

FIG. 3. Specimen of *Antaresia maculosa* (PNGM 25085) from Weam, Western Province, Papua New Guinea. Top: dorsal view of head; lower: whole body view. Photos by Mark O'Shea.

TABLE 1. Comparison of features of *Antaresia maculosa* (based on Smith 1985) with the specimen of *A.* cf. *maculosa* from Weam, PNG.

Character	Australian *A. maculosa*	Weam specimen
Dorsal scales at neck	28–35	33
Dorsal scales at midbody	35–44	41
Dorsal scales at vent	22–28	25
Ventrals	246–287	253
Subcaudals	37–48	48
Ventrals + subcaudals	288–332	301
Supralabials	10–11 (11–12)	10
S/L contacting orbit	5th & 6th	5th & 6th
Infralabials	12–14	12
Pairs of prefrontals	2	2
Azgygous scale present	variable	yes
Loreals	3–10	4–5
Preoculars	1	1
Postoculars	3–4 (2–5)	3
Anterior temporals	3–4 (3–5)	2
Dorsal coloration	yellow-brown to dark brown	olive brown
Dorsal pattern	irregular rough-edged spots	dark irregular, rough-edged spots arranged in transverse rows
Scale iridescence present	yes	yes
Ventral color	immaculate off-white	immaculate off-white merging to light yellow
Head coloration	brown with spotted markings posteriorly	as body with single or fused dark spots on every scute, dark canthal and temporal stripe and off-white labials below
Color of iris	brown to orange or gold	dark orange

in Western Province, the 2000 wet season lasted well into July. Nevertheless, humidity levels were moderate (50–60%), and the environment was generally dry and warm (29–31°C). Though we have no direct evidence of the diet of this python in PNG, there were numerous geckos (*Hemidactylus frenatus*) between the same metal sheets.

The live specimen was left in the live collection at the Papua New Guinea National Museum and Art Gallery under the care of Ilaiah Bigilale. It has subsequently died and been accessioned into the museum collection (PNGM 25085).

Acknowledgments.—The finding of this python was recorded at the moment of capture during the filming of an episode of "O'Shea's Big Adventure" for Animal Planet. The episode, entitled "Tree Crocodile," was first transmitted in the USA on 10 December 2000. We gratefully thank David Barker and Gerry Swan for their advice, the film crew from Yorkshire/Associated Producers, the owners and employees of Bensbach Lodge for support in the field, Central Air Transport, and the Tondo Wildlife Committee and Councillor Lucas Mahuse of Weam village for permission to carry out filming and fieldwork within the Tondo Wildlife Reserve area.

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Description of the Female of the Enigmatic Lizard, *Liolaemus heliodermis* (Iguania: Liolaemidae)

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The lizard genus *Liolaemus* has experienced remarkable growth in recent years. In the past decade an average of four new species has been described each year and dozens more await description (Etheridge and Espinoza 2000). Given this trend, and recent estimates of cryptic diversity in some clades (e.g., Lobo and Espinoza 1999; Morando et al. 2003), *Liolaemus* may someday surpass even *Anolis* (sensu lato) in species richness. Currently, *Liolaemus* includes approximately 160 species. A recent molecular phylogenetic analysis (Schulte et al. 2000) of 60 species representing all major *Liolaemus* lineages recovered two similarly sized clades and corroborated the results of several morphological studies (reviewed by Etheridge 1995). One of these major clades, the *chiliensis* group, includes approximately 80 species and has been further divided into numerous subgroups (Etheridge 1995; Lobo 2001). One of these subgroups, the *elongatus-kriegi* group (sensu Morando et al. 2003; see also Cei 1979), has experienced recent growth with the addition of seven species since 2000 (Avila et al. 2003, 2004; Cei and Videla 2003; Espinoza et al. 2000; Espinoza and Lobo 2003). Moreover, molecular analyses of populations in southern Argentina suggest that the *elongatus-kriegi* group may include as many as three times the number of species currently recognized (Morando et al. 2003). Given their recent discovery and remarkable diversity, the natural and life history of most species belonging to this group is poorly understood.

Among members of the *elongatus-kriegi* group, *L. heliodermis* is likely the most enigmatic. This species belongs to a recently diagnosed clade (Espinoza and Lobo 2003) that consists of four species (*L. capillitas*, *L. dicktracyi*, *L. heliodermis*, and *L. umbrifer*; but see Avila et al. 2004 for a more inclusive definition). In contrast to the other three species belonging to this northern radiation, and to the *elongatus-kriegi* group on whole, *L. heliodermis* is an unusually rare lizard (Espinoza et al. 2000). The species was described from just three specimens: two adult males and a juvenile female. The coloration of male *L. heliodermis* is unlike that of virtually all other *Liolaemus*: black heads with vibrant sulfur-yellow torsos (see Espinoza et al. 2000 for a color illustration). Interestingly, the juvenile female paratype is brown, but because no adult female was available for study, only speculation could be offered regarding the occurrence and ontogeny of sexual dichromatism in this species. Documenting sexual dichromatism in *L. heliodermis* may be the first step toward revealing related aspects of the lives of these poorly known lizards because sexual dimorphism is absent in most other members of this lineage (Espinoza and Lobo 2003). Here we describe an adult female *L. heliodermis* to provide much needed information on variation in squamation of this enigmatic taxon. Second, we address the hypotheses posed by Espinoza et al. (2000) regarding the ontogeny and intersexual occurrence of sexual dichromatism in this species.

On 25 January 2000, an adult female *Liolaemus heliodermis* (deposited at the Fundación Miguel Lillo, Tucumán, Argentina; FML 8974) was found at km 98 on Ruta Provincial 307, Departamento Tafí del Valle, Provincia de Tucumán, Argentina, just 3 km from the type locality. The specimen was dead and had been trapped in the freshly paved asphalt of this provincial highway (G. Scrocchi, pers. comm.). The lizard likely succumbed to exposure after adhering to the tar (Hubbs and Walker 1947). Before preservation, gasoline was used to remove tar from the lizard, which resulted in loss of some scales. The specimen is otherwise in good condition with the exception of the loss of approximately three quarters of the tail. Notes on color were taken prior to preservation.

The following description adopts terminology for squamation from Smith (1946) as modified by Espinoza et al. (2000) and Espinoza and Lobo (2003). We followed Frost (1992) for definitions of neck folds. Snout–vent length (76.05 mm), tail length (13.55 mm, autotomized), axilla-groin distance (34.05 mm). Head (anterior border of auditory meatus to the tip of the snout 17.94 mm), head width (anterior border of auditory meatus 13.64 mm), snout length (posterior margin of canthal to tip of snout 5.14 mm), intraorbital distance 4.34 mm, tibial length (16.23 mm), foot length

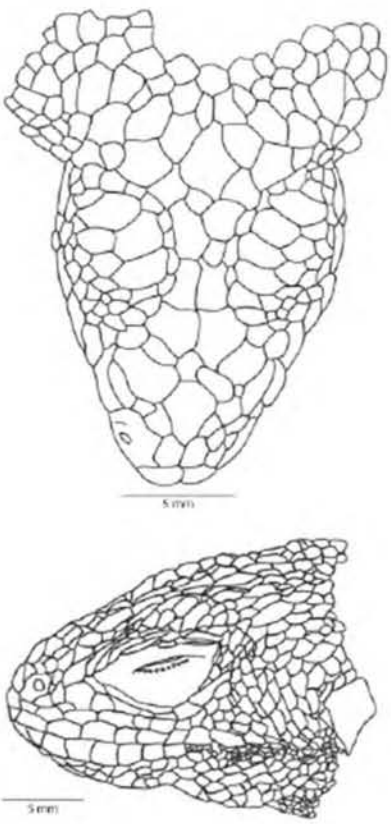

FIG. 1. Dorsal and lateral views of the head of an adult female *Liolaemus heliodermis* (FML 8974).

(22.34 mm).

Dorsal and lateral views of the head are provided in Fig. 1. Dorsal head scales smooth, 15 between occiput at the level of the anterior border of auditory meatus and rostral. Nine smooth temporals, most with a scale organ at their posterior margin. Interparietal subpentagonal, of similar size to the parietals, surrounded by seven scales. Frontal scale divided longitudinally, forming two scale rows between circumorbitals. Five scales between frontal and rostral. Two postrostrals. Each postrostral with 12–13 scale organs. Supraorbital semicircles complete. Four/five (right/left) enlarged supraoculars. Five scales between frontal and supercilliaries. Five/six flat, elongate superciliaries. Canthal separated from nasal by one or two scales. Loreal region flat. Eight scales surrounding nasals. Nasal in slight contact with rostral. Eight/nine lorilabials, fourth through eighth/nine in contact with subocular. Six/seven supralabials. Fourth/fifth supralabial curved upward posteriorly but not in contact with subocular. Infralabials five, slightly taller than supralabials. Four internasals. Orbit with 16 upper and 15 lower ciliaries. Orbit diameter 3.5 mm (measured between upper and lower ciliaries). Subocular scale elongate. Preocular unfragmented. Longitudinal ridge along upper margin of the three ocular scales. Rostral scale wider (3.88 mm) than high (1.39 mm) fragmented along left side. Mental wider (2.03 mm) than long (3.46 mm), followed posteriorly by two rows of 4/5 chinshields. Chinshields in contact with first infralabial. Scales of throat between chinshields juxtaposed, becoming slightly imbricate toward the auditory meatus. Fifty gulars between auditory meatus. Three/four scales along anterior border of auditory meatus project outward. Auditory meatus higher (4.12 mm) than wide (2.28 mm). Lateral scales of neck granular. Subdermal fat bodies give inflated appearance to neck region. Antehumeral fold distinct. Rictal, postauricular, and longitudinal folds present but less conspicuous than antehumeral. Thirty-nine scales between auditory meatus and antehumeral fold (counted along postauricular and longitudinal folds).

Scales of neck region smaller than dorsals. Sixty-four dorsal scales between occiput and anterior surface of thighs. Dorsal body scales round to rhomboidal, very weakly keeled. Fifteen to 17 longitudinal keeled scale rows over dorsum of trunk. Scales become increasingly rounded laterally and along flanks. Sixty-nine scales around midbody. Ventral scales of similar size to dorsals, 110 between mental and mid-thigh. Ventral surface of thighs with enlarged, laminar imbricate scales anteriorly, abruptly changing to smaller granular scales posteriorly at mid thigh. No precloacal pores. Fourth finger with 23 tridentate, subdigital lamellae. Claw relatively straight, moderately short, pointed, opaque brown. Fourth toe with 28 subdigital lamellae. Claw similar to that of fourth finger.

At the time of collection the specimen was dead, but apparently not for long (G. Scrocchi, pers. comm.), so its color in life was probably reasonably well preserved. Dorsally, head to near insertion of the forelimbs black. Laterally, head black with some barely noticeable gray scales. Throat charcoal black with black margins and many small, irregularly dispersed black spots. Dorsal torso gray with many small yellow flecks. Vertebral field (sensu Lobo and Espinoza 1999) much darker than remainder of dorsal body. Color much lighter from hind limbs to portion of tail not autotomized than for remainder of dorsal body. Dorsal forelimbs black with yellow flecks. Hind limbs much lighter than forelimbs. Ventrally gray, abdominal region gray with larger flecks of black and laterally with flecks of yellow. Ventral forelimbs gray with very few yellow flecks; ventral hind limbs much lighter. Overall the brightness of the yellow on this specimen was considerably less vibrant or extensive on the trunk compared to the two males described previously (G. Scrocchi, pers. comm.).

After 2.5 years in preservative (70% EtOH) the color is somewhat faded: black extends to shoulders, beyond which, dorsal scales grade to pale cream-yellow on torso. Yellow color of torso extends to first quarter of tail (last three quarters of tail autotomized). Ventral surface light gray with dark gray to charcoal flecks becoming denser laterally. Flank with larger charcoal gray marks flecked with scales of cream-yellow. Throat darker than belly, densely flecked with gray marks especially along perimeter. Ventral surfaces of thighs with a longitudinal band of pale cream scales.

The only other known female of *L. heliodermis*—a juvenile (paratype; FML 6007)—has a brown head and lighter brown dorsal torso with flecks of cream-colored scales. This is in stark contrast to the black head and sulfur-yellow torso exhibited by adult males of this species (Espinoza et al. 2000). Consequently, at the time of the original description, only speculations could be made about the development and occurrence of sexual dichromatism of this species. Three possibilities were offered to account for the marked differences in coloration in this species: (1) males and females are sexually dichromatic, wherein females retained the brown coloration of juvenile described above, (2) the species is not sexually dichromatic, and the bright coloration develops ontogenetically in both sexes, or (3) sexual dichromatism is present and develops ontogenetically for both sexes, perhaps with females

becoming less brightly colored than the males. The description of the adult female *L. heliodermis* provided above suggests that sexual dichromatism, although present, is not as dramatic as would be the case if the juvenile coloration were retained into adulthood for females. Although females undergo a dramatic change in coloration ontogenetically (brown → yellow), the yellow coloration could brighten to levels not detected in specimens collected to date. For example, females may develop brighter coloration when gravid, as is apparent in other *Liolaemus* (Espinoza and Lobo 2003; Etheridge 2000; R. E. Espinoza, pers. observ.) and numerous other iguanian lizards (Cooper and Greenberg 1992). Consequently, the apparent dichromatism, at least in color saturation, may be apparent only during portions of the breeding season. Collection of a juvenile male is required to resolve the question of the ontogeny of male coloration. We predict, as in females, juvenile males are brown and also undergo an ontogenetic change in coloration.

Acknowledgments.—We thank G. Scrocchi for bringing this specimen to our attention and for providing a color photo and a description of its coloration in life. We are grateful to S. Kretzschmar (FML) for curatorial support, J. Hogue for help with the camera lucida, and G. Köhler for comments on the manuscript.

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Handling Stress and Plasma Corticosterone Levels in Captive Male Western Diamond-backed Rattlesnakes (*Crotalus atrox*)

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Reptiles are similar to other vertebrates in that they show both behavioral and physiological stress responses to a wide variety of stimuli (reviewed by Greenberg and Wingfield 1987; Lance 1990; Guillette et al. 1995; Wingfield and Romero 2001; Greenberg 2002; Greenberg et al. 2002; Moore and Jessop 2003). Frequently reported stressors include extreme temperature (Jessop et al. 2000), crowding (Hayes 1997), social dominance (Alberts et al. 1994; Matter et al. 1998; Schuett et al. 1996; Greenberg 2002, 2003), starvation (Romero and Wikelski 2001), as well as a range of anthropogenic factors (Hofer and East 1998) including capture and handling (Moore et al. 1991; Kreger and Mench 1993; Cash et al. 1997; Lance and Elsey 1999; Cree et al. 2000; Moore et al. 2000; Gregory and Schmid 2001; Mathies et al. 2001; Franklin et al. 2003; Jessop et al. 2003).

The hypothalamo-pituitary-adrenal (HPA) axis is unquestionably the best-studied physiological system concerning the stress response (Selye 1973), and there is a relatively long history on adrenal hormones (glucocorticoids) in reptiles (Greenberg and Wingfield 1987; Lance 1990). Cortisol and corticosterone (CORT) are adrenal glucocorticoids released in response to stressors, and when elevated have important metabolic functions in converting stored energy (e.g., lipids and proteins) to available glucose for escape or defense (Dallman et al. 1995; Guillette et al. 1995). Chronically high levels, however, can have profoundly negative

downstream effects on immune function (Guillette et al. 1995; Moynihan 2003). The primary glucocorticoid in reptiles is CORT (Greenberg and Wingfield 1987)

Researchers interested in measuring levels of circulating CORT for studies on metabolism or reproduction face the problem of obtaining blood samples quickly to avoid adversely influencing "true state" levels through handling stress. It is thus important to understand the influence of handling stress on CORT levels. A quantitative sense of the timing of the CORT response during handling permits evaluation of handling techniques as potential confounding variables in the analysis of CORT itself, other steroids such as testosterone (Lance et al. 2004), and a wide range of physiological parameters immediately removed from but affected by elevated levels of CORT (e.g., immune responses) (Guillette et al. 1995; Moynihan 2003)

The goal of this study was to determine whether certain handling procedures cause a significant CORT response in a laboratory colony of male Western Diamond-backed Rattlesnake (*Crotalus atrox*) derived from the wild. The measurements of CORT we report are not intended to stand as surrogate values for subjects living in the wild. Rather, they denote important baseline data for laboratory analyses and prospective field studies.

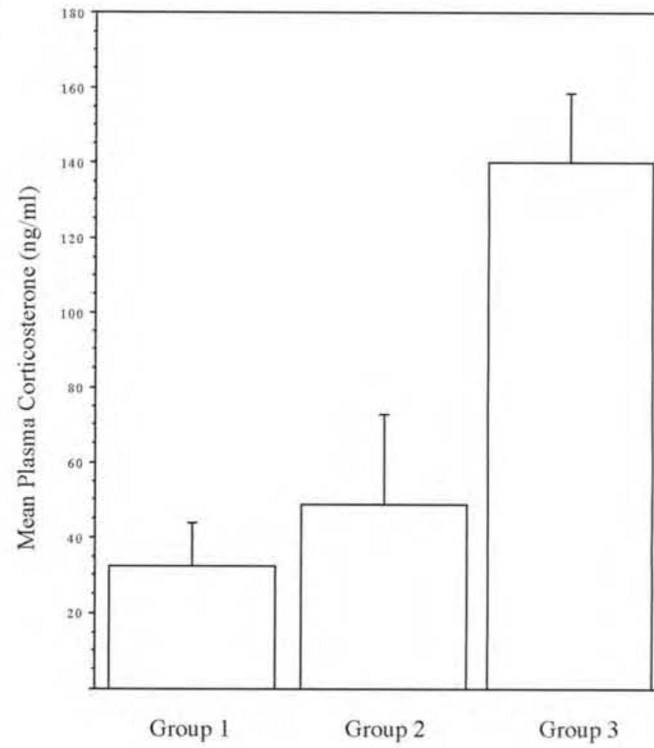

FIG. 1. Mean (± 1 SE) concentration of plasma corticosterone (ng/ml) for 17 adult male *Crotalus atrox* in three independent experimental groups. Control Group: Group 1 = no handling stress and blood sampling at 5-min post arena exposure. Treatment Groups: Group 2 = 5-min handling stress and blood sampling at 15-min post-handling. Group 3 = 5-min handling stress and blood sampling at 30-min post-handling.

MATERIALS AND METHODS

Subjects.—Seventeen adult male Western Diamond-backed Rattlesnakes (*Crotalus atrox*) were used. All subjects were long-term (3–4 years), healthy captives (housed in the Life Sciences Department, Arizona State University West, Animal Care Facility), and were collected as adults from several areas in central Maricopa County, Arizona, near the vicinity of Phoenix. Mean (± 1 SE) snout–vent length (SVL) was 89.1 ± 2.39 cm, range 74.0 to 98.0 cm, and mean (± 1 SE) body mass was 480.45 ± 32.81 g, range 278.80 to 639.3 g. Subjects were housed individually in glass enclosures (91 L x 30 W x 25 H cm) fitted with screen covers, with the front end heated by commercial heat tape (8 cm wide; 32°C) during photophase. Newsprint was used as a floor covering. Artificial lighting (eight 40 W fluorescent tubes) positioned 3 m above the cage was electronic timer-controlled to simulate natural (Arizona time) photoperiod year round. Laboratory rodents were offered weekly during the active season (March through October), and water was available in glass bowls *ad libitum*.

Testing procedures.—Experimental procedures for testing handling stress were performed in the laboratory. Handling procedures involved the following. The experimental subjects were randomly selected and placed in three groups: group 1 (N = 5), the control, and two treatment groups, group 2 (N = 5) and group 3 (N = 7). Testing occurred in a large observation arena (2.5 L x 1.5 W x 1 H m). The arena floor had three commercial strips of heat tape (16 cm wide; 32°C) running its length, and on top of them newsprint covered the entire arena floor. Each trial (N = 12) involved placing a single subject in the middle of the test arena, and each was gently and consistently (every 5 sec) prodded and grabbed with a commercial snake grabber (snake tongs; 1 m in length) for a total time of 5-min. Following this procedure they were immediately returned to their individual permanent enclosures, and bled at 15-min (group 2) and 30-min (group 3) post-handling, respectively, and returned to their permanent enclosures. The control (group 1) involved placing subjects (N = 5) into the arena for 5-min but they were not prodded nor grabbed. They were bled immediately after removal from the arena, and returned to their individual permanent enclosures. All tests occurred during the late morning of 24 March 2000.

Collection of blood and plasma.—Subjects were gently removed from their individual permanent enclosures, quickly restrained in a standard squeeze-box, bled, and returned to their enclosures. The entire process required 1–3 min. Blood was obtained from tail vessels using sterile 1.0 ml tuberculin syringes (25-G5/8") treated with porcine-derived heparin sodium (1,000 units/ml). Blood was immediately placed on ice (Taylor and Schuett 2004), followed by centrifugation for 4-min at 6000 rpm. Plasma was individually collected in 1.5 ml centrifuge tubes and stored in an ultra-low freezer (- 80ºC) until radioimmunoassays (RIAs) could be performed (< 1 year).

Radioimmunoassay of plasma.—The general procedures for conducting RIAs for measurement of CORT are published elsewhere (Schuett et al. 1996; Schuett and Grober 2000), but will be briefly described below. RIA kits were used (ImmuChem double antibody corticosterone, RIA I; ICN Biomedicals, Inc.). Validation for the RIA was by quantitative recovery and parallelism. Quantitative recovery of CORT added to snake plasma was 100%, and parallelism was demonstrated between the inhibition curve for the standards and dilutions. In this analysis CORT did not require an extraction procedure. The minimum detectable concentration was ≥ 50 pg. Samples (N = 34) were analyzed in duplicate in one RIA. The intra-assay coefficient of variation was 2.4%. All CORT values are pre-

sented as arithmetic means ± 1 SE (ng/ml).

Statistical analyses.—Prior to performing statistical tests (StatView 5.01, SAS Institute, Inc.), data were inspected for outliers, normality (skewness and kurtosis), and equality of variance. Outliers were not detected, and conditions for normality and equality of variance were met. Because of the tendency of snakes with larger body mass to have relatively higher levels of circulating gonadal steroids (Schuett et al. 2001a, b; 2002; Taylor and Schuett 2004), we inspected body mass as a potential covariate for ANCOVA. Although body mass of individuals ranged widely, mean body mass of the three treatment groups was not significantly different (ANOVA, $F_{2,14} = 0.854$, $p = 0.447$), and linear regression showed no significant relationship between body mass and levels of plasma CORT (Group 1: $r^2 = 0.411$; ANOVA, $F_{1,3} = 2.097$, $p = 0.243$. Group 2: $r^2 = 0.515$; ANOVA, $F_{1,5} = 5.305$, $p = 0.070$. Group 3: $r^2 = 0.236$; ANOVA, $F_{1,3} = 0.926$, $p = 0.410$.). Accordingly, ANOVA was used instead of ANCOVA. All tests were two-tailed; the α-level of significance was set at $p < 0.05$.

Results

Mean (± 1 SE) concentrations of plasma CORT in the three experimental groups of *C. atrox* are presented in Fig. 1. ANOVA demonstrated a significant treatment effect ($F_{2,14} = 9.829$, $p = 0.0022$), and post hoc (Fisher's PLSD) analyses showed that the mean concentration of CORT in group 3 (blood obtained at 30-min post-handling) was significantly greater than in group 2 (blood obtained at 15-min post-handling) or in group 1 (control). There was no significant difference ($p = 0.578$) in the mean CORT levels between group 1 and group 2. Therefore, in adult male *C. atrox* subjected to mild handling stress, the response time for detection of significantly elevated levels of CORT is at least 30-min post-handling.

Discussion

The present data show that wild-collected adult male *C. atrox* held long-term (3–4 years) in a laboratory situation show a relatively rapid and significant CORT response to mild handling stress at 30-min post-handling. Our results should not be used as surrogate values for free-ranging subjects, but they emphasize the importance of obtaining blood for CORT measurements relatively quickly to obtain "real state" values. The duration of capture and the time required to obtain blood are potential confounding variables in analyzing CORT and other steroid hormones (Moore et al. 1991; Lance et al. 2004). If captivity has the influence of reducing the time course of the stress response due to habituation, we suspect that free-ranging *C. atrox* might be even more sensitive to handling stress (i.e., show a greater and more rapid CORT response). We do not, however, have data to support this view in snakes. Interestingly, the subjects in this study showed no signs of behavioral habituation with respect to defensive behaviors (e.g., striking, rattling) despite being removed from the wild as adults for 3–4 years. In a non-reptilian example, a battery of stress tests using wild and domestic cavies (Rodentia, *Cavia aperea*) showed that long-term breeding (30 generations) in captivity did not result in significant changes in behavioral and CORT responses (Künzl et al. 2003). A similar study on snakes and other reptiles would be valuable for comparison.

Other researchers investigating handling stress and CORT levels in snakes obtained results similar to ours. Kreger and Mench (1993) used three common handling techniques to investigate stress responses in captive Ball Pythons (*Python regius*). Although their study had potential problems because of repeated-sampling of a small number of subjects (N = 4), none of the short-term (10-min) handling procedures evoked a significant elevation of plasma CORT. A study on Brown Treesnakes (*Boiga irregularis*) in Guam showed that protracted (1 night) confinement stress in traps showed significantly elevated plasma CORT, and there was limited evidence that other sex steroids were affected negatively (Mathies et al. 2001). Moore et al. (2000) showed that capture stress in male Red-sided Garter Snakes (*Thamnophis sirtalis parietalis*) did not result in suppression of courtship. There was, however, a significant elevation in plasma CORT, as well as a significant negative correlation between levels of plasma CORT and testosterone (Moore et al. 2000). Nonetheless, Moore et al. (2000) suggested that the behavioral stress response is uncoupled from the hormonal stress response during mating to maximize reproductive success. All of the above examples clearly show that capture and handling stress can elicit a CORT response, and that there are complex issues concerning species differences, as well as seasonal and sex differences.

We would like to specify several limitations of this study and point to further research. First, we have few concerns regarding diel effects in this study based on the fact that all sampling occurred in a narrow time frame in a single day (Cree et al. 2000; Summers and Norman 1988; Tokarz et al. 1998; Tyrell and Cree 1998). Although we have not determined in either captive or wild adult male *C. atrox* whether or not plasma CORT concentrations show diel patterns, we do know that there is no significant variation in plasma CORT during their active season (Mar.–Oct.) (Taylor et al. 2004). Second, we have not tested adult female *C. atrox* for CORT responses to handling. Several studies have demonstrated that there are sex differences in the CORT response (Lance et al. 2001; Mathies et al. 2001; Moore and Jessop 2003), and in females differences can be seasonal and influenced by reproductive states (Cree et al. 2000; Lance et al. 2001). During parturition, for example, mean plasma CORT levels in *C. atrox* are exceedingly high (> 350 ng/ml) yet their behavioral state appears to be stress-free. In fact, females appear to be tranquil and unremarkable (Schuett et al., *in press*). Third, there are few data on stress in juvenile reptiles. Behavioral (e.g., social) stressors can affect growth and immunocompetency (Alberts et al. 1994; Guillette et al. 1995). Finally, because our data set is limited to captive animals, tests of handling stress in free-ranging *C. atrox* across their active season and spanning different contexts (e.g., reproductive vs. non reproductive) would provide a broader range of knowledge.

In conclusion, our results on handling stress have direct utility for investigations of CORT in *C. atrox* in a wide range of laboratory-based studies of physiology and behavior (Guillette et al. 1995), as well as in free-ranging populations. Moreover, there are implications for studies of stress and CORT levels in the collection of free-ranging individuals for commercial uses, such as in rattlesnake roundups (Fitzgerald and Painter 2000).

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Aural Abscesses on Florida Box Turtles are Associated with Abnormally Wet Winters

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Box turtles (*Terrapene*) frequently have been reported with aural abscesses, correctly referred to as an abscessation of the middle ear. The abscesses produce noticeable sebaceous-like swellings on one or both sides of the head, and in extreme cases the abscesses become so large that the turtle is unable to feed or even to withdraw its head into the shell. Other conditions associated with aural abscesses include palpebral edema, lethargy, discharge of inflammatory debris from the mouth or eye socket, and emaciation. The inflammatory debris aggregates in the middle ear, where a caseous material builds up and may be encapsulated by fibrous connective tissue (see color photo 47 in Dodd 2001). In the extreme, this caseous material hardens into an acrylic-like substance. Gram-negative bacteria such as *Citrobacter, Enterobacter, Proteus morganii, P. rettgeri*, and *Pseudomonas* are associated with massive infections, but these bacteria also are part of the normal flora of box turtles (Jackson et al. 1972; Murray 1996).

Whereas most veterinary references discuss the prevalence and etiology of aural abscesses associated with captive box turtles, wild box turtles also have been found with such abscesses. In captivity, aural abscesses are usually attributed to poor husbandry, poor diet, keeping animals at suboptimal temperatures, or a combination of these factors (Boyer 1992; Murray 1996). For wild box turtles or box turtles kept in semi-natural conditions outdoors, the most common suggested causes are insect bites, infectious protozoans, parasitism, or trauma to the buccal cavity with secondary infection (Allard 1935; Dodd 2001; Jackson et al. 1972). Although each of these factors might contribute to the progression of the condition, hypovitaminosis A also is known to lead to abscesses of the middle ear cavity (Boyer 1996; Murray 1996). Interference with Vitamin A metabolism by organochlorine compounds recently has been suggested as leading to aural abscesses in wild *T. carolina* (Holladay et al. 2001).

Between the years 1991 and 2002, we made from one to five visits per year to conduct research on the life history of the Florida Box Turtle (*T. c. bauri*) on Egmont Key, Hillsborough County, Florida. Egmont Key is a long, narrow, north-south trending island located at the entrance of Tampa Bay on Florida's west-central coast. Surveys (N = 35 sampling periods) lasted from three to five days, with from two to five biologists participating in each survey. Box turtles were found in all sections of Egmont Key's approximately 120 ha. As of May 2002, 2477 different box turtles have been recorded, based on 5384 captures. More extensive information on the box turtle study and a physical description of the island are presented elsewhere (Dodd et al. 1994; Dodd 2001).

Throughout the survey, all captured animals were examined in the field for their physical condition. No disease symptoms other than an occasional emaciated turtle were seen until the spring of 1998 when we began to encounter turtles with aural abscesses. In this paper, we describe abscess prevalence and location, field treatment, and recovery based on subsequent recaptures of affected turtles. Further, we relate the appearance of aural abscesses with an unusual weather pattern observed in the winter of 1997–98.

Abscess prevalence and location.—A total of 26 *T. c. bauri* were found with aural abscesses between 1991 and 2002: 14 males, 7 females, and 5 juveniles. The sex ratio generally mirrors that of the overall adult population (1.9 males per female, N = 1776), although the percentage of juveniles with aural abscesses (19%) is less than the percentage of juveniles within the population (27.8%, N = 684 juveniles of 2460 turtles whose sex or life stage could be determined). Turtles with aural abscesses were found as follows: 10 (April 1998), 9 (May 1998), 1 (October 1998), 1 (April 1999), 1 (October 1999), 1 (March 2000), 3 (April 2001). Thus, 73% of the turtles with aural abscesses were found in the early spring of 1998.

The location of the aural abscesses varied, that is, abscesses were not equally distributed. The most common location was on the left side of the head (N = 12: 7 males, 2 females, 3 juveniles), followed by bilateral (N = 9: 4 males, 4 females, 1 juvenile), and finally on the right side of the head (N = 3: 2 males, 1 female). An additional male found basking in direct sunlight had caseous exudate in his mouth, a nasal discharge, and a necrotic rhamphotheca, but no externally observable abscess. We did not record the location of the abscess on one juvenile, although we noted palpebral edema and breathing difficulties. We also noted instances of palpebral edema on three other affected turtles; one adult male with pneumonitis whose abscess extended into the left nostril (this turtle also was very dehydrated); and one turtle whose cyst extended well into the left eustachian tube and exited through the right eye socket.

Turtles with aural abscesses generally were lethargic and appeared unaware of the approach of the observers. Whereas a few

attempted to withdraw their head or limbs into the shell, most did not. Turtles with aural abscesses often were found basking in open locations in the direct sunlight, even during the heat of the day, a behavior that was never observed among box turtles without aural abscesses. Reptiles affected by disease commonly raise the body temperature through basking, a process known as behavioral fever, which aids in fighting bacterial infection (Kluger 1979).

Field treatment.—Because of Egmont Key's relatively isolated location and the logistic difficulties and stress of transporting turtles to the mainland and keeping them under observation after standard veterinary treatment, we decided to treat the animals in the field. One of us (MLG) had 12 years of veterinary surgical experience.

Turtles with aural abscesses were induced to extend their necks as fully as possible. The tympanum was flushed with sterile saline, and a horizontal incision was made across the central bulge of the abscess. In most cases, the caseous material popped out and was removed with small forceps. The flaps of the incision then were opened, and the middle ear cavity was examined internally, using a pen light when necessary, to determine if any inflammatory debris remained. Additional material was gently removed and the cavity repeatedly flushed until all debris was cleansed from the cavity. During removal, we tried to avoid damaging the columella. The cavity required a final flush with sterile saline, and an antimicrobial agent was applied. The amount and consistency of the caseous material removed varied among turtles, and it was sometimes difficult to remove all inflammatory debris without considerable effort.

Before release, close examination of the mouth was conducted to ensure absence of debris from the buccal cavity and areas around the eye sockets. The eustachian tubes connect the middle ear to the oropharynx, and it is through this pathway that pathogens enter the middle ear and that inflammatory debris exits. In nearly all treated turtles, recovery was instantaneous. Where previously the turtle was lethargic and inattentive, it immediately became active, alert, and ready to move off. Allard (1935) also noted a quick recovery among his captive box turtles after similar abscess removal.

Recapture of treated turtles.—Of the 26 turtles treated for aural abscesses, we recaptured 11 whose abscesses had healed and appeared healthy (6 males, 4 females, 1 juvenile); 1 adult male turtle marked in April 1998 was found dead of unknown cause in April 1999. All of these turtles originally had been captured in the spring of 1998. Of the 14 remaining abscess-treated turtles, 1 was first captured in October 1999, 1 was first captured in March 2000, and 3 were first captured in April 2001. The abscess of one of these turtles, a male, was extremely hard indicating a long period of infection. The abscesses of the turtles found in 1999 and 2000, both males, were in the process of rupturing naturally. All of the 9 unaccounted for turtles were last seen in the spring of 1998.

Although treated turtles seemed to recover with no ill effects, the long-term effects of untreated abscesses on turtles are undetermined. It appears that some turtles may recover naturally, because naturally ruptured abscesses were found on several animals. On the other hand, if the abscess hardened into a very hard solid substance and the turtle was unable to feed or withdraw its head over a long period of time, it seems likely that some animals could die from complications resulting from the abscesses. Jackson et al. (1972) reported restructuring of the skull due to massive bacterial infection (based on post mortem examination), and we found several box turtle skulls with bilateral or one-sided bone degeneration, usually affecting the tympanic bulla. However, we cannot directly relate the bone degeneration to the presence of aural abscesses.

Association with unusually wet winter weather.—Because low temperature had been suggested as a possible contributor to abscess development, we examined weather data for the St. Petersburg area, available from the Southeast Regional Climate Center (http://cirrus.dnr.state.sc.us/cgi-bin/sercc/cliMAIN.pl?fl7886). The monthly mean, maximum, and minimum temperatures did not deviate by more than approximately 1°C in any one year from 1991 to 2002 from the monthly mean values from 1948 to 2000. These data suggest that the box turtles on Egmont Key did not experience unusually hot or cold temperatures throughout the study.

When rainfall data were examined, however, one winter season stood out for its excessive rainfall: the winter (November to March) of 1997–98. During this period, Egmont Key received 21.5 cm of rain compared with the normal mean of 5.4 cm. In a normal year, St. Petersburg receives 20.5 cm of rainfall, but in 1998 the area received 28.7 cm, 45.6% of which fell from January to March. From 1991 to 2002, the mean annual rainfall was 19 cm per year (range 15.7–25.2), excluding 1998. In the next closest year in rainfall amount (1995, with 25.2 cm), most rainfall resulted from summer tropical depressions, and winter rainfall was below normal.

Although it might be impossible to determine a cause-effect relationship between the sudden appearance of aural abscesses and an unusually high winter rainfall, such a relationship seems possible. Box turtles are active year-round on Egmont Key (Dodd et al. 1994), but during the winter they spend extended time buried in organic soils to escape cool weather, dry conditions (winter is the dry season in west-central Florida), and periods of low humidity. During this time, heavy rains would result in saturating the shallow organic soils, thus exposing semi-dormant turtles to potentially long periods of direct exposure with wet soils.

Ingestion of contaminated water over an extended period of time results in the colonization of the oropharnyx by infectious bacteria (Murray 1996), so it seems feasible that prolonged exposure to saturated organic soils or the water that accumulates in remnant ditches also might result in bacterial infections through the mouth. Interestingly, all but one of the abscessed turtles was found in the central part of the island, an area crisscrossed by drainage ditches built by the military, and in the Tampa Bay Pilots Association compound, an area with a foul-smelling stagnant water frequented by box turtles. Susceptibility to aural abscesses might be enhanced if the turtle's immune system had been compromised (e.g., by chronic pneumonia; Evans 1983), if the turtle entered dormancy in poor nutrition, or if organochlorines were present in the soil or water which might disrupt Vitamin A metabolism. We suggest that field biologists examine local winter rainfall patterns to determine if the correlation between excessive winter rainfall and aural abscesses that we have observed on Egmont Key is replicated elsewhere.

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Putting the Squeeze on Venomous Snakes: Accuracy and Precision of Length Measurements Taken with the "Squeeze Box"

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Snout–vent length (SVL) is the most commonly reported measure of linear body size for snakes (Fitch 1987). SVL is correlated with litter or clutch size in many species (Gregory and Larsen 1996; Seigel and Ford 1987) and is an indicator of sexual maturity (Macartney and Gregory 1988) and sometimes of age class (Waye 1999). Measurement of SVL in the field can be difficult for venomous snakes for several reasons: (1) investigator safety must be maintained while restraining the snake, (2) stress and injury to the snake must be minimized, and (3) measurements need to be completed in a timely fashion. Various methods have been developed that deal with each of these constraints to different degrees including physical handling or pinning and stretching (Fitch 1987), anesthesia (Fitch 1987; Hardy and Greene 1999), nooses (Gregory et al. 1989; King and Duvall 1984), and squeeze boxes (Cross 2000; Quinn and Jones 1974).

Quinn and Jones (1974) introduced the 'squeeze box' to estimate the SVL of venomous snakes, which effectively addresses the three concerns stated above. Tongs are used to place the snake into a clear plastic box and a piece of foam or rubber and a clear plastic lid are placed over the snake to hold it in place. The box is inverted and the SVL of the snake is traced for measurement with a map reader, flexible measuring tape, or other device. The procedure is time efficient and relatively safe, and investigators with little experience in handling venomous snakes (e.g., seasonal assistants) show little difficulty in learning its use quickly. The squeeze box thus appears to be an efficient tool to obtain SVLs of snakes, venomous or otherwise.

Despite the apparent merits and widespread use of the squeeze-box method to measure SVLs of snakes, to our knowledge no rigorous analysis of its accuracy and precision has been conducted. Fifty repeated measurements of a single juvenile False Water Cobra (*Hydrodynastes gigas*) showed little variation (Quinn and Jones 1974), but these measurements were not compared to the SVL of the snake measured using alternative methods such as pinning and stretching. Measurements of 10 Cottonmouths (*Agkistrodon piscivorus*) using a modified squeeze box suitable for field studies were compared to the same animals when anaesthetized, and differed by <1 cm (Cross 2000). Here we use data collected during a study of the Northern Pacific Rattlesnake (*Crotalus oreganus*) to address two questions in the use of squeeze boxes: (1) How accurate are length measurements obtained from squeeze boxes compared to those obtained from stretched lengths? (2) How precise are repeated tracings and measurements using squeeze boxes?

We measured SVLs of *C. oreganus* collected during an inventory project (1999–2001) in the vicinity of Kamloops, British Columbia, Canada. Additional data came from animals encountered during the monitoring of a hibernaculum near Vernon, British Columbia (P. T. Gregory and K. W. Larsen, unpubl. data). To measure its snout-vent length, each snake was pinned and grasped behind the head, then stretched along a meter stick. For consistency, one of us (KWL) collected all measurements of SVL. Hereafter we refer to these data as 'standard measurements' of SVL.

After the standard measurement of SVL was obtained for each snake, the animal was transferred to a squeeze box. Our squeeze box consisted of an open-top clear plastic box measuring 42 x 26 x 13 cm. Inside the box were two 5-cm thick pieces of commercial upholstery foam, on top of which fitted a clear lid equipped with a handle that could be grasped by commercial snake tongs. Three tracings were taken for each snake (described below); between tracings the snake was placed on the ground and then picked up and replaced in the squeeze box. We manipulated the position of the animal in the squeeze box only if it was coiled such that a section of its body overlapped another section, e.g., if part of the snake was in a 'figure-eight' position, we would gently prod it until it assumed another position. After the three tracings were

made, we took three measurements of each tracing, using a pocket On Tour Map Measurer™ (Pico Design, Toronto, Ontario).

In total, nine measurements (three tracings, three measurements each) were recorded for each of 21 snakes ranging in SVL from 347–845 mm. We had an additional seven animals for which we had one tracing (with three measurements each). We included these animals in some of our analyses (see below), because they improved the range of sizes of measured snakes. Standard SVL was measured only once for all 28 animals. We determined the sex of each snake by probing for hemipenal pouches or via hemipene extrusion (Blanchard and Finster 1933; Gregory 1983).

TABLE 1. Comparison of different methods used to estimate the snout–vent length (SVL) of rattlesnakes (to nearest mm). Sample size is 21 for all measures. Estimating SVL using a standard approach (stretching animal along a meter stick) provided SVL estimates that were significantly higher than those produced using a squeeze box. Three of the squeeze-box methods involved multiple measurements on the same snake being used to generate a mean value that was used as an estimate of snake SVL. The standard deviation of these multiple measurements also was calculated for each snake, and the average of these standard deviation values is provided.

Method Used to Estimate SVL	Estimated SVL (± SE)	Comparison Standard SVL (paired t-test)	Mean SD
Standard SVL (meter-stick stretch)	696 (± 40.4)	—	—
One tracing, one measurement	603 (± 35.7)	P < 0.001	—
One tracing, three measurements	602 (± 35.9)	P < 0.001	3.9
Three tracings, one measurement each	597 (± 36.2)	P < 0.001	14.4
Three tracings, three measurements each	596 (± 36.3)	P < 0.001	13.6

We used four methods to calculate squeeze-box estimates of SVL, which collectively represent the varying degrees of time and effort that might be invested by an investigator measuring SVL in the field: (1) one tracing, one measurement: one measurement obtained from the single tracing; (2) one tracing, three measurements: mean of three measurements from the single tracing; (3) three tracings, one measurement each: one measurement taken on each of three tracings; (4) three tracings, three measurements each: mean of three tracings used to calculate mean of the three measurements. The grand mean of these three means was used as the datum in analyses.

We compared the estimates of snake SVLs obtained from the four squeeze-box methods to those obtained from the standard method using paired t-tests. Because the latter three methods each produced three initial estimates of SVL per snake (prior to calculation of the grand mean), we were able to calculate the standard deviation (SD) of these measures for each snake. We used the mean SD obtained under each of these squeeze-box methods to assess the variation caused by the inclusion of multiple tracings of the same animal. With only one measurement of standard SVL per snake we could not estimate the variance associated with multiple measurements, however a recent study using a similar method of determining SVL (flexible tape run along the venter of suspended, stretched snakes) found repeated SVL measurements (10 measurements on 20 snakes) to be quite precise as indicated by small deviations of the individual measurements from the mean (mean coefficient of variation = 1.10 ± 0.10%) (Blouin-Demers 2003). Repeated standard SVL measurements in garter snakes also have low variance, even between researchers, once a reasonable amount of experience with the technique has been established (Larsen, unpubl. data).

Estimates of snake SVL provided by the standard method were significantly higher than those provided by any of the four squeeze-box methods (in all cases, $P < 0.001$; Table 1). The average SVL estimates provided by the four squeeze-box methods were similar (± 1.2%), however, variation in the estimates of SVL for each snake expectedly increased as multiple tracings and/or measurements were added (Table 1). Accuracy in estimating SVL (using standard estimates for reference) was not improved by providing additional tracings and/or measurements. A simple regression shows the relationship between measurements of SVL obtained using standard and squeeze-box methods (Fig. 1).

To further illustrate the use of squeeze-box estimates of SVL, we compared a size-frequency histogram developed using squeeze-box data from the one tracing, three measurements calculation (Fig. 2A), with a second histogram constructed using data from the standard method (Fig. 2B). Both frequency distributions have three peaks, however a Kolmogorov-Smirnov two-sample test (Sokal and Rohlf 1969) indicated that the differences in the two distributions were marginally significant ($D_{28,28} = 0.36$; $P = 0.055$).

Our study indicates that using the squeeze box resulted in significantly lower SVL estimates than those obtained using the standard approach irrespective of tracings or measurements. However, because the correlation between squeeze-box estimates

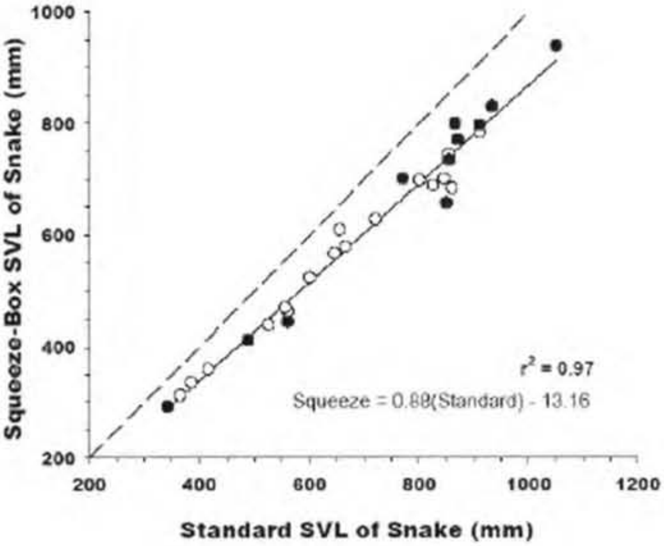

FIG. 1. Relationship between estimates of Northern Pacific Rattlesnake (*Crotalus oreganus*) snout–vent length (SVL) obtained using a squeeze box and values obtained by stretching the snake along a meter stick (standard method; N = 28). Estimates of snake SVL taken using the squeeze box consistently underestimated SVL. Squeeze-box estimates were the average of three measurements from the same tracing of one snake. Data from female snakes are represented by white circles, males by black circles. The dashed line represents a 1:1 relationship.

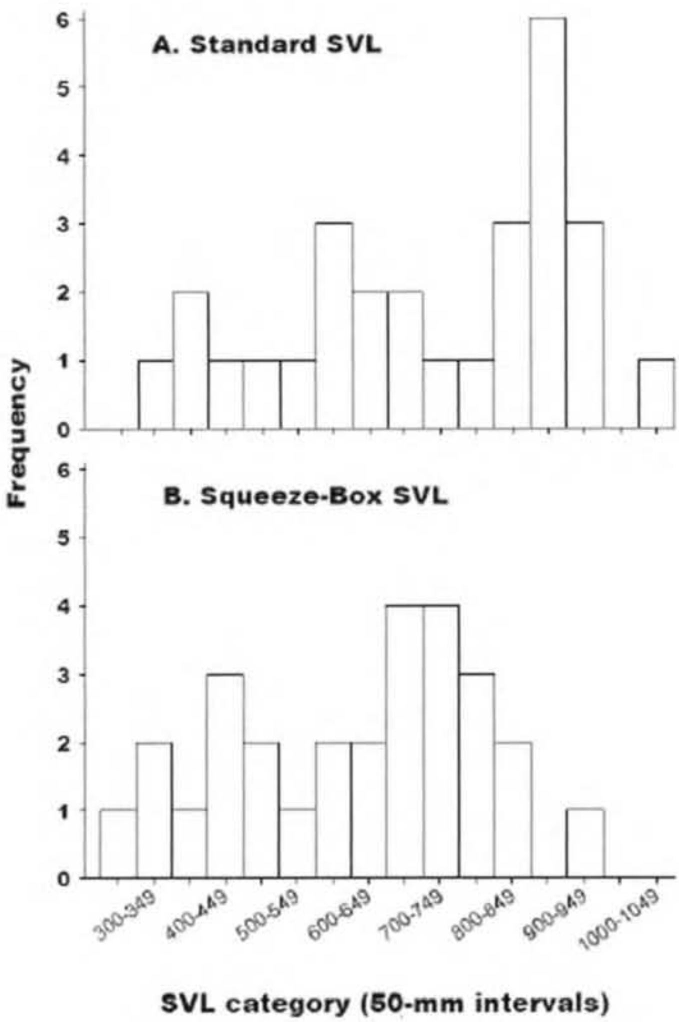

FIG. 2. Differences in size-frequency histograms of Northern Pacific Rattlesnakes (*Crotalus oreganus*) generated from the same animals using A. the standard snout-vent-length (SVL) determined by stretching a snake along a meter stick, and B. using a squeeze box. Each SVL is the mean of three measurements from the same tracing of the same animal.

and standard measurements was strong ($r^2 = 0.97$), it is possible to accurately predict standard SVL from squeeze-box SVLs. Also, because the length estimates obtained from the squeeze box were reasonably precise (i.e., high repeatability), repeated measures of snakes in the squeeze box are unnecessary. The one tracing, three measurements method described here appears to represent a good compromise between maximizing accuracy and precision and minimizing measurement time. Taking three measurements on the same tracing should preclude gross errors in SVL estimation without adding to the stress of the animal. Collecting additional tracings and measurements would increase processing time without improving the accuracy or precision of the estimates.

Different methods exist for measuring the length of snake tracings and may influence accuracy. Quinn and Jones (1974) placed a string along the snake tracing and then measured the string against a meter stick. Cross (2000) used a flexible metric tape for measuring the length of the snake tracing. Regardless of the tool used to record the length of the snake tracing, some error is to be expected. For example, use of a metric tape to measure tracings from tightly coiled animals can be problematic (C. L. Cross, pers. comm.). For these reasons, repeated measurements of each tracing are desirable.

The size of the squeeze box in relation to the snakes being measured also may be an important factor in determining the accuracy of SVL estimates. Squeeze boxes that are large relative to the snakes being studied may be more desirable. In this study there was a trend, albeit weak, of squeeze-box estimates for larger snakes to be less accurate (Fig. 1). This suggests that a larger box might increase the accuracy of measurements, presumably because the snakes would be less contracted during the tracings. The ratio of squeeze-box floor space (cm^2) to maximum snake SVL (mm) was approximately 1:1 in this study. Cross (2000) reported a high degree of accuracy for his squeeze-box estimates of SVL for cottonmouths measured in a squeeze box with a ratio of 1:3.4 (Cross 1998). Relatively large squeeze boxes may be more desirable, but logistics will dictate what size box can be transported in the field. For example, our squeeze box needed to fit into a backpack as it often was carried over long distances.

Given the potential usefulness of squeeze boxes, additional work on the accuracy and precision of this tool is warranted, preferably spanning a variety of taxa. Even the 'standard' method that we used in this study could be examined in more detail: we used data from this method as the benchmark for assessing the validity of length estimates based on squeeze-box measurements, but perhaps an even more effective and less stressful method exists. In general, investigators will need to determine the level of accuracy and precision in SVL measurements required to reach the goals of their respective studies. Detailed studies on life-history trade-offs experienced by snakes may require very accurate SVL data. Conversely, monitoring programs may not need to 'correct' SVL estimates from squeeze boxes, providing the methodology remains constant over time and among researchers.

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The Distribution of the Ring-necked Snake (*Diadophis punctatus*) in Utah

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We examined records from the literature and museum specimens of Ring-necked Snakes (*Diadophis punctatus*) in Utah and conclude that the current conception of the geographic range is inaccurate. Recent field guides (e.g., Cox and Tanner 1995; Stebbins 2003) map a hypothetical range that extends as a narrow, continuous band from the southwest corner of the state through the high-elevation plateaus and mountains of central and northern Utah to southeast Idaho, with a disjunct population in the Deep Creek Mountains of extreme west-central Utah. However, available data do not support this concept of the distribution.

We queried 17 museums, and five of these (BYU, LACM, MVZ, SDSNH, UU; institutional abbreviations follow Leviton et al. 1985) provided records of *Diadophis* in Utah and southeastern Idaho. Localities reported in the literature (e.g., Tanner 1941; Tanner and Banta 1966; Woodbury and Smart 1950) are represented by specimens in museum collections. All records discovered during our searches fall within the Bonneville Basin or the Virgin River drainage (Fig. 1). The elevational range of records appears to be ~1250–2250 m, with the majority falling between ~1500–2000 m. We are not aware of any reports or collections of *Diadophis* in the Wasatch Mountains of north-central Utah. Although the species occurs near Pocatello and Preston in southeastern Idaho (Linder and Fichter 1970; Tanner 1940), the northernmost locality in Utah of which we are aware is at the north end of the Stansbury Mountains (SDSNH 64446), which is about 150 km south of Preston. The range currently is thought to include the Wasatch Mountains between these localities (Cox and Tanner 1995; Stebbins 2003), but we consider the presence of an undetected population to be im-

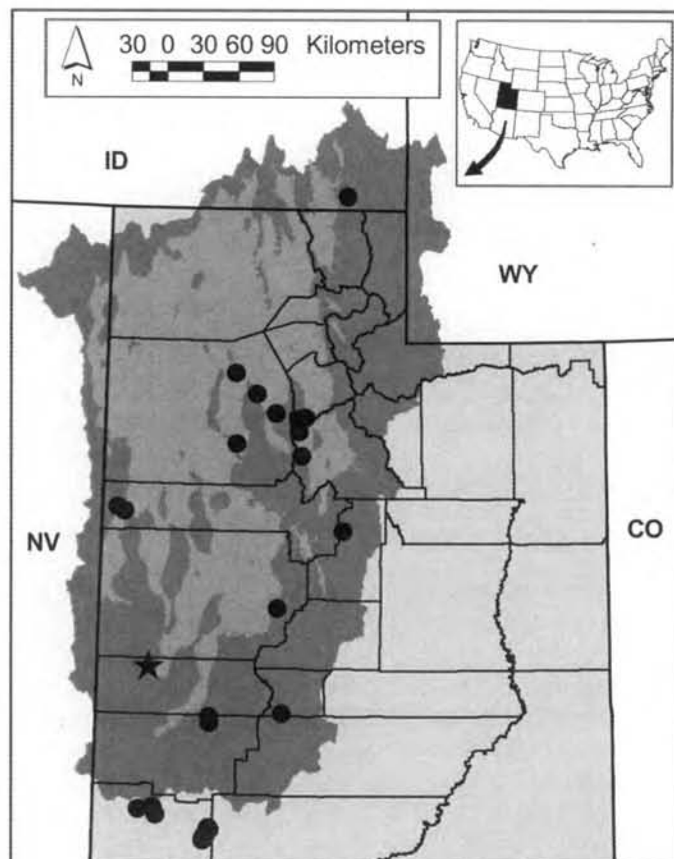

Fig. 1. The distribution of records of *Diadophis punctatus* in Utah and portions of the Bonneville Basin in neighboring states. Circles represent localities from museum specimens or literature; star represents a newly discovered population. Thin black lines within Utah represent county boundaries. The dark shaded area is the Bonneville hydrologic basin (U.S. Geological Survey Great Salt Lake and Escalante Desert-Sevier Lake hydrographic subregions; Steeves and Nebert 1994), and the lighter shaded area is the maximum extent of Lake Bonneville, approximately 14,000 years ago (adapted from Currey et al. 1984).

probable because this is the most urbanized region of Utah and is among the most intensively sampled parts of the state.

Two new records support the concept of a distribution in Utah centered in the Bonneville Basin. Identifications were verified by J. Sites. On 15 May 2001, we found a live female *D. punctatus* (photo specimen BYU 47340) at 2130 h on Hwy 21, 3.2 km west of Wah Wah Summit, Wah Wah Mountains, Beaver Co., Utah, 1849 m elevation. The surrounding vegetation was dominated by grasses (e.g., *Bromus tectorum*, *Oryzopsis hymenoides*) and sparse, small shrubs (e.g., *Chrysothamnus* sp., *Ephedra* sp., and *Artemisia tridentata*). This snake was photographed and released. We found a DOR female (BYU 47353) the following night on the same road, 0.5 km west of Wah Wah Summit, 1955 m elevation. The vegetation at this location was dominated by grasses (especially *B. tectorum*) in a sparse, open stand of juniper (*Juniperus utahensis*) mixed with few small shrubs (mostly *A. tridentata*).

The presence of a population of *Diadophis* in the Wah Wah Mountains suggests that the species may be broadly distributed in the Bonneville Basin (Fig. 1). Areas dominated by juniper and shrub associations are distributed throughout this remote and infrequently visited region. The new records reported herein fill a gap in the known distribution of this species, lying 68 km from the nearest record to the southeast (Minersville, BYU 30021), 120 km from the nearest record to the south (Pine Valley Mountains, BYU 11118), and 130 km from the nearest record to the north (Deep Creek Mountains, UU 1213). Because the species is rarely encountered in this region, the pattern of distribution is difficult to interpret, but the distribution in the basin appears to be associated with the former shoreline of Lake Bonneville (Fig. 1), a large Pleistocene freshwater lake of which the Great Salt Lake is a remnant. It is not apparent, however, if this association arose because suitable habitat is lacking in the presumably unoccupied parts of the basin, because the species failed to colonize suitable habitats that developed after the lake receded approximately 14,000 years ago (Benson et al. 1990), or if the pattern merely reflects sampling effort.

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Vocalizations and Aggressive Behavior of *Phyllomedusa rohdei* (Anura: Hylidae)

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The complexity of anuran reproductive behavior in prolonged breeders has been described in several neotropical species (Bastos and Haddad 1995, 2002; Martins et al. 1998; Pombal et al. 1994). For example, in contrast to explosive breeders, prolonged breeders often have a variety of functionally different vocalizations that are used during the breeding seasons (Bastos and Haddad 1995, 2002; Cardoso and Haddad 1984; Martins and Haddad 1988). Thus, besides advertisement and release calls, some prolonged breeders frequently also emit courtship, encounter, reciprocal, and territorial calls (Bastos and Haddad 2002; Given 1987; Martins and Haddad 1988).

The main reason males compete with each other in breeding aggregations is the scarcity of females (Wells 1977). Males that engage in agonistic interactions sometimes assess the fighting ability of potential opponents, possibly to avoid physical encounters with larger, stronger rivals. One way to do this is to escalate from non-physical to physical interactions, relaying information about body size or motivation before necessarily becoming involved in costly combat. Thus, non-physical displays (e.g., vocal interactions) might be able to resolve conflicts before escalating to physical combat when interacting males differ greatly in size, allowing smaller males to avoid physical encounters with larger opponents (Given 1988; Howard 1978; Parker 1974). Generally, three characteristics determine the outcome of fights: (1) size (Davies and Halliday 1978; Dyson and Passmore 1992; Howard

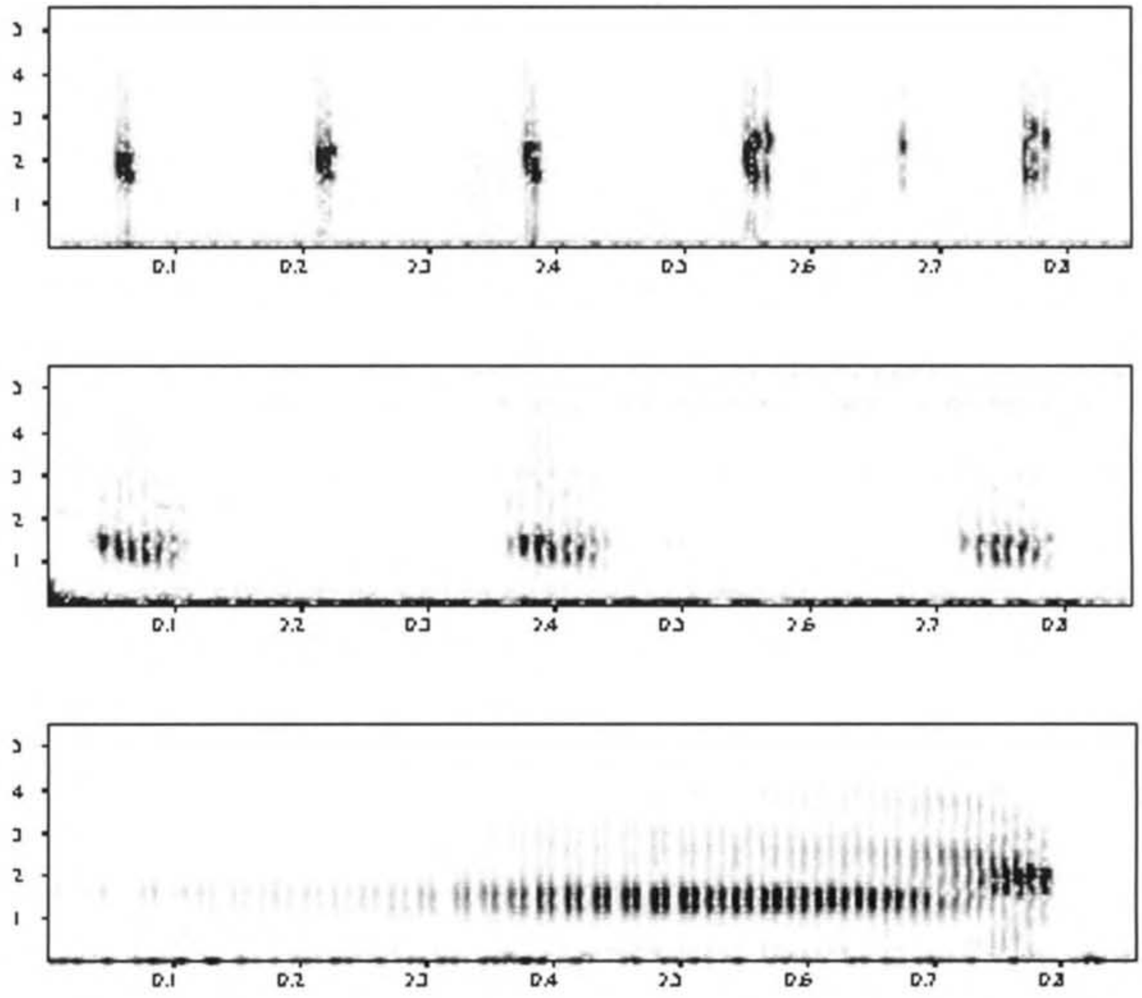

FIG. 1. Sonograms of vocalizations of *Phyllomedusa rohdei*: (A) advertisement call with extra note between the last two notes; (B) territorial call type 1 (T1); (C) territorial call type 2 (T2).

1978), (2) residence (Crump 1988; Given 1988; Pombal et al. 1994), and (3) body condition (Bastos and Haddad 2002).

Our main aim in this paper is to examine the vocal repertoire and aggressive behavior between males of *Phyllomedusa rohdei* Mertens, 1926. Our objectives were to: (1) describe the different call types, (2) describe the social context in which each call type was emitted, (3) describe behavior during aggressive encounters, and (4) determine whether size, residence, or body condition influenced the outcomes of fights.

We studied *P. rohdei* in a temporary pond approximately 170 m^2, located at the edge of a forest at Palmital (22°50'S; 42°27'W), Municipality of Saquarema, State of Rio de Janeiro, southeastern Brazil. The population was monitored from July 1999 to July 2000 for a total of 84 nights (411 h). The visits were monthly when the pond was dry (from July 1999 to November 1999 and from March 2000 to July 2000), and every two weeks when the pond held water (from December 1999 to February 2000). Field observations were conducted usually between 1700 h and 24 h.

Snout–vent length (SVL) was measured to the nearest 0.1 mm with calipers and body mass weighed to the nearest 0.05 g with a Pesola® balance. Individuals were weighed weekly or more frequently when they engaged in aggressive interactions. Males were marked individually by toe clipping (opposable fingers and toes were not clipped).

Focal animal and all occurrence sampling were used for behavioral records (Lehner 1979). A winner was the male that remained in a site after an encounter, while the loser was the one that moved away from the site where the fight occurred. A male was considered a resident if he was the first male to occupy a determined site or if he was already calling or patrolling (see Matos et al. 2000) at the beginning of the focal observations. The time of residence of males was the total number of nights a male spent in a same site.

We recorded the vocalizations with UHER 4000 recorder at a tape speed of 19 cm/s and UHER microphone. Calls were analyzed by the software Avisoft-Sonograph Light 1, version 2.7. The nomenclature of vocalizations follows Duellman and Trueb (1994).

For statistical analysis of results, we used Student's t-test, ANOVA, and Spearman's correlation coefficient (r_s) (Zar 1999). Body condition was estimated by a regression between logs of SVL and mass. We compared slopes of SVL versus mass regressions between winners and losers of aggressive encounters (Zar 1999). Descriptive statistics are given as mean ± SD.

Phyllomedusa rohdei males used vocalizations and physical interactions to defend calling sites. The vocal repertoire included

TABLE 1. Summary of acoustical parameters of the vocalizations of *Phyllomedusa rohdei*. Values are presented as mean ± SD (range) (N).

Characteristics	Advertisement	Calls Types Territorial 1	Territorial 2
Call duration (ms)	553.0 ± 201.0 (178.0–1123.0) (63)	1152.0 ± 718.0 (345.0–3626.0) (18)	841.0 ± 209.0 (574.0–1178.0) (16)
Number of notes	4.3 ± 1.4 (2–7) (63)	4.7 ± 2.4 (2–13) (18)	1
Note duration (ms)	18.0 ± 5.0 (7.0–34.0) (270)	70.0 ± 12.0 (44.0–95.0) (75)	—
Interval between notes (s)	144.0 ± 29.0 (25.0–223.0) (208)	223.0 ± 38.0 (155.0–323.0) (58)	—
Number of pulses	2.3 ± 0.5 (1.0–4.0) (245)	7.8 ± 1.0 (4.0–10.0) (70)	71.2 ± 22.2 (44.0–116.0) (9)
Pulse durations (ms)	7.0 ± 2.0 (3.0–14.0) (549)	6.0 ± 2.0 (3.0–13.0) (420)	7.0 ± 2.0 (3.0–13.0) (303)
Dominant frequency range (kHz)	1.3 ± 0.1 to 2.6 ± 0.2 (1.1–3.2) (62)	0.8 ± 0.1 to 1.9 ± 0.3 (0.7–2.6) (18)	1.2 ± 0.3 to 2.5 ± 0.3 (0.9–3.0) (16)

six types of vocalizations: advertisement call, two territorial calls, two encounter calls, and one release call.

The advertisement call (Fig. 1A, Table 1) was the most common call emitted in breeding aggregations. Males emitted this call at irregular intervals throughout the night. Each call had 1–7 multipulsed notes. One-note calls were emitted frequently at the beginning of the night or in choruses of one or two calling males. Calls greater than three notes sometimes had an extra note of lower intensity between the last two notes (Fig. 1A). In close-range vocal interactions between males of *P. rohdei*, several advertisement calls were emitted in response to another advertisement call or to territorial ones, even when the behavior of both opponents increased in aggressiveness.

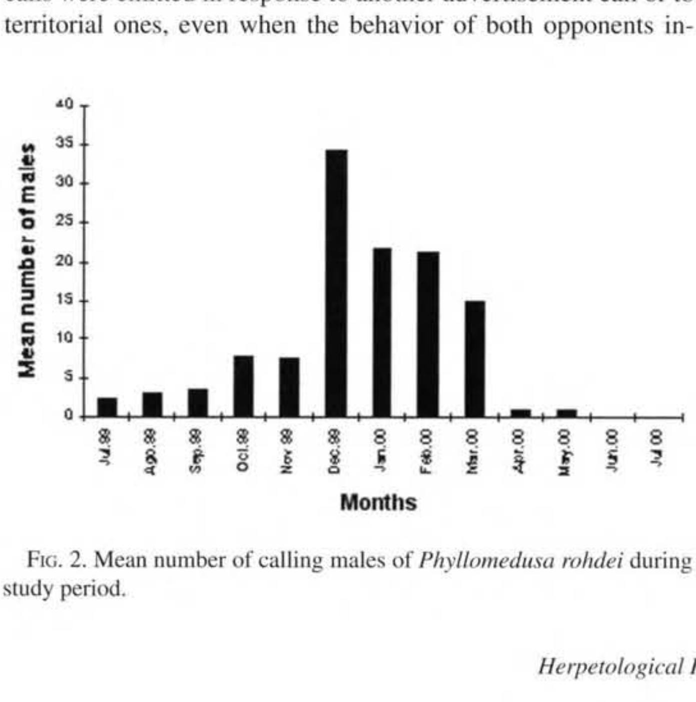

FIG. 2. Mean number of calling males of *Phyllomedusa rohdei* during study period.

Males emitted territorial calls either in response to the advertisement or territorial calls of neighboring males (isolated males did not emit these vocalizations). We observed two types of territorial calls: type 1 (T1) is composed of 2–13 short multipulsed notes (Fig. 1B, Table 1) and type 2 (T2) is a long multipulsed note (Fig. 1C, Table 1). In several agonistic interactions the T1 call was emitted frequently before the T2 by the same male, suggesting an escalated aggressive behavior.

In a few cases, we observed two unusual sounds that were added

TABLE 2. Size difference and resident status of winners of aggressive encounters where opponent differed by more than 3.0 mm in SVL. A positive size difference means that the winner was larger than the loser.

Resident Status	Size difference (mm)
I	9.7
I	7.0
R	6.1
R	4.8
I	4.0
R	3.0
R	-3.3
R	-4.0
R	-4.2
R	-4.4

FIG. 3. Two males of *Phyllomedusa rohdei* in physical combat.

at the end of the territorial calls. Both types consisted of multipulsed notes emitted by resident males during close-range agonistic interactions. Judging by the social context within which they were evoked, these unusual sounds are probably encounter calls.

Finally, a male emitted release calls when trying to dislodge an opponent from his back. These calls are similar to the T1 call with lower intensity.

When neighboring males approached each other and emitted advertisement calls, antiphonal calling between rivals took place. Calls escalated from advertisement calls to both types of territorial calls. One or both males walked under the vegetation searching for the other. Sometimes an individual ceased searching and remained silent or resumed advertisement calling, apparently tolerating its neighbor. However, when males met, vocal interactions continued with two alternative outcomes: (1) one male fled while the other pursued with no fighting, or (2) physical combat occurred. In 15 pursuits observed, the pursuer male was larger (mean ± SD, 39.7 ± 2.1 mm) than the pursued (38.1 ± 1.9 mm; t = 2.20; P = 0.03). However, pursuer and pursued males were not significantly larger (38.9 ± 2.1 mm; N = 30; t = 0.15; P = 0.88) than males that actually fought (38.8 ± 2.5 mm; N = 54). Likewise, the body size differences of males involved in pursuit (2.16 ± 1.93 mm; N = 15) versus those involved in fights (2.65 ± 2.33 mm; N = 27) also were not significantly different (t = -0.69; P = 0.49). Only four pursuer males (27.7%) were smaller than pursued ones. The body differences for all 15 pursuer/pursued pairs were significantly different than zero (F = 18.70; P = 0.0002).

When the pond was dry, we observed only male-male vocal interactions and no physical combat. The distances between calling males before Dec / 99 (pond dry) were larger (154.17 ± 86.40 cm; N = 18) than distances between males after Dec / 99 (pond full) (55.00 ± 37.99 cm; N = 23; t = 4.78; P = 0.00002). More calling males were present when the pond was full than when it was dry (Fig. 2).

During physical combat, each male tried to seize the opponent with his arms and feet (Fig. 3). The uppermost male seized his opponent by the head, neck, or waist, and shook him up and down. The fight finished when the seized male was released by the other or escaped. The loser quickly left and remained in a submissive posture or called from a farther distance than before the interaction, while the winner returned to the original site and resumed calling. Sometimes, winner males oriented toward the loser and shook his body up and down. The duration of fights ranged from 10 s to 30 min and each male had an average of 1.5 fights (range 1–6; N = 36) over the entire breeding season.

In 27 aggressive encounters, the winners (SVL = 39.2 ± 2.1 mm; N = 27; mass = 3.21 ± 0.42 g; N = 23) were not significantly larger (t = 1.23; P = 0.23) nor heavier (t = 1.05; P = 0.30) than losers (SVL = 38.4 ± 2.8; N = 27; mass = 3.08 ± 0.36; N = 23), but the slope of the SVL versus mass regression of winners was significantly higher (b = 1.983 ± 0.43; F = 7.07; P = 0.01) than that of losers (b = 0.519 ± 0.31), indicating that the winners were in better body condition than losers (Fig. 4). When resident and intruder status was determined, 18 of 25 (72%) winners of fights were residents males. The mean time (± SE) of residence of males that fought was 2.2 ± 1.9 nights (range = 1–8; N = 48). Ten fights occurred between males with differences greater than 3.0 mm (Table 2). Smaller males only won these fights when they were residents.

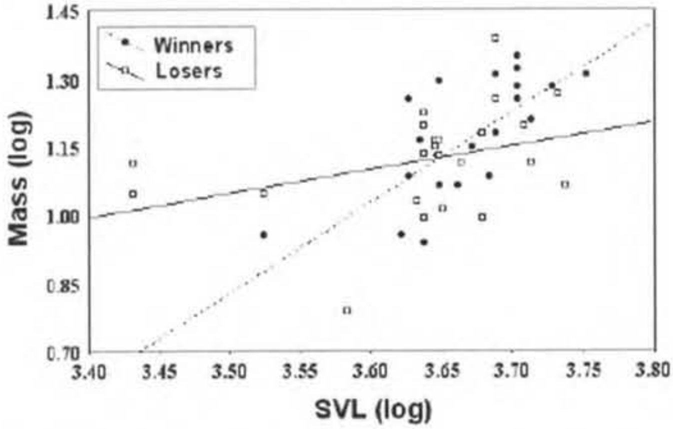

FIG. 4. Linear regression between SVL and mass of winners and losers of aggressive encounters. Variables were log-transformed prior to the analysis.

The complexity of the vocal repertoire in *P. rohdei* reflects social behavior typical of a prolonged breeder (Bastos and Haddad

2002; Cardoso and Haddad 1984; Wells 1977). A secondary function for many vocalization types can be associated with male-male evaluation, especially when aggressive behavior takes place. Threat signals sometimes evolve to enable contestants to assess each other's strength or motivation without resorting to a serious fight (Andersson 1980; Davies and Halliday 1978; Wells 1978). Besides the use of advertisement call, males of *P. rohdei* have two distinct territorial calls and probably two encounter calls. Variable aggressive calls may represent a graded communication system, because these calls may signal the motivational state of the combatants (Given 1987; Martins et al. 1998). In *P. rohdei*, males may be able to assess opponents through acoustic displays, because pursuer males were larger than those pursued and the SVLs of males involved in fights were not different. In other words, if your rival is bigger, run away, and if he is of similar body size, confront him. Nevertheless, differences in size between males engaged in fights (winner/loser pairs) versus pursuer/pursued pairs were not significantly different.

We did not observe physical combat when the pond was dry. This probably can be explained by the greater distance between males when the pond was dry (a mean of 155 cm versus 55 cm when the pond was filled), resulting in fewer close-range male-male encounters. As observed by Sullivan and Hinshaw (1992), low population density was responsible for an apparent lack of direct male-male competition for mates during breeding aggregations of *Hyla versicolor*. When males of *Phyllomedusa hypochondrialis* were distant from each other, fights were not observed (Matos et al. 2000).

In some cases, winners performed visual displays toward losers during aggressive encounters. This behavior was similar to "body jerking" defined by Hödl and Amézquita (2001). However, in body jerking, the movements were performed forward and backward instead of up and down.

Our results showed that residence and body condition influenced the results of 27 aggressive encounters between males of *P. rohdei*. A resident male in better physical condition might have better fighting ability because of larger energy reserves, higher motivational state, or different hormone levels (Wells 1978). Small males only won fights if they were the resident.

Acknowledgments.—We thank Clarissa Canedo, Márcio Martins, Mac F. Given, and Martha L. Crump for their critical reading of and suggestions for the manuscript. We thank F. N. Ramos for field assistance. We are grateful to the CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico), FAPERJ (Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro), and FUJB (Fundação Universitária José Bonifácio) for financial support.

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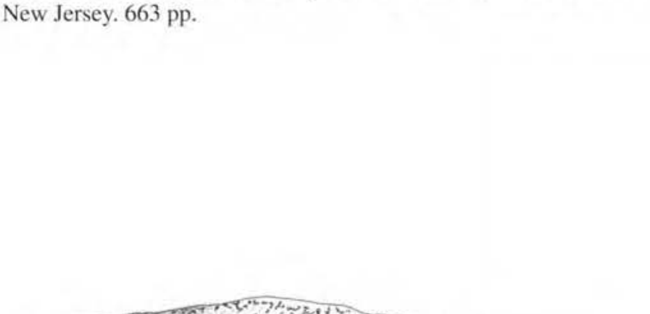

Smilisca baudinii tadpole (UMRC 93-19), 30 mm TL. Belize: Cayo: Vaqueros Creek at San Luis. Illustration by Julian C. Lee.

Continents, Between Two Seas. The University of Chicago Press, Chicago. 934 pp.). A single individual of *Tantilla reticulata,* collected from under moss on a tree limb at a height of 6.1 m, is the only documented case of any arboreal activity for this species (Wilson and Meyer 1971. Herpetologica 27:11–40).

In the course of several years of work in the canopy of Costa Rican rainforests, four individual of *T. reticulata* were observed crawling on tree branches at heights of over 27 m. None of these individuals, unfortunately, was vouchered. On 8 March 2003, during a visit to Rara Avis Rainforest Reserve, Heredia Province, Costa Rica (10°18.16'N, 84°02.62'W; 650 m elev.), an adult *T. reticulata* was observed falling from the thatched roof of a building from a height of ~ 5 m. In addition, on 12 March, about 1400 h another *T. reticulata* was observed actively moving about on an epiphyte-covered branch of an emergent canopy tree (*Vantanea barbouri*) at a height of 30.7 m above the ground. Both snakes were collected, photographed (YPM slide collection 1025–26), and released *in situ.* Gregory Watkins-Colwell verified identification of the present snakes.

These observations indicate that *T. reticulata* is more arboreal than previously assumed. The crowns of epiphyte-laden trees in the Rara Avis area provide a microhabitat with a humus layer and moss cover that is often more extensive than that of the local forest floor. It is not clear, however, how these small snakes detect the presence of a suitable habitat far overhead or how they succeed in reaching the canopy, crossing a vertical distance of 30 meters on smooth tree bark.

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TRIMORPHODON BISCUTATUS (Western Lyresnake). **PREDATION.** On 7 May 2003, 1250 h, we tracked a male *T. biscutatus,* 810 mm SVL and 153 g, implanted with a 5.2 g radio transmitter in the southern Tortolita Mountains near Oro Valley, Arizona, USA (32°28.201'N, 110°59.015'W). We located the transmitter signal from within 1 m of a *Bubo virginianus* (Great Horned Owl) nest site, which was actively defended by an adult pair of *B. virginianus.* Assuming the snake was dead, we left the site to avoid disturbing the owls further. On 14 May 2003, the owls were not present at the nest, and we found an owl pellet containing the snake's transmitter (Fig. 1) just below the nest. Great Horned Owls are generalist predators, preying on a variety of vertebrates including snakes (Houston et al. 1998. Great Horned Owl. Birds of North America. 372:1–28). We know of no previous records of avian predation on *T. biscutatus.*

FIG. 1. A pellet from *Bubo virginianus* containing a 5.2 g radio-transmitter from *Trimorphodon biscutatus.*

We thank Kirk Setser for his critical reading of this manuscript.

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GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 35, Number 1 (March 2004). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extensions unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA OPACUM (Marbled Salamander). USA: ARKANSAS: SEVIER CO: 8.0 km W Falls Chapel off Frog Level Rd. 28 February 2004. Z. D. Ramsey. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28277). Verified by Stanley E. Trauth. New county record filling hiatus in extreme southwestern Arkansas (Trauth et al. In press. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville). Also reported previously from adjacent McCurtain County, Oklahoma (Sam Noble Oklahoma Museum of Natural History Database of Amphibians [http://www.snomnh3.ou.edu/db/amphibians/]; Oklahoma Biological Survey's Distribution of Oklahoma Amphibians and Reptiles by Recorded Sightings, DOKARRS [http://www.biosurvey.ou.edu/dokadesc.html]).

Submitted by **ZACHARY D. RAMSEY** and **CHRIS T. McALLISTER,** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA; e-mail: chris.mcallister@tamut.edu.

AMBYSTOMA ORDINARIUM (Mexican Stream Salamander). MÉXICO: MÉXICO: Municipality of Malinalco (18°56'32"N, 99°29'18"W). 27 May 1941 and 20 February 1948. L. Verdeja. ENCB 2548–2550, 2611–2615. Municipality of Tianguistenco: Laguna Santiago Tilapa (19°11'22"N, 99°25'4"W). 25 October 1964. R. Aguilar and R. Cruz C. ENCB 3545–3553. Municipality of El Oro de Hidalgo (19°48'4"N, 100°8'4"W). 9 May 1964. H. Romero and P. Reyes. ENCB 3485–3504. Verified by Fernando Mendoza-Quijano. First records from state of México (Casas-Andreu et al. 1997. Univ. Auntón. Edo. México. Ciencias y Técnicas/32. 201 pp.) and extends the known range southeastward ca. 140 km from Ciudad Hidalgo, Michoacán (Anderson 1975. Cat. Amer. Amphib. Rept. 164:1–2).

Submitted by **NOEMI MATIAS-FERRER** and **SERGIO MURILLO**, Laboratorio de Cordados Terrestres, Departamento de Zoología, Escuela Nacional de Ciencias Biológicas, IPN, Carpio y Plan de Ayala s/n, Ap. Postal 42-186, CP. 11340, Distrito Federal, México; e-mail noemigecko@hotmail.com.

AMBYSTOMA TIGRINUM (Tiger Salamander). USA: TENNESSEE: DECATUR Co: Bath Springs, 3965 Hwy 69 S, 0.3 km S of Mount Nebo Church on E side of highway (352524N, 880650W). 1 March 2004. Elizabeth Harden. Verified by A. Floyd Scott, Austin Peay State University Museum of Zoology, APSU 17485 (digital photo). One adult found on carport at ca. 1000 h following all-day rain. First record from Decatur County (Redmond and Scott. 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.; http://www.apsu.edu/amatlas/, accessed 4 March 2004).

Submitted by **CHARLES HARDEN**, Natural Areas Program, Division of Natural Heritage, 362 Carriage House Drive, Jackson, Tennessee 38305-2222, USA; e-mail: Charles.Harden@state.tn.us.

HEMIDACTYLIUM SCUTATUM (Four-toed Salamander). USA: INDIANA: MARTIN Co: Plaster Creek Seep, SW 1/4, NE 1/4, Sec. 11, T2N, R4W. 8 April 2003. Lee A. Casebere and Michael J. Lodato. Verified by Greg Schneider, University of Michigan Museum of Zoology, UMMZ 229816. First record for county; extends range ca 94 km W of nearest known locality in Jackson County (Minton 2001. Amphibians and Reptiles of Indiana. 2nd ed., revised. Indiana Acad. Sci. 404 pp.; Meretsky and Pyles. 2001. Herpetol. Rev. 32:268.) OWEN Co: Jordan Seep, SW 1/4, SW 1/4, Sec. 6, T11N, R4W. 15 April 2003. Lee A. Casebere and Michael J. Lodato. Verified by Greg Schneider, University of Michigan Museum of Zoology, UMMZ 229818. First record for county; extends range ca 37 km SW of nearest known record in Morgan County. (Minton, *op. cit.*) JEFFERSON Co: Chelsea Flatwoods, NE 1/4, NE 1/4, Sec. 33, T3N, R9E. 12 April 2003. Lee A. Casebere. Verified by Greg Schneider, University of Michigan Museum of Zoology, UMMZ 229817, and JEFFERSON Co: Western Wooded Parcel (0.8 km S of the southern boundary of Big Oaks National Wildlife Refuge), NE 1/4, Sec. 31, T5N, R10E. 5 May 2003. Hanover College Herpetology Class. Verified by Joseph R. Robb, U.S. Fish and Wildlife Service. Photo voucher in Illinois Natural History Survey (INHS 2004a–b). First records for county; extends range ca 38 km SE of nearest record in Jackson County (Minton, *op. cit.*; Meretsky and Pyles, *op. cit.*) and ca 16 km S from a recently vouchered (5 April 2003) record in adjacent Ripley County (Skilbred and Meretsky. 2003. Herpetol. Rev. 34:379)

The seep springs at the Martin and Owen county localities support bog-like conditions under or adjacent to hardwood forest canopy. Here the mucky, highly saturated soils are kept wet by perennial groundwater seepage. In contrast, the Jefferson County localities were in hardwood forest on flat, poorly drained, acid, clay soils. Unlike the seep spring sites kept wet year-round by seepage, the flatwoods sites depend on precipitation runoff for the creation of temporary breeding pools. At each of the new localities most of the salamanders encountered were females brooding egg masses, and were well hidden within moss mats, primarily *Thuidium*, on fallen logs and at the base of trees.

These new distributional records are significant in that *Hemidactylium scutatum* is an endangered species in Indiana. It is also noteworthy that all these new localities are from the southern portion of the state, where the species is extremely rare and known only from widely disjunct colonies.

Submitted by **LEE A. CASEBERE**, Indiana Department of Natural Resources–Division of Nature Preserves, 402 West Washington Street, Rm. W-267, Indianapolis, Indiana 46204, USA (e-mail: lcasebere@dnr.state.in.us), **MICHAEL J. LODATO**, 925 Park Plaza Drive, Evansville, Indiana 47715, USA (e-mail: mlodato229@aol.com), and **DARYL R. KARNS**, Biology Department, Hanover College, Hanover, Indiana 47243, USA (e-mail: karns@hanover.edu).

NOTOPHTHALMUS VIRIDESCENS LOUISIANENSIS (Central Newt). USA: ARKANSAS: LITTLE RIVER Co: 8.8 km E Ashdown off Arkansas St. Hwy 32 at Lake Millwood State Park, Waterfowl Way Trail. 26 January 2004. Z. D. Ramsey and J. P. Fuller. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28106). Verified by Stanley E. Trauth. New county record (Trauth et al. *In press.* Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville) filling a distributional hiatus in extreme SW part of state. Also reported previously to the south in adjacent Bowie County, Texas (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station. 421 pp.) and west in McCurtain County, Oklahoma (Oklahoma Biological Survey's Distribution of Oklahoma Amphibians and Reptiles by Recorded Sightings DOKARRS [http://www.biosurvey.ou.edu/dokadesc.html]).

Red eft specimen (SVL = 26 mm) found under decaying log in bottomland forest along with sympatric *Ambystoma maculatum*, *A. opacum*, and *Rana catesbeiana*.

Submitted by **ZACHARY D. RAMSEY**, **JONATHAN P. FULLER**, and **CHRIS T. McALLISTER**, Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA; e-mail: chris.mcallister@tamut.edu.

ANURA

BUFO DEBILIS INSIDIOR (Western Green Toad). USA: NEW MEXICO: SIERRA Co: White Sands Missile Range, earthen tank at Martin Ranch HQ (T10S R4E NW1/4 Sec 30) E of Rio Grande (1 male, 1 female). 31 July 1997. Douglas W. Burkett and Larry K. Kamees. Museum of Southwestern Biology (MSB 60800–01). First county record, filling in distribution between SE Socorro Co. and SW Lincoln Co. records. SIERRA Co: NM Hwy 27, 5.6 rd miles N of Nutt (T19S R6W, Sec 30) W of Rio Grande (1 male). 7 June 2000. Bruce L. Christman. MSB 62031 Verified by J. Tomasz Giermakowski. MSB second county record extending range N from records in Luna Co. (Degenhardt et al. 1996, Amphibians and Reptiles of New Mexico. Univ. of New Mexico Press, Albuquerque. xii + 431 pp.).

Submitted by **BRUCE L. CHRISTMAN**, 3914 Simms SE, Albuquerque, New Mexico 87108, USA, **DOUGLAS W. BURKETT**, BAE Systems, Building 126, White Sands Missile Range, New Mexico, 88002 USA, and **LARRY K. KAMEES**, New Mexico Department of Game and Fish, 1 Wildlife Way, Santa Fe, New Mexico 87507, USA.

ELEUTHERODACTYLUS AUGUSTI CACTORUM (Western Barking Frog). USA: ARIZONA: SANTA CRUZ CO.: Patagonia Mts., E slope of Red Mtn., 4.0 km (airline) NNW Harshaw, 1620 m elev., 31°30.238' N, 110°42.766'W. 18 July 2003. E. Enderson, K. Bezy, R. Bezy. UAZ 55425. Verified by George Bradley. First record for Patagonia Mts.; extends the range of the species in Arizona (Goldberg 2003. Sonoran Herpetol. 15:54–57) 30 km SE from Madera Canyon, Santa Rita Mountains (Slevin 1931. Copeia 1931:140–141), and 46 km NW from Coronado National Memorial, Huachuca Mountains (Schwalbe et al. 1997. Bajada 5[3]:1). This specimen, one of over 30 *E. augusti* heard in the area on 18 July, was calling from a talus slope in chaparral with scattered oaks and piñons.

Submitted by **ERIK F. ENDERSON**, 806 South Pantano Road, Tucson, Arizona 85710, USA (e-mail: eenderson@cox.net), **KIT B. BEZY**, 3776 East Nugget Canyon Place, Tucson, Arizona 85718, USA, and **ROBERT L. BEZY**, Herpetology, Natural History Museum of Los Angeles County, Los Angeles, California 90007, USA.

ELEUTHERODACTYLUS RUGULOSUS (Central American Rain Frog). MÉXICO: MORELOS: Municipio de Tlalquiltenango: Sierra de Huautla Biosphere Reserve, on paved road from Huautla to Xantiopa (18°25'52.0"N, 98°59'51.2"W), 1000 m elev. 23 June 2001. Jorge Chávez-Juárez, Harald Alcaraz-Cruz, and David Valenzuela Galván. Amphibian Collection, Centro de Educación Ambiental e Investigación Sierra de Huautla–Universidad Autónoma del Estado de Morelos (MOR-AN-146-04-03 No. 7). Verified by Edmundo Pérez Ramos. First record for Morelos and the Sierra de Huautla Biosphere Reserve, extending known range ca. 130 km NW from nearest known locality at Agua de Obispo, Guerrero (Flores-Villela 1998. Formación de una base de datos y elaboración de un atlas de la herpetofauna de México. Colección de Anfibios y Reptiles, Museo de Zoología "Alfonso L. Herrera," Departamento de Biología, Facultad de Ciencias, Universidad Nacional Autónoma de México. Bases de Datos SNIB – CONABIO, Proyecto A 14, México, D.F.).

Submitted by **DAVID VALENZUELA GALVÁN**, Departamento de Ecología y Conservación de los Recursos Naturales, Centro de Educación Ambiental e Investigación Sierra de Huautla, UAEM, Morelos, México (e-mail: dvalen@buzon.uaem.mx), **JORGE CHÁVEZ-JUÁREZ** (e-mail: herpetologia@hotmail.com) and **HARALD ALCARAZ-CRUZ,** Facultad de Ciencias Biológicas, Universidad Autónoma del Estado de Morelos (UAEM), Morelos, México (e-mail: biohac@hotmail.com).

ELEUTHERODACTYLUS W-NIGRUM (Zurucuchu Robber Frog). PERU: PIURA: PROVINCIA HUANCABAMBA: Distrito Carmen de la Frontera: Santuario Nacional Tabaconas-Namballe (05°06'50.7"S, 79°21'16.3"W, 2200 m elev.). 23 and 26 April 2003. C. Aguilar. Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, (MHNSM 19912), Museum fuer Tierkunde Dresden (MTD 45952). Verified by W. E. Duellman. Specimens were caught at night on ground in a secondary montane forest. First record for Peru and southernmost for its range (Lynch and Duellman 1997. Univ. Kansas Nat. Hist. Mus. Spec. Publ. 23:1–236). Extension of distribution ca. 230 km (airline) S of the previously known locality records (Cuenca region) in southern Ecuador.

Submitted by **EDGAR LEHR**, Staatliche Naturhistorische Sammlungen Dresden, Museum fuer Tierkunde, Koenigsbruecker Landstrasse 159, 01109 Dresden, Germany (e-mail: edgar.lehr@snsd.smwk.sachsen.de), and **CESAR AGUILAR**, Museo de Historia Natural, Departamento de Herpetología, Universidad Nacional Mayor de San Marcos, Av. Arenales 1256, Jesús María, Ap. 14–0434, Lima, Perú (e-mail: aguilarpuntriano@yahoo.es).

GASTROPHRYNE USTA (Two-spaded Narrowmouth Toad). MEXICO: MORELOS: Municipio de Tlalquiltenango: 1 km W Quilamula (18°30'28"N, 99°01'35"W), 1060 m elev. 27 June 2002. Jorge Chávez-Juárez, Harald Alcaraz-Cruz, and David Valenzuela Galván. Amphibian Collection, Centro de Educación Ambiental e Investigación Sierra de Huautla - Universidad Autónoma del Estado de Morelos (MOR-AN-146-04-03 Nos. 9–10). Verified by Edmundo Pérez Ramos and Georgina Santos. First record for Morelos and the Sierra de Huautla Biosphere Reserve, extending the known range ca. 66 km NE from the nearest record at Tecpán de Galeana, Guerrero (Flores-Villela 1998. Formación de una base de datos y elaboración de un atlas de la herpetofauna de México. Colección de Anfibios y Reptiles, Museo de Zoología "Alfonso L. Herrera," Departamento de Biología, Facultad de Ciencias, Universidad Nacional Autónoma de México. Bases de Datos SNIB – CONABIO, Proyecto A 14, Mexico, D.F.). Both specimens were collected while calling from a pool in a cornfield.

Submitted by **DAVID VALENZUELA GALVÁN**, Departamento de Ecología y Conservación de los Recursos Naturales, Centro de Educación Ambiental e Investigación Sierra de Huautla, UAEM, Morelos, Mexico (e-mail: dvalen@buzon.uaem.mx), **JORGE CHÁVEZ-JUÁREZ** (e-mail: herpetologia@hotmail.com) and **HARALD ALCARAZ-CRUZ** Facultad de Ciencias Biológicas, Universidad Autónoma del Estado de Morelos (UAEM), Morelos, Mexico (e-mail: biohac@hotmail.com).

OSTEOPILUS SEPTENTRIONALIS (Cuban Treefrog). USA: FLORIDA: MARION CO.: Ocala, 611 SE 9th Ave. (29°10'51"N, 82°07'39"W). 30 October 2003. Gerald R. Johnston. Verified by Kenneth L. Krysko. Florida Museum of Natural History (UF 140125). New county record. Adult male (50 mm SVL) found on balcony of apartment building. This species has been reported from many counties throughout peninsular Florida (Meshaka 2001. The Cuban Treefrog in Florida: Life History of a Successful Colonizing Species. Univ. Press of Florida, Gainesville, Florida, 208 pp.).

Submitted by **GERALD R. JOHNSTON**, Department of Natural Sciences, Santa Fe Community College, Gainesville, Florida 32606, USA; e-mail: jerry.johnston@sfcc.edu.

PROCERATOPHRYS AVELINOI (Cow Frog). BRAZIL: PARANÁ: Guarapuava municipality, Municipal Park of Araucarias (25°21'S, 51°28'W, ca. 1073 m elev.). 16 February and 19 November 2002. C. Hiert. Museu Nacional do Rio de Janeiro, Rio de Janeiro (MNRJ 33193–94). At night in a freshwater swamp (ca. 9 x 6 m), in a mixed temperate rain forest (Araucária Forest). Previously known from Moncholito, Misiones, República Argentina

(Mercadal de Barrio and Barrio. 1993. Amphibia-Reptilia 14:13–18), and Ipuaçu municipality, Santa Catarina (Hatmann and Garcia. 2001. Herpetol. Rev. 32:272), and Londrina and Tres Barras do Paraná municipality, Paraná, Brazil (Bernarde and Machado. 2000. Cuad. Herpetol. 14:93–104). Third record from Paraná state; extends known distribution 222 km SW from Londrina and 175 km N from Três Barras do Paraná, the previously cited localities in Paraná state.

Submitted by **CRISTIANE HIERT** (e-mail: chiert@unicentro.br) and **MAURICIO O. MOURA** (e-mail: moura@unicentro.br), Curso de Pós-Graduação em Ecologia, Departamento de Ciências Biológicas, Universidade Estadual do Centro-Oeste, C.P. 3010, 85010-090, Guarapuava, Paraná, Brazil.

RANA CLAMITANS (Green Frog). USA: TENNESSEE: ROBERTSON CO: Tilley Spring, ca. 25 m N of Hoopers Hollow Road (36.3771N, 87.0593W). 31 March 2003. Timothy D. Brown and Nathan L. Parker. Verified by A. Floyd Scott, Austin Peay State University Museum of Zoology, APSU 3344. First record from Robertson County (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.; http://www.apsu.edu/amatlas/, accessed 15 January 2004).

Submitted by **TIMOTHY D. BROWN** (e-mail: tdb9342@mail.apsu.edu) and **NATHAN L. PARKER** (e-mail: nlp6618@mail.apsu.edu), The Center for Field Biology, Austin Peay State University, P.O. Box 4718, Clarksville, Tennessee 36044, USA.

RANA ZWEIFELI (Zweifel's Frog). MÉXICO: MORELOS: Municipio de Tepalcingo: Sierra de Huautla Biosphere Reserve, near El Limón (18°31'17.0"N, 98°56'18.3"W), 1040 m elev. 22 October 2002. Jorge Chávez-Juárez, Harald Alcaraz-Cruz, and David Valenzuela Galván. Amphibian Collection, Centro de Educación Ambiental e Investigación Sierra de Huautla – Universidad Autónoma del Estado de Morelos (MOR-AN-146-04-03 No. 47). Verified by Edmundo Pérez Ramos. First verified record for Morelos and the Sierra de Huautla Biosphere Reserve, extending the known range of the species ca. 130 km SE from nearest known locality at Amatepec, México (Casas-Andreu 1999. Sistema de información geográfica sobre la herpetofauna del Estado de México. Departamento de Zoología, Instituto de Biología, Universidad Nacional Autónoma de México. Bases de Datos SNIB – CONABIO, Proyecto H 103, México, D.F.). Bustos-Zagal et al. (2002. Abstracts of the 49th Annual Meeting of the Southwestern Association of Naturalists, 25–27 April, Cuernavaca, Morelos, Mexico, 0-59:23) reported its occurrence in the Amacuzac River Basin, Morelos, but no voucher specimens are available from that area. The El Limón specimen was found near a small creek surrounded by tropical dry forest.

Submitted by **JORGE CHÁVEZ-JUÁREZ** (e-mail: herpetologia@hotmail.com), **HARALD ALCARAZ-CRUZ** (e-mail: biohac@hotmail.com), Facultad de Ciencias Biológicas, Universidad Autónoma del Estado de Morelos (UAEM), Morelos, Mexico, and **DAVID VALENZUELA GALVÁN,** Departamento de Ecología y Conservación de los Recursos Naturales, Centro de Educación Ambiental e Investigación Sierra de Huautla, UAEM, Morelos, Mexico (e-mail: dvalen@buzon.uaem.mx).

SCINAX WANDAE (NCN). VENEZUELA: ESTADO BARINAS: 3 km up Acequias River, 8°24'N, 70°42'W, 200 m. 24 September 2002. A. Buitrago. Colección de Vertebrados, Universidad de los Andes, Facultad de Ciencias (CVULA 6613–4). First state record. ESTADO MERIDA: Santa María de Caparo, Sector el Vegón, 215 m. September 2000. CVULA 6492. First state record. Both verified by O. Fuentes. This species has been reported only recently from Amazonian Venezuela (Barrio-Amorós and Fuentes 2003. Herpetol. Rev. 34:163). These are the first reports from the llanos-piedmont bio-region (*sensu* Barrio-Amorós 1998. Acta Biol. Venez. 18[2]:1–93.). Both records are about 450 km NE of the type locality at Villavicencio, Colombia, and about 480 km ESE from the closest record known in Venezuela, Puerto Ayachucho (Barrio-Amorós and Fuentes, *op. cit.*).

Submitted by **CÉSAR L. BARRIO-AMORÓS**, Fundación AndígenA. Apartado Postal 210. Mérida 5101-A. Venezuela (e-mail: atelopus@andigena.org), and **ANDRÉS CHACÓN-ORTIZ**, Instituto Venezolano de Investigaciones Científicas, Centro de Ecología, Lab. de Ecología y Genética de Poblaciones. Km 11, carretera panamericana, Altos de Pipe, Estado Miranda, Apartado 21827 Caracas, Venezuela (e-mail: aecortiz@yahoo.com).

SPEA MULTIPLICATA (Mexican Spadefoot Toad). MEXICO: MORELOS, Municipio de Tlalquiltenango: along a creek N of Quilamula (18°32'01.2"N, 99°01'07.3"W), 1116 m elev. 6 September 2002. Jorge Chávez-Juárez, Harald Alcaraz-Cruz, and David Valenzuela Galván. Amphibian Collection, Centro de Educación Ambiental e Investigación Sierra de Huautla – Universidad Autónoma del Estado de Morelos (MOR-AN-146-04-03 No. 6). Verified by Rafael Aguilar Cortés. First record for Sierra de Huautla and for southern Morelos, extending the known range ca. 36 km SE from the nearest locality at Alpuyeca and Puente de Ixtla, Morelos (Flores-Villela 1998. Formación de una base de datos y elaboración de un atlas de la herpetofauna de México. Colección de anfibios y reptiles, Museo de Zoología "Alfonso L. Herrera," Departamento de Biología, Facultad de Ciencias, Universidad Nacional Autónoma de México. Bases de Datos SNIB –CONABIO, Proyecto A 14, México, D.F.). The area surrounding the creek is in tropical dry forest.

Submitted by **JORGE CHÁVEZ-JUÁREZ** (e-mail: herpetologia@hotmail.com), **HARALD ALCARAZ-CRUZ** (e-mail: biohac@hotmail.com), Facultad de Ciencias Biológicas, Universidad Autónoma del Estado de Morelos (UAEM), Morelos, Mexico, and **DAVID VALENZUELA GALVÁN**, Departamento de Ecología y Conservación de los Recursos Naturales, Centro de Educación Ambiental e Investigación Sierra de Huautla, UAEM, Morelos, Mexico (e-mail: dvalen@buzon.uaem.mx).

GYMNOPHIONA

GYMNOPHIS MULTIPLICATA (Culebra de Dos Cabezas). NICARAGUA: MATAGALPA: Selva Negra (12°59.92'N, 85°54.66'W), 1250 m elev. 3 September 1997. T. Leenders. Herpetological Media Collection (YPM 1099–1100). Verified by G. Köhler. First records for Matagalpa and extends the range ca. 100 km SW of the closest known locality at El Naranjo, Atlántico Norte (Köhler 2001. Anfibios y Reptiles de Nicaragua. Offenbach

[Herpeton], Verlag, Germany. 208 pp.). They are also the first records from a highland locality in Nicaragua, where previously it had been found only below 150 m elevation (Köhler, *op. cit.*).

Submitted by **TWAN A. A. M. LENDERS** (e-mail: twanleenders@scinax.com) and **GREGORY J. WATKINS-COLWELL** (e-mail: gregory.watkins-colwell@yale.edu), Division of Vertebrate Zoology, Yale Peabody Museum of Natural History, 170 Whitney Avenue, P.O. Box 208118, New Haven, Connecticut 06520, USA.

TESTUDINES

APALONE SPINIFERA (Spiny Softshell). USA: ILLINOIS: McDonough Co: S of Macomb on IL 67, 16 km S of intersection of IL 67 and county road 700 N. 6 June 2003. James T. Lamer. INHS photographic record 2004.01. Verified by Chris Phillips, Illinois Natural History Survey. First county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Hat. Hist. Surv. Manual 8, 282 pp.).

Submitted by **JAMES T. LAMER,** Department of Biological Sciences, Western Illinois Universtiy, 1 Universtiy Circle, Macomb, Illinois 61455, USA, and **JOHN K. TUCKER,** Illinois Natural History Survey, 8450 Monclair Ave, Brighton, Illinois 62012, USA.

GOPHERUS POLYPHEMUS (Gopher Tortoise). USA: GEORGIA: Irwin Co.: Sterling Conservation Area, 10 individuals observed in an area begining1.6 km N of Crystal Lake and 1.6 km E of Big Bend Lake and ending 3.14 km N of Crystal Lake and 1.48 km E of Turner Lake. Four occupied burrow locations recorded with global positioning system (31°41'4.83"N, 83°26'42.47"W; 31°41'11.11"N, 83°26'43.22"W; 31°41'37.51"N, 83°26'59.85"W; 31°41'51.84"N, 83°26'40.63"W). 9 June 2003. Christopher R. Wilson. Verified by M. E. McGhee. Georgia Museum of Natural History (GMNH 49219 color photograph). First vouchered and published county record (Williamson and Moulis 1994. Distribution of Amphibians and Reptiles in Georgia. Special Publication No. 3. Savannah Science Museum. 712 pp). Portions of this population occur on a conservation easement held by North American Land Trust.

Submitted by **CHRISTOPHER R. WILSON**, North American Land Trust / NC Field Office, 196 Arnett Hollow Road, Vilas, North Carolina 28962, USA.

GRAPTEMYS GEOGRAPHICA (Northern Map Turtle). USA: New Jersey: Sussex Co: E side of Delaware River (41°05'34"N, 74°59'28"W), Delaware Water Gap National Recreation Area (DEWA). 13 June 2001. John L. Behler, Christina M. Castellano, and Timothy J. Crockett. Adult female with palpable eggs; maximum carapace and plastron lengths, and mass were 177.3 mm and 160.0 mm, and 605 g, respectively. Photographic voucher deposited in Research and Resource Planning Division files, DEWA, National Park Service (NPS/WCS043-045). Verified by Alvin R. Breisch. Prior to capture, the specimen was observed basking on an exposed, flat rock ca. 9 m away from the shoreline with several common mergansers (*Mergus merganser*) and mallard ducks (*Anas platyrhynchos*). This species' occurrence in the Delaware River, in Bucks County, Pennsylvania, was not detected until recently (Arndt and Potter 1973. J. Herpetol. 7:373–375). Since that time, anecdotal reports (Serrao 2000. The Reptiles and Amphibians of the Poconos and Northeastern Pennsylvania. Llewellyn & McKane Inc., Wilkes-Barre. 49 pp.) suggest that the species' range has extended northward to Northampton Co., Pennsylvania. Between June 2000 and September 2002, more than 50 observations of basking *G. geographica* were recorded in DEWA while surveying turtle riverine habitat. The Delaware River was surveyed from river mile 247 in Sussex (NJ)-Pike (PA) counties at the north end of the park to mile 210 (from the river's mouth) in Warren (NJ)-Monroe (PA) counties near the park's southern boundary. The majority of observations occurred between miles 228 and 218 and in the vicinity of large river islands with sizable sandbanks and adjacent sections of deep water. Basking turtles were typically > 5m from the shoreline on the distal ends of wind-thrown trees, or on exposed logs and flat rocks. The capture location cited above represents a new county record for the species and extends the northward expansion of its range upriver ca. 40 km.

We appreciate the assistance of survey team members Stanley Boder, David Wood, and Sandy Mattfeldt.

Submitted by **JOHN L. BEHLER,** Department of Herpetology, Wildlife Conservation Society, 2300 Southern Boulevard, Bronx, New York 10460-1099, USA (e-mail: jbehler@wcs.org), **CHRISTINA M. CASTELLANO**, Department of Biological Sciences, Fordham University, 441 East Fordham Road, Bronx, New York 10458, USA (e-mail: expansa@aol.com), and **TIMOTHY J. CROCKETT**, Department of Environmental Science and Biology, State University of New York College at Brockport, 350 New Campus Drive, Brockport, New York 14420, USA (e-mail: crocke08@hotmail.com).

PSEUDEMYS RUBRIVENTRIS (Red-bellied Cooter). USA: New Jersey: Warren Co.: Depew Access Road 0.2 km W of Old Mine Road (41°03'31"N, 75°00'17"W), Delaware Water Gap National Recreation Area (DEWA). 4 May 2001. Christina M. Castellano and John L. Behler. Adult female, maximum carapace and plastron lengths were 301 mm and 291 mm, respectively. Photographic voucher deposited in Research and Resource Planning Division files, DEWA, National Park Service (NPS/WCS040-042). Verified by Alvin R. Breisch. Prior to capture, the specimen was observed basking on 24 April 2001 with several *Chrysemys picta* on a small hummock in a 1.5 m deep beaver pond in Miller Farm Marsh 400 m S of its capture site which is located 600 m E of the Delaware River. The distribution of this species in the Delaware River drainage is thought to be restricted to the coastal plain. However, it is likely that viable populations of this species ranged more broadly in the past as it was heavily exploited for eastern food markets in the late 1800s and probably extirpated from its range north of southern New Jersey (Hulse et al. 2001. Amphibians and Reptiles of Pennsylvania and the Northeast. Cornell University Press, Ithaca, 419 pp.). This capture location is ca. 60 km NW of the northernmost locality in the New Jersey Herp Atlas database (Raritan River, vicinity of Somerville, Somerset County; Jason Tesauro, pers. comm.), and is the first report of this species' occurrence above New Jersey's piedmont region.

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and **JOHN L. BEHLER**, Department of Herpetology, Wildlife Conservation Society, 2300 Southern Boulevard, Bronx, New York 10460-1099, USA (e-mail: jbehler@wcs.org).

TRACHEMYS SCRIPTA ELEGANS (Red-eared Slider). USA: CALIFORNIA: SACRAMENTO CO: 500 m NE of intersection of East Bidwell and Blue Ravine Road (38°39'N, 121°09'W). 22 May 2003. Eric W. Stitt, Dustin Brown, and Peter S. Balfour. Verified by Cecil R. Schwalbe. Slide voucher, University of Arizona Collection of Amphibians and Reptiles (UAZ 55579-PSB). Female, 218 mm midline carapace length, 1515 g. Captured on the bank of a man-made pond ca. 3 m from water's edge, possibly preparing to lay eggs (although no eggs could be felt by palpation). Several other adult *Trachemys* have been observed here, together with the native *Actinemys marmorata*. This subspecies is native to eastern New Mexico through Louisiana, and has been widely introduced throughout the western states (Stebbins 2003. Western Reptiles and Amphibians, Third Edition. Houghton Mifflin Co., New York, NY. 533 pp.). In northern California, this turtle occurs in the Sacramento-San Joaquin Delta, but the status of most populations is unknown (Stebbins, *op. cit.*). Also, although this species is occasionally recorded in local field guides (e.g., The American River Natural History Association. 1993. The Outdoor World of the Sacramento Region: A Local Field Guide. ARNHA, 214 pp.) specific locality data are lacking. Museum records exist from Putah Creek near Davis, Yolo County, California, ca. 60 km ESE of this new locality (CAS 203705–06, 203710). This verifies the turtle's presence in Sacramento County, in the vicinity of Folsom Lake and Lake Natoma.

Submitted by **ERIC W. STITT**, University of Arizona, School of Renewable Natural Resources, 125 Biological Sciences East, Tucson, Arizona 85721, USA (e-mail: estitt@u.arizona.edu), **DUSTIN BROWN**, The Masters College, 21726 Placerita Canyon Road, Santa Clarita, California 91321, USA, and **PETER S. BALFOUR**, ECORP Consulting, Inc., 2260 Douglas Blvd., Suite 160, Roseville, California 95661, USA.

LACERTILIA

ANOLIS CAROLINENSIS CAROLINENSIS (Northern Green Anole). USA: TEXAS: KERR CO: Kerrville, off Texas Hwy 16, 2145 Sidney Baker Street, at Econo Lodge. 5 March 2004. Z. D. Ramsey and S. F. Barclay. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28279). Verified by Stanley E. Trauth. New county record partially filling hiatus in Edward's Plateau of Hill Country (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M University Press, College Station, Texas. 421 pp.).

Submitted by **ZACHARY D. RAMSEY, STEPANIE F. BARCLAY,** and **CHRIS T. McALLISTER,** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA; e-mail: chris.mcallister@tamut.edu.

CNEMIDOPHORUS LONGICAUDA. ARGENTINA: BUENOS AIRES: Partido Monte Hermoso: Monte Hermoso (38°59'S, 61°21' S). 16 February 2002. C. H. F. Perez and P. F. Petracci. Verified by L. J. Avila. Fundación Miguel Lillo Herpetological Collection, San Miguel de Tucumán, Argentina (FML 15208). *Cnemidophorus longicauda* is widely distributed in western Argentina following the Monte phytogeographic province (Cei 1993. Mus. Reg. Sci. Nat. Torino, Mon. XIV:1–949) reaching the Atlantic shores in Buenos Aires, Chubut, and Rio Negro provinces. This represents the easternmost record for this teiid species in Buenos Aires province and extends known range 100 km E of type locality at Bahia Blanca (Williams 1991. CIC 1[4]:1–21; Cei 1993, *op. cit.).* In Buenos Aires province, the species was cited with "doubts" for Partido de Puan, and as "confirmed" for Partido de Villarino and Partido de Bahía Blanca (Williams 1991, *op. cit.)* but without mention of voucher specimens.

The Bahía Blanca record is in the original description but the species was never found again in this locality, probably because of human disturbance of the area. The Monte Hermoso populations probably represent isolated remnants of a more extensive, historical distribution in Buenos Aires province. The lizard was collected in a seashore dune system, outside urban limits of Monte Hermoso City, with typical psammophyllous vegetation and in sympatry with *Liolaemus multimaculatus* and *L. gracilis*.

Submitted by **CRISTIAN HERNAN FULVIO PEREZ**, Agustin Alvarez 1182 A, 8000, Bahía Blanca, Buenos Aires, Argentina (e-mail: liolaemu@criba.edu.ar), and **PABLO FABRICIO PETRACCI**, Patricios 712, 8000, Bahía Blanca, Buenos Aires, Argentina.

GERRHONOTUS LIOCEPHALUS (Texas Alligator Lizard). MEXICO: HIDALGO: 12 km N Metztitlán, 1200 m elev. 16 September 1976. Oscar J. Polaco. Verified by Fernando Mendoza-Quijano. Herpetozoarios Collection of the Escuela Nacional de Ciencias Biológicas (IPN. ENCB-9019). First vouchered record for Hidalgo and a range extension of ca. 253 airline km NW from the nearest record at Cacaloapan, Puebla (Good 1994. Herpetol. Monogr. 8:180–202). Smith (1984. Bull. Maryland Herpetol. Soc. 20:152–158) indicated that *G. liocephalus* occurs in Hidalgo, but gave no corroborating evidence. The subadult female was collected in xerophytic scrub vegetation.

Submitted by **JOSÉ ISMAEL CAMPOS-RODRÍGUEZ** (e-mail: ismaelcampos@msn.com) and **JUAN CARLOS LÓPEZ-VIDAL**, Laboratorio de Cordados Terrestres, Departamento de Zoología, Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional, Apdo. Post. 42-186, Carpio y Plan de Ayala s/n. Santo Tomás, México D.F., 11340, Mexico (e-mail: jclopez@bios.encb.ipn.mx).

HEMIDACTYLUS GARNOTII (Indo-Pacific Gecko). USA: FLORIDA: MARION CO: Ocala, 611 SE 9th Avenue (29°10'51"N, 82°07'39"W). 2 November 2003. Gerald R. Johnston, Jennifer C. Johnston, and Vaughn A. Newman. Verified by Kenneth L. Krysko. Florida Museum of Natural History (UF 140123–24). New county record. Two individuals (juvenile 26 mm SVL, adult 42 mm SVL) captured on wall of apartment building. This species has been reported from many counties throughout peninsular Florida (Townsend and Krysko 2003. Florida Sci. 66:204–208).

Submitted by **GERALD R. JOHNSTON**, Department of Natural Sciences, Santa Fe Community College, Gainesville, Florida 32606, USA; and **JENNIFER C. JOHNSTON**, 225 NW 4th Street, High Springs, Florida, 32643, USA. e-mail: jerry.johnston@sfcc.edu.

HEMIDACTYLUS TURCICUS TURCICUS (Mediterranean Gecko). USA: MISSOURI: St. Louis Co.. A hatchling sized (SVL = 21.7 mm) gecko was collected in the offices of Beta Gamma Sigma (BGS) at 125 Weldon Parkway, Maryland Heights, Missouri, 63043, 38°42.460'N, 90°26.487'W. 16 October 2003. Debi Galloway. Verified by A. F. Scott, Austin Peay State University Museum of Zoology, APSU 17482. Employees of BGS continued to observe at least one other hatchling sized individual basking on the outside of their building during warm/sunny days into the last week of October 2003. This is the first documented occurrence of *H. t. turcicus* in Missouri (Johnson 2000. The Amphibians and Reptiles of Missouri. Missouri Department of Conservation, Jefferson City, Missouri. 400 pp.)

Conant and Collins (1998. A Field Guide to Reptiles and Amphibians: Eastern and Central North America, 3rd ed., expanded. Houghton Mifflin, Boston, Massachusetts. 616 pp.) comment on the rapid expansion of *H. t. turcicus* across the southern USA and speculate that it is likely due to humans inadvertently transporting geckos or their egg clutches. The offices of BGS are in the suburbs of St. Louis, Missouri. The large commercial complex is surrounded by residential neighborhoods and retail shopping district. It seems likely that these animals arrived with a shipment of goods to one of the businesses in the commercial complex.

I thank the employees of BGS for reporting the lizard activities they observed, especially my mother-in-law, Donna Binek, for telling me about the lizards running around her new office and Debi Galloway for capturing one.

Submitted by **ANGELO P. BUFALINO**, Department of Biology, Saint Louis University, 3507 Laclede Avenue, St. Louis, Missouri 63103, USA; e-mail: bufalino@slu.edu.

OPHISAURUS VENTRALIS (Eastern Glass Lizard). USA: FLORIDA: Lafayette Co: 4.7 km N of Dixie Co. line on County Road 357 (29°01'50"N, 82°18'04"W), DOR at 2044 h. 9 September 2003. Michael E. Welker and Michael Arnold. Verified by Kenneth L. Krysko. Florida Museum of Natural History (UF 138411). New county record (Ashton and Ashton 1991. Handbook of Reptiles and Amphibians of Florida. Part 2. Lizards, Turtles and Crocodilians. Second ed. Windward Publishing, Miami, Florida, 191 pp.).

Submitted by **MICHAEL E. WELKER** and **MICHAEL ARNOLD**, 1911 NW 55th Terrace, Gainesville, Florida 32605, USA; e-mail: herpconservation69@yahoo.com.

PRISTIDACTYLUS ACHALENSIS. ARGENTINA: SAN LUIS: Merlo (32°21'S, 65°02'W), 1955 m elev. 2 January 2004. N. E. Salas. Herpetological Collection of Universidad Nacional de Río Cuarto, Ecología, Río Cuarto, Córdoba, Argentina. (UNRC-ECO 781–2). Verified by R. Martori. First province record. Endemic species from Argentina, previously known from Pampa de Achala, departments of San Alberto, Santa Maria, and Punilla, Córdoba (Gallardo 1964. Neotropica 10[33]:132; di Tada et al. 1980. I Reunión Iberoamer. Zool. Vert. 493–512; Avila et al. 2000. *In* Lavilla et al. [eds.], Categorización de los Anfibios y Reptiles de República Argentina, pp. 51–74. Asociación Herpetológica Argentina) and La Paz, department San Javier, Córdoba (Cabrera and Speroni 1986. Hist. Nat. 6[1]:1–12; Cabrera 1996. *In* di Tada and Bucher [eds.], pp. 215–238. Ed. UNRC). Present record extends the known distribution 30 km S from the previously known record.

Submitted by **NANCY E. SALAS** (e-mail: nsalas@exa.unrc.edu.ar), **M. BELEN GIORDANA,** and **ISMAEL E. DI TADA,** Ecología, Departamento de Ciencias Naturales, Facultad de Ciencias Exactas, Físico-Químicas y Naturales, Universidad Nacional de Río Cuarto, Km 601, Ruta N° 36 (X5804BYA) Río Cuarto, Córdoba, Argentina.

SCELOPORUS LUNDELLI (Lundell's Spiny Lizard). MEXICO: TABASCO: 7 km NW Tenosique (17°24'36.3"N, 91°29'9.7"W), ca. 250 m elev. 25 April 2002. Julio César Bolón López. MZFC 14414 (formerly Colección de Amphibios y Reptiles de Tabasco [CART 00321]), CART 00327. Verified by Edmundo Pérez Ramos. First record for Tabasco and extends range ca. 120 km S of Laguna de Términos, Campeche (Lee 1996. The Amphibians and Reptiles of the Yucatán Peninsula. Cornell Univ. Press, Ithaca, New York, 500 pp.).

Submitted by **ROSARIO BARRAGÁN-VÁZQUEZ,** Div. Académica de Ciencias Biológicas, Universidad Juárez Autónoma de Tabasco, Km 0.5 Carr. Villahermosa-Cárdenas, Tabasco, Mexico, **LUIS CANSECO MÁRQUEZ,** and **OSCAR FLORES VILLELA**, Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, A.P. 70-399, México, D.F. 04510, México (e-mail: ofv@hp.fciencias.unam.mx).

SCELOPORUS UNDULATUS (Eastern Fence Lizard). USA: NEW YORK: Kings Co: Sunset Park. Private property ca. 20 m N of 44th Street between 3rd and 4th Avenues (40°39'02"N, 74°00'36"W). 4–5, 12 September 2002. Jeremy A. Feinberg. Verified by Michael Klemens. American Museum of Natural History (AMNH 153364–68). Locality is the first record from county as well as for the entirety of Long Island, extending the range of this species northeast from the nearest known population in Richmond Co., New York by a distance of ca. 25 km (A. R. Breisch, pers. comm.). Specimens include two hatchlings, one sub-adult, and two adults collected among rocks and wood in the backyard of a private residence. Additional lizards were observed in the yards of adjacent properties. The occurrence of this population within New York City (and on Long Island) is likely the result of an introduction.

Submitted by **JEREMY A. FEINBERG**, United States Fish and Wildlife Service, Brookhaven National Laboratory, Building 120, 81 Cornell Avenue, Upton, New York 11973, USA; e-mail: jerfein@aol.com.

STENOCERCUS FIMBRIATUS (NCN). PERU: JUNÍN: Tarma: Pampa Hermosa (10°59'33.3"S, 75°25'58.0"W, 1540 m elev.). 28 August 2003. Rudolf von May and Edgar Lehr. Museum für Tierkunde Dresden (MTD 45664). Verified by Omar Torres-Carvajal. First record for Departamento de Junín (Avila-Pires 1995. Lizards of Brazilian Amazonia [Reptilia: Squamata]. Zool. Verh. Leiden 299:151–159; Carrillo de Espinoza and Icochea 1995. Publ. Mus. Hist. Nat. UNMSM(A) 49:1–27), and extension of altitudinal distribution. Previously known up to 1050 m on the eastern slopes of the Andes in Peru (Avila-Pires 1995, *op. cit.*). The specimen was caught on a tree branch ca. 1 m above ground in a primary

forest at night.

Submitted by **EDGAR LEHR** (e-mail: edgar.lehr@snsd.smwk.sachsen.de), Staatliche Naturhistorische Sammlungen Dresden, Museum fuer Tierkunde, Königsbruecker Landstrasse 159, 01109 Dresden, Germany, and **RUDOLF VON MAY,** Asociación para la Conservación de la Cuenca Amazónica (ACCA), Calle Cuzco 499, Puerto Maldonado, Madre de Dios, Peru (e-mail: vonmay@terra.com).

TARENTOLA MAURITANICA MAURITANICA (Moorish Gecko). SPAIN: ALMERÍA: Alborán Island (35°56'24"N, 3°02'04"W; in Alborán Sea, the westernmost area of the Mediterranean Sea), 13 m elev., an isolated island 86 km S and 56 km N from the continental coasts of Adra, Almería, Spain and Tres Forcas Cape, Beni-Bu-Gafar, Morocco, respectively. 13 November 2003. Mariano Paracuellos. Dept. of Animal Biology and Ecology, Granada University, Granada, Spain (DBAG-TAMA-30). Verified by Juan M. Pleguezuelos and Xavier Santos. First island record. Two more individuals, belonging to the same species, were observed on the same day, but were not collected. The paucity of herpetofauna on Alborán Island (Ludwig Salvador 1898. Alborán. Heinr. Mercy Sohn, Prag; García and Salas 1984. Jábega 45:76–80; Yus and Cabo 1986. Guía de la naturaleza de la región de Melilla. Exmo. Ayuntamiento de Melilla, Melilla) might be attributed to its small size (7.1 ha) and distance from the mainland. Discovery of three *T. m. mauritanica* on the same day of 2003, after periodic unsuccessful searches since 1994, might indicate a recent colonization probably in association with recent, frequent, transportation of building materials and equipment from the Iberian Peninsula coast, where the species occurs (Hódar 2002. *In* Pleguezuelos et al. [eds.], Atlas y Libro Rojo de los Anfibios y Reptiles de España, pp. 188–190. Dirección General de Conservación de la Naturaleza-AHE, Madrid: for similar cases on other islands, see Pleguezuelos [2002. *In* Pleguezuelos, *op. cit.*, pp. 501–532]).

Submitted by **MARIANO PARACUELLOS** and **JUAN C. NEVADO**, Dept. of Flora and Fauna, Consejería de Medio Ambiente, Junta de Andalucía, C/ Reyes Católicos, 43, Almería E-04071, Spain; e-mail: mparacuellos@cajamar.es.

SERPENTES

ATRACTUS MAJOR (Big Ground Snake). BRAZIL: PARÁ: "Estação Científica Ferreira Penna" (ECFP), between the basins of the Xingu and Tocantins Rivers (01°42'33"S, 51°31'45"W), in the eastern Brazilian Amazon. 11 October 2000. A. L. Prudente. Museu Paraense Emílio Goeldi, Belém, Pará, Brazil, (MEPG 19967). 6 March 2002. R. Vaz. (MEPG 20189). Verified by M. Hoogmoed. First vouchered state record; extends known range ca. 1000 km W from previous records at Manaus, Preto da Eva River, and Presidente Figueiredo municipality (Martins and Oliveira 1993. Zool. Meded. Leiden 67[2]:21–40). This species was cited previously from Pará state without a voucher specimen or locality reference (Vogt and Bernhard 2003. Biodiversidade e Biogeografia de Répteis e Anfíbios da Amazônia, Instituto Amazônia, 40 pp.).

Submitted by **ANA LÚCIA DA COSTA PRUDENTE**, Museu Paraense Emílio Goeldi, Departamento de Zoologia, Setor de Herpetologia, CxP: 399, CEP: 66040-170, Belém, Pará, Brazil (e-mail: prudente@museu-goeldi.br); and **MARIA CRISTINA DOS SANTOS COSTA**, Universidade Federal do Pará, Departamento de Biologia, Cx.P.479, CEP: 66.075-110, Belém, Pará, Brazil (e-mail: mcscosta@museu-goeldi.br).

ATRACTUS RETICULATUS (NCN). URUGUAY: RIVERA: Establecimiento "Trinidad," Campos de COFUSA, Potrero 9 (31°01'55"S, 55°26'41"W). 22 November 2003. R. Maneyro. Colección Zoología Vertebrados, Reptiles, Facultad de Ciencias, Montevideo, (ZVC-R 6237, juvenile female). Captured in a pitfall trap in a forested area (*Pinus*, 6–8 yr old stand) near a small stream. The range of the species includes southern Brazil from São Paulo to São Lourenço do Sul and Argentina, Corrientes and Misiones (Peters and Donoso-Barros 1970. Bull. U.S. Nat. Mus. 297[1]: 33; Cei 1993. Mus. reg. Sci. nat. Torino, Monograf. 14:526; Fernandes 1995. Comun. Mus. Ciênc. Tecnol. PUCRS, Sér. Zool., Porto Alegre 8:37–53; Scrocchi and Giraudo 2002. Smithson. Herpetol. Infor. Serv. 132:11). First country record, extends known distribution 300 km S from São Lourenço do Sul, Rio Grande do Sul, Brazil (Fernandes 1995, *op cit.*). We thank Raul Maneyro for collecting the specimen.

Submitted by **SANTIAGO CARREIRA** (e-mail: carreira@fcien.edu.uy), **MELITTA MENEGHEL**, and **FEDERICO ACHAVAL**, Sección Zoología Vertebrados, Facultad de Ciencias, Iguá 4225, CP 11400, Montevideo, Uruguay.

BOTHROPS BRAZILI (Brazil's Lancehead). ECUADOR: PROVINCIA DE ZAMORA-CHINCHIPE: Bombuscaro River (entrance to the Podocarpus National Park), ca. 04°07'S, 78°58'W, 1000 m elev.). 13 August 1997. R. Tapia. Laboratorio de Anfibios & Reptiles, Universidad San Francisco de Quito & Fundación Herpetológica G. Orcés, Quito (FHGO-USFQ 1639). ECUADOR: PROVINCIA DE MORONA-SANTIAGO: Centro Makuma and surroundings, ca. 02°08'S, 77°42'W, 600 m elev. November 1993–January 2000. D. Holmes, C. Kayap, R. Mangkash, G. Wisurna, et al. (FHGO-USFQ 043 + 16 others). Verified by Jean-Marc Touzet. First locality for Zamora-Chinchipe province, extending its range ca. 200 km SW and 80 km NNW from nearest localities (Río Cusuime, Ecuador and Bagua, Perú; Schatti and Kramer 1993. Rev. Suisse Zool. 100[2]:235–278; Carrillo de Espinosa 1983. Publ. Mus. Hist. Nat. Javier Prado [30]:1–55), representing the westernmost locality of the species and among the highest altitudinal records. Second locality for Morona-Santiago province fills the gap between Pastaza and Morona-Santiago localities, and extends its range 50 km N and 70 km WSW from previous known localities (Schatti and Kramer, *op. cit.*). Despite the species being widely distributed in the Amazon Basin, it is considered rare and was not reported from Ecuador until 1989 (C. Myers *in* Campbell and Lamar 1989. The Venomous Reptiles of Latin America. Cornell Univ. Press. Ithaca, New York. 425 pp.), remaining known from only three localities at Pastaza and Morona-Santiago provinces (Schatti and Kramer, *op. cit.*, Pérez-Santos and Moreno 1991. Mus. Reg. Sci. Nat. Monogr. 11:1–538).

Submitted by **DIEGO F. CISNEROS-HEREDIA**, Laboratorio de Anfibios & Reptiles, FHGO-USFQ, Universidad San Francisco de Quito, Ave. Interoceanica y calle Diego de Robles, Campus Cumbaya, edif. Newton Plaza, Casilla Postal 17-12-841, Quito, Ecuador; e-mail: diegofrancisco_cisneros@yahoo.com.

CHARINA BOTTAE (Rubber Boa). USA: WYOMING: Yellowstone National Park, south of Gibbon Meadows on The Grand Loop Highway, 0.64 km S of Artist Paint Pot trailhead, 2256 m (UTM 520183, 4948444). 11 July 1994. Stephen R. Sullivan. Verified by Charles R. Peterson. Idaho Museum of Natural History (IMNH 1921). Found dead in road at 2230 h. First museum collection record from Yellowstone and Grand Teton National Parks (Koch and Peterson 1995. Amphibians and Reptiles of Yellowstone and Grand Teton National Parks. Univ. Utah Press, Salt Lake City. 188 pp.)

Submitted by **STEPHEN R. SULLIVAN**, Department of Biology and Chemistry, Carroll College, Helena, Montana; 1601 N. Benton Ave Helena, Montana 59625, USA; e-mail: ssulliva@u.washington.edu.

CONIOPHANES LATERITIUS (Stripeless Snake). MEXICO: MORELOS: Municipio de Tlaquiltenango: Sierra de Huautla Biosphere Reserve, 600 m SW of Estación Biológica Sierra de Huautla, on old trail to Huatla (18°27'36.1"N, 99°02'05.2"W), 900 m elev. 20 June 2001. Jorge Chávez-Juárez, Harald Alcaraz-Cruz, and David Valenzuela Galván. Reptile collection, Centro de Educación Ambiental e Investigación Sierra de Huautla - Universidad Autónoma del Estado de Morelos (MOR-REP-145-04-03 No. 46). Verified by Edmundo Pérez Ramos. First record for Sierra de Huautla Biosphere Reserve and southern Morelos, extending its range ca. 60 km S from the nearest collection site at Corredor Biológico Chichinautzin, Morelos (Castro-Franco and Bustos-Zagal 1994. Southwest. Nat. 39:171–213). Juvenile found at 1228 h in rocky terrain adjacent to Lorenzo Vazquez Dam in riparian forest that was surrounded by steep slopes covered by tropical dry forest.

Submitted by **HARALD ALCARAZ-CRUZ** (e-mail: biohac@hotmail.com), **JORGE CHÁVEZ-JUÁREZ** (e-mail: herpetologia@hotmail.com), Facultad de Ciencias Biológicas, Universidad Autónoma del Estado de Morelos (UAEM), Morelos, Mexico; and **DAVID VALENZUELA**, Departamento de Ecología y Conservación de los Recursos Naturales, Centro de Educación Ambiental e Investigación Sierra de Huautla, UAEM, Morelos, Mexico (e-mail: dvalen@buzon.uaem.mx).

CONOPHIS VITTATUS (Striped Road Guarder). MÉXICO: MÉXICO: Municipality of Texcoco: San Salvador Atenco (19° 33' 29" N, 98° 55' 11" W), 2000 m elev. 25 July 1965. F. Aguilar. ENCB 1657. Verified by Fernando Mendoza-Quijano. First record for the state of México (Casas-Andreu *et al.* 1997. Univ. Auntón. Edo. México. Ciencias y Técnicas/32. 201 pp.) and extends the known range 80 km northwest of the closest known locality, 7 mi (11.2 km) south of Cuernavaca, Morelos (MVZ 32258).

Submitted by **NOEMI MATIAS-FERRER** and **SERGIO MURILLO**, Laboratorio de Cordados Terrestres, Departamento de Zoología, Escuela Nacional de Ciencias Biológicas, IPN, Carpio y Plan de Ayala s/n, Ap. Postal 42-186, CP. 11340, Distrito Federal, México; e-mail: noemigecko@hotmail.com.

CORALLUS RUSCHENBERGERII (Ruschenberger Tree Boa; Falsa Mapanare; Dormilona). VENEZUELA: ESTADO TRUJILLO: Municipio Trujillo: Quebrada Valerita, Monay. February 1982. R. Pérez. Colección de Vertebrados de la Universidad de Los Andes, Mérida, Venezuela (CVULA 3299). Verified by Fabián Zerpa. First state record (Roze 1966. La Taxonomía y Zoogeografía de los Ofidios en Venezuela. Univ. Central de Venezuela, Edic. Biblioteca. Caracas, 362 pp.; Lancini and Kornacker 1989. Die Schlangen von Venezuela. Verlag Armitano ed. Caracas, Venezuela, 381 pp.; Henderson.1997. Caribb. J. Science 33 [3–4]: 198–221). *Corallus rushengergerii* is distributed from Costa Rica to northern South America (Colombia, Venezuela and the islands of Margarita, Trinidad and Tobago), according to Henderson (*op. cit.*). The new record is the first intra Andean locality for this relatively widespread species. In Venezuela, this boa snake was previously known north and west of the Guianan shield in Amazonas and Bolívar states, and north of the Orinoco river, in Zulia and Falcón states (Mijares-Urrutia 2000, Herpetofauna of estado Falcón, northwestern Venezuela: a checklist with geographical ecological data, Smithson. Herpetol. Infor. Serv. 123:1–20), Distrito Federal, Carabobo, and Miranda states (Roze 1966, *op. cit.*; Henderson 1997. Carib. J. Sci. 33[3–4]:198–221), Apure, Barinas Bolívar, Delta Amacuro, Guárico, Nueva Esparta, Portuguesa, and Sucre states (Henderson, *op. cit.*; Markezich 2002. Herpetol. Rev. 33:69–74). None of these records predicted this new unsuspected location within the Andes, since all the remaining Colombian and Venezuelan records are from outside the main Cordillera de Los Andes. The new locality record additionally documents the species for the first time from the Lake Maracaibo versant of the Cordillera de Mérida. The closest published geographical records are from near 270 km to the W, in Zulia state, near 250 km to the NE in Falcón state, and ca. 100 km to the E, in Portuguesa state, across the Venezuelan Andean Cordillera de Mérida.

Submitted by **LUIS FELIPE ESQUEDA**, Centro Universitario Herpetológico Forestal y Laboratorio de Biogeografía, Facultad de Ciencias Forestales y Ambientales, Universidad de Los Andes, Mérida 5101, Venezuela (e-mail: adenomera@hotmail.com), and **ENRIQUE LA MARCA**, Laboratorio de Biogeografía, Escuela de Geografía, Facultad de Ciencias Forestales y Ambientales, Universidad de Los Andes, Apartado Postal 116, Mérida 5101-A, Venezuela (e-mail: lamarca1@telcel.net.ve).

CROTALUS ATROX (Western Diamond-backed Rattlesnake). MEXICO: MEXICO: Municipality of Atizapán de Zaragoza: Calocoaya (19°32'N, 99°14'32"W). 13 November 1970. H. Hernández. ENCB 6276. Verified by Fernando Mendoza-Quijano. First record for the state and extends known range ca. 140 km SW of Metztitlán, Hidalgo (Campbell and Lamar 1989. The Venomous Reptiles of Latin America. Cornell Univ. Press, Ithaca, New York. xii + 425 pp.).

Submitted by **NOEMI MATIAS-FERRER** and **SERGIO MURILLO**, Laboratorio de Cordados Terrestres, Departamento de Zoología, Escuela Nacional de Ciencias Biológicas, IPN, Carpio y Plan de Ayala s/n, Ap. Postal 42-186, CP 11340, Distrito Federal, México; e-mail: noemigecko@hotmail.com.

CROTALUS OREGANUS CONCOLOR (Midget Faded Rattlesnake). USA: ARIZONA: Coconino Co: Labyrinth Canyon. July 1954. Jim Rigg. University of Arizona (UAZ 39830). State record. Originally in the Arizona Sonora Desert Museum collection as ASDM 916. The original ASDM card associated with this

specimen lists "Labyrinth Canyon" in the 'Specific Locality' field, and "Arizona: Coconino Co., Colo. River" under the 'General Locality' field, all in the same handwriting and pen. In a different pen, someone later added "34.5 river miles N. of Lees Ferry," apparently in reference to the confluence of Labyrinth Canyon and the Colorado River. An American Museum of Natural History specimen (AMNH 75814) collected in adjacent Utah from a "sandbar on the Colorado River about 40 mi upstream from Lee's Ferry, Arizona" by R. Zeller on 19 June 1956 and is also *concolor*. The collection locality of AMNH 75814 appears to lie ca. 6–7 km upstream of UAZ 39830 in Glen Canyon. Both of these specimens agree with all scutulation, color, and pattern characters as described in the original description (Woodbury 1929. Bull. Univ. Utah 20:3–4) and in Gloyd (1940. The Rattlesnakes, Genera *Sistrurus* and *Crotalus*. Chicago Acad. Sci. Spec. Publ. 4). Counts of dorsal scale rows at midbody, ventrals, subcaudals, supralabials, infralabials, body blotches, and tail blotches all fall within the ranges (and usually near the means) presented for *concolor* by Gloyd (*op. cit.*). Both specimens are nearly identical to published portraits of the form in systematic or authoritative works (e.g., Plate 25 in Gloyd, *op. cit.* and Fig. 2:66 in Klauber 1972. Rattlesnakes. Their Habits, Life Histories, and Influence on Mankind. 2 Vol. 2nd ed. University of California Press, Berkeley and Los Angeles), and neither shows any morphological evidence of intergradation with adjacent forms.

Although most specimens from San Juan County, Utah appear to be *Crotalus viridis* based on mtDNA haplotype, a single specimen from "27.8 km E of Halls Crossing Marina" on the Colorado River had a *concolor* haplotype (Douglas et al. 2002. *In* Schuett et al. [eds.], Biology of the Vipers, pp. 11–50. Eagle Mountain Publishing, Eagle Mountain, Utah.). Gloyd (*op. cit.*) illustrates the southern terminus of the range of *concolor* in the general vicinity of Halls Crossing. We believe that the *concolor* lineage probably occupied much of Cataract Canyon, and portions of Glen Canyon as far downstream as its confluence with Labyrinth Canyon. Further downstream, specimens from Antelope Island and Wahweap Marina agree morphologically and by mtDNA haplotype with *abyssus* (Douglas et al., *op. cit.* and pers. comm.). The collection localities of both UAZ 39830 and AMNH 75814 in Glen Canyon have been flooded since the late 1960s by Powell Reservoir. It remains to be seen if this form is extant in the side canyons of Glen Canyon (Arizona and Utah).

Submitted by **THOMAS C. BRENNAN** and **ANDREW T. HOLYCROSS**, School of Life Sciences and Museum, Arizona State University, Tempe, Arizona 85287-4501, USA.

CROTALUS SCUTULATUS (Mojave Rattlesnake). MEXICO: MEXICO: Municipality of Ixtapaluca: Cerro del Pino (19°20'N, 99°55'18"W). 2500 m elev. 13 July 1967. R. Cruz C. ENCB 6276. Verified by Fernando Mendoza-Quijano. This confirms the presence of this species in the state of México (Casas-Andreu et al. 1997. Univ. Auntón. Edo. México. Ciencias y Técnicas/32. 201 pp.). The previous record is a fossil specimen from Zumpango (Brattstrom 1955. Bull. South. California Acad. Sci. 54:1–4).

Submitted by **NOEMI MATIAS-FERRER** and **SERGIO MURILLO**, Laboratorio de Cordados Terrestres, Departamento de Zoología, Escuela Nacional de Ciencias Biológicas, IPN, Carpio y Plan de Ayala s/n, Ap. Postal 42-186, CP. 11340, Distrito Federal, México; e-mail: noemigecko@hotmail.com.

DENDROASPIS POLYLEPIS (Black Mamba). CAMEROON: Adamaoua Province: Nyassar (ca. 50 km NE of Ngaoundéré: 7°32'20"N, 14°02'38"E, 800 m elev.). Elevated soudanian savanna. 15 August 2001. Matthew LeBreton and Laurent Chirio. Verified by Ivan Ineich. MNHN 2002.921 (Field No. 4582X). First confirmed record for this species in Cameroon. A number of authors have indicated the uncertainty of the occurrence of this species in Cameroon (Håkansson and Madsen 1983. J. Herpetol. 17:186–189; Rasmussen 1994. Nord. herpetol. Forening 37:61–65; Chippaux 2001. Les serpentes d'Afrique occidentale et centrale. IRD Paris 292 pp.) despite the presence of at least one record of possible sighting there (Stark 1986. J. Herpetol. Assoc. Africa 32:31, without voucher specimens).

Submitted by **MATTHEW LEBRETON**, CAMHERP Project C/- Cameroon Biodiversity Conservation Society, BP 3055 Messa Yaoundé, Cameroon (present address: Johns Hopkins Cameroon Program, BP 7039, Yaounde, Cameroon), and **LAURENT CHIRIO,** 14 Rue des Roses, 06130 Grasse, France.

DRYMOLUBER BRAZILI. BRAZIL: BAHIA: Municipality of João Dourado, District of Gruta dos Brejões (11°00'S, 41°25'W). 1 August 2002–31 August 2003. Collector unknown. Museu de Zoologia da Universidade Estadual de Santa Cruz, Ilhéus, Bahia (MZUESC 3815). Verified by Miguel Trefaut Rodrigues. Previously known only from southcentral Brazil (Nogueira 2001. Herpetol. Rev. 32:285; Peters and Orejas-Miranda 1986, Bull. U.S. Nat. Mus. 297:100). First record for northeastern Brazil; extends range ca. 1000 km NE of Brasília municipality (Nogueira, *op. cit.*), the previous northernmost limit for the species.

Submitted by **ANTÔNIO JORGE SUZART ARGÔLO**, Universidade Estadual de Santa Cruz – UESC, Km 16 Rodovia Ilhéus-Itabuna, CEP 45650-000, Ilhéus, Bahia, Brazil; e-mail: lachesis@uesc.br.

FARANCIA ABACURA ABACURA (Eastern Mudsnake). USA: FLORIDA: UNION CO: 0.8 km N of State Road 100 on County Road 231 (29°55'55"N, 82°19'41"W), 105 meters elevation, 2248 hours. 6 June 2002. Michael E. Welker. Verified by Kenneth L. Krysko. Florida Museum of Natural History (FLMNH), Gainesville, Florida, USA (UF 133816). New county record (Ashton and Ashton 1988. Handbook of Reptiles and Amphibians of Florida. Part 1. The Snakes. Second edition. Windward Publishing, Miami, Florida. 176 pp.). This specimen was found DOR.

Submitted by **MICHAEL E. WELKER**, 1911 NW 55th Terrace, Gainesville, Florida 32605, USA; e-mail: herpconservation69@yahoo.com.

GEOPHIS BLANCHARDI (Blanchard's Earth Snake). MÉXICO: OAXACA: Municipality of San Bernardino: Sierra Mazateca, Puerto Soledad. (18°09.499'N, 96°59.981'W), 2510 m elev. 10 June 1993. Luis Canseco Márquez and Alejandro Ramos Torres. MZFC 13303 (regurgitated by a *Thamnophis godmani*). 1 km SW Puerto Soledad, 2240 m elev. 13 November 1993. MZFC 13304. Both verified by Edmundo Pérez Ramos. First records for Oaxaca and extends the range ca. 69 km (airline) SE of Acultzingo, Veracruz (Downs 1967, Misc. Publ. Mus. Zool., University of Michigan 131:1–193). Both specimens were found in cloud forest.

Submitted by **LUIS CANSECO MÁRQUEZ, ALEJANDRO RAMOS TORRES,** and **OSCAR FLORES VILLELA**, Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, A.P. 70-399, México, D.F. 04510, México; e-mail: ofv@hp.fciencias.unam.mx.

HETERODON PLATIRHINOS (Eastern Hog-nosed Snake). USA: FLORIDA: Dixie Co: 0.03 km E of County Road 351 on County Road 353 (29°41'37"N 83°01'52"W). 1 November 2003. Michael E. Welker and Michael Arnold. Verified by Kenneth L. Krysko. Florida Museum of Natural History (UF 141054). New county record (Ashton and Ashton 1988. Handbook of Reptiles and Amphibians of Florida. Part 1. The Snakes. Second edition. Windward Publishing, Miami, Florida. 176 pp.). This specimen was found on the shoulder of the road in the grass.

Submitted by **MICHAEL E. WELKER** and **MICHAEL ARNOLD**, 1911 NW 55th Terrace, Gainesville, Florida 32605, USA; e-mail: herpconservation69@yahoo.com

LAMPROPELTIS TRIANGULUM ELAPSOIDES (Scarlet Kingsnake). USA: FLORIDA: Lafayette Co: 1.4 km N of Dixie Co. line on County Road 357 (29°51'18"N 83°14'40"W), 2021 hours. 13 September 2003. Michael E. Welker and Michael Arnold. Verified by Kenneth L. Krysko. Florida Museum of Natural History (UF 141055 photographic voucher). New county record (Ashton and Ashton 1988. Handbook of Reptiles and Amphibians of Florida. Part 1. The Snakes. Second edition. Windward Publishing, Miami, Florida. 176 pp.). Female found crossing the road. It is currently maintained in captivity and will be deposited at FLMNH upon death.

Submitted by **MICHAEL E. WELKER** and **MICHAEL ARNOLD**, 1911 NW 55th Terrace, Gainesville, Florida 32605, USA; e-mail: herpconservation69@yahoo.com.

NINIA ATRATA (Hallowell's Earth Snake; Culebra de Tierra; Viejita). VENEZUELA: ESTADO BARINAS: Municipio Bolívar: Barinitas, Parque Moromoy. E. La Marca, D. Briceño and F. Ayaach. 22 March 1997. Colección de Anfibios y Reptiles, Laboratorio de Biogeografía, Universidad de Los Andes, Mérida, Venezuela (ULABG 4334). First state record. Second record from a Venezuelan Andean locality, fills the gap between a Táchira state record located 220 km to the SW at Burgua River (Roze 1966. La Taxonomía y Zoogeografía de los Ofidios en Venezuela. Univ. Central de Venezuela, Edic. Biblioteca. Caracas, p. 106) and a Portuguesa state record at Mesa de Cavacas, 75 km to the NE (Markezich 2002. Herpetol Rev. 33:69–74), corroborating its presence in the lowland versant of the Andean Cordillera de Mérida (Lancini and Kornacker 1989. Die Schlangen von Venezuela. Verlag Armitano ed. Caracas, Venezuela, 381 pp.). ESTADO BOLÍVAR: Municipio Caroní: Las Piñas, Guri. Ciudad Guayana. 150 m elev. 28 January 1985. Grupo de Ecología Animal. Colección de Vertebrados de la Universidad de Los Andes, Mérida, Venezuela (CVULA 3696). First state record and first Venezuelan locality south of the Orinoco River (Roze 1966, *op. cit.*; Rivas and Oliveros 1997, Memoria Soc. Cienc. Nat. La Salle 94:36–43). This specimen documents a range extension of 300 km S from the closest northern Venezuelan locality at Cueva del Guácharo in Monagas State (Roze 1966, op. cit.; Gorzula and Señaris 1999 "1998". Contribution to the Herpetofauna of the Venezuelan Guayana I. A Data Base. Scientia Guaianae 8:i-xviii + 1–269 + 32 pls.) and brings the species into the Venezuelan Guayanan shield area, making this taxon part of its Herpetofauna, a fact that was previously explicitly denied (Gorzula and Señaris, op. cit.: 174).

Submitted by **ENRIQUE LA MARCA**, Laboratorio de Biogeografía, Escuela de Geografía, Facultad de Ciencias Forestales y Ambientales, Universidad de Los Andes, Apartado Postal 116, Mérida 5101-A, Venezuela (e-mail: lamarca1@telcel.net.ve), **LUIS FELIPE ESQUEDA**, Centro Universitario Herpetológico Forestal y Laboratorio de Biogeografía, Facultad de Ciencias Forestales y Ambientales, Universidad de Los Andes, Mérida 5101, Venezuela (e-mail: adenomera@hotmail.com); **JESÚS MANZANILLA**, Museo del Instituto de Zoología Agrícola, Universidad Central de Venezuela, Maracay, Aragua, Venezuela (e-mail: jmanzanilla@mncn.csic.es).

OPHEODRYS AESTIVUS AESTIVUS (Northern Rough Greensnake). USA: FLORIDA: Hamilton Co: 3.9 km W of County Road 135 on County Road 6 (30°30'37"N, 82°5001"W), 107 m elev. 30 May 2003. 0.1 km W of County Road 135 on County Road 6 (30°30'05"N, 82°44'17"W), 108 m elev. 19 June 2003. Michael E. Welker and Michael Arnold. Verified by Kenneth L. Krysko. Florida Museum of Natural History (UF 137230–231. New county record (Ashton and Ashton 1988. Handbook of Reptiles and Amphibians of Florida. Part 1. The Snakes. Second edition. Windward Publishing, Miami, Florida. 176 pp.). The first specimen was found alive on the road and is represented by a photograph. The second specimen was found DOR and is represented by a preserved specimen.

Submitted by **MICHAEL E. WELKER** and **MICHAEL ARNOLD**, 1911 NW 55th Terrace, Gainesville, Florida 32605, USA; e-mail: herpconservation69@yahoo.com.

OPHEODRYS VERNALIS BLANCHARDI (Smooth Green Snake). USA: SOUTH DAKOTA: Marshall Co: vegetable garden at home-site in Sacred Hills Circle Community, ca. 1.6 km NW Veblen (45°52'42.8"N; 97°18'30.8"W). 22 September 2003. Laurs Bryan James Williams. Verified by Stanlee Miller. Campbell Museum, Clemson University (CUSC 2169). County record. Previously reported in adjacent Roberts County. (Fishbeck and Underhill 1959. Proc. South Dakota Acad. Sci. 38:107–113).

Submitted by **LAURS BRYAN JAMES WILLIAMS** and **STEVEN G. PLATT**, Department of Math and Science, Oglala Lakota College, P.O. Box 490, Kyle, South Dakota 57752-0490, USA.

PITUOPHIS LINEATICOLLIS LINEATICOLLIS (Middle American Gopher Snake). MÉXICO: JALISCO: Rancho San Francisco, ca. 1.5 km NE Tapalpa, 2134 m elev. 21 June 1983. Jonathan A. Campbell, William W. Lamar, and David M. Hillis. UTA R-25959. Verified by Eric N. Smith. New state record and extends the range ca. 150 km SW from the nearest record at Dos Aguas, Michoacán (Duellman 1961, Univ. Kansas. Publ. Mus. Nat. Hist. 15:1–148).

Submitted by **PAULINO PONCE-CAMPOS**, Bosque Tropical, A. C., Apartado Postal 5-515, Guadalajara, Jalisco 45042, México; (e-mail: poncecp@hotmail.com), and **PAUL C. USTACH**,

Department of Biology, The University of Texas at Arlington, Arlington, Texas 76019-0498, USA.

RAMPHOTYPHLOPS BRAMINUS (Brahminy Blind Snake). USA: FLORIDA: HILLSBOROUGH Co.: Tampa, 12801 N 52 Street (28°3.748'N, 82°23.826'W). 29 November 2003. K. C. Hennessy and M. Michalak. Verified by Kenneth L. Krysko. Florida Museum of Natural History, University of Florida (UF 140726). Found within leaf litter. New county record (Wilson and Porras 1983. Univ. Kansas Mus. Nat. Hist., Spec. Publ. 9, 89 pp.).

Submitted by **KELLY C. HENNESSY** and **MARTIN MICHALAK**, Florida Museum of Natural History, Division of Ichthyology, University of Florida, Gainesville, Florida 32611, USA; e-mail: kelly3@ufl.edu.

SIBYNOMORPHUS TURGIDUS (Slug-eating Snake). ARGENTINA: CÓRDOBA: DEPARTAMENTO MARCOS JUÁREZ: Marcos Juárez city (32°42'S, 62°06'W). 6 December 2001. Herpetological collection, Fundación Miguel Lillo, Tucumán, Argentina (FML 12522). Verified by G. Scrocchi. Species known from northern and central Argentina, Bolivia, Paraguay, south of Mato Grosso in Brazil, and Uruguay (Franco 1994. O gênero *Sibynomorphus* Fitzinger 1843, no Brasil [Colubridae; Xenodontinae; Dipsadini], Dissertação de Mestrado em Zoologia, Pontifícia Universidade Católica do Rio Grande do Sul, Brazil, 148 pp.; Achával and Olmos 1997. Anfibios y reptiles del Uruguay, Montevideo, Uruguay, 128 pp.; Giraudo and Scrocchi 2002. Smithson. Herpetol. Infor. Serv. 132, 53 pp.). Second record for the province (205 km S airline from previous citation: Cabrera and Merlini 1989. Iheringia, Ser. Zool. 69:151–153), extends known distribution in Argentina 180 km (airline) SW from previous southernmost record (Scrocchi et al. 1993. Rev. Brasil. Biol. 53[2]:197–208).

Submitted by **GERARDO C. LEYNAUD** and **RAQUEL SILMARA CERVANTES**, Centro de Zoología Aplicada, Universidad Nacional de Córdoba, Casilla de Correo 122, Córdoba (5000), Argentina; e-mail: gleynaud@efn.uncor.edu.

SISTRURUS MILIARIUS BARBOURI (Dusky Pygmy Rattlesnake). USA: FLORIDA: HAMILTON Co: 5.2 km N of US 41 on County Road 135 (30°25'58"N, 82°41'08"W), 108 m elev. 1.1 km W of County Road 135 on County Road 6 (30°29'07"N, 82°45'79"W). 13 October 2002. Michael E. Welker and Michael Arnold. Verified by Kenneth L. Krysko. Florida Museum of Natural History (UF 137117, 137116). New county record (Ashton and Ashton 1988. Handbook of Reptiles and Amphibians of Florida. Part 1. The Snakes. Second edition. Windward Publishing, Miami, Florida, 176 pp.).

Submitted by **MICHAEL E. WELKER** and **MICHAEL ARNOLD**, 1911 NW 55th Terrace, Gainesville, Florida 32605, USA; e-mail: herpconservation69@yahoo.com.

STORERIA DEKAYI WRIGHTORUM (Midland Brownsnake). USA: ARKANSAS: SEVIER Co: 8.0 km W Falls Chapel off Frog Level Rd. 28 February 2004. Z. D. Ramsey. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28278). Verified by Stanley E. Trauth. New county record partially filling hiatus in extreme southwestern Arkansas (Trauth et al. *In press*. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville). *Storeria dekayi* has also been reported previously from adjacent McCurtain Co., Oklahoma (Webb 1970. Reptiles of Oklahoma. Univ. Oklahoma Press, Norman, Oklahoma, 370 pp.; Secor and Carpenter 1984. Oklahoma Herp. Soc. Spec. Publ. 1:1–57; Sam Noble Oklahoma Museum of Natural History Database of Reptiles [http://www.snomnh3.ou.edu/db/reptiles/]; Oklahoma Biological Survey's Distribution of Oklahoma Amphibians and Reptiles by Recorded Sightings, DOKARRS [http://www.biosurvey.ou.edu/dokadesc.html]).

Submitted by **ZACHARY D. RAMSEY** and **CHRIS T. McALLISTER,** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA; e-mail: chris.mcallister@tamut.edu.

TROPIDODRYAS STRIATICEPS (Jiboinha). BRAZIL: RIO GRANDE DO SUL: Municipality of Osório (29°53'S, 50°16'W). 17 November 2002. C. Hofstadler-Deiques and P. Schmitt. Museu de Zoologia da Universidade do Vale do Rio dos Sinos, São Leopoldo, Rio Grande do Sul (MZU 451). Municipality of Viamão: Capão da Porteira (30°06'S, 50°41'W). 16 November 1996. A. Amaral. Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre (MCP 9058). Verified by R. Fernandes. Species previously known from northeastern to southern Brazil, from the state of Bahia to Rio Grande do Sul (Thomas and Dixon 1977. The Pearce-Sellards Series 27:1–20; Argôlo 1999. Herpetol. Rev. 30:56; Lema 2002. Os Répteis do Rio Grande do Sul: atuais e fósseis - biogeografia - ofidismo. Edipucrs, Porto Alegre, 264 pp.). First records outside the municipality of São Pedro de Alcântara (cited as Torres by Lema 2002, *op. cit.*), in the state of Rio Grande do Sul. Extends southern range ca. 81 km airline, and southwestern range ca. 115 km airline.

Submitted by **CLARICE HOFSTADLER-DEIQUES** and **PAULA SCHMITT**, Laboratório de Embriologia, Centro de Ciências da Saúde da Universidade do Vale do Rio dos Sinos, Avenida Unisinos, 950, 93022-900 São Leopoldo, Rio Grande do Sul, Brazil (e-mail: deiques@bios.unisinos.br), and **MARCOS DI-BERNARDO**, Laboratório de Herpetologia, Museu de Ciências e Tecnologia & Faculdade de Biociências, Pontifícia Universidade Católica do Rio Grande do Sul, Avenida Ipiranga, 6681, 90619-900 Porto Alegre, Rio Grande do Sul, Brazil (e-mail: madibe@pucrs.br).

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Amphibian and Reptile Distribution Records for Louisiana

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The following records add to a comprehensive summary of the occurrence of amphibians and reptiles within Louisiana, based on specimens housed in the Louisiana State University Museum of Natural Science (LSUMZ). Receipt of new records is largely due to the accession into LSUMZ of the collections formerly housed at the University of Louisiana at Lafayette and Southeastern Louisiana University, uncatalogued material from Northwestern State University, as well as recent collecting efforts by several individuals credited within the following accounts. All records are new for their respective parishes, based on Dundee and Rossman (1989), unless otherwise noted.

Caudata

Ambystoma maculatum (Spotted Salamander). SABINE PARISH: Bayou Toro at LA 392. 16 August 1973. Jack Deshotels, Philip St. Romain, Mark Staton. LSUMZ 60050.

Amphiuma tridactylum (Three-toed Amphiuma). SAINT JOHN THE BAPTIST PARISH: Frenier Rd, 200 m W of Lake Pontchartrain. 15 April 1988. Cliff Fontenot. LSUMZ 58689.

Hemidactylium scutatum (Four-toed Salamander). EAST FELICIANA PARISH: Idilwild LSU Experimental Farm, SC boundary on Gross Rd, 2.2 km E of Idilwild Rd. 1 February 2001. Jeff Boundy. LSUMZ 82992.

Necturus louisianensis (Red River Mudpuppy). NATCHITOCHES PARISH: Kisatchie Bayou approx. 9 km NE of Kisatchie. 9 April 1977. Tom Hardaway. LSUMZ 62955.

Anura

Eleutherodactylus planirostris (Greenhouse Frog). LAFAYETTE PARISH: Memory Ln, Lafayette. 30 July 2000. David Patton. LSUMZ 81452. PLAQUEMINES PARISH: LA 23, E side of Boothville. 7 September 2000. Jeff Boundy. LSUMZ 81461. Latter record extends range of this introduced species to near mouth of Mississippi River.

Gastrophryne carolinensis (Eastern Narrow-mouthed Toad). RED RIVER PARISH: 14.4 km E of Coushatta on LA 155. 12 May 1973. N. Loftin. LSUMZ 85447–449.

Hyla avivoca (Bird-voiced Treefrog). WEST FELICIANA PARISH: LA 964, 3.6 km SE of US 60. 28 April 1966. William Fullilove. LSUMZ 14756.

Hyla chrysoscelis (Cope's Gray Treefrog). ST. JAMES PARISH: 1.0 km N of Grand Point. 20 February 2003. Jeff Boundy. LSUMZ 86113–114.

Hyla femoralis (Pine Woods Treefrog). LIVINGSTON PARISH: LA 22, 3.6 km W of Killian. 26 July 1996. Steve Karsen. LSUMZ 57774, 57775. Also from Livingston Parish: LSUMZ 87350.

Hyla squirella (Squirrel Treefrog). ST. JAMES PARISH: 1.0 km N of Grand Point. 19 April 2003. Jeff and Scot Boundy. LSUMZ 87155.

Pseudacris crucifer (Spring Peeper). WINN PARISH: 4.8 km S of Winnfield. 4 April 1971. Collector unknown. LSUMZ 85163.

Rana palustris (Pickerel Frog). BEAUREGARD PARISH: LA 111, 3.6 km N of US 190. 8 April 1967. Larry D. Wilson. EAST FELICIANA PARISH: LA 10, 11.3 km W of Clinton. 27 April 1969. J. Moore. LSUMZ 69957. VERNON PARISH: LA 111, 2.9 km S of LA 392. 19 February 1966. Larry D. Wilson. LSUMZ 42249.

Rana sphenocephala (Southern Leopard Frog). WINN PARISH: 3.6 km E of Brewton's Mill. 1 July 1974. B. Stewart. LSUMZ 70332. An additional record from Winn Parish: LSUMZ 70333.

Scaphiopus hurterii (Hurter's Spadefoot). RED RIVER PARISH: 14.4 km E of Coushatta on LA 155. 12 May 1973. N. Loftin. LSUMZ 84987. A supporting record from Red River Parish: LSUMZ 85318.

Crocodilia

Alligator mississipiensis (American Alligator). RED RIVER PARISH: Red River near Coushatta. 15 September 1964. John H. Champion. LSUMZ 14567.

Testudines

Apalone spinifera (Spiny Softshell). VERMILION PARISH: LA 70, 1.8 km E of LA 92. 28 April 1975. Lou Wahlen. LSUMZ 75144.

Chelydra serpentina (Snapping Turtle). BIENVILLE PARISH: Friendship Lake on LA 4. 15 April 1969. G. Alvarez, Douglas Rossman, D. Ramsden. LSUMZ 32820. A supporting record from Bienville Parish: LSUMZ 86121. ST. JOHN THE BAPTIST PARISH: Edgard. 3 February 1969. C. G. Boerne. LSUMZ 32823.

Deirochelys reticularia (Chicken Turtle). ALLEN PARISH: US 190, 13.9 km WNW of Kinder. 14 April 1968. Douglas A. Rossman, Nita J. Rossman. LSUMZ 19202.

Graptemys ouachitensis (Ouachita Map Turtle). EAST BATON ROUGE PARISH: Baton Rouge. 11 May 1963. Brent Nickog. LSUMZ 34026. TENSAS PARISH: Louisiana side of Rodney Lake. 18 November 1995. Steve Shively. LSUMZ 57267.

Malaclemys terrapin (Diamond-backed Terrapin). LAFOURCHE PARISH: Bayou Ferblanc, approx. 5.4 km NW of Jefferson Parish line. 15 August 1970. Jim Bishop, Bo Blackman. LSUMZ 29569. VERMILION PARISH: University of Southwestern Louisiana Biological Field Station. 18 February 1961. C. R. Norden. LSUMZ 74149.

Pseudemys concinna (River Cooter). EAST FELICIANA PARISH: Amite River at LA 10. 3 June 1971. Patricia Kimmich Blaney. LSUMZ 41103. GRANT PARISH: 3.6 km S of Georgetown. 21 April 1950. J. Pharis. LSUMZ 1661. LAFAYETTE PARISH: D. S. Young Farm, Kaliste Saloom Rd 2.2 km W of Flanders Rd. 5 May 1973. Kenneth M. Fahey. LSUMZ 74179, 74180.

Terrapene carolina (Eastern Box Turtle). VERMILION PARISH: 43 km S of Kaplan. 19 April 1964. Larry D. Wilson. LSUMZ 32916. RED RIVER PARISH: 3.2 km S of Coushatta on LA 1. 25 April 1973. Tom Damico. LSUMZ 86169. 20.8 km E of Coushatta. 12 May 1973. N. Loftin. LSUMZ 86170.

Lacertilia

Anolis sagrei (Brown Anole). EAST BATON ROUGE PARISH: Louisiana Nursery near Bluebonnet Blvd and Perkins Rd, Baton Rouge. 9 October 2001. Ryan Chabarria. LSUMZ 83818. Adults and juveniles persisted at this site through mid-2002, but it could not be determined whether they represented a reproducing population or repetitious importations via plants (R. Chabarria, pers. comm.). LAFAYETTE PARISH: Lafayette Nursery, Lafayette. 1975. No collector. LSUMZ 71668. ORLEANS PARISH: jct of Decatur and Esplanade, New Orleans. 24 September 2000. Frank Burbrink. LSUMZ 81976. *Anolis sagrei* was found in substantial numbers in the LaPlace area, Saint John the Baptist Parish at various times during the 1980s and early 1990s, supposedly introduced accidentally by reptile dealers, but populations never persisted, evidently due to winter mortality (L. Prima, D. Vicknair, pers. comm.; no vouchers).

Eumeces anthracinus (Coal Skink). ALLEN PARISH: 20 km S of jct of LA 26 and LA 1156. 9 April 1973. Marion Moore. LSUMZ 71698. BEAUREGARD PARISH: Smyrna Rd, 24 km E of DeRidder. 3 April 1980. Mike Harbison. LSUMZ 85891.

Eumeces fasciatus (Common Five-lined Skink). ASCENSION PARISH: NW Intersection of I-10 and LA 22, Sorrento. 5 March 1998. Jeff Boundy. LSUMZ 59491. Bluff Swamp directly E of Bayou Braud. 17 March 1999. Jeff Boundy, Steve Shively. LSUMZ 80890. An additional specimen form ASCENSION PARISH: LSUMZ 86480. BIENVILLE PARISH: 4.8 km S of Castor. 20 June 1976. John Bruza. LSUMZ 85895.

Eumeces laticeps (Broad-headed Skink). SAINT JOHN THE BAPTIST PARISH: 0.5 mi S of US 61, W of Evangeline Rd, LaPlace. 1 October 1997. Jeff Boundy. LSUMZ 58581.

Hemidactylus turcicus (Mediterranean House Gecko). PLAQUEMINES PARISH: Belle Chasse Naval Air Station. 20 April 1998. Jeff Boundy, Steve Karsen. LSUMZ 59610. ST. CHARLES PARISH: Bonne Carre Spillway, W side, 0.8 km S of US 61. 14 February 2001. Jeff Boundy, Adam Leache. LSUMZ 83029–030. TANGIPAHOA PARISH: Southeastern Louisiana University Campus. 23 March 1987. C. Knight. LSUMZ 59591. Also from Tangipahoa LSUMZ 59592. WEST BATON ROUGE PARISH: LA 76, 0.9 km E of LA 417. 18 January 1963. M. J. Fouquette. LSUMZ 75397.

Ophisaurus attenuatus (Slender Glass Lizard). ACADIA PARISH: Egan. 5 February 1966. E. M. Trumps. LSUMZ 73501. EVANGELINE PARISH: LA 10, 7.6 km SE of Beaver. 28 June 1965. Jack Fouquette, Jim Delahoussaye. LSUMZ 73497. LAFAYETTE PARISH: LA 92 bridge E of Maurice city limits. 26 April 1975. Michael Courville. LSUMZ 73511. NATCHITOCHES PARISH: Red Dirt Wildlife Management Area, jct of Longleaf Trail and Bluff Camp Rd. 2 June 1995. Darrel O'Quinn. LSUMZ 57077. Also from Natchitoches Parish: LSUMZ 57639, 80998, 83492, 84660, 85797. ST. TAMMANY PARISH: Lake Ramsey Rd, 0.5 km E of Lake Ramsey Subdivision. 16 October 1998. Steve Karsen, Brian Horn. LSUMZ 80718. AVOYELLES PARISH: road between Marksville and Alexandria. 9 April 1959. Harold Cleveland. LSUMZ 86417.

Sceloporus consobrinus (Prairie Lizard). AVOYELLES PARISH: 1.7 km W of Cottonport on Bayou Rouge. 15 April 1965. Glenda Tarver. LSUMZ 75562–75564. EVANGELINE PARISH: Clearwater. 15 November 1958. G. M. Stokes. LSUMZ 75530. Additional specimens from Evangeline Parish: LSUMZ 75535, 75539–40, 75545.

Serpentes

Agkistrodon contortrix (Copperhead). ACADIA PARISH: near Eunice. 15 November 1961. McClendon. LSUMZ 82238. Additional speciemens from Acadia Parish: LSUMZ 82239–243.

Carphophis amoenus (Eastern Worm Snake). ASCENSION PARISH: near Gonzales. September 1966. Collector unknown. LSUMZ 18218.

Cemophora coccinea (Scarletsnake). CALCASIEU PARISH: LA 12, 18 km NE of Starks. 19 June 1971. Jim Roberts. LSUMZ 75938.

Crotalus horridus (Timber Rattlesnake). NATCHITOCHES PARISH: Longleaf Trail, 1.8 km E of Kisatchie Bayou. 21 April 1990. Douglas A. Rossman. LSUMZ 49582. Additional vouchers from Natchitoches Parish include: LSUMZ 58462, 83711, 84967. RAPIDES PARISH: LA 8 at Sharp. 23 April 1997. Theron Magers. LSUMZ 58475. Additional specimens from Rapides Parish: LSUMZ 78817–18.

Diadophis punctatus (Ring-necked Snake). ASCENSION PARISH: 5.4 km S of Kleinpeter. 23 February 1962. Laurence Binford, Burt Monroe Jr. LSUMZ 11969–70. Additional vouchers from Ascension Parish: LSUMZ 16688, 22956, 29341, 58257, 80895.

Farancia abacura (Red-bellied Mudsnake). ACADIA PARISH: Interstate 10, 9 km E of Jennings. 11 May 1975. James McLean. LSUMZ 28594. Additional vouchers from Acadia Parish. LSUMZ 75906, 59063.

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Regina rigida (Glossy Crayfish Snake). ASCENSION PARISH: Bluff Swamp. 8 December 1982. C. Yates. LSUMZ 41510. Additional specimens from Ascension Parish LSUMZ 42161, 42174.

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Storeria occipitomaculata (Red-bellied Snake). ASCENSION PARISH: Gonzales. 15 October 1998. Frank Marabella. LSUMZ 80971. EVANGELINE PARISH: approximately 6.5 km N of Basile. 5 April 1969. Paul Meier. LSUMZ 77955. WINN PARISH: 11.2 km E of

Atlanta. 21 April 1962. Keith A. Arnold. LSUMZ 12254. Also from Winn Parish LSUMZ 23902.

Thamnophis proximus (Western Ribbonsnake). WINN PARISH: LA 501, 2.3 km N of Calvin. 26 April 1969. R. Munz. LSUMZ 23861.

Thamnophis sirtalis (Common Gartersnake). ASSUMPTION PARISH: 8 km S of Napoleonville on LA 401. 15 April 1968. A. J. Kern. LSUMZ 79299. LAFOURCHE PARISH: Kraemer. 5 April 1975. Collector unknown. LSUMZ 47312. NATCHITOCHES PARISH: near Robeline. No date. Theron Magers. LSUMZ 85826, 86342–43.

Virginia striatula (Rough Earthsnake). EVANGELINE PARISH: Basile. 10 April 1969. Mark Meier. LSUMZ 81527. Additional records from Evangeline Parish: LSUMZ 81528, 81529. 81530. VERMILION PARISH: Vermilion Bayou 1.8 km S of Abbeville. 15 May 1971. Cecil LeBlanc. LSUMZ 81561–62.

Virginia valeriae (Smooth Earthsnake). GRANT PARISH: Pollock. April 1996. Kristi Wharton. LSUMZ 57754-57758. WEST FELICIANA PARISH: Butler's Mansion, 3.6 km N of St. Francisville. 16 March 1963. Douglas H. Morse. LSUMZ 17901.

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Additional Records and Range Extensions of Reptiles from Morelos, México

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As a part of the project entitled Herpetofauna of the Sierra de Huautla and Biological Corredor Chichinautzin in central Mexico, we collected six species previously unknown in Morelos and documented range extensions for three others. The new records were found in the Sierra de Huautla in southern Morelos, an extensive natural protected area of tropical dry forest and oak forest. The specimens were captured and preserved using the standard methods proposed by Simmons (1987). The specimens were deposited in the herpetological collection of the Universidad Autónoma del Estado de Morelos (EBUM). All specimen identifications were verified by Fausto Mendez de la Cruz.

Testudines

Apalone spinifera spinifera (Eastern Spiny Softshell). An adult female (EBUM 2898), found in the Río Amacuzac near the Las Huertas spa, Municipality of Tlaquiltenango (18°33'50"N, 99°33'50" W), 947 m elev., 17 October 1999. The first vouchered record for Morelos. An individual was previously observed in Cruz Pintada pond, Sierra de Huautla, but not reported by Castro-Franco and Bustos (1994). These turtles were introduced to Morelos as pets released near rivers.

Lacertilia

Cnemidophorus communis (= *Aspidoscelis communis*) (Colima Giant Whiptail). One subadult (EBUM 2355) captured in Ajuchitlán (18°28'30"N, 99°0'6"W), Municipality Tlaqiltenango 1053 m elev., 25 October 1997. Previously known from the coastal lowlands of Colima, Jalisco, and Michoacán, from the plateau region of Colima, and the low valleys of the Sierra de Coalcoman and Tepalcatepec Valley, Michoacán (Duellman and Zweifel 1962).

Cnemidophorus lineattissima (= *Aspidoscelis lineattissima*) (Twelve-lined Whiptail). One female (EBUM 2435) collected in Chimalacatlán (18°23'13"N, 99°7'20"W), Municipality Taquiltenango, 760 m elev., 8 February 1998. This species was known to occur in lowlands, northwestward from the Río Balsas Basin in Tepalcatepec Valley, Michoacán and Nayarit (Duellman and Wellman 1960).

Phrynosoma asio (Giant Horned Lizard). Two adult males (EBUM 3421–22), collected 2 km S of the pyramids archaeological zone Chimalacatlán, Municipality of Tlaquiltenango, 1065 m elev., 8 February 1998. Previously reported by Smith and Taylor (1950) from Colima through coastal Michoacán, Guerrero, Oaxaca, Chiapas, and Mexcala, Guerrero along the Río Balsas.

Sceloporus utiformis (Largescale Spiny Lizard). An adult male (EBUM 2373), collected 4 km S of Tilzapotla (18°27'7"N, 99°16'6"W) in Puente de Ixtla county, in a tropical dry forest, "Los Cocos" canyon, bordering the state of Guerrero. Three adult females (EBUM 2371–72, 2374) were collected on "Cerro Frio" (18°27'7"N; 99°16'8"W) 1 km S of Tilzapotla in oak forest. Recorded previously by Smith and Taylor (1950) near Colima. They described the distribution as being on Pacific slopes from southern Sinaloa to western Guerrero, extending inland about 125 miles in the southern part of the range. Previously known in Sinaloa, Nayarit, Jalisco, Colima, Michoacán, Guerrero (Smith and Taylor 1950; Ramírez-Bautista 1994).

Serpentes

Agkistrodon bilineatus bilineatus (Mexican Cantil). One male (EBUM 3422) was collected SE of Coaxitlán, Municipality of Tlaquiltenango (18°26'39"N, 99°10'21"W) under fallen leaves in a dry forest. Previously known in Morelos from Progreso (18°53'0"N, 99°10'0"W), Jiutepec 9 km E of Cuernavaca City (Davis and Smith 1953).

Coniophanes lateritius (Stripeless Snake). An adult male (EBUM 3420) captured in Rancho la Herradura, Ahuatepec, 7 km NE of Cuernavaca (18°57'30"N, 99°12'10"W) 1850 m elev., 7 August 1988, and another observed in the Sierra de Huautla in southern

Morelos, 15 April 2002. Previously known in Morelos from Huajintlán, south of Puente de Ixtla (Smith and Taylor 1945).

Ficimia publia (Blotched Hook-nosed Snake). One male (EBUM 2446) was found dead on the road 2 km S of Chimalacatlán (18°26'21"N, 99°06'22"W) Municipality of Tlaquiltenango, in tropical dry forest. Smith and Smith (1976) reported *F. publia*, *F. ruspatur*, and *F. olivacea* near Cuernavaca, Morelos, where we have frequently observed *Pseudoficimia frontalis* but not specimens of *Ficimia*. Hardy (1972) believed that records of *Ficimia* from Cuernavaca were misidentified specimens of *P. frontalis*. Castro-Franco and Bustos (1994) supported Hardy (1972) and commented that *Ficimia* does not occur in the Cuernavaca area. Thus, our record of *F. publia* from Chimalacatlán is the first confirmed report of this species from Morelos.

Micrurus laticollaris (Balsan Coral Snake). Several records extend the range of this species within Morelos. EBUM 2390, a female collected near Cruz Pintada pond, Sierra de Huautla, Municipality of Tlaquiltenango (18°33'39"N, 99°01'26"W) at 1050 m elev., 25 October 1997; EBUM 055 and 502, females captured in El Texcal, Municipality of Jiutepec (18°50'00"N, 99°10'00"W) at 1380 m elev., 23 November 1978; EBUM 500, 503 in Cuautla (18°50'45"N, 98°56'30"W); EBUM 501, 2 km E of Palpan, Municipality of Miacatlán (18°51'0"N, 99°25'0"W); EBUM 504, 6 km N of Michapa pond, Coatlán del Rio (18°39'45"N, 99°29'0"W). All specimens were found in dry forest. Previously recorded from Cuernavaca, Morelos (Smith and Taylor 1945) and Progreso, Jiutepec (Davis and Smith 1953).

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BOOK REVIEWS

Herpetological Review, 2004, 35(2), 197–199.

Biology of the Vipers, edited by Gordon W. Schuett, Mats Höggren, Michael E. Douglas, and Harry W. Greene. 2002. Eagle Mountain Publishing, 7705 North Wyatt Earp Avenue, Eagle Mountain, Utah 84043, USA. Hardcover. xii + 580 pp., 16 pls. US $75.00. ISBN 0-9720154-0-X.

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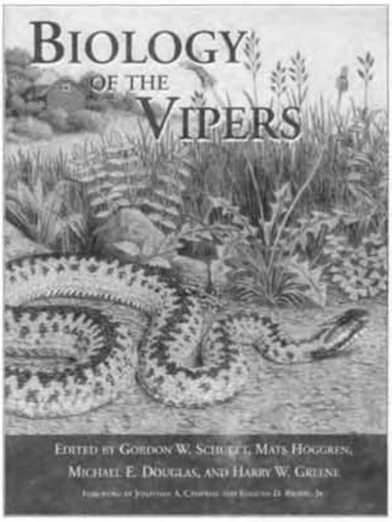

Multi-authored volumes always strike me as potentially iffy propositions. When the chapters are carefully edited and united by a common conceptual theme, the result can be a well-integrated body of work that makes a major collective contribution to its field. Too often, however, such volumes are simply collections of loosely related chapters that could just as easily have been published separately in disparate outlets. *Biology of the Vipers* does have a common theme, but it is a taxon rather than a conceptual area, and the chapters that comprise the book cover the map in terms of subject matter. Thus, the likely audience is clear (and fairly narrow): snake biologists. I study snakes, so I naturally was drawn to *Biology of the Vipers*, and, although I cannot offer unqualified praise, I found my time reading it to have been quite well spent.

Biology of the Vipers originated in an international conference held in May 2000 in Marielund, Sweden. The book also serves as a companion and, in some ways, successor to an earlier multi-authored volume, edited by Campbell and Brodie (1992), on pitvipers. The two books are identical in size and format and *Biology of the Vipers* even has a foreword by Campbell and Brodie, cementing this line of succession. The main difference is the increase in breadth of the newer work to include all vipers. Appropriately enough for this wider embrace and for the location where the conference was held, the picture on the dust jacket, by William B. Montgomery, is of the adder, *Vipera berus*. The authors comprise a virtual who's-who of students of viper biology, both seasoned veterans and younger practitioners. Coverage is biased towards New World and European taxa, with relatively little on Asiatic species and no chapters on African species. This presumably reflects bias both in where research is being done and in who participated in the conference.

Biology of the Vipers is a big book, 580 pages long, with 35

chapters under four section headings: Systematics, Taxonomy, and Phylogeography; Behavior, Ecology, Natural History, and Evolution; Physiology and Reproductive Biology; and Conservation. Chapters range in type from reviews to more particular studies on a single species. Several chapters discuss work that is in its early stages; one such chapter essentially amounts to a detailed research proposal. The biggest section, with 21 chapters, is the second one on Ecology. It seems to be a bit of a catch-all for papers that did not fit obviously under any of the other headings. This section in fact easily could have been subdivided into more cohesive units. Several papers on envenomation and predatory behavior (Cundall; Hayes et al.; Kardong and Smith; Stiles et al.) are clearly closely related, but they do not even appear close to one another in the apparently random order of chapters in this section. The section on Conservation is the shortest, with only two chapters. The book concludes with 16 pages of fine color plates showing most (or all? —I didn't count) of the many species mentioned in the text, complete with notes on natural history in the captions.

The most cohesive section, it strikes me, is the first one on Systematics. Not only were there common themes here, but the various authors seemed to be aware of each other's chapters and made appropriate cross-references. I am neither a molecular biologist nor a systematist, but I found these chapters, while not a gripping read, a very useful overview and update (among the latter being the genus *Daboia*, which was new to me). Because of the snake fauna in the region where I live, I was especially interested in the chapter by Douglas et al. on the phylogeography of the Western Rattlesnake (*Crotalus viridis*) complex, which has been the subject of much analysis, including some recent papers. Douglas et al.'s conclusions are strongly shaped by their support for the phylogenetic species concept, which in turn leads to some important differences with other workers in taxonomic assignments. Thus, the Northern Pacific Rattlesnake (*Crotalus oreganus*) is either a separate species (Douglas et al.) or a subspecies of a more widely distributed Western Rattlesnake (Ashton and de Queiroz 2001). This is an important debate, but I think that it could be conducted with a little more temperate language: Douglas et al.'s dismissal of the conclusions of others as "gratuitous" is impolite, at best.

As an ecologist, I found myself on more familiar and comfortable ground in the long section on behavior, ecology, etc. However, I also found the papers in this section to be very uneven in quality. Some, though, were models of their kind. For example, the chapter by Hayes et al. on factors influencing venom expenditure was a well-written, comprehensive, and critical review that also incorporated some new data. I was especially interested in the differences between defensive and predatory strikes, which I must admit I had thought about only fleetingly in the past. Most important, though, Hayes et al. (p. 225) encourage researchers to widen their view beyond just snakes in order to put envenomation by snakes into a broader evolutionary context. I say "Amen" to that sentiment. Other authors in this book also make clear links between their work and general theory (e.g., Douglas et al., Höggren and Tegelström), but this kind of connection is lacking in some chapters. In fact, I was reminded in places of an article by Bonnet et al. (2002), on taxonomic chauvinism in publishing, in which they complained that papers on ectothermic vertebrates in "high-impact" ecological journals had to be framed more conceptually than those on endotherms. Bonnet et al. (2002) supported this argument with data showing, among other things, that the first mention of the study organism appeared significantly later in papers on ectotherms. I'm not so sure that this is a bad thing, and not just for papers on ectotherms.

A number of other chapters in the Ecology section were highlights for me. Greene et al. combine detailed natural history observations, experiments, and phylogenetic analysis in revealing strong evidence for postpartum (or post-hatching) parental behavior in many vipers. One of the points that intrigued me in this chapter was the extreme care that the authors took to minimize disturbance when they observed wild rattlesnakes. This can only be a good thing, but I was left wondering: "Are rattlesnakes really that sensitive?" In my experience, rattlesnakes are among the most watchable of snakes in the wild, an observation supported by the details presented in this chapter, which would be difficult to obtain for many (most?) other kinds of snakes. Sealy, in a chapter in the later section on Conservation, also touches on this point. He observes, for example, that Timber Rattlesnakes (*Crotalus horridus*) in woodlands can be approached very closely without any apparent response unless directly disturbed. Snakes away from cover, by contrast, exhibit various defensive behaviors when approached. Thus, context matters.

Greene et al. also go to some lengths to reduce the effects of handling on short- or long-term behavior, taking all measurements from their snakes with the animal under anesthesia. But how important are these effects? Are they necessarily worse than the grogginess accompanying recovery from anesthesia? No doubt there is variation among taxa, but I doubt that the requirement for anesthesia is a general one for handling snakes. For example, I have watched garter snakes return to foraging and catching food within seconds of release, just after I have stretched, weighed, and palpated them for food. Greene et al. raise an important issue, though, and one that I've thought about a lot, but also one that is difficult or impossible to test. How can we study any animal, even just watching it, without potentially disturbing it? How can we know that what we are seeing is natural?

Another chapter that caught my attention was that by Mori et al. on the subtropical Hime-Habu (*Ovophis okinavensis*), a low-temperature binge-feeder on breeding ranid frogs. This chapter reminded me of the Rubber Boa (*Charina bottae*), which is sometimes active at night at quite low temperatures that are below its apparent preferred body temperature (Dorcas and Peterson 1998). The Hime-Habu shows little evidence of physiological adaptation to low temperature; for example, it cannot digest food quickly at low temperatures (although it can retain it for digestion). Apparently, activity on cool nights and low-temperature feeding are seen in some other Asiatic vipers: in their chapter, Orlov et al. note such behavior in at least two other species of *Ovophis* and in *Azemiops*.

The chapter by Orlov et al. is in fact one of the real services that this book provides, one that would be unlikely to be duplicated in a journal article. Orlov et al. summarize distribution, taxonomy, and natural history information for 21 species and subspecies of little-known Asiatic viperids. Coupled with the color plates at the back of the book, this chapter provides the beginnings of what could be a very useful field guide.

The third section (Physiology) of *Biology of the Vipers* consists of six chapters, of which three struck me as particularly interest-

ing, albeit in different ways. Almeida-Santos and Salomão report on reproduction in tropical vipers, discussing, among other things, uterine muscular twisting (apparently similar in function to the copulatory plug of natricines), evidence for parthenogenesis (surely molecular tools could be used to settle this question), and the occurrence of inter-sex females in *Bothrops insularis*. In another chapter, Beaupre uses an individually based physiological simulation to model growth and reproduction in rattlesnakes. The model itself is informative enough, but so are Beaupre's introductory admission to having seen the error of his ways about the utility of models and his good advice about the role that models can play in the development of hypotheses to test experimentally. He provides plenty of such ideas. Bonnet et al., in the following chapter, argue for applying the complementary approaches of physiological experiment and mark-recapture population analysis to determine costs of reproduction. Although I think that Bonnet et al. misconstrue the aims of some other studies, including one of my own, I found much of value in this chapter. One fascinating observation for me is that female Aspic Vipers (*Vipera aspis*), which Bonnet et al. study, have extremely high costs of reproduction, especially manifested in postpartum mortality, which makes these animals effectively semelparous (see also Luiselli and Zuffi's chapter in the Ecology section). This contrasts markedly with the rattlesnakes discussed elsewhere that experience long lives and multiple opportunities for reproduction (see chapters by Greene et al., Beaupre, Martin). Why are the costs so different in these two groups of vipers? Even more important, why is there no discussion of this among authors?

The selection of chapters mentioned above is biased to some extent by my own interests, but there are far too many chapters for me to discuss them all individually in any case. I will not even attempt to list them all. However, topics covered, in addition to those I already have noted, include: phylogenetic correlates of food habits (Martins et al.), caudal luring (Reiserer), patterns of rattle loss (Rowe et al.), the fossil record of vipers (Szyndlar and Rage), translocation of "problem" rattlesnakes (Nowak et al.; Sealy), and what I can only describe as adaptive constipation (Lillywhite et al.).

Despite numerous strengths, *Biology of the Vipers* also has significant weaknesses. The more trivial of these are technical details that suggest inattentive proofreading and editing. After awhile, I gave up trying to keep track of the numerous typographical and grammatical errors, but examples are not difficult to find (e.g. "Craycraft" instead of "Cracraft" on p. 40; "climactic" instead of "climatic," p. 287; "determinate" instead of "determinant," p. 567). The book generally is well presented and has a nice appearance, but there are signs of running ink in Fig. 4 of Reiserer's chapter. These points, however, are minor; my somewhat muted enthusiasm for this book is based on more substantive criticisms.

First, I think that the editors should have been much more ruthless in limiting the length of some of the longer chapters, including their own. Second, the detail in a couple of chapters verges on presentation of raw data. Readers cannot be expected to assimilate that which has not been properly digested (and this book is a big meal to begin with). In some cases, the data simply are too thin for meaningful inferences to be drawn, a situation that will not be helped by further analysis (or catalysis), only by further fieldwork or experimentation. Thus, one real problem with this volume is that some of the work presented is incomplete and prematurely published. Schuett et al. even acknowledge this in a curious paragraph concluding the introduction to their chapter. Admittedly, it can be difficult to recognize the logical stopping point for a study, and all studies are snapshots of ongoing work, but in the end, something is either publishable or it is not. *Biology of the Vipers* would have benefited from application of some of the same standards used in most journals. It also would have benefited from closer integration among chapters. The result would have been a leaner, tighter, and better book.

All this makes me ask: What motivates an author to publish a chapter in a book rather than a paper in a journal? After all, the latter is usually seen as more valuable from the point-of-view of earning grant funds, etc. I suspect that the answer lies, at least partly, in the opportunity to review a body of work (e.g., Hayes et al.) or to expand on a topic in a detailed way that might not be possible in the confines of a journal article (e.g., Greene et al.). Also, book chapters, especially those based on conference proceedings like this one, offer an opportunity to publish "works in progress," which may or may not see the light of day later in more fully developed form in a journal. These are worthwhile aims and, done well, this kind of diversity is more than welcome. However, it also is a bit risky.

Would *Biology of the Vipers* have been a better book had it not been based on proceedings of a conference? Not necessarily—but I think conference proceedings work better when the resulting volume is more selective and focused on specific, well-integrated topics. I, and others who study snakes, will find this book valuable and no doubt use it frequently in both research and teaching. Others will consult it now and then to find a snake example of this or that. However, with no clear conceptual focus, it likely will not attract a broader audience. *Biology of the Vipers* is a good book with some very bright spots indeed, but it is not as good a book as it could have been.

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True Vipers: Natural History and Toxinology of Old World Vipers, by David Mallow, David Ludwig, and Göran Nilson. 2003. Krieger Publishing Company, Malabar, Florida (www.krieger-publishing.com). 410 pp. Cloth US $79.50. ISBN 0-89464-877-2.

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Vipers are in! This is demonstrated by a wealth of recently published studies (e.g., Thorpe et al. 1997; Joger 1999; Schuett et al. 2002). This was not always the case, however, as the genesis of this book demonstrates. David Mallow, a keeper of several viper species and an amateur herpetologist, started this project ten years ago because he could not find any specific books about his passion. He was quickly joined in this task by his friend David Ludwig. The initial phase was an extensive literature search that soon produced a massive listing of references. The authors then tackled the formidable task of collecting these documents, driving around the country, spending nights in motels and days in universities or museums, photocopying hundreds of papers. Finally, these articles were read and summarized (D. Mallow, pers. comm.). The manuscript was almost ready for publication when the editor strongly advised the authors to bring Nilson (Head of the Vertebrate Department, Göteborg Natural History Museum) into the project: "We used your [Golay et al.] 1993 collaborative book on endoglyphs as the foundation for our [taxonomic] system. However, as we were finishing the book it was brought to our attention by our editors that the taxonomy we were using was evoking a great deal of criticism especially with [respect to] the European vipers" (D. Mallow, in litt.).

True Vipers is divided into 14 taxonomic chapters preceded by a table of contents, a preface, authors' acknowledgments, and an introduction, and followed by the bibliography and a glossary. Within the taxonomic accounts species are ordered alphabetically within genera (or subgenera), and genera are likewise alphabetical within subfamilies. Oddly, however, non-nominate subgenera do not appear to follow any particular pattern.

The Preface clearly states the objective of the work, which is to "furnish the reader with a summary of taxonomy, general biology, and toxinology for vipers." The Introduction defines the scope of the study, which is limited to the "true vipers," which, among the Viperidae, are distinguished from the Crotalinae by the lack of thermo-receptive pit between the nostril and eye. Thus, this book is devoted to the subfamilies Azemiopinae, Causinae, and Viperinae. Parts of this introduction are real masterpieces, especially the sections treating the venom delivery system, toxinology, venom effects, and the treatment of snakebites. The authors do their very best to explain complex phenomena in a simple and didactic way; Sherman Minton would have been proud of his protégés. In this section, we also see the first signs of the most striking aspect of this publication, its lack of cohesion. This singularity, found all through the work, is evident in the disparity between the taxonomic and natural history/toxinology parts of the introduction (1.5 vs 9.5 pp.); despite his undeniable experience, Nilson did not have enough time (six months – G. Nilson, pers. comm.) to bring his contribution to the level of thoroughness of his coauthors.

The format of the taxonomic accounts was mostly inspired by Carl Ernst's (1992) *Venomous Reptiles of North America* (D. Mallow, pers. comm.), but because of the great disparity of information available, the authors were unable to strictly follow this model. This fact is clearly illustrated by the variable size of entries (from the thickest account, for *Bitis gabonica* – 14 pp., to the thinnest one, for *B. worthingtoni* – 1.5 pp.). The accounts are divided into sections: Recognition (Head, Body, Size, Pattern), Taxonomy and Distribution, Habitat, Food and Feeding, Behavior, Reproduction and Development, Bite and Venom (Epidemiology, Yield, Toxicity, Content, Symptoms and Physiological Effects, Hematological Activity, Case Histories, Treatment and Mortality) and Remarks (i.e., breeding, conservation, enemies, longevity, mimicry). Smaller accounts often lack the Remarks section and in many cases no information is provided under one or more of the other headings.

The bulk of the book is divided into 14 chapters. The content of six of them, Azemiopinae (genus *Azemiops* – 1 species), Causinae (genus *Causus* – 6 spp.), *Cerastes* (3 spp.), *Eristicophis* (1 sp.), *Montatheris* (1 sp.), and *Proatheris* (1 sp.) is non-controversial and raises no particular problems. The same cannot be said of the remaining taxonomic sections.

Chapter 3 Viperinae (genus *Adenorhinos* – 1 sp.) exhibits an especially disconcerting feature of this volume – the inconsistency of criteria used for the recognition of taxa. Not surprisingly, Nilson's decisions are mostly based on biochemical investigations performed by Ulrich Joger and his team. Although the authors "understand that full taxonomic agreement is not likely for some time to come," some taxonomic units seem to reflect an underlying "splitter's" point of view, whereas others follow a "lumping" approach. The most significant systematic changes espoused are derived from a single paper by Lenk et al. (2001). However, the way Nilson analyzes the results obtained is puzzling. Concerning *Adenorhinos*, the "splitting" policy was used, despite the fact that Lenk et al. demonstrated that *A. barbouri* and *Atheris ceratophora* are sister taxa.

Chapter 4 (genus *Atheris* – 12 species) reveals a problem in accounting: according to the table of contents, the genus *Atheris* contains 11 species; however, we later learn that "the genus *Atheris* currently includes 12 species" (p. 39) (the recently described *Atheris hirsuta* being mentioned only in the Taxonomy and Distribution section of the generic account).

Chapter 5 (genus *Bitis* – subgenera *Bitis* [1 sp.], *Calechidna* [11 spp.], *Macrocerastes* [3 spp.], and *Keniabitis* [1 sp.]) presents another inconsistency: "the two subspecies *Bitis g. gabonica* and *B. g. rhinoceros* are separated on species level by Lenk et al. 2001"

(p. 60) and "Currently two subspecies are recognized: *B. g. gabonica* … and *B. g. rhinocerus* (sic)" (p. 102); the "lumping" policy being here followed.

A significant taxonomic change is proposed in Chapter 7 (genus *Daboia* – 2 spp.) with the inclusion of *D.* (*Vipera*) *palaestinae* based on the findings of Lenk et al. However, the results of Lenk et al. are not taken to their logical conclusion, as following this would imply that *Macrovipera deserti* and *M. mauritanica* should also be included in the genus *Daboia.* Thus, Nilson here adopts a "splitting" policy.

Chapter 8 (*Echis* – 10 spp.) confirms the elevation of *Echis khosatzkii* (formerly included in the synonymy of *E. p. pyramidum*) to species level, as well as the questionable validity of the species *E. multisquamatus*, a probable subspecies of *E. carinatus*. The presence of *E. leucogaster* in Morocco is overlooked.

Chapter 10 deals with *Macrovipera* (4 spp.). As already mentioned, *Macrovipera deserti* and *M. mauritanica* should be included in the genus *Daboia* according to the results of Lenk et al. In this chapter Nilson resurrects *Macrovipera schweizeri siphnensis*, a form originally described by Wettstein (1952) on the basis that "the form from Siphnos is larger and has a different color pattern than the nominate subspecies" (Cattaneo 1989). The taxonomic conclusions expressed here are a good illustration of mixed "lumping" and "splitting" policies.

Chapter 13, *Pseudocerastes* (1 sp.), is another example of the "lumping" policy, Lenk et al. having clearly demonstrated that *Pseudocerastes fieldi* and *P. persicus*, here regarded as subspecies, should be treated as separate species.

As expected, Chapter 14, which considers *Vipera* with its subgenera *Pelias* (8 spp.), *Acridophaga* (6 spp.), *Montivipera* (8 spp.), and *Vipera* (5 spp.), is the most controversial part of the book. Concerning the subgenus *Pelias*, there is once again a mismatch between the table of contents and the systematic accounts, *Vipera magnifica* and *V. orlovi* being mentioned only in the *V. kaznakovi* account. To be fair, however, Nilson mentions that "additional research will demonstrate whether these taxa are full species or incipient species." The *V. darevskii* and *V. dinnicki* accounts clearly exemplify the danger of the "cut and paste" technique; the two accounts feature identical paragraphs concerning the mean length and weight of newborns. In this section, the "splitting" policy is invariably followed: "*Vipera nikolskii* could either be looked upon as a subspecies of *V. berus*, or as a full species;" moreover, *Vipera pontica* retains its species status, whereas according to Baran et al. (2001), it should be placed in the synonymy of *V. barani*.

In the subgenus *Vipera*, *V. transcaucasiana* is treated as a full species (see Herrmann et al. 1987); however, the possibility of the convergent evolution of *V. latastei* and *V. ammodytes transcaucasiana* albumins cannot be definitively ruled out. The *Vipera aspis* and *berus* accounts illustrate some irritating features: (1) In the Distribution section, the authors repeatedly cite general references (e.g., Street 1979; Mehrtens 1987, etc.), whereas David and Ineich (1999) and various European herpetological atlases are entirely ignored. (2) Statements are sometimes quite loosely interpreted. For example, in the Food and Feeding section, the authors write that "neonates eat insects and worms" whereas the original sentence is "the very young are said to eat insects and worms" (Street 1979, without substantiation). Further, their assertion that amphibian prey are not taken is incorrect (see Monney 1993 for evidence of frogs as prey of this species); (3) Blinded by their quest to be exhaustive, the authors were not critical enough to properly evaluate the reliability and currency of different sources of information, such as peer-reviewed articles, compilations, and "gray" literature; a good illustration of this failure is the sempiternal citation of U.S. Navy (1991) (which should be correctly cited as Moore 1991), an unaltered reprint of a 1966 book that is significantly out of date in many respects; (4) truisms, such as "most bites occur from March through October," are found even in Nilson's "secret garden" (the *V. berus* account).

In such a thorough review of the world literature, a bibliography plays an essential role; one must be able to easily retrieve cited works. Alas, in the preface alone, two out of four citations contain errors (Golay et al. 1993 and Herprint International [i.e., Ulber] 1994) and a third one (David and Ineich 1999) is not to be found in the bibliography. These unexpected errors drove me to test this section for its completeness. I verified that the citations mentioned in every 10th page (i.e., pp. xi, 7, 17, 27 … 297) were present among the bibliographic entries. One citation was lacking (Cherlin 1990) and I spotted two misprints (Laurent instead of Laurenti 1768 and Schnurrenburger instead of Schnurrenberger 1959). I accidentally found other missing entries (Darevsky 1956, Herrmann et al. 1987, Nilson et al. 1994) and misprints (Stucki-Stern instead of Stucki-Stirn 1979, Mierte instead of Meirte 1992).

Checking the accuracy of the bibliography, I was stunned! I found countless errors concerning dates of publication (e.g., Laurenti 1798 instead of 1768), editors (e.g., Calmette A. 1907 *In* Bucherl W., editor. 1967), pagination (Pitman 1938, 27 pp. instead of 362 pp.), patronyms (e.g., Boonpucknoaviq instead of Boonpucknavig), publishers (e.g., Klemmer 1967a *In* Bucherl W. – Masson, Paris instead of Academic Press, New York), and titles (e.g., *Historic Amphiorum naturalia et litterariae* instead of *Historiae Amphibiorum naturalis et literariae* Schneider 1801). Moreover, out of 65 French references, 52 contain errors! Among these is a real howler: "Geoffroy E, Saint-Hilaire T. 1827 Description del reptiles quo se trouvent en Egypt. In: Audouin V [editor]. Description de l'Egypte, ou recueil observations et Del recherches quo Ott en Egypt pendant l'expedition de l'Armee Franchise. Hist. Nat 1(1) :121–160." However, accuracy is much better for Spanish and German, despite the failure to capitalize some words or use proper diacritical marks.

Unfortunately, the manuscript of this potential bestseller apparently received little, if any, copyediting and was not subject to rigorous peer review. It is obvious that my complaints are negligible relative to the formidable amount of work produced by the authors. Therefore, I have no hesitation in recommending this excellent summation of the natural history and toxinology of true vipers as a reference. However, the taxonomic part of this volume proves that Krieger has come closer to the goal of gaining maximum profit on minimal investment than it has to reaching "the frontier of knowledge of viper taxonomy" (quote from rear cover of *True Vipers*).

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South American Frog Calls

Frogs of Tambopata, by Rex Cocroft, Victor R. Morales, and Roy W. McDiarmid. 2002. Macaulay Library of Natural Sounds, Cornell Laboratory of Ornithology, 159 Sapsucker Woods Road, Ithaca, New York 14850, USA (http://birds.cornell.edu). 1 CD, 1 booklet (27 pp.). US $18.95. ISBN 0-938027-57-3.

Sounds of Frogs and Toads of Bolivia (Guia Sonora de las Ranas y Sapos de Bolivia), edited by Rafael Márquez, Ignacio De la Riva, Jaime Bosch, and Eloisa Matheu. 2003. ALOSA, Sonidos de la Naturaleza, Apartado de Correos 9259, E-08080, Barcelona, Spain (http://www.sonidosdelanaturaleza.com). 2 CDs, 1 booklet (47 pp.). 25€+ 9€ shipping (approx. US $29 + $10.40). ISBN 84-607-4138-9.

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Nearly half a century has passed since the calls of North American anurans recorded by the late Charles M. Bogert with archaic recording equipment were transcribed onto a vinyl record (Bogert, 1958). Since then the recording of animal sounds has become a routine effort for many field biologists. Many recordings have been edited, grouped, and transcribed onto compact discs, especially by the Cornell Laboratory of Ornithology, which currently offers dozens of CDs of bird songs and three of North American anurans.

In recent years, herpetologists have been blessed with CDs of calls of frogs from various parts of the world (e.g., West Africa by Grafe 2000 and Panama by Ibáñez et al. 1999, containing recordings of 24 and 52 species, respectively). The two sets of discs reviewed here are the results of ambitious projects that required untold effort. With few exceptions the recordings are of good quality, although in many, background noise, principally calls of other species, is distracting. Both CDs are accompanied by small booklets (12 x 12 cm) containing brief comments on, and small color

photographs of, each species. Throughout the following commentary, the two works are referred to as "Bolivia" and "Tambopata."

Tambopata contains recordings of 70 species—3 bufonids, 1 centrolenid, 5 dendrobatids, 36 hylids, 21 leptodactylids, and 4 microhylids. All are identified to species, except a *Dendrophryniscus*, a *Hyalinobatrachium*, a member of the *Eleutherodactylus lacrimosus* Group, and a member of the *Hyla parviceps* Group that likely is *Hyla bokermanni*. Two distinctly different calls referred to *Osteocephalus "leprieurii"* are given; likewise there are recordings of *Adenomera* Species 1 and Species 2, in addition to *Adenomera andreae* and *A. hylaedactyla*. The call of a *Phyllomedusa*, noted as a yet-to-be-described species, is that of *P. camba* (De la Riva 2000a). The nomenclature of *Scarthyla ostinodactyla* should read *Scarthyla goinorum* (De la Riva 2000b). All recordings are from the vicinity of the Explorer's Inn on the Río Tambopata, Departamento de Madre de Dios, Peru, except for two each from Cocha Cashu and Pakitza in the same department. The brief account of each species includes a statement on breeding and specifics about the recording, usually temperature and always tape number in the United States National Museum or the Macaulay Library of Natural Sounds. Most of the color photographs are of good quality and despite their small size (27 x 23 mm) are useful in identifying the frogs.

Bolivia contains 166 recordings; 151 of these are of 129 species—8 bufonids, 3 centrolenids, 8 dendrobatids, 53 hylids (including 2 pseudines), 53 leptodactylids, and 5 microhylids. All are identified to species, except one *Colostethus* and one *Adenomera*, neither of which is represented by a photograph in the booklet. There are two recordings of 12 species, three of two species, and four of another. Most of these are simply recordings from two or more localities, but there is a release call of *Atelopus tricolor*, an aggressive call of *Ceratophrys cranwelli*, and a distress call of *Pseudis paradoxa*. The brief account of each species (English and Spanish) includes statements on breeding and distribution, calls of other species in the background, locality and temperature at time of recording, and name of person responsible for the recording. There is no documentation regarding the disposition of the recordings, but they are deposited in the Fonoteca Zoologica Digital in the Museo Nacional de Historia Natural (I. De la Riva, pers. comm.). Most of the 15 recordings of choruses include calls of 2–10 species, but three are of large choruses of single species—*Leptodactylus fuscus*, *L. rhodonotus*, and *Pseudopaludicola mystacalis*. Most of the photographs are reasonably good, but their small size (18 mm square) limits their utility.

Together, these two sets of CDs contain recordings of 151 species of anurans; 48 of the species nominally are included in both sets. However, taxonomic issues plague both publications. For example, the systematics of the toads of the "*Bufo typhonius* complex" is unresolved; a member of this complex is referred to *Bufo* cf. *typhonius* in Tambopata and as *Bufo margaritifer* in Bolivia; their calls are different. The distinctiveness of calls among cryptic species of *Adenomera* probably will result in at least two new taxa being recognized in Bolivia and Peru (Angulo and Icochea 2003). Two "species" of *Osteocephalus leprieurii* are recognized in Tambopata and another as *Osteocephalus* sp. in Bolivia. Three different calls are involved; most likely none of these is *O. leprieurii* as defined by Jungfer and Hödl (2002). However, these CDs are incredibly valuable for anyone studying calls of South American anurans. Individual calls can be downloaded into sound analysis programs (e.g., Canary) that can measure call parameters and produce waveforms and spectrograms, thus allowing other recordings to be compared with those on the CDs.

Both booklets emphasize that the CDs will be helpful in identifying frogs in the field and in monitoring frog populations. Theoretically, if a biologist is in the rainforest in southern Peru or adjacent Bolivia, and if he/she has a portable CD player, he/she could identify frogs by comparing calls heard in the field with those on the CDs. This is easier said than done. Very few persons have the auditory abilities and memory to recognize scores or even hundreds of sounds, as did the late Theodore H. Parker III for bird songs. Nevertheless, as stated by Zimmerman (1994), CDs such as these can be useful learning tools for auditory monitoring of anuran populations in the regions covered.

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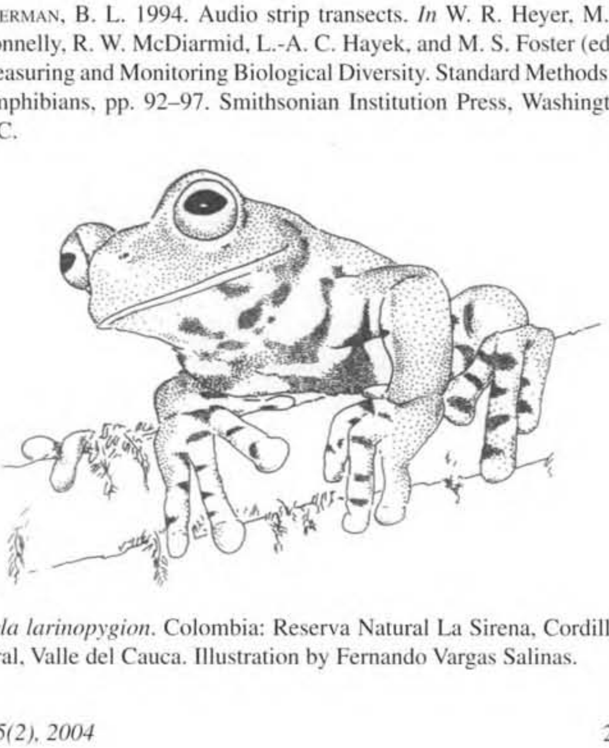


Hyla larinopygion. Colombia: Reserva Natural La Sirena, Cordillera Central, Valle del Cauca. Illustration by Fernando Vargas Salinas.

PUBLICATIONS RECEIVED

Crocodiles: Inside Out, A Guide to the Crocodilians and their Functional Morphology, by K. C. Richardson, G. J. W. Webb, and S. C. Manolis. 2002. Surrey Beatty & Sons, Chipping Norton NSW, Australia (distributed in the US by Bibliomania! – www.herplit.com). viii + 172 pp. Hardcover. AU$ 99.00 (US$ 65.00). ISBN 0-949324-90-6.

This book is a detailed guide to the anatomy of crocodilians, aimed at a wide audience, including those working with crocodiles and alligators commercially, as well as veterinarians and zoologists. It opens with an introductory chapter on crocodilian taxonomy and diversity and another on topographic dissection. It then takes a classic systems approach to anatomy, with chapters on the integument, skeleton, musculature, cardiovascular system, respiratory system, digestive system, urogenital system, and nervous and special sensory systems. These contain boxed insets on a variety of peripheral, but related topics, such as indicators of age in crocodilians, growth, diving, and vocalization. A chapter on histology covers tissues from all organ systems. A series of appendices cover muscle topography, the vascular system, and neuroanatomy, providing details of terminology, function, and position in tabular form. The book concludes with a "Further Reading" section of more than 200 references and a list of relevant websites, a glossary of more than 250 terms, and a comprehensive index. The volume is illustrated throughout, chiefly in color. Although many of the illustrations and observations are based on the two Australian species of crocodiles, the work is aimed at a more global audience including all crocodilian biologists as well as reptile morphologists.

De Dos Mundos, Las Ranas, Sapos y Salamandras de la Peninsula de Yucatán, Mécico/ Of Two Worlds, The Frogs, Toads and Salamanders of the Yucatan Peninsula, Mexico, by Carlos Galindo-Leal. 2003. Pangaea, Saint Paul, Minnesota (info@pangeae.org). xvii + 133 pp. Softcover. US $19.95. ISBN 1-929165-52-8.

This small bilingual book, with Spanish and English text on facing pages, covers the two species of salamanders and 20 species of anurans occurring on the Yucatan Peninsula. It is illustrated throughout by Roberto Arreola Alemón. Although clearly aimed at a non-technical audience, the book provides a good deal of detailed information in accessible form. Among the topics covered are activity, reproduction, life history stages, vocalization, diet, and defense. These are grouped under whimsically entitled chapters such as "Multiple Personalities" and "Tenors, Baritones and Basses." What makes the book unique is the integration into the main text of quotes, poems, proverbs, and stories relating to amphibians. These derive from sources as diverse as Aesop and Jimmy Buffet songs and originate from countries from China to Germany to Argentina, and of course Mexico. Species accounts are just a few paragraphs in length and provide etymological information, basic identifying features, a summary of habitat and reproduction, and a statement of distribution. Each is accompanied by a color illustration. The book concludes with sections on human uses of amphibians, from Mayan rain invocation rituals to pregnancy tests, and a consideration of conservation, with details relating to vulnerable amphibians of the Yucatan and the success of the cane toad, *Bufo marinus*. Short lists of relevant literature and websites are also provided.

Reptiles and Amphibians of the Amazon: An Ecotourist's Guide, by R. D. Bartlett and Patricia Bartlett. 2003. University Press of Florida, Gainesville, Florida (www.upf.com). xviii + 310 pp. Softcover, US $29.95. ISBN 0-8130-2623-7.

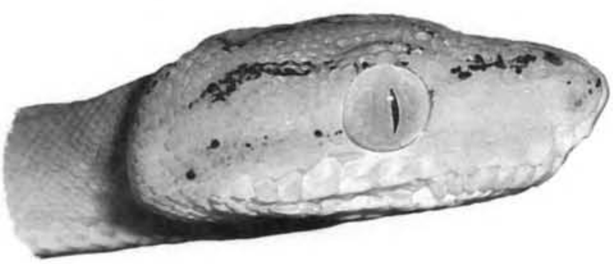
This latest offering from the prolific herpetological writing team of Bartlett and Bartlett provides travelers to Amazonian South America a convenient and colorful introduction to the region's impressive herpetofaunal diversity. Aside from the 310 pages of text, there are an additional 128 pages (unnumbered) containing 297 color photographs of herps, habitats, and predators. Photo quality is mostly good to excellent, with more than 250 taxa depicted. Although not exhaustive in its coverage, the authors have included those species most likely to be encountered by ecotourists, especially in Amazonian Peru. Brief written accounts for each of the included species offer information on size, identification, reproduction, similar species, habitat and range, and voice (for anurans). Tips for travel in the neotropics include things like clothing, medications, currency exchange, field gear, and items useful when trading with the locals.

Parental Behavior in Lepidosaurian and Testudinian Reptiles, A Literature Survey by Louis A. Somma. 2003. Krieger Publishing Company, Melbourne, Florida (www.krieger-publishing.com). x + 174 pp. Hardcover. US $33.50. ISBN 1-57524-201-X.

This book brings together the extensive literature on parental behavior (defined as "all behavioral contributions by the parent(s) to offspring survival *after* parturition"). After a brief overview of selected historical, legendary, and folkloric views of parental behavior in non-archosaurian reptiles, the author defines 19 categories of parental behavior (including several reflecting varying degrees of reliability). These are employed in a series of three tables (one each for turtles, snakes, and non-ophidian lepidosaurs) that list the type(s) of parental care and the reference(s) reporting for each of 336 species of lepidosaurs and 7 turtles. Two summary tables list the number of genera and species exhibiting parental behavior by family, and the prevalence of maternal, paternal, and biparental behavior across lepidosaurs. Additional tables more briefly overview parental behavior in other extant vertebrates and in extinct reptiles, experimentally-derived studies of parental behavior, and historical literature dealing with snakes swallowing their young. The bibliography of parental behavior is 100 pages long and includes citations from Gesner and Topsell to the 21st Century, derived from the literature of natural history, herpetoculture, and other sources. A combined subject and taxon index to the tables and introductory material completes this useful reference.

Interpretive Atlas of Texas Lizards, by Ralph W. Axtell. 1986–2003, *et. seq*. Privately published by and available from the author (Ralph W. Axtell, 1033 Randle Street, Edwardsville, Illinois 62025, USA; e-mail: raxtell@siue.edu). Individual accounts available separately. Cost: US $0.15/page + postage and handling.

The most recent installments (numbers 27–28) in this series are *Scincella lateralis* (Little Brown Skink) and *Cnemidophorus exsanguis* (Chihuahuan Spotted Whiptail). These new accounts comprise 41 and 10 pages, respectively, in addition to a detailed range map. Axtell provides an in-depth discussion of distribution for each species in Texas, along with current taxonomy, geographic variation, conservation status, and suggestions for future work. He retains usage of *Cnemidophorus sensu lato*, treating *Aspidoscelis* as a subgenus (by extension, *Ameiva* and *Kentropyx* are also regarded as subgenera) pending further resolution of phylogenetic relationships among teiids.



Corallus hortulanus (Common Tree Boa). Guyana. Photolithograph by Will Brown.

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NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 35, Number 1 (March 2004).

CAUDATA

CRYPTOBRANCHUS ALLEGANIENSIS ALLEGANIENSIS (Eastern Hellbender). **BREEDING SEASON**. The breeding season of eastern populations of *Cryptobranchus a. alleganiensis* has been fairly well documented in the literature. In general, the season lasts from mid-August through mid-September (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press. 587 pp.), although in Alabama it can continue into early October (Mount 1975. The Reptiles and Amphibians of Alabama. Auburn Univ. Agri. Exp. Station. 347 pp.). Herein, we report what we believe to be the first documented records of gravidity and nesting from Georgia, perhaps the southeastern-most state within this salamander's range.

In an effort to collect skin mucous for bacterial analyses, we hand-captured *C. alleganiensis* at Cooper Creek, Union County, Georgia on 5 Sept 2002. Among the hellbenders captured were two gravid females, one of these discharged ca. five eggs when placed in a dilute solution of MS-222 to anesthetize the animal. Additionally, a nest guarded by an adult hellbender was discovered under a large flat rock. We immediately replaced the rock and did not collect either the eggs or the adult. We were not able to confirm the sex of this animal.

A previous collection trip to this same section of creek on 22 July 2002 yielded seven adult male and two adult female *C. alleganiensis*, none in reproductive condition.

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PLETHODON GLUTINOSUS (Northern Slimy Salamander). **REPRODUCTION**. Detailed life histories are known for only a few populations of the *Plethodon glutinosus* complex and include several reports of egg clutches and very few reports of new hatchlings (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Smithsonian Instit. Press, Washington, D.C. 587 pp.).

On 24 Oct 2002, we discovered a female *P. glutinosus* (72 mm SVL) attending a newly laid clutch of eggs in Pettijohn Cave in Dickson Gulf on the eastern side of Pigeon Mountain, Walker County, Georgia, USA. The clutch was located in a horizontal crevice in the limestone rock of the cave wall ca. 1.3 m above the cave floor. It was suspended by a pedicel from the roof of the crevice and consisted of 17 eggs, each measuring 6.0–6.1 mm in diameter. The clutch was ca. 12 m from the cave opening. The outside air temperature was 16.5°C; the temperature inside the cave was 13.0°C. We monitored the clutch through the winter, revisiting it on 14 Dec 2002, 21 Jan, 9 Feb, and 1 March 2003. On 14 Dec 2002 the pedicel was broken, and the eggs lay in a heap on the floor of the crevice. The loss of suspension did not seem to interfere with development or the female's attendance. The significance of the 12-m distance from cave opening became apparent on cold days during the winter. The clutch was located at a depth closest to the opening where the thermal environment was relatively stable.

On 2 March 2003, one egg had hatched. The hatchling measured 16.4 mm SVL and 19.7 mm total length. Its belly was extended with yolk, it had distinct gills, and skin pigment was poorly developed. Because *Plethodon* hatchlings resorb their gills within a few days of hatching (Highton 1956. Copeia 1956:75–93) and because the other eggs seemed healthy and unhatched, we presumed that the hatchling was < 24 h old. Therefore, the gestation period was 128+ days.

This represents the latest seasonal dates of oviposition and hatching for the complex and >1 month later than those reported from caves in northern Alabama (Highton 1962. Copeia 1962:597–613). These were also the largest eggs and the longest gestation period reported for the *P. glutinosus* complex (Petranka 1998, *op. cit.*).

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ANURA

BUFO PARIETALIS (Forest Toad). **PREDATION.** Although the toxic secretions of toads are repellent against many predators, there are numerous reports for predators of toads throughout the world (Haddad and Rogério 1997. Amphibia-Reptilia 18:295–298). The population ecology and the natural predators of amphibians in the forest ecosystems of India are poorly studied. *Bufo parietalis* is a rare and little-known toad, endemic to tropical rainforests of the Western Ghats (Molur and Sally 1998. Zoo's Print 13[12]:29). Since 1999, we have observed the natural history of *B. parietalis* as part of population studies. Herein, we report predation by an invertebrate (mosquito) and a vertebrate (bird) on males engaged in reproductive activity in Karnataka, South India.

On 22 Feb 2001, we observed large breeding populations of *Bufo parietalis* at two sites on the western slope of Western Ghats within the Bisale Reserve Forests (12°15'N; 75°37'E, 150 m elev.). At 1700 h we witnessed a large number of mosquitoes feeding on calling toads (59.8–73.5 mm SVL; N = 8). Mosquitoes were observed to suck blood mainly from the limbs rather than other body parts. The toads were disturbed by the bites and kicked the limbs sideways in an attempt to drive away the mosquitoes. As they kicked and rubbed the face they would stop calling. To get rid of the mosquitoes they also dove into the water and floated on the water with only the face above the surface. The toads surfaced when the mosquito flew from the body. The mosquitoes were identified as *Culex quinquefaciatus*. Although *Aedes aegypti* was found in the same habitat attacking humans, they were not found preying on the forest toads.

On 7 April 2000 at 0600 h, 360 m elevation, we observed a jungle crow (*Corvus macrorhynchos*), preying on an adult *Bufo parietalis* (69.8 mm SVL, 23.5 g) on a road that passes through the forest, thereby opening the canopy cover. The crow was observed to open the abdominal cavity and feed on the visceral contents. The skin and the limbs were not eaten. We also observed the crow prey on breeding adults by stepping on the hind limbs and pecking the eye and head from behind. During the late breeding season, adult male *B. parietalis* are found actively searching for the females. The risk of predation is increased as toads enter an open canopy area where they are more readily seen by crows.

Submitted by **SAVITHA KRISHNA** and **K. K. VIJAYALAXMI**, Department of Biosciences, University of Mysore P.G.C., Hemagangothri, Hassan, Karnataka 573220, India.

BUFO PELTOCEPHALUS (Cuban Toad). **DIURNAL RETREAT**. *Bufo peltocephalus* is a large Cuban toad that lives in most habitats in the central and eastern Cuban archipelago. Maximum female SVL is 163 mm (Schwartz and Henderson 1991. Amphibians and Reptiles of the West Indies. Descriptions, Distributions, and Natural History. Univ. Florida Press, Gainesville, 720 pp.). This toad diurnally retreats underground, protected by rocks, stones, palm leaves or other vegetation. It may excavate its own tunnels, or use the burrows of Burrowing Owls (*Athene cunicularia*) (Valdés 1978. Misc. Zool. 7:4; Schwartz and Henderson 1991, *op. cit.*). During the first hours of the night it emerges from the retreat to feed and mate.

From 12 to 17 May 2003, we studied the herpetofauna of Península de Zapata (Zapata Swamp), Matanzas Province, Cuba. During the nights of 12–13 May we observed a group of toads in the yard at the Cuban Ministry of Science, Technology, and Environment, between Pálpite and Playa Larga (22°19'02"N, 81°11'23'W). The habitat is a grassy lawn on a "diente de perro" limestone soil. Between 2105–2120 h the toads were emerging from the holes of the "diente de perro." This habitat is an unusual retreat for *B. peltocephalus* that has never been reported.

Herein we report a novel diurnal retreat for a Cuban bufonid and clarify its distributional status at one locality of Zapata Swamp. We thank Julio Guillermo Calvear for help during fieldwork. Special thanks for the staff of the office of the Cuban Ministry of Science, Technology, and Environment for logistic and scientific help.

Submitted by **VILMA RIVALTA GONZÁLEZ, LOURDES RODRÍGUEZ SCHETTINO, ADELA TORRES BARBOZA,** and **MERCEDES MARTÍNEZ REYES,** Departamento de Vertebrados, Instituto de Ecología y Sistemática, C. de Varona km 3.5, Boyeros, CP 10800, AP 8029, La Habana, Cuba (e-mail: zoologia.ies@ama.cu), and **JULIO LARRAMENDI JOA**, Calle 3ª #806, Playa, La Habana, Cuba (e-mail: jlarramendi@hotmail.com).

BUFO RUFUS (Rusty Toad). **DIET.** *Bufo rufus* ranges from Brazil (Goiás State and Minas Gerais State) to northeastern Argentina (Misiones) (Frost 1985. Amphibian Species of the World. Allen Press, Inc. and Assoc. Systematics Collections. Lawrence, Kansas. 732 pp.). Aspects of the trophic ecology of this species have been little investigated in natural populations from central Brazil. We analyzed the gastrointestinal contents of 12 specimens (males: 72.4 ± 8.92 mm SVL, N = 4; females: 89.62 ± 11.04 mm SVL, N = 8) collected during the Corumbá I Hydroelectric Power Plant reservoir formation (17°59'S, 48°31'W), Caldas Novas municipality, Goiás State, between Sept 1996 and April 1997. The diet of *B. rufus* was better represented numerically by Isoptera and volumetrically by Hymenoptera (Formicidae) (Table 1). The process of reservoir formation might have affected food resource availability and the local distribution of toads (Paiva 1999. Conservação da Fauna Brasileira. Ed. Interciência. Rio de Janeiro. 260 pp.).

TABLE 1. Prey consumed by *Bufo rufus* (N = 12) from Corumbá I Hydroelectric Power Plant reservoir, Brazil.

Items	N	% Total	Vol (mm^3)	% Vol.	Freq.
ARACHNIDA					
Araneae	1	0.19	42.28	0.15	1
Opiliones	1	0.19	595.97	2.21	1
Scorpiones	1	0.19	1138.98	4.23	1
INSECTA					
Coleoptera					
(Tenebrionidae)	4	0.76	483.30	1.79	4
Diptera	1	0.19	180.06	0.66	1
Hemiptera	1	0.19	124.19	0.46	1
Hymenoptera					
(Formicidae)	240	45.28	12697.15	47.20	6
Isoptera	270	51.52	8678.59	32.26	3
MIRYAPODA					
Diplopoda	1	0.19	2234.05	8.30	1
Chilopoda	1	0.19	465.35	1.72	1
MISCELLANEOUS					
Vegetable remains	2	0.38	190.80	0.70	2
UNIDENTIFIED					
MATERIAL	1	0.19	67.71	0.25	1
TOTAL	524	100	26899.43	100	

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HYLA ALBOPUNCTATA (Spotted Treefrog). **DIET.** *Hyla albopunctata* is distributed in central and southeastern Brazil, northeastern Argentina (Provincia Corrientes), and eastern Paraguay (Frost 1985. Amphibian Species of the World. Allen Press, Inc. and Assoc. Systematics Collections. Lawrence, Kansas. 732 pp.). Aspects of the trophic ecology of this species have been little investigated in natural populations from central Brazil. We analyzed the stomach contents of 21 specimens (males: 54.41 ± 2.16 mm SVL, N = 6; females: 61.63 ± 4.04 mm SVL, N = 15) collected during the Corumbá I Hydroelectric Power Plant reservoir formation (17°59'S, 48°31'W), Caldas Novas municipality, Goiás State, between September 1996 and April 1997. The analysis indicated that the most frequently taken prey items were Araneae (N = 5; 35.71%), Blattaria (N = 1; 7.14%), Chilopoda (N = 1; 7.14%), Orthoptera (N = 4; 28.57%), and unidentified material (N = 3; 21.42%).

The volume (in mm^3) of the items were Araneae (spiders) 982.13 (21.86%), Blattaria 469.57 (10.45%), Chilopoda 638.69 (14.22%), Orthoptera 2321.11 (51.67%), and unidentified material 79.92 (1.77%). Araneae, Blattaria, and Chilopoda were present in only one stomach, Orthoptera in three, and unidentified material in two. Sixteen stomachs were empty. The diet of the 21 *H. albopunctata* studied was dominated numerically by Araneae and volumetrically by Orthoptera.

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HYLA CINEREA (Green Treefrog). **PREDATION.** McCormick and Polis (1982. Biol. Rev. 57:29–58) reported that the Okefenokee Fishing Spider, *Dolomedes okefinokensis* (Araneae, Pisauridae) preys upon treefrogs, but no particular species of treefrog was listed in their review. During an inventory of amphibians and reptiles in Big Cypress National Preserve, Collier County, Florida, USA, we observed *D. okefinokensis* preying on *Hyla cinerea* on two occasions.

On 15 March 2002 at 2330 h, a 40 mm (body length) *D. okefinokensis* was discovered with a 35 mm SVL *H. cinerea* in its chelicerae 50 cm above the 70 cm deep water on the stem of a bald cypress (*Taxodium distichum*). The skin of the treefrog had become transparent and the muscle was visible. On 4 Dec 2002 at 1950 h, a second *D. okefinokensis* was observed preying upon *H. cinerea*. This pair was found on a bald cypress buttress 35 cm above the water, and both the *H. cinerea* (SVL) and the *D. okefinokensis* (body length) were estimated to be 40 mm (Fig. 1).

Fig. 1. Photograph of *Hyla cinerea* held by the chelicerae of *Dolomedes okefinokensis*.

The pair was observed intermittently for 1.5 h, during which the *H. cinerea* lost some green pigmentation and started to become transparent. The *H. cinerea* continued to struggle for the entire 1.5 h. Both of these predation events were observed in flooded cypress domes (Myers and Ewel 1990. Ecosystems of Florida. Univ. Central Florida Press, Orlando, 765 pp.) with a long hydroperiod (ca. 9 months).

Submitted by **BRIAN M. JEFFERY**, **J. HARDIN WADDLE**, and **ANDREW J. MASKELL**, University of Florida, Big Cypress National Preserve, 33100 Tamiami Trail, Ochopee, Florida 34141, USA (e-mail [JHW]: hardin_waddle@usgs.gov).

HYLA CREPITANS (Emerald-eyed Treefrog). **DIET.** *Hyla crepitans* is distributed in central and northeastern Brazil, Guianas, northern Colombia and Venezuela, eastern Panama, and northern Honduras (Frost 1985. Amphibian Species of the World. Allen

Table 1. Prey consumed by *Hyla crepitans* (N = 20) from Corumbá I Hydroelectric Power Plant reservoir, Brazil.

Items	N	% Total	Vol (mm^3)	% Vol.	Freq.
ARACHNIDA					
Araneae	9	23.07	717.47	13.49	3
INSECTA					
Blattaria	1	2.56	179.94	3.38	1
Coleoptera	15	38.46	1459.34	27.44	7
Dermaptera	2	5.12	464.78	8.74	1
Diptera	1	2.56	—	—	1
Hemiptera	1	2.56	620.80	11.67	1
Hymenoptera (Vespidae)	1	2.56	137.96	2.59	1
Lepidoptera	2	5.12	476.12	8.95	1
Orthoptera	4	10.25	1261.39	23.72	4
MISCELLANEOUS					
Vegetable remains	2	5.12	—	—	2
UNIDENTIFIED MATERIAL	1	2.56	—	—	1
TOTAL	39	100	5317.80	100	

Press, Inc. and Assoc. Systematics Collections. Lawrence, Kansas. 732 pp.). Aspects of the trophic ecology of this species have been little investigated in natural populations from central Brazil. Herein we report the gastrointestinal contents of 20 specimens (males: 58.86 ± 1.75 mm SVL, N = 8; females: 58.8 ± 2.58 mm SVL, N = 12) collected during the Corumbá I Hydroelectric Power Plant reservoir formation (17°59'S, 48°31'W), Caldas Novas municipality, Goiás State, from September 1996 to April 1997. We were unable to determine % volume in some prey items. The diet of the 20 *H. crepitans* studied was better represented numerically and volumetrically by Coleoptera (Table 1).

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HYLA FABER (Smith Frog). **DIET.** During fieldwork on the *Araucaria* Plateau of Rio Grande do Sul, southern Brazil, various leptodactylid species were collected and stomach-flushed using the methodology described by Patto (1998. Herpetol. Rev. 29:156–157). On 27 Dec 2001 a male *Hyla faber* (95.3 mm SVL, 54.33 g), was observed within a pond near the Pró-Mata research station (29°30'S, 50°10'W) by M. Wittmann. As this specimen seemed to be unusually fat for a calling hylid male it was collected and stomach-flushed. A single adult male *Scinax granulatus* (36.2 mm SVL), one of the most common frogs of that region, was found in the stomach. The flushing of another male *H. faber* (87 mm SVL, 55.46 g), captured on 16 Nov 02 at 2300 h by BP near the Pró-Mata reserve, yielded insects and the fragments of an anuran leg (tibia and femur). On 5 Dec 2002 at 2200 h, a male *H. faber* (95.9 mm SVL, 66.36 g) caught on the border of an *Araucaria* forest near a small pool within the Pró-Mata reserve by MS contained an adult partly digested *Aplastodiscus perviridis*. Most hylids do not feed during the time they spend at the reproduction sites, but little is known about the diet of *H. faber*. To our knowledge this is the first report of anurophagy for this species.

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HYLA RANICEPS (Chaco Treefrog). **DIET.** *Hyla raniceps* has a distribution in French Guiana, Brazil, Paraguay, northern Argentina and eastern Bolivia (Frost 1985. Amphibian Species of the World. Allen Press, Inc. and Assoc. Systematics Collections. Lawrence, Kansas. 732 pp.). Ecological data for this species are scarce (Lutz 1973. Brazilian Species of *Hyla*. Univ. Texas Press, Austin and London, 260 pp.; Guimarães et al. 2001. Herpetol. Rev. 32:102; Peltzer and Lajmanovich 2001. Herpetol. Rev. 32:247–248) and the diet has been little investigated in populations from central Brazil. Twenty-five specimens (males: 67.01 ± 5.43 mm SVL, N = 17; females: 69.15 ± 7.37 mm SVL, N = 8) collected during the Corumbá I Hydroelectric Power Plant reservoir formation (17°59'S, 48°31'W), Caldas Novas municipality, Goiás State, between Sept 1996 and April 1997, had their gastrointestinal contents analyzed. Volume was not determined for prey classified as unidentified material. The diet of the 25 *H. raniceps* studied was better represented numerically and volumetrically by Orthoptera (Table 1).

TABLE 1. Prey consumed by *Hyla raniceps* (N = 25) from Corumbá I Hydroelectric Power Plant reservoir, Brazil.

Items	N	% Total	Vol (mm^3)	% Vol.	Freq.
ARACHNIDA					
Araneae	2	3.77	252.06	4.46	2
Araneae (Mygalomorphae)	1	1.88	537.15	9.51	1
INSECTA					
Blattaria	3	5.66	197.42	3.49	1
Coleoptera	4	7.54	550.05	9.73	3
Hemiptera	7	13.20	217.99	3.85	4
Hymenoptera (Apidae)	1	1.88	202.03	3.57	7
Hymenoptera (Formicidae)	7	13.20	168.08	2.97	7
Larva	1	1.88	228.22	4.04	1
Orthoptera	14	26.41	2874.33	50.88	11
MOLLUSCA					
Gastropoda	1	1.88	344.04	6.09	1
MISCELLANEOUS					
Vegetable remains	10	18.86	76.87	1.36	9
UNIDENTIFIED MATERIAL	2	3.77	—	—	2
TOTAL	53	100	5648.24	100	

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LEPTODACTYLUS OCELLATUS (Rã-Manteiga). **DIET.** *Leptodactylus ocellatus* is found in many parts of Brazil. Its diet includes arthropods (Vaz-Ferreira and Gehrau 1975. Physis 34:1–14; Strussman et al. 1984. J. Herpetol. 18:138–146) and vertebrates (Haddad and Sazima 1991. Anfíbios Anuros da Serra do Japi, pp. 188–211). During the night of 11 Dec 2002, we collected an adult male *L. ocellatus* (105.9 mm SVL; Museu de Biodiversidade do Cerrado, UFU 2415) near a lake in Uberlândia municipality. Examination of the stomach contents revealed the skink *Mabuya*

dorsivittata (61.5 mm SVL; UFU 1204). The consumption of a heliothermal terrestrial lizard indicates that *L. ocellatus* forages during the day.

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PHRYNOHYAS VENULOSA (Milky Treefrog) **DIET.** *Phrynohyas venulosa* is broadly distributed in Latin America, ranging from México to Argentina (Frost 1985. Amphibian Species of the World. Allen Press, Inc. and Assoc. Systematics Collections. Lawrence, Kansas. 732 pp.). Aspects of trophic ecology of this species have been little investigated in populations from central Brazil. We analyzed the gastrointestinal contents of 20 specimens (males: 67.2 ± 19.91 mm SVL, N = 14; females: 84.13 ± 13.05 mm SVL, N = 6) collected during the Corumbá I Hydroelectric Power Plant reservoir formation (17°59'S, 48°31'W), Caldas Novas municipality, Goiás State, from September 1996 to April 1997. We were unable to determine % volume in some prey items. The diet of the 20 *P. venulosa* studied was better represented numerically by Hymenoptera (Formicidae) and volumetrically by Coleoptera (Tenebrionidae) (Table 1).

TABLE 1. Prey consumed by *Phrynohyas venulosa* (N = 20) from Corumbá I Hydroelectric Power Plant reservoir, Brazil.

Items	N	% Total	Vol (mm³)	% Vol.	Freq.
ARACHNIDA					
Araneae	1	4.54	10.67	19.37	1
INSECTA					
Blattaria	1	4.54	—	—	1
Coleoptera (Tenebrionidae)	4	18.18	28.90	52.46	4
Hemiptera	1	4.54	—	—	1
Hymenoptera (Formicidae)	9	40.90	15.51	28.15	5
MISCELLANEOUS					
Vegetable remains	6	27.27	—	—	6
TOTAL	22	100	55.08	100	

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PHYLLOMEDUSA HYPOCONDRIALIS (Orange-legged Monkey Frog). **DIET.** *Phyllomedusa hypocondrialis* has a distribution in South America east of the Andes from Bolívia, Colombia, and the Guianas southward to Argentina, Paraguay, and southeastern Brazil (Frost 1985. Amphibian Species of the World. Allen Press, Inc. and Assoc. Systematics Collections. Lawrence, Kansas. 732 pp.). Some aspects of ecology of this species were discussed by Cei (1980. Amphibians of Argentina. Monitore Zoologico Italiano [NS]. Monogr. 2, 609 pp.) and Dure (1999. Herpetol. Rev. 30:92), but the diet has been little investigated in populations from Central Brazil. Twenty-five specimens (males: 32.16 ± 4.09 mm SVL, N = 10; females: 38.24 ± 3.14 mm SVL, N = 15) collected during the Corumbá I Hydroelectric Power Plant reservoir formation (17°59'S, 48°31'W), Caldas Novas municipality, Goiás State, between September 1996 and April 1997, had their gastrointestinal contents analyzed. Volume was not determined for prey classified as miscellaneous or unidentified material. The diet of the 25 *P. hypocondrialis* studied was better represented numerically by Hemiptera and volumetrically by Blattaria (Table 1).

TABLE 1. Prey consumed by *Phyllomedusa hypocondrialis* (N = 25) from Corumbá I Hydroelectric Power Plant reservoir, Brazil.

Items	N	% Total	Vol (mm³)	% Vol.	Freq.
ARACHNIDA					
Araneae	4	9.30	63.66	4.68	3
INSECTA					
Blattaria	8	18.60	927.04	68.29	5
Coleoptera	1	2.32	20.46	1.50	1
Diptera	2	4.65	15.02	1.10	2
Hemiptera	9	20.93	144.09	10.61	7
Hymenoptera (Formicidae)	8	18.60	36.75	2.70	5
Larva	1	2.32	42.91	3.16	1
Orthoptera	5	11.62	107.52	7.92	4
MISCELLANEOUS					
Vegetable remains	2	4.65	—	—	2
UNIDENTIFIED MATERIAL	3	6.97	—	—	3
TOTAL	43	100	1357.45	100	

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PHYSALAEMUS NATTERERI (NCN). **ATTEMPTED PREDATION.** Many species of frogs have skin toxins that have an antipredatory function. *Physalaemus* species are known to have physalaemins in the skin, which act as a hypotensive and stimulate smooth muscles in vertebrates (Erspamer et al. 1964. Experimentia XX/9:489–490). *Physalaemus nattereri* experimen-

tally offered to *Nasua nasua* (Mammalia: Carnivora) produced poisoning and inhibited predation (Sazima and Caramaschi 1986. Rev. Biol. 13:91–101). Here we report field observations of two unsuccessful attempts at predation on *P. nattereri* by *Leptodactylus ocellatus*. Observations were made during the night at a pond where both frogs reproduce, in the municipality of Uberlândia (Minas Gerais, Brazil), between November and December 2002. On the first occasion, we saw an adult male *L. ocellatus* (80 mm SVL) swim toward a calling male *P. nattereri* (41 mm SVL) and capture him by the head. The predator swam back to the pond margin and tried to swallow the prey. While swallowing, the predator pushed at the prey with its hands. While being swallowed the prey remained motionless. The predator took 70 minutes to complete swallowing. After swallowing was completed, the predator was collected and placed in a plastic bag. After one minute in the bag the predator started to regurgitate the prey. When about half of its body was out of the predator's mouth, the prey started to struggle energetically until it became free. After the prey was released the predator started to repeatedly open and close its mouth and wipe it with its hands.

On a second occasion, we found an adult *L. ocellatus* with an adult *P. nattereri* already in its mouth, the prey being swallowed headfirst. Again the prey was motionless while being ingested. This time the predation attempt was aborted when the first half of the body of the prey was in the mouth of the predator. Remaining still while being swallowed may be an important strategy of *P. nattereri* to avoid injuries while in the predator's mouth. We believe that in both cases the abortion of the predation attempt was because of the action of skin toxins of *P. nattereri*.

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***PLEURODEMA BUFONINUM* (NCN) and *BUFO SPINULOSUS PAPILLOSUS* (NCN). PREDATION.** Spider predation of anurans has been frequently documented (Formanowicz 1984. Anim. Behav. 32:774–781; Mitchell 1990. Herpetol. Rev. 21:89–90; McLister and Lamond 1991. Can. Field-Nat. 105:574–575; Johnson 1996. Herpetol. Rev. 27:140; Rogers 1996. Herpetol. Rev. 27:75; Blackburn et al. 2002. Herpetol. Rev. 33:299; Griffin and Case 2002. Herpetol. Rev. 33:301). Herein we report the first account on predation of the wolf spider, *Trochosa albopunctata* (Lycosidae) on *Pleurodema bufoninum* (Leptodactylidae) and *Bufo spinulosus papillosus* (Bufonidae) tadpoles. During stream and ponds surveys on 29 Nov 2002, we searched for potential predators of *Pleurodema bufoninum* and *Bufo spinulosus papillosus* tadpoles. Four specimens of the wolf spider *Trochosa albopunctata* were captured along the edge of the Ñireco River (41°10' 52.3"S, 71°19'13.6"W), 906 m elev., 3 km NW San Carlos de Bariloche City, Río Negro Province, Argentina, and 3 km SW National Route 258. To determine if wolf spiders are potential predators of *Pleurodema* and *Bufo* tadpoles we established four adult spiders (mean = 10.6 mm body length; SE = 0.44) in the laboratory in four separate aquariums. The specimens were acclimated during 24 h and after this period, 3 tadpoles of each one of the anurans were offered to the spiders. A total of 48 tadpoles were offered to the spiders (*Bufo* N = 24, mean = 18.1 mm total length, SE = 0.59; *Pleurodema*, N = 24, mean = 21.6 mm total length, SE = 1.7). Tadpoles were replaced each time they were eaten by the spiders.

In the first 24 h each spider built a web and did not feed. After 48 h all spiders preyed upon *Pleurodema* and *Bufo* tadpoles. The spiders ate only one tadpole each day except one spider ate 3 tadpoles during a single day. Detailed observations of feeding were recorded in only one spider. We observed that the tadpole was anaesthetized by the spider, wrapped in the web, and later fed upon. After finishing feeding, skin remains of the tadpole were present in the spider web. To corroborate this observation, we conducted a field survey for spider webs containing tadpole rests. On 25 Jan 2003 on the Ñireco River foodplain eight spider webs were observed and three of them contained tadpole skin remains, presumably belonging to *P. bufoninum*.

Bufo spinulosus papillosus and *Pleurodema bufoninum* breed in a wide range of freshwater habitats across northern to southwestern Patagonia (Cei 1980. Monit. Zool. Ital. [NS] Monogr. 2: XII. 609 pp.). Tadpoles of these species are preyed upon by several groups of aquatic insects (dragonflies, damselflies, dytiscid larvae, hemipterans), and fish. However, the relative importance of wolf spiders as predators of *B. spinulosus papillosus* and *P. bufoninum* tadpoles remains unclear. We thank P. Goloboff for identifying the spiders.

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***RANA AURORA AURORA* (Northern Red-legged Frog). ENDOPARASITES.** *Rana aurora* occurs from southwest British Columbia to northwest Baja California (Stebbins 2003. A Field Guide to Western Reptiles and Amphibians. 3rd Ed., Houghton Mifflin Co., Boston, Massachusetts. 533 pp). The helminths of *R. aurora* from California are listed in Goldberg and Bursey (2002. Bull. So. Calif. Sci. 101:118–130). The purpose of this note is to report the presence of three helminth species in tadpoles of *R. a. aurora* from northern California. Fifteen *R. a. aurora* tadpoles were examined: one from Del Norte County (collected June 2002) and fourteen from Humboldt County (two collected June 2001 and twelve collected June 2002). The tadpoles were fixed in 10% formalin then preserved in 70% ethanol. The abdominal cavity was opened, the gastrointestinal tract removed, slit longitudinally and examined under a dissecting microscope. Helminths were removed to a drop of undiluted glycerol for identification. Digeneans were regressively stained in Mayer's hematoxylin and studied as wholemounts.

Found in the intestines were one species each of Digenea, *Megalodiscus microphagus*, Nematoda, *Gyrinicola batrachiensis*, and Acanthocephala, *Neoechinorhynchus rutili*. Helminths were

placed in vials of 70% ethanol and deposited in the United States National Parasite Museum (USNPC), Beltsville, Maryland as *Megalodiscus microphagus* (93429–30), *Gyrinicola batrachiensis* (93431), *Neoechinorhynchus rutili* (93432); tadpoles were deposited in the herpetology collection of the Natural History Museum of Los Angeles County as LACM 155028–35. Prevalence of infection (number infected tadpoles/number tadpoles examined) x 100 and mean intensity of infection (mean number of infected individuals) ± 1 SD and range were: *M. microphagus* (33%, 17.6 ± 27.3 SD, 1–65); *G. batrachiensis* (53%, 9.3 ± 7.1 SD, 2–22); *N. rutili* (7%, 2).

Megalodiscus microphagus was described originally from *Bufo boreas* from northern California by Ingles (1936. Trans. Amer. Microsc. Soc. 55:73–92) and has been reported in *R. aurora* from Oregon (Macy 1960. J. Parasitol. 48:662) and British Columbia, Canada (Efford and Tsumura 1969. Amer. Midl. Nat. 82:197–203). Our record is the first report of *M. microphagus* in *R. aurora* from California.

Gyrinicola batrachiensis is known from a variety of anurans (bufonids, hylids, ranids) from eastern North America (Baker 1987. Mem. Univ. Newfoundland, Occas. Pap. Biol. 11:1–325). It apparently only occurs in tadpoles (Adamson 1981. Can. J. Zool. 59:1368–1376). *Rana aurora* represents a new host record for *G. batrachiensis*. California is a new locality record.

Neoechinorhynchus rutili has been reported from numerous fish species of the northern hemisphere (Van Cleave and Lynch 1950. Trans. Am. Microsc. Soc. 69:156–171). It is also known from *Rana esculenta* in Europe (Walton 1942. Contrib. Biol. Lab. Knox College 79:1–16) and *R. catesbeiana* from Canada (McAlpine and Burt 1998. Can. Field-Nat. 112:50–68). *Rana aurora* represents a new host record for *N. rutili*. California is a new locality record.

Tadpoles were collected under scientific collecting permit 803031-05 issued by the California Department of Fish and Game.

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RANA AURORA DRAYTONII (California Red-legged Frog). **MICROHABITAT**. Little has been reported on microhabitat use by California red-legged frogs (*Rana aurora draytonii*). Cook (1997. MS Thesis, Sonoma State Univ., 23 pp.) investigated the utilization of microhabitats within marshes. Use of upland and other non-aquatic habitats have been reported by others (USFWS 2003. Recovery Plan for the California Red-legged Frog; Rathbun et al. 1997. Herpetol. Rev. 38:85–86). Here I report the use of an atypical, non-aquatic microhabitat by *R. a. draytonii*.

Five annual surveys were conducted between 1998 and 2002 on 90 managed ponds in the upper Kellogg Creek Watershed, Contra Costa County, California. Ponds were surveyed throughout the year or until they dried during the summer months. During surveys conducted from 1998 to 2002, *R. a. draytonii* were observed utilizing all 90 ponds.

In September 2000, I walked across the bottom of a dry pond. The pond had been dry (no surface water) since the previous survey 4 weeks earlier. Pond bottom substrate consisted of a silt/clay mix that was completely dry, leaving deep (>50 cm) desiccation cracks. While walking across this pond bottom, a single adult *R. a. draytonii* was observed within a deep crack in the dry pond (Fig. 1). The frog was resting at the bottom of the crack facing skyward. Closer investigation revealed apparent soil moisture in the deepest reaches of the cracks. In October 2000, 7 adult and 22 subadult *R. a. draytonii* were observed using similar cracks in two other ponds. There was no apparent standing water, and the ponds were otherwise considered dry. During pond surveys throughout 2001 and 2002, five additional dry ponds were found in which frogs were utilizing cracks several weeks after all surface water was gone. Frogs were found deep (>30 cm) within desiccation cracks where soil moisture was still apparent.

Many authors have reported the ability of amphibians to obtain moisture from damp soil (e.g., Stebbins 1945. Copeia 1945:25–28). These *R. a. draytonii* might also be avoiding predation, direct solar exposure, and evaporative water loss by remaining below the surface. The utilization of this microhabitat might enable this species to remain in the area of the pond until more favorable conditions exist for movement (i.e., rain events, higher humidity).

Observations of *R. a. draytonii* using this type of microhabitat are significant for several reasons: this species is federally listed as threatened by the U. S. Fish and Wildlife Service; *R. a. draytonii* occurs in areas where its aquatic habitat is often ephemeral; and lands upon which the species occurs might be managed and its aquatic habitat might be altered through dredging.

In the course of conducting U.S. Fish and Wildlife protocol-level surveys, observers should not assume that a recently dried pond signifies the absence of this species from the site. The importance of documenting the presence of this frog is vital to understanding the range of the species and in promoting the recovery of *R. a. draytonii.* In some cases, searching the deep cracks of recently dried ponds might reveal the presence of this frog.

Stock ponds, where this species might occur, are often dredged to remove built-up silt loads (pers. obs.). Typically, dredging oc-

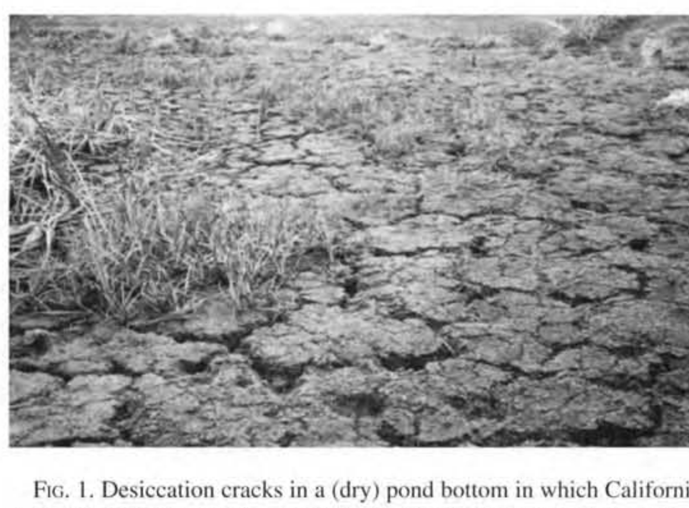

FIG. 1. Desiccation cracks in a (dry) pond bottom in which California red-legged frogs were observed utilizing as refugia in east Contra Costa County California.

curs after ponds have dried, following the assumption that frogs have retreated from the site. This practice might result in a high level of mortality to an already threatened species.

I recommend that biologists conducting surveys for *R. a. draytonii*, and land managers who may be dredging "dry" ponds, consider the use of this microhabitat by *R. a. draytonii.* Further, searching this microhabitat should be a part of investigations where there is a potential for the occurrence of *R. a. draytonii.*

I thank Andrea F. Zuur, Jennifer L. Alvarez, and the Contra Costa Water District for support and assistance with this investigation.

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RANA AURORA DRAYTONII (California Red-legged Frog). **PREDATION**. Herein we report on predation of California Red-legged Frogs observed during the course of a radio-telemetry study at Point Reyes National Seashore, Marin County, California, USA.

Rana aurora draytonii is federally listed as a threatened species; hence, there is considerable interest in learning more about its ecology and life history. During January 2000, we had 19 *R. aurora* outfitted with radiotransmitters (Rathbun and Murphey 1996. Herpetol. Rev. 27:187–189). Two of these frogs were captured at a breeding pond on 12 Jan 2000, fitted with a transmitter, PIT tagged, and released at the capture site. On 14 Jan, both frogs were still present in the pond. On 18 Jan, we attempted to relocate the frogs and found that the signal was originating 400 m north of the pond, along a small, unnamed tributary to Olema Creek. As we approached the creek, a great blue heron (*Ardea herodias*) took flight. We noticed that the transmitter signal immediately changed, and after switching the receiver to the second frequency, confirmed that both transmitters were inside the heron.

The transmitters continued to function, and we were able to radio-track the heron for three days. During that time, the heron spent most of its time within 2 km of the breeding pond. On 24 Jan, we recovered both transmitters in a California blackberry (*Rubus ursinus*) thicket below a dead red alder (*Alnus rubra*) snag along Olema Creek, 1200 m from the pond.

The *R. aurora* were both adult males (6.5 cm SVL and 33.7 g; 7.4 cm SVL and 41.7 g). Because we did not observe the predation event, it is not possible to determine the time of day that the frogs were eaten. Normally, *R. aurora* are nocturnal, but it is not unusual to find a few *R. aurora* floating at the water surface or sitting on the bank during the middle of the day (pers. obs.).

There are no published reports of herons or other waterbirds feeding on adult red-legged frogs. The Recovery Plan for the California Red-legged Frog (*Rana aurora draytonii*) (U.S. Fish and Wildlife Service. 2002. Portland, Oregon) discusses predation, but it focuses on non-native predators such as fish and bullfrogs (*Rana catesbeiana*). The plan mentions Raccoons (*Procyon lotor*), Great Blue Herons, American Bitterns (*Botaurus lentiginosus*), Black-crowned Night Herons (*Nycticorax nycticorax*), Red-shouldered Hawks (*Buteo lineatus*), and garter snakes (*Thamnophis* spp.) as predators on adult *R. aurora*, but only the hawk predation is supported by a published report (Rathbun and Murphey, *op. cit.*).

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RANA CAPITO (Florida Gopher Frog). **DEFENSIVE BEHAVIOR**. About 2100 h on 17 July 1970 I collected a small (60 mm SVL) gopher frog (*Rana capito*) in southern Leon County, Florida, USA. The frog, sitting in the mouth of a gopher tortoise burrow, immediately became rigid, bent its head downward while arching its back, and placed its hands up over its closed eyes, palms up. I could hold the rigid frog in my hand and flip it like a coin without causing it to abandon its rigid posture. More recently (1996–2003), I observed this same behavior on numerous occasions while handling *Rana capito* at a drift fence encircling a temporary pond in southern Leon County, Florida. Then, between 7 Feb and 4 March 2003, every one of 14 immigrating frogs displayed this behavior to varying degrees when I scratched its head with my fingernail.

The behavior described herein is similar to the "unken reflex" reported in *Boophis albilabris* (Andreone 2003. Herpetol. Rev. 33:300–301), but differs in some respects. In *R. capito* (Fig. 1), just the hands are raised over the head, the back is flexed upwards rather than downwards, and the head is bent down. No bright coloration is exposed nor is a release call or other sound emitted while individuals displayed this behavior. A bitter-tasting, frothy secretion possessing a musty smell was produced when the skin of the back or head was rubbed. The eye-covering behavior, musty smell, and bitter taste or tingling of the human tongue has been noted in wild caught specimens throughout the range of the species from southern Alabama, panhandle Florida, central Florida, Georgia, and North Carolina (Mark Bailey, Paul Moler, Richard Franz, John Jensen, Alvin Braswell, pers. comm.).

The unken reflex has not been reported for any species in the family Ranidae and no warning coloration or sounds are involved so the behavior described here may not be aposematic and might have evolved independently in *R. capito* for a specific purpose.

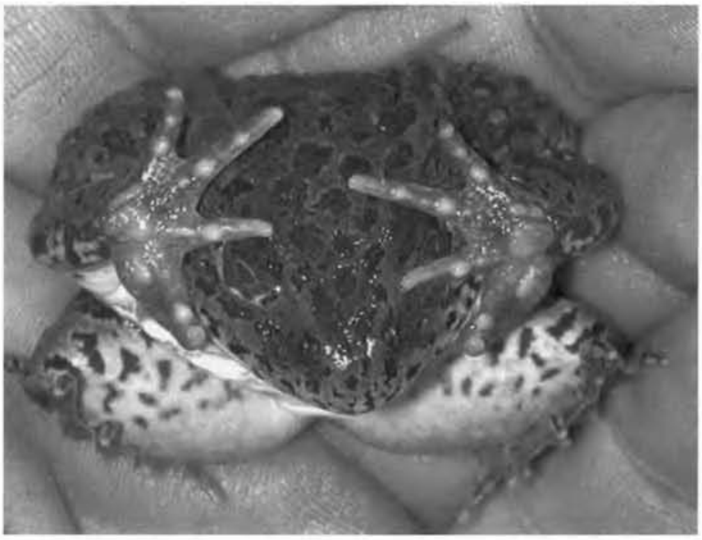

FIG. 1. Adult male *Rana capito* exhibiting "hands-up" defensive behavior. The body was so rigid that the frog could be held in an upright sitting position. Photographed in the field in southern Leon County, Florida.

One such purpose was suggested by observations made during the filming of a Gopher Frog in the presence of the Gopher Tortoise, *Gopherus polyphemus*, in an artificial burrow. I noticed that the frog, partially buried in sand, exhibited its "hands up," rigid-body posture when the much larger tortoise crawled over it at the bottom of the burrow. I was able to elicit the behavior by slapping the dorsum of a Gopher Frog, scratching its head with my fingernail, or pressing down on a frog's body with my hand. One function of this behavior might be to protect the Gopher Frog's eyes and dorsum from abrasion and sharp toenails.

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CROCODYLIA

ALLIGATOR MISSISSIPPIENSIS (American Alligator). **HOMING AND SITE FIDELITY**. Since the passage of the Lacey Act Amendment in 1969 and the Endangered Species Act in 1973, American alligator populations in Florida have increased substantially (Mazzotti and Brandt 1994. *In* Davis and Ogden, [eds.], Everglades: The Ecosystem and Its Restoration, pp. 485–505. St. Lucie Press, Delray Beach, Florida). Simultaneously, human populations and waterfront development have increased, leading to greater conflict between humans and alligators (e.g., Conover and Dubow 1997. Herpetol. Rev. 28:120–124). Several management options exist for resolving potential human-alligator conflicts, one of which is alligator translocation (e.g., Hines and Woodward 1980. Wildl. Soc. Bull. 8:234-241). However, homing by translocated alligators could negate the purpose of this management action. Juvenile alligators have been observed to home directly toward their origination site when displaced up to 10 home range diameters away, unless a major habitat barrier separated an alligator from its home site (Rodda 1984. Behav. Ecol. Sociobio. 14:241-246). Here, we augment the few data on homing following translocations with the report of an adult *A. mississippiensis* from southeastern Florida.

On 30 April 1998, we translocated an adult (2.2 m) female *A. mississipiensis* ca. 3.3 km straight-line distance from a pool on the North Fork of the Loxahatchee River (3-5 m average width) in Jonathan Dickinson State Park (JDSP; Florida) to a lake in the southwest corner of the park. The alligator was a breeding female and its pool was adjacent to human traffic, with harassing intrusions by humans being commonplace. The decision to move the alligator was based on human health and safety concerns, because she would aggressively defend her young from such (unlawful) intrusions. As required by Florida statutes, the capture and translocation of an alligator of this size was conducted by a nuisance alligator trapper (the senior author [JWW] herein) licensed by the Florida Fish and Wildlife Conservation Commission (license no. ATL 3725).

No direct waterways existed connecting the origination and relocation sites. Intervening habitat was comprised of a mix of pine-flatwoods, scrubby-flatwoods, and sand pine scrub. Eight days after translocation, the alligator was opportunistically observed in the same pool from which it had been moved. As the site of origin was not specifically monitored for the female's return, the 8 days is an upper bound on return time. Distinctive scars on its back, a missing right eye, and its size unmistakably identified this female, making it impossible to confuse with other individuals. The alligator remains in the same pool at this writing, and continues to breed annually.

The distance traveled by this alligator was not as remarkable as its ability to traverse the intervening terrain, and its ability to locate the same small pool from which it was removed. We were unable to discern the route of this animal's return to its site of origin. A water-based route would have required the female to "hopscotch" between small wet areas. However, Rodda (1984. Behav. Ecol. Sociobio. 14:241–246) observed juvenile alligators to chose direct routes towards their sites of origin, even when much easier indirect routes were available, supporting the hypothesis that alligators possess a directed navigational ability. Thus, given that no major topographic obstacles existed between the sites of origin and translocation, and the short span of time for this alligator to return, a direct return would seem logical. From a management perspective, translocation of alligators might not be successful unless a barrier to movement exists between the point of origin and translocation sites. Even if a barrier does exist, the intervening habitat near the translocation site should be evaluated to reduce the likelihood that an attempted return would place the animal in a position of conflict with humans, such as in a residential area. Hines and Woodward (1980. Wildl. Soc. Bull. 8:234–241) believed relocation to be the least economical and effective management approach for handling nuisance alligators. It might be warranted for select cases, but seems contraindicated as a general management tool.

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LACERTILIA

AGAMA AGAMA (Red-headed Rock Agama). **NOCTURNAL ACTIVITY**. The broadly distributed anthropophilic African agamid *A. agama* is uniformly described as diurnal (Caxton-Martins and Nganwuchu 1978. J. Anat. 125:477–480; Spawls et al. 2002. A Field Guide to the Reptiles of East Africa. Academic Press, Natural World. 543 pp.). Harris (1964. The Life of the Rainbow Lizard. London, Hutchinson Tropical Monographs. 174 pp.) reported that the lizard's activity starts at sunrise and ends soon after sundown in Nigeria; the earliest activity time Harris reported was 0650 h. According to Ekundayo and Otusanya (1969. Niger. Fld. 34:83–90), activity at Lagos, Nigeria is maximal between 1000 and 1100 h, and is also high around 1800 h. Halstead (1970. Niger. Fld. 35:86–89) reported from Ife, Nigeria that activity starts, depending on the weather, between 0730 and 0830 h; between 1800 and 1900 h, they sluggishly retreat to rest. Here, we report activity in *A. agama* in the city of Mouila, Douya-Onoy Department, Ngounie Province, Gabon that is distinctly different from previ-

ous reports in being nocturnal.

On 15 November 2001, one of us (OSGP) noted a nocturnal activity by *A. agama* in the Quartier Dikongo near the Carrefour Barbier in the city of Mouila (01°52'07''S, 11°02'59''E; elev. 90 m). A group of 8 subadults (SVL ca. 70 mm) and adults (SVL ca. 110 mm) were observed from 2000 to 2300 h foraging for insects around the neon lights on an inhabited house. In this habitat, they were syntopic with 4 *Hemidactylus mabouia* (voucher specimen IRSNB 16211). The inhabitants of the house told us that these *A. agama* are active around the lamps year-round between dusk and 2330 h. We collected one (IRSNB 16210; subadult female; SVL 67 mm; 69 midbody scale rows) at 2300 h, when locals indicate that they are easiest to catch because they retire around that time. Its stomach was full of insects, mainly Coleoptera (Carabidae and Staphylinidae), Homoptera, Hymenoptera (Formicidae), and Lepidoptera. We observed night-active *A. agama* the same evening on 3 other lighted houses in the neighborhood.

These agamids were seen actively preying on insects, but they might also occasionally prey on *H. mabouia*. Gramentz (1999. Salamandra 35:193–208) reported a case of predation by *A. agama* on *Hemidactylus brookii*, but it occurred during the day. Why *A. agama* has not developed such a nocturnal activity around lamps in other and larger cities in Gabon like Libreville remains a mystery.

These observations were made as part of WWF Ecoregion Program-sponsored field surveys. We thank E. Mamfoumbi Kombila and M. Mpami (Direction de la Faune et de la Chasse, Libreville) for research and collecting permits, and J. Mayombo, R. Mikala-Mussavu and A. Pepy Boutolini (WWF-CARPO) for their kind help in the field. We are grateful to G. Lenglet and G. Coulon (Institut Royal des Sciences Naturelles de Belgique - IRSNB, Brussels) for processing our voucher specimens.

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AMPHISBAENA DARWINII TRACHURA (Worm Lizard). **ALBINISM**. An adult male *Amphisbaena darwinii trachura* showing partial albinism (Prüst 1984. Litt. Serp. 4:6–15) was collected by M.A.A. da Silva on 11 Oct 1992 in the municipality of Cidreira (30°11'S, 50°12'W), on the coastal plain of Rio Grande do Sul State, southern Brazil. This is the first report of albinism in this species, and is to our knowledge the only reported incidence of albinism in amphisbaenids. The specimen, deposited in the herpetological collection of the Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul (MCP 4805), measures 271 mm SVL, and presents no other abnormalities in morphological, meristic, or morphometric data. When alive, its dorsal coloration was entirely white with a pinkish tinge, except for the markedly dark eyes, and scattered melanistic marks (Fig. 1). The belly was immaculate white. This report reinforces the prediction of Sazima and Di-Bernardo (1991. Mem. Inst. Butantan 53:167–173) who suggested, with regard to snakes, that additional instances

FIG. 1. Albino *Amphisbaena darwinii trachura* (MCP 4805), from Rio Grande do Sul, southern Brazil.

of albinism will probably continue to be found mainly among species with nocturnal or cryptozoic habits, or those otherwise protected against visually orientated predators.

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AMPHISBAENA FENESTRATA (Virgin Islands Worm Lizard). **EVAPORATIVE WATER LOSS.** *Amphisbaena fenestrata* is endemic to the Virgin Islands of the Puerto Rico Bank. Like most members of its fossorial genus, it is rarely seen and thus little-known (Gans and Alexander 1962. Bull. Mus. Comp. Zool. 128:67–158). In the course of evaporative water loss studies on Virgin Islands squamates (e.g., Perry et al. 2000. Biotropica 32:722–728, and citations therein), we had the opportunity to test 3 *A. fenestrata*.

The 3 individuals examined were collected on Guana Island (18°38'N, 65°25'W), British Virgin Islands. All were found surface-active during the day following heavy rains. Collection sites were up to 70 m above sea level and had thick plant cover, providing protection from direct sunlight. Substrates varied from sandy to rocky loam. Total water loss was measured in the laboratory using the methods of Dmi'el et al. (1997. Biotropica 29:111–116). Animals were tested within 24 h of capture, having been maintained with ad lib water but no food. Following the study, animals were euthanized and deposited at the Yale Peabody Museum (YPM 12061: TL 214 mm, 5.0 g; YPM 12986: TL 181 mm, 2.5 g) and the Sam Noble Oklahoma Museum of Natural History OMNH 39481 (TL 197 mm, 3.1 g). The sex of these animals was not determined. We report water loss calculated two ways. First, we used mass to calculate water loss in mg g^{-1} h^{-1}. Our results were as follows: OMNH 39481 had the lowest water loss rate: 5.64 mg g^{-1} h^{-1}. The largest individual (YPM 12061) lost 5.99 mg g^{-1} h^{-1}, and the smallest animal (YPM 12986) had the highest water loss rate: 6.56

mg g^{-1} h^{-1}. We also calculated water loss per unit surface. To quantify surface area, we assumed an amphisbaenid is cylindrical in shape, and calculated surface area (A) from total length (TL, in mm) and average diameter (D, measured to the nearest 0.1 mm at three positions: just behind the head, at midbody, and just anterior to the cloaca), using the equation $A = p \cdot D \cdot TL$. We were unable to partition respiratory from cutaneous water loss, and thus used total water loss, which includes both. However, cutaneous gas exchange in amphisbaenians is especially large (Abe et al. 1987. J. Exp. Biol. 127:159–172), implying a relatively low breathing rate. We therefore expect water loss through the respiratory tract to be low as well, making our values only somewhat higher than actual cutaneous water loss rates. Our results were as follows (surface area and water loss rate, respectively, indicated for each): OMNH 39481: 32.2 cm^2, 0.55 mg cm^{-2} h^{-1}; YPM 12061: 44.3 cm^2, 0.66 mg cm^{-2} h^{-1}; YPM 12986: 26.2 cm^2, 0.62 mg cm^{-2} h^{-1}.

Few comparative data exist for amphisbaenians. Krakauer et al. (1968. Nature 218:659–660) graphed total water loss for 13 individuals. Of 7 species examined, 6 were comparable in size to *A. fenestrata*. These 6 species broke into two distinct groups based on habitat: humid or desert. However, the experimental design of Krakauer et al. (*op. cit.*) differed in that dried, flowing air was used rather than air at ambient humidity, preventing a precise comparison of results. Nonetheless, values for *A. fenestrata* seem most similar to the desert group, as might be expected from a species residing on a fairly dry island (Dmi'el et al. 1997. Biotropica 29:111–116).

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CALEDONISCINCUS AUSTROCALEDONICUS (Common Litter Skink). **HERBIVORY.** Frugivory and nectivory in lizards, and their concomitant effects of seed dispersal and pollination, have begun to attract long overdue attention (Olesen and Valido 2003. Trends Ecol. Evol. 18:177–181; Perry and Lazell 1997. Herpetol. Rev. 28:150–151). Here, we add to this still relatively limited observation base with an observation of frugivory in common litter skink *Caledoniscincus austrocaledonicus* in New Caledonia.

On 23 January 2003, we visited islands in the Baie de Goro off the southeast coast of Province Sud, Grande Terre (22°15'S, 167°02'E). At ca. 1100 h on Ilot Kouaneak, and ca. 1500 h on Ilot Nie, we observed litter skinks eating the bright red berries of *Rivina humilis* (Phytolaccaceae). The fruits of this same plant are eaten by *Anolis* in the Caribbean (Lazell and Perry 1997. Herpetol. Rev. 28:150; Lazell and Mitchell 1998. Herpetol. Rev. 29:237). On both Kouaneak and Nie, litter skinks are hyper-abundant (densities reach 4 m^{-2}). Olesen and Valido (*op. cit.*) suggest that herbivory might facilitate unusually high lizard densities on islands, through density compensation and ecological release.

We thank Aaron Bauer and Ross Sadlier for introducing us to the wonders of New Caledonia, and Jonathan Kolby, Elisabeth Hills, and Greg Watkins-Colwell for field assistance. Voucher specimens were collected under permit 6034-346, Direction des Ressources Naturelles, Province Sud, whose staff was most helpful.

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CHALCIDES THIERRYI PULCHELLUS (Cylindrical Skink). **ATTEMPTED PREDATION.** *Chalcides thierryi pulchellus* is a medium-sized (72–122 mm SVL) tan and brown terrestrial and semi-fossorial lizard that is native to West African woodlands and semi-arid bushlands (Schätti 1986. Revue suisse Zool. 93:765–778; Caputo et al. 1995. Trop. Zool. 8:95–152; Joger and Lambert 2002. Trop. Zool. 15:165–185). Although the diet of West African members of the genus remains unknown, North African *Chalcides* prey upon a broad range of invertebrates and small lizards, and cannibalism is suspected in *C. mionecton* and *C. ocellatus* (Schleich et al. 1996. Amphibians and Reptiles of North Africa. Koeltz Scientific Books, Koenigstein, Germany. 627 pp.). Herein, we report a predation attempt by *Chalcides thierryi pulchellus* upon a snake of the genus *Dipsadoboa*.

On 24 September 1984, Beat Schätti (*op. cit.*) collected an adult female (119 mm SVL) *Chalcides thierryi pulchellus* (MHNG 2235.1) under a rock in humid dense "Guinea Savanna" forest (Schätti, pers. comm.) at Naréna, Mali (12°13'60"N, 08°37'60"W; elev. 393 m). Examination of stomach contents from this specimen revealed a tail of a snake (Fig. 1). Lacerations at the proximal end of the tail suggest that it had recently been bitten off by the *Chalcides*. The tail is slender and 108 mm long; there are 62 single subcaudals with smooth slightly overlapping scales and a markedly expanded row of vertebrals following fusions with the paravertebral ones. Seven transverse scale rows exist at the proximal end of the tail, five transverse rows 16 subcaudals distal to this point, and three transverse rows 33 subcaudals from the proximal edge of the tail. The tail tip is missing. The dorsum and sides of the tail are brown to light brown with dark brown spots or blotches on the posterior and sides of some scales. Although dark blotches occur in the centers of some scales, no discernable pattern exists. The venter is immaculate cream. The internal tissues of the proximal end of the tail are partly digested, however, as no retractor penis muscles could be observed more distally, the tail probably originates from a female.

Identification of the tail to genus is possible because of the unusual combination of morphology, shape, length, and color; the presence of single subcaudals eliminates most African snake genera. The viperid genera *Atheris, Causus*, and *Echis* have keeled scales, and the maximum number of subcaudals for the actractaspidid genera *Atractaspis* and *Polemon* is only 32. Apart from some species of *Dipsadoboa*, the minimum number of

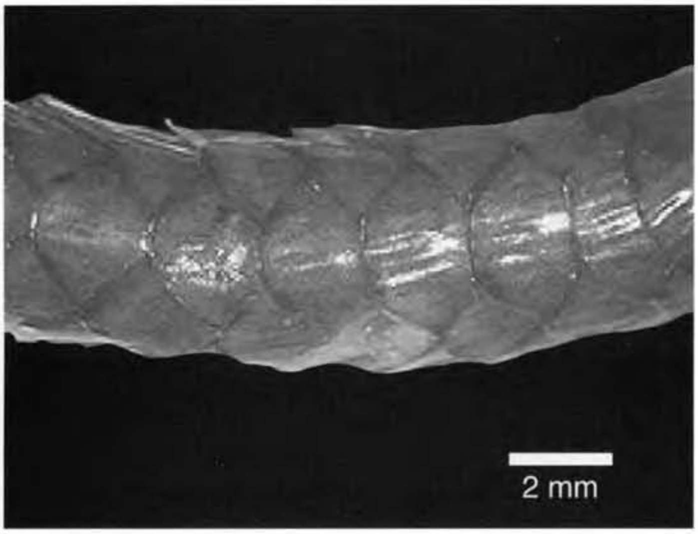

FIG. 1. Dorsal view of a section of the tail of an adult *Dipsadoboa* sp. removed from the stomach of an adult female *Chalcides thierryi pulchellus* from Naréna, Mali.

subcaudals falls within the range of *Lamprophis olivaceus* (38–63), *Aparallactus lunulatus* (41–65), and *A. niger* (33–64), but these taxa have black or gray dorsal tail coloration (Chippaux 1999. Les Serpents d'Afrique Occidentale et Centrale, IRD Éditions, Lyon, France. 278 pp.). Moreover, *Lamprophis olivaceus* has dark pigment on the ventrals and subcaudals (Pitman 1974. A Guide to the Snakes of Uganda, Wheldon and Wesley, London, UK. 290 pp.) and more (> 9) transverse scale rows at the proximal end of the tail (J. Rasmussen, pers. obs.). The maximum tail length of *Aparallactus lunulatus* (100 mm) is shorter than the tail fragment we describe, and *A. niger* has black pigment on the margins of its subcaudals (Witte and Laurent 1947. Mem. Mus. R. Hist. Nat. belge [ser. 2] 29:1–134.).

Thus, only the genus *Dipsadoboa* remains. Because both the proximal and distal ends of the tail are missing, the snake might be any of the four West African *Dipsadoboa* with single subcaudals: *underwoodi* (71–87 subcaudals), *unicolor* (52–78 subcaudals), *viridis* (68–103 subcaudals), or *weileri* (54–73 subcaudals). The transverse scale reduction is most consistent with *D. unicolor* whereas the tail coloration is most consistent with *D. underwoodi,* but these species are not known from Mali (Rasmussen. 1993. Steenstrupia 19:129–196; Joger and Lambert 1996. J. afr. Zool. 110:21–51; Chippaux, *op. cit.*). However, both species are known from tropical rain forest habitats and could have survived as relicts in the humid forest at Naréna.

We thank S. Fisch-Muller for permission to dissect the *Chalcides* specimen, B. Schätti for information about Naréna, A. Larson (FMNH) for comparative material, U. Joger for initial discussions, and L. Trueb for comments on the manuscript.

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CROTAPHYTUS COLLARIS (Eastern Collared Lizard). **HOMING AFTER DISPLACEMENT.** Homing is known from distances > 500 km in sea turtles, and from 1–2 km in crocodilians and snakes. By contrast, homing over more than 200 m is rare in lizards, particularly in species that maintain territories (Zug et al. 2001. Herpetology: An Introductory Biology of Amphibians and Reptiles. Academic Press, San Diego, California. 630 pp.). I observed an unusual instance of homing back to an established territory by a displaced male collared lizard, *Crotaphytus collaris*, at Arcadia Lake Dam, Edmond, Oklahoma.

At this site, males establish territories on the boulder fields that line the north and south slopes of the 0.5-km long flood control spillway behind the dam (Baird et al. 2001. Ethology 107:15–32). During water release, a flowing (rate = 1 m/sec) 9.5-m wide channel separates these slopes. Lizards usually venture only to the water's edge, but when the outflow is closed, males sometimes make forays into the dry channel to pursue odonates. A uniquely paint-marked male that had defended a territory since 1 April 2001 on the eastern end of the north slope was apparently displaced when the outflow was opened at 0900 h on 17 June 2002. This male was re-sighted on the south slope at 1230 h that same day, but by 1030 h two days later he had returned to his original territory even though the spillway flow was not interrupted during this period.

Homing by a landward route would have required this male to travel at least 416 m west along the south slope, turn 90° to the north slope, and then turn again 90° eastward to travel 390 m back to his territory. Such a return route would have been > 800 m, and would have required his crossing through the territories of 7 other males. Alternately, he could have taken the most direct return route by swimming across the flowing channel while avoiding being swept over a waterfall that was 30 m downstream of where he was sighted on the south slope. Aquatic behavior in collared lizards has been reported, but simply involved diving into calm water at the edge of ponds to take refuge under rocks (Burt and Hoyle 1934. Trans. Kansas Acad. Sci. 37:193–216; McAllister 1983. Herpetol. Rev. 14:11). One day after his return, this displaced male disappeared and was not sighted subsequently despite daily systematic search of the study site through 15 July 2002. Sudden disappearance during the peak reproductive season strongly suggests that he died, possibly as a consequence of the high physiological costs associated with either the long overland migration or the strenuous swim.

This study was conducted under Oklahoma Department of Wildlife Conservation permit 3201 issued to Troy A. Baird.

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EUMECES ELEGANS (Elegant Skink). **DEFENSIVE BEHAVIOR**. Amphibians and reptiles use numerous behaviors and mechanisms to avoid predation. Among lizards, bluff, crypsis, immobility, mimicry, retaliation, and tail autonomy are common behaviors that reduce the likelihood of predation. In contrast, diving into water and remaining submerged is a defensive behavior generally associated with aquatic amphibians, turtles and snakes, although selected lizards (e.g., some monitors, *Varanus* spp.) are

known to engage in this behavior (Mattison 1989. Lizards of the world. Facts on File, Inc., New York. 65 pp.; Zug et al. 2001. Herpetology an introductory biology of amphibians and reptiles. Academic Press. San Diego. 284 pp.). Here, we describe diving and submergence behavior in the elegant skink, *Eumeces elegans*.

At 1348 h on 8 February 2002, an adult (ca. 75 mm SVL) *E. elegans* of unknown sex, was seen moving over a patch of dry silt in an irrigation ditch in the agricultural area of Santzepu (23°25'42"N, 120°28'55"E), Shuisan District, Chiayi County, Taiwan. Conditions were sunny and warm (air temperature 28.7°C).

Initially, the skink tried to shelter among black-jacks (*Bidens pilosa* var. *radiata*) and horsetails (*Equisetum ramosissum debile*) partly covering the silt patch, but upon our further approach, the animal dove into the adjacent shallow (ca. 10 cm) pool. There it sought shelter among the rocks. The lizard's body was mostly concealed under a rock 13 cm wide x 16 cm long with its head and tail protruding from each end. After remaining in this position for ca. 10 seconds, the skink pushed its head above the water surface just enough to take a few breaths then retreated under the rock.

A water route was not the only escape option. The skink could have used a terrestrial escape route by running in either direction along the ditch, or fleeing to the edge of the ditch and running up the wall and out of the ditch. *Mabuya multifasciata*, introduced to southern Taiwan (Ota et al. 1994. Zoological Studies 33:86–89), has been observed to dive into water to escape capture both in captivity and in the wild (Chu 2000. Nature Conservation Quarterly Issue 29:50–53 [in Chinese]), but this behavior has not been observed in any other lizard species in Taiwan.

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EUMECES LATICEPS (Broad-headed Skink). **PARASITES.** Blow (Diptera: Calliphoridae) and flesh (Diptera: Sarcophagidae) flies may opportunistically parasitize amphibians and reptiles. Flesh fly infestations have been reported in some turtles (e.g., *Graptemys pseudogeographica*, Vogt 1981. Copeia 1981:457–459; *Terrapene carolina*, references in Dodd 2001. North American Box Turtles, A Natural History. Univ. Oklahoma Press, Norman. 231 pp.), and Bleakney (1963. Can. Entomol. 95:107–108) noted blow fly parasitism on live American toads (*Bufo americanus*). Here, we add a report on an instance of blow fly parasitism on the broad-headed skink, *Eumeces laticeps*.

During a herpetological survey of the George Washington Memorial Parkway (National Park Service), Fairfax County, Virginia (38°57'57"N, 77°09'20"W; NAD 83) on 4 June 2002, we encountered an adult male *E. laticeps* (111 mm SVL) 2 m from the edge of the Potomac River clinging to the base of a 1.5 m diameter oak (*Quercus* sp.). The habitat is a mixed deciduous floodplain edge forest dominated by oaks (*Q. alba*, *Q. rubra*), beech (*Fagus grandifolia*), and tulip poplar (*Liriodendron tulipifera*). The *E. laticeps* had 4 puncture wounds on the head and neck (midventrally 2 mm anterior to the forelimbs, below the right jaw, in the right temporal region, and middorsally in the parietals; the dorsal wounds were 19 mm apart), and the tail had been severed at about mid-

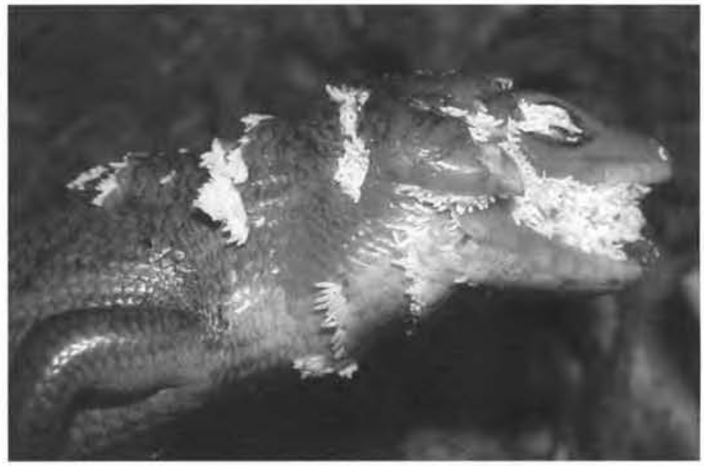

FIG. 1. Blow fly parasitism on *Eumeces laticeps* in Fairfax County, Virginia.

length. Approximately one dozen blow flies were laying eggs on the skink (Fig. 1). They were actively depositing ova in the lizard's mouth, eyes, nostrils, puncture wounds, and in the end of the broken tail. Fly ova were also found on the anterior surfaces of the rear limb insertions and between dorsal scale rows where no wounds existed. Close inspection revealed an approximate respiration rate of one breath every 10 seconds, suggesting to us that the lizard was stressed. When touched, the skink lunged weakly to the side in an attempted defensive bite despite having a mouth full of fly eggs. We believe that the lizard might have been injured during an unsuccessful predation attempt (possibly by a felid or mustelid) and subsequently parasitized by the flies. We euthanized the skink humanely but did not salvage it.

Our work in this national park was conducted under permit GWMP-2001-SCI-0002 to Thomas K. Pauley (Marshall University). We thank Art Evans (Richmond, Virginia) for help with fly identification.

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HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). **LONGEVITY.** In 1999, we initiated a population study of the introduced *Hemidactylus turcicus* on Smith Hall, a one-story brick building on the McNeese State University campus, Lake Charles, Louisiana, USA. Lizards were caught by hand, measured, weighed, and identified by unique toe-clip combinations. On 15 June 1999, we captured a male 56 mm SVL, making it a sexually mature adult because it exceeded the minimum adult size for males of 42–44 mm SVL (Selcer 1986. Copeia 1986:956–962; Punzo 2001. Florida Scientist 64:56–66). Male *H. turcicus* reach sexual maturity 8–9 months after hatching (Selcer, *op. cit.*; Punzo, *op. cit.*; pers. obs.), so this male must have hatched during or prior to the summer of 1998. We recaptured this male on 5 May 2002 (59 mm

SVL), so it survived 4 winters and was at least 4 years old.

On 14 June 1999, we captured a 49 mm SVL female, making it sexually mature because it exceeded the minimum female adult size (41.5–43 mm SVL; Selcer, *op. cit.*; Punzo, *op. cit.*). Because female *H. turcicus* also reach sexual maturity 8–9 months after hatching (Selcer, *op. cit.*; Punzo, *op. cit.*; pers. obs.), this female must also have hatched during or prior to the summer of 1998. We recaptured this female on 2 June 2002 (57 mm SVL), so it also survived 4 winters and was at least 4 years of age.

Longevity of these two *H. turcicus* exceeds the 3 year lifespan proposed by Selcer (*op. cit.*). Both were among the largest lizards we caught when they were captured in 2002, implying that 4 years might approach the maximum lifespan for this species.

Lizards were collected under the authority of Louisiana Department of Wildlife and Fisheries Scientific Collecting Permits LNHP-99-019 and LNHP-02-018 issued to Mark A. Paulissen.

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IGUANA IGUANA (Sinimbu, Green Iguana). **REPRODUCTION.** The iguanid *Iguana iguana* has a broad geographic distribution across Central and South America. In most South American countries, iguanas have significant socioeconomic importance in rural communities as a food resource (Divers 1995. Brit. Herpetol. Soc. Bull. 51:6–26). In Brazil, where the sinimbu has a distribution through the Amazon, the Pantanal and Caatinga, no information exists on the biology of the species in the wild. Here, I provide preliminary data on nests, nest colonies, densities, and reproduction for *I. iguana* from Pantanal habitat in southern Brazil.

This study was conducted on Paraguay River near the city of Corumbá, Mato Grosso Sul (18°59'S, 56°39'W; elev. 60 m) in November–December 1992, when iguanas lay eggs. Nests colonies were located, and I opened intact nests in order to count eggs and measure the dimensions (length and width) of 8–19 egg samples. I also captured females near the nests, measured them (SVL), and assessed their reproduction condition (gravid or not). I considered females gravid if they had an expanded abdominal cavity and had excavated nests, and non-gravid if they had a deflated abdominal cavity and were located within nest holes. Between 0900 and 1200 h on 18–20 January 1994, I also conducted an iguana census by boat that covered both banks of two stretches of the Paraguay River. Each stretch covered 4 km.

I located 6 groups of nests 3 to 300 m apart and a total of 18 nests over a 2-km length of river. Nests were located in clay river banks in open habitat within 3 m of the river margin. I saw females excavate nest holes with both their limbs and their mouth. At each nest group, nest holes were within 50 cm of one another. Each nest group had 3 nests with eggs; the remaining excavated holes appeared empty. Ten nests were predated, the other 8 were intact. Clutch size of intact nests averaged 14 (SD = 3.2, range: 12–19) and eggs averaged slightly over 1.4 times as long as wide (mean length 42.6 mm, SD = 1.7 mm; mean width 29.7 mm; SD = 1.3 mm). The vicinity of nests had many predated or rotten eggs. I observed Yellow Anacondas (*Eunectes notaeus*) three times near nests: twice with *I. iguana* eggs in their mouths and once in a hole near a nest colony. I captured 8 reproductive age female iguanas (4 gravid and 4 that had recently deposited eggs). These females were 31.0–39.5 cm SVL (mean 33.5 cm SVL, SD = 2.6 cm). During the riverbank survey, I recorded 3.5 iguanas/km in one stretch of the river, and 2.0 iguanas/km in other.

The aggregative behavior I describe for nesting *I. iguana* females along the banks of Paraguay River at the end of the dry season is similar to aggregative behavior for reproduction that has been observed on Barro Colorado Island in Panama, and in Venezuela (Rand 1968. Copeia 1968:837–842; Rodda and Grajal 1990. Amphibia-Reptilia 11:31–39). Aggregation might help maintain nest temperatures or facilitate defense against egg predators (Greene et al. 1978. J. Herpetol. 12:169–176). The dry-season nesting interval for iguanas in Panama (Rand 1972. Herpetologica 28:252–253) coincides with the seasonal pattern in the Pantanal. The clutch sizes of 12–19 I report for the Pantanal are generally smaller than most other reports. In Surinam, clutch size varied from 24 to 57 (Hoogmoed 1973. Biogeographica: Notes on the Herpetofauna of Surinam IV 4:419); in Panama from 9 to 71 (Rand 1984. Vertebrate Ecol. Syst. 10:115–122); and in Colombia from 14 to 70 (Muller 1972. Zoologische Beitrage NF 18:109–131). Generally lower clutch sizes might reflect the range margin conditions of my study areas.

I thank Procópio Ferreira for help in the field.

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LEIOCEPHALUS CARINATUS ARMOURI (Northern Curly-tailed Lizard). **PREDATION.** Indigenous species preying on exotic herpetofauna in Florida might be an important source of mortality (Butterfield et al. 1997. *In* Simberloff et al. [eds.], Strangers in Paradise, pp. 123–138, Island Press, Washington, DC). The Little Blue Heron (*Egretta caerulea*) feeds mainly on small fish, invertebrates (mostly crustaceans), and small amphibians (Rodgers and Smith 1995. *In* Poole and Gill [eds.], The Birds of North America, Species Account No. 145, The Academy of Natural Sciences, Philadelphia, Pennsylvania and The American Ornithologists' Union, Washington, DC). Here, we report an observation of predation by the Little Blue Heron on *Leiocephalus carinatus armouri*, an exotic species in Florida (Weigl et al. 1969. Copeia 1969:841–842).

At ca. 1325 h on 19 February 2003, a hazy-sunny day with a temperature ca. 27°C, HTS observed a juvenile (white plumage) Little Blue Heron prey on a small (4–5 cm SVL) *L. c. armouri* on a concrete seawall in Martin County. This site is adjacent to the 1999 county record location (Hauge and Butterfield 2000. Herpetol. Rev. 31:53), but has been occupied since at least 1994 (Smith and Engeman 2002. Florida Field Nat. 30:132–133) and is at the northern end of a relatively contiguous 90 km surveyed range of this species (Smith et al., *in press*. International Biodeterioration and Biodegradation). The heron was foraging on top of the seawall using the "walk slow" behavior (Rodgers 1983. Colonial

Waterbirds 6:11–23), when it saw the lizard (also on top of the seawall) dart into a vertical crevice. In 10–15 seconds of slow approach, the heron waved its head and neck slowly in a wide side to side sweep. When it reached a position over the crevice, the heron plucked the lizard out with one strike and swallowed it in < 10 sec.

The event was noteworthy because it involved a juvenile wading bird foraging in a terrestrial situation and preying on the exotic *L. c. armouri*. Although the Little Blue Heron occasionally hunts on land, most time is spent methodically foraging in shallow water (Willard 1977. Condor 79:462–470; Rodgers and Smith, *op. cit.*). Although herons and egrets have been known to capture and consume exotic lizards in terrestrial situations (Franz 2001. Herpetol. Rev. 32:253), and *L. carinatus* has been the subject of other unusual predation events (Smith and Engeman, *in press*. Herpetol. Rev.), we know of no similar wading bird depredation reports for *L. carinatus* in the literature.

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LEPIDOPHYMA FLAVIMACULATUM (Yellow-Spotted Night Lizard). **PLACENTOPHAGIA**. Placentophagia (consumption of placental tissues) is known from among a few of the live-bearing lizards that exhibit placental development, namely the Australian scincid genera, *Egernia* and *Tiliqua* (Greer 1990. The Biology and Evolution of Australian Lizards. Surrey Beatty & Sons, Sydney, 264 pp.), and the xantusiid *Xantusia vigilis* (Bellairs 1969. The Life of Reptiles. Vol. 2, The Weinfeld and Nicolson Natural History, London, United Kingdom, 307 pp.). Here, I augment the scarce data on placentophagia in squamates with observations of this behavior in the Neotropical xantusiid *Lepidophyma flavimaculatum*.

During June 2002, each of two female *L. flavimaculatum* of uncertain origin gave birth to 9 young. One captive for over a year, had never been in contact with a male. The second was gravid when acquired, and gave birth eleven days later. Parturition allowed opportunity to observe placentophagia. One of the first female's newborn pulled out the remains of unidentified extra-embryonic tissues joined by the umbilical cord to its abdomen, then ate it. The other neonates from each of the two females or the females themselves may have done the same because each was devoid of extra-embryonic tissue remains when I first had the opportunity to observe each one and no evidence of extra-embryonic tissues was been found in the terrarium.

Placentophagia reported in *Xantusia vigilis* involves the female (Bellairs, *op. cit.*). Only in the two Australian scincid genera *Egernia* and *Tiliqua* was placentophagia performed by neonates (Greer, *op. cit.*), so behavior might be more widespread among scincomorph lizards. Field data will be required to determine whether the neonate placentophagia observed here is typical or just a function of captive conditions. Litters of *L. flavimaculatum* vary from 2 to 6 (Telford and Campbell 1970. Copeia 1970:379–381), so the two clutch sizes of 9 are high, but this could also be a function of available food in captivity. Lastly, unless *L. flavimaculatum* has the capability of storing sperm for an extended period of time, the females on which I report here might be derived from one or two of several parthenogenetic populations in Costa Rica or Panama (Telford and Campbell, *op. cit.*; Bezy 1972. Contr. Sci. Nat. Hist. Mus. Los Angeles 277:1–29).

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LEPOSTERNON MICROCEPHALUM (NCN). **PREDATION.** Data about the natural history of South American amphisbaenids are scarce, reflecting their fossorial habits (Dunham et al. 1998. *In* Gans and Huey [eds.], Biology of the Reptilia, Volume 16 (Ecology B): Defense and Life History, pp. 441–522. Alan R. Liss, Inc., New York). In particular, few data exist on the predators of *Leposternon microcephalum*, an amphisbaenid widely distributed across South America (Peters and Donoso-Barros 1970. U. S. Nat. Mus. Bull. 297: 293 pp.). Fossorial snakes of genus *Micrurus* and some elapomorphines seem to be important predators of the amphisbaenid genus *Leposternon*, but some bird and mammal predators have also been reported (Marques and Sazima 1997. Herpetol. Nat. Hist. 5:88–93; Zamprogno and Sazima 1993. Herpetol. Rev. 24:82–83). As the omnivorous South American coati (*Nasua nasua*: Procyonidae) is not among reported predators, we report coati predation on *L. microcephalum*.

During a herpetological survey in the conservation area of Parque Florestal do Rio da Onça, Matinhos Municipality, Paraná, Brasil (25°45'–25°50' S; 48°30'–48°35' W; Coastal Atlantic Forest, restinga habitat) from April 1999 to April 2000, we observed a free-ranging but human tolerant 1-year old female *N. nasua* preying on *L. microcephalum* 17 different times. Each *L. microcephalum* was located by sniffing the litter or sand substrate (a behavior that *Nasua narica* displays constantly; Kaufmann 1962. Univ. California Publ. Zool. 60: 95–222), digging with the snout, capturing the prey with mouth and forepaws, and ingesting it in pieces immediately after the capture. Only 4 of 17 *L. microcephalum* were completely eaten. The other 13 were abandoned after being partially eaten, and are deposited in the herpetological collection of Museu de História Natural Capão da Imbuia, Curitiba, Paraná, Brasil (MHNCI 9688–9694, 9705–9710). In four of these individuals, the head and anterior part of the trunk were eaten; in seven others, the posterior third of the body was eaten; both ends of remaining two were eaten.

Nasua nasua has a broadly generalized diet that include flowers, fruits and small invertebrates often taken from epiphytic bromeliads or on the ground (Beisiegel 2000. Braz. J. Biol. 61: 689–692) as well as anurans and crustaceans (M. Oliveira, E. R. Ribas, pers. obs.). A crab-eating fox (*Cerdocyon thous*) was the only mammal reported to prey on the related *Leposternon wuchereri* (Zamprogno and Sazima, *op. cit.*), but this is the first record of *N. nasua* predation on any amphisbaenid.

The Ambiental Institut of Paraná provided the permit to Mitzi Oliveira that enabled survey in the Parque Florestal do Rio da Onça conservation area.

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LIOLAEMUS SANJUANENSIS (NCN). **BODY TEMPERATURE.** *Liolaemus sanjuanensis* is a lizard endemic to the Sierra de Pie de Palo, an old 60 x 30 km cordillera in Western Argentina with geologic history different from the Andes. *Liolaemus sanjuanensis* has an ambiguous conservation status, as it has been defined as a species for which "insufficient knowledge" exists (Lavilla et al. 2000. Categorización de los anfibios y reptiles de la República Argentina. Asoc. Herp. Arg., San Miguel de Tucumán, Argentina. 97 pp.). Data on its biology are sparse. Marinero et al. (2002. Actas XVI Reunión de Comunicaciones. La Plata. [www.fcnym.unlp.edu.ar/xvirch]) and Buff et al. (2002. Actas XVI Reunión de Comunicaciones. La Plata.) made observations on its reproduction and morphology based on relatively few lizards (N = 29), providing the only published data on this species' biology. Here, we present the first data addressing the species' thermal ecology.

We conducted field work in the Sierra de Pie de Palo, Departamento Angaco, Provincia de San Juan (31°22'S, 67°58'W) on 8–9 December of 2001. Data are based on 29 captures made between 1100 and 1400 h in the Altoandina Phytogeographic Province over an elevation range of 2870–2994 m. The flora, largely Andean, is dominated by needlegrasses (*Stipa*) with patches of various forbs, with the genera *Fabiana*, *Baccharis*, *Adesmia*, and *Senecio* being important (Cei 1980. Hist. Natural. 1:137–140). To collect data, we revisited a randomized selection of bushes and low rocks across the study site. Each individual was captured by hand. The cloacal (TC), substrate (TS) and air (TA) temperatures were measured (to nearest 0.1°C) with a rapid reading Miller-Weber thermometer. For each capture, we took TS at the exact point of observation, and TA 1 cm above the substrate.

Mean body temperature of 29 *L. sanjuanensis* was 30.1°C (s = 3.2°C). Body size was negatively associated with TC ($r = -0.46$, $P = 0.01$). An ANCOVA (body size as the covariate) revealed no inter-gender differences in TC ($F_{2,25} = 0.81$, $P = 0.45$). An ANOVA revealed significant differences between TC and TA ($F_{2,66} = 9.93$, $P < 0.01$) and TA and TS ($F_{2,66} = 9.93$, $P < 0.01$). Cloacal temperature and TS differences were not significant ($F_{2,66} = 9.93$, $P = 0.99$). Cloacal temperature and each of TS and TA were correlated ($r = 0.40$, $P = 0.03$; $r = 0.46$, $p = 0.01$, respectively)

Our data suggest that *L. sanjuanensis* thermoregulates behaviorally in a manner similar to *L. wiegmanni* (Martori et al. 1998. Rev. Esp. Herp. 12:19–26), *L. olongasta* (Cánovas et al. 2001. V Congreso Arg. Herp. pp. 32–33) and *L. koslowsky* (Martori et al. 2002. Cuad. Herp. 1:78–99). These species actively thermoregulate by moving among microhabitats having different temperatures, and differ from *L. pseudoanomalus* (Villavicencio et al. 2001. IV Congreso Arg. Herp. pp. 81–82), an apparent thermoconformer that appears to have body temperatures that closely track substrate and air temperatures.

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PRISTIDACTYLUS SCAPULATUS (NCN). **DIET.** *Pristidactylus scapulatus*, one of six species in its genus in Argentina (Cei et al. 2001. J. Herpetol. 35:597–605), is thought to be widespread in the high Andes from north of San Juan in San Guillermo Provincial Reserve to Chubut Province (Cei 1986. Museo Regionale di Scienze Naturali Torino. Monografie IV. Torino, 527 pp.). However, its conservation status is ambiguous as it is defined as a species for which "insufficient knowledge" exists (Lavilla et al. 2000. Categorización de los anfibios y reptiles de la República Argentina. Asoc. Herp. Arg., San Miguel de Tucumán, Argentina, 97 pp.). *Pristidactylus scapulatus* has been considered insectivorous, but its biology is poorly known largely because it occurs at relatively low densities (Cei, *op. cit.*). Of the 6 *Pristidactylus* species that occur in Argentina, only *P. achalensis* (an endemic to the Pampa de Achala in Cordoba Province of central Argentina) is mentioned as being herbivorous, eating alternatively leaves and flowers (Etheridge and Williams 1985. Breviora 483:1–18). Here, we provide preliminary data on the diet of *P. scapulatus*, indicating that it can be frugivorous.

Our observations were based on data from 3 individuals. One, an adult female (96 mm SVL) was collected on 15 February 2002 north of El Leoncito National Park (31°45'S, 69°10'W; elev. 3100 m), Calingasta Department, on rocky slopes in the Puna Zone. Here, *Lobivia formosa*, *Lycium scleitery*, *Lycium chanar*, *Ephedra breana*, *Fabiana denudata*, and *Stipa* spp. dominated the vegetation. We collected the remaining 2 individuals, an adult male (103 mm SVL) and a juvenile female (49 mm SVL) on 23 April 2002 in Don Carmelo Multiple Use Reserve (31°10'S; 69°46'W; elev. 3000 m), Ullum Department, San Juan Province, also in the Puna Zone. Here, *Stipa speciosa var. breviglumis*, *L. chanar*, *Artemisia mendozana*, *Ephedra breana*, and *Maihueniopsis glomerata* dominate the vegetation. The lizards were taken to the laboratory, where they defecated and their feces were examined with a magnifying lens. Although we generally analyzed the samples qualitatively because of variation in disintegration of the fecal materials, we estimated the percentage (by volume) of plant and animal material.

About 90% of the feces consisted of *L. chanar* and *E. breana*, but fruits and seed of *L. chanar* were particularly conspicuous. The remaining material consisted of beetle (Coleoptera) parts from scarabs (Scarabaeidae) and darkling beetles (Tenebrionidae). We found the fruits of *L. chanar* and *E. breana* in the feces to be in various stages of digestion. Whole fruit as well as partialy digested fruit and seeds were present.

Similar partial digestion, in this case of flowers and leaves, is also found in diet of *P. achalensis* (R. Martori, pers. comm.). This

pattern of digestion may indicate that extraction of water and sugar is more important in *P. scapulatus* frugivory than the extraction of other materials from fruits. *Lycium chanar* and *E. breana* are distributed from Bolivia south to north of Mendoza, Argentina (Carretero 1995. Bol. Soc. Argent. Bot. 31:27–40). Both species occupy patches associated with rocky slopes in Puna Zone habitats in San Juan. *Lycium chanar*, the more abundant and widespread species, bears fruit from late January to April (J. Márquez, pers. comm.), and provides a dense thorny structure that may provide important cover from predators for *P. scapulatus*. Given the aforementioned pattern of frugivory, the importance of this lizard in seed dispersal deserves investigation.

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STENOCERCUS AZUREUS (NCN). **REPRODUCTION**. Few data exist on the reproductive biology of the tropidurid *Stenocercus*. Clutch size is known for fewer than half of the species. Two eggs have been reported in all species to date except *Stenocercus humeralis*, for which 4 eggs were recorded (Torres-Carvajal 2000. Univ. Kansas Mus. Nat. Hist. Sci. Pap. [15]:1–38). Here, I report on a second species of *Stenocercus* with a clutch size >2.

Upon examination of a radiograph, a 67 mm SVL female *S. azureus* (AMNH 17013) was found to contain 6 large eggs occupying about half the body volume. Using the formula for a prolate spheroid, the volume of these eggs was determined to average 451 mm^3 (range: 349–593 mm^3).

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TAKYDROMUS HANI (Green Grass Lizard). **NATURAL HISTORY**. In the recent description of the lacertid *Takydromus hani*, Chou et al. (2001. Herpetologica 57:497–508) reported that the species, including the paratype (IEBR-L100), occurred in "undergrowth by streams in primary subtropical forests." Herein, I correct information in Chou et al. and report additional observations that suggest the species is primarily a tree-canopy inhabitant.

The paratype IEBR L100 (American Museum of Natural History [AMNH] Field Series 14140; collected by Darrin Lunde [AMNH] and D. Kizirian) was captured after it dropped from the tree canopy onto equipment in camp at 200 m elevation on a tributary of the Rao An, Huong Son Reserve, Ha Tinh Province, Vietnam (18°21'N, 105°13'E). An additional specimen (AMNH R147115) from the same locality, but excluded from the original description, was also captured after it dropped from the canopy onto David Grimaldi (AMNH). Despite exhaustive fieldwork by ca. 20 biologists within 1 km of the above locality over 32 days (19–22 April 1998, 4–22 May 1998, 16–24 April 1999), < 5 individuals of this species were observed, all of which dropped from the canopy and immediately ran up the trunks of large trees back into the canopy. All *Takydromus hani* were observed only in camp, which may reflect their preference for riparian forest or a sampling bias associated with the location of the campsite.

Specimens were collected with permission from the Vietnam National Centre for Natural Sciences and Technology, Hanoi and exported (Export Certificate No. 102-98) with permission from the Forest Protection Department, Ministry of Agriculture and Rural Development, Hanoi, Vietnam and the CITES management authority of Vietnam.

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TEIUS OCULATUS (Green Lizard). **HATCHING AND CLUTCH SIZE.** The teiid *Teius oculatus* occurs in southern Brazil, eastern Paraguay, Argentina and Uruguay (Cei 1993. Monogr. XIV. Mus. Reg. Sci. Nat. Torino, 940 pp). The species is widespread in Rio Grande do Sul State in southern Brazil and is common in grassland habitats. Beyond limited information on a September–March seasonal activity, data on the ecology and natural history of this diurnal terrestrial lizard is scarce (Lema 1994. Com. Mus. Ci. PUCRS 7:41–150; Bujes and Krause 1999. Biociências 7:41–45). Notably, data are lacking on hatching size. Martori and Acosta (1990. Cuad. Herp. 5:15–18) classified individuals of this species that were 35.0–59.0 mm SVL as juveniles, but did not mention hatchlings. Hence, we provide preliminary information on hatchling and clutch size for *T. oculatus* from southeastern Brazil.

On 8 and 21 December 2002, during a study on the ecology of *T. oculatus* at Fazenda Chapada (30°25'23.5"S, 52°18'41.4"W), Serra do Sudeste, Rio Grande do Sul State, we collected two gravid females that were kept at ambient laboratory temperatures and provided *ad libitum* food. On 11 December 2002, the first female (103.3 mm SVL, 188.0 tail length [TL]) we collected deposited a clutch of 6 eggs (mean long axis length (LAL) = 16.9, 0.23 mm SD; mean mass = 0.8, 0.04 g SD). After 71 days, 3 hatchlings hatched from eggs (mean SVL = 39.4, 0.87 mm SD; mean mass = 1.4, 0.11 g SD). On 4 January 2003, the second female (105.1 mm SVL; 202.0 TL mm; 32.7 g) deposited five eggs (mean LAL = 16.9, 0.48 mm SD; mean mass = 0.93, 0.12 g SD); but these never developed. This female weighed 23.6 g after oviposition.

The hatchling sizes we found are similar to those for the smallest individual reported in the congeneric *T. teyou,* which was considered a neonate (Cruz et al. 1999. J. Herpetol. 33:420–429). The clutch sizes we found in *T. oculatus* (5 and 6 eggs) agree with Blanco and Acosta (1998. Bol. Soc. Biol. Concepción 69:33–38), who indicated a range of 2–8 eggs/clutch among *T. oculatus* from Cordoba Province, Argentina. These authors found that a larger proportion of gravid females in early December; in late December, only post-reproductive females were recorded. Our data suggest that the oviposition interval in *T. oculatus* from the Serra do Sudeste may be longer than that which Blanco and Acosta (1998,

op. cit.) report. Data on the second female suggests that reproductive effort in *T. oculatus* represents about one sixth of female body mass.

Voucher specimens (female and hatchlings) were deposited in the herpetological collection of the Museu de Ciências e Tecnologia da Pontifícia Universidade Católica of Rio Grande do Sul (MCP 14359, 14381–83). We thank Arlete Ballestrin Outeiral and Custódio de Almeida for permission to work on the Fazenda Chapada, and CAPES for financial support to LHC.

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TROPIDURUS TORQUATUS (Collared Lizard, Calango) **SAUROPHAGY.** Saurophagy, often opportunistic behavior among lizards (e.g., Kiefer 1998. Herpetol. Rev. 29:41), may involve feeding on conspecifics (cannibalism), as in *Mabuya frenata* (Vrcibradic and Rocha 1996. Herpetol. Rev. 27:201–202) and *Tropidurus montanus* (Kiefer and Sazima 2002. Herpetol. Rev. 33:136) or feeding on heterospecifics (e.g., *Mabuya agilis*: Vrcibradic and Rocha 1995. Herpetol. Rev. 26:129–131; *Anolis sagrei*: Campbell and Gerber 1996. Herpetol. Rev. 27: 200). Here, we provide two reports of *Tropidurus torquatus* (Tropiduridae) preying on *Hemidactylus mabouia* (Gekkonidae) from southeastern Brazil.

Our observations were made in a residential area in Contagem municipality, State of Minas Gerais (19°55'S, 43°56'W). We made observations of two different individuals of *T. torquatus*; when first sighted, each was carrying a dead *H. mabouia* adult lengthwise and head first in its jaws. The first observation occurred at ca. 1400 h on 12 December 2000 when we saw an adult male (ca. 130 mm SVL) *T. torquatus* 170 cm high on a brick wall trying to swallow a dead adult (ca. 50 mm SVL, unknown sex) *H. mabouia*. The second observation occurred on 24 June 2001 at ca. 1300 h on the same wall 10 m away from the previous observation. Here, another adult (ca. 60 mm SVL, unknown sex) *H. mabouia* had also been captured, but in this case a female *T. torquatus* (ca. 100 mm SVL; also on the wall, but ca. 200 cm above ground) was shaking its prey while carrying it. In each case, we observed the respective *T. torquatus* for a ca. 10-min period until it ran out of sight into a crown of a tree. Our observations imply that other lizards may constitute alternative prey for *T. torquatus*.

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TUPINAMBIS MERIANAE (Tegu Lizard). **FUNGIVORY.** Tegu lizards (genus *Tupinambis*) are generalist consumers with a diet based on diverse vertebrates (fishes, amphibians, reptiles, birds, and small mammals) and invertebrates (millipedes, arachnids, insects, and mollusks), as well as seeds, fruits, eggs, and carrion (Dessem 1985. Copeia 1985:245–247; Donadio and Gallardo 1984. Rev. Mus. Ciênc. Nat. Bernadino Rivadavia 13:117–127; Keifer and Sazima 2002. Amphibia-Reptilia 23:105–108; Martuscelli and Olmos 1996. Herpetol. Rev. 27:21; Mercolli and Yanosky 1994. Herpetol. J. 4:15–19; Milstead 1961. Copeia 1961:493–495; Sazima and Haddad 1992. *In* Morellato [ed.], História natural da Serra do Japi, pp. 212–236. Editora da Unicamp, Campinas, Brazil; Rivas et al. 2001. Herpetol. Rev. 32:108; Souza et al. 2002. Herpetol. Rev. 33:209). However, fungivory is unreported. Hence, we provide an observation of the tegu, *T. merianae*, feeding on mushrooms.

On 2 December 2002 around 1200, we observed a subadult (ca. 28 cm SVL) male *Tupinambis merianae* feeding on the fruiting body (mushroom) of the basidiomycete, *Macrocybe praegrandis*, growing on a lawn on the *campus* of the Universidade Estadual Paulista, Rio Claro, São Paulo, Brazil. The lizard was seen taking a small bite atop one of three fruiting bodies available; it ate half the fruiting body (15 cm in diameter) in less than a minute. The lizard readily ingested the mushroom and showed no apparent sign that would suggest distastefulness. However, the lizard fled just after noticing the observer, which occurred after 20 sec of observation. This individual is part of a group of about a dozen free-ranging, semi-tame tegus that live on the University grounds. These lizards receive no other management beyond occasional food supplementation that consists of one-day-old chicks and bananas. Over the 14-day period during which the fruiting body of this fungus persisted, no other feeding episode was recorded, even though disappearance of more of the fruiting body implied continued consumption.

To our knowledge, among reptiles (in the historic paraphyletic sense), only tortoises of the genus *Kinixys* are known to regularly consume fungi (Hailey et al. 1997. J. Trop. Ecol. 13:469–474), although trace amounts of fungi are recorded in the diet of *Gopherus agassizii* (Hansen et al. 1976. Herpetologica 32:274–251). Thus, our observation may represent the first record of fungivory in a squamate reptile. Our observation of fungivory could reflect either atypical ingestion by a naive animal, or inclusion of previously unrecognized food item that may be difficult to identify from stomach content analysis. As no other tegus were seen feeding on this mushroom after the initial observation, the former alternative is most likely.

We thank Marina Capelari for the specific identification of the mushroom, Augusto S. Abe and Marc P. Hayes for kindly revising the manuscript. Fungi voucher material (DZRC 1002) was deposited in the collection of the Department of Zoology, Universidade Estadual Paulista, Rio Claro, São Paulo, Brazil. CNPq graduate

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UMA EXSUL (Coahuila Fringe-Toed Lizard). **BURROWS.** For sand-swimming members of the genus *Uma,* burial in loose soil is both the typical refuge from predators and a thermoregulatory tactic (Pough 1969. Comp. Biochem. Physiol. 31:868–884; Pough 1970. Copeia 1970:145–157; Pough et al. 1978. Copeia 1978:81–86; Gadsden et al. 2001. Boletín Soc. Herpetol. Mexicana 9:51–66). Some of these authors mention the use of rodent burrows by *U. exsul*, but burrow creation in the genus *Uma* has only recently been recognized. Gadsden et al. (*op. cit.*) first detected the presence of *U. paraphygas* burrows during a study in Chihuahua (Mexico) in 1999 and subsequently noted the same for *U. exsul* at Coahuila. Here, we quantify the relationship between the seasonal density of *U. exsul* and their burrows in southwestern Coahuila, Mexico.

We conducted field work in the sand dune systems of the Mapimian subprovince of the Chihuahuan Desert in the dry Laguna de Viesca in southwestern Coahuila. We examined the seasonal density of *U. exsul* and their burrows in two populations (Gabino Vázquez = A, Saucillo = B) during fall 2000 and spring 2001. The two study plots were located on independent sand dunes separated by 10 km. Each 2 ha study plot was subdivided into 400-m^2 square quadrats (Tinkle and Ballinger 1972. Ecology 53:570–584; Tinkle and Dunham 1986. Copeia 1986:1–18). We flagged each burrow to avoid double counting, and conducted one burrow count in each season sampled. Lizard density was calculated based on Gadsden et al. (*op. cit.*). The lizards were caught with a noose, and were permanently marked by clipping two toes, one per foot (Tinkle and Dunham, *op. cit.*). Finally the toe-clip number was painted on the dorsal side with black, fast-dry enamel and the lizards were released at the site of initial observation (Turner and Schwalbe, 1986. Final Report. Arizona Game and Fish Department Heritage Fund. IIPAM Project No. 195042. 78 pp.). How frequently the areas were censused each day depended on number of lizards previously marked. Generally, the first census required four days, during which virtually all of the lizards observed were unmarked and had to be captured. With each succeeding pass, the number of new individuals decreased and re-sightings increased, allowing more passes per day. Generally, most adults were captured in the early censuses, whereas juveniles tended to be captured towards the tail of census intervals. After each complete pass, the number of new individuals captured was added to the total from all previous passes, giving an estimate of the total present for each of the two populations (Cuellar 1993. Bull. d'Ecologie 24[2–4]:109–149).

We used a Pearson correlation coefficient to assess the relationship between burrow and lizard densities, using data from each season in each of the two populations as separate data points.

We counted a total of 173 burrows (123 in fall, 50 in spring) and a total of 122 lizards (86 in fall, 36 in spring). In population A, we counted 20.5 burrows/ha and 15 lizards/ha in the fall; and 13 burrows/ha and 9 lizards/ha in the spring. In population B, we counted 41 burrows/ha and 28 lizards/ha in the fall, and 12 burrows/ha and 9 lizards/ha in the spring.

We found the densities of *U. exsul* and their burrows to be strongly correlated ($r^2 = 0.998$, $P = 0.001$, $N = 4$). Albeit limited, these preliminary data suggest that burrow density may be a useful indicator of lizard density for this protected endemic species (SEMARNAP 2000. Diario Oficial de la Federación (16 octubre), México, D. F., México.).

We thank Hugo López Corrujedo for fruitful discussions on this topic and suggestions on the manuscript.

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SERPENTES

AGKISTRODON CONTORTRIX (Copperhead). **MAXIMUM PREY SIZE**. On 22 March 2003 at approximately 1100 h, we observed a juvenile Copperhead swallowing a large Cotton Mouse (*Peromyscus gossypinus*) in the Kisatchie National Forest of western Louisiana, USA. The snake's jaws and skin appeared to be stretched to their limits as they reached the posterior end of the mouse. The snake weighed 62 g and the mouse weighed 46 g, which represented a prey weight ratio (WR) of 74%. This prey animal was considerably larger than the mean prey WR of 18.5% and may exceed the largest prey WR of "over 50%" reported by Fitch (1960. Univ. Kansas Publ. Mus. Nat. Hist. 13:85–288).

We thank Paul Leberg and Alan Hitch for help identifying the mouse.

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AUSTRELAPS SUPERBUS (Australian Copperhead) and ***EGERNIA SAXATILIS*** (Black Rock Skink). **PREDATION**. There are relatively few observations of predation events by snakes in the field. Here I report on ambush predation of a Black Rock Skink (*Egernia saxatilis*) by the Australian Copperhead (*Austrelaps superbus*). The observation occurred in the Kanangra-Boyd National Park, Blue Mountains, New South Wales (GR 150003'E, 33058'S) in an area vegetated primarily by Snow and Mountain Gums (*Eucalyptus paucifora, E. dalrympleana,* and *E. macarthuri*)

and Alpine snow grass (*Poa sieberana*). While observing *E. saxatilis* as part of another study, an individual of *A. superbus* was noted basking under a fallen *Eucalyptus* branch. The area of the branch over the snake was raised 5–10 cm above the ground. The snake (~1.5 m TL) was basking in an S-shape with its coils exposed on both sides of the branch and its head hidden beneath the branch. An individual of *E. saxatilis* was observed moving along the ground using the branch for overhead cover, and it ran along the body of the snake from the tail to and over the snake's head. The snake struck the lizard and grabbed its mid-body. The snake had a firm grip on the skink for ca. 2 min. At that point, I pried the snake's jaws open in order to retain a radio-transmitter implanted in the skink. As the skink was alive at the time, I brought the skink back to Sydney and kept it housed in a terrarium. For the next few days the skink could barely move, after which it started recovering and eventually was released. It was found alive in the field and apparently healthy 9 months later.

Because *A. superbus* is generally assumed to be an active forager (Shine 1987. J. Herpetol.21:21–28), it is possible that the snake simply took advantage of an opportunity while basking and was not actually waiting in ambush for prey. Furthermore, not only does this observation document a predation event in the wild but it also provides an interesting anecdote about the effect of venom on a prey item. It is highly unlikely the skink would have escaped from the snake, or even survived in the wild if it had. Irrespective of this, the present skink was in the snake's mouth for about 2 min and presumably was envenomated during this time; the venom was not lethal nor did the skink appear to suffer any obvious long-term effects of the encounter.

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BOA CONSTRICTOR (Boa Constrictor). **DIET**. The diet of *Boa constrictor* is known to include avian prey (Greene et al. 2003. Herpetol. Rev. 34:146; and summarized in Boback et al. 2000. Herpetol. Rev. 31:244–245). Here I report the first non-passerine avian prey item, an adult black vulture (*Coragyps atratus*, Cathartidae), from an adult female *B. constrictor* (244.5 cm TL, 6.85 kg) captured on 22 May 2002, 1549 h, at the Belize City Dump, Belize, Central America (17°29'44.6"N, 88°13'25.3"W).

A *B. constrictor* was found basking with a large bolus in its stomach and appeared to have a broken mandible. After capture, it was noticed that the tail of an adult male iguana (*Iguana iguana*, 2.2 kg) was looped within the boa's mouth, distorting the gular integument. After grasping the snake by the neck, the iguana's tail protruded (~12 cm) from its mouth. It was assumed from the appearance of the bolus that the iguana extended from the pyloric end of the stomach out the mouth of the snake. The iguana was voluntarily regurgitated 2 days post-capture. The boa was collected for experiments and placed in a nylon snake bag. At 43 days post-capture, the boa produced a fecal that contained numerous feather parts and portions of a tarsometatarsus and tibiotarsus of a black vulture. Prey identification was verified by David W. Steadman at the Florida Museum of Natural History.

I thank the Belize Forestry Department, Conservation Division for the opportunity to collect the boa under permit CD/60/3/02.

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BOGERTOPHIS SUBOCULARIS (Trans-Pecos Rat Snake). **PREY**. On 19 May 2003, at approximately 2300 h, we collected an adult *Bogertophis subocularis* on a roadway in the Black Gap Wildlife Management Area in Brewster Co., Texas, USA. The snake had a large lump from a recent meal, and after being placed in a cotton bag it regurgitated two nestling desert cottontail rabbits (*Sylvilagus audubonii*). One prey animal was undigested and the other was nearly completely digested except for the feet, which indicated that the animals represented different meals perhaps from different nests. The lie of the fur on the regurgitated whole rabbit suggested that it had been swallowed head-first. The snake was 415 g and the undigested rabbit was 62 g, which was 15% of the snake's mass. *Bogertophis subocularis* is known to feed on rabbits in captivity and on a variety of other mammals in nature (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. University of New Mexico Press, Albuquerque, New Mexico, 431 pp.; Reynolds and Scott 1982. *In* Scott [ed.], Herpetological Communities, pp. 99–118. USDI Fish Wildl. Serv., Wildl. Res. Report 13; Werler and Dixon. 2000. Texas Snakes: Identification, Distribution, and Natural History. University of Texas Press, Austin, 437 pp.). To our knowledge, however, this is the first report of *B. subocularis* feeding on rabbits in nature.

We thank Paul Leberg for obtaining permits and helping to collect the snake and identify the rabbits. Alan Hitch also helped identified the prey.

Submitted by **BRAD R. MOON** and **ALI M. RABATSKY**, Department of Biology, University of Louisiana at Lafayette, Lafayette, Louisiana 70504-2451, USA; e-mail: BradMoon@louisiana.edu.

BOTHROPS COTIARA (Cotiara) and ***BOTHROPS FONSECAI*** (Fonseca's Pitviper). **REPRODUCTION**. Among the Brazilian continental pitvipers from southern and southeastern regions, the sister species *B. cotiara* and *B. fonsecai* (Salomão et al. 1999. Kaupia 8:127–134) have the most restricted geographical ranges. Both species inhabit isolated remnants of *Araucaria angustifolia* pine forests on highlands, which are exposed seasonally to sub-freezing temperatures (Campbell and Lamar 1989. The Venomous Reptiles of Latin America. Cornell Univ. Press, Ithaca, New York, 425 pp.; Müller 1971. Salamandra 7:9–30) and are under rapid habitat destruction. Data on reproduction for these species are limited, with one report on 14 embryos in *B. fonsecai* (Sazima and Manzani 1998. Herpetol. Rev. 29:102–103). Here I report on a litter of *B. fonsecai*, born on 16 March 1993, and a litter of *B. cotiara*, born on 22 March 1998. Both adult females were collected in the wild (February 1993 and January 1998, respectively) and gave birth in captivity at Instituto Butantan, São Paulo, Brazil. The former species (820 mm SVL, 105 mm TL, and 267 g after parturition) was from Fazenda Pião, Jesuânia, Minas Gerais state, Brazil (21°59'S, 45°17'W, 903 m elevation) produced seven living neonates (3 males, 2 females, 2 unsexed) (mean ± SD: SVL: 264.6 ± 14.5mm; TL: 41.7 ± 5.8mm; 12.71 ± 1.1 g), one stillborn

individual of undetermined sex, and one unfertilized ovum. Additionally, and vouchered in the Coleção Herpetológica "Alphonse Richard Hoge" at the same institution *loc cit.*, on 3 and 14 March 1961, two specimens from Queluz (22°53'S, 44°77'W, 498 m elevation) (IB 19777) and Campos do Jordã (22°73'S, 45°59'W, 1628 m elevation) (IB 19871), São Paulo state, Brazil gave birth to 9 (IB 19778–786) and 10 (IB 19872–881) living neonates, respectively. The *B. cotiara* (860 mm SVL, 90 mm TL, and 325 g after parturition) from São Joaquim, Santa Catarina state, Brazil (28°17'S, 49°55'W, 1354 m elevation) gave birth to 2 live neonates (male: 249 mm SVL 48 mm TL, and 5 g; female 196 mm SVL, 31 mm TL, and 9 g), one disfigured stillborn (unsexed: 115 mm SVL, 25 mm TL, and 10 g), and six unfertilized ova.

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CONTIA TENUIS (Sharp-tailed Snake). **NOCTURNAL BEHAVIOR and HABITAT**. The autecology of *Contia tenuis* is poorly known. It is a small and fossorial species, ranging from central California to Vancouver Island, British Columbia (Stebbins 2003. A Field Guide to Western Reptiles and Amphibians, 3rd edition. Houghton Mifflin, Boston, Massachusetts. 533 pp.). Throughout its range, it is primarily associated with coniferous forests and oak woodlands. It is believed to be primarily active on the surface during cool, wet weather in the spring and autumn (St. John 2002. Reptiles of the Northwest. Lone Pine Publ., Renton, Washington. 272 pp.).

On 17 June 2003, at 2300 h, I observed a male *C. tenuis* (285.7 mm SVL, 7.4 g) AOR, ca. 0.10 mile S of mile-post 22 on State Route 821, Kittitas County, Washington, USA. A second specimen (12.5 mm SVL, 1.3 g,) was observed AOR at 2330 h, ca. 0.25 miles N of mile-post 19, of the same highway. Air temperature was 27.5°C. Both localities are in areas where the vegetation is dominated by rabbit brush (*Chrysothamnus* sp.), big sage (*Artemisia tridentata*), diffuse knapweed (*Centaurea diffusa*), and cheatgrass (*Bromus tectorum*).

The only report of nocturnal behavior in the literature is based on a single observation of a specimen from the southwest coast of Oregon (St. John, pers. comm.). These observations might indicate that *C. tenuis* is nocturnally active through the summer, and surface activity might not be limited to periods of rainfall or similar moist conditions.

I thank A. St. John for discussion, and D. M. Darda for commenting on this manuscript.

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CROTALUS ATROX (Western Diamond-backed Rattlesnake). **ENTRAPMENT and OPPORTUNISTIC COURTSHIP**. Avian exclosure netting (e.g., Bird-X® netting, Dalen Products, Knoxville, Tennessee) is made of polypropylene and is inexpensive (mesh openings measure 18 x 26 mm). This netting is draped over trees and shrubs to exclude birds and other frugivorous animals. Herpetologists have used this material to capture aquatic snakes (Lutterschmidt and Schaefer 1996. Herpetol. Rev. 1996:131–132), suggesting that when discarded or left unattended such netting may pose a threat to wild animals (Stuart et al. 2001. Herpetol. Rev. 32:162–164). Animals trapped and immobilized in exclosure netting do not succumb immediately, but instead may remain alive for days and die from prolonged exposure to the elements. Animals trapped in this netting are at much greater risk of predation; a less recognized consequence of such entrapment is that an animal may not be able to fend off unwanted sexual advances from conspecifics. Here we report the entrapment of two *Crotalus atrox* in avian exclosure netting and a presumed opportunistic mating attempt directed at an entrapped individual. Also, we provide further evidence that exclosure netting can entrap and kill other squamates.

On 29 March 2003, during a herpetology class field trip, we explored an abandoned dump site northwest of Tucson, Arizona (USA). At 1125 h (air temperature 23.3°C, ground temperature 28.2°C, wind < 4 mph, 0% cloud cover) we observed a pair of *C. atrox* next to a bundle of black avian exclosure netting (ca. 30 x 25 x 10 cm) in full sun. Based on behavioral differences, and because we saw another pair of *C. atrox* copulating about 50 m away, we assumed the pair consisted of a male (≥ 1 m total length) and a female (< 1 m total length). The male was engaged in apparent courtship behavior, including dorsal body-looping, tongue-flicking, and chin-rubbing of the female (Gillingham 1987. *In* Seigel et al. [eds.], Snakes: Ecology and Social Behavior, pp. 184–209. Macmillan, New York). We watched for ca. 5 min., but when disturbed by our presence, the male moved ca. 1 m into the shaded lumen of a large diameter pipe. The female was unable to retreat, apparently because she was trapped in an opening of the mesh. Closer inspection revealed that she was entangled approximately a third of the way down her body and her skin was folded and sagging, consistent with dehydration. The site of constriction and ca. 15 mm anterior and posterior of the constriction, appeared somewhat abraded and discolored, but not bloody. We believe her receptivity to the courting male may have been influenced by her immobilized state. We released her by cutting the mesh with a pocketknife taped to a snake stick and she departed into the same shade retreat as the male. The male remained atop the female in the shaded lumen of the pipe for at least two hours.

We examined the netting bundle, which itself was anchored by heavy gauge wire and other debris, and discovered remains of another dead, desiccated *C. atrox* in the mesh. Two pieces were entangled—the first (ca. 75 mm long) comprised a skull with skin and scales attached to anterior vertebrae, and the second consisted of ca. 115 mm of vertebrae with skin and scales from midbody. If it had been summer, the *C. atrox* that we released from the netting would likely have succumbed in a matter of hours without intervention.

One of us (GLB) has noted several squamate captures when avian exclosure netting was used to protect tomato plants in Avra

Valley, near Tucson, Arizona. During a two-year period of using netting in a residential garden, observed fatalities include one each of *Pituophis catenifer*, *Lampropeltis getula*, and *Phrynosoma solare;* two *Masticophis flagellum* (one individual deposited as UAZ 51802); and ca. 5 *Sceloporus magister.* Animals captured and released alive include one *Dipsosaurus dorsalis* and ca. 5 *Sceloporus magister*. Similarly, another local herpetologist (C. R. Schwalbe, pers. comm. 2003) noted that avian exclosure netting used for two years to protect a peach tree in midtown Tucson, Arizona killed several *S. magister* as well as mourning doves (*Zenaida macroura*). Thus, it seems clear that avian exclosure netting may capture a broad range of squamates, and to prevent unwanted fatalities this netting should be monitored when used.

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CROTALUS TIGRIS (Tiger Rattlesnake). **DIET**. *Crotalus tigris* is considered to be primarily a lizard eater (Lowe et al. 1986. The Venomous Reptiles of Arizona), and a *C. tigris* was observed eating a unidentified species of *Aspidoscelis* (= *Cnemidophorus*) (Ortenburger and Ortenburger 1926. Proc. Oklahoma Acad. Sci. 6:101–121). Few species of lizards, however, have been recorded in the diet of *C. tigris*. We document *Crotaphytus collaris* in the diet of *C. tigris*. On 24 July 2002 we located the radio transmitter signal of an adult female *C. collaris* (94.9 mm SVL, 174.4 mm TL, 27.3 g) with a 1.8 g radio transmitter within an adult male *C. tigris* (590 mm SVL, 173 g, including *C. collaris* and radio transmitter) in the southern Tortolita Mountains near Oro Valley, Arizona, USA (32°28.340'N, 111°00.085'W). A radiograph (Fig. 1) confirmed that the *C. tigris* had ingested the lizard and radio transmitter.

We thank Kirk Setser for his critical reading of this manuscript, and James Jarchow for providing the radiograph.

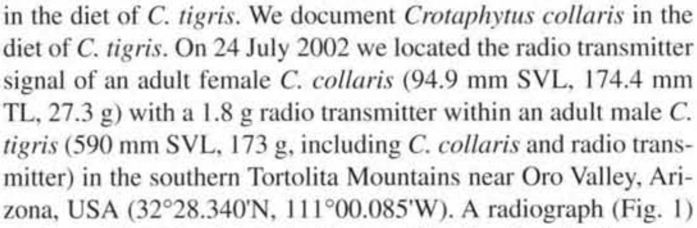

FIG. 1. Radiograph of *Crotalus tigris* showing PIT-tag (top), 1.8 g radio transmitter attached to *Crotaphytus collaris* (middle), and 5.2 g radio transmitter implanted in snake (bottom).

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HYPSIGLENA TORQUATA (Night Snake). **DIET.** Few snakes have been recorded in the diet of *Hypsiglena torquata*, and records include *Crotalus viridis, Leptotyphlops dulcis, Leptotyphlops humilis,* and *Sonora* spp. (Rodríguez-Robles et al. 1999. Copeia 1999:93–100). We report an additional observation of *L. humilis* as prey of *H. torquata*. On 16 July 2002 we encountered a freshly killed adult (302 mm SVL, 61 mm TL, 13.8 g) *H. torquata* at 2205 h on a road in the foothills of the Tortolita Mountains near Oro Valley, Arizona, USA (32°27.227'N, 110°58.552'W, elevation ca. 950 m). Dissection revealed an undigested adult *L. humilis* (203 mm SVL, 11 mm TL, 1.6 g) within the *H. torquata*. Both the *H. torquata* (UTA R-52347) and the *L. humilis* (UTA R-52414) were deposited in the Collection of Vertebrates, University of Texas, Arlington, Texas.

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LAMPROPELTIS TRIANGULUM ELAPSOIDES (Scarlet Kingsnake). **REPRODUCTION**. A *Lampropeltis triangulum elapsoides* collected on 13 March 2003 near Wilma, Liberty Co., Florida, USA, oviposited 10 eggs (total mass of 29.3 g) on 6 May 2003. The largest clutch size reported for this subspecies is seven eggs (Groves and Sachs 1973, J. Herpetol. 7:389–390), but a captive specimen laid nine eggs in each of three consecutive years (Tony Mills, pers. comm.). Immediately postpartum, the female was 60 g, 565 mm SVL, and 653 mm TL. Seven days after oviposition, the eggs had a mean length of 23.2 mm ± 1.69 SD, range = 21.5–26.4 mm, and a mean width of 14.8 mm ± 0.41 SD, range = 14.0–15.5 mm. The total mass of the adherent eggs was 32.1 g on 13 May, and 39.9 g on 19 June. All 10 eggs hatched on 26 June after 51 days of incubation at 23–30°C. Neonates had a mean SVL of 154.4 mm ± 4.25 SD, range = 148–160 mm; a mean TL of 179.6 mm ± 4.74 SD, range = 173–187 mm; and a mean mass of 2.9 g ± 0.12, range = 2.7–3.1 g. The sex ratio was 5:5.

The female laid a second clutch of eggs (N = 8) on 19 June 2003. Her mass was 80 g on 10 June three days before ecdysis, and 50 g immediately postpartum. Seven days after oviposition, the eggs had a mean length of 25.9 mm ± 1.93 SD, range = 24.6–30.4 mm; a mean width of 13.8 mm ± 0.37 SD, range = 13.5–14.6 mm; and a total mass of 25.5 g. Eggs in the second clutch were longer ($t = 3.16$, $df = 16$, $P = 0.006$) and narrower ($t = 5.69$, $df = 16$, $P < 0.0001$) than eggs in the first clutch, but the mean egg mass of the two clutches was identical. One egg hatched on 8 and 9 August, and six eggs hatched on 10 August after 52 days of incubation at 24–30°C. Neonates had a mean SVL of 136.3 mm ± 17.2 SD, range = 109–153 mm; a mean TL of 159.8 mm ± 19.5 SD, range = 129–177 mm; and a mean mass of 2.3 g ± 0.80 SD, range = 1.0–3.0 g. Neonates from the second clutch had a shorter

SVL ($t = 3.23$, df = 16, $P = 0.005$) and lower mass ($t = 2.36$, df = 16, $P = 0.03$) than those from the first clutch, primarily because of the small size of the first two hatchlings (≤ 115 mm SVL and ≤ 1.2 g). The sex ratio was 6 males:2 females.

Multiple clutching has been reported for larger subspecies of *L. triangulum* (Tryon 1984. Trans. Kansas Acad. Sci. 87:98–104; Applegate 1992. The General Care and Maintenance of Milk Snakes. Advanced Vivarium Systems, Lakeside, California. 71 pp.), but this is the first reported instance for *L. t. elapsoides*. However, a long-term captive *L. t. elapsoides* from Hernando Co., Florida, oviposited two clutches twice and three clutches once of fertile eggs from a single breeding annually (Susan Sentman, pers. comm.). Multiple clutching is undoubtedly less common in wild than in captive *L. t. elapsoides* but probably occurs occasionally in larger females, particularly in Florida where the activity period is longer than in more northerly portions of the taxon's range. Groves and Assetto (1976. Herpetol. Rev. 7:114) speculated that a clutch oviposited on 8 October by an *elapsoides* from Miami-Dade County, Florida, might indicate multiple clutching.

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LIOPHIS TYPHLUS (Velvet Swampsnake). **COLORATION.** On 22 March 2003 an adult female *Liophis typhlus* (510 mm SVL, 105 mm TL, 61 g) was captured on the secondary forest floor at the edge of the Río Orosa near the Madre Selva Field Station (03°37'14.7"S, 72°14'47.8"W) in Amazonian Peru. The present animal matched the description in Dixon and Soini (1986.The Reptiles of the Upper Amazon Basin, Iquitos Region, Peru. Milwaukee Pub. Mus.) with the exception of coloration. Ventral scales were white with red to orange margins and numerous blotches of the same color. Dorsal scales were generally red to orange with an olive hue. The diagonal black streaks were limited to the interstitial skin and a black streak was absent between the nostril and eye.

James R. Dixon confirmed identification of the snake. A photographic record has been deposited in the University of Texas at Arlington slide collection (28997).

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MASTICOPHIS FLAGELLUM (Coachwhip). **DIET.** *Masticophis flagellum* feeds upon a wide variety of vertebrates including chelonians. Douglass and Winegarner (1977. J. Herpetol. 11:236–238) reported the remains of a juvenile *Gopherus polyphemus* from the feces of *M. flagellum* in Florida, and an unidentified turtle was reported in the diet of *M. flagellum* in the western United States (Ortenburger 1928. Mem. Univ. Michigan Mus. 1. 247 pp.). Other snakes, including *Crotalus adamanteus*, *Drymarchon corais*, and *Agkistrodon piscivorus conanti* are also known to prey on *G. polyphemus* (Butler and Sowell 1996. J. Herpetol. 30:455–458 and citations therein). However, we are unaware of any records of snake predation on *Gopherus agassizii*. Here we report an observation of predation by *M. flagellum* on *G. agassizii*. On 15 July 2002 at 1132 h we found an adult female *M. flagellum* (945 mm SVL, 205 g) eating a juvenile *G. agassizii* (46.6 mm midline carapace length, 17.0 g) in the southern Tortolita Mountains near Oro Valley, Arizona, USA, 958 m elevation (32°28.250'N, 111°00.528'W). Approximately half of the tortoise was ingested when we encountered the snake (Fig. 1), but the snake regurgitated the tortoise after we disturbed them. After release by the snake, the tortoise was alive but visibly damaged with a dented shell. We captured both the snake and tortoise, measured each, and placed them together in a five gallon plastic bucket. The snake made no further attempt to consume the tortoise. The tortoise died within a few hours of capture, presumably from injuries inflicted during ingestion. The tortoise measured 30.9 mm in width and 16.7 mm in height. The snake's head width (at widest point) was 19.6 mm; head length 39.6 mm, mouth length 27.1 mm. The deceased tortoise (UTA R-52413) was deposited in the Collection of Vertebrates, University of Texas, Arlington, Texas. We thank Randy Hill for the use of his photos.

FIG. 1. Adult female *Masticophis flagellum* eating a juvenile *Gopherus agassizii*.

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MORELIA AMETHISTINA (Amethystine Python). **DIET**. On 20 November 1995 at about 1800 h, during fieldwork in the Crater Mountain Wildlife Management Area of Chimbu Province, Papua New Guinea, I found a large (SVL ~ 5.9 m, measured twice by four workers using a tape) adult male Amethystine Python (*Morelia amethistina*) on warm rocks in a streambed. I brought the snake back to the Crater Mountain Biological Research Station at Wara Sera (10.5 km ENE of Haia village, 6°43'S and

145°05'E) to be held until it could be weighed and photographed the following morning. The snake escaped during the night, and it regurgitated a partially digested Forest Wallaby (*Dorcopsulus macleayi*), ~ 3 kg and BL 40 cm. *Morelia amethistina* is the longest species of snake in the rainforests of New Guinea, and it is an important predator of large mammals (O'Shea 1996. A Guide to the Snakes of Papua New Guinea. Independent Group Pty Ltd., Singapore. 239 pp.). This report is the first record of *M. amethistina* eating *D. macleayi* in Papua New Guinea.

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NOTHOPSIS RUGOSUS (Rough Coffee Snake). **REPRODUCTION.** The Rough Coffee Snake (*Nothopsis rugosus*) occurs in evergreen lowland and pre-montane forests from eastern Honduras to northwestern Ecuador; it is apparently oviparous (Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas. The University of Chicago Press, Chicago. 934 pp.). There is, to my knowledge, no information on its clutch sizes. The purpose of this note is to present information on an egg clutch from *N. rugosus*.

One female *N. rugosus* was examined from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California, USA. The specimen (LACM 153777) was collected 12 June 1974, from Heredia Province, Costa Rica; it is 255 mm SVL and contained three enlarged follicles (mean length 13 mm ± 0.6 SD ± SD, range: 12–13 mm). A clutch of three eggs, presumably, would have been deposited.

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OXYRHOPUS GUIBEI (False Coral Snake). **PREDATION**. The False Coral Snake (*Oxyrhopus guibei*) is a common species in southeastern Brazil, and occurs in both forest edges and open areas. The only records of predation on *O. guibei* refer to the laughing falcon (*Herpetotheres cachinnans*) and the colubrid *Erythrolamprus aesculapii* (Sazima and Abe. 1991. Stud. Neotrop. Fauna Environ. 26:159–169). Here we report on a possible predation on *O. guibei* by the Maned-wolf (*Chrysocyon brachyurus*), the largest South American canid. On 26 April 2002, we found fresh *C. brachyurus* scat on an unpaved road crossing an area of pristine "campo sujo" (shrubby grassland; 22°12'30"S, 47°54'45"W, elev. 760 m) at Itirapina Ecological Station (IES), municipality of Brotas, São Paulo State, southeastern Brazil. The analysis of this scat revealed a fragment (125 mm) of a snake that included an intact tail. It was a young male *O. guibei* (400 mm, estimated SVL; TL was 105 mm).

Besides *O. guibei*, one species of coral snake (*Micrurus frontalis*) and two other supposed coral snake mimics (*O. rhombifer* and *Simophis rhinostoma*) occur in the area. Most predators at the IES seem to avoid snakes with coral snake color pattern (O. A. V. Marques, in prep.; F. Spina, unpubl. data), but *C. brachyurus* does not avoid them; *C. brachyurus* is known to consume venomous snakes, such as the tropical rattlesnake, *Crotalus durissus* (S. C. S. Belentani, unpubl. data) and lanceheads, *Bothrops* spp. (D. Queirolo, unpubl. data), although they are likely to be an occasional food item in most populations (less than 10% of the wolf scats have snake remains; Motta-Junior and Martins. 2002. *In* Levey et al. [eds.], Seed Dispersal and Frugivory: Ecology, Evolution and Conservation, pp. 291–303. CAB International, Wallingford, Oxfordshire, UK.); even so, *C. brachyurus* appears to be an efficient and regular snake predator in the Brazilian Cerrado.

The voucher specimen of *O. guibei* is deposited in the Museu de História Natural, Universidade Estadual de Campinas (ZUEC 2684). D. Zanchetta and the staff of Instituto Florestal allowed and facilitated our fieldwork at IES. Funded by FAPESP (00/12339-2; 00/01412-0; 99/05664-5). We thank L. Pizzatto for laboratory assistance and Gordon Schuett for suggestions. This is publication number 15 of the project "Ecology of the Cerrados of Itirapina."

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PITUOPHIS CATENIFER (Gopher Snake) **DIET.** *Pituophis catenifer* is a large-bodied colubrid that occupies a variety of habitats, including grasslands, oak-woodlands, open forests, as well as deserts (Stebbins 2003. A Field Guide to Western Reptiles & Amphibians, Houghton Mifflin). Its prey base is equally varied, including insects (Parker and Brown 1980. Milwaukee Publ. Mus. 7:1–104), lizards, birds, bird eggs, and mammals (Diller and Wallace 1996. Herpetologica 52:343–360, Fitch 1949. Am. Midl. Nat. 41:513–579). In a recent study, 2613 specimens of *P. catenifer* were examined from most of its distribution (Rodriguez-Robles. 2002. Biol. J. Linn. Soc. 77:165–183). Of 1066 prey items, 86 (8.6%) were birds, seven (0.7%) were nestling birds, and 127 (11.9%) were bird eggs. Here I report on the predation of multiple bird nestlings of two different taxa by *P. catenifer* from a geographic region not covered by Rodriguez-Robles (*op cit.*).

A dead-on-road male *P. catenifer* (116 cm SVL, 240.5 g) was collected on 15 June 2002, 2230 h, between mile-post 13 and 14 on State Route 821 in Kittitas Co., Washington. A noticeable bulge was present 10 cm below the head, extending well into the midbody. Upon internal examination of the snake, an egg, and five recently ingested nestlings (total mass of ingested prey was 14.1 g total) of two different avian taxa were discovered. The egg was small and crushed, and ca. 2.5–3.0 cm long. Because of its condition I was unable to make a positive species identification. The first four nestlings, positioned posteriorly in the stomach, were a species of finch or sparrow that was unidentifiable. The most common species of finch or sparrow in the area where the snake was collected is the Lazuli Bunting (*Passerina amoena*). Several nesting pairs of this species were observed in 2003 during the same

time period that the present snake was collected in 2002. The fourth and fifth birds, positioned more anteriorly in the stomach, were Western Kingbirds (*Tyrannus verticalis*). All of these prey items were preserved in 10% buffered formalin, and transferred to 70% ethanol for permanent storage at Central Washington University.

Although the number of prey items (N = 6) is interesting (only 14 specimens from the study by Rodriguez-Robles (*op. cit.*) contained six or more prey items), what is more significant is that two different avian taxa were taken in apparent rapid succession. All species of sparrow in the vicinity where the snake was found construct nests relatively low to the ground, or on the ground, and Western Kingbirds typically build nests that are elevated from the ground. It would appear likely that the present snake predated a nest near the ground and continued to forage higher, actively searching for avian prey.

I thank K. Wishert for bringing this snake to my attention and D. M. Darda, and P. W. Mattocks for commenting on this manuscript.

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PITUOPHIS MELANOLEUCUS MELANOLEUCUS (Northern Pine Snake). **SEXUAL BEHAVIOR**. *Pituophis m. melanoleucus* is a large, secretive colubrid whose range in Tennessee is limited to a few disjunct populations. Seasonal timing of sexual behavior (e.g., courtship, coitus) in Tennessee populations has not been reported. The only detailed studies on the reproductive biology of *P. m. melanoleucus* have been conducted in the northern-most part of the range, in the New Jersey Pine Barrens (Burger and Zappalorti 1986. Copeia 1986:116–121; Burger and Zappalorti 1991. J. Herpetol. 25:152–160), where breeding takes place in late spring; females seek nest sites from mid-June to mid-July. Zappalorti et al. (1983. Bull. Chicago Herpetol. Soc.18:57–72) observed that this taxon mates in May. We report for the first time copulatory behavior in a pair of *P. m. melanoleucus* from Tennessee.

On 28 May 2001 at 1115 h, we observed a pair of *P. m. melanoleucus* copulating in the southwestern portion of Arnold Air Force Base in Franklin County, Tennessee, USA. The male (123 cm SVL, 1370 g) was an individual being radio-tracked. The female, which had not been observed, was immediately captured and measured (138 cm SVL, 1614 g). The snakes were ca. 1 m above the ground on piled tree trunks and branches in an open area that had been logged approximately one year earlier. The habitat was an early successional "weedy" clear-cut (formerly a loblolly pine plantation) with abundant herbaceous groundcover, no midstory or overstory, and a significant amount of post-logging woody debris. Ambient air temperature was 27°C, and no precipitation occurred in the past 24 h.

Fieldwork was funded by Arnold Air Force Base through contract to CH2M HILL.

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PYTHON SEBAE (African Rock Python). **HABITAT USE and HOME RANGE.** Similar to most other species of python, the ecological and behavioral diversity of *Python sebae* is poorly understood (Pitman 1974. A Guide to the Snakes of Uganda. Codicote Weldon and Wesley, Ltd; Broadley 1983. FitzSimons' Snakes of Southern Africa. Parklands, Jonathan Ball and Ad. Donker; Shine and Fitzgerald 1996. Biol. Conserv. 76:113–122). Interpretation of existing information is obscured because a number of reports generalize and conflate data from geographically and ecologically distant regions (Stucki-Stirn 1979. Snake report 721. Herpeto-Verlag, for Cameroon forests is verbatim from FitzSimons 1962. Snakes of Southern Africa. Purnell and Sons, from South Africa). The biology of free-living individuals is restricted to a study of a Gambian population (Starin and Burghardt. 1990. The Snake, 24:50–62) and one from Nigeria (Luiselli and Akani 1999. Herpetozoa 11:99–107; Luiselli et al. 2001. African J. Ecol. 39:116–118). Here I present radio-telemetric data on habitat use and home range size and characteristics of a single adult female *P. sebae* in the rainforest of southwestern Cameroon.

Locations of *P. sebae* were confined to a mosaic of secondary forest and farms near Bayenti village, Southwest Province, Cameroon. A description of the area is published (Lawson 1993. Herpetol. Nat. Hist. 1:27–90). The present female was collected on 12 Nov 1996, from a snare separating a small subsistence farm from secondary forest. At the time of capture she was ~ 2.4 m SVL, and 3.7 kg. On 15 Nov, she was implanted (Raphael et al. 1996. Wildlife Disease Association Annual Meeting Proceedings, Alaska. p. 82) with an Advanced Telemetry Systems (ATS, Isanti, Minnesota, USA) radio-transmitter with 3 h duty cycle and 3 mo life-span, and released at point of capture 18 Nov. The radio-transmitter was replaced 28 Feb 1997 with an ATS temperature sensitive transmitter and released 11 Mar at the second point of capture. On average, she was located ~ 48 h for one year (201 locations 19 Nov 1996–18 Nov 1997) using a Custom Electronics CE-12 or Telonics TR-2 receiver and hand-held H-antenna. The snake was directly observed on only one occasion as it sheltered approximately 5 m above the ground in the crotch of a tree in a farm. At every other location, she was concealed, either below ground, under and/or inside a log or debris, or high in a tree. Sampling intensity varied monthly from 100% of days in Dec to 20% of days in May, and seasonally from 66% of dry season days (Nov–Mar), to 47% of rainy season days (Apr–Oct). Positions in the field were surveyed and related to a single point geo-referenced with a hand-held global positioning system. Minimum convex polygon and harmonic surface area home range estimates (Table 1) were derived using the Computer Aided Mapping and Resource Inventory System (CAMRIS version 3.46, Ecological Consulting, Inc., 1997). The present female greatly expanded its range into the forest during the dry season; however, the majority of both dry and rainy season movements and locations were confined to a core area of approximately 24000 m^2.

General and microhabitat utilization shifted between seasons

with the snake occupying underground retreats in more open, disturbed areas during the rainy season. In the dry season, she was located 53% of the time (100 samples) in forest, 19% in farm, 22% in a stream, and 6% in heavily disturbed areas (either under a timber bridge along an active logging road or in an abandoned rock quarry). In the dry season, 38% were arboreal, 44% underground, and 18% aquatic. In the rainy season, the snake was located 28% of the time (100 samples) in forest, 41% in farm, 8% in a stream, and 23% in heavily disturbed areas. Of these locations, 31% were arboreal, 57% underground, and 13% aquatic. Although the relative importance of particular habitat types may vary among geographic regions and individual snakes, the utilization of a mosaic of habitats within an individual range as observed here is supported by the observations of Starin and Burghardt (*op. cit.*) as well as other accounts. Broadley (*op. cit.*) reports large specimens of *P. sebae* lying along low, overhanging branches to drop on prey, but does not indicate that they exploit higher forest strata. Starin and Burghardt (*op. cit.*) state that arboreal behavior was not observed in the population they studied in Gambia. Pope (1973. The Giant Snakes. Alfred A. Knopf) emphasized that *P. sebae* lacks strong arboreal tendencies. Although these reports might be partially attributable to structural differences among habitats, the present individual was an excellent climber, and she spent considerable time in canopy habitats. When occupying arboreal retreats, she was typically far above the ground (> 5 m) and not visible. Lack of visibility in arboreal retreats might explain the absence of arboreal observations by Starin and Burghardt (*op. cit.*). Large adult size might preclude the use of some arboreal retreats, but this microhabitat is clearly significant for rainforest animals < 3 m in length.

In this study, the female was within 10 m of a stream or river 81% of times located. Of the 39 locations away from water, 17 occurred in the dry season and 22 in the rainy season. Only 15 of 49 individual retreat locations were >10 m from a stream or river, reflecting this species' reported affinity for water in general accounts from other areas (Murphy and Henderson 1997. Tales of Giant Snakes: A Historical Natural History of Anacondas and Pythons. Krieger Publ. Co., Malabar, Florida). My study female seemed to use streams and a river as travel corridors, occasionally being located in a retreat several hundred meters up or downstream from the previous day's location.

I recorded the present female at 49 different retreats (32 in the dry season, mean 6.4/mo; 39 in the rainy season, mean 5.6/mo) with 37 locations/retreats being used only once, 9 twice, 1 three times, 1 four times, and 1 on 7 different occasions in 6 different months. Of the 12 sites used multiple times, 5 were tree tops adjacent to or overhanging a river; 3 were under logs or other cover immersed at the edge of the river; 2 were under logs and debris in a swampy overgrown pocket in a farm, one was under a log in a small coffee farm, and one was under/in a timber bridge in the middle of the road. She spent >10 d at a single retreat on at least five occasions. The two longest stays were in excess of 20 d following transmitter replacement, but stays of 12, 13, and 15 d occurred during the dry season in rock quarry, in stream, and in coffee farm, respectively. Multiple days in one location might belie more complex movement patterns from secure retreats. On one occasion, at 0848 h, she was tracked to the same site that was occupied the previous day. At 1400 h, a farmer reported that a python (the present female) was in a snare adjacent to his farm ca. 140 m up a small stream from the snake's location earlier in the day. However, given that this snake was located over 200 times and never observed active, it is unlikely that diurnal movement from secure retreats was commonplace. Limited forays from retreats might be an important, but as yet unappreciated, aspect of the species' behavior.

Starin and Burghardt (*op. cit.*) estimated a population size of 20–25 adult *P. sebae* in a study area similar in size (0.335 km^2) to the total minimum convex polygon home range estimate of the present female. Despite that she was trapped on two occasions in one year, no other pythons were found or collected within this animal's home range, and there was only a single reliable report of a large python several kilometers away in similar habitat. Although additional animals could have gone undetected, it is extremely unlikely that more than a few adults had overlapping ranges with the study animal. My observations indicate that this species is not common in the rainforest zone. The extensive use of wire snare traps in the farm/forest mosaic and incidental killing undoubtedly decimate already low forest populations near human settlement.

The present female was weighed in the early dry season at the time of capture (3.7 kg), late in the dry season when recaptured for transmitter replacement (3.4 kg), and late in the rainy season when it was again found in a trap (4.85 kg). These few measurements indicate a loss of mass during the dry season, with considerable gain during rainy season. Body temperatures varied from 24.1°C (Jul) to 34.1°C (May) and did not closely follow ambient temperatures. Available ambient temperatures ranged from 21.5°C to 37.5°C.

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TABLE 1. Home range estimates (km^2) for a single female *Python sebae* in southwestern Cameroon for dry, wet, and combined seasons. Harmonic surface is calculated at probabilities of 0.9, 0.75, and 0.5 (i.e., areas including 90%, 75%, and 50% of locations).

Season	Minimum convex polygon	Harmonic surface		
		0.9	0.75	0.5
Dry season (Nov–Mar)	0.31417	0.14262	0.06528	0.017878
Wet season (Apr–Oct)	0.072319	0.085808	0.066314	0.016653
Dry + Wet (Nov 96–Nov 97)	0.32718	0.10760	0.064781	0.02412

***TANTILLA RETICULATA* (NCN). ARBOREAL ACTIVITY.** Neotropical species of the genus *Tantilla* are fossorial insectivores reported to live under moss and leaf litter (Savage 2002. The Amphibians and Reptiles of Costa Rica. A Herpetofauna Between Two

Continents, Between Two Seas. The University of Chicago Press, Chicago. 934 pp.). A single individual of *Tantilla reticulata,* collected from under moss on a tree limb at a height of 6.1 m, is the only documented case of any arboreal activity for this species (Wilson and Meyer 1971. Herpetologica 27:11–40).

In the course of several years of work in the canopy of Costa Rican rainforests, four individual of *T. reticulata* were observed crawling on tree branches at heights of over 27 m. None of these individuals, unfortunately, was vouchered. On 8 March 2003, during a visit to Rara Avis Rainforest Reserve, Heredia Province, Costa Rica (10°18.16'N, 84°02.62'W; 650 m elev.), an adult *T. reticulata* was observed falling from the thatched roof of a building from a height of ~ 5 m. In addition, on 12 March, about 1400 h another *T. reticulata* was observed actively moving about on an epiphyte-covered branch of an emergent canopy tree (*Vantanea barbouri*) at a height of 30.7 m above the ground. Both snakes were collected, photographed (YPM slide collection 1025–26), and released *in situ*. Gregory Watkins-Colwell verified identification of the present snakes.

These observations indicate that *T. reticulata* is more arboreal than previously assumed. The crowns of epiphyte-laden trees in the Rara Avis area provide a microhabitat with a humus layer and moss cover that is often more extensive than that of the local forest floor. It is not clear, however, how these small snakes detect the presence of a suitable habitat far overhead or how they succeed in reaching the canopy, crossing a vertical distance of 30 meters on smooth tree bark.

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TRIMORPHODON BISCUTATUS (Western Lyresnake). **PREDATION**. On 7 May 2003, 1250 h, we tracked a male *T. biscutatus*, 810 mm SVL and 153 g, implanted with a 5.2 g radio transmitter in the southern Tortolita Mountains near Oro Valley, Arizona, USA (32°28.201'N, 110°59.015'W). We located the transmitter signal from within 1 m of a *Bubo virginianus* (Great Horned Owl) nest site, which was actively defended by an adult pair of *B. virginianus*. Assuming the snake was dead, we left the site to avoid disturbing the owls further. On 14 May 2003, the owls were not present at the nest, and we found an owl pellet containing the snake's transmitter (Fig. 1) just below the nest. Great Horned Owls are generalist predators, preying on a variety of vertebrates including snakes (Houston et al. 1998. Great Horned Owl. Birds of North America. 372:1–28). We know of no previous records of avian predation on *T. biscutatus*.

FIG. 1. A pellet from *Bubo virginianus* containing a 5.2 g radio-transmitter from *Trimorphodon biscutatus*.

We thank Kirk Setser for his critical reading of this manuscript.

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GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 35, Number 1 (March 2004). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extensions unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA OPACUM (Marbled Salamander). USA: ARKANSAS: SEVIER CO: 8.0 km W Falls Chapel off Frog Level Rd. 28 February 2004. Z. D. Ramsey. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 28277). Verified by Stanley E. Trauth. New county record filling hiatus in extreme southwestern Arkansas (Trauth et al. In press. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville). Also reported previously from adjacent McCurtain County, Oklahoma (Sam Noble Oklahoma Museum of Natural History Database of Amphibians [http://www.snomnh3.ou.edu/db/amphibians/]; Oklahoma Biological Survey's Distribution of Oklahoma Amphibians and Reptiles by Recorded Sightings, DOKARRS [http://www.biosurvey.ou.edu/dokadesc.html]).

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AMBYSTOMA ORDINARIUM (Mexican Stream Salamander). MÉXICO: MÉXICO: Municipality of Malinalco (18°56'32"N, 99°29'18"W). 27 May 1941 and 20 February 1948. L. Verdeja. ENCB 2548–2550, 2611–2615. Municipality of Tianguistenco: Laguna Santiago Tilapa (19°11'22"N, 99°25'4"W). 25 October 1964. R. Aguilar and R. Cruz C. ENCB 3545–3553. Municipality of El Oro de Hidalgo (19°48'4"N, 100°8'4"W). 9 May 1964. H. Romero and P. Reyes. ENCB 3485–3504. Verified by Fernando Mendoza-Quijano. First records from state of México (Casas-Andreu et al. 1997. Univ. Auntón. Edo. México. Ciencias y Técnicas/32. 201 pp.) and extends the known range southeastward ca. 140 km from Ciudad Hidalgo, Michoacán (Anderson 1975. Cat. Amer. Amphib. Rept. 164:1–2).

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TECHNIQUES

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The Use of Polystyrene for Drift Fence Sampling in a Tropical Forest

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Drift fences used with pitfall and/or funnel traps are a standard field technique used to sample amphibian and reptile communities (Campbell and Christman 1982; Corn 1994). Drift-fence sampling is effective in collecting large numbers of animals in a relatively short period of time (Gibbons and Semlitsch 1981; Rodda et al. 2001).

A variety of materials have been used for drift fences, but aluminum flashing is the best choice for long-term studies because of its durability (Gibbons and Semlitsch 1981). Aluminum flashing is expensive and often is not feasible for short-term inventory studies that do not have a large budget. Polyurethane has been used for drift fences to study amphibian reproductive biology by encircling breeding ponds (Douglas 1979).

Enge (1997) proposed the use of silt fencing as an alternative. Silt fencing is a woven polypropylene material that is about one-third the cost of aluminum flashing and is particularly desirable when sampling hydric environments. Silt fencing can also be used in terrestrial habitats. Zug et al. (2001) report the use of silt fencing for monitoring amphibian and reptile populations at a tropical site in Myanmar and one of us (JHM) has used silt fencing for short-term sampling (2–3 months) of herpetofaunal communities in the Edwards Plateau of Texas.

In the tropics, where "common species are rare and rare species are common" (Forsyth and Miyata 1984), drift-fence sampling might be an effective technique to sample amphibian and reptile species, yet little data are available (but see Brown et al. 1996; Zug et al. 2001). In the United States aluminum flashing and silt fencing are both readily available, but elsewhere, particularly in the tropics, this may not be the case. Furthermore, the cost of importing aluminum flashing or silt fencing via air carrier might be exceedingly high because of the weight of the material. Another problem with drift fencing in wet tropical forest is the high rate of treefalls (Brokaw 1996). Treefalls can destroy aluminum or silt-based drift fencing and require considerable effort to repair (pers. obs.). Therefore, for drift fence sampling to be convenient and feasible in a tropical forest, the material must be available, affordable, and the drift fence should be repairable in a modest amount of time. As an alternative to aluminum flashing and silt fencing, we herein describe the use of polystyrene to construct drift fences

used in a baseline amphibian and reptile inventory of Parque Nacional Carara (PNC) (09°46'27.0"N, 84°36'20.0"W), Puntarenas Province, Costa Rica.

Polystyrene, a thermoplastic, is more rigid than polyurethane. We purchased 0.76-mm thick polystyrene in 180 x 120 cm sheets from a plastic dealer in San Jose, Costa Rica (Serigráficos Suretka S.A. c/o Plasticom M&F). The cost of this material was ca. US \$53/trap (one trap = 19.44 m^2 of fence or \$2.73/m^2 of polystyrene) which is less expensive than US \$71/trap (\$3.65/m^2) for aluminum flashing. We cut these sheets into 40 x 180 cm sections that were rolled into bundles for delivery to the sampling site. Nine sections were laid end to end and slightly overlapped, thereby creating a drift-fence arm ca. 15 m in length. Lacquer thinner solvent (33.7% acetone, 2.8% methyl isobutyl ketone, 1.9% glycol ether, 37.3% heptane, 8.6% isopropyl alcohol, 3.9% methanol, and 11.9% toluene) was applied to each section with a paint brush. There is a health risk associated with inhaling vapors of lacquer thinner and care should be taken to avoid excessive exposure to vapors. These overlapping sections were pressed together for approximately five seconds to fuse the sections, thereby creating a continuous fence. Because the sections are fused and not glued, the fence can withstand a myriad of weather conditions without coming apart.

Drift fences were installed in a "Y" formation. Each fence arm was set upright and held in place using 40 cm wooden stakes at ca. 2 m intervals. Leaves were then placed at the bottom of the fence to seal gaps and prevent animals from crawling under the polystyrene. Each fence arm was set at an approximately 120° angle. At the end of each arm and at the junction of the three arms, a 19-liter plastic bucket was sunk flush with the substrate. A notch was cut into the lip of each bucket to hold the fence in place. In the middle of both sides of each arm (ca. 7.5 m) a 45-cm funnel trap was placed flush with the polystyrene fence, for a total of six funnel traps/array. Funnel traps were made by rolling a 45 x 60 cm section of 3-mm aluminum screen into a cylinder. Next, two cones were fashioned from two 30 x 60 cm sections of aluminum screen. These cones were inserted on each end of the cylinder and attached with baling wire to form the completed funnel trap.

During 154 trap nights from May 1999 to April 2000, six polystyrene arrays were used to sample amphibians and reptiles (one array open/night = one trap night). A total of 41 frogs, 76 lizards, and eight snakes were captured, representing 28 species of amphibians and reptiles. The most common frog species was *Dendrobates auratus* with 20 captures. *Ameiva leptophrys* was the most common lizard species with 28 captures. *Mabuya unimarginata, Micrurus alleni, Rhadinaea decorata,* and *Urotheca decipiens* were recorded in the park only from drift fence captures.

In the case of treefalls, polystyrene drift fences offer advantages over other materials. A treefall on aluminum flashing or silt fencing is difficult to repair and can leave the array with permanent damage (pers. obs.). Polystyrene fences can be fixed quickly and easily. During this study, several treefall events occurred. Repair was accomplished by moving the tree or branch, cutting out the broken fence sections and replacing them with new sections using methods described above. After tree removal, the fences were repaired in ca. 15 minutes. Repair is further facilitated by the fact that materials can be rolled into light bundles for easy transportation.

Acknowledgments.—We kindly thank Miguel Regueyra Edelman for suggesting the use of polystyrene as a potential drift fence material. This study was authorized under Ministero del Ambiente y Energía Resolución No. 237-98-OFAU and Resolución No. 019-2000-OFAU. The East Texas Herpetological Society and the Explorers Club (Youth Activity Grant) provided funding to JHM. Also, thanks to James and Mary Dixon, and Thad Williams for helping to install drift fences and constructing funnel traps. The Parque Nacional Carara staff provided facilities and logistical support during the study. Janalee Caldwell edited and thereby greatly improved the quality of the manuscript.

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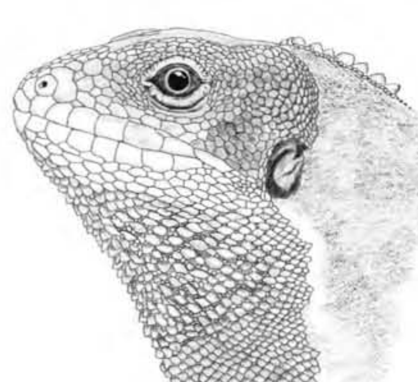

Brachylophus fasciatus (Fiji Banded Iguana). Illustration by John Bendon (Lizardwizard@btinternet.com).

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Outdoor Enclosure Design and Technique for Studying Three-Dimensional Movement Patterns of Arboreal Lizards

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For arboreal lizards, field studies often are impractical because of poor visibility in the canopy, whereas laboratory studies lack realism. The use of large, outdoor enclosures that allow for movement and behavioral observation would provide the researcher an opportunity to observe behavior in a semi-natural setting while maintaining the ability to manipulate and control desired experimental variables. However, the literature is void of any suggestions on how to construct large, outdoor enclosures for studying arboreal lizards. We describe a technique for constructing large outdoor enclosures for arboreal lizards and outline a methodology for monitoring diurnal movement patterns within these enclosures using focal observations.

Enclosure design and construction.—We constructed six, large outdoor enclosures for use in a behavioral and physiological study of the panther chameleon, *Furcifer pardalis*. In this study, it was necessary to observe and record behavior while simultaneously manipulating variables related to physiological parameters. This required the use of large enclosures that allowed for experimental manipulation and ease of behavioral observation. Each circular enclosure measured ca. 2.2 m in height and 2 m in diameter. We are presenting the specific dimensions of the enclosures used in our studies, however potential modifications of the dimensions to suit other studies will be discussed below. The enclosures were constructed using 1.27 x 2.54 cm mesh welded wire. Welded wire was purchased in 30-m rolls and measured 1.2 m in width. We surveyed the study site to determine the areas most suitable for enclosure construction. Typically, we constructed enclosures near trees 2 m or less in height with dense foliage. Once a central tree was designated, all other trees were cleared from the area within a 2-m radius.

Small, moveable markers were used to outline a uniform circle of ca. 2 m diameter around the tree. A trench was then dug to a uniform depth of ca. 10–15 cm along the circle. The width of the trench was ca. 7.5–12.5 cm to accommodate any expansion or sliding of the wire. We measured the circumference of the trench and cut a piece of welded wire commensurate in size (adding 30–60 cm for overlap). We placed the wire in the trench, with the ends overlapping, and temporarily secured each end to form an enclosed circle. Four, small metal posts were placed along the outside of the enclosure, and the wire was secured to the posts to prevent collapse. Once secured vertically to the posts, we permanently

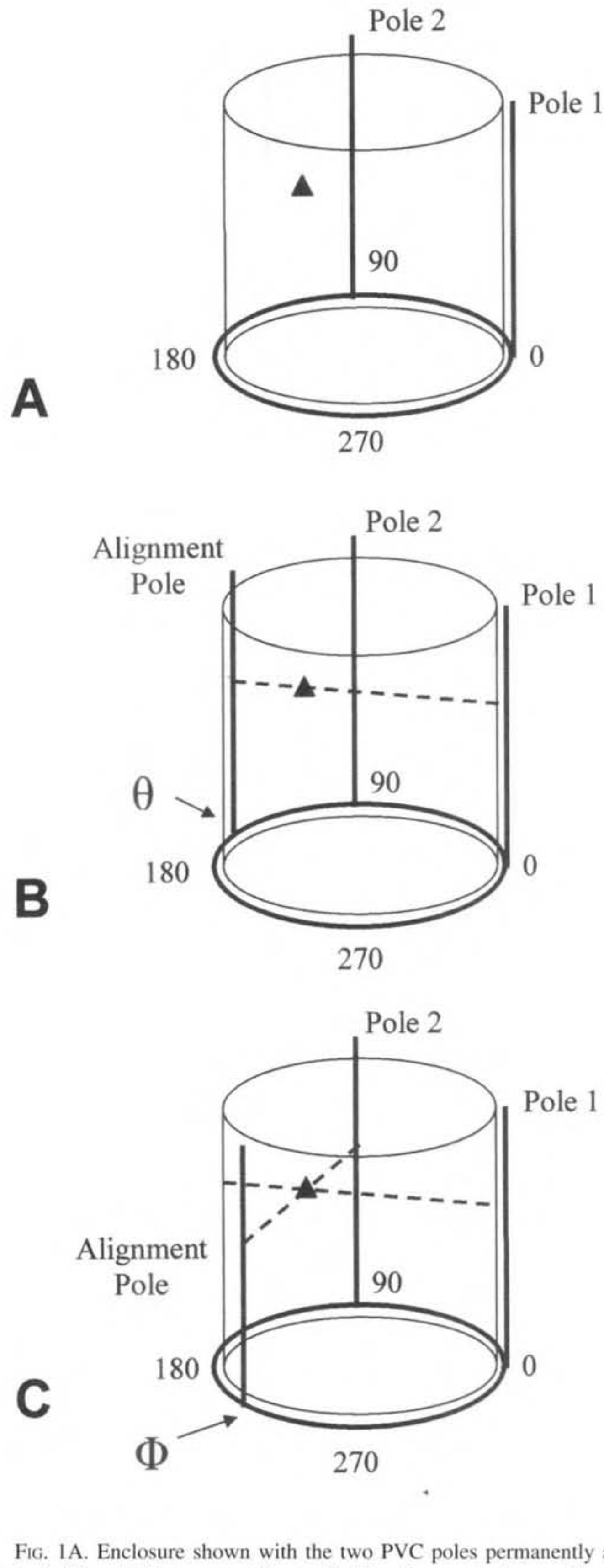

FIG. 1A. Enclosure shown with the two PVC poles permanently attached at 0 and 90 degree coordinates. B. The alignment pole was aligned in the same plane as the lizard (solid triangle) and the pole at 0 degrees (θ). C. Next, the alignment pole was aligned in the same plane as the lizard and the pole at 90 degrees (Φ). Additionally, the height of the lizard was recorded (H_L), providing a quantitative three-dimensional position. See text for details.

secured the overlapping ends of the wire using J-clamps. We then placed aluminum flashing with a width of 60 cm along the inside of the enclosure, then filled the inner portion of the trench with soil to press the flashing flush with the wire. The aluminum flashing prevents arboreal lizards from climbing onto the welded wire (with the exception of lizards with adhesive toe pads), preventing them from using the wire rather than the enclosed habitat. Once the flashing was flush with the wire mesh on the inside, we filled the outer portion of the trench with soil. This 1.2-m high wire structure serves as the foundation for the rest of the enclosure.

We then cut another section of wire of the same circumference as the first section of wire to serve as the second layer, adding an additional 80–90 cm in height to the enclosure. The second layer was secured to the first layer permanently using J-clamps, with ca. 30–40 cm overlap, yielding a total height of ca. 2.0–2.1 m.

To allow access to the inside of the enclosure, we cut a 1 x 1 m square out of the side of the enclosure, and placed a piece of wire mesh slightly larger than the opening over the entrance, securing the left side using J-clamps. This procedure allows door opening and closing with minimal bending of the wire. We securely fastened the door (the unattached end) to the enclosure using taught springs with hooks on each end, providing quick opening and closing of the door.

We constructed the roof of the enclosure using two sections of wire mesh cut ca. 60 cm larger in diameter than the enclosure. These two pieces were attached using J-clamps to form a square piece of mesh that was larger than the diameter of the enclosure by 60 cm on all four sides. The square piece (roof) was securely attached to the enclosure by weaving it to the side of the enclosure with steel wire. The top piece was then cut to a circular shape, and we made eight additional cuts perpendicular to the cylinder to allow segments to be bent downward and lay flush with the sides of the enclosure.

Construction of one enclosure requires approximately two days work, and costs ca. US $90–100. This design provides a sturdy, yet affordable and long-lasting enclosure. After four years, there have been no signs of degradation of enclosures.

Monitoring diurnal movement patterns.—Movement patterns of arboreal lizards can be monitored using these enclosures. To precisely monitor movement patterns, one needs three coordinates to find an exact location in three-dimensional space. We marked coordinates around the circumference of the enclosure, from zero to 359 degrees. At zero degrees, we secured to the enclosure a 2.54 cm wide PVC pole approximately the same height as the enclosure. At 90 degrees, we attached another pole to the enclosure (Fig. 1A). We utilized a third pole of similar size, in combination with the other two, to determine the three-dimensional coordinates of a lizard at any given time. However, the third pole (hereafter referred to as the alignment pole) was not secured to the enclosure, but instead was movable. We marked the alignment pole with height markers starting from zero at ground level. We placed the alignment pole along the outside of the enclosure while visually aligning the alignment pole, the lizard, and the pole located at zero degrees within the same linear plane (Fig. 1B). We then recorded the first coordinate by noting the degree at which the alignment pole was located (angle θ). To obtain the second coordinate, we visually aligned the alignment pole, the lizard, and fixed pole two (at 90 degrees) in the same linear plane and recorded the degree at which the alignment pole was located (angle Φ, Fig. 1C). Using the height markers on the alignment pole, we next recorded the height at which the lizard was found (H_L), giving a precise, quantitative three-dimensional location of the lizard (Fig. 1C). Utilizing this methodology, we monitored lizard movement patterns throughout the enclosure for the duration of a 12-h diurnal period. Data collection required human presence near the enclosure for brief periods, but there were no observable impacts on lizard behavior. However, caution must be exercised to minimize the duration of coordinate data collection as longer periods of data collection may adversely affect lizard behavior.

This three-dimensional tracking method can be used to replicate animal movements, or it can also be visually interpreted in a three-dimensional scatterplot. Converting actual coordinate data (θ, Φ, H_L) into an x-y-z coordinate scatterplot requires the use of a series of relatively simple equations:

$$x = 1 + \alpha / \alpha - \beta \qquad (1)$$

$$y = -\alpha(\beta - 1) / \beta - \alpha \qquad (2)$$

$$z = \gamma (H_L / H_T) \qquad (3)$$

where:

$\alpha = \sin\theta / (\cos\theta - 1)$

$\beta = (\sin\Phi - 1) / \cos\Phi$

γ = enclosure height / enclosure radius

H_L = height of lizard

H_T = height of the enclosure

Coordinate data recorded from the enclosures (θ, Φ, and H_L) can be converted to x-y-z coordinates using many types of spreadsheet software packages. Once the data are converted to a three-dimensional scatterplot, data points can be viewed as a cloud of microhabitat locations (using software packages such as SigmaPlot or SPSS), or the distance traveled by the organism can be calculated providing the radius and height of both the actual and virtual enclosures are known. In the x-y-z scatterplot, the radius of the enclosure is 1 unit. In our study, the height of the enclosure was approximately two times the radius, thus the height of our enclosure in an x-y-z scatterplot is 2 units. However, the ratio of height:radius (γ) should be adjusted for studies that deviate from our dimensions.

This design establishes a protocol that might be beneficial in many behavioral studies. This technique can be used to determine movement directions, movement patterns, movement distances, and microhabitat use in relation to environmental variables in a variety of organisms. Although these enclosures were constructed for use in studies of arboreal chameleons, they could be used in other studies where behavior might be difficult to record in the field. This design is flexible enough to allow the researcher to modify enclosure size, depending on the size and spatial requirements of the animal. This design might be extended to other taxa including arboreal *Sceloporus* species, *Abronia* species, other chameleon species, or even avian or small arboreal mammals. A shorter, larger diameter enclosure could also be employed in studies of terrestrial, non-fossorial lizards. Not only does this enclosure design provide plasticity in construction parameters, but it

also provides an ideal way to observe and quantitatively record movement patterns and microhabitat locations without disturbing animal behavior.

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A New Method for Immobilizing Fossorial Frogs After Radiotransmitter Implantation and Notes on Movement Patterns of the Pig-nosed Frog, *Hemisus marmoratus*

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Little is known about the activity patterns and habitat use of fossorial anurans. Radiotelemetry provides a solution to tracking such individuals over longer periods of time (Richards et al. 1994). However, transmitters need to be implanted for anurans that spend a substantial proportion of their time buried underground. In anurans, the healing of cuts after transmitter implantation, is made extremely difficult especially in small species that inflate their lungs in response to disturbance or as a means to enlarge underground burrows.

In this study we describe a method of immobilizing frogs that prevents sutures from rupturing and thus shortens the healing process after implantation of transmitters. This method was used in a study of the population biology of the pig-nosed frog *Hemisus marmoratus*. Our study was conducted in the Comoé National Park, Ivory Coast, West Africa at the beginning of the rainy season in 1997. Previous work in West Africa has shown that female pig-nosed frogs provide parental care in terrestrial breeding chambers (Rödel et al. 1995) and release tadpoles by either opening flooded chambers or leading tadpoles to open water over a slide (Kaminsky et al. 1999). Our objective in transplanting transmitters in females was to obtain information on migration patterns and habitat use during the breeding season.

Materials and Methods. —To determine movement patterns of pig-nosed frogs we implanted radiotransmitters (1.15 ± 0.04 g) into the body cavity of five females. We used a PLL synthesized tracking receiver (TRX-1000S, Wildlife Materials Inc.) and senders with individual frequencies (Holohil Systems Ltd.) that had a maximal range of 50 m, a life-span of two to four weeks, and were equipped with magnetic reed switches to activate or deactivate the sender.

Females were captured at a drift fence as part of a long-term study of the population biology of *H. marmoratus*. We picked only females whose mass was at least 10 times that of the sender (12.7 ± 1.08 g, range 11.8–14.5 g). Males were too light to be included in the study (range 2.5–5.6 g). Females were anesthetized by placing them in a 0.001 % solution of MS-222 Sandoz (Sigma). After 30 min females were turned on their backs and a small incision made through the ventral skin and abdominal wall. The activated sender was then placed in the abdominal cavity and the peritoneum and epidermis sown together with linen thread.

To prevent the fresh suture from rupturing when females inflated their lungs, a common occurrence in many anuran species, individuals were placed in customized plastic restrainers (Fig. 1). Restrainers were molded from an alginate (Alginoplast, Bayer Dental) imprint of a large female museum specimen. The alginate was diluted to a watery solution to lengthen processing time. After the alginate had hardened and the preserved specimen had been removed, we poured a fast-binding dental plaster (Dento-Stone Klassik, Dentona) into the mold. The ventral side of the female mold was then covered with translucent foil (Omnidur 2 mm, Omnident) to form the bottom of the restrainer. The foil was heated with a Bunsen burner to make it workable. The dorsal side of the mold was fitted with light hardening plastic (Individo Lux, Voco) to form the top of the restrainer. Caudal and cranial holes of 3–5 mm were left open to allow water to pass through the restrainer.

Females who had been implanted with radiotransmitters were placed into the restrainer and both halves held together with rubber bands. To prolong battery life, a magnet was placed on the restrainer to activate the switch and interrupt the current in the transmitter. To reduce the duration of anesthesia, water was repeatedly poured through the restrainer until we could clearly see females breathing through the translucent bottom. Restrainers were then packed into a wet towel to prevent females from desiccating and the healing process observed through the opaque half of the restrainer. After three days females were removed from the restrainers and placed into plastic terraria (23 x 15 x 24 cm) with a wet sponge for several days. After new epidermis had formed, the

FIG. 1. Restrainer used to immobilize females after surgical implantation of a radiotransmitter.

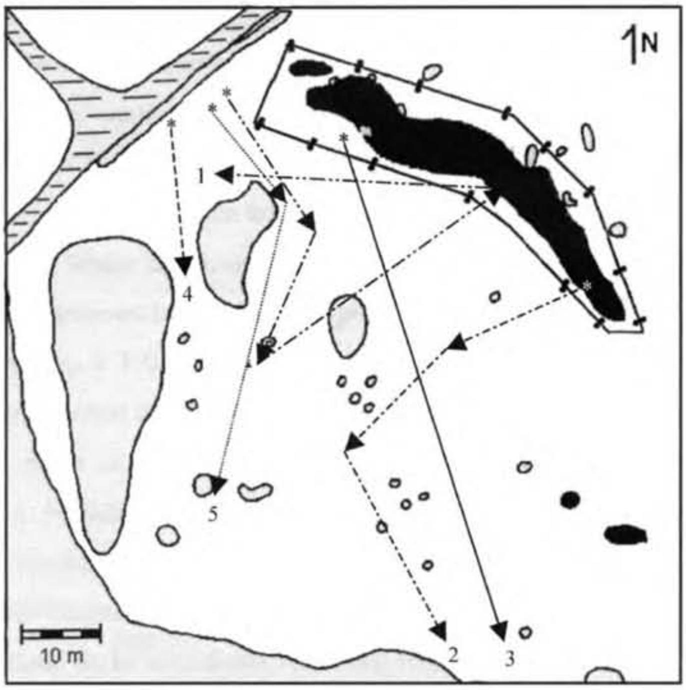

FIG. 2. Patterns of movement of five *Hemisus marmoratus* females implanted with transmitters. Black surfaces indicate ephemeral ponds, white areas grass savanna, gray areas bush savanna and the hatched area is a dirt road. The black lines with circles show the location of a drift fence with pit traps. Stars indicate where females (1–5) were found and released after transmitter implantation. Arrows show the direction of movement and numbers indicate the location at which females were last found. Last sites of females 2 and 3 were outside the area of the map.

suture fell off together with the voided skin. Because females spent most of their time underneath the sponge it was possible to place a magnet underneath the terraria to continue interrupting the circuit in the transmitter. Females were released with the next rains at the study site after wounds had completely healed. Their position was determined telemetrically at regular intervals two to three times a day.

Results and Discussion.—We followed five females and determined their activity pattern over a time period between 8 and 32 days. No adverse effects of surgery were seen in females recovered in the field. Fig. 2 shows the movement patterns of females. FEMALE 1: We followed Female 1 for 32 days. She remained for eight days at the release site, migrated 40 m south on a night after it rained and spent 11 days submerged under a clump of grass. Two days later Female 1 was found in amplexus at the fence; we placed her over the fence and two hours later she was still in amplexus trying to leave the fenced area. We again lifted her over the fence; she traveled west for 40 m where she was located underground, presumably attending eggs in her nest. Female 1 remained at this site for the following 11 days until a downpour flooded the area and the signal was lost. Most probably the female opened the nest cavity that night, released her tadpoles and left the study area. FEMALE 2: Female 2 burrowed 5 cm into the ground after being released inside the fenced area. She did not move for 15 days at which time battery power was low and she was excavated. This female was again implanted with a transmitter and released at the same site; upon release she migrated over 185 m south on three nights when it rained. Six days after being released her signal was lost. FEMALE 3: Female 3 moved 150 m into the bush savanna during one night and spent nine days buried under a grass clump 5 cm beneath the surface until reduced battery power led us to excavate her and remove the transmitter. FEMALE 4: Female 4 spent four days buried underground at the release site until it rained; she then moved 25 m in a southerly direction, burrowed into the substrate again and remained there for the next eight days. Despite an intensive search, no signal was detected the next day. FEMALE 5: Female 5 also spent four days buried underground. During the next rain she migrated 60 m southeast, then to the southwest. After five days underground, we lost contact with Female 5.

The loss of signals can be attributed to females leaving the study area, to predation, or to transmitter failure (although we think transmitter failure unlikely). All females that were fitted with transmitters were active above ground after rains. Dry periods between rains were spent underground where they were seemingly inactive. This activity pattern is consistent with earlier studies that suggest the pig-nosed frog spends most of its time below ground and emerges mainly for reproduction and possibly to feed (Passmore and Carruthers 1979; Rödel 2000; Stewart 1967; Wager 1986).

The telemetry data did not reveal use of distinct home ranges. Instead individual females seemed to roam widely throughout the area. Additional pig-nosed frogs need to be followed to determine whether they use distinct home ranges or not. It seems likely that we followed females during their excursions to and from breeding sites and that their home ranges lie elsewhere (see Spieler and Linsenmair 1998).

None of the females recovered showed any infections, inflammations, or other negative effects of the implants. Implanted transmitters have the great advantage of not hampering frogs searching for retreat sites or in amplexus and are an absolute necessity in tracking fossorial species such as *H. marmoratus*. The restrainer described in this study prevents sutures from rupturing due to lung inflation in response to disturbance and thus considerably shortens the healing process. It is recommended for all small anurans in which transmitters are implanted.

Acknowledgments.—We thank the government of the Ivory Coast for granting the necessary research permits. For assistance in the field we thank Alexandra Dill and Annette Schmidt. We also acknowledge the technical expertise provided by Christian Menrad and Müller's dental laboratory in Wolfsburg. The experiments comply with current laws and ethical standards in Germany and the Ivory Coast. This study was supported by grants from the Volkswagenstiftung (AZI/64 102) and the Deutsche Forschungsgemeinschaft (SFB 251/B3).

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A Comparison of Aquatic Drift Fences with Traditional Funnel Trapping as a Quantitative Method for Sampling Amphibians

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Recent reports of amphibian declines have sparked increased efforts to inventory and monitor amphibian populations worldwide (Keisecker et al. 2001; Pechmann and Wilbur 1994). Standard techniques for the quantitative inventory and monitoring of amphibian populations include systematic observations, automated recording of calling anurans, drift fences with pitfall traps, and aquatic funnel trapping of amphibian larvae (Heyer et al. 1994). Terrestrial drift fence arrays with pitfall traps are an effective way to sample general species richness of amphibians and can be especially effective at detecting rare or cryptic species (Corn 1994; Gibbons and Semlitsch 1982). Drift fences intercept the movements of animals and guide them into traps, generally increasing capture rates (Corn 1994). Aquatic drift fences, or net leads, have been effectively used to increase trap capture rates for fish (Hubert 1983) and turtles (Vogt 1980); however, they have seldom been used to sample aquatic amphibian species and life stages (but see Beuch and Egeland 2002; Enge 1997a).

One preferred method for sampling aquatic amphibians and amphibian larvae is funnel trapping of aquatic environments (Heyer et al. 1994; Olson et al. 1997). A variety of funnel traps have been used, including cylindrical wire or plastic minnow traps, collapsible rectangular traps, and plastic soda bottles with the top inverted (Adams et al. 1997; Beuch and Egeland 2002; Willson and Dorcas 2003). Beuch and Egeland (2002) tested the efficiency of several different types of aquatic funnel traps for capturing amphibian larvae in seasonal forested wetlands in Minnesota. They applied the drift fence principle to aquatic funnel trapping by staking a 3.0-m section of minnow seine between two cylindrical minnow traps. They concluded that the seine did not increase trapping efficiency.

We compared the effectiveness of aquatic drift fences to traditional funnel trapping for capturing amphibians within a large ephemeral wetland in the western Piedmont of North Carolina. We used a paired-sample design, with five pairs of trap arrays, to account for spatial variation in amphibian abundance within the wetland. Each pair consisted of one experimental and one control array, set 1 m apart in a straight line (Fig. 1). The relative position (right or left) of the experimental and control arrays was determined randomly and locations for the five pairs of trap arrays within the wetland were chosen based on comparability of water depth (approximately 0.5 m) and uniformity of habitat.

Each experimental array consisted of four collapsible rectangular mesh minnow traps [model RN10; Memphis Net and Twine Co. Inc., Memphis, Tennessee; US $10.99] placed at each end and along the middle of a 3.0-m long section of silt fencing (Enge 1997) supported by three wooden stakes (Fig. 1). To ensure that trapped animals had access to air we placed an air-filled 0.6-L soda bottle inside each trap to serve as a float and tied traps loosely to 1-m bamboo garden stakes, allowing the trap to slide up and down with fluctuations in water level. Each control array consisted of four traps, positioned identically to the first array, but without silt fencing (Fig. 1). To examine the efficiency of this technique, we recorded the time required to set up and monitor both experimental and control arrays.

We checked traps every other day between 17 March and 3 April 2002 and identified to species, counted, and released all amphibians captured. MANOVA (SAS 2000; alpha = 0.05) was used to assess the effects of fencing on amphibian captures and to make univariate comparisons for individual species, life stages, and number of species captured between experimental and control traps.

Over the 18-day trapping period we captured a total of 998 amphibians representing 8 species (Fig. 2). Traps with drift fencing

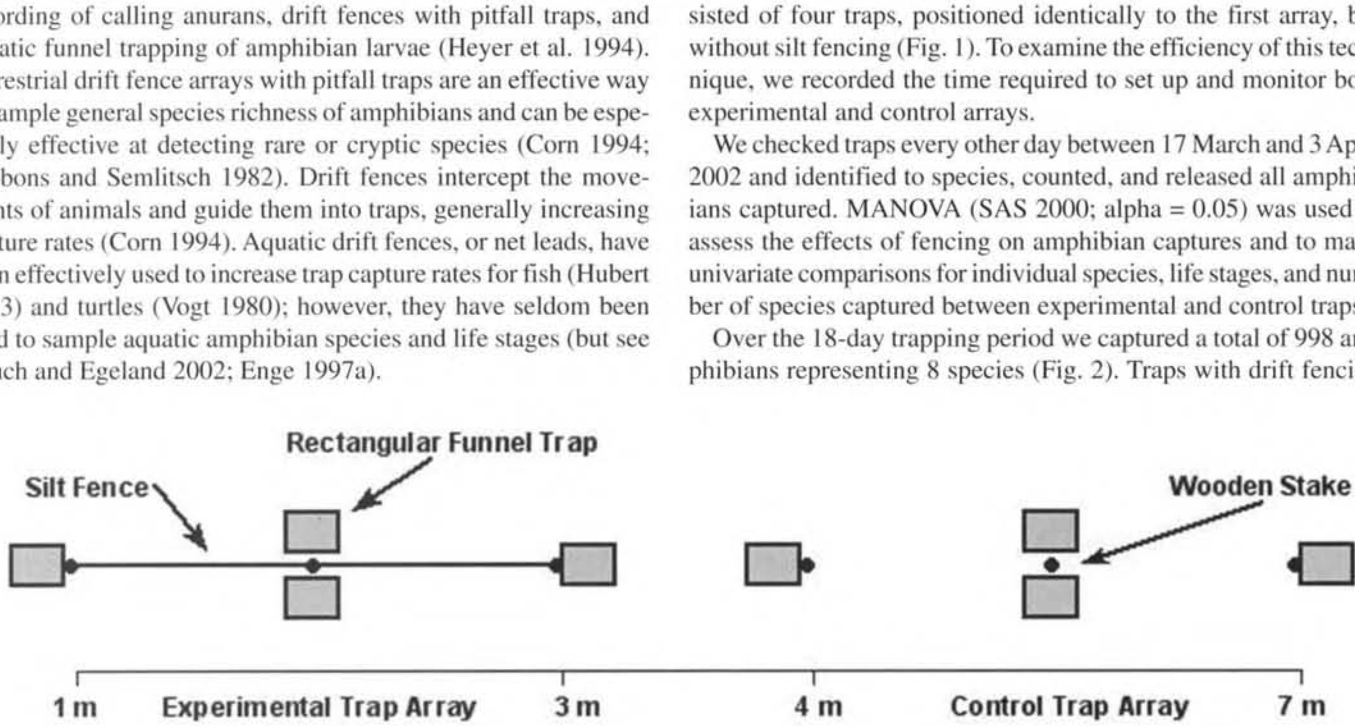

Fig. 1. Design for control and experimental trap arrays. Each array consisted of a set of four rectangular funnel traps. One array of funnel traps was placed along a section of silt fencing and one was not. Five pairs of trap arrays were set within the wetland.

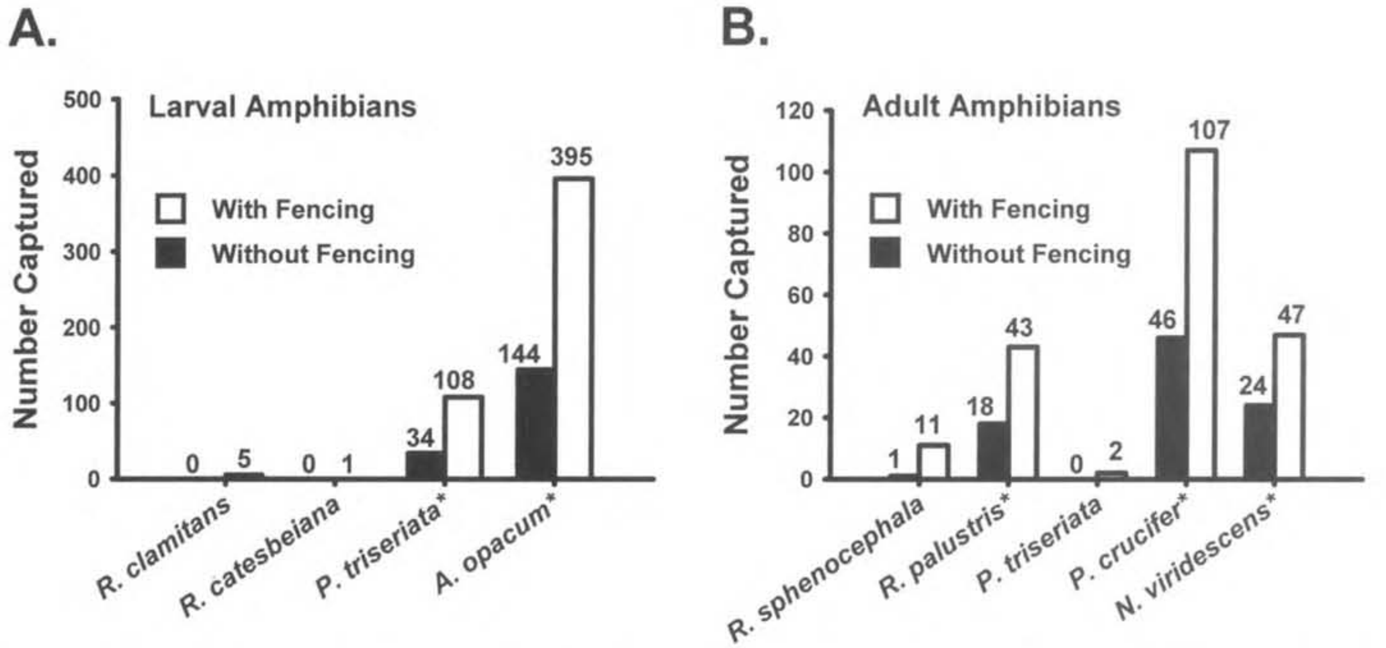

FIG. 2. Total captures of A) amphibian larvae and B) adult amphibians by species between trap arrays with and without drift fencing in a large seasonal wetland within the western Piedmont of North Carolina. Asterisks (*) denote significant differences in number of individuals captured between traps with and without fencing when compared using MANOVA.

captured over twice as many individual amphibians as did control traps (Fig. 2; MANOVA, $P < 0.0001$). Univariate comparisons revealed that traps with fencing captured significantly greater numbers of larval *Ambystoma opacum* ($F = 43.93$, $df = 1$, $p < 0.001$), and *Pseudacris triseriata* ($F = 12.15$, $df = 1$, $p = 0.001$), and adult *Rana palustris* ($F = 6.96$, $df = 1$, $p = 0.012$), *P. crucifer* ($F = 15.60$, $df = 1$, $p = 0.003$), and *Notophthalmus viridescens* ($F = 8.81$, $df = 1$, $p = 0.005$) than did traps without fencing. Additionally, traps with fencing captured significantly more species or life stages per trap than did unfenced traps ($F = 19.62$, $df = 1$, $p = < 0.001$). Small sample sizes prevented detection of statistically significant differences in other species and life stages, though for all species, traps along the fences captured more individuals than traps without fencing (Fig. 2).

The construction of aquatic drift fences added approximately $1.50 US to the cost and approximately 4 min to the installation time of each trap when compared to funnel traps without fencing. However, both the amount of time and money invested per amphibian captured was substantially lower when drift fences were used in conjunction with the traps (Fig. 3).

Buech and Egeland (2002) found that net leads had no effects on capture rates of amphibians in Minnesota temporary wetlands. They speculated this result might be due to the sedentary nature of the larval amphibians they captured (*R. sylvatica*, *A. laterale*, and *P. crucifer*). In our study, placing funnel traps along lengths of silt fencing greatly improved capture rates of both large, highly mobile amphibians (e.g., adult ranid frogs, *P. crucifer*, and *N. viridescens*) and small amphibian larvae (e.g., *A. opacum* and *P. triseriata*). We suspect that we recorded substantially higher success rates with aquatic drift fences than did Buech and Egeland (2002) because we used rectangular funnel traps, which can be placed flush along the side of the fencing, rather than cylindrical funnel traps. Cylindrical funnel traps cannot not lie flush against the fencing material and thus allow amphibians to easily swim over or under the trap openings.

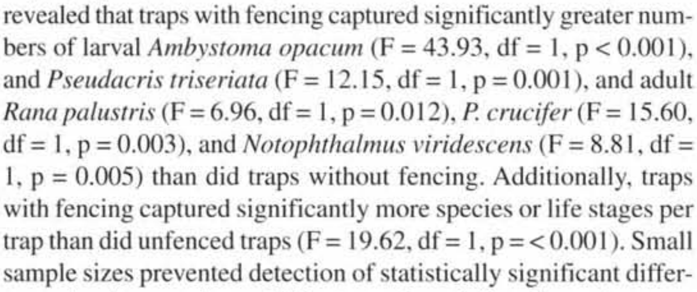

FIG. 3. Comparisons of A) cost and B) time invested per amphibian captured between traps with and without drift fencing.

In conclusion, creating aquatic drift fences by placing rectangular funnel traps along sections of silt fencing significantly improved amphibian capture rates, and thus offers a valuable and efficient complement to traditional sampling techniques for surveying and monitoring amphibian populations. Although further research is necessary, we suspect that aquatic drift fences would also prove superior to traditional funnel trapping for capturing aquatic reptiles (e.g., watersnakes) and detecting rare aquatic reptile and amphibian species.

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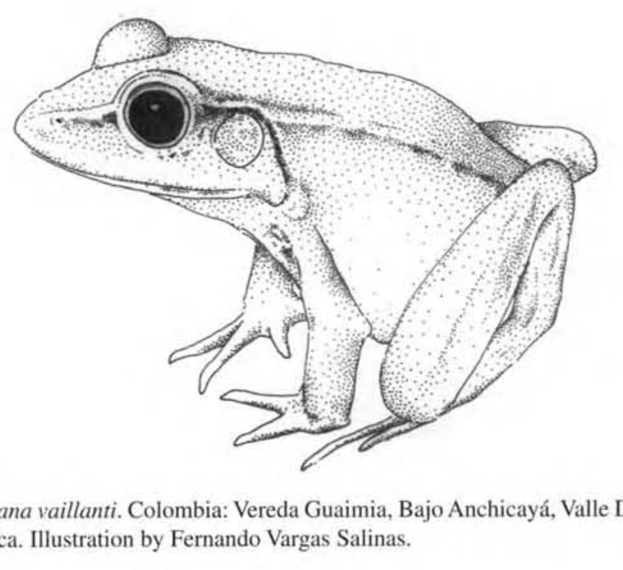

Rana vaillanti. Colombia: Vereda Guaimia, Bajo Anchicayá, Valle Del Cauca. Illustration by Fernando Vargas Salinas.

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PVC Pipe Diameter Influences the Species and Sizes of Treefrogs Captured in a Florida Coastal Oak Scrub Community

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Artificial refugia constructed of polyvinyl chloride (PVC) pipes has shown to be effective for capturing treefrogs, yet capture success has varied among species, size classes, pipe designs, and placement (Boughton et al. 2000; Moulton et al. 1996). Differential capture success in studies using multiple PVC pipe designs indicates that at least some species or size classes of treefrogs are selective in their use of artificial refugia (Boughton et al. 2000; Moulton et al. 1996). Therefore it is reasonable to expect that variation in the PVC pipe design may change the detection probability of different species and sizes of treefrogs under artificial refugia, bias count data, and population estimates, unless this effect is known. Consequently, a validation experiment was undertaken to critically assess the influence of PVC pipe diameter on the species and sizes of treefrogs captured under artificial refugia in a Florida coastal oak scrub community.

The study was carried out at Rookery Bay National Estuarine Research Reserve (RBNERR) in Collier County, Florida, USA. RBNERR encompasses ca. 50 ha of coastal oak scrub that occurs in a mosaic with pine flatwoods on well-drained and lightly colored sands. The most extensive tract of oak scrub located adjacent to Shell Island Road was selected for study on the basis that it offered an area large enough for investigation (> 5 ha) with uniform soils, vegetation and topography, while allowing easy access. The study site does not have a flowing water source, and the hydroperiod of small depression ponds is dependent upon localized rainfall and rising groundwater. The low (< 4 m) canopy is dominated by a sparse to dense layer of *Quercus chapmani, Q. geminata, Q. myrtifolia,* and *Ceratiola ericoides*, with *Pinus elliottii* appearing occasionally as an emergent. The lower shrub layers are more complete with *Serenoa repens*, *Lyonia lucida*, *Ximenia americana* and *Asimina reticulata*. Ground cover is sparse yet diverse, frequently with bare siliceous sand, or with lichen, spikemoss, and occasional tufts of grass and herbs. Preliminary surveys at the study site captured *Hyla cinerea, H. squirella,* and *Osteopilus septentrionalis* taking shelter in the cavities of *Q. chapmani* and axils of *S. repens* (pers obs.).

Three identical PVC pipe arrays were set out widely spaced (> 100 m) at random. Each array was comprised of 1-m long sections of four different diameter pipes (13, 25, 38, and 51 mm) inserted upright 10 cm into the ground directly along side each other. This pipe design and placement was chosen because of the naturally low canopy height combined with the preferences of *H. cinerea* and *H. squirella* for long (60 cm) PVC pipes driven into the ground or hung vertically in trees (Boughton et al. 2000). Each pipe was set up 20 July 2001, and data were collected during 12 widely spaced (15–35 d) capture sessions from 21 July 2001 to 5 May

Table 1. Number of *Hyla cinerea*, *H. squirella* and *Osteopilus septentrionalis* captured and recaptured among different PVC pipe sizes.

Species	Pipe Diameter (mm)					
	13		25		38	
	Capture	Recapture	Capture	Recapture	Capture	Recapture
H. cinerea	8	2	19	7	—	—
H. squirella	17	4	42	22	11	—
O. septentrionalis	—	—	5	1	12	10

2002. During capture sessions, each pipe was checked between 0900 and 1500 h. Treefrogs were removed from a pipe and placed in a 19-liter bucket with lid, measured, marked (Hero 1989), and then released directly back into the same pipe. Snout–urostyle length (SUL) was measured with a ruler fitted with a right-angle stop at one end, and age classes were specified as juvenile when SUL was < 37 mm for *H. cinerea*, < 23 mm for *H. squirella* (Wright and Wright 1949), and < 28 mm for *O. septentrionalis* (Meskaka 2001).

Capture and recapture data among different pipe sizes were analyzed as described in Boughton et al. (2000). Repeated measures Analysis of Variance (ANOVA) were used to identify differences between number of captures among pipes of each array and size. The Least Significant Difference (LSD) test was then used to identify differences between the levels of each significant variable. Count data was transformed ($y' = \div\{y + 0.5\}$) due to zero values and in order to normalize variances. ANOVA for unbalanced designs was used to identify differences in the SUL of treefrogs using each pipe size and the duration of recapture of individuals. Spearman's correlation coefficient (r_s) was used to detect relationships in the coexistence of treefrogs among each array. Mean values are followed by ± 1 SE.

Over a period of 289 days, there were 114 captures of 68 individuals of three species, with 46 recaptures (Table 1). *Hyla squirella* were captured most frequently (61%) followed by *H. cinerea* (24%) and *Osteopilus septentrionalis* (15%). These treefrogs are nocturnal feeders, foraging mainly on insect prey of the shrub and herb strata, remaining inactive and taking shelter during the daylight hours except when the humidity is high (Goin 1958; Goin and Goin 1957; Haber 1926; Kilby 1945; Meshaka 2001). We currently have a limited understanding of why the treefrogs are using the PVC pipes, but the attraction might simply be because they provide suitable diurnal shelter from adverse environmental conditions. Similar to the cavities of trees and axils of bromeliads and palmettos (Lee 1969; Neill 1951), PVC pipes placed upright in the ground retain moisture and provide a place of shelter from the sun, wind, and predators. The preference for moist refugia is indicated by the data that PVC pipes hung vertically in trees capped on the bottom with water inside were used more frequently by *H. cinerea* and *H. squirella* than those of the same diameter that were either capped on top or uncapped (Boughton et al. 2000). Stewart and Pough (1983) found that introducing bamboo refugia increased the density of a treefrog species on those plots, perhaps by increasing their protection from predators. For example, Neill (1951) captured *Elaphe obsoleta rossalleni* in a bromeliad with two *H. cinerea* in its stomach. During this study, *Coluber contrictor priapus* were observed feeding on adult *H. squirella* and *O. septentrionalis*, but this and other snakes would have difficulty climbing the PVC pipes and the small diameter prevents entry by other potential predators such as birds and mammals.

Treefrog captures were made only within the 13, 25, and 38 mm diameter pipes (Table 1). Most of the captures of both *H. cinerea* (70%) and *H. squirella* (60%) were in the 25 mm diameter pipes. The majority of *O. septentrionalis* captures (91%) were in the 38 mm diameter pipes. The number of captures of all three species varied significantly with pipe size ($P < 0.0006$), but only *O. septentrionalis* showed significant ($P = 0.012$) array-to-array differences (Table 2). *Hyla cinerea* and *H. squirella* were captured significantly ($P < 0.05$) more in 25 mm pipes than in 13 or 38 mm pipes. Similarly, where PVC pipe refugia were driven into the ground, 98% and 2% of pooled *H. cinerea* and *H. squirella* captures were in 20 mm and 50 mm pipes, respectively (Moulton et al. 1996). These studies present consistent evidence that both *H. cinerea* and *H. squirella* discriminate between artificial refugia sizes, and the majority of individuals will take shelter within 20–25 mm pipes.

Some of the variation in captures of each species can be attributed to the significant positive relationship between pipe diameter and treefrog size ($N = 114$, $r_s = 0.65$, $P < 10^{-4}$). The SUL of individuals varied with pipe size (Table 3). All species except *O. septentrionalis* showed significant ($P < 0.05$) pipe-size to pipe-size differences. Native treefrogs captured in the pipes were of juvenile and adult age, but all *O. septentrionalis* were adults (Table 3). Neill (1951) indicated that the majority of *H. cinerea* and *H. squirella* found in bromeliads were juveniles. In the same way, variation in the PVC pipe diameter was an important determinant of the sizes or age classes of *H. cinerea* and *H. squirella* that took shelter within it. The average size of treefrogs increased with increasing pipe diameter, and only juveniles and small adults used the 13 mm pipes. Juveniles and adults of most sizes and age classes used the 25 mm diameter pipes. Only adult *H. squirella* and *O.*

Table 2. ANOVA table for repeated measures analyses, comparing number of *Hyla cinerea*, *H. squirella*, and *Osteopilus septentrionalis* captured among different arrays and PVC pipe sizes.

Source	df	*H. cinerea*		*H. squirella*		*O. septentrionalis*	
		F	P	F	P	F	P
Array	2, 94	0.61	0.549	1.11	0.331	4.59	0.012
Pipe Size	2, 94	18.6	< 0.0001	18.4	< 0.0001	8.3	0.0006

septentrionalis used the 38 mm pipes. Likewise, Boughton et al. (2000) discovered that with 38 mm PVC pipes hung vertically in trees, only a small proportion of all *H. cinerea* (1.6–3.2%) and *H. squirella* (0.9–2.4%) captures were juveniles. Thus, the use of pipes < 13 mm or > 25 mm diameter will significantly change the detection probability of different sizes of *H. cinerea* and *H. squirella* under artificial refugia, bias count data, and population estimates.

Several researchers indicated that *H. cinerea, H. squirella* (Boughton et al. 2000; Goin and Goin 1953; Goin 1958; Moulton et al. 1996), and *O. septentrionalis* (Meshaka 2001) might return day after day to the same resting site. Overall, 33%, 37%, and 65% of all *H. cinerea, H. squirella,* and *O. septentrionalis* captures were recaptures. Marked individuals of each species were recaptured over 15–155 days during the study period, which suggest the maintenance of a partially confined activity range. Of all recaptures, 83% were within the same initial size pipe and the remainder moved from 13 or 38 mm to 25 mm diameter pipes. Excluding individuals captured only once, *O. septentrionalis* occupied a pipe for the longest number of consecutive days (60 ± 33, range = 15–155, N = 4) followed by *H. cinerea* (37 ± 7, range = 15–64, N = 7) and *Hyla squirella* (33 ± 4, range = 15–92, N = 22) but differences were not significant ($F_{2,30}$= 1.69, P = 0.210). The failure of individuals to return to the same pipe over longer periods of time indicates that they might have occupied a much larger range and simply chose a different resting place, fell victim to some predator while out foraging, or some negative factor associated with being captured.

TABLE 3. Mean (± SE, range) snout–urostyle length and age classes of *Hyla cinerea*, *H. squirella*, and *Osteopilus septentrionalis* captured among different PVC pipe sizes. ANOVA differences at the P = 0.05 level are indicated by different letters.

Species	Pipe Diameter (mm)		
	13	25	38
H. cinerea	22 ± 0.6a, 19–24	32 ± 1.1b, 29–42	—
Adult	—	2	—
Juvenile	8	17	—
H. squirella	26 ± 0.7a, 22–33	34 ± 0.6b, 24–41	37 ± 1.5b, 30–41
Adult	14	42	11
Juvenile	3	—	—
O. septentrionalis	—	41 ± 1.8a, 37–48	45 ± 1.3a, 41–55
Adult	—	5	12
Juvenile	—	—	—

Groups of treefrogs in PVC pipes are common (Boughton et al. 2000; Moulton et al. 1996), but little is known about how different species and age classes interact. Some of the variation in *H. squirella* captures might be attributed to the significant negative correlation with the coexistence of *O. septentrionalis* (N = 36, r_s = –0.54, P < 10^{-4}). There were no significant correlations between the coexistence of *H. cinerea* and either *H. squirella* (N = 36, r_s = –0.06, P = 0.732) or *O. septentrionalis* (N = 36, r_s = 0.06, P = 0.722). Meshaka (2001) found negative relationships between *H. cinerea, H. squirella*, and *O. septentrionalis* and suggested that predation was responsible for the unstable coexistence of these species across a wide variety of coastal habitats. The degree to which *O. septentrionalis* might reduce populations of native treefrogs is unknown.

Although little is known about use of artificial versus natural refugia, enough information might be gleaned from validation experiments to know that the occurrence of different species and size classes of treefrogs under PVC cover will vary to some degree with pipe diameter and the presence of *O. septentrionalis*. However, by setting out a standardized number of 25 mm pipes, it is possible to inventory and monitor most sizes and ages classes of *H. cinerea, H. squirella*, and *O. septentrionalis* with a consistent sampling technique. The 13 mm and 38 mm pipes can be used to examine more specifically juvenile or adult populations, respectively. PVC pipes placed along transects between breeding and non-breeding habitats cover the greatest area and potentially provide more information on movement, home range size, and habitat requirements than do random sites. Mark-recapture techniques might be used to examine populations of these treefrogs year-round, across different breeding and non-breeding habitats.

Acknowledgments.—Support was provided by Rookery Bay National Estuarine Research Reserve, and collection and handling procedures were conducted under the auspices of permit number WV01455 of the Florida Fish and Wildlife Conservation Commission. Thanks to Jennifer Bartareau, Renee Wilson, and anonymous reviewers for comments on the manuscript.

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The Cottonmouth Condo: A Novel Venomous Snake Transport Device

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We describe here a device that allows a large number of venomous snakes to be transported and manipulated while minimizing risk to the snakes and investigators. We developed a need for such a device in the course of our investigations of the ecology of the cottonmouth (*Agkistrodon piscivorous*). Our device expands on the use of clear tubes for capture or restraint of venomous snakes (Fowler 1995; Murphy 1971).

Our device, the "cottonmouth condo," consists of 10 lengths of polyethylene tubing (McMaster-Carr part number 2044T49) attached to a pair of central spacers. We use tubes that are 60 cm long and 4.2 cm diam, a size that accommodates all but the largest individuals in our study population. The central spacers can be made of wood or closed cell foam (which allows the unit to float) the edges of which have been notched with semi-circular holes drilled into the margin (Fig. 1). The notches are spaced 5 cm apart on center to provide clearance between tubes. The tubes are glued onto the central spacers and then bound together with duct tape. The tubes are open at both ends allowing snakes to be inserted or removed from either end. The ends of the tubes are capped with replacement end caps designed for fluorescent light bulb safety shields (McMaster-Carr part number 1626K11). These end caps fit tightly and have an oval hole in the center to provide air for the animals inside and to drain water in the event that the unit is briefly submerged. Friction fit of the caps can be increased by wrapping thin strips of duct tape around the end of the tubes. For transport of animals that are small enough to fit through holes in the endcaps, vinyl shipping tube caps (McMaster-Carr part number 2044T69) with a small hole punched in the end are placed over the standard end caps. Alternately, vinyl coated fiberglass window screen can be glued inside the caps. The tubes are numbered to assist in keeping track of captures and the device has a shoulder strap for easy transport in the field.

For use in the field, caps are removed from one end of all tubes. Once a snake is encountered, the condo is laid horizontally on a nearby log, mud flat, or vegetation mat. The snake is then captured with Pilstrom-style tongs and the head maneuvered into an open tube. In general, we have found that snakes readily enter the tube as the jaws of the tongs are slowly relaxed. When more than half of the snake's body is within the tube, the tail can be grasped and examined safely for scale clips or other identifying marks. Once the snake is fully in a tube, an end cap is used to close the tube. Because the transport tubes often are of a larger diameter than the snakes being captured, care must be taken to prevent the snake from doubling back before the end cap is placed or while checking for scale clips.

In the laboratory, snakes can be removed for further examination by removing the end cap nearest the head and inserting a separate polyethylene tube of smaller diameter, usually just slightly larger than the maximum diameter of the snake (see Fowler 1995; Murphy 1971). Snakes that are reluctant to move can be prodded gently from the opposite end of the tube through the oval opening, allowing the end cap to remain in place. Once laboratory procedures are completed, return of the snake to the condo can be accomplished in one of two ways. First, the tail (untubed) end of the snake can be placed in the condo tube and the snake's head can be prodded gently with a soft plunger until the snake crawls backward into the condo tube. When the snake's head is four to five inches from the opening of the transport tube the restraining tube can be removed and an end cap of the condo reattached. Alternately, the head end of the handling tube can be placed into the condo and the snake allowed to crawl forward into the condo tube.

When releasing snakes, the end cap nearest the snake's head is removed and the condo held at the opposite end at a slight downward angle allowing the snake to crawl out. The snake may be gently prodded from the opposite end, through the opening in the end cap, to initiate movement.

Over three years, we have used this system to transport cotton-

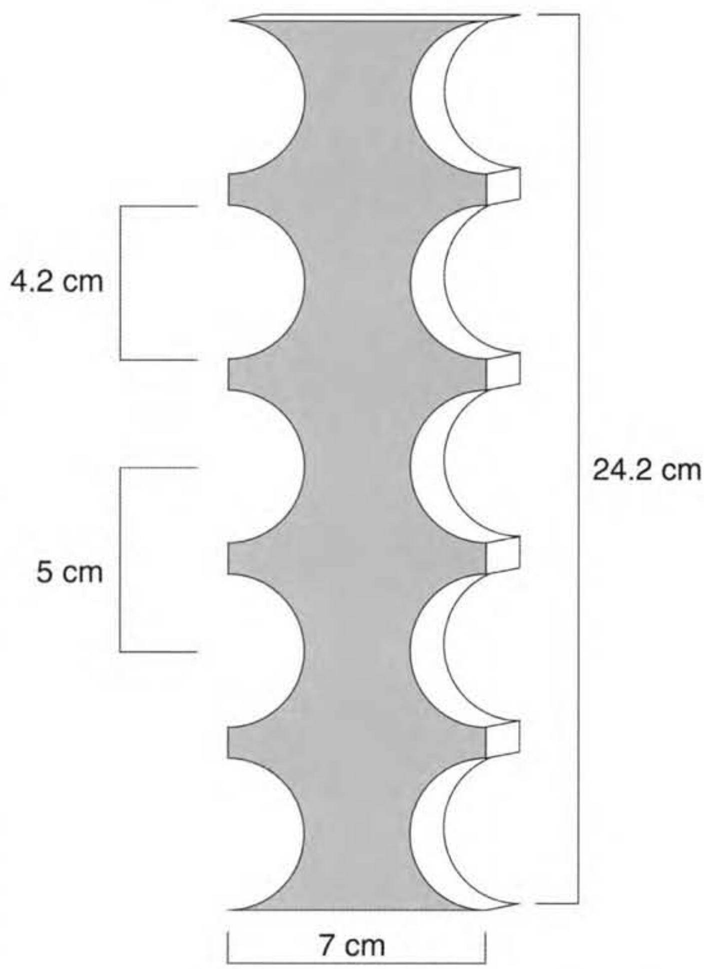

FIG. 1. Template for the construction of the central spacers for the tube unit. Dimensions are indicated with brackets. The wood or foam used should be at least 1.8 cm thick.

mouths on a regular basis (N = 321) without injury to the animals or investigators. Snakes have been safely retained within the tubes for up to 24 h with no obvious ill effects. Snakes handled in this method have been recaptured numerous times over the course of three years (maximum of 12 recaptures for an individual). By using the tube-to-tube transfer method, snakes are only gripped with tongs once throughout their capture, transport, and release.

To limit potential stress from visual stimuli (the researcher or snakes in adjacent tubes) the tubes can be abraded with coarse steel wool or fine sandpaper to make them opaque on the sides and/or ends. However, we point out that the safety of this device is derived from the transparency of the polyethelyne tubes and thus care should be taken not to compromise this feature. As with any closed container, care should be taken to avoid overheating. We also suggest regularly checking tubes and caps for damage. Damaged tubes are easily replaced by removing the duct tape, removing and replacing the tube, and reapplying duct tape. Cleaning and sterilizing can be accomplished by using an appropriate sized bottlebrush taped to a dowel to scrub the insides.

Our device costs ca. US $20.65 to build. A future improvement would be to incorporate screw caps, however we have been unable to locate any readily available source. Many diameters and lengths of tube can be purchased for use with other species or life stages of different lengths and girths. Tubing and caps can be ordered inexpensively from industrial supply houses such as McMaster-Carr Supply Company (http://www.mcmaster.com, 6 January 2003).

Although this technique might not be appropriate for every research situation, we have found the use of this system has improved both the safety and efficiency when working with cottonmouths. Finally, let it be said that no system is foolproof and there is no substitute for common sense.

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Cyclura carinata bartschi (Booby Cay Rock Iguana). Illustration by John Bendon (Lizardwizard@btinternet.com).

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Identifying Individual Rattlesnakes Using Tail Pattern Variation

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Biologists often need simple, reliable, safe, and inexpensive ways to identify individual study animals. For field and laboratory research on snakes, identification techniques include scale clipping, external tags, paint marks, tattoos or brands, and natural markings (e.g., for reviews see Ferner 1979; Lang 1992; Wright and Minott 1999). Recent studies have used passive integrated transponder (PIT) tags and radio transmitters to identify individual snakes in the field. However, these devices require equipment that can be prohibitively expensive for some projects; in such cases, alternative marking techniques are necessary. Permanent natural markings that are clearly visible, such as color patterns, can be valuable for non-invasive field identification of small to moderate samples (e.g., Carlström and Edelstam 1946; Francini et al. 1990; Hardy and Greene 1999).

In laboratory and field studies on Western Diamondback Rattlesnakes (*Crotalus atrox*), we have used sketches, photocopies, and photographs of the black and white banding pattern on the tail to identify individual snakes. The tail banding pattern varies substantially among individuals (Fig. 1). In 240 *Crotalus atrox* studied over several years on the grounds of the Arizona-Sonora Desert Museum, no two snakes had the same tail banding pattern. Each of these snakes was also marked by painting the rattle, clipping the ventral scales, or implanting PIT tags, which aided in verifying the identification based on tail pattern. Furthermore, tail banding patterns did not change with growth in 21 neonate snakes that were raised in the laboratory for one year. Natural markings are also fixed throughout the life of each individual in other species such as *Natrix natrix* (Carlström and Edelstam 1946). Similar tail patterns in different individuals might occasionally lead to false-positive identifications, but the frequency is lower than 0.4% (1 in 261 individuals).

To keep track of large numbers of individuals, photographs or sketches of the tails can be categorized by the banding patterns. For example, we have used a hierarchical system of organizing individual patterns based on (a) the number of solid black bands, (b) the number of offset black bands, (c) the number of broken black bands on the right side, (d) the presence and completeness of a dorsal stripe connecting the black bands, (e) the consistency in width of the black bands along the tail, and (f) the number of spots or blotches in the white bands. Other ordered systems (e.g., Francini et al. 1990) might work equally well if the criteria are clear and systematically applied.

Pronounced black and white tail bands occur in several rattle-

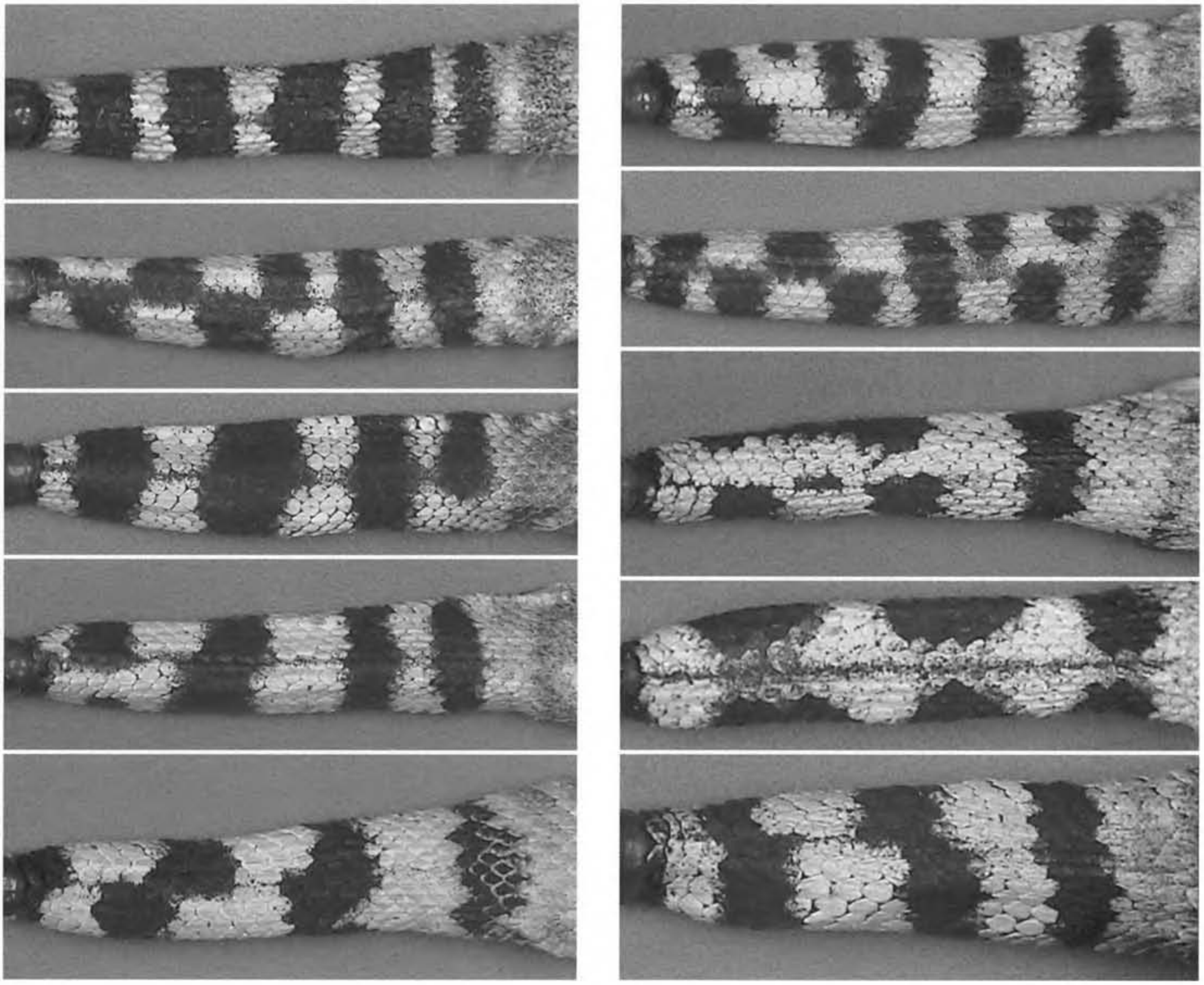

FIG. 1. Photographs of the tails of 10 Western Diamondback Rattlesnakes (*Crotalus atrox*) representing a small sample of the diversity of tail banding patterns. Photographs not to same scale.

snakes, including *Crotalus atrox*, *C. catalinensis*, *C. ruber*, *C. scutulatus*, and *C. tortugensis* (Klauber 1972). Less pronounced banding patterns occur in some populations or individuals of *C. adamanteus*, *C. cerastes*, *C. lepidus*, *C. mitchellii*, and *C. viridis*, among other species (Klauber 1972; Werler and Dixon 2000). These banding patterns might be useful for identifying individual snakes in the field without capturing them, at least whenever the animal's posture keeps the tail visible. Even when the tail is hidden, minimal disturbance might induce the snake to reveal it.

Major advantages of using natural patterns to identify individual snakes are that they are permanent, highly variable and visible, do not require invasive techniques or repeated handling of the animals, and involve little or no special equipment for application and monitoring. Permanent and non-invasive individual markings, such as body or tail color patterns, should prove to be particularly valuable for studying undisturbed snakes in the wild.

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NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 35, Number 1 (March 2004).

CAUDATA

CRYPTOBRANCHUS ALLEGANIENSIS ALLEGANIENSIS (Eastern Hellbender). **BREEDING SEASON**. The breeding season of eastern populations of *Cryptobranchus a. alleganiensis* has been fairly well documented in the literature. In general, the season lasts from mid-August through mid-September (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press. 587 pp.), although in Alabama it can continue into early October (Mount 1975. The Reptiles and Amphibians of Alabama. Auburn Univ. Agri. Exp. Station. 347 pp.). Herein, we report what we believe to be the first documented records of gravidity and nesting from Georgia, perhaps the southeastern-most state within this salamander's range.

In an effort to collect skin mucous for bacterial analyses, we hand-captured *C. alleganiensis* at Cooper Creek, Union County, Georgia on 5 Sept 2002. Among the hellbenders captured were two gravid females, one of these discharged ca. five eggs when placed in a dilute solution of MS-222 to anesthetize the animal. Additionally, a nest guarded by an adult hellbender was discovered under a large flat rock. We immediately replaced the rock and did not collect either the eggs or the adult. We were not able to confirm the sex of this animal.

A previous collection trip to this same section of creek on 22 July 2002 yielded seven adult male and two adult female *C. alleganiensis*, none in reproductive condition.

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PLETHODON GLUTINOSUS (Northern Slimy Salamander). **REPRODUCTION**. Detailed life histories are known for only a few populations of the *Plethodon glutinosus* complex and include several reports of egg clutches and very few reports of new hatchlings (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Smithsonian Instit. Press, Washington, D.C. 587 pp.).

On 24 Oct 2002, we discovered a female *P. glutinosus* (72 mm SVL) attending a newly laid clutch of eggs in Pettijohn Cave in Dickson Gulf on the eastern side of Pigeon Mountain, Walker County, Georgia, USA. The clutch was located in a horizontal crevice in the limestone rock of the cave wall ca. 1.3 m above the cave floor. It was suspended by a pedicel from the roof of the crevice and consisted of 17 eggs, each measuring 6.0–6.1 mm in diameter. The clutch was ca. 12 m from the cave opening. The outside air temperature was 16.5°C; the temperature inside the cave was 13.0°C. We monitored the clutch through the winter, revisiting it on 14 Dec 2002, 21 Jan, 9 Feb, and 1 March 2003. On 14 Dec 2002 the pedicel was broken, and the eggs lay in a heap on the floor of the crevice. The loss of suspension did not seem to interfere with development or the female's attendance. The significance of the 12-m distance from cave opening became apparent on cold days during the winter. The clutch was located at a depth closest to the opening where the thermal environment was relatively stable.

On 2 March 2003, one egg had hatched. The hatchling measured 16.4 mm SVL and 19.7 mm total length. Its belly was extended with yolk, it had distinct gills, and skin pigment was poorly developed. Because *Plethodon* hatchlings resorb their gills within a few days of hatching (Highton 1956. Copeia 1956:75–93) and because the other eggs seemed healthy and unhatched, we presumed that the hatchling was < 24 h old. Therefore, the gestation period was 128+ days.

This represents the latest seasonal dates of oviposition and hatching for the complex and >1 month later than those reported from caves in northern Alabama (Highton 1962. Copeia 1962:597–613). These were also the largest eggs and the longest gestation period reported for the *P. glutinosus* complex (Petranka 1998, *op. cit.*).

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ANURA

BUFO PARIETALIS (Forest Toad)**. PREDATION.** Although the toxic secretions of toads are repellent against many predators, there are numerous reports for predators of toads throughout the world (Haddad and Rogério 1997. Amphibia-Reptilia 18:295–298). The population ecology and the natural predators of amphibians in the forest ecosystems of India are poorly studied. *Bufo parietalis* is a rare and little-known toad, endemic to tropical rainforests of the Western Ghats (Molur and Sally 1998. Zoo's Print 13[12]:29). Since 1999, we have observed the natural history of *B. parietalis* as part of population studies. Herein, we report predation by an invertebrate (mosquito) and a vertebrate (bird) on males engaged in reproductive activity in Karnataka, South India.

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The Society for the Study of Amphibians and Reptiles, the largest international herpetological society, is a not-for-profit organization established to advance research, conservation, and education concerning amphibians and reptiles. Founded in 1958, SSAR is widely recognized today as having the most diverse society-sponsored program of services and publications for herpetologists. Membership is open to anyone with an interest in herpetology—professionals and serious amateurs alike—who wish to join with us to advance the goals of the Society.

All members of the SSAR are entitled to vote by mail ballot for Society officers, which allows overseas members to participate in determining the Society's activities; also, many international members attend the annual meetings and serve on editorial boards and committees.

ANNUAL DUES AND SUBSCRIPTIONS: Annual membership dues for the year 2004 in the Society for the Study of Amphibians and Reptiles are as follows: **REGULAR** membership US$60 (Student $30)—includes *Journal of Herpetology* and *Herpetological Review*; **PLENARY** membership US$80 (Student $45)—includes *JH*, *HR*, and annual subscription to the *Catalogue of American Amphibians and Reptiles*; **INSTITUTIONAL SUBSCRIPTION** $115—includes JH and HR. Additional fee for airmail postage outside USA $35 for one year. Additional membership categories available on the SSAR webpage: http://www.ssarherps.org/pages/membership.html.

All members and institutions receive the Society's primary technical publication, the *Journal of Herpetology*, and its news-journal, *Herpetological Review*; both are published four times per year. Members also receive pre-publication discounts on other Society publications, which are advertised in *Herpetological Review*.

Payment must be made in USA funds, payable to "SSAR," or by International Money Order, or with VISA or MasterCard (account number and expiration date must be provided). Payment should be sent to: Theodora Pinou, SSAR Treasurer, Peabody Museum of Natural History, P.O. Box 208118, New Haven, Connecticut 06520-8118, USA. Fax: (203) 432-5176; e-mail: theodora.pinou@yale.edu

Future Annual Meetings

2004 — University of Oklahoma, Norman, Oklahoma, 26–31 May (with ASIH, HL)
2005 — University of South Florida, Tampa, Florida, 7–11 July (with ASIH, HL)

About Our Cover: *Saltuarius salebrosus*

With its slender limbs splayed astride the ochre stencil of an adult aboriginal hand, this Australian Leaf-Tailed Gecko (*Saltuarius salebrosus*) shows its true dimensions. At 14 cm SVL it is one of the largest of Australia's 112 described species of geckos.

The 13 named species of leaf-tailed geckos occur along eastern Australia between Sydney and Cape York Peninsula. They are currently placed in three allied genera (Couper et al. 2000. Mem. Queensland Mus. 45[2]:253–265; Hoskin et al. 2003. Austral. J. Zool. 51:153–164). Eight *Phyllurus* have cylindrical to flattened heart-shaped tails and a disruptive pattern of dark flecks; a single *Orraya* has a long neck, dark flecks and a fringe of spines around its flat original tail; and four *Saltuarius* have bold, lichen-like marbling and elaborately flanged tails.

Thirty years ago this complex of spectacular geckos were classified as only two species, both placed in *Phyllurus*. Some were simply assumed to be fragmented populations of one species, but most were overlooked because they occupy isolated rainforest blocks. Several are restricted to single localities. Taxonomic research on these geckos, most of it over the last decade, has helped shed light on the fragmentation of Australia's rainforests, the evolution of species in isolation, and the conservation value of seemingly insignificant stands of forest.

Leaf-tails are sedentary geckos that rely on stealth and concealment rather than speed (Wilson 2000. Austral. Geogr. Mag. 59:72–89). They emerge each evening from narrow rock crevices or cavities within the latticed trunks of rainforest fig trees, and rest head downwards a short distance from their shelter sites. They appear to maintain a strong site-fidelity, seldom venture far, and probably are long-lived. In the forested coastal ranges of mid-eastern Queensland, a cluster of four leaf-tail species in the genus *Phyllurus*, all named since 1993, occur side by side with no overlap in their distributions. The islands of rainforest they inhabit are as effectively isolated by woodland barriers, some less than 20 km apart, as they would be by an ocean.

The presence of these narrowly endemic species in apparently similar abutting forests, separated by seemingly trivial gaps of drier terrain, is an artifact of the expansion and contraction of Australia's rainforests (Couper et al. 1993. Mem. Queensland Mus. 34[1]:95–124). They are derived from a common ancestor but because they are now isolated, they have evolved into different species. It also illustrates the antiquity of their current isolation, the integrity of those small forest pockets, and the need, when planning development, to carefully consider each as a separate community.

Thanks to its association with a broader range of habitats than its relatives, *Saltuarius salebrosus* is the most widespread of the leaf-tails. In addition to rainforests it is also a rock dweller, occupying a band of granite and sandstone escarpments, caves, and overhangs from central to mid-eastern Queensland. The animal pictured, from the Blackdown Tableland, has a regenerated tail. The original tail is equally impressive, having a fringe of spines and a slender tip. Tail-loss in leaf-tails seems too common to attribute solely to predation attempts. With up to half of adults sporting regenerated tails it is likely that many are forfeited in disputes with rivals. Tails, you lose.

Steve Wilson is an Australian herpetologist based in Brisbane, Queensland. He recently co-authored (with Gerry Swan) Australia's first comprehensive reptile handbook, *A Complete Guide to Reptiles of Australia*. His next book, *A Field Guide to the Reptiles of Queensland*, is due for release in January 2005.

The gecko was photographed on Fuji Sensia 100 ASA film using an Olympus OM4Ti camera, a 50mm f3.5 macro lens, and an Olympus T10 ringflash.

SSAR BUSINESS

Dean E. Metter Memorial Award Application Deadline Extended Until 15 July 2004

The Dean E. Metter Memorial Award will be given annually by SSAR to a herpetology student. Its purpose is to encourage students to pursue field research in herpetology and to facilitate field research by providing funds for relevant expenses. Because this award has been so recently established, deadlines will be different for 2003 and 2004 ONLY. This year (2004), membership in SSAR must be paid no later than 1 July 2004 and proposals must be submitted by 15 July 2004. Proposals should be submitted electronically as e-mail attachments or by regular mail. Submit proposals or questions regarding application procedures to the Chair of the Metter Award Committee, Dr. Joseph J. Beatty (beattyj@science.oregonstate.edu). Awards will be announced on or around 15 August 2004.

Check the SSAR Web Site for submission instructions (http://www.ssarherps.org/pages/metter.html), background information, and format for the proposal.

Kennedy Student Award Committee Annual Report, 2004

The Kennedy Award Committee (Robin Andrews, Michael Dorcas, Terry Schwaner, Lynette Sievert, Robert Gatten, Jr., Chair) has completed its work for Volume 37 of the *Journal of Herpetology*. The Committee has selected "Testes size in Leptodactylid frogs and occurrence of multimale spawning in the genus *Leptodactylus* in Brazil" by **Cynthia P. de A. Prado** (student) and C.F.B. Haddad (Vol. 37: 354-362). The Kennedy Award carries with it a cash prize of US$200 or the winner's selection of any SSAR publications valued at twice that amount.

The committee invites all student members of the Society to submit their work to the *Journal*, and encourages regular members who supervise the work of students to draw this award to the attention of those students.

NEWSNOTES

12th Ordinary General Meeting of Societas Europaea Herpetologica

The 12th Ordinary General Meeting of European Herpetological Society (12thOGM SEH) was held in August 2003 in conjunction with the 2nd Ordinary Meeting of the A. M. Nikolsky's Herpetological Society under the Russian Academy of Sciences and North Eurasian Reptile Specialist Group of SSC IUCN. Approximately 360 delegates from 33 counties attended five days of meeting (12–16 August). Because of combined meeting of two societies there were many more participants than for previous SEH

meetings (176 persons in France in 1998, 148 persons in Cretea, Greece in 1999, and 86 persons in Slovenia in 2001). The meeting hall at the Zoological Institute was too small to accommodate this large turnout, and thus the main sites of the 12th OGM were the beautiful historical buildings of the St.Petersburg Branch of the Russian Academy of Sciences, St.Petersburg State University, and the Zoological Institute.

The purpose of this joint meeting was to promote mutual enrichment and further development of cooperation between both societies in the field of fundamental and conservation research. It enabled the research findings of Russian scientists to be presented in full, especially those relating to nature protection, in order that programs among the different countries of CIS and Europe can be articulated, with joint programs drawn up between Europe, the European part of Russia, and the Baltic region.

The meeting opened on the morning of 12 August in historical Big Hall of the St.Petersburg Branch of the Russian Academy of Sciences, made famous by many prominent events. This same venue hosted the Nobel Prize announcements in April 2003. Meeting participants were welcomed by Dr. Oleg Pugachev (vice-director of Zoological Institute), Academican Ilya S. Darevsky (President of A. M. Nikolsky's Herpetological Society under the Russian Academy of Sciences), and Dr. Natalia B. Ananjeva (President of the SEH, head of Department of Herpetology, Zoological Institute).

Plenary lectures followed: Ettore Olmo, Teresa Capriglione, Gaetano Odierna and Larissa Kupriyanova ("The contribution of cytogenetics to the study of reptiles systematics"), and Michael Shishkin ("On the patterns of evolution of the early Triassic herpetofauna in Europe and Southern Gondwana").

Two concurrent sessions of oral presentations began on the afternoon of the 12th, and continued during the balance of the meeting. Special sessions were held as follows: Molecular taxonomy and phylogeny of reptiles; Ecology and distribution of amphibians; Morphology and phylogeny of amphibians and reptiles; Ecology and conservation of amphibians and reptiles; Phylogeny and taxonomy of lacertid lizards; Ecology of arid reptiles; Urbanization effect, conservation and ecology of amphibians and reptiles; Speciation and population genetics of amphibians; Biogeography and ecology of amphibians and reptiles; Phylogeny, taxonomy and behavior of amphibians; Ecology and behavior of amphibians; Faunistics and systematics of reptiles. Four poster sessions were held with about 180 participants. Two workshops focused on the methods of variability evaluation and on the history of herpetology. During the latter workshop, a special poster was presented by Natalia B. Ananjeva and Igor G. Danilov to commemorate significant anniversary dates in Russian herpetology: 2003 was the anniversary year of prominent herpetologists Sergei Chernov, Paul Terentyev (100th Anniversary), and Lev Khozatsky (90th Anniversary).

Many presentations addressed problems of developing species protection strategies and putting these into practice, including problems related to importing and exporting herps. Considerable time was devoted to discussions of modern methods of molecular research and their role in the creation of gene banks.

On 14 August, whole day excursions enabled participants to see St. Petersburg sights during a tour of the city, and later, to visit Petershof parks and palas. A party took place on a boat on the Neva River from where it was possible to view St. Petersburg in the evening light.

Business meetings of SEH and Nikolsky's Society were conducted on 14 and 15 August, respectively.

Some publications in Russian were issued just prior to or in conjunction with the 12th SEH OGM, in addition to the 197-page book of meeting abstracts. The latter, in English, featured 291 abstracts and a database of addresses of all presenters (more than 540 persons), now available on the SEH website <www.gli.cas.cz>. The Russian-language publications are:

Modern Herpetology. Collected papers. Vol. 2. Saratov Univ. Press. N. B. Ananjeva et al. (eds.). 175 pp.

and two books edited by S. L. Kuzmin:

Kubykin, R. A. (compiler). 2003. Fascinating World of Reptiles. Moscow, Nauchnyi mir, 262 pp. + many color plates. The book contains chapters written by leading ex-Soviet herpetologists on reptiles of Middle Asia.

Russian translation (S. M. Lyapkov, translator) of the book**: Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians** (W. R. Heyer et al., editors of the English edition). Moscow, KMK 380 pp.

—Submitted by Natalia B. Ananjeva

A Report on the Symposium on Turtle Origins, Evolution and Systematics Held August 2003 in St. Petersburg, Russia

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An International Symposium on Turtle Origins, Evolution and Systematics was held at the Zoological Institute of the Russian Academy of Sciences (St. Petersburg) 18–20 August 2003. This symposium continued a tradition started 20 years ago by the First International Symposium on Fossil Turtles (Paris, 1983). Since then, there have been two sessions within larger meetings: one within the 75th Annual Meeting of the American Society of Ichthyologists and Herpetologists (Edmonton, 1995) and one within the 56th Annual Meeting of the Society of Vertebrate Paleontology (New York, 1996). Unfortunately, for political and later for financial reasons, Soviet and Russian specialists were not able to participate in any of these meetings.

FIG. 1. A group photo of some of the participants of the International Symposium on Turtle Origins, Evolution and Systematics at the Zoological Institute of the Russian Academy of Sciences. 1: S. Krasnova; 2: J. Claude; 3: V. Sukhanov; 4: G. Cherepanov; 5: A. Rezvyi; 6: V. Egorova; 7: D. Brinkman; 8: S. Kuratani; 9: W. Joyce; 10: S. Chapman; 11: V. Gillespie; 12: O. Piskurek; 13: E. Buffetaut; 14: I. Danilov; 15: J. Parham; 16: R. Hirayama; 17: Y. Ohya; 18: H. Tong.

FIG. 2. Walter Joyce gets acquainted with a specimen of *Anatolemys* (foreground) and the holotype of *Lindholmemys* (in box) as Igor Danilov (center) discusses some Russian literature with Ren Hirayama (left) and Don Brinkman (right) at the Chernyshev's Central Museum of Geological Exploration in St. Petersburg. Photo by James Parham.

Russia has a long tradition of turtle studies. L. G. Bojanus (1776–1827) published his famous "Anatome Testudinis Europaea" (1819, 1821), while he was rector of the University in Vilna (now Vilnius, Lithuania), then part of the Russian Empire. This work remains the most detailed description of turtle anatomy and was republished in 20th century twice (1902, 1970). Academician A. A. Strauch (1832–1893), Director of the Zoological Museum in St. Petersburg (now the Zoological Institute), is well known for his papers on chelonology (Strauch 1862, 1890). In fact, the term "chelonology," introduced by Polish turtle expert M. Mlynarski, was based on Strauch's (1862) "Chelonologische Studien" (Borkin, pers. comm.). W. A. Lindholm (? –1935) should also be mentioned among turtle experts of the beginning of the 20th century, although he is better known as a malacologist.

Large collections of fossil turtles from the territory of the Russian Empire, and later Soviet Union, are housed in St. Petersburg (Leningrad) at the Zoological Institute (ZISP) and at the Chernyshev's Central Museum of Geological Exploration (CCMGE). These collections were studied by A. N. Riabinin

(1874–1942), L. I. Khostazky (1913–1992), and L. A. Nessov (1948–1995). In the second half of the 20th century, turtle specialists appeared in other parts of the Soviet Union: Moscow (Russia), Kiev (Ukraine), Tbilisi (Georgia), and Almaty (Kazakhstan). Soviet chelonologists formulated important ideas about turtle phylogeny and systematics. Unfortunately, their ideas were not published in English and so were often ignored by foreign colleagues. Furthermore, the possibility of direct contact between Soviet and foreign scientists, and access to published materials, was limited. The 2003 international symposium on turtles in St. Petersburg aimed not only to solve scientific problems, but to establish close contacts between Russian and foreign turtle specialists (Fig. 1).

The Symposium was organized by an international team (Parham, Hirayama, Cherepanov), led by I. G. Danilov (ZISP). The scope of the symposium was expanded in comparison to previous ones to include problems connected with studying both fossil and recent turtles. The number of registered participants was 19, including scientists from Russia (7), Japan (4), France (3), USA (2), United Kingdom (1), Canada (1) and Georgia (1). This symposium was the largest by number of presentations (21). The age composition of participants was shared equally between young and middle generations. There were only two participants older than 60, V. B. Sukhanov (Moscow, Russia) and V. M. Chkhikvadze (Tbilisi, Georgia). It is worth mentioning that besides registered participants, sessions were attended by up to 50 additional people (colleagues from ZISP, students of the St. Petersburg University, and visitors). The official language of the Symposium was English. The welcoming speech was made by the Head of the Department of Ornithology and Herpetology of ZISP, N. B. Ananjeva. She noted that this Symposium took the baton from the XII Ordinary General Meeting of the Society Europaea Herpetologica, which had been just held in ZISP and SPSU (12–16 August 2003).

Besides the oral and poster presentations, an important part of the program was work with scientific collections of ZISP and CCMGE (Fig. 2). In the ZISP, work was conducted at the Department of Herpetology. Fossil specimens, including holotypes, and publications were made available. During those final days, one could find all the participants of the symposium sitting around a big table examining specimens, engaged in discussions with colleagues. Following the symposium, eight participants traveled to Moscow to visit the rich collections of the Paleontological Instititute (PIN).

The Program and Abstracts book of the symposium was published. The next Symposium on Origins, Evolution and Systematics of Turtles will be held in 2005 in Tokyo (Japan).

The organizers would like to express deep gratitude to Drs. N. B. Ananjeva, E. N. Kurochkin (PIN), V. B. Sukhanov (PIN), as well as administration and staff of the CCMGE for help in organization of the symposium. We thank L. Y. Borkin (ZISP) and Walter Joyce (Yale) for useful comments on this report.

Gopher Tortoise Council Grants

The J. Larry Landers Student Research Award is a Gopher Tortoise Council competitive grant program for undergraduate and graduate college students. Proposals can address research concerning Gopher Tortoise biology or any other relevant aspect of upland habitat conservation and management. The amount of the award is variable, but has averaged US $1,000 over the last few years. The proposal should be limited to four pages in length and should include a description of the project, a concise budget, and a brief resume of the student. Proposals should be submitted by 31 August 2004 to: Bob Herrington, Chair of Research Advisory Committee, Georgia Southwestern State University, Department of Biology, Americus, Georgia 31709, USA; e-mail: bherring@canes.gsw.edu.

MEETINGS

Meetings Calendar

15–20 November 2004—VI Symposium of Zoology, Topes de Collantes, Sancti Spiritus, Cuba. Information: www.geocities.com/zoologiacubana/simposio or by e-mail: zoologia.ies@ama.cu.

16–18 January 2005—Biology of the Rattlesnakes conference, Loma Linda, California, USA. Information: www.BiologyoftheRattlesnakes.org.

OBITUARIES

Herpetological Review, 2004, 35(2), 100–101.

Walter John Breckenridge 1903–2003

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PHOTO BY BARBARA FRANKLIN

Walter John Breckenridge passed on May 23, 2003 at the age of 100. Breck, as he was known to his friends and colleagues, was Minnesota's premier naturalist. He was born on March 22, 1903 in Brooklyn, Iowa. After graduating form The University of Iowa in 1926, he moved to Minneapolis to work for Thomas Roberts at the Bell Museum of Natural History as a preparator/taxidermist. Breck's influence can be found in many of the museum's dioramas. He received his MA in 1937 for doing research on Marsh Hawks and his PhD in 1941. He became a curator in the 1930's and the director in 1946, remaining in that po-

sition for 24 years until his retirement in 1969.

Breck was best known in amphibian and reptile circles for his book, *Reptiles and Amphibians of Minnesota,* which was published in 1944. The book was a popularized edition of his 1941 Ph.D. of the same title. His book was the only reference for Minnesota for 50 years and was in print for 40 years. Breck's first herpetological paper was published in 1937 and over the next 30 years he authored or co-authored 29 more herpetological articles, including in-depth studies on Black-banded (Northern Prairie) Skinks, Canadian Toads, and Spiny Softshells. The Northern Prairie Skink work was the first detailed study on the life history of this lizard.

Professionally, Breck was more closely associated with the ornithological community. He was a life member of the Minnesota Ornithologist's Union. He published numerous papers on Minnesota birds and served as the President of the Wilson Ornithological Society. His ornithological accomplishments were honored by the creation of the Breckenridge Chair in Ornithology at the Bell Museum.

From the beginning of his career Breck established his reputation as an artist and illustrator. He drew all of the line drawings in his books and articles. His paintings were published in many books, including Thomas Robert's *Birds of Minnesota.*

Breck was a pioneer in wildlife photography. He went on to make a number of popular films including *Wood Duck Ways, Spring Comes to the Subarctic*, and *Migration Mysteries*. Breck traveled the country presenting these films as part of the Audubon film series. The Bell Museum has recently restored these classic nature films.

Breck is survived by his wife of almost seventy years, Dorothy, his daughter Barbara Franklin, son Thomas, five grandchildren, and six great grandchildren.

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Herpetological Review, 2004, 35(2), 101–107.

In Memoriam: Roger Conant (1909–2003) with Reflections by Some of Roger's Many Friends and Colleagues

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Conant studying a specimen of *Agkistrodon contortrix* in his laboratory at the University of New Mexico (1983).

On December 19, Roger Conant died peacefully in his sleep at the age of 94. He had been a regular contributor to North American herpetology since his first publication in November 1929. His last title, a major monograph on the garter snakes of transvolcanic Mexico, appeared just seven months before he died. In between, Roger produced a steady stream of notes, reviews, and papers punctuated by a dozen major works that mark his long career as one of the most distinguished of any American herpetologist of any generation. His volume in the Peterson Field Guides series, in its several editions, is the most widely-used book ever produced in our discipline. These alone would have assured his place as a major figure in the history of herpetology.

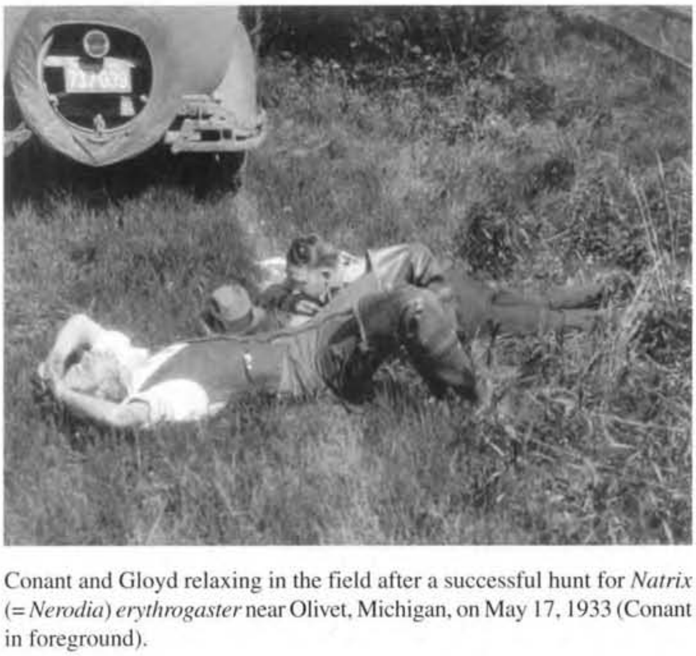
But the impact of Roger Conant was far greater than even these enviable contributions to the literature. He was one of the great zoo men of the 20th century. He impacted the lives of literally tens of thousands of young people through his authorship of the "Reptile Study" merit badge booklets (four editions, from 1944 to 1976) issued by the Boy Scouts of America. He also encouraged the budding careers of a multitude of would-be herpetologists, mostly teenagers and myself among them, by having the patience of Job to systematically answer every single letter sent to him over a period of some 70 years. His pride in this facet of his distinguished career is demonstrated by the fact that all of these letters were proudly displayed, bound in cloth covers, on a very long shelf in his Albuquerque library.

Roger was clearly not an ordinary herpetologist and this obituary, by a dozen of his closest colleagues, attempts to touch on some of the many aspects of his life and career in the hope that the younger herpetologists of today will understand the respect and even reverence that we of the older generation give to Roger Conant. It is my privilege, therefore, to begin this tribute with a brief summary of his remarkable life.

Roger Conant was born in Mamaroneck, New York, on May 6, 1909. His interest in reptiles, especially snakes, began at age 12 when he caught some water snakes at a boy scout camp. He quickly became so knowledgeable about snakes that he was soon giving lectures to scout troops and other groups. He briefly attended the University of Pennsylvania but had to drop out for financial reasons. Soon he had his first big break: to be hired, in 1929, as Curator of Reptiles at the Toledo (Ohio) Zoo. He was only 19. The reptile collection grew rapidly and soon Roger was General Curator (in effect, director) of the zoo. The Toledo period also represented his graduate-level training because Ann Arbor was nearby with its constellation of herpetologists at The University of Michigan—Ruthven, Gaige, and Blanchard and their many students. Roger regularly visited Ann Arbor and, among other beneficial interactions, he befriended a graduate student, Howard K. Gloyd, who became a close friend and lifelong colleague.

A formal portrait, taken in 1930 or 1931 by Howard K. Gloyd, when Conant was Curator of Reptiles at the Toledo Zoological Park.

In the 1930s, zoos generally did not have scientific programs, but Roger had unusually ambitious plans. As an adjunct to his zoo work—which included the design and construction of a new reptile house that is still used to this day—he decided to write a book, "The Reptiles of Ohio." To obtain the necessary specimens, he financed his own expeditions to all parts of Ohio (using an insurance payment for a doctor's bungled handling of a rattlesnake bite that cost him his left thumb). The voucher specimens he collected were kept in a makeshift museum at the zoo. The book, published in 1938 (and republished with revisionary addenda in 1951), was called "a landmark in the development of herpetology in the Eastern United States" by Karl P. Schmidt. Roger was now prominently on the national map. His monograph became the standard for state herpetologies and his basic format is still in use today.



Conant and Gloyd relaxing in the field after a successful hunt for *Natrix* (= *Nerodia*) *erythrogaster* near Olivet, Michigan, on May 17, 1933 (Conant in foreground).

Three years before the book was published, Roger moved to the Philadelphia Zoo as Curator of Reptiles. He later added other titles (Public Relations and Membership Secretary in 1936 and Director in 1967) and retired in 1973. Philadelphia Zoo was the first American zoo to exhibit live reptiles (1874), but Roger inherited an old building originally built for birds. Finally, in 1972, a new reptile house was opened, designed by him. It incorporated many modern features that have been widely imitated. Prior to its design, Roger visited many other facilities to get ideas and learn best practices. During his 38 years at the zoo, Roger pioneered some of the earliest captive breeding programs, developing combinations of diet and environment that also led to numerous longevity records for many species. He edited the zoo's publications for 28 years and wrote and conducted, for 33 years, a weekly radio show for the Philadelphia affiliate of NBC. He made frequent appearances on television to promote the zoo and an understanding of animals. Roger was not shy about his interests in animals and he had a commanding presence as a public speaker.

During Roger's Philadelphia years, his primary research interest was the systematics of water snakes, an interest that eventually led to Mexican expeditions (1949–1967) with his wife, Isabelle Hunt Conant, who was an outstanding wildlife photographer. In 1951, following preliminary correspondence, Roger Tory Peterson visited the zoo to ask Roger to write the volume on amphibians and reptiles in the field guide series that bears his name. Roger was the logical choice because of his prior publications and his prominence as a specialist on reptiles, but surely Isabelle's ability to take the photographs was a huge advantage since the book really required a team effort. They set out to illustrate every species and subspecies found east of the 100th meridian, so at one time or another they temporarily possessed examples of almost every one of them alive. Roger wrote the text and assembled the detailed and up-to-date distribution maps. Isabelle, with Roger's assist, made the photographs in black-and-white and then colored each one by hand with watercolor dyes, using the living specimens as her guide. The result, "A Field Guide to Reptiles and Amphibians of the United States and Canada," was published in 1958 and was an instant success. A second edition was published in 1975 but covered more territory to the west since

The Conants demonstrating their technique for obtaining photographs for use in the "Field Guide" (middle to late 1960s).

The Conants working in the shelter of their camper parked near the source of the Río Nazas in Durango, Mexico (September 1960).

Bob Stebbins's 1966 book on western herps extended only to the eastern borders of the Rockies. The new edition was appropriately retitled "Eastern and Central North America."

The third edition was issued in 1991. Together, these three editions represent the most widely used book in all of herpetology. More than half a million copies have been sold. In 1998, a "third edition, expanded" was issued in which Roger had virtually no part. He issued a public statement commenting upon what he called a "face lifting" perpetrated by his publisher simply to increase sales. He noted that there were color photographs added but no new text. He lamented the fact that pagination had increased from 450 to 616 pages and this, together with the use of coated paper, led to a much thicker and heavier book that was less a field book than the earlier versions. He publicly wondered if Peterson would be horrified. Clearly Roger was.

After retiring from the zoo early because of Isabelle's illness, they moved to Albuquerque where Roger had an adjunct professorship at the University of New Mexico. Here, devoid of his zoo duties, Roger could devote more time to herpetology. After Isabelle's death in 1976, there was a huge void in Roger's life and within weeks of her death he visited his old Ann Arbor colleague, Howard Gloyd, then living in Tucson. In 1932, they had mapped out a plan to monograph the pit viper genus *Agkistrodon*, a group of species found in Asia and in North and Central America, but it had been put aside for some years. Gloyd had sustained the renewed work since 1958 and Conant reentered the project in 1976. But Gloyd was terminally ill by this point and it was Conant, with the help of Gloyd's widow, Kathryn, who became Roger's wife in 1979, who completed this massive volume published by SSAR in 1990. I served as Roger's editor on this project. He would call me precisely at nine every Thursday morning, 7AM his time, over a period of three years, to talk about the manuscript, proofs, illustrations, and with digressions into everybody and everything herpetological. One reviewer, Jonathan Campbell, wrote, "This book is one of the few herpetological works that can truly be considered a 'classic' from the date of its first appearance." Roger thereafter modestly referred to it merely as his "heavy book." As part of his work to complete the book, Roger visited Costa Rica, Japan, China, Taiwan, Thailand, Malaysia, Indonesia, India, and Sri Lanka, in order to learn more about these snakes in their native habitats. It was my good luck to join him for the strenuous field work, in the middle of a typhoon, on Hainan Island off the Vietnamese coast in September 1985. He was 77 at the time.

Besides the various editions of "Reptiles of Ohio" and the "Field Guide" and the *Agkistrodon* volume, Roger published several other major works, including "What Snake Is That? A Field Guide to the Snakes of the United States East of the Rocky Mountains" (1939), "A Review of the Water Snakes of the Genus *Natrix* in Mexico" (1969), and his autobiography, appropriately titled "A Field Guide to the Life and Times of Roger Conant" (1997). The last-named title chronicles his long and exciting life in a series of chapters with headings like "Youthful Trials and Triumphs," "The Miracle at the Toledo Zoo," "Monkeys Invade West Philadelphia," "Acapulco, the Basilisk, and the Fiery Volcano," and "Hoodlums, Vandals, and Other Problems," among dozens of others. There are also vignettes of prominent herpetologists and zoo people who were friends of Roger's. This book is very nearly a history of North American herpetology in the 20th Century. The incredible detail recorded in this volume, even from Roger's teenage years, is testimony to the way in which he meticulously recorded every aspect of his fascinating life. This meticulousness extended to every aspect of his life including, most especially, his scientific contributions.

Besides his research, Roger gave freely of his time to numerous organizations. He edited the zoo section of *Parks and Recreation* magazine for 20 years and served as both secretary and, later, president of the Association of Zoological Parks and Aquariums. He held several prominent positions, including president, in the American Society of Ichthyologists and Herpetologists and chaired the important ASIH committee that began the standardization of English names for the amphibians and reptiles of the United States and Canada. He served on the Board of Directors of SSAR, but it was his book, "Reptiles of Ohio," that influenced the early development of The Ohio Herpetological Society, SSAR's predecessor organization, in the late 1950s. His book was a kind of bible that inspired the early officers of OHS, then mostly high school and college students, to do serious field research and he served as an unofficial adviser during the early years of OHS. Some have even referred to him as the society's godfather and he was invited to

With early officers of The Ohio Herpetological Society (the precursor to the Society for the Study of Amphibians and Reptiles), gathered for the society's 25th annual meeting in Raleigh, North Carolina (August 1982). *From left*: Kraig Adler, Ray E. Ashton, Jr., Paul M. Daniel, Stephen G. Tilley, David M. Dennis, Barry D. Valentine, Roger Conant, Corson J. Hirschfeld, Joseph T. Collins, Ronald A. Brandon, and Henri C. Seibert.

join the present and former officers who gathered in 1982 to celebrate the 25th anniversary of OHS–SSAR.

Among his many honors, surely the most meaningful to Roger was the honorary Doctor of Science degree awarded to him by the University of Colorado in 1971. For someone who was not able to complete his undergraduate degree, this recognition of his professional career by his academic colleagues was very special indeed. In 1989, his zoo colleagues also honored him, with the R. Marlin Perkins Award for professional excellence, for his example of combining serious research with the more usual duties of a zoo curator. This has had a transformative effect on bridging the gap that separated zoo staff from their academic colleagues in universities and museums. He also received the Distinguished Service Award from the National Recreation and Park Association. Among his most recent awards are these: Gold Medal for Natural Resource Conservation (Boy Scouts of America, 1999), Cardinal Award (Ohio Department of Natural Resources, 1999), Herbert Osborn Award (Ohio Biological Survey, 2000), Hall of Fame (Ohio Department of Natural Resources, 2001), and the W. Frank Blair Eminent Naturalist Award (Southwestern Association of Naturalists, 2003).*

Roger Conant's life has been an inspiration to generations of herpetologists in North America and beyond, and it will stand as an example for years to come. Besides his many scientific contributions to herpetological science and to zoo development, perhaps his most important impact was the encouragement of thousands of young people to develop careers in herpetology, biology, conservation, and related fields.

Each career is unique, but Roger's was truly unusual and special. Its impact on our field has been immense and broadly felt. It is hard to imagine that we will ever see another whose influence on our discipline will be so profound as Roger's has been. I now yield to my collaborators to explain the special ways in which Roger influenced them as a colleague or as a mentor. For me, he was both, and also a dear friend, as he was to so many others. He will be very deeply missed by us all and by legions of others he did not personally know.

* These awards are given in some detail since they occurred after the publication of Roger's autobiography. For this information, I am grateful to Raymond Novotny, who organized the documentation leading to the nominations for these awards.

I had extensive correspondence with Roger Conant long before I ever met him. One matter of mutual interest was the taxonomy and distribution of snakes of the genus *Pituophis*. In 1947, I was employed by the U.S. Fish and Wildlife Service. Roger was aware of my herpetological activities in California, and when I moved to Louisiana, he wrote to me with an urgent request that I be alert for Louisiana pine snakes (*Pituophis melanoleucus ruthveni*). I was already aware of this rare snake and keenly interested in finding some. I lived with my family in Leesville, but every day I drove to the national forest, where my studies involved mainly white-tailed deer, but also were concerned with armadillos, bobwhite, mourning doves and other birds, and their effect as seed-eaters on longleaf pine regeneration. The long daily drive on little-used roads improved my chances of finding snakes. I identified and recorded all that I saw.

I found one *ruthveni* on the road before my correspondence with Roger. I preserved it and sent it to Klauber. Subsequently I found two more and sent them alive to Roger. I found the dried carcass of a fourth one but did not preserve it. In 1956, Roger published a paper based on my two *ruthveni* and a few records of *lodingi*, the black pine snake from near Mobile. In this paper, Roger quoted my field notes at length.

The relationships among pine snakes of the eastern states, the bull snake of the Great Plains, and the gopher snakes of western states have been controversial, and their scientific names have been unstable. *Pituophis melanoleucus ruthveni* was named by Stull (a doctoral candidate at the University of Michigan) in 1929 from two specimens from Rapides Parish, Louisiana. In 1935, Burt mentioned a third specimen from Zavalla, Angelina County, Texas. Few were known at the time of my collection. In Roger's 1956 paper, he mentioned three localities from Natchitoches Parish, Louisiana, one locality in Rapides Parish, and four from Vernon Parish, and referenced five localities in Texas.

The Louisiana pine snake, *ruthveni*, was stated by Conant in 1956 not to intergrade either with the *melanoleucus* subspecies nor with *sayi* on the west. But in several editions of the List of Common and Scientific Names, all U.S. *Pituophis* were considered conspecific under the name *melanoleucus*. In 1995 however, Reichling concluded that *ruthveni* is indeed a distinct species, as advocated long ago by Conant. It must be acknowledged that all his writings are exemplary samples of scientific writing, characterized by logic, clarity, and brevity.

—*Henry S. Fitch*

When I was a kid, Ditmars and Conant, at least their writings anyway, were my constant herping companions. And so when I discovered a strange looking salamander in a neighbor's swimming pool, I consulted my dog-eared copy of the Conant *Field Guide*. The lucid, friendly text was easy for me to follow, and I concluded, with growing excitement, that I had found something extraordinary: a Jefferson Salamander. Up in Saint Louis, this would have been unremarkable, but I lived in Memphis, where this species had never been seen.

What to do? Somehow, I knew that Roger Conant was Director of the Philadelphia Zoo, so I summoned my courage and telephoned him. He was not available, but his secretary, no doubt a veteran of such calls, instructed me to send the specimen to the zoo. I packed the little salamander with the utmost care and dropped it into the mail. Several days later the phone rang and a voice at the other end requested that I hold for Dr. Conant.

I held my breath. Time stood still. But soon I found myself talking with a cheerful person who treated me as a colleague. Conant praised my packing job and informed me that the salamander had not only arrived in splendid condition, but was already feeding! More importantly, he confirmed my suspicions by agreeing with my identification! I walked with giants.

Conant told me he was sending the specimen to Tom Uzzell, who at the time was doing biochemical research on salamanders. After the call, I realized I liked Roger Conant. He was friendly, enthusiastic, and obviously very wise. When Uzzell's analysis was final, I received another call from Philadelphia. This time the news was perplexing to both of us. Uzzell had found that it was simply an aberrant Small-mouthed Salamander, a species utterly commonplace in West Tennessee. Oh well.

So began a friendship that ran for decades. It brought me excellent advice on everything from herps to politics. I worked for several years with Roger on his memoirs, and was treated to weekly, marathon phone calls in which he shared anecdotes about many of the great herpetologists he had known. I listened in awe, and encouraged him to include as many as were fit to print in his book. He did, and his autobiography ranks as a history of twentieth century herpetology in America. My time at the Conant house in Albuquerque is one of my fondest memories.

Roger inspired me with his orderly approach to work and life. He never lost sight of his passion: the reptiles and amphibians. That focus kept him modest and accessible while his professional awards multiplied. He was a chivalrous gentleman who hailed from an era that produced real leaders. I am honored to have been associated with Roger Conant as a herpetologist, but I am proudest to have had him as a friend.

And by the way, we agreed to the end that the little salamander was a Jefferson.

—*William W. Lamar*

Roger Conant had a huge impact on me as a budding herpetologist in the early 1960s through his 1958 *Field Guide to Reptiles and Amphibians*. Like many other young people, it served as a cornerstone of my passion and later my career. As a professional, I interacted with Roger through his editing of my papers (including one co-written with him) and discussions over things herpetological. I was always struck by his meticulous editing and writing skills, paying close attention to the smallest of details. He was one of my mentors.

Although I had first met Roger briefly in 1982, I came to know him and his wife Kathryn Gloyd in September 1989 at the First World Congress of Herpetology in Canterbury, England. Along with another 40 or so colleagues and spouses, my wife and I had booked the, as it turned out, infamous one-day bus trip to Paris. All of us were destined to spend a very long day on that bus. It left at about 0600, taking the ferry across the English Channel from Dover to Chalice, France, arriving in Paris after several hours on the road in mostly hard rain. We had three hours more on the bus in Paris seeing the sights, stopping twice briefly, once at the Eiffel Tower and again at the Notre Dame Cathedral. Coming back required another ferry ride, but this time it was in rough seas. All of us well remember the large ferry boat riding the huge waves and the smacking sound that the propellers made when they emerged from the water as they broke free of each crest. Roger had a problem with his balance and I stayed with him on that voyage, helping him move around when he needed to change locations. Many friendships were solidified on that bus trip and Roger and I were fast friends when we finally got back to Canterbury close to midnight.

In 1991, I had the privilege of assembling and binding a set of letters written to Roger by numerous friends, family, colleagues, and students. I presented them to Roger at a reception following a two-day symposium in his honor at the SSAR meeting at Pennsylvania State University. Reading these letters showed me just how much he was appreciated and loved for all the attention and mentoring he provided for just about everyone throughout his life. These included people from the zoo world, herpetologists, and many others. Several of the letters were from people to whom he had given time while a busy zoo curator and director when they were young.

I visited Roger in Albuquerque at the end of 1991 and rode with him in his Volkswagon bus to Tucson during 2–3 January 1992, stopping by my master's thesis field site south of Willcox along the way. He was 82 at the time and insisted on driving the entire way, although we had to make it a two-day trip so he could rest overnight at a hotel near Deming. I had volunteered to help pack up the Howard K. Gloyd personal library then housed at Kathryn Gloyd's condo. Kathryn and Roger had given it to the University of Texas at Arlington (UT-A). They were doting hosts and kept me well fed at local restaurants; they frequently ate out. Much of the time spent with Roger on that trip was devoted to discussions of the history of herpetology and focused particularly on biographical information of people he had known well, such as H. K. Gloyd and E. R. Dunn. After three days of packing books, correspondence, and other materials, I drove the Gloyd library in a U-Haul truck to the Dallas–Fort Worth area 6–7 January. The collection is now at UT-A under the watchful eye of Jonathan Campbell.

Roger was a true friend and colleague, and encouraged me many times to be the best person I could be. I certainly benefited from his field guide when I was young and from his mentoring later in my professional life. My memories of him will be largely of those days late in his life in Albuquerque and Tucson, and on the ride in his VW bus between them, when we talked about herpetology and its history.

—*Joseph C. Mitchell*

A few years after I started my career at the Dallas Zoo in 1966, the American Zoo and Aquarium Association held a regional meeting in the Dallas–Fort Worth area. Since there were large herpetological collections at the two zoos, it seemed logical to invite a number of prominent herpetologists to present papers and interact with the delegates. Included in this stellar group were Roger Conant and Edward H. Taylor from the University of Kansas. I invited both of them to stay at my home.

Each morning as I dragged myself out of bed, the strains of operatic arias emanated from my stereo. Roger and Ed would be sitting in the living room eating graham crackers, drinking coffee, and reminiscing about their careers in herpetology and adventures in the field. Every evening, I invited colleagues and friends to my home and we sat spellbound as these two great herpetologists told us about their herpetological experiences and their favorite places, especially Mexico. It was a remarkable week.

Some years later, we hatched gray-banded kingsnakes and Trans-Pecos ratsnakes at our zoo. Roger was director of the Philadelphia Zoo and I asked him if he would like some of these baby snakes for his zoo collection. He accepted with enthusiasm and we sent these reptiles in cloth bags in a wooden shipping crate. Several weeks later, Roger returned our crate and I was surprised to find the bags laundered, neatly pressed, and folded. I called him to express my amazement at the pristine state of these bags—he said that it was the only way that bags should be returned. It must be said that Roger was the only one to ever return clean bags!

Thirty years after I started in Dallas, I decided to retire and move to Washington, DC. I was apprehensive as horrific stories about lethargy, boredom, and depression after retirement permeated my brain. Clearly, I needed advice and counsel if my retirement was to be pleasant. I asked Roger if he could share his thoughts about successful retirement. His first rule was that one always needed to have a future project in mind. His second was to ensure that the preceding day and the following day are different from the present day. He lived by this philosophy—last year, as proof of his continuing productivity, he sent an inscribed copy of his recently completed monograph on Mexican garter snakes published by the American Museum of Natural History.

It will be unlikely, even amazing, if our profession ever produces another Roger Conant. He was my confidant, mentor, and friend—I will miss him.

— *James B. Murphy*

On my birthday in 1959 I received a copy of Roger Conant's field guide. This magical guide to amphibians and reptiles, full of detailed information and wondrous illustrations by Isabelle Hunt Conant, was to have an immeasurable impact on my youth, just like it did in the lives of so many others.

In 1968, J. R. McCranie and I found an axanthic cornsnake west of Miami. Cornsnakes lacking red pigment were a rarity in those days, and since I was soon traveling to Philadelphia on business I brought the snake along, chancing the opportunity to meet and show it to the Conants—and I did. I met Roger and Isabelle in their historic Penn House office at the Philadelphia Zoo. After a brief introduction, I pulled the snake from a bag and Dr. Conant replied, "That's an unusual Pilot Black Snake you have there," but as I turned the snake over to reveal its checkerboard belly he gasped, "Oh my!" That day Roger Conant took time from his busy schedule to show me around the zoo. This fortuitous rendezvous was the start of a close relationship that was to last for three and a half decades.

In the years that followed I sent the Conants a few introduced reptiles from Florida, for photographs in the second edition of their field guide. After Isabelle and H. K. Gloyd passed away, Roger called to request photographs of various *Agkistrodon* for the upcoming Gloyd and Conant

monograph. Because I am a native Costa Rican, our discussion turned to *A. bilineatus* in the region, which at that time was poorly known. In early 1982, in the company of a mutual friend, G. W. Schuett, Roger and I decided to travel to Costa Rica in search of specimens.

Roger Conant was a great storyteller. During that trip Schuett and I bombarded Roger with questions, asking him what herpetology was like in the "early days," and for insight into the personalities of numerous herpetologists who came before our time. Roger responded by showering us with tidbits of herpetological history, but the real pearls came late at night—just before bedtime. Each night he told us a story, and every morning we awoke to find Roger writing diligently in his notebook. At the time, we didn't know Roger was busy jotting down the story from the night before, and a few months later, much to our surprise, we received a booklet in the mail published by the Toledo Herpetological Society and entitled *Herpetology in Ohio—Fifty Years Ago*. Mine was inscribed with: This "Bedtime Story Book" is inscribed with fond memories of a wonderful two weeks in Costa Rica.

According to Roger, our eagerness to learn about the past was the incentive he needed to begin serious work on his memoirs. His exhaustive autobiography, published by Selva in 1997, leaves us a detailed accounting of his life and accomplishments, but it also contains a treasure-trove of historical information, herpetological and otherwise. Because of my involvement in the publishing business, how fortunate I was to share in Roger's joy when presenting him with the first copy!

As a giant in herpetology, no doubt many will be writing about Roger Conant's amazing organizational skills, attention to detail, literary contributions, lifelong productivity, and so on. From a personal perspective, however, Roger was my friend, mentor, and father figure. He enriched my life in so many ways, and it would warm his heart to know that by simply following his example, he will continue to do so.

—Louis W. Porras

My memories of Roger Conant span over two decades, and it was my good fortune to have known him as a colleague and friend since the beginning of my scientific career. In the late 1970s, as an undergraduate at the University of Toledo, I spent most of my spare time at the Toledo Zoo, and primarily in the Reptile House. At that time Bill Dennler was the newly appointed Curator of Reptiles, and he was most generous in allowing Fred Kraus, Jeff Cook, and me to volunteer our services behind the scenes. Although I knew of Roger Conant by way of the Boy Scouts (Reptile Study Merit Badge) and his field guide, during those volunteer sessions I became more familiar with his research and zoo legacy. In 1929, when Roger was merely 19 years old, he held his first official position in herpetology as Curator of Reptiles at the Toledo Zoo. That important time in his life is chronicled in his memoirs.

Bill regularly encouraged bull sessions in the kitchen of the Reptile House which often entailed discussions of the "early days" at the Toledo Zoo and the challenges Roger Conant faced as a young curator. Because of our keen interest in the local herpetofauna, we discussed Conant's "extra job"— surveying the reptiles of Ohio. This work resulted in Roger's classic, *The Reptiles of Ohio*. Fred Kraus and I were particularly enthusiastic of that publication, since we would soon embark on a survey of the herpetofauna of the coastal zone of western Lake Erie. Conant's work was absolutely essential to us, and we fittingly dedicated our manuscript to him. Those were mighty good days.

During those lively discussions at the zoo, I could have never imagined that a few years later I would be invited to assist Roger in hunting cantils (*Agkistrodon bilineatus*) in northwestern Costa Rica. That unexpected opportunity, arranged by Louis Porras, allowed me to work in the field side-by-side with one of our country's foremost experts in herpetology and world authority on a group of snakes (*Agkistrodon*) for which we shared a passion. Costa Rica was my second foray to Central America, but surprisingly it was Roger's first. He was like a kid in a candy store! Each day as we prepared for the field, his eyes lit up with excitement in anticipation of searching for the elusive "Castellana." Although we were unable to secure live individuals we did not return to the States empty handed. Through the kind gesture of the Instituto Clodomiro Picado, preserved specimens were given to Roger for his use. He was stunned. On our return to our hotel in Liberia, Roger expressed his sheer joy by shouting colorful expletives that I never heard the likes from him again! At that time, I was shocked that someone could become so excited over a few dead snakes. I learned so much from that experience.

Publication of the Gloyd and Conant *Agkistrodon* opus was a great moment in herpetological history, and it was a tremendous honor to assist Roger in various ways. At his insistence, my wife Laura completed over a dozen delineations for the "heavy book" (as Roger called it)—he loved her art.

In reflection, I have no doubt that Roger Conant possessed genius. His was not displayed in eccentric mannerisms and arrogant actions, but in a subtle and quiet ability to collect, organize, and process information for large-scale projects. In his research, each and every detail was painstakingly considered. Roger's vast achievements are even more remarkable knowing that he was largely self-educated. If genius is measured by the degree to which one's ideas and work influence others, Roger stands among the giants of knowledge.

Cheers to you, Roger, to your remarkable and enviable life.

—Gordon W. Schuett

Roger was an adjunct professor at the University of New Mexico when I arrived there in 1974. At that time, he was hard at work on the third edition of his eastern field guide to reptiles and amphibians. When that was finished, he tackled the *Agkistrodon* monograph that he and Howard Gloyd were writing. Howard died when the manuscript was still embryonic and Roger, aided by Howard's widow and his own wife-to-be, Kathryn, saw it through to completion. He had me read the final draft. As in all of Roger's work it was almost impeccable, and I was able to find only one or two minor errors. Next came the monograph on the garter snakes of the lakes of the Mexican plateau, based on collections that he and Isabelle made in the mid 1900s. My wife and I revisited many of these lakes and were able to confirm that the *Thamnophis* were still present in several of them. He finished that work after I left New Mexico in 1993.

Roger and I became good friends during the 18 years I was there. My main impression of Roger is that he was completely goal-oriented. He moved from one large project immediately to the next one. Health problems slowed him down at times, but his results testify to his staying power. He worked in the mornings, and always took a nap in the afternoon. When he came over to the Museum of Southwestern Biology, we would talk of mutual interests, especially in the systematics of snakes and the enduring values of museum collections. Roger never learned modern techniques of systematic analysis, but I am sure that his garter snake monograph, based on classical morphological techniques, will stand the test of time.

—Norman Scott

The long career of Roger Conant overlapped my own almost completely. He was born three years earlier. His first publication came in 1929, mine in 1931. His first new taxon was described in 1934, mine in 1935. Other parallelisms followed. Circumstances dictated, however, that his academic life would be short; he had but two years at the University of Pennsylvania. The beginning and end of his professional life was with zoos, where academic degrees did not limit achievement, at that time. The eminence he achieved during his lifetime might never have been possible within the constraints of academia.

Nevertheless, there are constraints in zoo administration, too, but he rose above them to become far more productive than most academics,

both scientifically and in promotion of familiarity of the general public with especially amphibians and reptiles, but also with a wide variety of other animals.

Thus the circumstances that led to my perennial academic life did not lead to direct contacts with Roger until the early 1940s, when we both had developed a great interest in the herpetology of Mexico. He was then interested in a monograph of it, but in deference to my own efforts he left the field to me. I will always wonder how much better a job he would have done with it, for he has always represented the ultimate in perfectionism.

It was a great occasion when we arranged for Roger to receive academic recognition with a Doctor of Science degree from the University of Colorado in 1971. It was a degree earned many times over for accomplishments in each of the academic areas of performance: research, service, and teaching. Very few other academics match his excellence in all those areas.

—Hobart M. Smith

Despite our lengthy and close association by correspondence, chiefly in relation to our eastern and western field guides, Roger Conant and I met in the flesh only five or six times. This happened at scientific meetings. I'm deeply thankful for these occasions.

My most vivid memory of him occurred at the 52nd annual meeting of the American Society of Ichthyologists and Herpetologists in Boston in 1972. Society members were housed in a tall building. A fire-alarm sounded and people poured out of the building. I soon found many of my friends, but where was Conant? Finally, he appeared bearing an arm-load of his precious maps for the eastern field guide. He brought them to meetings for updating with the help of colleagues. There was no way he would leave them, even at the risk of being cooked!

Roger was a man of great devotion—to his wife, his research, his directorship of the Philadelphia Zoo, and to his friends. He helped me immensely as I began work on my own field guide to the reptiles and amphibians of the West, including allowing me to use his map plates for my guide. In one of his letters to me, he wrote that the best thing he ever did in his life was to marry Isabelle. He always spoke of the great pride he felt in her artistic talents and that he was sorry that her pictures had to be so small because of the many species to be covered by the eastern guide.

I will remember Roger as one of the great men of our time, not only because of his scientific accomplishments, but also for his important contributions to the nature education of the general public.

—Robert C. Stebbins

Shortly after I arrived at the American Museum of Natural History late in June 1954, Chuck Bogert took me to meet Roger and Isabelle at their home in Taunton on the edge of the New Jersey Pine Barrens. This initiated a friendship lasting nearly 50 years. How welcoming they were to a young herpetologist very much out of his element in the East! And how wonderful it was to be introduced by an expert to such a place as the Pine Barrens.

Roger's long relationship with AMNH as a Research Associate in Herpetology assured a continuing professional and personal friendship. Later, with both of us retired and established in the Southwest, we saw one-another in Albuquerque or Tucson scarcely less often than when we both lived in New Jersey. Looking back, I think that what I most admired in Roger was the energy and drive that enabled him to combine a distinguished career as a zoo curator and director with an output of research and popular publications that would be the envy of many colleagues.

—Richard Zweifel

CURRENT RESEARCH

The purpose of **Current Research** is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, **Eli Greenbaum** or **Omar Torres-Carvajal**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can be found at: http://www.herplit.com/contents.

Origin of Venom in Snakes

The wide distribution of Duvernoy's glands and differentiated maxillary dentitions across colubroid lineages suggests that toxic secretions are a synapomorphy of Colubroidea. The authors isolated and compared a polypeptide toxin from the Duvernoy's secretion of the Asian ratsnake *Coelognathus radiatus* with toxins of other snake taxa. The isolated toxin was named α-colubritoxin, and represents the first colubrid toxin for which the complete amino acid sequence has been obtained. This sequence was aligned with several elapid 3FTX sequences in CLUSTAL-X and phylogenetic analyses using Bayesian inference were performed. The authors found that α-colubritoxin is part of the three-finger toxin (3FTX) family, which was thought to be unique to elapids. Moreover, toxins with similar molecular weights were detected in several other colubrid taxa. These results suggest that this toxin family originated early in the evolutionary history of advanced snakes. In addition, the absence of 3FTXs in viper venoms supports the basal phylogenetic position of vipers among colubroids.

Fry, B. G., N. G. Lumsden, W. Wüster, J. C. Wickramaratna, W. C. Hodgson, and R. M. Kini. 2003. Isolation of a neurotoxin (α-colubritoxin) from a nonvenomous colubrid: evidence for early origin of venom in snakes. Journal of Molecular Evolution 57:446–452.

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Mitochondrial Diversity in Malagasy Poison Frogs

With 17 species, Malagasy poison frogs *Mantella* are among the most prominent representatives of the endemic fauna of Madagascar. One of the clades within *Mantella* is the *M. madagascariensis* group, which is characterized by a high diversity in color phenotypes. The authors used 2.8 kbp of three mitochondrial and one nuclear gene of 15 *Mantella* species to study the phylogenetic relationships among the five species included in the *M. madagascariensis* group. Sequences were aligned with CLUSTAL-X and partition homogeneity was tested using the ILD test. Analyses included maximum parsimony, maximum likelihood, Shimodaira-Hasegawa tests, bootstrapping, and Bayesian posterior probabilities. These analyses supported the monophyly of the

M. madagascariensis group. In addition, haplotype variation in the cytochrome *b* gene among and within seven populations of the group also was examined. Haplotype networks were constructed, and analysis of molecular variance was performed to determine hierarchical structuring of genetic variation. The authors found a relatively high haplotype diversity within populations of the *M. madagascariensis* group. Because quaternary records suggest periods of fluctuating climate in parts of Madagascar, the authors hypothesized that Malagasy poison frogs have been repeatedly isolated in small refugia with subsequent range expansion and intensive introgression in contact zones.

VENCES, M., Y. CHIARI, L. RAHARIVOLOLONIAINA, AND A. MEYER. 2004. High mitochondrial diversity within and among populations of Malagasy poison frogs. Molecular Phylogenetics and Evolution 30:295–307.

Correspondence to: Miguel Vences, Institute for Biodiversity and Ecosystem Dynamics, Zoological Museum, University of Amsterdam, P.O. Box 94766, Amsterdam 1090 GT, The Netherlands; e-mail: vences@science.uva.nl.

The Middle Ear of *Rana catesbeiana*

The tympanic cavity mainly conducts middle and high sound frequencies in anurans. The author studied the morphology and functional role of the middle ear in *Rana catesbeiana*. Audiograms were obtained from nine adult frogs by stimulating the intact ear from the outside. Thereafter, middle ear structures were removed and a second round of audiograms was obtained by stimulating the amputated columella. Differences between these audiograms indicated the mechanical role of the structures removed. Werner found that the extracolumella and columella of the American bullfrog are distinct units jointed at an angle with potential motion. Moreover, he noticed that this ossicular chain included a mechanical lever and was able to confirm this lever action with physiological experiments.

WERNER, Y. L. 2003. Mechanical leverage in the middle ear of the American bullfrog, *Rana catesbeiana*. Hearing Research 175:54–65.

Correspondence to: Yehudah Werner, Department of Evolution, Systematics and Ecology, The Hebrew University of Jerusalem, 91904 Jerusalem, Israel; e-mail: yehudah_w@yahoo.com.

Sensory Drive and Dewlap Design in Anoles

Signal diversification might play an important role in promoting species richness of taxa characterized by rapid and intensive speciation. The sensory drive hypothesis has been proposed as a mechanism leading to signal diversity between closely related species. Under this hypothesis, species or populations come to occupy different habitat conditions where selection for effective communication promotes divergence in signal designs. The authors used four allopatric populations of *Anolis cristatellus* from mesic and xeric habitats in Puerto Rico to test whether the process of sensory drive can take place at the population level. They measured total intensity and spectral quality of the light at each location, as well as spectral transmission and reflectance properties of male dewlaps. Leal and Fleishman found that dewlaps from mesic populations reflect more light than dewlaps from xeric populations, and that the relative detection probability of dewlap design was affected by habitat light conditions. These and other results suggest that sensory drive might be an important mechanism in the dynamics of the speciation process in anoles.

LEAL, M., AND L. J. FLEISHMAN. 2004. Differences in visual signal design and detectability between allopatric populations of *Anolis* lizards. The American Naturalist 163:26–39.

Correspondence to: Manuel Leal, Department of Biological Sciences, Vanderbilt University, VU Station B 351634, Nashville, Tennessee 37235-1634, USA; e-mail: manuel.leal@vanderbilt.edu.

Evolutionary Significance of Oral Morphology in Carnivorous Tadpoles

Asian-African tiger frogs (*Hoplobatrachus)* have carnivorous tadpoles with peculiar oral features, such as keratinized spurs on the buccal floor. Based on a molecular phylogeny and detailed morphological descriptions, the authors studied the evolution of larval oral morphology in these frogs. Phylogenetic analyses included 2430 bp of two nuclear and four mitochondrial genes and corroborated monophyly of *Hoplobatrachus*, with *Euphlyctis* as sister taxon. Carnivorous specializations in tadpoles of *Hoplobatrachus* could explain why this taxon has been so successful in adapting to arid environments where ponds are at high risk of desiccation. Grosjean et al. hypothesize that evolution of carnivorous tadpoles was the key innovation that enabled *Hoplobatrachus* to disperse into its present wide distribution area in Asia and Africa.

GROSJEAN, S., M. VENCES, AND A. DUBOIS. 2004. Evolutionary significance of oral morphology in the carnivorous tadpoles of tiger frogs, genus *Hoplobatrachus* (Ranidae). Biological Journal of the Linnean Society 81:171–181.

Correspondence to: Stéphane Grosjean, Laboratoire des Reptiles et Amphibiens, Muséum National d'Histoire Naturelle, 25 rue Cuvier, 75005 Paris, France; e-mail: sgrosjea@cimrs1.mnhn.fr.

Female-Biased Dispersal in *Rana catesbeiana*

The mating system of the North American bullfrog is well characterized, yet little is known about its dispersal behavior and patterns of gene flow. Using data from seven polymorphic DNA microsatellite loci, the authors studied sex-biased dispersal patterns in *Rana catesbeiana* based on two predictions. First, philopatry should benefit males by allowing familiarity with local reproductive resources, and second, greater dispersal by females should occur, which reflects the importance of mate choice in inbreeding avoidance and reproductive success. Frogs were sampled from nine locations within the Frontenac Axis region of eastern Ontario, where populations share a common postglacial history. The authors found some evidence for female-biased dispersal in bullfrogs.

AUSTIN, J. D., J. A. DÁVILA, S. C. LOUGHEED, AND P. T. BOAG. 2003. Genetic evidence for female-biased dispersal in the bullfrog, *Rana catesbeiana* (Ranidae). Molecular Ecology 12:3165–3172.

Correspondence to: Stephen C. Lougheed, Department of Biology,

Queen's University, Kingston, Ontario, Canada K7L 3N6; e-mail: lougheed@biology.queensu.ca.

Evolution of Aposematism and Diet Specialization in Dendrobatid Frogs

The Neotropical family Dendrobatidae includes approximately 210 species. Some of these are brightly colored and toxic, whereas others are cryptic and nontoxic. Thus, dendrobatids are ideal organisms to study the association of unprofitability with a warning signal (i.e., aposematism) in an evolutionary context. Based on mtDNA data from a broad taxon sample of cryptic and aposematic species, the authors performed phylogenetic and statistical analyses to study the evolution of aposematism and diet specialization in dendrobatid frogs. Contrary to what had been suggested in previous studies, Santos et al. found that the association of conspicuous bright coloration and toxicity appeared several times. In addition, evidence is presented that diet specialization has occurred more than once, and is associated with the multiple origins of conspicuousness and toxicity. According to the authors, these results suggest parallel and correlated evolutionary trends toward specialization.

Santos, J. C., L. A. Coloma, and D. C. Cannatella. 2003. Multiple, recurring origins of aposematism and diet specialization in poison frogs. Proceedings of the National Academy of Sciences 100:12792–12797.

Correspondence to: Juan C. Santos, Section of Integrative Biology C0930, 1 University Station, University of Texas, Austin, Texas 78712, USA; e-mail: jcsantos@mail.utexas.edu.

Xenopus Might Help Understanding Alzheimer's Disease

One of the central features of Alzheimer's disease (AD) in its late stages is the specific loss of neurons that seems to depend on amyloid α-peptide deposition and synaptic dysfunction. Little is known about the functional characteristics of the neurotransmitter receptors of the AD brain, partly because of technical difficulties of the methods employed. Using postmortem brains of humans that suffered AD, the authors were successful in trying an alternative method that has been previously used to study neurotransmitter receptors and ion channels from the human brain in great structural and functional detail. This method involves microtransplantation of cell membranes from the brain to the membrane of *Xenopus* oocytes. The foreign membrane fuses with the oocyte's own plasma membrane, providing an opportunity to study the original receptors and related molecules while they are still embedded in their natural lipid environment.

Miledi, R., Z. Dueñas, A. Martinez-Torres, C. H. Kawas, and F. Eusebi. 2004. Microtransplantation of functional receptors and channels from the Alzheimer's brain to frog oocytes. Proceedings of the National Academy of Sciences 101:1760–1763.

Correspondence to: R. Miledi, Department of Neurobiology and Behavior, University of California, Irvine, California 92697-4550, USA; e-mail: rmiledi@uci.edu.

Countergradient Variation in *Rana sylvatica* at Microgeographic Scales

Many studies provide evidence that macrogeographic gradients in temperature associated with latitude and altitude lead to countergradient patterns of variation. A general pattern is that individuals from colder environments grow or develop faster than their conspecifics from warmer environments when placed in a common setting. The author evaluated the importance of countergradient variation in the wood frog *Rana sylvatica* at microgeographic scales. *In situ* observations at the Yale-Myers Forest in northeastern Connecticut revealed that eggs in shaded wetlands developed much slower than eggs in insolated wetlands. Thereafter, Skelly performed a common garden experiment with more than 700 embryos. He found that individuals from the darkest wetlands developed up to 12% faster than those from the lightest wetlands, which indicates that countergradient variation occurs at microgeographic scales in the wood frog.

Skelly, D. K. 2004. Microgeographic countergradient variation in the wood frog, *Rana sylvatica*. Evolution 58:160–165.

Correspondence to: David K. Skelly, School of Forestry and Environmental Studies and Department of Ecology and Evolutionary Biology, Yale University, 370 Prospect Street, New Haven, Connecticut 06511, USA; e-mail: david.skelly@yale.edu.

Systematics of Pygopodid Lizards and Diversification of Australian Temperate Biotas

The lizard family Pygopodidae has 38 species endemic to Australia and New Guinea. This endemicity and some fossil evidence suggest that pygopodid lizards were present in Australia before the time when Asian taxa invaded Australia. The authors used molecular (2079 bp) and morphological (86 characters) data to study the phylogenetic relationships of 32 species and two subspecific taxa of Pygopodidae. Parsimony, maximum likelihood, and Bayesian analyses were performed, with two species of diplodactyline geckos as outgroups. The molecular clock method and parametric bootstrapping were used to root the trees and test different phylogenetic hypotheses, respectively. *Aprasia*, *Delma*, *Lialis*, *Ophidiocephalus*, *Pletholax*, and *Pygopus* were recovered as well-supported clades with robustly supported relationships among them. After performing biogeographical analyses, the authors found results congruent with the idea that speciation of mesic-adapted biotas in the southeastern and southwestern corners of Australia occurred between 12 and 23 million years ago, as opposed to repeated dispersal between these two regions.

Jennings, W. B., E. R. Pianka, and S. Donnellan. 2003. Systematics of the lizard family Pygopodidae with implications for the diversification of Australian temperate biotas. Systematic Biology 52:757–780.

Correspondence to: Bryan Jennings, Museum of Comparative Zoology, Department of Organismic and Evolutionary Biology, Harvard University, 26 Oxford Street, Cambridge, Massachusetts 02138, USA; e-mail: bjennings@oeb.harvard.edu.

Norops polylepis Eggs Do Well in Pastures

How human activities affect the distribution and population dynamics of other species is a major question in ecology and conservation biology. Populations might not be self-sustaining in a habitat that is unsuitable to one or more life stages, such as the egg-stage of oviparous reptiles. Predicting that eggs would fare poorly in pastures, the author studied the effects of forest to pasture conversion on the egg stage of the Costa Rican anole *Norops polylepis*. The research was conducted in a 25-ha primary rain forest fragment that has been surrounded by pasture for 30 years. Using eggs from captive females, experiments were performed on six 25-m long transects parallel to the forest-pasture edge. Contrary to his expectation, Schlaepfer found that the eggs underwent normal development in pastures. Moreover, the incubation period was reduced in pastures, and the survival curve was significantly higher for pasture than for forest eggs.

SCHLAEPFER, M. A. 2003. Successful lizard eggs in a human-disturbed habitat. Oecologia 137:304–311.

Correspondence to: Martin A. Schlaepfer, Department of Neurobiology and Behavior, Cornell University, Mudd Hall, Ithaca, New York 14853-2702, USA; e-mail: mas50@cornell.edu.

Addendum

In the March 2004 Current Research (p. 6), we summarized a recent paper concerning the effects of UVB on amphibian embryos (Licht 2003. Bioscience 53:551–561). However, readers should also be aware of a published rebuttal to this paper by Andrew R. Blaustein and Lee B. Kats which appeared in the November 2003 (p. 1028) issue of Bioscience.

ZOO VIEW

Gerald Durrell (1925–1995) was the founder of the Jersey Wildlife Preservation Trust, now called Durrell Wildlife Conservation Trust [DWCT]. He started the Trust in 1959 on the Channel Islands off the coast of England to conserve endangered fauna, especially insular taxa. He brokered arrangements with wildlife officials and governmental agencies in those countries where endangered species occurred. His approach included management plans with both *in situ* and *ex situ* components. To accomplish this, he often arranged partnerships with other zoos, building an *in situ* component, and supporting institutions within the country of origin.

As an example of his broad approach, feral mammals and alien vegetation were eliminated before reintroduction of the Round Island boa (*Casarea dussumieri*) was attempted. Durrell was a visionary who created effective conservation enterprises, with time and money. Today, The Durrell Institute of Conservation and Ecology at the University of Kent at Canterbury UK and Durrell Wildlife Conservation Trust promote important conservation initiatives throughout the world.

At Jersey, the Gaherty Reptile Breeding Centre (now re-named the Gaherty Amphibian and Reptile Conservation Centre) is a small facility where the majority of breeding and research on taxa at risk takes place behind the scenes: ploughshare (*Geochelone yniphora*), flat-tailed (*Pyxis planicauda*) and radiated (*G. radiata*) tortoises, Round Island boa (*Casarea dussumieri*), gecko (*Phelsuma guentheri*), and skink (*Leiolopisma telfairii*), Mallorcan midwife toad (*Alytes muletensis*), Montserrat mountain chicken (*Leptodactylus fallax*), Coahuilan box turtle (*Terrapene coahuila*), San Francisco garter snake (*Thamnophis sirtalis tetrataenia*), Antiguan racer (*Alsophis antiguae*), Jamaican and Puerto Rican boas (*Epicrates subflavus, E. inornatus*), St. Lucian whiptail (*Cnemidophorus vanzoi*), spring frog (*Rana dalmatina*), and ground iguanas (*Cyclura collei*).

FIG. 1. Gerald Durrell with female Parson's chameleon. This picture was taken during the same filming trip in 1981 for 'The Ark on the Move,' probably in October, in Berenty, Madagascar. Credit: Durrell Wildlife.

Durrell published 38 books and many other articles dealing with animals (see Botting 1999. Gerald Durrell. The Authorized Biography. Carroll & Graf Publishers, Inc., New York).

Following Durrell's vision, Richard Gibson and Kevin Buley built a multi-faceted program for the flat-tailed tortoise as detailed in the following article. Gibson was Herpetology Department Head at the Trust but has since moved to the London Zoo. Buley was associated with the Department but has relocated to the Chester Zoo.

Dwight Lawson from Zoo Atlanta in Georgia USA has been a major player in the Turtle Survival Alliance (TSA). I asked him to explain the mission of this important organization and his description follows.

After forty-plus years, Peter Brazaitis retired from the Wildlife Conservation Society, headquartered at the Bronx Zoo in New York. For most of that time, Pete and I have known each other and whenever we would get together, he would regale me with humorous anecdotes. Discovering that he had published a book on his experiences at the zoo, mostly in the herpetology section, I was certain it would be an enjoyable read as he is an accomplished raconteur. When his book arrived (Villard Books, New York, 2003: ISBN 1-4000-6012-5), I eagerly picked it up and was not disappointed — how could I be when the title reads *You Belong in a Zoo. Tales from a Lifetime Spent with Cobras, Crocs, and Other Creatures* and the text reveals that his nickname was "The Bald-Headed Snake Keeper in the Bronx."

Brazaitis is one of our most respected zoo herpetologists (see Card and Murphy 2000. Lineages and histories of zoo herpetologists in the United States. Herpetol. Circ. No. 27 for details). He is a committed conservationist and his efforts to protect crocodilians, both *in situ* and *ex situ*, are a remarkable achievement. Even after retirement, Brazaitis remains active in herpetology. His professional legacy, one might ask? Pete will always be saddled with the unenviable reputation that he was the first to sex crocodilians by plunging his index finger into their cloacae, not a pretty sight for the zoo visitor!

— James B. Murphy, Section Editor

Herpetological Review, 2004, 35(2), 111.

Partners in Saving Turtles: The Turtle Survival Alliance

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More than 300 million years in the making, the world's turtle and tortoise fauna is now disappearing at an unprecedented rate. In addition to the usual habitat loss and degradation, massive commercialization of wild-caught animals for food and traditional medicine in the previously closed Asian markets is fuelling the removal of vast numbers of turtles and tortoises from fragile habitats in Southeast Asia and as far away as Africa and the US. To combat the accelerating scope and scale of this loss, zoological parks and aquariums, dedicated private specialists, veterinarians, researchers, and other interested individuals and organizations have forged a new and unique partnership to link and synergize their individual and institutional efforts for chelonian conservation. Established in 2001 as the Turtle Survival Alliance (TSA), the group was designated an autonomous Task Force of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group. The mission of the TSA is to develop and maintain an inclusive, broad-based global network of collections of living tortoises and freshwater turtles with the primary goal of maintaining chelonian species over the long term to provide maximum future options for the recovery of wild populations. By combining the volunteer efforts of its partners with financial support from zoological institutions such as Disney's Animal Kingdom, Cleveland Metroparks, Fort Worth, Columbus, the Wildlife Conservation Society, San Diego, Minnesota, and Atlanta, the TSA has made significant progress during its brief history.

Now more than 200 partners strong, the TSA is implementing an ambitious program of coordinating existing *ex-situ* turtle collections into viable *ex-situ* conservation management programs known as assurance colonies. Building on partnerships with government regulatory authorities in the US and abroad, the TSA has also moved otherwise doomed, illegally traded, and confiscated turtles and tortoises into this assurance colony network. The TSA currently manages more than 4000 animals, and partners have made tremendous strides in captive management and reproduction of a number of rare or enigmatic species such as the Flat-tailed Tortoise (*Pyxis planicauda*), the Sulawesi Forest Turtle (*Leucocephalon yuwonoi*), Forsten's Tortoise (*Indotestudo forsteni*), and the Yellow-headed Box Turtle (*Cuora aurocapitata*), among others.

To tie the *ex-situ* programs to efforts in the field, the TSA is expanding its capacity-building role in range countries and in the US. With financial support from organizations such as the Institute of Museum and Library Services and the American Zoo and Aquarium Association, TSA partner institutions will be conducting training programs on small population management techniques for assurance colony mangers in the US in 2004–2005. Teams of TSA partners will also be conducting regional training programs on assurance colony development and captive management aimed at animal and facilities managers and wildlife officials in Hong Kong, Singapore, and China. These programs will be assisted by a recently hired, full-time coordinator in Asia who will also inventory the resources and needs of current conservation projects and programs in southeast Asia that have potential to contribute to turtle and tortoise protection.

Showcasing the successes of its first two years, the TSA held its first annual conference in Orlando, Florida 17–19 August 2003. The event highlighted that the strength of the TSA lies in the diversity of its partners and supporting organizations. The conference featured more than 40 presentations on topics ranging from natural history observations in the field, captive management and veterinary care, to purely academic research, and was attended by more than 80 participants from 10 countries.

The breadth of TSA programs and projects points to a need for additional academic collaboration and scientific expertise in the organization, and a constant infusion of science in the process of saving turtles. For more information on TSA activities, to find out how to become a partner, or simply to help, contact Dwight Lawson (dlawson@zooatlanta.org) or Rick Hudson (rhudson@fortworthzoo.org), or visit the TSA website at www.turtlesurvival.org.

Herpetological Review, 2004, 35(2), 111–116.

Biology, Captive Husbandry, and Conservation of the Malagasy Flat-tailed Tortoise, *Pyxis planicauda* Grandidier, 1867

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With the exception of taxonomic debate, anatomy, and Malagasy herpetofaunal reviews (Siebenrock 1903a, 1906; Vaillant and Grandidier 1910; Vuillemin 1972; Obst 1978; Bour 1979, 1981) the Malagasy Flat-tailed Tortoise has received little scientific attention. Only in the past 10–15 years have radiotelemetric and distribution studies revealed anything of the species' life history in the wild. Captive populations held for the last 15 years at Durrell Wildlife Conservation Trust's (DW) headquarters at Jersey Zoo in the Channel Islands, UK, and at its Malagasy Chelonia Field Conservation Station (CFCS) in Ampijoroa, Ankarafantsika National Park, northwestern Madagascar, have also helped to reveal much about behavior and breeding ecology.

Unfortunately, what has been learned regarding its distribution and status in the wild, together with the rapid deterioration of its forest home, gives grave cause for concern. Endemic to the Menabe region on the central western coast of Madagascar, the deciduous forests of the region are coming under increasing pressure from both international developers and logging companies, and from

FIG. 1. Adult female *Pyxis planicauda* at Jersey Zoo.

local subsistence agriculture, charcoal production, hunting, and general disturbance by people and their domestic animals. Recent unsustainable and largely illegal commercial trade in the species for the North American, European, and Far Eastern hobbyist markets has exacerbated the tortoise's precarious position. Furthermore, the sensitivity of this enigmatic tortoise in captivity and the nature of its breeding biology give little hope for large-scale conservation or commercial breeding programs. As a result, the survival of this mysterious and beautiful tortoise is in serious doubt.

Taxonomy.—Debate concerning this species' taxonomic position revolves around its inclusion in the genus *Pyxis* (Bell 1827) or separation to *Acinixys* (Siebenrock 1903b). Obst (1978, 1980) and Bour (1981) embedded *Acinixys* within *Pyxis*, designating it a subgenus. However, the characters used by Obst (1980) and Bour (1981) are juvenile traits common not only to *Acinixys* and *Pyxis*, but also to all other African testudinidids, *Homopus, Psammobates, Chersina, Kinixys,* and even some *Testudo* and *Geochelone* (Ernst and Barbour 1989). Herpetologists are divided in their use of the two genera and further examination is required to clarify the situation.

Description.—Though commonly referred to in the scientific and popular literature (even on IUCN and CITES listings) as the flat-shelled spider tortoise, *P. planicauda* is neither. Its carapace is slightly flattened along the dorsal surface but it would seem logical to refer to this animal in accordance with one of its most striking anatomical features, and its scientific name—the flattened tail. Adult females reach a maximum carapace length of 130–150 mm and weigh up to 670 g (Kuchling and Bloxam 1988; Bloxam and Hayes 1991) (Fig. 1). Males are smaller with carapace lengths rarely exceeding 130 mm, and weights up to 400 g (Bloxam and Hayes 1991). Other than their size difference females tend to be relatively wider, have an entirely flat plastron, and a very short tail. Males in contrast are narrower in shape, have more pronounced flaring of the anterior marginal scutes, a deeply concave plastron, and a long, dorsoventrally flattened tail ending with a large horny scale on the dorsal surface.

Distribution and Habitat.—*P . planicauda* inhabits dry deciduous forest on the semi-arid central western coast of Madagascar. It is restricted to fragments of forest in the Menabe region between the rivers Morondava and Tsiribihina and a small isolated population north of the latter river. The extent of its habitat is very limited and is decreasing steadily.

The substrate in this forest is a very loose, well-drained, sandy soil covered in a deep layer of leaf litter. During the wet season (late November to early April) the trees are in leaf and form a broken canopy. It rains heavily during this season, often daily and sometimes for several hours at a time. Humidity remains fairly high and temperatures can soar to 37°C or more. In the dry season (April to November) standing water is rare, rainfall is extremely unusual, and the trees lose their leaves. Temperatures drop considerably to around 27°C during the day and as low as 12°C at night (Bloxam, pers. comm.).

Behavior.—During the dry season *P. planicauda* enters a state of torpor (aestivation) and remains inactive buried deep beneath leaf litter. The relatively cool temperatures experienced deep beneath the insulating leaves and their moisture trapping properties help to ensure the survival of the tortoises during the waterless months. During rare unseasonable showers tortoises will emerge briefly to drink before returning to their retreats.

When the rains start in late November or December temperatures rise and the tortoises emerge to drink copiously. Tortoises straighten their rear legs, tilting their carapaces forward, so that rain runs down over their heads and pools in the leaves beneath them. On dry days, even during the wet season, tortoises return under the leaves and await further rain.

Tortoises are rarely seen basking in direct sunshine and body temperatures of active tortoises have been measured between 26°C in early morning and 29.5°C in mid afternoon (Kuchling and Bloxam 1988). Bloxam and Hayes (1991) found evidence that smaller, more brightly colored juveniles tended to be found in areas of open canopy and sun-dappled forest floor while darker, more uniformly colored adults were found predominately in areas of shady, closed-canopy forest.

Radio-telemetric data describing activity and movements have been collected over a number of seasons but are not yet published (Behler and Bloxam, in prep.). Even active, radio-tagged tortoises are difficult to locate and approach owing to their cryptic coloration, acute eyesight, and wary nature (Bloxam, pers. com.).

In the only study of *P. planicauda* density tortoises were estimated to occur at between 0.58 and 1.95 tortoise/1000 m^2 (Bloxam et al. 1996). These low densities suggest a largely solitary existence as tortoises would rarely encounter each other. However, this study assumed even distribution across the study area. As the habitat structure and quality is not uniform, at least temporary aggregations seem likely.

Diet.—Little data exist on wild diet. Kuchling and Bloxam (1988) observed tortoises eating the fruit of two trees (*Breonia perrieri* and *Aleanthus greveanus*), as well as leaves and shoots of various bushes. Fungus also appears to be an important part of the diet in the wild (Bloxam, pers. comm.) and would be the first available food item to tortoises emerging with the first rain after the dry season. Over 200 species of trees have been identified from the forests in which these tortoises live (Kuchling and Bloxam 1988) and it seems likely that their wild diet is extremely varied. Like many other testudinids it is likely that they are opportunistic carnivores.

Reproduction.—No data have been collected on the reproduc-

tion of *P. planicauda* in the wild. In ten years of field observations tortoises were only seen interacting on a single occasion—when two males were observed fighting (Bloxam, pers. comm.).

Hatchling tortoises have been found shortly after the start of the rainy season which suggests that eggs may hatch to coincide with the rain and subsequent availability of food. It is estimated that sexual maturity is attained in 8–12 years.

All our information on reproductive biology is derived from captive studies at the DW's Jersey Zoo headquarters and at the CFCS in northwestern Madagascar.

Captive Husbandry

Background.—DW began working with *P. planicauda* in 1988 when five (2.3; M/F) animals were collected from the Kirindy forest in western Madagascar and established at the CFCS. A additional four adults (2.2) were added in 1997 following successful management of the original animals.

Jersey Zoo obtained its first specimens (4.2) in early 1991. Three additional females were added to this group in 1997. All animals were collected from the Kirindy.

Accommodation.—*P. planicauda* at Jersey Zoo are accommodated in a purpose built, dedicated facility housing only this species. Open topped enclosures measuring 50 x 50 cm are used to individually house the males (Fig. 2). A larger 400 x 50 cm open-topped enclosure is used for communally holding the females. The 20 cm high walls of all enclosures are solid and opaque. All enclosures are constructed of fiberglass covered plywood, with sloping floors and drainage holes.

A warm water sprinkler system is used to irrigate enclosures at a height of 20 cm above the substrate. Substrate consists of a 5 cm deep layer of volcanic pebbles (Hydroleca™) covered with capillary matting to facilitate drainage. A 2–3 cm deep layer of sandy soil and deep leaf litter provides a more naturalistic substrate over the capillary matting base. One quarter of the females' enclosure is not connected to the main spray system and has a 10–12 cm deep substrate of slightly dampened sandy soil for nesting.

The enclosures are furnished with small logs under which tortoises can shelter and hardy plants such as *Ficus*, *Sansevera*, *Maranta*, *Syngonium*, and *Yucca*. The plants not only provide a natural vegetative cover but also help to maintain high humidity levels during the rainy season.

At the CFCS in Madagascar tortoises are housed simply in 150 x 250 cm enclosures divided by 22 cm high concrete blocks. Substrate is natural forest soil and leaf litter and the enclosures are shaded by small shrubs, bushes, and large teak trees (Razandrimamilafiniarivo et al. 2000).

Environmental parameters.—Replication of the extreme seasonal climatic variation is essential for the maintenance of this species in captivity. The animals at Jersey Zoo were given a six-month shift in their seasons when they were brought into captivity. The rationale for this was that the hot, wet season would then coincide with the European summer and the cooler, dry season with the winter. Although the animals are maintained in a heated, well-insulated room, obviously it is easier to provide the appropriate seasonal conditions when there is some correspondence to the local climate.

Pyxis planicauda at Jersey Zoo are kept at 27–34°C during the day and 22–26°C at night during the wet season; rainfall is simulated with a warm (20°C) water sprinkler system in operation 0.5–4 h per day. Humidity remains above 70% at all times and approaches 95% during and immediately after showers.

Fig. 2. Individual enclosures for male *Pyxis planicauda* at Jersey Zoo.

To simulate the dry season, 'rainfall' is reduced to zero as the temperatures are gradually lowered to 22–28°C in the daytime. A cooling system ensures that low night time temperatures (14–18°C) are achieved and maintained.

Photoperiod and general room lighting is provided by ZooMed Reptisun 2.0™ and varies from 14:10 h (light:dark) at the peak of the wet season to 11.5:12.5 h in the middle of the dry season. Localized hotspots/basking areas (45–55°C) are provided during the wet season. The large female enclosure is fitted with two 275W Active UVHeat™ spotlights and the male enclosures are each fitted with a 60W incandescent spotlight.

At the CFCS in Madagascar tortoises are exposed to the local seasonal climate in their outdoor enclosures which is very similar to that of their native habitat.

Diet.—At Jersey Zoo, simulated rainfall with the warm water sprinkler system is essential to rouse the animals from their dry season torpor and to ensure that they are fully rehydrated. Although water bowls are provided they have rarely been observed to use them and prefer to drink water as it pours over their head and collects in dry leaves beneath them. Daily 'rainfall' is also required to stimulate the animals to feed.

The key dietary item in the first weeks of the wet season is fungus. Oyster mushrooms are preferred but beef, shitake, and button mushrooms are also readily taken. This early season preference for fungus might reflect their wild diet where this food item would be among the first to emerge with the onset of the rains.

As the wet season progresses they begin to accept a wider variety of food items including soft and finely chopped hard fruits (particularly tomato, pear, and papaya), green vegetation (including dandelion, chicory, and pakchoi), and small quantities of animal protein in the form of a low-fat cat food.

Fruit feedings are always supplemented with Nutrobal™ multivitamin powder. Animals are fed every day during the wet season. They receive green vegetation 3–4 times per week, fruit 3–4 times per week, and animal protein 1–2 times a month. Mushrooms are provided daily for the first two weeks of the wet season and twice per week thereafter. Chopped cuttlefish bone (*Sepia* sp.) is provided *ad libitum* and sweet potato tubers are planted in the substrate, or in pots, to provide growing vegetation on which they can browse. The species is enthusiastically coprophagous which may have important implications for the inoculation of baby tortoises with beneficial gut flora.

P. planicauda at the CFCS are fed four times per week and receive a variety of leaves and fungi from the forest supplemented with *Opuntia*, banana, mango, papaya, and tomato (Razandrimamilafiniarivo et al. 2000).

Medical considerations.—Captive *P. planicauda* are prone to heavy nematode infestations which can be detected in analyzed fecal samples. This has never proven pathogenic with adult tortoises but has been implicated in the death of juveniles at the facility in Madagascar (Razandrimamilafiniarivo et al. 2000). High standards of hygiene are needed to prevent accumulation of parasites within the confines of an enclosure.

Tortoises at Jersey Zoo are occasionally wormed with Fenbendazole (Panacur™)—via stomach tube, or poured over a palatable food item—when particularly high parasites loads are apparent. Routine treatment is avoided because of the disruption to symbiotic gut flora.

Jersey Zoo has recorded one case of egg retention and binding. Oxytocin and calcium therapy was unsuccessful in this case but should normally be expected to work if the condition is diagnosed early.

P. planicauda not provided with adequate water by simulated rainfall are apt to become dehydrated, stop feeding, and lose weight quickly.

Breeding.—Observing the reproductive behavior of this timid tortoise has proven problematic at both captive facilities. At the CFCS in Madagascar a blind was built to enable observers to approach and remain in close proximity undetected. At Jersey Zoo a regular and extended staff presence in the room housing the tortoises has resulted in habituation (after 6-18 months in captivity) and specimens will now feed, drink, fight, and mate in the presence of staff.

At Jersey Zoo animals are introduced for breeding purposes shortly after the start of the wet season. Two males are paired for 15–60 minutes for intra-sexual combat in their smaller enclosures. Vigorous combat ensues involving butting and aggressive biting of fore and hind limbs. Dominant animals will often be observed to mount the other male after a period of aggressive combat.

The paired males are then separated to their individual enclosures and a female introduced. Mounting by the male is usually preceded by bouts of butting and frantic circling of the female. Receptive females remain stationary while mounting and mating occurs. Unreceptive females move continuously around the enclosure making mounting and mating impossible for the male. Confirmation of successful copulation and measurement of its duration is difficult. Once mounted on a female, males typically stretch their head and neck to its full extension and open their mouth widely. During attempted and actual copulation males make quiet, strained 'gasping' noises (the only vocalization recorded for the species). Females are left with a male for variable periods of time during the wet season (2–24 h) before being separated to their own enclosure. Repeated attempts at copulation may occur during this time. Mating is most common in the early hours of the morning but has been observed at all times of the day.

This management regime of male-male combat followed by pairing with females is repeated 3–6 times per week throughout the wet season. Successful mating has been recorded throughout the wet season but is typically more frequent during the first 2–3 months.

Pyxis planicauda at the CFCS are introduced for mating in small groups of one male and two females. This has proven successful at this facility (Razandrimamilafiniarivo et al., 2000), but trials at Jersey Zoo with this group structure resulted in males being distracted while mounted on one female by the presence of a second (pers. obs.). Similarly, a group structure of two males and one female also leads to interruption with the mounted male distracted by the competing male or the competitor dislodging the mounted male from the female (pers. obs.; Razandrimamilafiniarivo et al. 2000).

Egg laying usually begins 30+ days after mating is first observed (Razandrimamilafiniarivo et al. 2000). Females usually begin nesting after sunset and will continue into the early hours of the following morning. The nest is dug in sandy soil (5–6 cm deep) and a single large egg deposited. Females may lay up to three clutches of one egg in a season at intervals of 3–6 weeks. Data for 38 eggs are as follows (mean, range): mass = 19.7 g (15.4–22.2 g); length = 38.0 mm (34.1–41.6 mm); width = 29.7 mm (27.2–31.7 mm).

Eggs are laid in the second half of the wet season but do not hatch until the beginning of the following wet season. There appears, therefore, to be suspended development of eggs (diapause) such that hatchlings emerge when food is abundant rather than in the middle of the dry season. Consequently, incubation periods vary considerably. Eggs laid three months apart in one wet season may hatch within days of one other at the start of the following season.

Razandrimamilafiniarivo et al. (2000) have recorded incubation periods between 257 and 343 days (mean = 291 days, N = 20) under natural incubation conditions. Artificially incubated eggs hatched at Jersey Zoo have incubated for >213 days, 262 days, and 306 days (Table 1). All eggs laid at Jersey Zoo are subjected to the environmental conditions experienced by the adult tortoises, thereby mimicking natural conditions. After nesting, eggs are excavated, weighed, and measured before being half buried in a small bowl of dry vermiculite. This bowl is then placed in a large (200 x 200 x 130 mm) opaque plastic box (with a lid) half-filled with dampened vermiculite (1:1 water:vermiculite, by weight). The box is kept in the *P. planicauda* room where it is subjected to the daily and seasonal temperature fluctuations. The box is opened twice per week to permit air exchange (this also has the gradual effect of allowing the dampened vermiculite to dry, and the humidity in the box to drop). Towards the end of the dry season the boxes are

FIG. 3. *Pyxis planicauda* hatching.

moved to an incubator where they are maintained at 30–31°C. Humidity in the box is gradually increased again by adding water to the vermiculite in the box.

At Jersey Zoo females have been consistent and regular egg layers. On average, 2–3 eggs are laid by each female each season. Despite observations of confirmed copulation prior to egg laying the instances of fertility have been very low. It is hypothesized that this may be due to the artificially imposed shift of seasonal activity by six months in order to correspond with our own European summer and winter seasons. If this is the case we expect the rate of fertility to improve over coming years as their behavioral and physiological cycles become aligned.

Hatchling *P. planicauda* may stay inside the shell for up to one week after pipping (Fig. 3). During this time they are prone to dehydration and are lightly sprayed with warm water. Hatchlings have a plastral fold so severe that it extends into the carapace giving them a crumpled appearance on emergence. Full straightening of the plastron and carapace can take weeks and a small crease is often visible in the centre of each bridge many months after hatching.

Juvenile *P. planicauda* have proven highly sensitive to nematode infestation at the CFCS. Changes in tortoise management including improved hygiene, regular substrate changes, and drug therapy are alleviating this problem (Razandrimamilafiniarivo et al., 2000).

Rearing of juveniles at Jersey Zoo has also proved problematic. The first hatchling died at 18 months of age after more than 6 months of poor appetite and failure to gain weight. It is hypothesized that deviation from the strict seasonal regime was to blame (the wet season was artificially extended to try to encourage feeding and weight gain). Two subsequent hatchlings are now given the same seasonal regime as the adult animals.

Only four *Pyxis planicauda* are reported to have been bred outside Madagascar in zoos. Three of these hatched at Jersey Zoo (Table 1) and one at Knoxville Zoo in the USA in May 2002. These four animals represent the total breeding success with *P. planicauda* at three internationally renowned zoos (including Bronx Zoo) over a collective period of more than 25 years. There are recent reports of successful hatching of eggs from recently imported (gravid) *P. planicauda* in the private sector in the USA and Europe but regular, repeatable reproduction of established long-term captive animals has yet to be achieved.

CONSERVATION

Pyxis planicauda is in real danger of extinction. It is listed by the World Conservation Union as Endangered (IUCN 2000). With its limited distribution and specialized habits it is vulnerable to forest disturbance, degradation, fragmentation, and destruction. All of these are occurring in the Menabe region. Oil prospecting in the early 1990s opened up the forest to local people and their cattle resulting in slash and burn agriculture, burning for cattle pasture, felling of firewood, and the spread of feral pigs which are suspected predators of eggs and young (Bloxam et al. 1993; Bloxam and Hayes 1991). Legal logging continues and there have been proposals for large agricultural developments including sugar cane, and more recently chicken farming and sisal plantations (Kuchling and Bloxam 1988; Bloxam, pers. comm.).

Pyxis planicauda is now listed by CITES (Convention on International Trade in Endangered Species) on Appendix I which prohibits any trade in wild specimens. This listing was made in response to an escalating and apparently unregulated international trade in illegal and legal specimens for the hobbyist trade in Europe, the USA, and the Far East during the late 1990s. Animals arriving in Europe and the USA alone far exceeded export quotas set by CITES and the Malagasy authorities. This poorly controlled and ill-advised trade has placed several thousand of these sensitive and shy tortoises in the hands of not just the experienced, dedicated amateur herpetoculturist, but also the unprepared pet keeper. Many of these tortoises will die prematurely and breeding among those that survive will be exceptional.

There is anecdotal evidence that an isolated population of *P. planicauda* towards the south of its range has been extirpated through trade in the past five years (Durbin and Lewis, pers. comm.).

The low density at which these tortoises appear to occur in the wild and their reproductive biology—with low fecundity and slow maturation—suggest that any level of commercial collection from the wild is likely to be unsustainable. The nature of the species' reproductive biology similarly hinders attempts to establish captive conservation populations and casts serious doubt upon existing and proposed self-sustaining commercial operations to supply the interna-

TABLE 1. Egg and hatchling data for three *Pyxis planicauda* hatched at Jersey Zoo.

Jersey Zoo ID	Date Hatched	Incubation Period	Egg Data Wt	L	W	Hatchling Data Wt	CL	CW	CH	PL	PW
R705	17/8/95	>213 days	—	—	—	15.7	38.9	38.0	21.6	—	—
R1232	20/6/01	306 days	19.8	37.9	29.8	13.7	37.4	35.2	—	36.2	31.8
R1265	12/4/02	262 days	18.6	37.6	29.1	13.8	37.8	35.2	—	34.9	30.2

Weight in grams; all dimensional data in mm. L = egg length; W = egg width. CL = carapace length, CW = carapace width, CH = carapace height, PL = plastron length, PW = plastron width.

tional pet trade.

If trends in collection, habitat destruction, forest fragmentation, and human encroachment persist, the long-term future of *P. planicauda* in the wild looks very bleak. The deciduous forests of the Menabe region are of enormous ecological importance and are home to a wide variety of endemic plants and animals and to many internationally threatened species.

It is not only *P. planicauda* whose survival is in question but also that of the Narrow-striped Mongoose (*Mungotictus decemlineata*), the Giant Jumping-Rat (*Hypogeomys antimena*), Berthe's Mouse Lemur (*Microcebus berthae*), a plethora of reptile and amphibian species, and possibly other endemic species not yet described.

International awareness of the plight of *P. planicauda* can provide valuable support for future conservation initiatives in the Menabe region. However, it will require many years of hard work by determined conservationists and herpetologists, the implementation of appropriate legislation, and a lot of luck to ensure that the forests of Menabe remain the home of kapidolo, the 'ghost turtle,' for centuries to come.

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Active UVHeat Lamps: Wild Inside, 132 Garden Street, Suite 24, Santa Barbara, California 93101, USA.

Hydroleca: Clark & Spears International, Hurst Lane, Egham, Surrey, TW20 8QJ, United Kingdom.

Nutrobal: Vetark Animal Health Products, P.O. Box 60, Winchester, Hants, SO23 9XN, United Kingdom.

Panacur: Intervet UK Limited, Walton Manor, Walton, Milton Keynes, Bucks, MK7 7AJ, United Kingdom.

ZooMed Reptisun 2.0: ZooMed Europe, Kapelanielaan 8, 9140 Temse, Belgium.

LETTERS TO THE EDITOR

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Protecting One's Research Turf: Right of Possession or Self-styled Imperialism?

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I was sitting in my graduate-student cubicle at the Savannah River Ecology Laboratory back in 1981 when my major professor, Whit Gibbons, unexpectedly appeared in the doorway. He was rhythmically slapping one hand into the other, a tell-tale signal that something was up. "It's mighty early in your career to be making enemies," he said. Earlier in the week I had phoned a leading authority, whom I shall refer to as Dr. Thibodeaux, about a research idea that I was pondering as a possible dissertation topic. We had what I thought was a pleasant, helpful conversation, but

Dr. Thibodeaux promptly called Whit and told him to stop me from pursuing the topic. He claimed that this was his idea, and he intended to work on it sometime in the indefinable future. Whit expressed his support for whatever I wanted to do, but I ended up changing dissertation topics. Little did I realize, however, that I would run into the same situation with another respected authority from a different field. Submission of my dissertation work for publication (Camp 1988) prompted a letter from Dr. Erhöhung (again, a pseudonym), who happened to serve as a reviewer for the journal. Dr. Erhöhung essentially told me to cease and desist from all work in this area as it competed with part of a broader study that he was conducting. He noted that he had earlier published a statement of intent concerning his study and, therefore, no one else had any right working on it. More recently, this same researcher has used his influence to get a major, publicly funded museum to deny me access to specimens for the same stated reason. Considering these personal experiences, I have no doubt that similarly minded researchers may use their influence to prevent "threatening" papers from getting published. I would hope, however, that this ploy succeeds only rarely.

I suspect that few researchers actually have the clout to prevent others from working in "their area." More commonly, perceived encroachment simply generates hard feelings, with the unfortunate consequence of preventing meaningful collaboration. On the other side of the same coin, I know researchers who avoid working on certain topics or even reviewing related manuscripts for fear of stepping on someone's toes. I do not know if this mindset of first-come, first-research is unique to herpetology, but other scientific disciplines seem rife with competitive research, as rival labs race for the accolades of scientific discovery.

Although herpetology may seem enviable with its ordered, friendly, even chivalrous approach to doling out research areas, the result is to stymie scientific advancement. Platt (1964) argued that science successfully proceeds by testing competing, alternative hypotheses. The effective stillbirth of such hypotheses through the exclusion of other minds translates into a *status quo* that retreads the same old stale ideas and stifles intellectual headway. I believe that this attitude has, at least in part, contributed to a "lack of novel hypotheses" (Tilley and Bernardo 1993) in certain areas of herpetology. Moreover, the confirmation of conclusions through the replication of results is an important, albeit often overlooked cog in the engine of scientific progress.

It is particularly disheartening when established researchers, whose careers have already been made, expect new, budding scientists (i.e., graduate students) to tug their forelocks in deference and meekly shuffle off to find something else to work on. This sends, if not exactly a stake through the heart of science, certainly a thorn into its flesh. After all, it is not the old dogs that create new, revolutionary ideas, but it is those who are "almost always...either very young or very new to the field....who, being little committed by prior practice to the traditional rules of normal science, are particularly likely to see that those rules no longer define a playable game and to conceive another set that can replace them" (Kuhn 1970).

We are all human, and none of us likes the thought of being scooped. I fully understand the annoyance resulting from a discussion with a young colleague that inadvertently creates a competitor. Even so, competition sharpens us as scientists, and the fear of it does not legitimize claims of ownership. Planting one's flag, so to speak, in certain research topics or taxonomic groups is nothing short of intellectual imperialism. Protecting research turf may contribute to legacy-construction, but science is driven by ideas, not legacies. Science in general, and herpetology in particular, benefits by putting personal claims aside. My advice to those who wish to avoid being scooped is to simply work faster. To those considering research projects in "pre-owned" areas, go ahead. Rather than deferring to the authorities, send them reprints.

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POINTS OF VIEW

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Snake Relationships and Ambiguous Data

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Dowling et al. (1996) used allozyme data from four protein loci to infer higher level snake phylogeny. Their conclusions were based on a single tree inferred using UPGMA clustering. Buckley et al. (2000) reanalyzed the allozyme data of Dowling et al. (1996), discovering numerous identical distance values between pairs of taxa and therefore the existence of numerous equivalent UPGMA trees. Based on more thorough tree searches using UPGMA clustering, minimum evolution, and parsimony analysis, they concluded that the data in question were highly ambiguous concerning the higher level phylogeny of snakes, and that the high degree of resolution in the tree of Dowling et al. (1996) was an artifact produced by selecting one out of many equivalent trees.

Highton et al. (2002) responded by questioning three of the practices used by Buckley et al. (2000) to reach their (our)

conclusions: 1) our exclusion of OTUs with allelic complements (and therefore genetic distances) identical to those of other OTUs in the distance matrix, 2) our use of a single taxon input order rather than multiple randomized input orders of taxa, and 3) our use of the strict consensus method rather than the majority-rule consensus method. The overall suggestion was that, when these three supposed problems are corrected, the data in question yield a high degree of phylogenetic resolution. That conclusion is unfounded, as we here demonstrate by addressing the three criticisms.

It should be noted that although Highton et al. (2002) stated that their original study was aimed primarily at lower level relationships, Dowling et al. (1996) nevertheless presented a tree that had considerable resolution regarding deep branches and called attention to the existence of 18 major groups and their interrelationships (see their Fig. 6). Furthermore, the somewhat less resolved tree defended by Highton et al. (2002) still exhibits considerable deep resolution. Thus, the issue remains whether the data of Dowling et al. (1996) support the level of resolution in the tree presented by Highton et al. (2002) as opposed to the much lower levels of resolution in the results of Buckley et al. (2000).

1. Exclusion of Identical Taxa

One of the reasons that Highton et al. (2002) obtained greater resolution than we did for the same data was that they retained taxa with identical alleles at all four loci that they surveyed. Buckley et al. (2000) removed identical taxa prior to analysis because such taxa provide no additional information about the structure of the tree (i.e., beyond the fact that they will always cluster with the taxa to which they are identical). According to Highton et al. (2002:720), "Actually, adding or deleting identical taxa may affect tree topology. If identical OTUs are removed from a study, the remaining OTUs may join more basal branches in a different order." Although they are correct in stating that removing identical taxa can affect tree topology, at least for some methods (see below), and although we overlooked the fact that this property holds for UPGMA clustering, we maintain that the sensitivity of that method to the presence or absence of identical taxa is an undesirable property. The resolution resulting from it in the trees of Dowling et al. (1996) and Highton et al. (2002) is therefore unwarranted.

Consider the example of *Amphiesma stolata*, *Clonophis kirtlandi* and various taxa with identical alleles at all four loci, *Sinonatrix annularis*, *Regina rigida*, and *R. septemvittata*. In our UPGMA consensus tree (Buckley et al. 2000:Fig. 1), based on an analysis that excluded the taxa identical to *Clonophis*, each of these taxa forms a separate branch of a large polytomy made up of 73 branches, three nodes above the root of the tree. This situation reflects the fact that several of the species in question exhibit distances of 0.5000 or (in one case) 0.7500 to one another, which are equal to or greater than distances between these species and other species making up other branches of the polytomy, in particular, those making up a group composed of species of *Rhabdophis* and *Xenochrophis*. In contrast, in the majority rule consensus tree of Highton et al. (2002:Fig. 1), the species of *Amphiesma*, *Clonophis* and identical taxa, *Sinonatrix*, and the two species of *Regina* form a resolved group, and moreover, that group is resolved as being most closely related to the group composed of *Rhabdophis* and *Xenochrophis* species.

These discrepancies result from the inclusion versus exclusion of identical taxa in combination with the properties of UPGMA clustering. UPGMA is an average linkage clustering method (Sneath and Sokal 1973). It operates by iteratively forming groups made up of pairs of taxa (OTUs), or of previously formed groups, based on the average distances between their member OTUs. As the name indicates, UPGMA uses an unweighted averaging procedure. This means that when OTUs or groups of OTUs are united to form an initial or larger group, the average distance between this new group and all other OTUs or groups (which is needed to determine which group to unite in the next iteration of the procedure) is calculated by taking the arithmetic mean (average) of all of the relevant pairwise distances between the individual OTUs as present in the original (unclustered) matrix. This "unweighted" averaging procedure has the effect of weighting all comparisons equally and can be contrasted with the weighted averaging procedure used in a related method known as WPGMA. In weighted averaging, the average distance between a group and all other OTUs or groups is calculated by taking the average of the pairwise distances, not between individual OTUs in the original matrix, but between the two groups of OTUs in the matrix used in the previous iteration of the procedure. For example, suppose a previously formed group composed of *Clonophis kirtlandi* and *Sinonatrix annularis* is united to form a larger group with *Regina septemvittata*. With unweighted averaging, the distance from the group composed of these three species to *Regina rigida* will be calculated as the average of the distances between *C. kirtlandi* and *R. rigida*, *S. annularis* and *R. rigida*, and *R. septemvittata* and *R. rigida* = (0.5000 + 0.5000 + 0.2500)/3 = 0.4166. In contrast, with weighted averaging, the distance from the group of three species to *R. rigida* will be calculated as the average of the distance between the group *C. kirtlandi* + *S. annularis* and *R. rigida* (calculated in the previous iteration of the procedure) and that between *R. septemvittata* and *R. rigida* = (0.5000 + 0.2500)/2 = 0.3750.

Because of the properties of unweighted averaging, it should be clear that the inclusion of identical taxa can indeed affect the results of UPGMA clustering (but should not affect those of WPGMA clustering). Thus, using the same example, if taxa with identical alleles to those found in *Clonophis kirtlandi* are included in the analysis, then these taxa will always cluster with *Clonophis* before either they or *Clonophis* clusters with other taxa, and therefore, the distance between any OTU or cluster and one containing *Clonophis* and these identical taxa will be affected by the inclusion (and number) of the identical taxa. Specifically, when taxa identical to *Clonophis* are excluded, *Amphiesma stolata* clusters with *Rhabdophis* and *Xenochrophis* rather than with *Clonophis*, *Sinonatrix* and *Regina* in some of the identical UPGMA trees, reflecting the fact that *A. stolata* exhibits distances to the former taxa (0.5000) that are as small or smaller than those that it exhibits to some of the latter taxa (0.5000–0.7500). However, if even one taxon identical to *Clonophis* is included, then the average distance from *Amphiesma* to any group containing *Clonophis* and identical taxa is decreased, and *Amphiesma* always clusters with one or more of *Clonophis*, *Sinonatrix*, and *Regina* before it clusters with *Rhabdophis* and *Xenochrophis*, despite the fact that some of the distances between *Amphiesma* and the former taxa (0.5000–0.7500) are as large or larger than those that it exhibits to the latter taxa

(0.5000). Such resolution is not warranted by the data, and this situation suggests that either the identical taxa should be excluded or, if they are to be included, that WPGMA rather than UPGMA clustering should be used.

2. Taxon Input Order

Highton et al. (2002) are correct in their assertion that randomization of the input order of taxa can be used to break ties. However, they are incorrect in stating that "Buckley et al. (2000) reached their conclusions [i.e., about lack of resolution] because they used only strict consensus trees and did not randomize the order of their input taxa" (p. 270). In fact, the procedure of randomizing taxon input order is functionally equivalent to the systematic (NTSYS) and random (PAUP) tie-breaking procedures used by Buckley et al. (2000). All of these methods cause the clustering procedure to follow different pathways in the case of tied-values, and consequently, they produce different, but equivalent, trees. The main differences are that all possible pathways are taken in the case of systematic tie-breaking, while (usually) different random pathways are taken in the case of random tie-breaking and randomizing taxon input order. Therefore, the greater resolution in the consensus tree of Highton et al. (2002:Fig. 1) relative to that of Buckley et al. (2000:Fig. 2) results from the difference in consensus methods (see below) and the fact that Highton et al. (2002) examined only 50 of the many equivalent trees, compared to the 9999 (systematic tie-breaking) and 1000 (random tie-breaking) equivalent trees examined by Buckley et al. (2000).

It should be noted that Highton et al.'s discussion of the relationships among *Carphophis*, *Diadophis*, and *Farancia*, which they used to argue that we should have used different random input orders of taxa, is confused. They correctly pointed out that the UPGMA tree of Dowling et al. (1996:Fig. 3) and the strict consensus of the 9999 UPGMA trees of Buckley et al. (2000:Fig. 2) both have the relationships ((*Carphophis*, (*Diadophis*, *Farancia*)), and this is also true for the majority rule consensus of the 50 UPGMA trees of Highton et al. (2002:Fig. 1). However, they incorrectly stated that "In [Buckley et al.'s] Fig. 3, their 9999 trees all had a different topology ((*Carphophis*, *Diadophis*), *Farancia*) indicating the input order had been reversed" (Highton et al. 2002:271). On the contrary, Fig. 3 of Buckley et al. is not the consensus of 9999 UPGMA trees but of six minimum evolution (ME) trees, with branches less than 0.0646 (the smallest observed value) collapsed. For our ME analysis, we used the same input order of taxa as for our UPGMA analyses. Therefore, the difference between our ME consensus tree and the various UPGMA consensus trees presumably results from the different method used for that analysis.

In contrast with UPGMA, the ME method does not assume (approximate) evolutionary rate equality among lineages. This property is important in the case of the three taxa in question, because although *Carphophis* exhibits a greater distance to *Diadophis* (0.3571) and *Farancia* (0.5991) than those taxa do to each other (0.3318), the *Carphophis* and *Diadophis* lineages appear to be evolving rapidly for the set of loci sampled, relative to the *Farancia* lineage. Assuming that these three taxa form a monophyletic group (as suggested by both the UGPMA and ME but not the parsimony analyses of Buckley et al. 2000), relative rate tests using *Calamaria gervasii* and *Rhamphiophis oxyrhynchus* (taxa that share the most alleles with *Carphophis*, *Diadophis*, and *Farancia*) as outgroups, reveals substantially greater distances to *Carphophis* and *Diadophis* (D = 0.8664 – 0.9286) than to *Farancia* (D = 0.5000–0.5991). Consequently, even though *Diadophis* is more similar to *Farancia* than to *Carphophis* (for the loci in question), as indicated by the results of the UPGMA analysis, it may share a more recent common ancestor with *Carphopis* than with *Farancia*, as indicated by the results of the ME analysis.

The pattern of shared alleles supports this interpretation. At the only locus (*Acp*) for which *Diadophis* and *Farancia* share an allele (24) not found in *Carphophis*, the allele in *Carphophis* (31) is unique to that taxon (among all snakes examined) and is therefore potentially autapomorphic. In other words, the allele shared by *Diadophis* and *Farancia* may be ancestral for all three taxa, and consequently, the fact that it is shared by *Diadophis* and *Farancia* does not support a relationship between those taxa to the exclusion of *Carphophis*. In contrast, *Carphophis* and *Diadophis* share an allele (07) at the *Mdh* locus that appears to be derived relative to the allele (06) present in *Farancia* (based on presence of allele 06 in other snake species), suggesting that *Carphophis* and *Diadophis* share a common ancestor not shared by *Farancia*.

Highton et al. (p. 271) reached their erroneous conclusion about taxon input order because they believed that "the *I*-value between the pair *Carphophis* and *Diadophis* is the same as that between *Diadophis* and *Farancia*" and "the tie was no longer present [in the majority rule consensus tree of Highton et al.] because [they] included two species of *Farancia*." On the contrary, the *I* value for the *Carphophis*-*Diadophis* comparison ($I = 0.6429$; D = 0.3571) is not the same as that for the *Diadophis* -*Farancia* comparison ($I = 0.6682$; D = 0.3318), reflecting the fact that the allele shared by *Carphophis* and *Diadophis* at the *Pgm* locus (08) is polymorphic in both taxa, while that shared by *Diadophis* and *Farancia* (also 08) is polymorphic in *Diadophis* but not in *Farancia* (both pairs of taxa share all their alleles at two of the other three loci and none at the third). Thus, the clustering of *Diadophis* with *Farancia* in the various UPGMA analyses has nothing to do with including two species of *Farancia*. Because the distance between those two taxa is smaller (D = 0.3318) than the distance between *Carphophis* and *Diadophis* (D = 0.3571) and that between *Carphophis* and *Farancia* (D = 0.5991), *Diadophis* and *Farancia* cluster together in all the various UPGMA analyses—both those excluding (Buckley et al. 2000:Fig. 2) and those including (Highton et al. 2002:Fig. 1) the second species of *Farancia*. (The same is true for the Cavalli-Sforza and Edwards chord distances used by Highton et al., which are 0.0383, 0.0444, and 0.0679, respectively.)

3. Consensus Methods

The suggestion by Highton et al. (2002) that we overlooked the phylogenetic signal present in the data of Dowling et al. (1996) by using the strict consensus method rather than the majority-rule consensus method highlights the general problem of deciding which groups are to be considered supported by the results of a phylogenetic analysis. Consensus methods, of which several have been proposed (reviewed by Swofford 1991; Nixon and Carpenter 1996), bear on this question in that they are commonly used to assess agreement among the members of a set of equivalent trees. The strict consensus method (Schuh and Polhemus 1981) used by

Buckley et al. (2000) retains only those groups that appear on all trees in the set. In contrast, the majority-rule consensus method (Margush and McMorris 1981) advocated by Highton et al. (2002) retains all groups that are present in some arbitrarily specified proportion of the trees greater than or equal to 50%. Other less-than-strict methods (e.g., reduced consensus, Adams consensus) also seek to retain more resolution, but this increased resolution is accomplished at the expense of ignoring contradictory data (Kearney 2002; Nixon and Carpenter 1996).

Choice of a consensus method reflects the stringency of the standard of group support adopted. Within this framework, various standards of group support form a continuum ranging from least rigorous to most rigorous as follows: any character support at all → present on any of the optimal trees → present on a majority (>50%) of the optimal trees (the criterion adopted by Highton et al. 2002) → present on various fractions of the optimal trees above 50% → present on all (100%) of the optimal trees (the criterion adopted by Buckley et al. 2000) → present on a majority (> 50%) of the optimal trees resulting from bootstrap/jackknife analysis (this criterion will not always be more stringent than the preceding one because it is based on a qualitatively different property) → present on various fractions above 50% of the trees resulting from bootstrap/jackknife analysis (commonly used fractions are 70%, 90%, and 95%).

In this context, Highton et al. (2002) advocated a consensus method (50% majority-rule) that resides near the permissive end of the spectrum, whereas Buckley et al. (2000) used one (strict or 100% majority rule) that corresponds with a more stringent criterion. As a result, Highton et al.'s (2002) consensus tree contains groups that are contradicted by some of their equivalent trees, whereas Buckley et al.'s (2000) consensus tree contains only those groups that are not contradicted by any of their equivalent trees. Although authors are free to adopt as permissive or stringent a criterion as they see fit, the recent trend in phylogenetics has been to use much more stringent criteria than the one adopted by Highton et al. (2002). Thus, the strict consensus method is the most commonly used consensus method for representing agreement among equivalent optimal trees resulting from a single phylogenetic analysis (Nixon and Carpenter 1996; Swofford 1991), and many recent authors demand even more stringent criteria for considering a group to be adequately supported, such as presence in 70% or even 95% of the optimal trees obtained using bootstrap or jackknife resampling methods.

We performed bootstrap analyses, each with 100 replicates, using the phylogenetic software packages PAUP* version 4.0b10 (Swofford 2002), for UPGMA and parsimony analyses, and FastME (Desper and Gascuel 2002), for minimum evolution analyses, to assess levels of support provided by the allozyme data for various groups of taxa. Following the program default, we considered presence of a group in 50% of the bootstrap replicates to be the minimum level of acceptable support (given that a group present in less than 50% of the replicates can be contradicted in more replicates than it is supported). The original published tree of Dowling et al. (1996) has 122 groups (nodes), or 103 excluding those composed of taxa with identical character states; the majority rule consensus tree of Highton et al. (2002) has 105 groups, or 86 excluding those composed of identical taxa. By comparison, bootstrap analysis using UPGMA yielded only 18 and 8 groups (total and excluding those composed entirely of identical taxa) supported in greater than 50% of the replicates; bootstrap analysis using minimum-evolution yielded only 40 and 19 groups; and bootstrap analysis using parsimony analysis yielded 0 groups.

In sum, the majority-rule consensus tree presented by Highton et al. (2002) corresponds with a relatively permissive criterion of support (presence in > 50% of the equivalent trees) in that it retains groups that are contradicted by some of the equivalent trees. Under more stringent criteria that are widely adopted by contemporary workers (presence in all of the optimal trees; presence in greater than 50% of the trees resulting from bootstrap analysis), considerably less resolution is obtained. Moreover, the UPGMA clustering method used by Highton et al. (2002) carries an unrealistic assumption of evolutionary rate constancy among lineages (de Queiroz and Good 1997, and references therein), and at least some alternative methods yield even less resolution and/or contradictory groupings (e.g., the relationships among *Carphophis*, *Diadophis*, and *Farancia*) for the allozyme data in question (Buckley et al. 2000).

Conclusion.—Rather than contradicting the conclusions of Buckley et al. (2000), the results presented by Highton et al. (2002) reinforce those conclusions. Although Highton et al. (2002) are correct in stating that the removal of identical taxa can affect the order of clustering by UPGMA, any increased resolution that results from including identical taxa is not warranted by the data in that it is an artifact of sampling and the averaging method used by UPGMA. Highton et al. (2002) are incorrect in stating that if we were interested in the effects of ties on the topology of UPGMA trees based on the snake allozyme data, we should have randomly reordered the input of taxa. In fact, the tie-breaking procedures that we used are equivalent to varying the input order of taxa, and we performed much more thorough tie-breaking analyses than did Highton et al. (2002) (our analyses effectively used 20 to ~200 times the number of different input orders used by them). Finally, Highton et al. (2002) used a very permissive criterion (majority-rule consensus) for deciding which nodes to consider resolved. A more conservative and widely used criterion (strict consensus) results in far less resolution (particularly when more thorough tie-breaking analyses are performed), and a standard method for assessing nodal support indicates that most of those nodes are very weakly supported.

For these reasons, our conclusions remain unchanged. The snake allozyme data of Dowling et al. (1996) are highly ambiguous concerning the higher level phylogeny of snakes, though they may be informative at lower hierarchical levels. The high degree of resolution in the original tree of Dowling et al. (1996:Figs. 1–6) is an analytical artifact that results from failure to consider alternative trees implied by numerous tied distance values. In addition, the new tree presented by Highton et al. (2002:Fig. 1), though less resolved than the one presented by Dowling et al. (1996), still contains more resolution than is warranted by the data. Many of the groups in that tree result from 1) retaining identical taxa in conjunction with use of a tree reconstruction method (UPGMA) that is sensitive to the numbers of identical taxa sampled, 2) performing a less than thorough tie-breaking analysis, and 3) using a permissive consensus method (majority-rule) that allows contradicted groups to be retained in the summary tree.

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ARTICLES

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Reproductive Arrest in *Sceloporus mucronatus* (Lacertilia:Phrynosomatidae) Correlated with "El Niño Southern Oscillation"

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The most common reproductive patterns in *Sceloporus* lizards that inhabit temperate and high mountain zones in central Mexico are viviparity and fall reproduction (Guillette and Méndez de la Cruz 1993; Méndez-de la Cruz et al. 1998). Indeed, all species of the *torquatus* group (*S. jarrovii, S. cyanogenys, S. mucronatus, S. torquatus, S. poinsetti, S. dugesi,* and *S. serrifer*) that have been studied exhibit fall ovulation and spring parturition following 5 to 7 months of gestation (Méndez-de la Cruz et al. 1998). Previous studies of these species have shown that one litter per year is characteristic, but that parturition might be delayed by less than one month (Guillette and Méndez-de la Cruz 1993; Méndez-de la Cruz et al. 1998).

Clutch size is an adaptation to abiotic and biotic environmental factors and is an important reproductive trait of lizards (Fitch 1985). In general, lizards produce at least one clutch per year, but clutch size might vary within a population from year to year (Abell 1999; De Marco 1989). Desert lizards might reduce egg production in response to low precipitation as described for several species of *Uma* (Mayhew 1965; 1966a; 1966b), *Urosaurus ornatus* (Martin 1977), and *Uta stansburiana* (Worthington 1982). Reproduction was totally curtailed in *Cnemidophorus tigris* (Pianka 1970) and *Sauromalus obesus* (Nagy 1973) when extremely dry conditions reduced food resources.

We suggest that the reported reproductive failure in *C. tigris* and *S. obesus* was associated with the climate phenomenon called "El Niño Southern Oscillation" (ENSO). This event is the result of unusual periodically occurring sea surface temperature conditions in the eastern tropical Pacific Ocean that have global climatic effects (Trenberth 1997). During the last 50 years, 12 ENSO events have been recorded; the most severe event in Mexico occurred during 1997–1998 (Magaña and Morales 1999).

Our study of the viviparous lizard *Sceloporus mucronatus*, which inhabits the high altitude zone of central Mexico, was carried out during three consecutive years (1996–1998) in the same outcrop. The study area was located near Zoquiapan, Estado de México (19°20'04"N, 98°42'49"W). Twenty-eight females were randomly collected from crevices in rocks by hand, noose, or by using a wire to force a lizard from its refuge. Lizards were captured in May and June, prior to parturition. Lizards were housed for approximately one month in terraria with food and water *ad libitum* until the beginning of parturition, which is marked by sinuous abdominal contractions as previously described by Cuellar (1984). Data obtained from each female were snout–vent length (SVL to 1 mm) and total body mass (TBM) plus litter weight (to 0.1 g). After parturition, litter size and litter mass per female were determined.

For years with offspring production, we statistically compared litter size (LS), litter mass (LM), individual litter mass (ILM), female SVL, and female mass by year using t-tests. ANCOVA was used to compare female TBM from all three years, using SVL as a covariate, and year as a factor. ANCOVA was also used to compare the litter size of this population with different populations described in a previous study (Méndez-de la Cruz et al. 1993), using SVL as a covariate and study as a factor. Data were analyzed using SYSTAT. A significance criterion of $p \leq 0.05$ was used for all statistical analyses. Means ± 1 SE are reported.

The twelve adult females collected during 1996 and 1997 were all gravid, and the t-test for LS, LM, ILM, and female SVL and TBM showed no significant difference between years ($t_{LT} = 0.93$, $P = 0.19$; $t_{LM} = 0.70$, $P = 0.25$; $t_{ILM} = 0.044$, $P = 0.33$; $t_{SVL} = 1.23$, $P = 0.13$; $t_{TBM} = 1.86$, $P = 0.07$). However, during 1998, none of the sixteen females collected was gravid, and no neonates were seen in the field. Females collected in 1998 were significantly different from the 1996–1997 females. The ANCOVA between body mass and year using SVL as a covariate showed significant differences between 1998 and 1996–1997, but not within 1996–1997 ($F_{1,2} = 19.09$; $P = 0.0001$). SVL and TBM for reproductive fe-

TABLE 1. Mean ± 1 SE and ranges for snout–vent length, litter size, and percent of follicular atresia for three populations of the viviparous lizard *Sceloporus mucronatus*. Elevation in meters above sea level; ? = unknown data.

	Monte Alegre, Distrito Federal	Tecocomulco, Hidalgo	Zoquiapan, Estado de México	
Year of study	(1981–1982)	(1990–1991)	(1996–1997)	(1998)
Elevation (m)	3200–3400	2500	3500	3500
N	23	22	12	16
Mean SVL (mm)	80.6 ± 1.1	79.4 ± 2.2	83 ± 2.2	76.4 ± 1.1
Range (mm)	71–90	56.6–102	73–94	66–86
Mean Litter Size	5.11 ± 0.24	6.46 ± 0.61	4.16 ± 0.34	0
Range	3–8	2–13	3–7	—
% of follicular atresia	54.6	17.0	?	100%
Source	Méndez-de la Cruz et al. 1993	Méndez-de la Cruz et al. 1993	Present study	Present study

males were 83.66 ± 0.65 mm and 26.48 ± 0.51 g, respectively. The average SVL and TBM for non-reproductive females were 78.56 ± 0.28 mm and 16.5 ± 0.19 g.

From August 1997 to June 1998 the National Center for Environmental Prediction (NCEP) documented the development and persistence of strong warm-episode conditions on the west coast of North America (http://www.ncdc.noaa.gov). In México, the ENSO decreased rainfall from Summer 1997 to Winter 1998 (Magaña and Morales 1999). Additionally, large fires and more dust than usual were evident in the study area, particularly during the first five months of 1998 (pers. obs.). These climate changes affected the structure and dynamics of many ecosystems (Delgadillo-Macias et al. 1999; Holmgren et al. 2001).

Previous studies showed a strong influence of food availability on reproductive traits in different reptiles (Ferguson and Talent 1993; Ford and Seigel 1994; Martin 1973, 1977; Seigel and Ford 2001; Shine and Madsen 1997). However, the only study of the negative impact on food availability during an ENSO was conducted on *Amblyrhynchus cristatus* (Wikelski and Thom 2000). We suggest that reproductive disruptions found in previous studies such as decreased reproductive activity (Abell 1999; De Marco 1989; Martin 1977; Mayhew 1965, 1966a, 1966b; Worthington 1982) or complete reproductive arrest (Nagy 1973; Pianka 1970), can be attributed to ENSO events, as ENSO periods correspond to field work or collecting dates in those studies.

Differences in female SVL and TBM observed during 1998 vs. 1996–1997 in *S. mucronatus* are correlated with the unusually dry environmental conditions brought on by the ENSO event during last five months of 1997, when females became vitellogenic and gravid and during the first five months of 1998 when gestation continues and parturition occurs. We suggest that the ENSO and resulting dry conditions caused the reproductive failure of 1998, possibly by reducing prey availability.

Previous studies on *S. mucronatus* showed that litter size is regulated by follicular atresia after vitellogenesis (Méndez-de la Cruz et al. 1993). A high elevation population from Monte Alegre, Distrito Federal (3200 m elev.), exhibited a 50% reduction in litter size compared to a lowland population from Tecocomulco, Hidalgo (2600 m elev.), even though the two populations did not differ in the initial number of vitellogenic follicles (Méndez-de la Cruz et al. 1993). Considering that each population produces the maximum number of vitellogenic follicles (Méndez-de la Cruz et al. 1993), the lizards in our study apparently had an even greater percentage of follicular atresia, as litter sizes of females collected during 1996–1997 were smaller than those from the Monte Alegre and Tecocomulco populations ($F_{1,3} = 24.07$; $P = 0.0001$). Atresia may have been as high as 100% in females collected during 1998 (Table 1).

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The Non-Fish, Vertebrate Diet of Sympatric Populations of the Cottonmouth (*Agkistrodon piscivorus*) and Northern Watersnake (*Nerodia sipedon*)

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The diets of the cottonmouth (*Agkistrodon piscivorus*) and northern watersnake (*Nerodia sipedon*) have been studied in detail (e.g., Kofron 1978; Meyer 1992). However, a comparison of food habits has not been made between these species in areas where they occur in sympatry along the Gulf of Mexico coastal plain, USA. Tributaries of rivers in the Gulf coastal plain often support large, sympatric populations of *A. piscivorus* and *N. sipedon* (pers. obs.). These species generally are non-specialized, opportunistic feeders that exhibit similar daily and seasonal activity patterns (Burkett 1966; Diener 1957). Moreover, where these snakes inhabit the same areas, both species tend to select habitats that contain abundant aquatic vegetation and woody debris such as logjams and half-submerged brushpiles (pers. obs.). Thus, these species appear to exhibit similar life histories and, where they occur in sympatry, may potentially compete for food resources.

Despite the typically euryphagic food habits of *A. piscivorus* and *N. sipedon*, reptiles may exhibit specific food preferences when occurring in sympatry, perhaps to lessen the potential for competition (e.g., Fitch 1982; James 1991; Moll 1990). The food habits of *A. piscivorus* and *Nerodia* spp. also are influenced in part by snake sizes: small (juvenile) and large (adult) snakes differ in foraging behavior (Burkett 1966; Mushinsky et al. 1982; Savitzky 1989) and gape sizes (Forsman 1996; Miller and Mushinsky 1990; Mushinsky et al. 1982), which may result in access to and acquisition of different prey taxa. Ontogenetic shifts in diet may further affect potential competitive relationships among and between *A. piscivorus* and *N. sipedon*. For example, according to optimal foraging theory (Pyke et al. 1977; Schoener 1971), large predator (e.g., snake) individuals are expected to "drop" small prey from their diet, and individuals of the same approximate size are expected to exhibit higher dietary overlap than do individuals of disparate sizes (reviewed by Arnold 1993).

To determine food habits of snakes, I examined preserved museum specimens of *A. piscivorus* and *N. sipedon* collected over a 48-year period (1951–1999) from the Chattahoochee, Choctawhatchee, Yellow, Escambia, Alabama, Tombigbee, Pascagoula, Pearl, and Mississippi river systems of western Georgia, western Florida, Alabama, Mississippi, and southeastern Louisiana. I surveyed all specimen localities at night on foot and for up to five times and only compared food habits between *A. piscivorus* and *N. sipedon* collected from sites where I observed individuals of both species in sympatry ($\leq$ 11.2 m from each other). Snakes were dissected and food items were removed from the esophagus and stomach, identified to the lowest possible taxon, and grouped according to the species and size class of snake (small: < 50 cm snout–vent length [SVL]; large: $\geq$ 50 cm SVL). The accurate calculation of prey sizes and masses was not feasible due to the advanced digestion and the poor preservation states of food items in most snakes.

I dissected a total of 359 *A. piscivorus* and 661 *N. sipedon* collected from sites where the species occur in sympatry (pers. obs.). Of these, 85 specimens of *A. piscivorus* and 23 specimens of *N. sipedon* contained non-fish vertebrate food items. Forty-three and 41 of the 84 specimens of *A. piscivorus* were allocated to the small and large size classes, respectively (small: mean SVL = 31.33 cm ± 2.48 [95% CI], range = 18–49 cm; large: mean SVL = 64.93 cm ± 3.17, range = 50–90 cm). Twelve and 11 of the 23 specimens of *N. sipedon* were allocated to the small and large size classes, respectively (small: mean SVL = 30.75 cm ± 7.53, range = 16–48 cm; large: mean SVL = 73.91 cm ± 13.74, range = 53–116 cm).

A Simpson's diversity index was used to compare diets within each species and size class of snake: $D = 1/SP^2_i$, where P_i is the proportion of prey individuals in species i that contributes to the total sample of prey within that species (Began et al. 1996). A

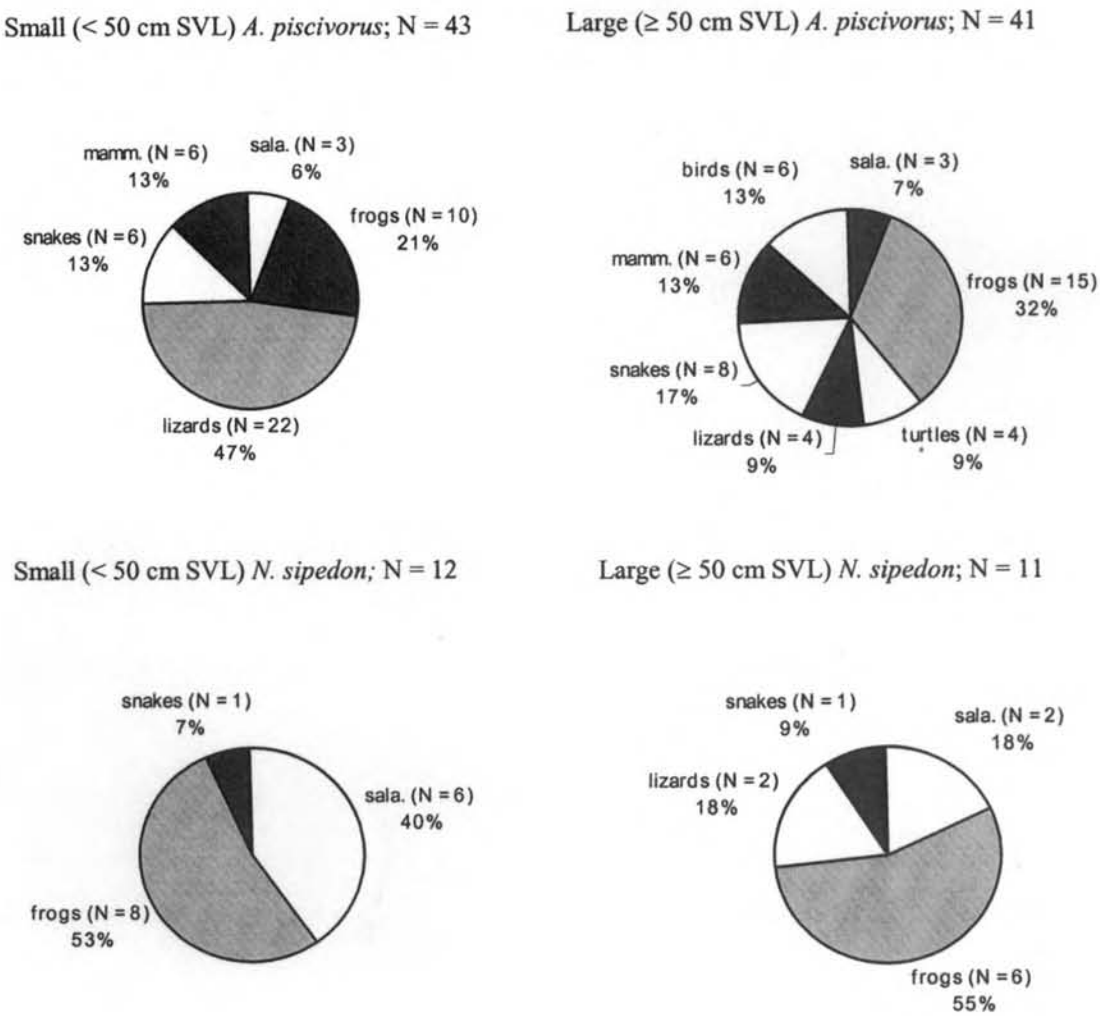

FIG. 1. Non-fish vertebrate food items obtained from *Agkistrodon piscivorus* and *Nerodia sipedon*. Sample sizes refer to the number of snakes containing identifiable food items. sala. = salamanders, mamm. = mammals.

Morisita's index of overlap was used to compare diets between species and size classes of snake: $I_M = 2Sx_iy_i/([l_1 + l_2]N_1N_2)$, where x_i is the total number of prey individuals in species i in community 1, y_i is the total number of prey individuals in species i in community 2, N_1 is the total number of prey individuals in community 1, and N_2 is the total number of prey individuals in community 2 (Brower et al. 1998).

Comparisons of fish and invertebrate components of snake diets indicated that niche breadth was relatively high among small *A. piscivorus*, intermediate among small *N. sipedon*, and relatively low among large *A. piscivorus* and *N. sipedon* (Himes 2002, 2003). Dietary overlap between *A. piscivorus* and *N. sipedon* was very low (regardless of snake size), although overlap between small and large *N sipedon* was very high (Himes 2002, 2003).

Examination of the vertebrate components of snake diets yielded a total of four families, five genera, and four species of caudates, and three families, four genera, and four species of anurans. However, of those amphibians identified to species, only *Rana sphenocephala* was found in both *A. piscivorus* and *N. sipedon*. A total of three families, two genera, and two species of turtles were found in *A. piscivorus*. A total of five families, genera, and species of lizard, and two families, eight genera, and nine species of snakes were identified. All but two individuals each of lizards and snakes were found in *A. piscivorus*, and of those reptiles that were identified to species, none was found in both *A. piscivorus* and *N. sipedon*. One specimen each of *A. piscivorus* and *N. sipedon* contained a conspecific. Two species of passerine birds (each from different families), three species of soricid insectivores, and one species of murid rodent were found in *A. piscivorus*. Of these, five prey species (a lizard, three snakes, and a bird) represented new records for *A. piscivorus* (Table 1).

Simpson's index indicated that dietary diversity was highest in large *A. piscivorus*, intermediate in small *A. piscivorus* and large *N. sipedon*, and lowest in small *N. sipedon* (Table 2). The highest and lowest diversities are respectively attributable in part to only the large *A. piscivorus* containing turtles and birds, and the small *N. sipedon* containing only salamanders and frogs, with the exception of an individual prey snake. Thus, among the small and large *N. sipedon*, only large snakes contained lizards. In turn, only *A. piscivorus* contained mammals, turtles, and birds, although turtles and birds were only found in large snakes. Frogs were most abundant in large *A. piscivorus*, and large and small *N. sipedon*. However, lizards were most abundant in small *A. piscivorus* (Fig. 1).

Morisita's index indicated that dietary overlap was high between large *A. piscivorus* and *N. sipedon*, with both containing salamanders, frogs (the most abundant food item in both species), lizards, and snakes. Overlap was also high between small and large *N. sipedon*, with both size classes containing salamanders, frogs (the most abundant food item in both size classes), and snakes. Overlap was intermediate between small and large *A. piscivorus*, with both size classes containing salamanders, frogs, lizards, snakes, and mammals. However, only large *A. piscivorus* contained birds and turtles, and lizards (rather than frogs) were the most abundant food item in small snakes. Overlap was relatively low between small *N. sipedon* and *A. piscivorus*. Lizards, which were absent in *N. sipedon*, were the most abundant food item in *A. piscivorus*, and only *A. piscivorus* contained mammals (Table 2).

According to these data, *A. piscivorus* consumes a wide diversity of non-fish vertebrates that includes amphibians (particularly frogs in large snakes), reptiles (particularly lizards in small snakes), mammals, and birds, whereas *N. sipedon* consumes primarily amphibians (particularly frogs). Among amphibians, three of four families of caudates (Ambystomatidae, Amphiumidae, Proteidae) were only found in *A. piscivorus*, and only one species of anuran (*Rana sphenocephala*) was found in both species of snake (Table 1). Dietary overlap of non-fish vertebrates was relatively low between small *A. piscivorus* and *N. sipedon*. Although dietary overlap of non-fish vertebrates was high between large snakes, overlap of fishes (by family), which comprised over 50% of all food items identified from large *A. piscivorus* and *N. sipedon*, was very low (Himes 2002, 2003). Thus, *A. piscivorus* and *N. sipedon* appear to exhibit different food habits, which may lessen the potential for interspecific competition (assuming food is limited) and enable large populations of these species to coexist

TABLE 1. Food items collected from *Agkistrodon piscivorus* and *Nerodia sipedon* from the Chattahoochee, Choctawhatchee, Yellow, Escambia, Alabama, Tombigbee, Pascagoula, Pearl, and Mississippi river systems.

	A. piscivorus (N = 84 snakes)		*N. sipedon* (N = 23 snakes)	
Categories	Prey (N)	% of total	Prey (N)	% of total
Caudata				
Ambystomatidae				
Ambystoma talpoideum	1	1.0	0	0
Amphiumidae				
Amphiuma means	1	1.0	0	0
Plethodontidae				
Desmognathus fuscus	0	0	1	3.8
Desmognathus spp.	2	1.9	1	3.8
Eurycea cirrigera	0	0	1	3.8
Unidentifiable to genus	1	1.0	3	11.5
Proteidae				
Necturus sp.	0	0	1	3.8
Unidentifiable to family	1	1.0	1	3.8
Anura				
Bufonidae				
Bufo spp.	0	0	4	15.3
Hylidae				
Acris sp.	0	0	1	3.8
Hyla cinerea	1	1.0	0	0
Hyla sp.	1	1.0	0	0
Ranidae				
Rana catesbeiana	3	2.9	0	0
Rana clamitans	0	0	2	7.7
Rana sphenocephala	6	5.8	2	7.7
Rana spp.	11	10.7	2	7.7
Unidentifiable to family	3	2.9	3	11.5
Testudines				
Chelydridae				
Chelydra serpentina	2	1.9	0	0
Emydidae				
Trachemys scripta	1	1.0	0	0
Kinosternidae				
Unidentifiable to genus	1	1.0	0	0
Squamata: Lacertilia				
Anguidae				
Ophisaurus sp.	1	1.0	0	0
Phrynosomatidae				
*Sceloporus undulatus**	3	2.9	0	0
Polychrotidae				
Anolis carolinensis	1	1.0	0	0
Scincidae				
Eumeces fasciatus	3	2.9	0	0
Eumeces inexpectatus	1	1.0	0	0
Eumeces sp.	0	0	1	3.8
Scincella lateralis	16	15.5	1	3.8
Unidentifiable to family	1	1.0	0	0
Squamata: Serpentes				
Colubridae				
*Coluber constrictor**	2	1.9	0	0
*Diadophis punctatus**	3	2.9	0	0
Elaphe obsoleta	1	1.0	0	0
Nerodia cyclopion	1	1.0	0	0
Nerodia sipedon	0	0	1	3.8
Storeria dekayi	1	1.0	0	0
Thamnophis sauritus	1	1.0	0	0
*Virginia striatula**	1	1.0	0	0
Unidentifiable to genus	1	1.0	0	0

over a large area of the Gulf coastal plain.

Snakes may undergo ontogenetic shifts in diet for several reasons, which may be either environmentally or genetically induced. More specifically, Mushinsky and Miller (1993) suggested that the high vulnerability of young snakes to predation may be a driving force in snake evolution because 1) "young individuals forage on different prey than [do] larger conspecifics", 2) the "young of species that are uniformly colored as adults often do not resemble their parents" (although this does not apply to *N. sipedon*, which is strongly patterned throughout life), 3) "relative to SVL, head width and length (elements associated with foraging capabilities) are greater in smaller individuals than [in] larger conspecifics", and 4) "relative to SVL, smaller individuals forage on larger prey (by mass) than [do] conspecific adults". Therefore, the food habits of young snakes often differ from those of adult conspecifics due in part to high predation pressure, which probably accounts for some of the dietary differences between small and large *A. piscivorus* (Himes, 2002, 2003).

For example, compared to adults, young *A. piscivorus* spend more time foraging at the land-water interface than do adults (Savitzky 1992), thereby avoiding areas of open water where aquatic predators (including adult conspecifics) are more plentiful and thus predation pressure is higher. This foraging strategy probably accounts for the large lizard component found in the diet of small snakes in this study. In addition, terrestrial foraging by juvenile *A. piscivorus* may serve several other purposes: 1) lessening intraspecific competition for food with other juveniles and adults, 2) lessening interspecific competition for food with juvenile *N. sipedon*, and 3) adding diversity to the diet (Himes 2002). The light-colored tail tip of juvenile *A. piscivorus* and other viperids, which generally darkens in subadults to match the remainder of the body coloration, is twitched to attract small terrestrial prey, particularly lizards (reviewed by Heatwole and Davison 1976). Therefore, it appears that juvenile *A. piscivorus* are morphologically specialized to exploit a food source that is not as frequently utilized by the adults (see also Wharton 1969).

By contrast, as overlap was extremely high between small and large *N. sipedon*, this species does not appear to undergo an ontogenetic shift in diet (Table 2). This relationship is particularly evident when considering fishes as prey, which comprised over 50% of all food items identified from both small and large snakes. Overlap of fishes by family was also very high between small and large snakes (Himes 2002, 2003). Additionally, unlike *A. piscivorus*, *N. sipedon* bears a similar coloration and pattern throughout life. Thus, if external morphology is related to or affects aspects of the life history of snakes such as habitat selection, which in turn may determine the available prey base and foraging opportunities, then snakes that do not undergo ontogenetic shifts in color or pattern (such as *N. sipedon*) may not exhibit a corresponding ontogenetic shift in habitat selection or diet.

The results of this study support the findings of Clark (1949) and Kofron (1978) that *A. piscivorus* has a more diverse diet than do sympatric species of *Nerodia* in the Atchafalaya River Basin of south-central Louisiana (Clark 1949) and the hill parishes of north-central Louisiana (Kofron 1978). They found that *A. piscivorus* consumed fishes, anurans, serpents, and mammals. However, unlike the specimens of *A. piscivorus* examined in my study, lizards were absent from the diets of snakes. Although *N. sipedon* is absent from both areas, several other species of aquatic snakes may be sympatric with *A. piscivorus*: *Nerodia cyclopion*, *Nerodia*

TABLE 1. Continued.

Categories	*A. piscivorus* (N = 84 snakes) Prey (N)	% of total	*N. sipedon* (N = 23 snakes) Prey (N)	% of total
Viperidae				
Agkistrodon piscivorus	1	1.0	0	0
Unidentifiable to family	2	1.9	1	3.8
Passeriformes				
Fringillidae				
Cardinalis cardinalis	1	1.0	0	0
Paridae				
*Baelophus bicolor**	2	1.9	0	0
Unidentifiable to family	3	2.9	0	0
Insectivora				
Soricidae				
Blarina carolinensis	3	2.9	0	0
Cryptotis parva	1	1.0	0	0
Sorex longirostris	1	1.0	0	0
Unidentifiable to genus	2	1.9	0	0
Rodentia				
Muridae				
Mus musculus	2	1.9	0	0
Unidentifiable to genus	2	1.9	0	0
TOTALS	**103**	**100**	**26**	**100**

TABLE 2. Simpson's diversity index (*D*) and Morisita's index of overlap (I_M) values for respectively comparing diets within (first column) and between (third column) small (SVL < 50 cm) and large (SVL ≥ 50 cm SVL) specimens of *Agkistrodon piscivorus* and *Nerodia sipedon*.

size class and species	*D*	size class and species	I_M
small *A. piscivorus*	0.71	large *A. piscivorus*	0.67
small *N. sipedon*	0.83	large *N. sipedon*	0.42
small / large *A. piscivorus*	0.59	small *A. piscivorus* / *N. sipedon*	0.92
large *A. piscivorus* / *N. sipedon*	0.69	small / large *N. sipedon*	1.03

fasciata, and *Nerodia rhombifer* consumed only fishes (primarily) and anurans (secondarily), *Nerodia erythrogaster* consumed only anurans, and *Regina grahamii* and *Regina rigida* consumed only crayfishes. These findings, combined with those of numerous other studies (reviewed by Gloyd and Conant 1990; Savitzky 1992) including my own, clearly indicate that the euryphagic feeding habits of *A. piscivorus* are widespread throughout the range of this species. The finding of *Sceloporus undulatus*, *Coluber constrictor*, *Diadophis punctatus*, *Virginia striatula*, and *Baelophus bicolor* adds to the list of food items reported for *A. piscivorus*; this is not surprising given the opportunistic feeding habits of *A. piscivorus* and availability of prey species.

Unlike the specimens of *N. sipedon* examined in my study, snakes examined from northeastern Kansas consumed exclusively frogs (Fitch 1982), snakes from western North Carolina often contained crayfishes, and snakes from southwestern Kansas lacked non-fish vertebrates (Diener 1957). Although *A. piscivorus* is absent from all of these areas, *N. erythrogaster* is sometimes sympatric with *N. sipedon* in Kansas. However, the respective diets of *N. sipedon* and *N. erythrogaster* consist almost exclusively of fishes and anurans (Diener 1957), and thus snakes do not appear to compete for food. Also by contrast to the specimens of *N. sipedon* examined in my study, over 50% of the food volume of snakes from south-central Georgia consisted of salamanders, *Necturus* (Camp et al. 1980). However, similar to the results of my study, frogs and toads were the most abundant non-fish vertebrate food items in the diets of snakes from New York (Brown 1940) and Michigan (Meyer 1992).

The results of experimental chemical tests indicate that *N. sipedon* has as innate preference for the scent of amphibians (and fishes), as exhibited by predatory behavior (Burghardt 1968; Dix 1968), thereby accounting for its narrower prey preferences relative to *A. piscivorus*. Thus, the source of the more specific food habits of *N. sipedon* may be genetic, and not directly related to the presence or absence of *A. piscivorus*, although preferences may be subsequently environmentally modified (e.g., by potential competitive interactions) (Dix 1968).

I dissected snakes that were collected over a 48-year period and from nine different river systems associated with the Gulf of Mexico. The prey base available to snakes is unlikely to be the same between these drainages, especially with regards to potential prey fishes (Mettee et al. 1996; Ross 2002), and the composition of the prey base is subject to temporal changes (both seasonal and yearly) in response to hydrological changes in these river systems. Therefore, caution should be drawn when comparing the results of my study to those of other studies. Nonetheless, because the snakes from my study were collected over a wide area (including all major river systems in the southern extremity of distribution of *N. sipedon*; Tennant and Bartlett 2000) and comprised a large sample, valid generalizations about the food habits of snakes can readily be made on a broader geographic scale, as well as for snakes in areas where *A. piscivorus* and *N. sipedon* occur in sympatry.

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First Description of a Clutch and Nest Site for the Genus *Caecilia* (Gymnophiona: Caeciliidae)

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Caecilians are tropical, limbless, primarily fossorial amphibians (Duellman and Trueb 1986). Although they may be fairly abundant in certain areas (Péfaur et al. 1987), their subterranean habits make them difficult to find and as a result, life histories are unknown for most of the 167 described species (for examples of studies that have documented caecilian life histories, see Gans 1961; Parker 1936, 1958; Sanderson 1937; Sarasin and Sarasin 1887–90; Taylor 1968; Wake 1980). Information on caecilian life histories is important not only for improving understanding of amphibian life history evolution, but also for developing management strategies for conservation. For example, life history data can be used to conduct ecological sensitivity analyses to infer which human activities are most likely to negatively impact caecilian populations (Biek et al. 2002).

Even such general information as reproductive mode remains unknown for many caecilian species (Wake 1992). Caecilians have a variety of reproductive modes including oviparity with aquatic larvae, oviparity with direct development, and viviparity (Wake 1977, 1992; Wilkinson and Nussbaum 1998). A large percentage of caecilians are viviparous, although the exact percentage of viviparous species remains controversial because of differences in opinion on which criteria are acceptable for inferring reproductive mode (Wake 1977; Wilkinson and Nussbaum 1998).

The family Caeciliidae, the largest family of caecilians, contains both oviparous and viviparous species (Gans 1961; Peters 1874, 1875; Sanderson 1937; Wake 1977, 1992; Wilkinson and Nussbaum 1998). However, reproductive mode has not been reported for any of the 33 described species in the genus *Caecilia*, the most speciose genus in the family Caeciliidae and one of the two largest genera in the entire order (AmphibiaWeb 2003). To date, evidence suggests that *Caecilia* species are oviparous or that some are oviparous and others are viviparous (Taylor 1968; Tschudi 1839; Wake 1977). Wilkinson and Nussbaum (1998) reported observing an unspecified *Caecilia* species lay eggs in captivity. Observations of large ova and larvae with gill slits have also been used to infer that some *Caecilia* species are oviparous (Tschudi 1839; Wake 1977, 1992). The presence of fetal teeth in other *Caecilia* species suggest that these species may be viviparous (Taylor 1968). However, the only conclusive evidence for reproductive mode is documentation of parturition, laid eggs, aquatic larvae, or oviductal fetuses for specific species.

In January 2001, we began an inventory of the amphibians of Yanayacu Biological Station, Ecuador, located at approximately 2100 m on the east side of the Cordillera Oriental of the Andes in Provincia Napo at 00°35'S 77°53'W. Yanayacu is surrounded by cloud forest with a 20–25 m high canopy as well as some pasture. On 16 January 2001, we found a clutch of *Caecilia orientalis* (Taylor 1968) eggs (Fig. 1), an adult female, two adult males, and one

Fig. 1. Clutch of *Caecilia orientalis* eggs found at Yanayacu Biological Station near Cosanga, Provincia Napo, Ecuador (2100 m elev.).

TABLE 1. Body measurements and primary and secondary annular counts of adult *Caecilia orientalis* and number and length of ovarian ova found in dissected females. One female (QCAZ 21417) and the two males (QCAZ 21418–21419) were found with the clutch of eggs reported in this article at Yanayacu Biological Station near Cosanga, Provincia Napo, Ecuador (2100 m). Baeza is also located in Provincia Napo at an elevation of 1990 m.

QCAZ	Sampling location	Month collected	Sex	Body measurements (mm)			Annuli (prim / sec)	Ova	
				Total length	Head length	Width at mid-body		Number	Length (mm)
2311	Baeza	August	F	400	10.7	10.5	116 / 139	120	< 1.5
6987	Cosanga	November	F	363	9.9	9.4	118 / 96	30	1.5–2.5
								110	< 1.5
6988	Cosanga	November	F	310	9.3	8.9	114 / 98	22	1.5–2.5
								115	< 1.5
21417	Yanayacu	January	F	625	13.5	15.2	122 / 208	7	3.5–5.7
								110	< 1.5
21418	Yanayacu	January	M	406	10.0	11.8	114 / 119	NA	NA
21419	Yanayacu	January	M	427	10.0	12.0	112 / 123	NA	NA

other individual that escaped capture underneath a large, highly decomposed log in pasture bordered by secondary cloud forest (Fig. 2). The clutch was almost certainly a *C. orientalis* clutch because no other caecilians have been documented at the site after two years of inventory work. All three captured adults were preserved as vouchers and stored at the Museo de Zoología of the Pontificia Universidad Católica del Ecuador in Quito, Ecuador (QCAZ; Table 1). The female (QCAZ 21417) was much larger than the two males (QCAZ 21418–21419) and the individual that escaped appeared to be a male based on its small size. The nest site was very wet and was several meters from a small 1 m wide creek. The female was found approximately 5 cm from the clutch and one of the males was approximately 5 cm from the female. The second male and the individual that escaped were found approximately 30 cm and 150 cm, respectively, from the other two adults.

The *C. orientalis* clutch had a total of seven eggs (Fig. 1). The eggs were connected to each other by cords attached to both ends of each egg. The eggs were transparent so that embryos could be seen inside. Embryos had distinct dark eyes, feathery external gills, and creamy yellow yolk sacs and moved when the eggs were touched. The lengths and diameters of three of the eggs were measured. The lengths of these eggs were 10.6 mm, 10.3 mm, and 10.2 mm (mean $\pm$ SE = 10.4 $\pm$ 0.1 mm) and the diameters in the same order were 8.8 mm, 8.3 mm, and 8.1 mm (mean $\pm$ SE = 8.4 $\pm$ 0.2 mm). Two of the seven eggs were preserved as vouchers on January 21, 2001 (QCAZ 21420). The remaining five eggs were given to Oscar Pérez and Eugenia M. del Pino in the Departamento de Ciencias Biológicas at the Pontificia Universidad Católica del Ecuador for study of the development of the embryos.

The observation of a clutch of *C. orientalis* eggs clearly demonstrates that this species is oviparous. Wilkinson and Nussbaum (1998) also report egg laying in a *Caecilia* species in captivity, but they do not specify which species was observed. Nonetheless, their observation and ours suggest that oviparity may be the predominant reproductive mode in the genus. Wake (1992) hypothesized that *C. pressula* and *C. subnigricans* are viviparous based on observation of fetal teeth. However, it has been suggested that fetal teeth are not a reliable character for inferring reproductive mode because some *Siphonops* possess what have been called fetal teeth, yet are known to be oviparous (Wilkinson and Nussbaum 1998).

The observation that the clutch was found several meters from a small stream also suggests that *C. orientalis* has direct develop-

FIG. 2. Site where *Caecilia orientalis* clutch, adult female, two adult males, and one other individual were found underneath a large, highly decomposed log at Yanayacu Biological Station.

ment with no aquatic larval stage. If *C. orientalis* had an aquatic larval stage, it seems more likely that the female would have laid the clutch directly adjacent to the stream to provide easy access to the water for recently hatched larvae as is the case in *Ichthyophis glutinosus* (Sarasin and Sarasin 1887–90).

Our observation of a female *C. orientalis* by the clutch suggests that she was attending her eggs as has been documented for other oviparous species of caecilians (Breckenridge and Jayasinghe 1979; Sanderson 1937; Sarasin and Sarasin 1887–90). However, we are unaware of any previous reports of male caecilians at nest sites. One possible explanation for why males were found at the nest site is that they were simply sharing a preferred microhabitat with the female. Another possibility is that the males were attempting to mate with the female. Finally, the male found closest to the female and closest to the eggs may have been the father of the eggs and may have also been attending them. This would be the first known case of biparental care in caecilians.

We also dissected the female *C. orientalis* found with the clutch and three additional females previously collected as vouchers from Provincia Napo, Ecuador, to count and measure ovarian ova (Table 1). All four females had large numbers of ova (mean $\pm$ SE = 129 $\pm$ 6 ova). Most ova were small ($<$ 1.5 mm), although the female found with the clutch (QCAZ 21417) contained seven ova ranging from 3.5–5.7 mm long and two of the other females (QCAZ 6987–6988) had 30 and 22 medium-sized ova, respectively, ranging from 1.5–2.5 mm long. The different sizes of ova likely represent different stages of development as documented in *Gymnopis multiplicata* (Wake 1968) and *Dermophis mexicanus* (Wake 1980).

The temporal sequence of ova maturation in the dissected females suggests that reproduction is seasonal in *C. orientalis* (Table 1). The observation of female QCAZ 21417 with a laid clutch of eggs on January 16 shows that ovulation starts by January, the beginning of the rainy season at Yanayacu Biological Station (Harold Greeney, owner and Station Manager of Yanayacu, pers. comm.). The female found in August had only very small ova, suggesting reproductive quiescence during this dry period of the year. The two females found in November have medium-sized ova indicating that by this point, vitellogenesis is occurring. This seasonal reproductive pattern matches that reported for *Dermophis mexicanus* in which birth occurs at the beginning of the rainy season (Wake 1980).

The observation that female QCAZ 21417 had mature ovarian ova at the same time she was guarding the reported clutch also suggests that *C. orientalis* is able to produce two clutches per rainy season. This conclusion is supported by the observation that *C. orientalis* females found after the rainy season (QCAZ 2311, 6987–6988) do not have mature ova. Thus, female QCAZ 21417 likely would have laid her mature ovarian ova later during the same rainy season in which she was caught. This frequency of parturition is four times greater than that observed in *Dermophis mexicanus* which only gives birth once every other year (Wake 1980). The slower rate of parturition in *D. mexicanus* is likely due to the long gestation period observed in this viviparous species (Wake 1980).

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Diets of Four Species of Horned Lizards (Genus *Phrynosoma*) from México

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Lizards in the genus *Phrynosoma* are, in general, dietary specialists on ants (Pianka and Parker 1975), with the ability to digest and detoxify their ant prey (Schmidt et al. 1989). While most *Phrynosoma* appear to be ant specialists, there may be flexibility and variability both among populations and among species. For example, Suarez et al. (2000) found that *P. coronatum* shift their diet away from ants in areas dominated by the invasive Argentine ant (*Linepithema humile*), which are not eaten and apparently eliminate palatable ant species.

Much of the information on *Phrynosoma* diets comes from populations in the United States (e.g., Bott et al. 2001; Munger 1984a,b; Pianka and Parker 1975; Rissing 1981; Shaffer and Whitford 1981; Suarez et al. 2000; Whitford and Bryant 1979). Less is known about the diets of the Mexican species (e.g., Blackshear and Richerson 1999; Pianka and Parker 1975). We report on the diets of four species of Mexican *Phrynosoma*: *P. asio* and *P. taurus* from Guerrero, and *P. cornutum* and *P. modestum* from Chihuahua.

Phrynosoma asio were collected opportunistically from 1993 to 1998 with nine collected from May to August, and one collected in January from the Cañon del Zopilote (600 m elevation; ca. 17°33'N, 99°30'W), north of Chilpancingo, Guerrero, and 14 km south of Mezcala. *Phrynosoma asio* is abundant on the hills on both sides of Río Zopilote, a tributary of the Río Balsas. Dominant vegetation at Cañon del Zopilote includes a variety of cacti, including *Neobuxbaumia* sp.; several species of *Bursera* and *Acacia*, *Lysiloma tergemina*, *Mimosa benthamia*, *Ficus continifolia*, *F. petiolaris*, and *Pithecellobium dulce*.

Phrynosoma taurus were collected opportunistically between 1996 and 1998 with 11 collected in June and one in August. The study site (1200 m elevation; 17°38'10.9"N, 99°32'42.08"W) was 3.25 km southwest of Zumpango del Río, Guerrero. *Phrynosoma taurus* is rare at this site (pers. obs.), found only on steep hills in the middle of the morning. Dominant vegetation at Zumpango del Río includes *Bursera* spp., *Acacia* spp., *Pithecellobium dulce*, and

TABLE 1. Diet of *Phrynosoma asio* from Cañón del Zopilote, Guerrero, México (N = 10).

Prey Taxon	Number of Stomachs	Number of Items	Percent of Diet	Total Volume (cm^3)	Percent of Diet by Volume
Coleoptera					
Coccinelidae	1	1	0.12	—	
Curculeonidae	2	5	0.58	0.062	0.72
Meloidae	1	2	0.23	0.042	0.49
Scarabidae	1	4	0.47	0.079	0.92
Tenebrionidae	5	13	1.52	0.493	5.71
"Larvae"	2	4	0.47	0.166	1.92
Hemiptera					
Pentatomidae	2	3	0.35	0.279	3.23
Thyrecoridae	1	1	0.12	0.136	1.58
Hymenoptera					
Formicidae					
Formycinae					
Camponotus	1	134	15.64	0.210	2.43
Myrmicinae					
Acanthognathus	1	28	3.27	0.330	3.82
Atta	1	46	5.37	0.580	6.72
Messor	1	42	4.90	1.000	11.59
Octostruma	2	167	19.49	0.896	10.38
Oligomyrmex	1	42	4.90	1.360	15.76
Pogonomyrmex	1	114	13.30	1.680	19.47
Perissomyrmex	1	2	0.23	0.014	0.16
Tetramorium	1	8	0.93	0.15	1.74
Isoptera					
Termitidae	1	240	28.00	1.020	11.82
Orthoptera					
Acrididae	1	1	0.12	0.110	1.27
Mineral	1			0.023	0.27

TABLE 2. Diet of *Phrynosoma cornutum* from Samalayuca, Chihuahua, México (N = 10).

Prey Taxon	Number of Stomachs	Number of Items	Percent of Diet	Total Volume (cm^3)	Percent of Diet by Volume
Coleoptera					
Anobiidae	1	2	0.30	0.27	2.32
Carabidae	1	2	0.30	0.42	3.62
Curculeonidae	3	6	0.89	0.90	7.75
Staphylinidae	1	1	0.15	1.00	8.61
Tenebrionidae	3	8	1.18	0.24	2.07
Hemiptera					
Coreidae	1	6	0.89	0.17	1.46
Pentatomidae	1	1	0.15	0.33	2.84
Hymenoptera					
Formicidae					
Dorilinae					
Nomamyrmex	1	84	12.44	0.5	4.30
Formycinae					
Myrmelachista	1	1	0.15	0.042	0.36
Myrmicinae					
Aphaenogaster	2	150	22.22	2.44	21.01
Messor	1	250	37.04	2.67	22.99
Octostruma	1	1	0.15	0.07	0.60
Oligomyrmex	3	54	8.00	0.83	7.15
Tetramorium	1	17	2.52	0.35	3.01
Wasmania	1	84	12.44	0.54	4.65
Vespidae	1	3	0.44	0.15	1.29
Orthoptera					
Acrididae	2	2	0.30	0.24	2.07
Grillidae	1	2	0.30	0.08	0.69
Lizard Skin	1	1	0.15	0.37	3.19

Mimosa sp.

Phrynosoma cornutum and *P. modestum* were collected at the Bolson Cabeza de Vaca, the extensive sand dune areas of northern Chihuahua (31°10' – 31°40'N, 106°13' – 107°30'W). Both species were collected opportunistically in 1997 and 1998 in June or July (7 *P. modestum*, 5 *P. cornutum*), and October (5 *P. modestum*, 5 *P. cornutum*). This area is dedicated to livestock grazing and free of agricultural cultivation. *Phrynosoma* are abundant in the sand dunes, and most specimens were opportunistically caught crossing gravel roads in late afternoon.

Lizards were collected by hand, preserved shortly after collection (initially in 10% formalin, and finally in 70% ethanol; specimens deposited in the Laboratorio de Ecología of the Unidad de Biología, Tecnología y Prototipos), measured (snout–vent length [SVL] to the nearest mm), and dissected to examine stomach contents. Diet items were identified to family where possible, and percent of prey volume for each taxa was calculated for each stomach (estimated by volumetric displacement).

Sample sizes were low (10 or 12 stomachs) for all species. In part this was because of the difficulty in collecting lizards, but also effort was made to minimize impacts on these populations. A recent rarefaction analysis suggests that samples of ≥ 10 can exhibit > 90% of a species' prey items (Winemiller et al. 2001).

The diet of *P. asio* (10 stomachs examined; all contained prey) was dominated by ants, in particular *Octostruma* sp., *Camponotus* sp., and *Pagomyrmex* sp., but non-ant insects contributed substantially to the diet (Table 1). Indeed, the most numerically important single prey item was termites because of one individual with 240 termites in its stomach. The Simpson's Diversity Index for the diet of this species was 5.96, mean Simpson's index for individuals was 1.45 ± 0.29 (range = 1–4). The only other previous report on *P. asio* diets found that about 75.3% of the diet numerically and 31.1% of the diet volumetrically were ants (Pianka and Parker 1975), which is consistent with our results.

The diet of *P. cornutum* (10 stomachs examined; all contained prey) was also dominated by ants, in particular *Messor* sp. and *Aphaenogaster* sp. (Table 2). Non-ant insects contributed volumetrically to the diet although they were relatively unimportant numerically. We also found lizard skin in one stomach. The Simpson's Diversity Index for the diet of this species was 4.45, mean Simpson's index for individuals 1.42 ± 0.17 (range = 1–2.7). Several previous studies on *P. cornutum* have demonstrated that the vast majority of their diet is made up of ants and other hymenopterans, such as velvet ants (Mutillidae) (e.g., Barbault and Maury 1981; Blackshear and Richerson 1999; Manley and Sherbrooke 2001; Pianka and Parker 1975; Whitford and Bryant 1979), as well as termites (Bott et al. 2001).

The diet of *P. modestum* (12 stomachs examined; one [8.3%] was empty) consisted almost exclusively of ants, in particular *Camponotus* sp., *Octostruma* sp., and *Messor* sp. (Table 3). Non-ant insects contributed relatively little numerically and volumetrically to the diet. We found lizard skin in one stomach, and nematodes (probably parasites) in another. The Simpson's Diversity Index for the diet of this species was 7.09, mean Simpson's index

TABLE 3. Diet of *Phrynosoma modestum* from Samalayuca, Chihuahua, México (N = 12).

Prey Taxon	Number of Stomachs	Number of Items	Percent of Diet	Total Volume (cm^3)	Percent of Diet by Volume
Coleoptera					
Curculeonidae	1	1	0.17	0.01	0.12
Meloidae	1	2	0.33	0.04	0.49
Tenebrionidae	4	5	0.83	0.39	4.74
"Larvae"	1	1	0.17	0.09	1.09
Dermaptera					
Labiidae	1	1	0.17	0.09	1.09
Hemiptera					
Coreidae	1	1	0.17	0.08	0.97
Nabiidae	1	2	0.33	0.03	0.36
Pentatomidae	1	3	0.50	0.18	2.19
Thyrecoridae	1	10	1.67	0.09	1.09
Hymenoptera					
Formicidae					
Dorilinae					
Chelyomyrmex	1	54	9.00	0.94	11.44
Formycinae					
Camponotus	1	134	22.33	0.21	2.55
Myrmicinae					
Acromyrmex	1	3	0.50	0.02	0.24
Aphaenogaster	1	45	7.50	0.50	6.08
Messor	1	103	17.17	1.27	15.45
Octostruma	2	107	17.83	1.96	23.84
Oligomyrmex	2	28	4.67	0.32	3.89
Tetramorium	3	63	10.50	0.49	5.96
Wasmania	1	30	5.00	0.16	1.95
Ponerinae					
Leptogenis	1	1	0.17	0.09	1.09
Vespidae	2	4	0.67	0.01	0.12
Lepidoptera					
"Larvae"	1	1	0.17	0.02	0.24
Lizard Skin	1	1	0.17	0.86	10.46
Nematoda	1	uncountable		0.37	4.50

for individuals was 1.35 ± 0.13 if only lizards with prey are included (range = 1–2.4), and 1.24 ± 0.16 if all lizards are included. Previous studies on the diets of *P. modestum* also found a diet of ants predominating (e.g., Barbault et al. 1978; Shaffer and Whitford 1981), although this can vary seasonally (Barbault and Maury 1981).

The diet of *P. taurus* (12 stomachs examined; two [16.6%] were empty) consisted primarily of insects (Table 4). On the basis of the number of items consumed, *Oligomyrmex* sp. was the most important; however, this numerical dominance can be attributed to a single individual with 360 *Oligomyrmex* ants in its stomach. Without this one stomach, the most important prey items were a variety of insects, including lepidopteran larvae, calliphorid flies, and scarabid beetles. The Simpson's Diversity Index for the diet of this species was 1.74, mean Simpson's index for individuals was 1.79 ± 0.35 if only lizards with prey are included (range = 1–4.5), and 1.49 ± 0.35 if all lizards are included. Pianka and Parker (1975) reported that, in *P. taurus*, ants made up 47.4% of the diet numerically and 56.5% of the diet volumetrically.

As expected, ants are an important food for all four species of *Phrynosoma* we studied. All species appeared to take other insects opportunistically, and in *P. taurus* other insect groups appeared to be at least as important as ants. Indeed, if one looks at the proportion of prey items that are ants (either numerically or volumetrically) as an index of specialization on ants, *P. taurus* has the least specialized diet, followed closely by *P. asio*. Both *P. cornutum* and *P. modestum* have very specialized diets, with about 95% of all prey items being ants. This relative ranking of ant specialization among these four species is generally consistent with results presented in Pianka and Parker (1975), although the use of ants in the diets are consistently higher in our study.

While at the species level numerous genera of ants were eaten, at the individual lizard level each stomach generally contained a single genus of ant. Such a result would be expected if horned lizards were foraging at ant colony openings or along foraging columns of ants (e.g., Munger 1984a) as opposed to haphazard encounters of single ants (e.g., Whitford and Bryant 1979). It appears that *P. asio* will also forage at the openings of termite mounds, as one individual had 240 termites in its gut. Bott et al. (2001) recently observed *P. cornutum* foraging on termite alates at the opening of a termite mound.

TABLE 4. Diet of *Phrynosoma taurus* from Zumpango, Guerrero, México (N = 12).

Prey Taxon	Number of Stomachs	Number of Items	Percent of Diet	Total Volume (cm^3)	Percent of Diet by Volume
Coleoptera					
Curculeonidae	1	1	0.20	0.04	0.34
Meloidae	1	1	0.20	0.05	0.42
Scarabidae	2	27	5.38	1.17	9.82
Tenebrionidae	3	5	1.00	0.81	6.80
"Larvae"	1	2	0.40	0.06	0.50
Diptera					
Calliphoridae	3	21	4.18	0.28	2.35
Hemiptera					
Coreidae	1	1	0.20	0.05	0.42
Cydnidae	1	8	1.59	0.65	5.45
Pentatomidae	2	7	1.39	1.01	8.47
Thyrecoridae	2	5	1.00	0.53	4.45
Hymenoptera					
Formicidae					
Myrmicinae					
Acromyrmex	1	1	0.20	0.14	1.17
Messor	1	22	4.38	0.68	5.70
Octostruma	1	1	0.20	0.01	0.08
Oligomyrmex	2	378	75.30	3.70	31.04
Solenopsis	1	1	0.20	0.02	0.17
Lepidoptera					
"Larvae"	4	17	3.39	1.66	13.93
Orthoptera					
Acrididae	3	3	0.60	0.24	2.01
Gryllacrididae	1	1	0.20	0.82	6.88

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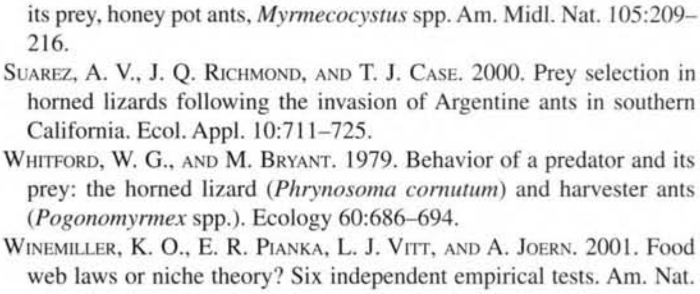

Liochlorophis (= *Opheodrys*) *vernalis* (Smooth Greensnake). USA: Indiana: Lake County. Photolithograph by Will Brown.

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Food Habits of *Eleutherodactylus parvus* (Anura: Leptodactylidae) at an Atlantic Rainforest Area, Southeastern Brazil

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The leaf litter on the floor of tropical forests harbors a diversity of invertebrates and vertebrates, these latter being mainly small reptiles and amphibians (Vitt and Caldwell 1994). In these habitats, the abundance and variety of food resources seem to influence the anuran community, as has been found for litter frogs in Panama and Peru (Toft 1980a,b). Several studies found a relationship between body size and prey size of litter anurans, where the differential use of prey by individual species seemed to correlate with the snout–urostyle length (SUL) of frogs, thus favoring resource partitioning (Caldwell 1996; Lima and Moreira 1993; Toft 1980b, 1981, 1995; Vitt and Caldwell 1994). Anurans do not chew their food and thus they are limited to eating prey that fits in their mouths, and this may cause a shift in prey size simply because the mean sizes of individual arthropod prey differ among orders (Lima and Moreira 1993). Based on her studies, Toft (1980a,b) categorized leaf-litter leptodactylid frog species as "non-ant specialists" because their diets consisted predominantly of soft-bodied, mobile arthropods such as crickets and large spiders.

The anuran genus *Eleutherodactylus*, family Leptodactylidae, is the most speciose (over 500 species) among amphibians (Lynch 1996). These frogs are common inhabitants of the leaf litter floor in tropical forests of Central and South America and the West Indies (Lynch 1996). *Eleutherodactylus* species typically are carnivorous, feeding mainly on arthropods (Duellman 1978; Ovaska1991; Toft 1980a,b).

Eleutherodactylus parvus occurs in forest floor litter communities in the Atlantic Rainforest of the states of Rio de Janeiro and São Paulo in southeastern Brazil (Haddad and Sazima 1992). In the litter anuran community in the Atlantic Rainforest of Ilha Grande, south of Rio de Janeiro State, *E. parvus* is one of the most common species found (Rocha et al. 2001). Despite being a common species, previous research on *E. parvus* has focused on morphology, systematics, or biogeography (Haddad and Sazima 1992; Heyer et al. 1990; Lynch 1976); no information is available on aspects of its ecology. In this study we analyzed the diet of *E. parvus*, specifically addressing the following questions: i) What is the diet composition of this species? ii) To what extent do males and females differ in their diets? and iii) What is the relationship between frog size and prey size?

The study was carried out in a remnant of undisturbed Atlantic Rainforest at Ilha Grande (23°11'S, 44°12'W; 240 m above sea level), Rio de Janeiro State, southeastern Brazil. This is the largest island (19,000 ha) on the Rio de Janeiro coast and is covered by Atlantic Rainforest in different levels of regeneration (Rocha et al. 2000). Annual rainfall in the area is ca. 1700 mm and the mean annual temperature is ca. 23°C (Rocha et al. 2001).

Frogs were collected monthly between August 1996 and October 1997, in 2 x 1 m plots, randomly established on the forest floor. Additional frogs were collected in the same area in 8 x 8 m plots, also randomly established (see Rocha et al. 2001, for a detailed description of sampling methods). We recorded snout–urostyle length (SUL) and jaw width (JW) to the nearest 0.1 mm using a caliper. Difference in SUL between sexes was tested using one-way ANOVA (Zar 1999).

Diet composition and trophic diversity were analyzed in 62 individuals (44 females, 18 males) using a stereomicroscope and based on prey found in the stomachs. The prey items were identified to the taxonomic level of Order or Family (in the case of Formicidae), counted, and measured in three dimensions with a digital caliper (0.1 mm precision) to estimate their volume (Schoener 1967). All insect larvae were grouped as a single prey category. The mean length of the five longest items and the mean

TABLE 1. Frequency (number and % of frogs containing a particular prey type), N (total number and % of each item found in the frog stomachs), and volume of prey types (mm^3 and % of total volume) found in the stomachs of *Eleutherodactylus parvus* (N = 62) in the Atlantic Rainforest area of Ilha Grande, RJ, Brazil.

Item	Frequency (%)	N (%)	Volume (%)
Orthoptera	6 (9.7)	6 (3.1)	39.5 (10.4)
Collembola	7 (11.3)	11 (5.6)	2.1 (0.6)
Hymenoptera	1 (1.6)	1 (0.5)	0.2 (0.1)
Formicidae	26 (41.9)	97 (49.5)	45.6 (12.0)
Diptera	2 (3.2)	2 (1.0)	4.1 (1.1)
Blattaria	2 (3.2)	2 (1.0)	32.4 (8.5)
Coleoptera	4 (6.4)	4 (2.0)	8.5 (2.2)
Homoptera	1 (1.6)	1 (0.5)	14.4 (3.8)
Hemiptera	4 (6.4)	5 (2.5)	9.5 (2.5)
Insect Larvae	8 (12.9)	10 (5.1)	8.0 (2.1)
Isopoda	11 (17.7)	12 (6.1)	61.9 (16.2)
Araneae	12 (19.3)	12 (6.1)	62.4 (16.4)
Acari	13 (21.0)	26 (13.3)	3.4 (0.9)
Pseudoescorpionida	1 (1.6)	1 (0.5)	0.3 (0.1)
Diplopoda	3 (4.8)	3 (1.5)	13.2 (3.5)
Chilopoda	2 (3.2)	2 (1.0)	4.3 (1.1)
Arthropod remains	—	—	71.4 (18.7)
TOTAL	—	196 —	381.8 —

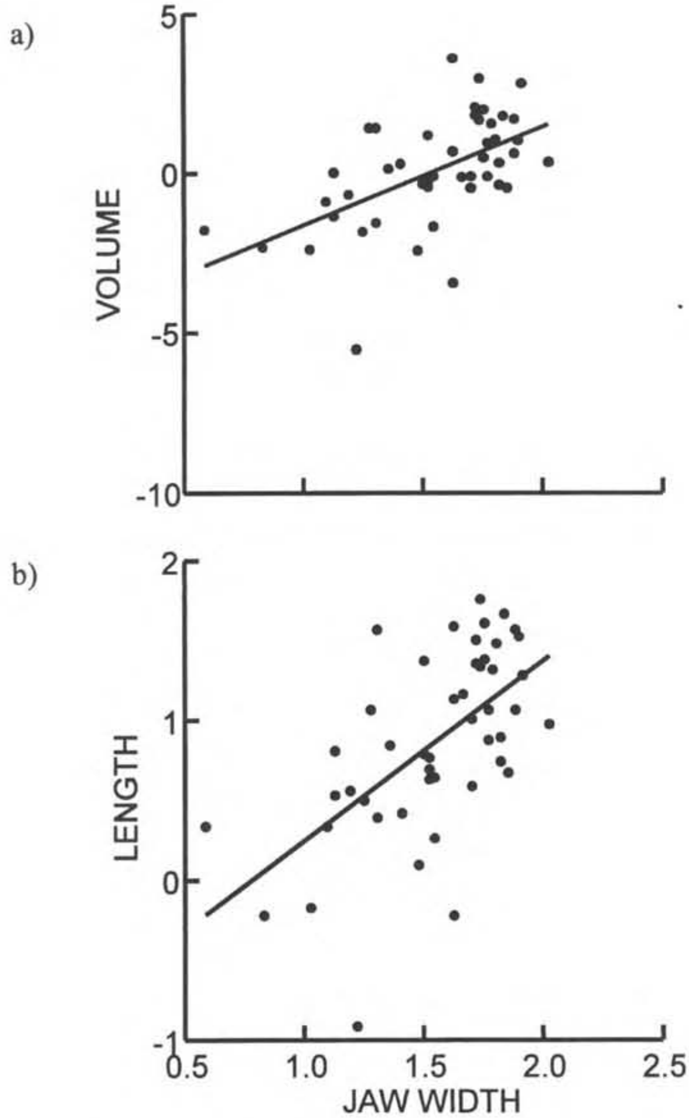

FIG. 1. Relationship between frog jaw width (in Log) and (a) mean volume of the five largest prey items (in Log) and (b) mean length of the five longest prey items ingested by *Eleutherodactylus parvus* (N = 62) at Ilha Grande, RJ, Brazil. ($F_{volume} = 19.44$; $R^2 = 0.30$; $P < 0.001$; $y = 1.10 + 0.69x$) ($F_{length} = 25.14$; $R^2 = 0.36$; $P < 0.001$; $y = 0.36 + 0.22x$).

volume of the five largest items were compared between sexes using the Mann-Whitney U test (Zar 1999). We calculated trophic diversity for adult males and females using Shannon-Wiener (H') index of diversity (Zar 1999) based on numeric percentages of prey types. Sexual differences in diet were compared using the t-test of Hutcheson (Zar 1999). We considered as adult males those frogs larger than 15 mm, the smallest body size of four *E. parvus* found calling at Ilha Grande Rainforest (unpubl. data) and as adult females, those larger than 17 mm, the smallest body size we found for 13 reproductive females (unpubl. data). To evaluate if items consumed by these frogs were size-limited and influenced by sex, we related mean volume of the five largest items and mean length (both log-transformed) of the five largest prey items consumed by each individual to the frog jaw width (log-transformed) using simple linear regression (Zar 1999).

Adults of *E. parvus* are sexually dimorphic in SUL, females (mean = 18.1 ± 0.6 mm, N = 13) being larger than males (mean = 15.4 ± 0.2 mm, N = 6) (t = 15.48; df = 18; $P < 0.001$). We found no significant ($P > 0.05$) difference in the mean length of the five largest items (U = 312.5) and mean volume of the five largest preys (U = 313.0) between males and females. Trophic niche diversity for males (H' = 0.747) and females (H' = 0.775) did not differ statistically (t = 0.317; df = 100; $P > 0.05$). For this reason we analyzed the diet for both sexes together.

Thirteen of the 62 individuals analyzed had empty stomachs. We found 15 prey types in *E. parvus* diet (considering all insect larvae together; Table 1). The most frequent items were Hymenoptera-Formicidae (41.9% of the stomachs analyzed), Acari (21%), Araneae (19.3%), and Isopoda (11.7%). Ants and mites were the most numerous (49.5% and 13.3% of the total items found, respectively) prey types consumed. In terms of volume, the most representative items were Araneae (62.4 mm^3, 16.4%), Isopoda (61.9 mm^3, 16.2%) and Formicidae (45.6 mm^3, 12.0%). Plant remains were found in only four (6.4%) of the frogs analyzed, being usually small fragments of dead leaves probably ingested incidentally during the capture of prey. As a result, we did not include these items in the diet estimation.

The relationship between jaw width and mean volume of the five largest items ($R^2 = 0.30$, $F_{1,45} = 19.44$) and mean length of the five largest prey items ($R^2 = 0.36$, $F_{1,45} = 25.14$) were both statistically significant ($P < 0.001$; Fig. 1).

At Ilha Grande, *E. parvus* fed exclusively on arthropods. Ants were the most frequent and numerous prey item and, together with mites, spiders, and isopods they seem to constitute important prey groups to maintain the *E. parvus* population at the studied area. Ants are common in the leaf litter arthropod community sampled in the same area (M. B. Vecchi, pers. comm.). Ant eating is known for several *Eleutherodactylus* species, in different frequencies (Duellman 1978; Ovaska 1991; Stewart and Woolbright 1996; Toft 1980b; 1981).

Spiders and isopods were the largest items found in the stomachs, and these prey types are relatively non-chitinous in relation to their body size, non-toxic, mobile, and cryptic (Toft 1980b) and, according to the categories created by Toft (1980b), *E. parvus* should be considered a "non-ant specialist" species, because of the ingestion of these prey types in large frequencies. But we have no data on selectivity of prey by *E. parvus*, and because ants were the most frequent item in the diet, we are not able to fit this frog into one of Toft's categories.

Our data show that the SUL of *E. parvus* affects the size of the ingested prey (by prey volume and length). This result is expected for predators which do not chew their prey and are further limited by gape size (Lima and Moreira 1993; Van Sluys et al. 2001). Prey size increases with increasing frog body size, a trend also found for *E. coqui* and other anurans (Woolbright and Stewart 1987 cited in Ovaska 1991).

Considering the broad range of prey types, we conclude that *E. parvus* is a carnivorous predator in the leaf-litter microhabitat, its diet being composed exclusively by arthropods.

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Natural History and Reproductive Behavior of *Nyctibatrachus cf. humayuni* (Anura: Ranidae)

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The genus *Nyctibatrachus* Boulenger 1882 (family Ranidae) is endemic to the Western Ghats mountain chain of southwestern India, and comprises ten described species (Dutta 1997; Krishnamurthi et al. 2001). Species of *Nyctibatrachus* are found mainly in the rocky streams of montane and submontane evergreen and semi-evergreen forests. Apart from taxonomic descriptions and distributional records there is little information on these frogs and the observations reported herein are the first accounts of natural history and reproductive behavior of any *Nyctibatrachus* species.

I observed *Nyctibatrachus cf. humayuni* at various localities (elevational range 75–300 m) in the states of Goa and Karnataka in southern India, but mainly between Castle Rock and Dudhsagar (15.41°N, 74.33°E to 15.35°N, 74.3°E). Annual precipitation here is 3000–5000 mm. The main rainy season, resulting from a southwest monsoon, is from June to September. There are a few showers from a northeast monsoon in November and early December. The forest is semi-evergreen and evergreen, ca. 15–25 m tall, and undergrowth is thick. Numerous small streams cut through these forests, often forming steep rocky watercourses with abundant overhanging vegetation. These streams are the natural habitat of this frog and the overhanging vegetation provides oviposition sites.

My observations span monsoonal seasons over a five-year period (1997–2001). During my study I captured individual frogs on first sighting, recorded snout–vent lengths (SVLs) to the nearest 0.1 mm using a vernier caliper, and noted sex. I marked each individual by fixing a narrow, uniquely colored strip of balloon around the waist and released each frog at point of capture. Marking with balloon strips did not seem to harm the frogs or disrupt their activities. Marked frogs neither abandoned their calling posts nor stopped vocalizing. Moreover, they seemed to attract females and fertilize eggs just as efficiently as they did before marking. I measured mating success of males (Fig. 3) over a period of 8 nights in the years 1998 and 2001 (total 16 nights). I considered only neighboring males to make direct comparisons meaningful, and excluded very old egg-clutches from male territories for this analysis because they could have been fertilized by other males in cases of territory takeovers. During the nights of direct observations I counted new clutches fertilized by territorial males. Therefore,

although my measurements might be slight underestimates, they are corrected for temporal (number of days the males were observed) and spatial (micro-spatial variation in mating success) biases.

I collected all the marked frogs from 1998 and 1999 and preserved them in 10% formaldehyde solution when field observations were terminated. Hemant Ghate in the Department of Zoology, Modern College, Pune, is currently studying the taxonomic status of *N. cf. humayuni*. Morphometric measurements and certain behavioral details pertaining to individual frogs observed in the field are described elsewhere (Kunte 2001).

Sexual dimorphism.—Sexes in *N. cf. humayuni* are subtly dimorphic. SVL of calling adult males was 42.08 ± 3.24 mm (range 32–47 mm; N = 29) and that of adult females, 41.42 ± 2.61 mm (range 37–45.5 mm; N = 15). Males lack the nuptial pads which are present in many male anurans; I attribute their absence to the lack of amplexus. Only adult males had femoral glands colored pale orange to bright orange or pink. Males also had larger toe-discs as compared to females. Toe-discs are known to offer firm hold on smooth substrates, such as leaves. Therefore, larger toe-discs of males probably help them hold onto smooth leaves during the extended vocalization periods.

Vocalization.—Breeding activity commenced by the end of May or early June at the onset of the southwest monsoon and continued until mid-September. Thereafter, occasional rains and the northeast monsoon triggered short spurts of breeding. Males vocalized throughout the breeding season. The vocalizations began at dusk. The call was a soft and melodious, prolonged note—OORRsss—with an occasional faint "OA" preceding the call. Males vocalized with an average frequency of 6 calls/min. They perched at a height of up to 1 m on leaves overhanging flowing water of forest streams. When overhanging vegetation was absent they positioned themselves on slanting moss-free faces of wet rocks flanking the streams.

Vocalization continued until ca. 2130–2200 h. Then some of the males stopped vocalizing while others vocalized less frequently or occasionally. The males foraged afterwards, as evidenced by gut contents of males that had been vocalizing for as long as 8 nights. After foraging, the males took refuge before dawn in crevices or under rocks.

Territoriality.—Males maintained large territories in which oviposition took place. An individual territory consisted of suitable calling posts on over-hanging vegetation or moss-free rock and the underlying portion of the stream. The average inter-male (between calling posts) distance was 7.92 ± 3.28 m (N = 32), with a mode at 5 m (N = 11). A minimum distance of 5 m was always maintained between two calling posts. The calling posts later served as oviposition sites.

Territories were exclusive, in which only one calling male reigned. In two instances new males replaced the territorial males; in both occurrences larger males seemed to have dominated (Kunte 2001). Adult males not engaged in reproductive activities were never seen close to territories of calling males. It is possible that these males have short non-reproductive spells of a few days or weeks during which they forage away from the territorial males, gain weight or mass and later replace territorial males. My search for silent satellite males, which associate themselves with calling territorial male frogs and intercept gravid females (Arak 1988; Bourne 1993; Howard 1978), did not reveal any in *N. cf. humayuni*.

Egg-laying.—I observed seven complete egg-laying sequences. The following was a standard egg-laying process. Males vocalized usually from leaves ca. 10–100 cm above flowing water 2–30 cm deep. Observations on marked females revealed that females foraged in the territories of several males, which probably provided them time and opportunity to rank males and their territories. When a female was ready to lay a clutch of eggs she climbed to the spot from where a chosen male had been vocalizing. The male vocalized with slightly higher frequency of calling when the female approached. The male moved a few centimeters away from its calling post when the female approached but continued vocalizing. The female reached the exact original calling post and deposited eggs. If the female laid part of her clutch in another spot, it was always the second spot to which the calling male had shifted upon the female's arrival. Thus, the male, rather than the female, determined oviposition sites, with the female laying eggs exactly at the spot from where the male had been calling. There was no amplexus or any physical contact between the sexes (however, in another egg-laying sequence I observed 'pseudo-amplexus.' This preceded oviposition by 5 min and therefore did not serve the pur-

FIG. 1. This figure shows oviposition behavior and lack of amplexus in *Nyctibatrachus cf. humayuni*. The female to the right was laying eggs without the male being in amplexus while another gravid female waited beside it (note the bulging abdomen). The male on the lower part of the leaf was waiting for the female to finish oviposition, it fertilized the eggs after the female left. Note the old clutch at an advanced stage of development beside the male. Egg-clutches fertilized by a male are often clumped. Also note much larger toe-discs and thicker digits of male as compared to the females.

pose of fertilization [Kunte 2001]). Vocal communication on the part of the female was not perceptible. After laying its clutch, the female immediately entered the water and moved away. The male then stopped vocalizing and positioned itself over the eggs to enable fertilization. For the same purpose, sometimes the male also moved a little over the clutch, seemingly ensuring that all the eggs received sperm. When it had released semen the male resumed vocalization within a few minutes from a different post only a few centimeters away from the freshly laid eggs, often on the same leaf. On successive nights the male continued vocalizing from the new post until another female visited. Thus, eggs laid by different females but fertilized by the same male tended to be spatially clumped on the same leaf or on neighboring leaves on the same branch (Fig. 1).

Clutch size, fertilization success, hatching success, and multiple clutching.—I observed a total of 1937 eggs comprising 85 clutches. Egg diameter at the time of oviposition was 2.5–3 mm (N = 15, from 3 clutches). Clutch size ranged from 10 to 55 eggs, with a median of 21 and mean of 22.79 ± 8.84 eggs (Fig. 2). Fertilization success in all 85 clutches was 100%. The length of the egg stage in the developmental process was approx. 12–15 days. When tadpoles were ready to hatch they wriggled violently in the egg-jelly, which burst, releasing the tadpoles. The ejected tadpoles fell in the flowing water below where they fed at the bottom close to the banks. I did not observe any pre-hatching mortality; tadpoles from over 700 eggs (ca. 30 observed clutches) ejected out of the jelly capsules successfully.

Six females were dissected for ovarian examination. Females preserved 1–4 days post-oviposition had a new batch of eggs developing in their ovaries; these would have matured in 10–15 days. Females that were caught close to calling males had a batch of eggs ready to be laid and yet another batch developing, which would have been ready after 10–15 days. It is evident, therefore, that females lay a minimum of two clutches. Judging from the prolonged breeding season of this species and assuming that eggs are produced throughout the breeding season, females can potentially produce as many as 6 egg-clutches per breeding season.

Male mating success and sexual dimorphism.—Most of the calling males were successful in obtaining at least one but typically multiple matings (Fig. 3). As a consequence, variance in reproductive success of male *Nyctibatrachus* might not be as high as in those species in which a few males monopolize all matings (Cherry 1993; Table 3.3 in Duellman and Trueb 1986). Also, many individual females possibly laid multiple clutches in a season. Hence, it would be interesting to work out reproductive success of both sexes in this species, which will perhaps be comparable. Thus, low variance in reproductive success of males and comparable fitness of both sexes may be the two reasons why sexes are similar in size, and only subtly dimorphic, in *Nyctibatrachus*.

The reproductive biology of *N. cf. humayuni* has remarkable features. Of particular interest is the lack of amplexus. In anurans amplexus has been considered an adaptive behavior that facilitates juxtaposition of cloacae of male and female during oviposition, which is important for success in external fertilization (Duellman and Trueb 1986). The total lack of amplexus has so far been reported only in Central and South American arrow-poison frogs (family Dendrobatidae) (Crump 1972; Limerick 1980) and Darwin's frog (*Rhinoderma darwinii*) (Busse 1991). These frogs

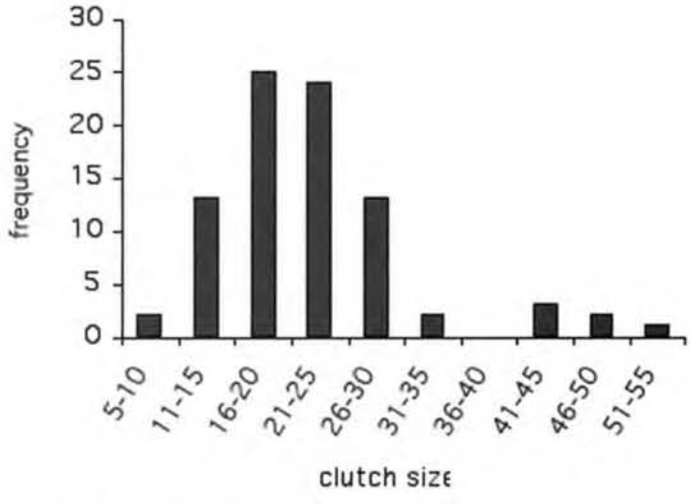

FIG. 2. Clutch size in *Nyctibatrachus cf. humayuni.*

have a different set of reproductive behaviors and life history traits as compared to *N. cf. humayuni.* For example, dendrobatids usually lay less than half a dozen eggs (some species, just one), and exhibit parental care unlike *Nyctibatrachus*. Darwin's frogs also have parental care. Interestingly, despite the evolutionary advantages usually attributed to the presence of amplexus, *Nyctibatrachus* has achieved 100% fertilization success in its total absence. Loose, abbreviated, or otherwise crude forms of amplexus are reported in many anurans, e.g., in *Discoglossus* (Knoepffler 1962) and Madagascan *Mantidactylus* (Blommers-Schlösser 1975) and *Mantella* (Arnoult 1966; Heying 2001). Therefore, *Nyctibatrachus* is only the third anuran group in which amplexus is totally absent and the first record of such a frog from the Old World.

Another notable feature of the breeding biology of this species is the nature of oviposition sites and clutch sizes. *Nyctibatrachus* is among the rare anurans that deposit eggs outside water—on ground or vegetation but not in a foam-nest, and whose larvae drop into water when they hatch (other examples in Duellman and Trueb 1986). Many of these species lay small clutches of large eggs. Central and South American glass frogs (family Centrolenidae) have similar breeding habits to *Nyctibatrachus*,

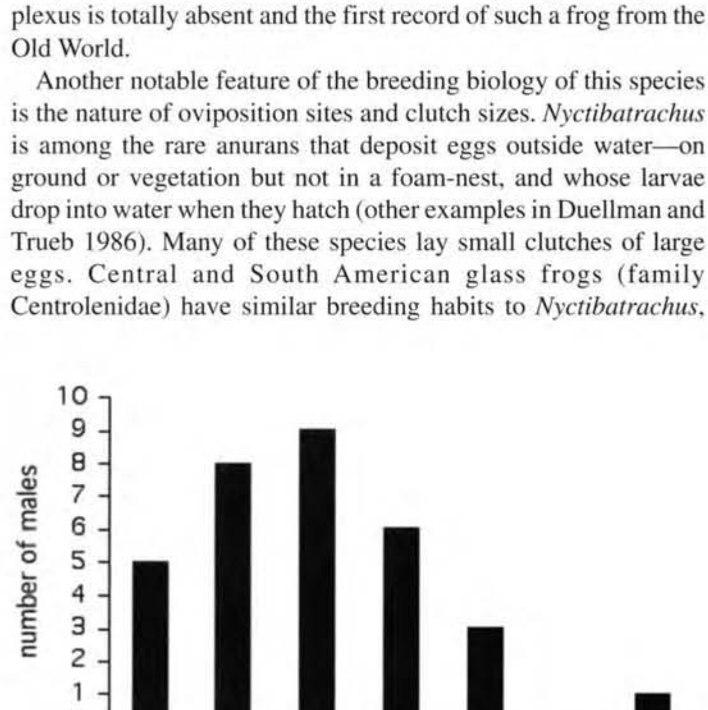

FIG. 3. Mating success of male *Nyctibatrachus*. Most males get at least one, typically multiple, matings.

although they have amplexus and parental care (Mc Diarmid 1978). *Phyllomedusa* and related genera (Kenny 1966; Vaira 2001) also have similar eggs, clutch sizes, and oviposition sites. It would be interesting to compare reproductive behaviors and mating success of these frogs.

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The Origins of the Anuran Interdigital Webbing Formula

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An established and useful part of anuran descriptions is the webbing formula, which expresses the extent of the webbing between fingers and toes in a standardized manner. This formula enumerates those phalanges which are free of webbing, rather than those which are webbed; this obviates the problem of whether to include metacarpals and metatarsals in the count of "phalanges." The development of the formula for expressing interdigital webbing has an interesting history, and its origin has often gone unacknowledged.

Many early authors used descriptors such as "¼ webbed" or "½ webbed." The major drawback to this system is that it requires a subjective assessment of the extent of the webbing, there being no clear, objective criteria upon which the fractions are based.

Edwards (1974) developed a formula which enumerated the number of phalanges which are covered by webbing. This system was used to describe webbing in *Colostethus* by La Marca (1985, 1997).

Loveridge seems to have been the first to quantify the extent of the webbing by enumerating the phalanges that are free of webbing. Loveridge (1933, p. 90) described the toes of *Glauertia* [*Uperoleia*] *russelli* as: "...strongly webbed, at most a single joint free with the exception of the fourth which has three joints free...." This method was elaborated upon in later work; "...of its toes only the first has a single joint free, the second, third and fifth are webbed to the disks on at least one side, the fourth has one and a half (right) to 2 (left) joints free of web" (Loveridge 1941, p. 129). Loveridge used "joint" as the equivalent of phalanx. Although Loveridge's descriptive method is useful and objectively quantifiable, no notation formula was established.

Rivero also described webbing using the number of free phalanges, but in his method "...the fingers and toes are placed close together and the extension of the webbing is determined by considering the middle, not the margins, of the membrane" (Rivero 1961, p. 15). Although Rivero stated that "Loveridge's system of measuring the amount of webbing by giving the number of free phalanges has been adopted here...." (*ibid*, p. 15), Rivero's system departs from Loveridge's in that Loveridge measured webbing by counting the number of free phalanges ("joints") to the point of contact between web and digit, while Rivero counted free phalanges to a point corresponding to the deepest emargination of the webbing between adpressed digits. An example of Rivero's notation is "...toes taken in order from first to fifth exhibit the following phalanges free of web: 1⅔, 1, 1½, 2½ to 3, 1 to 1¼;..." (*ibid*, p. 106). Although it is not explicitly stated, Rivero seems to offer a range of variation in the extent of the webbing, but makes no distinction between the inner and outer sides of the toes.

Savage and Heyer (1967) established a formula similar to that

which is widely used today. The formula is based on a phalanx numbering system in which "...A notation of 0 indicates that the web reaches the base of the finger or toe disk, 1 indicates that the web reaches the base of the terminal phalanx" (*ibid*, p. 116). Savage and Heyer clearly stated that "The position of the web was determined by the point of union with the digit, excluding narrow fleshy fringes on the digits..." The use of "+" and "–" in superscript position, representing the proximal and distal ends of the subarticular tubercles respectively, was also premiered in this paper. The following was used as an example of the formula (*ibid*, p. 116): "I 2–2,5 II 2^-–3^- III 2^+–2^- IV 3–3^- V." The same technique was used in subsequent papers (e.g., Savage 1968; Savage and Heyer 1969), although fractions rather than decimals were used to indicate the number of free phalanges (i.e., 2½ rather than 2,5).

Myers and Duellman (1982) modified this notation somewhat, by combining Savage and Heyer's "0" and "1" notations into a single "1" representing the terminal phalanx, inclusive of the disc. The "0" was reserved "...for those frogs in which the webbing extends to the very tip of a digit...." (*ibid*, p. 6, footnote). This formula was further refined by Savage and Heyer (1997). Myers and Duellman also modified the Savage and Heyer formula by using boldface for the Roman numerals. Myers and Duellman also pointed out that "....there is an element of subjectivity. Determining degree of webbing sometimes amounts to assigning a point on a smooth curve, as when a deeply emarginate web curves up to join a fringed digit near its tip." (*ibid*, p. 6, footnote). When modern publications credit the technique of webbing notation formula, it is Myers and Duellman (1982) that is typically cited.

However, a method to describe webbing by enumerating the number of phalanges which are free of webbing had been used previously by Guibé and Lamotte (1955a, 1957). In these publications the notation was not written on a single line of text, but as shown below (from Guibé and Lamotte 1957, p. 959):

I	II		III		IV		V
	int.	ext.	int.	ext.	int.	ext.	
2	2½	1	3	1	2	2	1

The notation is accompanied by a drawing of the foot, showing that the system of numbering phalanges is the same as that used by Myers and Duellman (1982). The notation is accompanied by an explanation in the text, e.g.: "The webbing....leaves the following numbers of phalanges free on each toe..." (Guibé and Lamotte 1957, p. 959).

There is no evidence that Guibé and/or Lamotte used the notation before 1955. In earlier papers (e.g., Guibé and Lamotte 1953) webbing was described in the text by listing the numbers of free phalanges on each toe in a fashion similar to that employed by Loveridge (1941).

The webbing notation was used inconsistently in subsequent publications by Guibé and/or Lamotte. For example, Guibé (1960), Guibé and Lamotte (1955b), and Lamotte (1967) used the notation, but Guibé (1973) and Guibé and Lamotte (1958, 1960, 1961) provided only a verbal description of the extent of the webbing, with illustrations. One interesting modification was the adaptation of the notation to compare the webbing of two or more taxa (Guibé and Lamotte 1955b, 1957; Lamotte 1967).

Lescure (1975), in his description of *Colostethus degranvillei*, used a formula based on Guibé and Lamotte (1957). Lescure (1975) refined Guibé and Lamotte's notational system by condensing the information to a single line of text; "....I 1–2 II 1½–3 III 2–4 IV 4–2½ V...." (*ibid*, p. 414). Lescure's use of the formula is very similar to the Myers and Duellman (1982) modification of Savage and Heyer (1967), the only difference being that the Roman numerals are not in boldface. Lescure (1975, p. 414) describes the webbing formula as: "... counting free phalanges, including the disc-bearing [phalanx], on each side of the digits [which are] numbered in Roman numerals...." As well as citing Guibé and Lamotte (1957) as the source of this technique, Lescure also states that the method is "...preferable to that of Rivero (1961) which I have been using previously. Toes [of specimens], which are often adpressed and rigid, prevent the accurate determination of the height of the middle of the webbing membrane." (p. 414, footnote). Lescure also used the same formula in subsequent publications (e.g., Lescure 1981). At no time did Lescure or Guibé and Lamotte use the "+" and "–" modifiers to indicate the point of contact relative to the position of the subarticular tubercles; this usage must be attributed to Savage and Heyer (1967).

Guibé and Lamotte have received little credit for the development of their notational system. This might be because the seminal paper was published in a journal which is not widely available. Furthermore, because even its originators did not utilize it consistently, it is perhaps not surprising that the scheme devised by Guibé and Lamotte was not widely accepted.

The system to describe interdigital webbing was devised as a notation by Guibé and Lamotte (1955a) and as a formula by Savage and Heyer (1967), independently. The former was refined by Lescure (1975), the latter by Myers and Duellman (1982). Whereas the work of Savage and Heyer (1967), as refined by Myers and Duellman (1982) and Savage and Heyer (1997), has been widely used and cited, Guibé and Lamotte's work suffered from inconsistent usage. Nonetheless, since Guibé and Lamotte (1955a) is the earlier date, this publication may be credited as the first use of a notation which enumerates free phalanges on either side of each toe.

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TECHNIQUES

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The Use of Polystyrene for Drift Fence Sampling in a Tropical Forest

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Drift fences used with pitfall and/or funnel traps are a standard field technique used to sample amphibian and reptile communities (Campbell and Christman 1982; Corn 1994). Drift-fence sampling is effective in collecting large numbers of animals in a relatively short period of time (Gibbons and Semlitsch 1981; Rodda et al. 2001).

A variety of materials have been used for drift fences, but aluminum flashing is the best choice for long-term studies because of its durability (Gibbons and Semlitsch 1981). Aluminum flashing is expensive and often is not feasible for short-term inventory studies that do not have a large budget. Polyurethane has been used for drift fences to study amphibian reproductive biology by encircling breeding ponds (Douglas 1979).

Enge (1997) proposed the use of silt fencing as an alternative. Silt fencing is a woven polypropylene material that is about one-third the cost of aluminum flashing and is particularly desirable when sampling hydric environments. Silt fencing can also be used in terrestrial habitats. Zug et al. (2001) report the use of silt fencing for monitoring amphibian and reptile populations at a tropical site in Myanmar and one of us (JHM) has used silt fencing for short-term sampling (2–3 months) of herpetofaunal communities in the Edwards Plateau of Texas.

In the tropics, where "common species are rare and rare species are common" (Forsyth and Miyata 1984), drift-fence sampling might be an effective technique to sample amphibian and reptile species, yet little data are available (but see Brown et al. 1996; Zug et al. 2001). In the United States aluminum flashing and silt fencing are both readily available, but elsewhere, particularly in the tropics, this may not be the case. Furthermore, the cost of importing aluminum flashing or silt fencing via air carrier might be exceedingly high because of the weight of the material. Another problem with drift fencing in wet tropical forest is the high rate of treefalls (Brokaw 1996). Treefalls can destroy aluminum or silt-based drift fencing and require considerable effort to repair (pers. obs.). Therefore, for drift fence sampling to be convenient and feasible in a tropical forest, the material must be available, affordable, and the drift fence should be repairable in a modest amount of time. As an alternative to aluminum flashing and silt fencing, we herein describe the use of polystyrene to construct drift fences

pus novemcinctus) is known to consume *V. stiatula* (Breece and Dusi 1995. *In* Montgomery [ed.], The Evolution and Ecology of Armadillos, Sloths, and Vermilinguas. Smithsonian Inst. Press, Washington. 451 pp.). The only record concerning avian predation on *V. striatula* that I am aware of involves the Eastern Screech Owl (*Otus asio*; Gehlbach and Baldridge 1987. Oecologia 71:560–563).

On 2 December 2002 at 1130 h, air temperature 13°C, I observed a Northern Mockingbird (*Mimus polyglottos*) holding a *V. striatula* in its beak. The event took place in the yard of a rural farmhouse 4.6 km (air) N of Waverly, in Chambers Co., Alabama, USA. The bird was grasping the snake by the tail, immediately posterior to the vent. Upon my approach, the bird flew from the stone terrace where it was perched and sought refuge behind dense shrubbery. When I saw the bird again, it had dropped the snake at its feet and took flight when I came within 4 m of it. At this point I collected the snake, which was entirely limp with the exception of an occasional twitch of its head. The subcaudal portion of the snake was bloody, and there was a single wound at mid-body. These injuries were presumably inflicted by the bird's beak. Additionally, I noted a slight abrasion on the snake's head and assume that the bird had subdued its prey by thrashing it against the stonework.

The snake (AUM 35662) is female, 197 mm SVL, 225 mm TL, and 3.4 g. The Northern Mockingbird is characterized as omnivorous, and is known to take *Anolis* lizards (Derrickson and Breitwisch 1992 *In* Poole et al. [eds.], The Birds of North America, No. 7, Northern Mockingbird (*Mimus polyglottos*), pp. 1–26. American Ornithological Union, Washington, D.C. and the Academy of Natural Sciences, Philadelphia, Pennsylvania). I believe this to be the first record of ophiophagy by *M. polyglottos*.

Thanks to S. M. Boback, and C. Guyer for constructive comments.

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GEOGRAPHIC DISTRIBUTION

Herpetological Review publishes brief notices of new geographic distribution records in order to make them available to the herpetological community in published form. Geographic distribution records are important to biologists in that they allow for a more precise determination of a species' range, and thereby permit a more significant interpretation of its biology.

These geographic distribution records will be accepted in a **standard format** only, and all authors *must* adhere to that format, as follows: SCIENTIFIC NAME, COMMON NAME (for the United States and Canada as it appears in Crother 2000. *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding*. SSAR Herpetol. Circ. 29:1–82, available online at <http://herplit.com/SSAR/circulars/HC29/Crother.html>; for Mexico as it appears in Liner 1994, *Scientific and Common Names for the Amphibians and Reptiles of Mexico in English and Spanish*. Herpetol. Circ. 23:1–113), LOCALITY (use metric for distances and give precise locality data), DATE (day-month-year), COLLECTOR, VERIFIED BY (*cannot* be verified by an author—curator at an institutional collection is preferred), PLACE OF DEPOSITION (where applicable, use standardized collection designations as they appear in Leviton et al. 1985, *Standard Symbolic Codes for Institutional Resource Collections in Herpetology and Ichthyology*, Copeia 1985[3]:802–832) and CATALOG NUMBER (required), COMMENTS (brief), CITATIONS (brief), SUBMITTED BY (give name and address in full—spell out state or province names—no abbreviations).

Some further comments. This geographic distribution section does not publish "observation" records. Records submitted should be based on preserved specimens which have been placed in a university or museum collection (private collection depository records are discouraged; institutional collection records will receive precedence in case of conflict). A good quality color slide or photograph may substitute for a preserved specimen *only* when the live specimen could not be collected for the following reasons: it was a protected species, it was found in a protected area, or the logistics of preservation were prohibitive (such as large turtles or crocodilians). Color slides and photographs *must* be deposited in a university or museum collection along with complete locality data, and the color slide catalog number(s) must be included in the same manner as a preserved record. Before you submit a manuscript to us, check Censky (1988, *Index to Geographic Distribution Records in Herpetological Review: 1967–1986*; available from the SSAR Publications Secretary) to make sure you are not duplicating a previously published record. The responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extensions unless a thorough literature review has been completed.

Please submit any geographic distribution records in the **standard format only** to one of the Section Co-editors: **Alan M. Richmond** (USA & Canadian records only); **Jerry D. Johnson** (Mexico and Central America, including the Caribbean islands); **Hidetoshi Ota** (all Old World records); or **Gustavo J. Scrocchi** (South American records). Short manuscripts are discouraged, and are only acceptable when data cannot be presented adequately in the standard format. **Electronic submission of manuscripts is required** (as Microsoft Word or Rich Text format [rtf] files, as e-mail attachments). Refer to inside front cover for e-mail addresses of section editors.

Recommended citation for new distribution records appearing in this section is: Schmitz, A., and T. Ziegler. 2003. Geographic distribution. *Sphenomorphus rufocaudatus*. Herpetol. Rev. 34:385.

CAUDATA

AMBYSTOMA TIGRINUM MELANOSTICTUM (Blotched Tiger Salamander). USA: SOUTH DAKOTA: ROBERTS CO.: wetland adjacent to South Dakota Hwy 25, ca. 1.6 km W Hammer (45°50' 55.6"N; 97°02' 21.3"W). 8 September 2003. Laurs Bryan Williams. Verified by Stanlee Miller. Campbell Museum, Clemson University (CUSC 2167). County record. Previously reported in adjacent Marshall, Day, and Grant counties (Fischer et al. 1999. A Field Guide to South Dakota Amphibians. South Dakota Agric. Exp. Sta. Bull. 733. South Dakota State University, Brookings. 52 pp.).

Submitted by **LAURS BRYAN WILLIAMS** and **STEVEN G. PLATT**, Department of Math and Science, Oglala Lakota College, P.O. Box 490, Kyle, South Dakota, 57752-0490, USA.

GYRINOPHILUS PORPHYRITICUS (Spring Salamander). USA: TENNESSEE: COFFEE CO: seep flowing into Davidson Branch, ca. 1.1 km SW of Ward Chapel, ca. 250 m N of Riley Creek Rd (35°28'02.5"N, 86°11'17.6"W). 19 April 2003. Matthew L. Niemiller. Verified by Addison Wynn. Smithsonian National Museum of Natural History, USNM-FS 186610. Larva found under rock within seep. Tissue sample collected; salamander was photographed and released. First record from Coffee County and southernmost record on the Eastern Highland Rim (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.). Tissue sample collected under authorization of the Tennessee Wildlife Resources Agency (permit no. 1724-03B).

Submitted by **MATTHEW L. NIEMILLER**, Middle Tennessee State University, Murfreesboro, Tennessee, 37130, USA; e-mail: mln2a@mtsu.edu.

ANURA

APARASPHENODON VENEZOLANUS (Venezuela Casque-headed Frog). BRAZIL: AMAZONAS STATE: Campina from Jaú National Park (01°54'45"S 61°35'20"W). 19 March 2000. S. Neckel-Oliveira and M. Gordo. Herpetological collection from Instituto Nacional de Pesquisas da Amazônia, Manaus (INPA - H 10939). Verified by J. Lynch. One male found at 2200 h at edges of ponds in campina habitat—characterized by sandy soil that is seasonally flooded by rainfall. First country record. Species previously known from southwestern Amazonian Venezuela and adjacent Colombia; present record extends known distribution ca. 900 km airline from Guaínia, Colombia (Frost 2003. Amphibian Species of the World. Version 2.21/2003).

Submitted by **SELVINO NECKEL-OLIVEIRA**, Instituto Nacional de Pesquisas da Amazônia, CP 478, 69011-970, Manaus, Am, Brazil (e-mail: neckel@inpa.gov.br), and **MARCELO GORDO**, Universidade Federal do Amazonas, Manaus, Am. Brazil; e-mail: mgordo@ufam.edu.br.

BUFO AMERICANUS (American Toad). USA: GEORGIA: FLOYD CO.: Dozier Creek. 21 July 2003. Bradley L. Johnston. GMNH 49220. Verified by John Jensen. New county record (Williamson and Moulis. 1994. Distribution of Amphibians and Reptiles in Georgia. Savannah Sci. Mus. Spec. Publ. No. 3, 712 pp.).

Submitted by **BRADLEY L. JOHNSTON**, 341 Bells Ferry Road, Rome, Georgia 30161, USA.

BUFO SPECIOSUS (Texas Toad). USA TEXAS: STERLING CO: AOR ca. 10 road km E of Sterling City, Hwy 87. 16 April 2001. James A. Holm and Kathryn E. Perez. Verified by J. Kelly McCoy. Angelo State University Natural History Collection (ASNHC 13581). First county record (Dixon 2000. Amphibians and Reptiles of Texas. Second Ed. Univ. of Texas A&M Press, viii + 421 pp.).

Submitted by **JAMES A. HOLM**, 18719 Woodglen Shadows Drive, Humble, Texas 77346, USA; e-mail: jaz_holm@hotmail.com.

ELEUTHERODACTYLUS BIPORCATUS (Puerto Cabello Robber Frog). VENEZUELA: ESTADO FALCON: Municipio Unión, Estación de Guardaparques, Parque Nacional Cueva Quebrada del Toro. August 2002. R. A. Rivero. Museo de la Estación Biológica de Rancho Grande (EBRG 4826), Ministerio del Ambiente y de los Recursos Naturales, Maracay. Verified by A. Arends. First state record (Mijares-Urrutia and Arends 2000. Smithson. Herpetol. Infor. Serv. 123:1–30). This record represents an extension of ca. 135 km NW from its nearest known locality in Coastal Range, northern Venezuela (Frost, 2002. Amphibian Species of the World [online]. Ver. 2.21. American Museum of Natural History, New York; Manzanilla et al. 1995. Acta Cient. Venez. 46:1–15).

Submitted by **RAMÓN RIVERO**, Museo de la Estación Biológica de Rancho Grande, Ministerio del Ambiente y de los Recursos Naturales, Apartado 184, Maracay 2101-A, Venezuela, and **ABRAHAM MIJARES-URRUTIA**, Colección Herpetológica Regional, CIEZA-UNEFM, Apartado 7559, Santa Ana de Coro 4101-A, Venezuela; e-mail: amijares@unefm.edu.ve.

ELEUTHERODACTYLUS DIMIDIATUS (Ranita de Antifaz). CUBA: MATANZAS: CIÉNAGA DE ZAPATA: ca. 5 km from Buenaventura, 100 m NE of the road to Santo Tomás (81°15'57.24"N, 22°19'27.48"W). May 1997. A. Rodríguez. Instituto de Ecología y Sistemática, Colección Zoológica de la Academia de Ciencias de Cuba (CZACC 14 3776). Verified by L. V. Moreno. CUBA: Isla de la Juventud: Los Indios River, ca. 800 m to the NE of the "Los Indios" Ecological Station (82°59'30.48"N, 21°4.68"W). 11 August 1999. A. Rodríguez and R. Alonso. CZACC 145600. Verified by L. V. Moreno. First record of this species from "Llanura de Zapata" and "Isla de la Juventud-Archipiélago de los Canarreos," two biogeographic regions from which it was considered absent (Hedges 1999, *In* Duellman [ed.], Patterns of Distribution of Amphibians, A Global Perspective, pp. 211–254. Johns Hopkins University Press, Baltimore and London).

Submitted by **ARIEL RODRÍGUEZ** and **ROBERTO ALONSO**, Instituto de Ecología y Sistemática, Carr. de Varona, Km 3, Capdevila, Boyeros. AP 8029, CP 10800, Ciudad de la Habana, Cuba; e-mail: zoologia.ies@ama.cu.

ELEUTHERODACTYLUS EILEENAE (Colín). CUBA: MATANZAS: CIÉNAGA DE ZAPATA: ca. 5 km from Buenaventura, 100 m NE from the road to Santo Tomás (81°15'57.24"N, 22°19'27.48"W). May 1997. A. Rodríguez. Instituto de Ecología y Sistemática, Colección Zoológica de la Academia de Ciencias de Cuba (CZACC 14 3415). Verified by L. V. Moreno. First record of this species in the "Llanura de Zapata," a biogeographic region where it was previously considered absent (Hedges 1999, *In* Duellman [ed.], Patterns of Distribution of Amphibians, A Global Perspective, pp. 211–254. Johns Hopkins University Press, Baltimore and London).

Submitted by **ARIEL RODRÍGUEZ** and **ROBERTO ALONSO**, Instituto de Ecología y Sistemática, Carr. de Varona, Km 3, Capdevila, Boyeros. AP 8029, CP 10800, Ciudad de la Habana, Cuba; e-mail: zoologia.ies@ama.cu.

ELEUTHERODACTYLUS LIBRARIUS (NCN). ECUADOR: PROVINCIA NAPO: CANTÓN TENA: Serena village, S side upper Napo River (01°05'43"S, 77°55'28"W), 560 m elev., 1 May 2003. K. R. Elmer and T. Sugahara. Museo de Zoología de la Pontificia Universidad Católica del Ecuador, Quito (QCAZ 25851: adult female, SVL 24.1 mm; QCAZ 25852: adult female, SVL 23.8 mm; SVL 22.9 mm; in an agricultural area surrounded by secondary forest, perched on vegetation < 1 m above ground). PROVINCIA ORELLANA: Yasuní River, south side, ca. 220 m elev., November 1993. F. Campos. (QCAZ 7356: juvenile, SVL 14.7 mm; QCAZ 7357: juvenile female, SVL 19.9 mm). CANTÓN COCA: ca. 5 km S of Dayuma village (00°41'44"S, 76°43'50"W), 267 m elev., 19 March 2003. K. R. Elmer, S. Padilla, and P. Menéndez-Guerrero. (QCAZ 25589: adult female, SVL 24.6 mm; in a coffee plantation with primary forest behind and a road on one side, perched on vegetation < 1 m above ground). PROVINCIA MORONA SANTIAGO: 600–1200 m elev., September 1997. J. Izquierdo. (QCAZ 12209: adult male, SVL 19.2 mm; QCAZ 12210: SVL 22.2 mm). All verified by Luis A. Coloma and Gregory O. Vigle. This species was previously known only from its type locality, the Jatun Sacha Biological Reserve, Napo, Ecuador (01°04'S, 77°36'W) (Flores and Vigle 1994. J. Herpetol. 28:416–424). These

new records represent a substantial range extension for the species: Serena is 34 km W, Dayuma is 107 km ENE, Morona Santiago is a minimum of 90 km, maximum of ca. 210 km S, and Yasuní River is 120–150 km E (all kms are straight-line) from the Jatun Sacha Reserve.

Submitted by **KATHRYN R. ELMER**, Department of Biology, Queen's University, Kingston, Ontario, K7L 3N6, Canada; e-mail: ElmerK@biology.queensu.ca.

ELEUTHERODACTYLUS PLANIROSTRIS (Greenhouse Frog). USA: FLORIDA: LEVY CO: Seahorse Key, upland hammock and beaches. 2 June 2001. Harvey B. Lillywhite and Coleman M. Sheehy III. Verified by Kenneth L. Krysko. Florida Museum of Natural History, University of Florida, Gainesville (UF 123955). This is a new record for Seahorse Key as well as the adjacent collective islands of the Cedar Keys. Several specimens were found active in leaf litter and in pitfall traps. Moreover, these frogs have been observed or heard calling on at least six occasions since the original discovery, all in connection with recent rainfall. Seahorse Key has no permanent source of fresh water, so this record affirms the success of this species in colonizing offshore islands that might be hostile environments for other amphibians. The presence of *E. planirostris* is possible because of its terrestrial mode of direct reproduction. It appears the frogs are quite common in leaf litter within the insular hammock and probably occur on other islands within the Cedar Keys as well. Elsewhere, in the Florida Keys and Caribbean, this species has been reported beneath stones and other objects on beaches at the very edge of the sea (Neill 1958. Bull. Mar. Sci. Gulf Caribbean 8[1]:1–97). *Eleutherodactylus planirostris* was not known from Seahorse Key or adjacent islands during the studies of Charles Wharton (1958. The Ecology of the Cottonmouths *Agkistrodon piscivorus piscivorus* Lacepede of Sea Horse Key, Florida. PhD dissertation, University of Florida, Gainesville). As at other sites (Johnson et al. 2003. Herpetol. Rev. 34:161–162), this species appears to have colonized parts of north Florida during the relatively recent past.

Submitted by **HARVEY B. LILLYWHITE** and **COLEMAN M. SHEEHY III**, Department of Zoology and Seahorse Key Marine Laboratory, University of Florida, Gainesville, Florida 32611-8525, USA; e-mail: hbl@zoo.ufl.edu.

ELEUTHERODACTYLUS RONALDI (NCN). CUBA: HOLGUÍN: FRANK PAÍS: Baconal, Sierra de Cristal (75°25'25.32"N, 20°34'35.04"W), ca. 600 m elev. 24 December 2000. A. Rodríguez and R. Alonso. Instituto de Ecología y Sistemática, Colección Zoológica de la Academia de Ciencias de Cuba (CZACC 1411402). Verified by L. V. Moreno. First record of the species in Sierra de Cristal and a range extension of ca. 45 km from the closest previous record in Cupeyal del Norte, Cuchillas del Toa (Garrido and Jaume 1984. Doñana, Acta Vertebrata 11:5–128).

Submitted by **ARIEL RODRÍGUEZ** and **ROBERTO ALONSO**, Instituto de Ecología y Sistemática Carr. de Varona, Km 3, Capdevila, Boyeros, AP 8029, CP 10800, Ciudad de la Habana, Cuba; e-mail: zoologia.ies@ama.cu.

ELEUTHERODACTYLUS TETAJULIA (NCN). CUBA: HOLGUÍN: FRANK PAÍS: El Desayuno, Sierra de Cristal (75°26'12.84"N, 20°31'54.48"W), ca. 700 m elev. 15–19 December 2000. A. Rodríguez and R. Alonso. Instituto de Ecología y Sistemática, Colección Zoológica de la Academia de Ciencias de Cuba (CZACC 1411403–4,1411407–11). Verified by L. V. Moreno. This record is a range extension of ca. 76 km W of the only previously known record at the type locality (Estrada and Hedges 1996. Herpetologica 52:435–439).

Submitted by **ARIEL RODRÍGUEZ** and **ROBERTO ALONSO**, Instituto de Ecología y Sistemática Carr. de Varona, Km 3, Capdevila, Boyeros, AP 8029, CP 10800, Ciudad de la Habana, Cuba; e-mail: zoologia.ies@ama.cu.

HYLA ALBOMARGINATA (White-edged Treefrog). BRAZIL: SANTA CATARINA: Municipality of Florianópolis: Ilha de Santa Catarina, Praia dos Naufragados (27°49'S, 48°34'W). 19 October 2002. A. Kwet and T. Miranda. Museu de Ciências e Tecnologia da PUCRS (MCP 6380–81), Porto Alegre, Brazil. Verified by M. Di-Bernardo. This first record for the island of Santa Catarina represents the southernmost locality for this species, which is widely distributed in the lower Amazon Basin and the Atlantic forests of eastern Brazil from Pernambuco to Santa Catarina (Frost 2002. Amphibian Species of the World: an online reference. V2.21 [15 July 2002] http://research.amnh.org/herpetology/amphibia/index.html). The new record extends the distribution ca. 150 km S from the previously cited southernmost locality near Guaramirim, northern Santa Catarina (http://www.ra-bugio.org.br/index.html). Four males were observed calling in a forest swamp with shallow water, ca. 300 m from the beach and perched on shrubs at heights of 1–2 m. One male took refuge in a large bromeliad (*Vriesea* sp.).

Submitted by **AXEL KWET**, Zoologie, Staatliches Museum für Naturkunde Stuttgart, Rosenstein 1, D-70191 Stuttgart, Germany (e-mail: axel.kwet@uni-tuebingen.de), **TATIANA MIRANDA**, Laboratório de Pesquisas Biológicas, PUCRS, Av. Ipiranga, 6681, CEP 90619-900 Porto Alegre, Brazil (e-mail: tatimiran@hotmail.com), and **ANNE ZILLIKENS**, Zoologisches Institut der Universität Tübingen, Auf der Morgenstelle 28, D-72076 Tübingen, Germany (e-mail: anne.zillikens@uni-tuebingen.de).

HYLA CINEREA (Green Treefrog). USA: VIRGINIA: GOOCHLAND CO., 2.65 km ESE Centerville (37°39'50.33"N, 77°39' 33.29"W, NAD83). 1 August 2003. J. C. Mitchell. USNM 559750–51. Verified by S. W. Gotte. Extension of known range in Virginia ca. 40 km W of nearest published location in eastern Hanover County in the Coastal Plain (Mitchell and Reay 1999. Atlas of Amphibians & Reptiles in Virginia. Spec. Publ. No. 1, Virginia Dept. Game & Inland Fisheries, Richmond, Virginia). County record and first record for Piedmont Physiographic Province in Virginia.

Submitted by **JOSEPH C. MITCHELL**, Department of Biology, University of Richmond, Richmond, Virginia 23173, USA.

HYLA PUGNAX (Rana Platanera; Banana-tree Frog). VENEZUELA: ESTADO FALCON: Municipio Mauroa, 22 km (by road) SW from Goajiro, ca. 500 m elev. 5 May 2003. A. Mijares and P. Palencia. Colección Herpetológica Regional del Centro de Investigaciones en Ecología y Zonas Áridas (CIEZAH 1147),

Universidad Francisco de Miranda, Santa Ana de Coro. Verified by A. Arends. Third known locality and highest elevation reported in Venezuela (La Marca 1996. Bull. Maryland Herpetol. Soc. 32:35–42; Mijares-Urrutia and Arends 1999. Herpetol. Rev. 30:115), second state record, and first report from the Municipio Mauroa (Mijares-Urrutia and Arends 1999, *op. cit.*; Mijares-Urrutia and Arends 2000. Smithson. Herpetol. Infor. Serv. 123:1–30). This record extends the known range of the species ca. 116 km (airline) SW from La Florida, State of Falcón and partially fills the large gap between the two previously known localities in Venezuela.

Submitted by **ABRAHAM MIJARES-URRUTIA**, Colección Herpetológica Regional, CIEZA-UNEFM, Apartado 7559, Santa Ana de Coro 4101-A, Venezuela; e-mail: amijares@unefm.edu.ve.

LEPTODACTYLUS POECILOCHILUS (Sapito Silbador). VENEZUELA: ESTADO FALCON: Municipio Petit, ca. 1.0 km SW Acarite, through the Spanish road, Sierra de San Luis, ca. 800 m elev. 3 July 2003. A. Mijares and P. Palencia. Colección Herpetológica Regional del Centro de Investigaciones en Ecología y Zonas Áridas (CIEZAH 1148, 1150–1153), Universidad Francisco de Miranda, Santa Ana de Coro. Verified by A. Arends. First record for the Municipio Petit, extending the range ca. 135 km west (Heyer 1978. Nat. Hist. Mus. Los Angeles Co. Sci. Bull., 29:1–85; Mijares-Urrutia and Arends 2000. Smithson. Herpetol. Infor. Serv. 123:1–30).

Submitted by **ABRAHAM MIJARES-URRUTIA**, Colección Herpetológica Regional, CIEZA-UNEFM, Apartado 7559, Santa Ana de Coro 4101-A, Venezuela; e-mail: amijares@unefm.edu.ve.

OSTEOCEPHALUS PLANICEPS (NCN). BRAZIL: AMAZONAS STATE: Campina from Jaú National Park (01°54'45"S, 61°35'20"W). 19 March 2000. S. Neckel-Oliveira and M. Gordo. Herpetological collection, Instituto Nacional de Pesquisas da Amazônia, Manaus, (INPA -H 10940–44). Verified by J. Lynch. Three males and two females were found at edges of ponds in campina habitat, 2000–2400 h. First country record. Species previously known from northeastern Amazonian Peru and adjacent Ecuador; likely present in Amazonian Colombia as well. Present record extends the known distribution ca. 1400 km air lane E from Nauta, Perú, the type locality (Frost 2002. Amphibian Species of the World. Version 2.21/2003).

Submitted by **MARCELO GORDO**, Universidade Federal do Amazonas, Manaus, Am, Brazil (e-mail: mgordo@ufam.edu.br), and **SELVINO NECKEL-OLIVEIRA**, Instituto Nacional de Pesquisas da Amazônia, CP 478, 69011-970, Manaus, Am, Brazil; e-mail: neckel@inpa.gov.br.

PACHYMEDUSA DACNICOLOR (Mexican Leaf Frog). MEXICO: CHIHUAHUA: Ejido la Junta, 2–3 km NW Batopilas (29°12'34.1"N, 107°45'44.5"W), 435 m elev. 8–12 July 2002. Julio A. Lemos-Espinal. Herpetological Collection of Unidad de Biología, Tecnología y Prototipos (UBIPRO) 9068. Verified by Richard L. Holland. First record for the state of Chihuahua, extending its known range ca. 75 km E from 13 km ESE Alamos, Sonora (Duellman 2001. Hylid Frogs of Middle America. SSAR Contrib. Herpetol. 18, xvi + 1158 pp.).

Submitted by **JULIO A. LEMOS-ESPINAL**, under CONABIO Projects U003, X004 and AE003, Laboratorio de Ecología, UBIPRO, Facultad de Estudios Superiores Iztacala, UNAM, Apartado Postal 314, Avenida de los Barrios No. 1, Los Reyes Iztacala, Tlalnepantla, Estado de México, 54090 México (e-mail: lemos@servidor.unam.mx); **DAVID CHISZAR** and **HOBART M. SMITH**, University of Colorado Museum, Boulder, Colorado 80309-0334, USA; e-mail: hsmith@colorado.edu.

RANA AURORA (Red-legged Frog). USA: ALASKA: Chichagof Island: SE of Hoonah: muskeg ponds with silty, organic bottoms surrounded by grasses and sedges. NMFS, Auke Bay Laboratory, Juneau, Alaska AB 02-21, 57°50'90.0"N, 135°03'8.3"W, 13 July 2002, Schroder, 2 subadults. Additional specimens include AB 02-82–87. Verified by Kelly McAllister and Bruce L. Wing.

This is the fist recorded *Rana aurora* from Alaska (Hodge 1976. Amphibians and Reptiles in Alaska, the Yukon and Northwest Territories, Alaska Northwest Publ. Co., Anchorage). Rumors among former Hoonah school students regarding the origin of the frogs surfaced. A former Hoonah school teacher allegedly released frogs, purchased form a biological supply company, into a pond near Hoonah. I located the former teacher in another city and the teacher confirmed he purchased one or two egg masses of *R. aurora* from Powell Laboratories (Carolina Biological Supply), Gladstone, Oregon , ca. 1982 and released a couple dozen froglets in a pond SE of Hoonah ca. 1982. Carolina Biological Supply staff confirmed that egg masses of *R. aurora* were collected in the Columbia River Gorge, Oregon and shipped from Powell Laboratories in Oregon to schools throughout the west during this time period.

The introduced *Rana aurora* are successfully reproducing and dispersing into adjacent wetlands. The effect this exotic introduction will have on native amphibians and other aquatic life remains to be determined. The genetic relationships of the Chichagof Island populations with Oregon populations merits investigation.

Ovaska et al. (2002. Herpetol. Rev. 33:318) recently documented *Rana aurora* from Graham Island in the Queen Charlotte Islands, British Columbia, Canada, speculating that these frogs might be introduced (although no record of such an event exists).

Rana aurora is the second exotic amphibian species introduced/ established in Alaska. *Pseudacris (= Hyla) regilla* (Pacific Treefrog) was human introduced on Revillagigedo Island in 1960 and is reproducing but apparently not dispersing into nearby wetlands (Norman and Hassler 1995. Unpubl. report, National Biological Service, Humbolt State University, Arcata, California). *Pseudacris regilla* also exists in the Queen Charlotte Islands as the result of human introduction.

Special thanks to Chuck Parsley, John Sargent, and staff of Hoonah USFS.

Submitted by **ROBERT PARKER HODGE**, ME2, POB 1521, Gig Harbor, Washington 98335,USA.

SCAPHIOPUS COUCHII (Couch's Spadefoot). USA TEXAS: STERLING CO: AOR, ca. 6.4 road km E of Sterling City on Hwy 87. 17 April 2001. James A. Holm and Kathryn E. Perez. Verified by J. Kelly McCoy. Angelo State University Natural History Collection (ASNHC) 13582. First county record (Dixon 2000. Amphibians and Reptiles of Texas. Second Ed. Univ. of Texas A&M Press, viii + 421 pp.).

Submitted by **JAMES A. HOLM**, 18719 Woodglen Shadows

Drive, Humble, Texas 77346, USA; e-mail: jaz_holm@hotmail.com.

STEFANIA SCALAE (Rana de la Escalera). VENEZUELA: BOLÍVAR: Wareipita River, tributary of the Cucurital River, Canaima National Park (06°00'31"N, 62°47'01"W), 370 m elev. 25–28 September 2000. R. Rivero, E. La Marca, C. Molina, D. Lew, and H. Rojas. Museo de Historia Natural La Salle, Caracas, (MHNLS 14995,15001, 15022, 15041–42). Verified by J. Ayarzagüena. Until now, this species has been considered endemic to the La Escalera region in Venezuela between 860 and 1360 m elev. (Señaris et al. 1996. Publ. Asoc. Amigos Doñana 7:1–57; Gorzula and Señaris 1999. Scientia Guaianae No. 8, xviii + 268 pp., 32 pls.), although Barrio (1998. Act. Biol. Venez. 18[2]:1–93) tentatively assigned an unvouchered specimen from Cerro Santa Rosa, South Serranía del Supamo, Bolívar State to this taxon. These specimens were collected at night, above and under rocks or in the marginal vegetation, along a small rocky tributary of the Cucurital River. These new specimens are the first documented records outside the type locality and are from the lowest elevation recorded for this species. They extend the range at least 140 km to the east of the previously known locality.

Submitted by **J. CELSA SEÑARIS**, **CESAR MOLINA**, Museo de Historia Natural La Salle, Apartado 1930, Caracas 1010-A, Venezuela (e-mail: josefa.senaris@fundacionlasalle.org.ve), and **ENRIQUE LA MARCA**, Laboratorio de Biogeografía, Escuela de Geografía, Facultad de Ciencias Forestales y Ambientales, Universidad de Los Andes, Mérida 5101, Venezuela; e-mail: lamarca1@telcel.net.ve.

TESTUDINES

APALONE SPINIFERA (Spiny Softshell). USA: GEORGIA: FLOYD CO: Dozier Creek. 1 June 2000. Bradley L. Johnston. GMNH 49223. Verified by John Jensen. New county record (Williamson and Moulis. 1994. Distribution of Amphibians and Reptiles in Georgia. Savannah Sci. Mus. Spec. Publ. No. 3, 712 pp.).

Submitted by **BRADLEY L. JOHNSTON**, 341 Bells Ferry Road, Rome, Georgia 30161, USA.

CHELYDRA SERPENTINA SERPENTINA (Eastern Snapping Turtle). USA: TEXAS: BROWN CO: Camp Bowie, Texas Army National Guard Training Site, Area 5 (UTM: 0506986 E, 3497907 N). 23 March 2003. James A. Holm. Verified by Robert C. Dowler. Angelo State University Natural History Collection (ASNHC) 14117. First county record (Dixon 2000. Amphibians and Reptiles of Texas. Second Ed. Univ. of Texas A&M Press, viii + 421 pp.).

Submitted by **JAMES A. HOLM**, 18719 Woodglen Shadows Drive, Humble, Texas 77346, USA; e-mail: jaz_holm@hotmail.com.

KINOSTERNON BAURII (Striped Mud Turtle). USA: FLORIDA: FRANKLIN CO: On land near East River, a distributary of the Apalachicola River (29.8632°N 85.0223°W). 16 August 1991. M. A. Ewert. Florida Museum of Natural History (UF 139566) adult female. FRANKLIN CO: On land on Forbes Island across the Apalachicola River from Fort Gadsden Historical Site (29.9401°N 85.0158°W). 17 May 1993. M. A. Ewert. UF 139567, adult female, on its nest. GULF CO: On land ca. 300 m N of Forbes Island and Brickyard Cutoff of the Apalachicola River (29.9528°N 85.0223°W), 18 August 1991. M. A. Ewert. UF 139568, adult female, nesting. LIBERTY CO: On land next to stream 4.8 km N of S.R. 20, Bristol (30.5016°N 84.9869°W), 5 June 1999. D.R. Jackson. UF 139569, adult female. JACKSON CO: In Spring Creek, 2 km SE Marianna (30.7501°N 85.1983°W), 12 June 2002. G. Guyot. UF 139570, photographic voucher of adult female and UF 139571 preserved hatchling from an egg from this female. Data that support our identifications include 1) "plastral formula" scores that favor *K. baurii* or *K. subrubrum hippocrepis* rather than *K. s. subrubrum* (Lamb and Lovich 1990. Copeia 1990:613–618; Lovich and Lamb 1995. J. Herpetol. 29:621–624), 2) at least a partial mid-dorsal stripe on the carapace of two of the six specimens, 3) production of eggs and nesting during late summer and fall (no evidence of this for *K. s. hippocrepis* (e.g., Dundee and Rossman 1989. The Amphibians and Reptiles of Lousiana. Louisiana State University Press, Baton Rouge. 300 pp.), and 4) eggs with embryonic diapause (Ewert and Wilson 1996. Chelon. Conserv. Biol. 2:43–54), not present in *K. s. hippocrepis* (Ewert, pers. obs.). All five records extend the range of *K. baurii* westward in Florida from the St. Marks River drainage (Wakulla Co., Etchberger and Iverson 1989. Florida Sci. 52:119–144) into the Apalachicola River drainage, including the Chipola River. *Kinosternon baurii* is recorded for the Apalachicola (Flint River) drainage of Georgia (Jensen and Moulis 1999. Herpetol. Rev. 40:240–247). Our new records extend the total known range further west by 19' to 32' of longitude (from Calhoun Co., Georgia; Williamson and Moulis 1994. Savannah Sci. Mus. Spec. Publ. 3:1–712). All specimens were verified by M. J. Aresco.

Submitted by **MICHAEL A. EWERT**, Department of Biology, Indiana University, Bloomington, Indiana 47405, USA (e-mail: mewert@bio.indiana.edu), **DALE R. JACKSON**, Florida Natural Areas Inventory, 1018 Thomasville Road, Suite 200-C, Tallahassee, Florida 32303 (e-mail: djackson@fnai.org), and **GHISLAINE GUYOT**, 6416 Dancer's Image Trail, Tallahassee, Florida 32309 USA (e-mail: gguyot13@aol.com).

KINOSTERNON SUBRUBRUM (Eastern Mud Turtle). USA: ILLINOIS: UNION CO: Cypress Road, 0.15 km W of Cypress Creek (SW 1/4 of SE 1/4 of SEC 23, T13S, R1E). 4 April 2003. John. G. Palis. SIUC-R4322. Verified by J. G. Stewart. Fresh DOR juvenile collected after rain at 2200 h. First record for county (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. llinois Nat. Hist. Surv. Manual 8:1–282).

Submitted by **JOHN G. PALIS**, P.O. Box 387, Jonesboro, Illinois 62952, USA

PSEUDEMYS CONCINNA (River Cooter). USA: ILLINOIS: JOHNSON CO: Grassy Slough Preserve (The Nature Conservancy) near Belknap (E 1/2 of NE 1/4 of SW 1/4 of Sec 6, T14S, R3E). 23 May 2003. John G. Palis. SIUC R-4324 color slide. Verfied by J. G. Stewart. Adult male found between constructed wetland and Cache River at 1730 h. First record for county (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8: 1–282).

Submitted by **JOHN G. PALIS**, P.O. Box 387, Jonesboro, Illinois 62952, USA

TRACHEMYS VENUSTA CATASPILA (Huastecan Slider). MÉXICO: HIDALGO: Municipality of Huejutla de Reyes, Chalahuiyapa, ca. 5.5 km NE Huejutla (21º09'N, 93°22'W), 120 m elev. 1 March 1999. Cristóbal Bautista Bautista. Colección Herpetológica, Instituto Tecnológico Agropecuario de Hidalgo (ITAH 063, complete shell only). Two additional specimens (ITAH 387, 470) are known from Hildalgo. All three specimens verified by Luis Canseco-Márquez. First specimens for Hidalgo, extending the range ca. 112 km WNW of the closest record at Río Tuxpan, Veracruz. This subspecies is known from numerous localities on the Gulf versant in the states of Tamaulipas, San Luis Potosí, and Veracruz (Seidel 2002. J. Herpetol. 36:285–292; Smith and Smith 1979. Synopsis of the Herpetofauna of Mexico, Vol. VI, Guide to Mexican Turtles, Bibliographic Addendum III. John Johnson, North Bennington. i–viii + 1044 pp.).

Submitted by **FERNANDO MENDOZA QUIJANO** (e-mail: mendozaq2000@yahoo.com.mx), and **SOL DE MAYO MEJENES LÓPEZ**, Instituto Tecnológico Agropercuario de Hidalgo, Km 5.5 Carr. Huejutla-Chalahuiyapa, Apdo. Post. 94, C.P. 43000, Huejutla de Reyes Hidalgo, Mexico, and **HOBART M. SMITH**, Department of EPO Biology and Museum, University of Colorado, Boulder, Colorado 80309-0334, USA (e-mail: hsmith@spot.colorado.edu).

LACERTILIA

COLEONYX VARIEGATUS (Western Banded Gecko). USA: ARIZONA: COCONINO CO: Wupatki National Monument: Deadman Wash, UTM (NAD27) 12S, 468940 E, 3932197 N, ca. 1390 m elev. 23 April 2002. Trevor B. Persons. Flagstaff Area National Monuments Vertebrate Collection, WUPA 24715. Kana-a Wash, ca. 0.25 mile E of Wukoki Ruin, UTM (NAD27) 12S, 470658 E, 3931404 N, ca. 1402 m. elev. 10 September 2002. Trevor B. Persons. WUPA 24722. Both verified by Charles A. Drost. Both specimens found under flat sandstone rocks in Great Basin Desertscrub habitat of Wupatki Basin. First records for the Little Colorado River basin, and first records from the Colorado Plateau away from the Colorado River (Dixon 1970. Cat. Am. Amph. Rept. 96.1–96.4; Stebbins 2003. A Field Guide to Western Reptiles and Amphibians, Third Edition. Houghton Mifflin Co., Boston, Massachusetts, 533 pp.). Brennan et al. (2002. Herpetol. Rev. 33:320) reported a specimen from Glen Canyon National Recreation Area NE of Page, Coconino Co., suggesting the species occurs throughout the Colorado River corridor in Arizona. These Wupatki specimens extend the range ca. 75 air km SE of the next furthest downstream Colorado River corridor record, Tanner Trail in Grand Canyon National Park (Miller et al. 1982. Amphibians and Reptiles of the Grand Canyon. Grand Canyon Nat. Hist. Assoc., Grand Canyon, Arizona). These records suggest the species occurs throughout the Little Colorado River valley between Grand Canyon and Wupatki, and may occur more widely in similar lower elevation habitats on the northern portion of the Navajo Indian Reservation. Because of the barrier imposed by the Mogollon Rim and Coconino Plateau to the south and west, respectively, the Little Colorado River valley probably represents the historical dispersal route from Grand Canyon of this and other desert species that reach their local terminus in the Wupatki area (e.g., *Sceloporus magister*, *Cnemidophorus tigris*, *Salvadora hexalepis*).

Submitted by **TREVOR B. PERSONS** (e-mail: Trevor.Persons@nau.edu) and **ERIKA M. NOWAK** (e-mail: Erika.Nowak@nau.edu), USGS Southwest Biological Science Center, Colorado Plateau Field Station, Box 5614, Northern Arizona University, Flagstaff, Arizona 86011-5614, USA.

DAREVSKIA VALENTINI (Caucasian Rock Lizard, introduced species). USA: OHIO: VAN WERT CO: west Delphos at Killbros Equipment Company on Ohio Rt. 697, collected Aug. 1986, specimen KU 206727 (Natural History Museum and Biodiversity Research Center, University of Kansas). Specimen had been misidentified as *Podarcis muralis* (Common Wall Lizard) and mapped by Conant and Collins (1998. Peterson Field Guide to Reptiles and Amphibians of Eastern and Central North America. Third edition expanded. Houghton Mifflin Company, Boston, Massachusetts, 616 pp., and in the precursor edition of 1991) as originating from a population in NW Ohio. I visited the site of collection on 21–22 May 2002 and found no lizards there. Both a local naturalist, George Bilbrey, and a regional herpetologist, Eric Juterbock, confirmed that *Eumeces fasciatus* is the only lizard species recorded from Delphos. Killbros Equipment Company staff kindly identified the person who collected the specimen as James Brokamp, a former employee. In an interview he stated that in 1986 he was in charge of unwrapping arriving agricultural machines shipped to Kilbros. When he slit open the tight fitting plastic wrap covering a machine he found the lizard "between the wheels," seized it and kept it for a week. He then forwarded it to his sister-in-law in Lima, Ohio who was working for the Ohio State Park System, and she sent it to Cincinnati, from where it was further sent to Lawrence, Kansas. Brokamp stated there was a newspaper article in the Delphos Herald about him and his lizard which he unfortunately discarded two years ago. Despite kind help from the *Delphos Herald* editor, Susan Gerker, I was unable to retrieve the article from the newspaper archive. The Kilbros staff helped me track down the machine's itinerary starting from an Italian agricultural machine manufacturer (Bondioli & Pavesi S.p.A, Via 23 Aprile, 35, Suzzara, Mantova) via Virginia (Bondioli & Pavesi Inc., 104 Sycamore Drive, Ashland, Virginia) to Delphos. A reasonable explanation is that someone put the lizard in the wrapping of the machine on purpose, perhaps as a joke. An internet search revealed that there is a long history of commercial traffic of agricultural machines to Italy from the former Soviet Union, one of the home countries of *Darevskia*. However I was unable to track down the itinerary of the machine beyond Italy. I conclude that the *Darevskia* record in Ohio is based on a single specimen only and that no population ever was established there. For specimen descriptions see Deichsel and Bischoff (2002. Herpetol. Rev. 33:65) and Bischoff and Deichsel (2002. Salamandra 38[2]:113–117).

Submitted by **GUNTRAM DEICHSEL**, Friedr.-Ebert-Str. 62, Biberach an der Riss, Germany D-88400; e-mail: guntram.deichsel@bc.boehringer-ingelheim.com.

EUMECES MULTIVIRGATUS (Many-lined Skink). USA: TEXAS: CROCKETT CO: along dirt road ca. 6.4 road km E of Highway 63, ca. 8 road km N of intersection of Highways 63 and 190. 8 April 2001. Collected by James A. Holm. Verified by J. Kelly McCoy. Angelo State University Natural History Collection

(ASNHC) 13552–53. First county records (Dixon 2000. Amphibians and Reptiles of Texas. Second Ed. Univ. of Texas A&M Press, viii + 421 pp.).

Submitted by **JAMES A. HOLM**, 18719 Woodglen Shadows Drive, Humble, Texas 77346, USA; e-mail: jaz_holm@hotmail.com.

HEMIDACTYLUS MABOUIA (Amerafrican House Gecko). USA: FLORIDA: INDIAN RIVER CO.: Stickmarsh boat ramp, at the end of Fellsmere Grade Road 9.6 km W of State Road 507, 5 m S of Canal 54 (27°49'24"N, 80°42'32"W). 12 August 2003. James U. Van Dyke. Verified by Kenneth L. Krysko. Florida Museum of Natural History (UF 137507–509). New county record. One adult and two juvenile geckos were collected on the eastern wall of the boat ramp bath house at night. Many *H. garnotti* were also observed in the same habitat. This record fills a void in the known range of this species in central Florida (Criscione et al. 1998. Herpetol. Rev. 29:248).

Submitted by **JAMES U. VAN DYKE** Department of Biological Sciences, Florida Institute of Technology, Melbourne, Florida 32901, USA; e-mail: jvandyke@fit.edu.

LEIOCEPHALUS CARINATUS ARMOURI (Little Bahama Curly-tailed Lizard). USA: FLORIDA: ST. LUCIE CO., NW side of intersection of U.S. Hwy 1 and Prima Vista Boulevard in the "St. Lucie Shopping Center" parking lot (27°19.601'N, 80°19.369'W), between the "Mobil" gas station and the "Prima Vista Professional Building." 4 October 2003. One individual (7.5 cm SVL male) observed 1456 h and collected 1507 h. C. L. Dean. Verified by Walter E. Meshaka, Jr. State Museum of Pennsylvania, Harrisburg (SMP-H2130). First record of this exotic species for St. Lucie County. Extends the range 23 km N of an allopatric population in Port Salerno, Martin County, discovered 31 August (SMP-H2108) (Dean et al. unpubl. rept.). Both of these sites are N of the previously known range that extends ca. 90 km along the Atlantic coastline extending from northern Broward County through Palm Beach County into southern Martin County (Smith et al. *In press*. Int. Biodet. Biodegrad.; Smith and Engeman, unpubl.). The U.S. Hwy 1 and Prima Vista Boulevard site likewise is ca. 113 km S of the most northern east coast of Florida population located in Cocoa Beach (Krysko and King 2002. Herpetol. Rev. 33:148); with no allopatric populations yet reported between these two locations.

Submitted by **CHRISTOPHER L. DEAN** and **HENRY T. SMITH**, Florida Department of Environmental Protection, Florida Park Service, 13798 S.E. Federal Highway, Hobe Sound, Florida 33455, USA, and **RICHARD M. ENGEMAN**, National Wildlife Research Center, 4101 LaPorte Ave., Fort Collins, Colorado 80521-2154, USA; e- mail: Richard.M.Engeman@aphis.usda.gov.

PANASPIS (LACERTASPIS) CHRISWILDI (Chris-Wild's Snake-eyed Skink). CAMEROON: TCHABAL MBABO-MASSIF: Summit. January 2000. Andreas Schmitz and Hans-Werner Herrmann. Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany (ZFMK 75735). Verified by Wolfgang Böhme. *Panaspis (Lacertaspis) chriswildi* was previously only known from its type locality, Mt. Kupe, South Cameroon (Böhme and Schmitz 1996. Rev. Suisse Zool. 103:767–774) and from the Takamanda Forest in southwestern Cameroon (ZFMK 68892). The new finding from the Tchabal Mbabo-massif in northern Cameroon represents the third known specimen of the species from this country, and the northernmost record of the species (it extends the known distribution ca. 350 km airline distance to the north). It was caught in gallery forest at 2000 m elev. Besides coloration and pattern, its 26 scales around the midbody, two pairs of nuchal scales, and 18–19 lamellae under the fourth toe are characteristic of *Panaspis (Lacertaspis) chriswildi*. The specimen is a male and has the largest snout–vent length (59.5 mm) so far recorded in this species. The specimen had fallen from a high branch (ca. 15 m above the ground) of a tree, situated at the edge of a small gallery forest.

Submitted by **ANDREAS SCHMITZ,** Zoologisches Forschungsinstitut und Museum Alexander Koenig, Adenaueralle 160, D-53113 Bonn, Germany (e-mail: A.Schmitz.ZFMK@uni-bonn.de).

SCELOPORUS UNDULATUS CONSOBRINUS (Southern Fence Lizard). MEXICO: CHIHUAHUA: Rancho Bros. Brown (= Rancho Los Nogales), Sierra de En Medio (31°10'32.6"N, 108°35'9.7"W), 1461 m elev. 19 September 2002. Julio A. Lemos-Espinal. Herpetological Collection of Unidad de Biología, Tecnología y Prototipos (UBIPRO) 10427–29. Verified by Richard L. Holland. First record for Chihuahua, extending its known range ca. 20 km S from its closest known locality in southwestern New Mexico (Lemos-Espinal et al. 2000. Bull. Maryland Herpetol. Soc. 36:133–138; Lemos-Espinal et al. 2001. Bull. Chicago Herpetol. Soc. 37:29-31). At this time, we do not follow Leaché and Reeder's (2002. Syst. Biol. 51:44–68) assessment that the name of this taxon should be *S. cowlesi*.

Submitted by **JULIO A. LEMOS-ESPINAL** (under CONABIO projects U003, X004, AE003), Laboratorio de Ecología, UBIPRO, Facultad de Estudios Superiores Iztacala, UNAM, Apdo. Postal 314, Avenida de los Barrios, No. 1, Los Reyes Iztacala, Tlalnepantla, Estado de México, 54090 México (e-mail: lemos@servidor.unam.mx); **DAVID CHISZAR** and **HOBART M. SMITH**, University of Colorado Museum, Boulder, Colorado 80309-0334, USA; e-mail: hsmith@colorado.edu.

SERPENTES

AGKISTRODON CONTORTRIX (Copperhead). USA: GEORGIA: FLOYD CO: Dozier Creek. 10 May 2002. Bradley L. Johnston. GMNH 49221. Verified by John Jensen. New county record (Williamson and Moulis. 1994. Distribution of Amphibians and Reptiles in Georgia. Savannah Sci. Mus. Spec. Publ. No. 3, 712 pp.).

Submitted by **BRADLEY L. JOHNSTON**, 341 Bells Ferry Road, Rome, Georgia 30161, USA.

CONOPHIS LINEATUS (Road Guarder). MÉXICO, TABASCO: Boca del Cerro, 7 km NW Tenosique (17°24'54.5"N, 91°29'13.2"W), ca. 200 m elev. 26 January 2002. Imelda Madai Castillo Sánchez. Colección de Anfibios y Reptiles de Tabasco, Universidad Juárez Autónoma de Tabasco (CART 00243). Verified by Luis Canseco Márquez. First record for Tabasco and extends the known range of the species ca. 130 km S of the closest known locality near Ciudad del Carmen, Campeche (Lee 1996. The

Amphibians and Reptiles of the Yucatán Peninsula. Cornell Univ. Press, Ithaca, New York. 500 pp.).

Submitted by **ROSARIO BARRAGAN-VÁZQUEZ** (e-mail: barragan@cicea.ujat.mx), **IMELDA MADAI CASTILLO-SÁNCHEZ,** and **JOSE ROBERTO FRIAS-AGUILAR**, División Académica de Ciencias Biológicas, Universidad Juárez Autónoma de Tabasco, Km. 0.5 Carretera Villahermosa-Cárdenas, C.P. 86990, Tabasco, Mexico.

CROTALUS BASILISCUS (Mexican West Coast Rattlesnake). MEXICO: CHIHUAHUA: Agua Salada (27°22'54.1"N, 108°28'8.6"W), 527 m elev. 2 October 2002. Julio A. Lemos-Espinal. Herpetological collection of Unidad de Biología, Tecnología y Prototipos (UBIPRO 10614–15, skins). Verified by Alan de Queiroz. First record for Chihuahua, extending known range ca. 58 km E from Alamos, Sonora (Bogert and Martín del Campo 1956. Bull. Am. Mus. Nat. Hist. 109:1–238; McCranie 1981. Cat. Am. Amph. Rept. 283:1–2; Campbell and Lamar 1989. The Venomous Reptiles of Latin America. Comstock Publ. Assoc., Ithaca, New York. 423 pp.).

Submitted by **JULIO A. LEMOS-ESPINAL**, under Conabio Projects U003, X004 and AE003, Laboratorio de Ecología, UBIPRO, Facultad de Estudios Superiores Iztacala, UNAM, Apartado Postal 314, Avenido de los Barrios s/n, Los Reyes Iztacala, Tlalnepantla, Estado de México, 54090 México (e-mail: lemos@servidor.unam.mx); **DAVID CHISZAR** and **HOBART M. SMITH**, University of Colorado Museum, Boulder, Colorado 80309-0334, USA; e-mail: hsmith@colorado.edu.

DIADOPHIS PUNCTATUS ARNYI (Prairie Ring-necked Snake). USA: OKLAHOMA: PUSHMATAHA Co: 0.8 km N Albion off US 271. 16 September 2003. Z. D. Ramsey. Arkansas State University Museum, Herpetological Collection (ASUMZ 28003). Verified by S. E. Trauth. New county record (Webb 1970. Reptiles of Oklahoma. Univ. Oklahoma Press, Norman, Oklahoma, 370 pp; Secor and Carpenter 1984. Oklahoma Herpetol. Soc. Spec. Publ. 3:1–57; Oklahoma Biological Survey's Distribution of Oklahoma Amphibians and Reptiles by Recorded Sightings, DOKARRS [http://www.biosurvey.ou.edu/dokasdesc.html]). Fills distributional gap between previous records from adjoining Atoka, Choctaw, Latimer, LeFlore, McCurtain, and Pittsburg counties.

Submitted by **ZACHARY D. RAMSEY** and **CHRIS T. McALLISTER**, Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA; e-mail: chris.mcallister@tamut.edu.

DIADOPHIS PUNCTATUS ARNYI (Prairie Ring-necked Snake). USA: TEXAS: BROWN Co: Camp Bowie, Texas Army National Guard Training Site, Area 7 (UTM: 0508914 E, 3498486 N). 14 August 2002. James A. Holm and Kristina N. Smyth. Verified by J. Kelly McCoy. Angelo State University Natural History Collection (ASNHC) 14035. First county record (Dixon 2000. Amphibians and Reptiles of Texas. Second Ed. Univ. of Texas A&M Press, viii + 421 pp.).

Submitted by **JAMES A. HOLM**, 18719 Woodglen Shadows Drive, Humble, Texas 77346, USA; e-mail: jaz_holm@hotmail.com.

DRYMARCHON COUPERI (Eastern Indigo Snake). USA: Georgia: CLINCH Co: Hwy 84, 0.15 km E of Lanier Co. (30° 57'02"N, 82° 58' 09"W). 13 November 2002. John G. Palis. GMNH 49218. Verified by Elizabeth McGhee. Fresh DOR adult collected at 1715 h. First record for county (Williamson and Moulis 1994. Distribution of Amphibians and Reptiles in Georgia. Savannah Sci. Mus. Spec. Publ. 3:1–712).

Submitted by **JOHN G. PALIS**, P.O. Box 387, Jonesboro, Illinois 62952, USA.

ECHINANTHERA OCCIPITALIS (Spot's Snake): BRAZIL: PARÁ: Município de Santarém (54°42'W and 22°6'S), Cucurunã. September 1996. Museu de Ciência e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre (MCP 7643); Curuatinga, 27 October 1996 (MCP 7904), 9 October 1996 (MCP 7912). R. B. Oliveira. All verified by M. Di-Bernardo. The species is known from northeastern Peru, southeast through Bolivia and Paraguay to northern Argentina, Uruguay, and southern Brazil, then northward along the coast to northeastern Brazil (Di-Bernardo 1992. Comun. Mus. Ciênc. PUCRS, 5[13]:225–256). It also occurs in the Amazonian region of Rondônia State, and the eastern and southern Pará State (Silva Jr. 1993. Herpetol. Nat. Hist. 1:37–86; Cunha and Nascimento 1993. Bol. Mus. Para. Emílio Goeldi, sér. Zool. 9:1–191; Cunha et al. 1985. Publ. Avul. Mus. Para. Emílio Goeldi 40:9–85). First record from the region of lower Tapajós River, extends the known range ca. 513 km from the area of Carajás, also in Pará (Cunha et al., *op. cit.*).

Submitted by **ALFREDO PEDROSO DOS SANTOS-JR.** (e-mail: alphredojr@hotmail.com) and **THALES DE LEMA** (e-mail: crothales@pucrs.br), Laboratório de Herpetologia, Faculdade de Biociências, Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), Av. Ipiranga, 6681 - C.P. 1429, CEP 90619-900, Porto Alegre, Rio Grande do Sul, Brazil.

ELAPHE GUTTATA MEAHLLMORUM (Southwestern Ratsnake). USA: TEXAS: BRAZORIA Co: ca. 2.1 road km W of road 2004 on Hwy 36. 14 May 2000. Clay White. Verified by J. Kelly McCoy. Angelo State University Natural History Collection (ASNHC) 13617. First county record (Dixon 2000. Amphibians and Reptiles of Texas. Second Ed. Univ. of Texas A&M Press, viii + 421 pp.).

Submitted by **JAMES A. HOLM**, 18719 Woodglen Shadows Drive, Humble, Texas 77346, USA; e-mail: jaz_holm@hotmail.com.

LEPTOTYPHLOPS DULCIS (Plains Threadsnake). USA: TEXAS: WARD Co: Monahans Sandhills State Park, ca. 8 road km E of Monahans, Texas (UTM 0705842 E, 3502508 N). 27 June 2002. James A. Holm. Verified by J. Kelly McCoy. Angelo State University Natural History Collection (ASNHC) 14033. Collected in pitfall during 2001–2002 herpetological survey of the park. First county record (Dixon 2000. Amphibians and Reptiles of Texas. Second Ed. Univ. of Texas A&M Press, viii + 421 pp.).

Submitted by **JAMES A. HOLM**, 18719 Woodglen Shadows Drive, Humble, Texas 77346, USA; e-mail: jaz_holm@hotmail.com.

LIOPHIS MARYELLENAE (Cobra d'água). BRAZIL: TOCANTINS: Mateiros municipality: Parque Estadual do Jalapão (10°16'S, 46°50'W). 24 June 2003. Frederico G. R. França. Coleção Herpetológica da Universidade de Brasília (CHUNB 32639). Verified by M. Zats. Northernmost record for the species, previously known from central and southeastern Brazil (Dixon 1985. Proc. Biol. Soc. Washington 98[2]:295–302; Dixon 1987. Ann. Carnegie Mus. 56:173–191; Valdujo and Nogueira 2001. Herpetol. Rev. 32:128–130). First state record, extends range 690 km NW of nearest known locality, Ibicoara, Bahia, NE Brazil (Argôlo 1999. Herpetol. Rev. 30:54).

Submitted by **FREDERICO G. R. FRANÇA**, Departamento de Ecologia, Universidade de Brasília, 70910-900, Brasília, Brazil; e-mail: fredgrf@terra.com.br.

OXYBELIS AENEUS (Narrow-headed Vine Snake, Bejuquilla). COSTA RICA: PUNTARENAS PROVINCE: Cabo Blanco: Refugio Nacional de Vida Silvestre: La Cueva del Murcielago (9°34'08.3"N; 85°06'48.2"W). 27 March 2003. R. A. Hernandez. Department of Herpetology, California Academy of Sciences (CAS-HPV 1, photographic voucher). Verified by Jay M. Savage. First record from the Nicoya Peninsula, Puntarenas Province. Extends the known range (Savage 2002. The Amphibians and Reptiles of Costa Rica, Univ. Chicago Press, Chicago, Illinois. 676 pp.) 60 km W across the Gulf of Nicoya from a record at Playa Jaco (9.616667°N; 84.63333°W), Puntarenas Province and 100 km S from the record at Parque Nacional Palo Verde, Guanacaste Province.

Submitted by **RAYMOND A. HERNANDEZ**, Department of Biology, California State University, Northridge, Northridge, California 91330-8303, USA; e-mail: rah56284@csun.edu.

REGINA SEPTEMVITTATA (Queen Snake). USA: GEORGIA: FLOYD Co: Dozier Creek. 13 April 2003. Bradley L. Johnston. GMNH 49222. Verified by John Jensen. New county record (Williamson and Moulis. 1994. Distribution of Amphibians and Reptiles in Georgia. Savannah Sci. Mus. Spec. Publ. No. 3, 712 pp.).

Submitted by **BRADLEY L. JOHNSTON**, 341 Bells Ferry Road, Rome, Georgia 30161, USA.

RHINOCHEILUS LECONTEI TESSELLATUS (Texas Long-nosed Snake). USA: TEXAS: STERLING Co: DOR, ca. 4.8 road km E of Sterling City, Hwy 87. 3 May 2001. James A. Holm, John D. Hanson, and Neal Jetton. Verified by J. Kelly McCoy. Angelo State University Natural History Collection (ASNHC) 13585. First county record (Dixon 2000. Amphibians and Reptiles of Texas. Second Ed. Univ. of Texas A&M Press, viii + 421 pp.).

Submitted by **JAMES A. HOLM**, 18719 Woodglen Shadows Drive, Humble, Texas 77346, USA; e-mail: jaz_holm@hotmail.com.

SEMINATRIX PYGAEA (Black Swampsnake). USA: FLORIDA: OKEECHOBEE Co: Northwest 144 Avenue, 4.96 km N of SR 274 (27°30'38.4"N, 80°58'24.3"W). 6 September 2003. James U. Van Dyke. Verified by Kenneth L. Krysko. Florida Museum of Natural History (UF 137766). Adult female captured on the road at 2138 h. New county record (Dowling 1950. Misc. Publ. Mus. Zool., Univ. Michigan No. 76. 38 pp.).

Submitted by **JAMES U. VAN DYKE**, Department of Biological Sciences, Florida Institute of Technology, Melbourne, Florida 32901, USA; e-mail: jvandyke@fit.edu.

SIPHLOPHIS COMPRESSUS (Tropical Flat Snake). ECUADOR: CHISPERO: Provincia de Esmeraldas, Cantón Eloy Alfaro (0°47'N, 78°55'W), 190 m elev. 13 March 1998. E. Toral, M. Morales, and A. Ortiz. Universidad San Francisco de Quito (FHGO 1996). Verified by J. Touzet. This is the first record of *Siphlophis compressus* from the western side of the tropical Andes. This species was previously known only from specimens collected at Santa Cecilia in the Amazonian Tropical Forest of Ecuador (Duellman 1978. Univ. Kansas Nat. Hist. Mus. 65:1–135). This specimen extends the known distribution of *S. compressus* 223 km to the west.

Submitted by **EDUARDO TORAL C.** (e-mail: guashote@yahoo.com), **MANUEL MORALES M.** (e-mail: brontotitanotherium@excite.com), and **AIDA ORTIZ P.** (e-mail: vickyortiz19@yahoo.com) Fundación EcoCiencia. Casilla 17-12-257, Quito, Ecuador.

SISTRURUS MILIARIUS MILIARIUS (Carolina Pigmy Rattlesnake). USA: GEORGIA: WILKES Co.: AOR, 16.0 km NE Washington, Georgia Hwy 44. 16 September 1997. Doug Stacks. North Carolina Museum of Natural Sciences (NCSM 58021). Verified by Jeffrey C. Beane. First county record and additional Piedmont record. Partially fills gap between Columbia County record and Fulton County record (Williamson and Moulis 1994. Savannah Sci. Mus. Spec. Publ. 3:1–712).

Submitted by **DENNIS W. HERMAN**, North Carolina Museum of Natural Sciences, 11 West Jones Street, Raleigh, North Carolina 27601-1029, USA.

STORERIA OCCIPITOMACULATA OCCIPITOMACULATA (Northern Red-bellied Snake). USA: KENTUCKY: NELSON Co: Bernheim Experimental Forest, along driveway SE off Pickett's Rd. bordering intermittent tributary of Wilson's Creek, 170 m elev. (37°51.715'N, 85°36.269'W). 4 April 2003. Paul J. Krusling. Thomas More College Herpetology Collection (TMC R261). Verified by Jeffrey G. Davis. New county record based on Meade (1993, Ph.D. Dissertation, University of Southern Mississippi).

Submitted by **PAUL J. KRUSLING, ERIC CHAPMAN, CARRIE JOHNSON, BRIAN KING, CHASE RUNYAN, SARAH SCHERDER, CHRISTOPHER LORENTZ, JOHN W. FERNER** (e-mail: john.ferner@thomasmore.edu), Department of Biology, Thomas More College, Crestview Hills, Kentucky 41017, USA, and **JODI P. FERNER**, Honors Program, Northern Kentucky University, Highland Heights, Kentucky 41009, USA.

TANTILLA NIGRICEPS (Plains Black-headed Snake). USA: TEXAS: WARD Co: Monahans Sandhills State Park, ca. 8 road km E of Monahans, Texas. 15 July 2001. James A. Holm. Verified by J. Kelly McCoy. Angelo State University Natural History Collection (ASNHC) 14043. First county record (Dixon 2000. Amphibians and Reptiles of Texas. Second Ed. Univ. of Texas A&M Press, viii + 421 pp.).

Submitted by **JAMES A. HOLM**, 18719 Woodglen Shadows

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UROMACERINA RICARDINII (Liana Snake). BRAZIL: MINAS GERAIS: Rio Preto Municipality (22°05'21"S, 43°49'40"W). 1991, L. R. de Freitas. Museu Nacional do Rio de Janeiro, Brazil (MNRJ 7078). Verified by Marcos Di-Bernardo. First verified record of this species in the state of Minas Gerais, Brazil (Argôlo 2001. Herpetol. Rev. 32:196–197).

Submitted by **SÍRIA LISANDRA DE BARCELOS RIBEIRO, FERNANDA MAURER D'AGOSTINI,** and **THALES DE LEMA**, Pontifícia Universidade Católica do Grande do Sul, Laboratório de Herpetologia, Museu de Ciências de Tecnologia e Faculdade de Biociências, Cx. Postal 1429, Av. Ipiranga 6681, Porto Alegre, RS, Brazil, 90619-900; e-mail: siherp@hotmail.com.

Herpetological Review, 2004, 35(1), 85.

Herpetofauna of Isla de La Plata, Ecuador

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La Plata is a 14.2-km^2 island situated 27 km from the Ecuadorian coast (01°16'S, 81°06'W). This small island is part of Machalilla National Park, located in Provincia Manabí, and is formed by a volcanic rock base similar to basalt (Tickell 1990). The highest point on the island is 167 m. From December to May, La Plata is characterized by high temperatures and heavy rains, whereas the rest of the year it is dry and cooler. The island vegetation is composed of species typical of Tropical Desertic Thicket (Cuéllar 1991), such as *Cordia lutea*, *Lantana peduncularis*, *Bursera graveolens*, *Capparis flexuosa*, and *Prosopis juliflora*.

The terrestrial herpetofauna of Isla de La Plata comprises three species of lizards and two species of snakes including a new record for Ecuador. These species have been reported for the Ecuadorian western lowlands except for the new snake record (Coloma et al. 2000; Pérez-Santos and Moreno 1990; Torres-Carvajal 2001). Although several species of birds and plants of Isla de La Plata also occur in the Galápagos Islands (Ortiz-Crespo and Agnew 1992; Tickell 1990), none of the species mentioned herein is present in the Galápagos. Fieldwork at Isla de La Plata was conducted in March 1995. In addition, I examined specimens deposited in the Museo de Zoología, Pontificia Universidad Católica del Ecuador, Quito (QCAZ). Luis A. Coloma and Chris Sheil verified the identification of specimens.

Ameiva edracantha. August 1990. A. Carrera, A. Lansdale, and G. Romero. QCAZ 941, 1157; March 1995. M. C. Terán and O. Torres-Carvajal. QCAZ 2847–48; May 1998. X. Cisneros and O. Bastidas. QCAZ 3967. Erroneously reported as *Amevia* sp. by Tickell (1990).

Microlophus occipitalis. August 1990. J. Ashworth. QCAZ 943, 944; August 1990. A. Carrera, A. Lansdale, and G. Romero. QCAZ 1158–60; March 1995. M. C. Terán and O. Torres-Carvajal. QCAZ 2875–77.

Phyllodactylus reissii. August 1990. A. Carrera, A. Lansdale, and G. Romero. QCAZ 942; March 1995. M. C. Terán and O. Torres-Carvajal. QCAZ 2849–51, 2874. Reported as *Phyllodactylus* sp. by Tickell (1990).

Mastigodryas melanolomus. August 1990. A. Carrera, A. Lansdale, and G. Romero. QCAZ 945–46. Erroneously reported as *Liophis albicara* by Tickell (1990) and Núñez et al. (1994). First record for Ecuador; extends range ca. 970 km SW of nearest recorded locality, Ibagué, Departamento Colima, Colombia (Pérez-Santos and Moreno 1988). This new record increases the number of Ecuadorian colubrid snakes to 159 and the number of species of Ecuadorian snakes to 224 (Coloma et al. 2000).

Oxybelis aeneus. August 1990. A. Carrera, A. Lansdale, and G. Romero. QCAZ 947. Reported as *Oxybelis* (*brevirostris* or *seneus* [lapsus for *aeneus*]) by Tickell (1990).

Acknowledgments.—I thank INEFAN for permission to collect in Machalilla National Park in 1995. Fieldwork was partially funded by Fundación Natura, Asociación de Escuela de Ciencias Biológicas (PUCE), Asociación de Escuela de Ciencias Exactas y Naturales (PUCE), and INEFAN. I am grateful to Laura Arcos, Luis Coloma, Gerardo Corrales, María Cecilia Terán, Jean-Marc Touzet, Linda Trueb, Carlos Zambrano, and Machalilla National Park personnel and fishermen for their comments and help.

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BOOK REVIEWS

Herpetological Review, 2004, 35(1), 86–87.

Snakes of Zambia: An Atlas and Field Guide, by Donald G. Broadley, Craig T. Doria, and Jürgen Wigge. 2003. Edition Chimaira, Frankfurt am Main, Germany (distributed in the U.S. by Zoo Book Sales, P.O. Box 405, Lanesboro, Minnesota 55949-0405). Hardcover. 280 pp. ¤ 39.80 (US $ 49.95). ISBN 3-930612-42-9.

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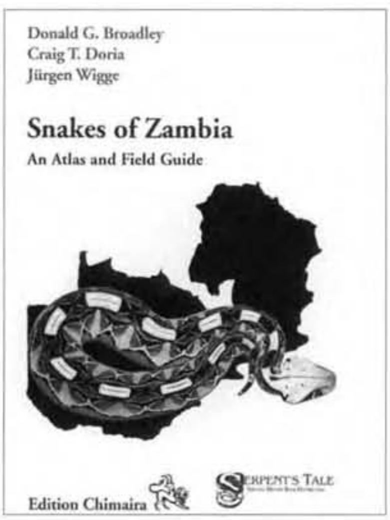

Zambia was once described to me by a cynical traveller as "a thousand miles of featureless bush, sandwiched between two waterfalls," although those falls are Africa's most spectacular, Victoria Falls, on the Zambian/Zimbabwe border, and Africa's highest, Kalambo Falls, on the Zambian-Tanzanian border. Certainly Zambia is a fairly flat country; most of it lies between 1000 and 1600 m elevation on the south central African plateau, although there is a small area of land over 2000 m in the northeast, in the western foothills of Malawi's Nyika Plateau. Much of the country is covered by woodland, dominated by *Brachystegia* trees (Miombo woodland) and Mopane (*Colophospermum mopane*), and rainfall is more or less uniform (800–1600 mm annually) throughout the country. However, the country contains some notable conservation areas and important wetlands. Zambia (formerly Northern Rhodesia) is the bridge between the east African and southern African herpetofauna, and an element of the central African forest fauna also occurs there, extending southwards out of the forest into the thick woodland on the Copperbelt and westwards from there along the border with the Democratic Republic of the Congo. The Zambian snake fauna seems somewhat impoverished—89 species or 0.118 species per 1000 km^2. In comparison, snake species densities for other African countries for which snake faunas are well known include: Uganda (0.402 species/1000 km^2), Kenya (0.206 species/1000 km^2), Zimbabwe (0.202 species/1000 km^2), Tanzania (0.154 species/1000 km^2), and Ethiopia (0.083 species/1000 km^2).

This handsome book fills an important niche in the documentation of the African herpetofauna; a task that is only just getting underway. Previously, little was available dealing directly with Zambian reptiles, save Pitman's speculative checklist (1934), Desmond Vesey-Fitzgerald's enjoyable anecdotal paper on his experiences while based at Abercorn, now Mbala, in northern Zambia (1958), and Wilson's 1965 paper on a big snake collection from eastern Zambia. In 1971 Don Broadley authored what remains the only comprehensive checklist of the reptiles and amphibians of Zambia (Broadley 1971), listing 74 species of snake, and in 1990 Don made a definitive collecting trip to the Mwinilunga area, a small projection extending up into the southern Democratic Republic of the Congo (Broadley 1991), this trip added several new species to the Zambian total. The relevant literature is rounded out by two small locally produced books, one dealing chiefly with common fishes, amphibians, and reptiles (Simbotwe and Mubamba 1993), and another on the snakes of Luangwa Valley (Doria and Nyirenda 1995). Doria, a game ranger in the Luangwa Valley Reserve in Zambia and Wigge, a medical doctor working in Zambia at the time, had the original idea for the volume under review here. They recruited Don Broadley for his systematic expertise and the book is largely the result of his efforts and is stamped with his customary thoroughness and scholarly professionalism.

The book opens with a table of contents (listing all species), a preface, and six pages on "The Zambian Environment," four pages of which are occupied by eight half-page color plates showing Zambian habitats. The text of this last section includes some brief zoogeographical data, mentioning the central African influence and the montane species found on the Nyika Plateau. Interestingly, none of the habitat plates shows a single hill, indicating the flatness of the Zambian landscape. There follows a map of Zambia showing provinces and important localities, ten pages of snake biology, a systematic list (which more or less duplicates the table of contents) and ten pages of keys. The description of the 89 known Zambian snake species occupies the bulk of the book (195 pages). This section includes 162 pictures, all half-page and nearly all color, illustrating 77 species. Each species description opens with a short summary paragraph followed by information presented under the headings: Description, Size, Colour, Distribution and Preferred Habitat, Field Notes, and Comments. For a number of species, especially the dangerous ones, this final section contains some remarkable and enjoyable anecdotes about the snakes, many contributed by Craig Doria, who as a wildlife professional in the Luangwa (one of Africa's most spectacular national parks), had regular close encounters with snakes. I particularly enjoyed the story on page 123 of how a Zambian game scout spat back at a Mozambique spitting cobra and was delighted to find out that the supposed "call" of the black mamba is actually that of the Pigmy Rail. There are some elegant turns of phrase, for example "The large elapids are the kings of African snakes, and … have an intelligent presence when encountered…" (p. 98). Accompanying most of the descriptions (53 of 89) is a set of three line drawings showing the head scales of the species from above, below, and in profile, in the style popularized by V.F.M. FitzSimons.

The book concludes with a 21-page section on snakebite (venoms, antivenoms, notes on individual venomous Zambian snakes and case history details, avoiding snakebite, first aid, medical treatment and use of antivenom), a seven-page bibliography, a two-page glossary, and two somewhat repetitive indices, one of scientific and vernacular names in that order and the other in the reverse order. The back cover is graced by photographs of the three authors. I was greatly pleased to see the one of Don Broadley, one of Africa's most prolific herpetologists but also one its most mod-

est; a published photograph of him is as rare as some of the snakes described in this book.

The book itself is well-written and very nicely produced. It is strongly bound, with good firm covers, and printed on glossy paper. As is usual with Chimaira publications, the photographic coverage is generous, with over 170 half-page color plates. Taken by a variety of photographers, the plates are astonishing. There are snakes here never before illustrated in color, or indeed in any form—animals like *Prosymna angolensis*, *Duberria shirana*, *Grayia ornata*, and *Natriciteres bipostocularis*. There are also color phases that I have never seen before, such as a vivid rufous *Dasypeltis scabra*, a green *Thrasops jacksoni*, a blue-and-orange barred *Philothamnus semivariegatus*, a startling color phase of *Boulengerina annulata* from Stanley Pool, and a curiously dark *Rhamphiophis rostratus*. The last of these is a species I have collected at opposite ends of its range, in Kenya and Botswana, and neither looked anything like the specimen shown here.

The book has a few shortcomings. I am a great believer in the adage "Something is better than nothing," and would rather see a poor picture of a previously unknown animal than nothing at all. In general, too, the quality of illustrations in this book is high, but there are a number which are rather poor. This is acceptable where there is no alternative, but, for example, in the illustration of the *Amblyodipsas ventrimaculatus* (p. 85), the head is out of focus and Don himself has a better picture in his "Snakes of Zimbabwe" (Broadley and Cock 1982). There are also better pictures available of the Bark Snake, *Hemirhagerrhis nototaenia*, than the soft-focus one on page 153. Many of the snakes illustrated are obviously dead, particularly those photographed by Woody Cotterill. These photos were taken on Broadley's expedition to Mwinilunga and the explanation behind them is a story typical of Africa. Don and Woody were crossing the Zambezi Valley and most of these snakes were alive when their Landrover broke down. The snakes died in the intense heat forcing Woody to hurriedly photograph them before Don preserved them by the side of the road.

The picture choice seems overindulgent in places, there are four pictures of *Bitis nasicornis*, a snake of doubtful occurrence in Zambia, and four Puff Adder pictures, none of which were taken in Zambia; a photograph of a Zambian specimen of this common species should have been available. In fact, of the 162 snake pictures, only 61 were actually taken in Zambia, with many of the rest from surrounding countries. The color in some of the pictures is startlingly different to the color of the same pictures as used in "Snakes of Zimbabwe." For example, the Snouted Night Adder (p. 64) is lying on a piece of blue cloth; in the same photograph in the Zimbabwe book the cloth is gray!

There are a few typos and minor errors in the text and some room for additional information. The descriptions of all the species run on without any generic introductions. I felt that a few of the pictures could have been dropped in favor of such accounts, which could give an overview of the genus. A gazetteer would also have been useful to find important localities like Mpulungu, Isombu Stream, and Isoka. Figure 56 is a *Dasypeltis scabra*, not a *Thelotornis*, and I laughed to find *Hemirhagerrhis* (admittedly a difficult name) spelled three different ways on pages 152 and 153, as Don Broadley and Barry Hughes have chided me in print for misspelling this same name (Broadley and Hughes 2000)! There are some odd common names in this book. For example, the authors call *Rhamnophis aethiopissa* the "Splendid Dagger-tooth Tree Snake," a magnificent name but myself and colleagues (Spawls et al. 2001) and Pitman (1974) have called it Large-eyed Green Tree-snake, I don't see any benefit in changing it; the epithet "Splendid" doesn't convey anything specific and a lay observer doesn't see the dagger-like teeth. I like common names, they make the subjects accessible to the layperson. I have coined a few myself, but I feel that they should convey something about the animal, and if a well-used common name exists, it is worth sticking to it (Spawls et al. 2002:27). The pictures in this book (which is what a layperson looks at first) are labelled with scientific names only, making cross referencing with the relevant text more difficult for non-specialists than it need be.

But these are minor criticisms and do not detract from the importance of this sound and professional work. This is a book that all Zambian naturalists will want, as well as all herpetologists interested in Africa. It will raise the profile of the Zambian herpetofauna and, as I never tire of saying, if anything will help save and protect Africa's wonderful and yet severely threatened flora, fauna, and wild places, it is the emergence of enthusiastic local naturalists who feel that the preservation of such things is worthwhile; books like this will help nurture their enthusiasm. The authors and the publisher deserve credit for making this information available in a popular form. I only hope the book will be available in Zambia.

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Erratum

The captions accompanying photolithographs of *Corallus caninus* by Will Brown in the last issue of HR (34:331) were reversed. Thus, the uppermost figure depicts an Amazonian Basin snake, while the lower figure is that of a snake from Guyana.

Herpetological Review, 2004, 35(1), 88–90.

Amphibians and Reptiles of Nepal: Biology, Systematics, Field Guide, edited by H. Hermann Schleich and Werner Kästle. 2002. A.R.G. Gantner Verlag, Ruggell (distributed by Koeltz Scientific Books: koeltz@t-online.de). [2], x + 1201 pp. Hardcover. € 149.00 (US $174.00). ISBN 3-904144-79-0.

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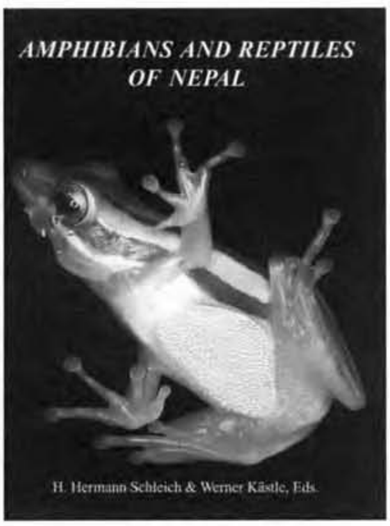

Amphibians and Reptiles of Nepal (*A&R of N*) joins the growing list of field guides, photographic atlases, and natural histories of the Asian herpetofauna. It is a totally different book from any of the other recent volumes on Asian herps, matching—actually exceeding—Zhao and Adler's *Herpetology of China* (1993) in total pagination. Weighing in at 2+ kg, it is a field guide for the laboratory or reading desk, certainly not for the backpack in Nepal's mostly vertical countryside. But Schleich and Kästle were not attempting to provide a guide for the hip pocket or backpack. Their goal was "to compile a summary of today's knowledge on Nepalese amphibians and reptiles." They have succeeded.

Of course, no book of this size and with multiple authors is without some shortcomings. In this case one problem is that the weight of the pages breaks the binding with minimal use. Others will be identified as I examine the different features of *A&R of N*, and I will also offer a few reviewer's laments expressing my desire for some things to have been done differently.

The herpetofauna of Nepal is modest, totaling 52 amphibian and 125 reptilian species (data from *A&R of N*): one salamander, one caecilian, 50 frogs, two crocodilians, 15 turtles, 39 lizards, and 69 snakes. The low diversity of the herpetofauna is not unexpected owing to Nepal's small size (140,400 km^2) and its mountainous landscape with a significant portion climatically unsuitable for herps. The editors note that only 3.17% of Nepal is habitable for amphibians and reptiles. While this precision of habitable area seems overstated and an underestimate (perhaps 31.7%?), the herpetofaunal Lebensraum is small. Nepal consists of a series of east-west stepwise bands of habitat, each of increasing elevation. The terai grasslands are shared with India. Next is a series of low hills that create multiple narrow valleys with a mixture of grasslands and dry evergreen forests. This is followed by a mountain range extending upward to about 2000 m; these mountains form the southern edge of the broad fertile midlands, formerly mainly forested and now largely farmed, with the mountains of the Fore Himalaya (2500–4000 m elevation) on their northern edge. Northward and upward of the Fore Himalaya is the Great Himalaya with landscapes largely inhospitable to herps. The habitable area for herps is also habitable for people and much of it has experienced human usage for hundreds of years. The impact has been increasing steadily since the end of World War II, with expanding human populations in the terai to midland areas because of malarial control and the immigration of Indian farmers. Trekkers arrived in the 1970s and as their numbers increased so did the demand for wildlife and forest resources. The Nepalese government and local conservation organizations recognized the situation and initiated programs to preserve habitats that accommodated the needs of residents and visitors. Even though the programs are not totally successful, they have preserved "wilderness" habitats for much of the wildlife. Preserves, such as the Royal Chitwan National Park, provide habitats for tigers, rhinoceros, and the recently described endemic *Rana chitwanensis*.

More species certainly will be discovered and the diversity of the Nepalese herpetofauna increased further. Two new agamid lizards are described in *A&R of N* and a few frogs and lizards are labeled as unknowns in the photographic plates. It was in Nepal that Alain Dubois recognized the complexities of the *Fejervarya limnocharis* complex; he found three species (*F. pierrei*, *F. syhadrenis*, *F. teraiensis*), two of them new, sympatric in the terai of central Nepal. Multiple Nepalese species likely hide today under a single name in other groups of amphibians and reptiles. In their advice to critics (= reviewers) paragraph, the editors identified four genera, e.g., *Calotes* and *Oriotiaris*, that contain more species than currently recognized. This phenomenon is probably common for most of the widespread South Asian species, because few systematists have examined local and regional variation in Asian species, and those that have quickly recognize a high level of regional speciation. A good example is Wüster's recognition of multiple species of *Naja* in South and Southeast Asia. It is our growing knowledge of the Asian herpetofauna and the expanding literature on this fauna that makes *A&R of N* useful. In addition to summarizing our current knowledge, it serves as a benchmark to assist our decisions on conservation and research priorities.

A&R of N follows the organization of the earlier compendium on the herpetofauna of North Africa by Schleich, Kabisch and Kästle (1995). With that volume, it shares many organizational features, the page layout, color plate quality and formatting, and publisher. The Nepalese volume, however, offers more topics, although similar treatment of the subject matter within the shared topical chapters. This volume also has a broader authorship; 12 authors are identified although I could match only eleven authors with chapters. Authorship is listed only at the beginning of each chapter and not all chapters have their authors identified. The chapters or sections and their authors are: 1) Introduction (authorship unidentified, presumably H. H. Schleich and W. Kästle); 2) The Environment (presumably Schleich and Kästle); 3) Amphibians and reptiles in Nepalese culture and economy (Karan B. Shah); 4) Snakebite avoidance and medical treatment (Klaus Kabisch); 5) Nepal's herpetofauna on a razor's edge between threat and conservation (Tirtha Maskey, Schleich and Kästle); 6) Species list with annotations (Schleich, Christiane Anders and Kästle); 7) Zoogeography of Nepalese amphibians and reptiles (Kästle, Schleich, Indraneil Das and Anders); 8) Special part - Detailed information

on Nepalese amphibians and reptiles (multiple sections devoted to accounts of the families, genera, and species of the herpetofauna). This section is multi-authored: Amphibia (C. Anders); Crocodilia (Maskey and Schleich); Testudines (Schleich and Kästle); lizards (Kästle, except *Draco* [Kalu Ram Rai], *Oriotiaris dasi* n. sp. [Shah and Kästle], *Sitana schleichi* n. sp. [Anders and Kästle], Scincidae [Valery Eremchenkoe]); Serpentes (multiple authors: Boidae including *Python* [Kabisch], Colubridae [Ulrich Gruber], *Coelognathus* and *Elaphe* [Notker Helfenberger], *Elachistodon westermanni* [Das], *Oligodon kheriensis* [Schleich and Kästle], Elapidae, Typhlopidae & Viperidae [Kabisch]); 9) Supplements (= Appendices); 10) Abbreviations and scientific terminology; 11) Literature references; 12) References for text figures; 13) Species index (with nine subsections). Andreas Diener is the listed author without chapter identification. Clearly, the contributions of Kästle and Schleich to this volume are substantial.

The substance of *A&R of N* begins with the second chapter "The Environment" (Note: the numbering of the chapters/sections is mine, not the editors'). This gives a concise introduction to landforms, climate, and life zones; it is not overly detailed but definitely adequate for those unfamiliar with Nepal. The third chapter offers a fascinating and brief introduction to herps in Nepalese religions and legends. It also provides an explanation of the various uses of amphibians and reptiles for medicine and food. The fourth chapter provides an overview of snakebite in South Asia with a focus on Nepal. It contains much information in a compressed presentation. I was surprised to discover that Russell's vipers were not implicated in any Nepal bite incidents, and that cobra and krait bites predominate; in contrast, Russell's vipers are responsible for the greatest number of bites and fatalities in the neighboring Indian state of Uttar Pradesh. This chapter also provides detailed first aid treatments for snakebite; this information is both unnecessary and dated (e.g., including cut and suction). The Nepalese audience requiring this information will not have access to this book and would potentially be harmed by some of the advice. The fifth chapter examines the conservation of Nepalese herps; while a broad brush review of the current situation, it contains a good history of conservation in Nepal and addresses both local use and trade in amphibians and reptiles.

The sixth chapter is "Species list with annotations." The annotations largely address distributional data and species misidentifications. These observations could have easily been incorporated in chapter eight, the taxonomic accounts. Zoogeography is the topic of Chapter 7. The presentation is mainly tabular, e.g., number of species in Nepal and adjacent countries, by elevation, by longitude, and so forth. This manner of presentation affords the reader a variety of distributional tidbits on each species or groups of species, although these factoids are more ecological than biogeographical. The authors begin their "biogeographic" discussion with an examination of centers of radiation for genera, each of which is implicitly accepted as a clade. The centers are subregions of biogeographic regions or realms that are explained in a subsequent section on distributional patterns. It is not clear in the centers or distributional sections how or why a species or genus is assigned to a zoogeographic subregion. The biogeographical analysis is descriptive and based on the *a priori* assignment of species to subregions, resulting in a chapter informative at a most general level.

Chapter 8 is the field guide portion of *A&R of N*. It is also the most extensive section of the book, totaling 915 pages. These pages are packed with information derived from the literature and recent fieldwork, and it is a section to be mined for natural history information on Asian species. It is also a chapter that frustrates me greatly because of data truncation. However, before outlining my frustrations, I must summarize the general organization of this section for readers unfamiliar with the earlier compendium on North African herpetology. Each group (class, order, family, etc.) contains a key if the group is not monotypic for Nepal. Each species account consists of up to 10 major sections (etymology, synonymy and vernacular names, identification, ecology and general behavior, reproduction, geographic range, systematics, subspecies, notes, references); the identification, ecology, and reproduction sections are further subdivided. Each of the higher categories has fewer sections and is notably brief. Page layout is double column; the right column is double the size of the left and is reserved mainly for text, the left column for figures. This page layout works well for the field guide portion where figures occupy most of the right column but is much less effective elsewhere where one third of each page is blank for many consecutive pages.

Text figures are black and white line drawings, functionally and, in most cases, attractively rendered. An idiosyncracy of the Schleich and Kästle compendia is that each page begins with a new Figure 1, thus there are hundreds of Figure 1s, tens of Figure 2s, and declining numbers of Figure 3 and beyond (15 figures on a single page appears to be the high). Legends are succinct and sufficient; they do, however, lack source information. That information is available in the "References for text figures" in the rear of the book. Schleich and Kästle have borrowed broadly from the herpetological literature and created many new illustrations. Each species commendably has its own spot distribution map, and each map is covered with a grid overlay. An additional and useful feature of the maps is that a smaller South Asian map lies below the Nepal map and displays the total Asian distribution of the species. Equally commendable, each spot can be identified by its position on the grid and reference to the alphabetical list of localities in the "Supplement" chapter. Additionally, the first section of the "Supplement" has a list of localities for each species. I applaud the editors on this much attention to mapping and providing the details on species occurrences and the localities. In spite of this massive effort, however, there is a problem that makes the distributional data less reliable or verifiable than it might be. The locality information, aside from that derived from the literature, may or may not be based on voucher specimens. Further, the editors provide no evidence that they checked the holdings of the world's major museums for locality data.

The textual sections of each account are overall data dense but with peculiar lapses. More attention is directed at the etymology of the scientific name and at vernacular names than at the synonymies. Each of the few synonymies checked (I used frogs because of the convenience and currency of Frost's *Amphibian Species of the World* website: http://research.amnh.org/herpetology/amphibia/index.html) lacked one or more primary synonyms. I did not locate an editorial statement that the synonymies were intentionally incomplete. The Identification (= Description) sections contain a broad range of characteristics and these are conveniently arranged in subsections. The presentation is also consistent within genera

and generally within major groups, thereby permitting a ready comparison between congeners. I find fault with two aspects of the Identification. First, it appears that much of the data therein is a composite from throughout the range of the entire species; this fault is particularly unfortunate because widespread Asian species are likely complexes and a summary of the traits in Nepal populations would have been most valuable. Second, the measurement section most commonly presents a maximum length of a male and of a female. Means and ranges are much preferable and should be derived from adult animals only. I also protest the use of only total lengths for snakes. I suspect that if I had a stronger ecological or behavioral interest that I would find similar faults with those sections; however, in my defense and as a commendation to Schleich and Kästle, the amount of information and its methodical organization for these topical areas far exceed that available in similar books.

I did not test the identification keys. They are laudably based solely on external morphology and, in most instances, on traits that can be counted, measured, or differentiated by naked eye and hand lens. Taxonomy and nomenclatural usage are variable in recency and explanation. Part of this variation results, I believe, from the asynchronous completion of the various taxonomic groups as well as the taxonomic inclinations of different authors. Based on the literature cited, some parts may have been completed in late 2000, others in late 1998 or early 1999. For example, the *limnocharis* complex of frogs is now widely placed in the genus *Fejervarya* not *Limnonectes*; the placement of some snake-eyed skinks in *Asymblepharus* has not yet gained wide acceptance (outside the former Soviet Union); and the elevation of the small bodied *Kachuga* subgenus *Pangshura* had not yet been published when *A&R of N* appeared; *Python* is considered a boid with no indication that the author is aware of literature addressing the differences of pythonids and boids.

A set of 127 tripartite photographic color plates separate the amphibian and reptilian taxonomic accounts. Many species are depicted with two or more images. The images at 5.5 x 10 cm are sufficiently large to reveal identification characteristics. Multiple images display variation in color and different aspects of the animals. The quality of the images is generally good, and a significant portion derive from Nepal specimens. As for the Identification section, use of Nepal individuals and samples increases the book's usefulness to those of us who study herps in other parts of Asia. Similarly, I find the habitat and the local consumption-trade images instructive.

The final sections of *A&R of N* include appendices, a bibliography, and indices. I noted earlier the presence of distributional and geographic data in the appendices. The final appendix is a glossary of scientific terms used in the text. The bibliography is extensive, reflecting the broad search of the herpetological literature for information on Nepal amphibians and reptiles. The species or taxonomic index consists of two parts, one arranged as a classification and the second alphabetically. These two include pagination references. The final three indices give Nepali, English, and German vernacular names for the Nepal herpetofauna. Although I am not a strong advocate of vernacular/common names, these indices will be a useful resource for many readers.

An ultimate question must be asked of a book of this size: Is it too large, or rather, did the editors/authors attempt too much? For me, the answer is yes! Multiple, smaller, topically more detailed and focused books would have better served the herpetological and other biological communities. The size of *A&R of N* will prevent most users from taking it into the field. Its cost, while reasonable at 12.5¢ per page, places it out of reach of many biologists and certainly for most Asian ones. Most academic libraries similarly cannot afford to purchase *A&R of N*, so despite its usefulness, its information will be unavailable to the majority of its intended audience. Another fault of attempting to cover all topics in a single volume is that the individual coverage of each topic becomes more superficial, as noted above.

When initially requested to review *A&R of N*, I thought that a comparison with Tej Kumar Shrestha's (2001) recent *Herpetology of Nepal: A Study of Amphibians and Reptiles of Trans-Himalayan Region of Nepal, India, Pakistan and Bhutan* would be useful. Alas, my attempts to find a bookseller who has a copy of the latter have shown that such sellers are as elusive as the yeti. *A&R of N*, in contrast, is readily available. If you have serious interest in the Asian herpetofauna, you should have a copy nearby on your bookshelf.

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Herpetological Review, 2004, 35(1), 90–91.

Turtles, Tortoises & Terrapins: Survivors in Armor, by Ronald Orenstein. 2001. Firefly Books Ltd., 4 Daybreak Lane, Westport, Connecticut 06880-2157, USA (e-mail: service@fireflybooks.com). xi + 304 pp. Hardcover. US $45.00. ISBN 1-55209-605-X.

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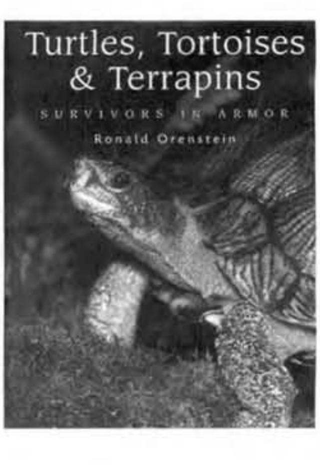

Chelonians have been treated in many field guides, faunal works, taxonomic monographs, and pet care manuals, but relatively few books in English have considered "turtles for turtle's sake." Some notable exceptions include the popular works by Obst (1986) and Lehrer (1990). Orenstein's comment: "I have written this book because turtles amaze me" is evidence that this is another such book. Indeed, it was written to help

the reader to see chelonians as exceptional and unique animals with specific conservation needs. Although the author is primarily a wildlife conservationist and lobbyist, and not a herpetologist, the combination of his passion for turtles ("I have become not just an admirer of turtles but one of their advocates") and his use of knowledgeable consulting editors (Jeanne Mortimer, George Zug, and Peter Pritchard) has resulted in a well-written and accurate text.

The book begins with "The Essential Turtle," an account of the morphology and physiology of turtles, with a particular focus on the shell and its relationship biological functions, such as respiration. Terms potentially unfamiliar to the novice, such as carapace and endochondral bone, are highlighted in italics and many of the terms and concepts are illustrated by photos. Chapter 2, "Turtles In Time," is a review of both the current thoughts on the evolutionary origins of chelonians as well as the history of these thoughts and how we have come to our current understanding. This chapter is illustrated chiefly by color reconstructions of early chelonians. Charts depicting the temporal relationships of various chelonian ancestors and relatives complement the text. This is followed by two chapters ("Turtles Around the World I & II") presenting an overview of family-level diversity of modern turtles. Familial characteristics are described and illustrated and most genera are mentioned and represented by at least one photo.

Chapters 5–7 cover a diversity of issues in chelonian biology, with an emphasis on terrestrial and freshwater species. "Under the Hood" reviews physiology, with an emphasis on topics such as freeze tolerance, hydration requirements, diving abilities, skin surface gas exchange, and circulatory physiology. "Life as a Turtle" outlines major topics in life history and ecology including life span, intelligence, daily and seasonal activity cycles, orientation, food and feeding specializations, habitat specialization, predators, and ecological roles of turtles. Development, egg output, courtship, sex determination mechanisms, nesting area selection, hatching and hatchlings, and the first season of activity are discussed in "Twixt Plated Decks" (a title derived from Ogden Nashe's poem "The Turtle"). A separate chapter, "The Endless Journey," deals specifically with the biology of sea turtles. The last two chapters of the book, "Peril on Land" and "Peril at Sea" document human-related causes of chelonian declines for freshwater and terrestrial forms and marine species, respectively.

I noted few errors in the text and these were limited chiefly to misplaced words. For example, on page 155: "Since animals cannot digest the cellulose in plants, many *plants* enlist the help of cellulose digesting bacteria." In addition there are a few layout inconsistencies. As a result the second page of the preface ("Why Turtles Matter") bears the header for Chapter 1, "The Essential Turtle." Likewise, the header for the chapter "Peril at Sea" runs into the Bibliography, Index, and Photo Credits sections, where it is either printed above those section's headers or replaces them.

It is clear that the author intended the book to be authoritative and, consequently, the research of many individuals is noted in the text. However, because the book was not intended for a technical audience, there are many cases in which there is no formal citation of the particular publications being referenced. For example, there is no bibliographic entry for a paper by Spotila et al. published in Nature in 2000, which is cited on page 277. In some cases it is not possible to determine if the author or one of the consulting editors is relating a personal observation, referring to unpublished work, or to uncited published works. However, all individuals whose work is cited in the text but not listed in the bibliography appear as entries in the index, along with scientific and common names, place names, other animal and plant names, and key anatomical and biological terms.

Illustrations are essential to the author's goal of generating an appreciation for turtles and their diversity. In all there are 303 color photographs (with an additional five on the dust jacket), 12 color illustrations, five black and white photographs, and three black and white illustrations. Seven range maps present distributions at the family level. All of the photos are of high quality and are well reproduced but many seemingly intended to show the whole animal have a foot, tail, or part of the carapace cropped off. Although no photos are duplicated within the book some Australian turtles can be recognized as the same subject animals figured in John Cann's (1998) *Australian Freshwater Turtles.*

With few exceptions, the animals are correctly identified. However, there are some corrections that should be noted: It appears that on page 19 the photos or text have been reversed, the animal on the left is the common snapping turtle, the animal on the right is the helmeted terrapin. The close-up head photo on page 58 is of a *Phrynops* sp., not the giant arrau, *Podocnemis expansa.* The softshell turtle on page 70 clearly shows septal ridges in the nostrils which would indicate this individual as a spiny softshell, *Apalone spinifera*, not a smooth softshell, *Apalone mutica.* The single basking turtle to the mid left on page 115 is a Florida cooter, *Chrysemys floridana.* The Japanese turtle depicted on page 139 more closely resembles *Geoemyda japonica* than *Mauremys japonica.* The upper right photo in the group of four illustrations on page 179 is a *Trachemys concinna*, not *T. scripta.*

While virtually all the photos show typical "wild type" specimens, those of a Chaco tortoise (p. 107) and a Central Asian tortoise (p. 239) exhibit the uneven shell growth associated with captive care. Although most of the photos clearly illustrate key features of the turtles they depict, two different photos of the pancake tortoise (Chapters 2 and 4) show an animal awkwardly posed in someone's hands and, despite their captions, do not show this species' adaptation to rock crevice occupation.

While *Turtles, Tortoises & Terrapins: Survivors in Armor* is not a technical or reference work by any stretch of the imagination, it would serve as an excellent tool for the basic education of many people for whom an understanding and appreciation of turtles would be beneficial. Among this potential audience are conservation policy makers, state and federal wildlife personnel, and public relations personnel with conservation organizations. Hobbyists seeking more than pet care information will find this book a great addition to their library as will non turtle-oriented herpetologists or animal health care professionals.

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Herpetological Review, 2004, 35(1), 92.

The Turtles of Russia and Other Ex-Soviet Republics (Former Soviet Union), by Sergius L. Kuzmin. 2002. Edition Chimaira, Frankfurt am Main (www.chimaira.de; or available from Zoo Book Sales, P.O. Box 405, Lanesboro, Minnesota 55949, USA; www.zoobooksales.com). 159 pp. Hardcover. 34.80 € (US $39.95). ISBN 3-930612-58-5.

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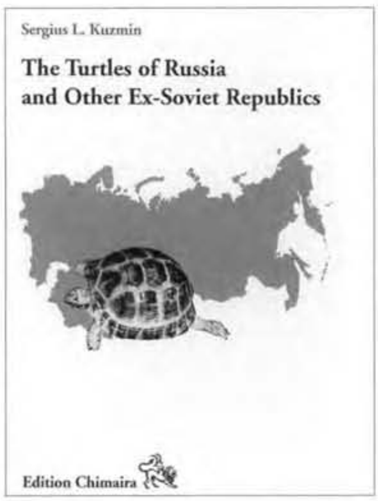

To characterize the chelonians of the former Soviet Union (FSU) as underrepresented in English language literature would be a gross understatement. A major reason for this is that the massive Eurasian landmass is largely unsuited for this order, yielding low chelonian species richness (Iverson 1992). General works (e.g., Pritchard 1979) have provided some coverage of turtles in the FSU, but these have been largely cursory. In light of the conservation concerns surrounding Asian chelonians, this information-packed octavo volume is particularly welcome and should be considered essential reading for those working with the chelonian species of this area, as well as those with even a passing interest in the subject.

The last significant work in English on the chelonians of the FSU appeared more than 40 years ago and was itself a translation of a much earlier work (Nikol'skii 1915). Although a number of minor works in Russian have been published in the interim, this volume is the first complete modern analysis of turtles of the FSU. Kuzmin is primarily known for his work on amphibians and here he has followed the template of his successful *The Amphibians of the Former Soviet Union* (Kuzmin 1999), bringing a unique perspective to the turtles of this politically and culturally diverse region and integrating his own research with past and present Russian research data previously unavailable in English.

Individual accounts for seven widely distributed species comprise two thirds of the book (105 pages). These provide a wealth of information on morphology, differentiation of subspecies, distribution, habitats, habits, parasites, natural enemies, abundance, activity, reproduction, diet, parasites, physiology, and fossil occurrences. For a book of this size to devote such a considerable amount of space to just seven species is astounding. Nikol'skii (1963) used only 30 pages for the ten chelonians he discussed in a similar area. Most other regional works also offer only a few pages per species (e.g., Das 1991 with 84 pages covering 33 species of the Indian Subcontinent; Lim and Das 1999 with 100 pages covering 25 species in Malaysia). Excluding the marine turtles, which lack wide distribution in this region and account for only nine pages with a combined range map, the individual accounts are generous and comprehensive with page counts ranging from eight (*Mauremys caspica*) to 29 (*Emys orbicularis*).

Sections on morphology, adaptation, and classification are very general in nature, differing little from those found in other, similar works. The balance of the book, however, is quite distinctive. One section deals with the history of chelonian herpetology in the FSU beginning with the work of Peter Simon Pallas in the 18th century. This information complements the author's recent review of the amphibians described by Pallas (Kuzmin 1997). Also of note are introductory sections on ethnozoology and zooarchaeology and the extensive data presented on captive care, anthropogenic pressures, commercial exploitation, and conservation topics.

The simple, but effectively designed pictorial boards appear to be quite sound and durable. The photos of the Russian tortoise on the front and habitat on the reverse are a prelude to the diverse and useful contents. The text layout is clear and organized in a convenient format on glossy paper. It is printed in a small, but readable font with well-reproduced photos, tables, maps, and figures. The 159 pages include three tables and 85 figures, including 76 photographs (67 of which are in color) that illustrate the morphology, coloration, and habitat of the seven species included in the book. Six range maps and several line drawings make up the remaining figures. Two of the three tables deal with egg data while the last identifies chelonian localities in nature reserves of the FSU. The book concludes with a comprehensive bibliography of 161 references, the majority in Russian.

The book could have been improved considerably by a capable English translator or editor. Scarcely a page can be read without encountering English irregularities, beginning with the acknowledgments (p. 6; "I thank…for their informations") and continuing throughout the text (e.g., p. 63; "the animals enter the land and spend many hours basking"). The inclusion of an index would also have greatly increased the serviceability of this work. Despite these relatively minor faults, this is a useful volume for both conservationists and hobbyists. The color photos alone justify the purchase price and shelf space for any chelonian bibliophile or researcher. The clear and concise format and wealth of previously inaccessible data reinforces this opinion. I highly recommend this work as an indispensable treatise for all those interested in turtles and tortoises of the FSU and congratulate Dr. Kuzmin and Chimaira for a timely and well-executed production.

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PUBLICATIONS RECEIVED

Non-Erycine Booidea from the Oligocene and Miocene of Europe, by Zbigniew Szyndlar and Jean-Claude Rage. 2003. Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Kraków, Poland (www.isez.pan.krakow.pl). 109 pp. Softcover. ISBN 83-919407-0-5.

This monograph reviews the fossil booid snakes (with the exception of members of the Erycinae) known from 38 middle Oligicene to middle Miocene (25–7 MY) sites in eight European countries from Portugal to Austria and the Czech Republic. The majority of the material is derived from France and Germany, however, and includes representatives of the Boinae, Tropidophiidae, and Pythoninae. The bulk of the work is devoted to descriptions and systematic accounts, including the descriptions of many new species and a new genus, each illustrated by vertebrae and other skeletal structures. This is followed by an overview of the history of the European Booidea during the period and a consideration of factors leading to the extinction of the non-erycine booids in Europe in the middle Miocene. A literature cited section of more than 150 references completes this thorough treatment of fossil European snakes. This contribution should be of interest to paleoherpetologists as well as snake systematists and those interested in historical biogeography.

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HERPETOLOGICAL HUSBANDRY

BOOK REVIEWS

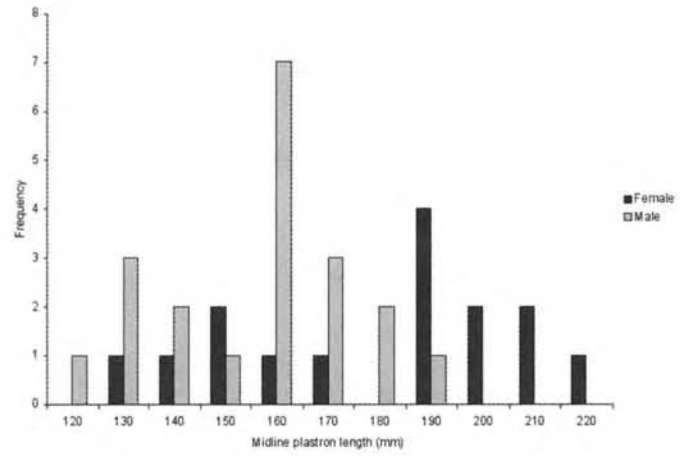

FIG. 1. Size frequency distribution of female and male *T. s. elegans* in Fox Pond.

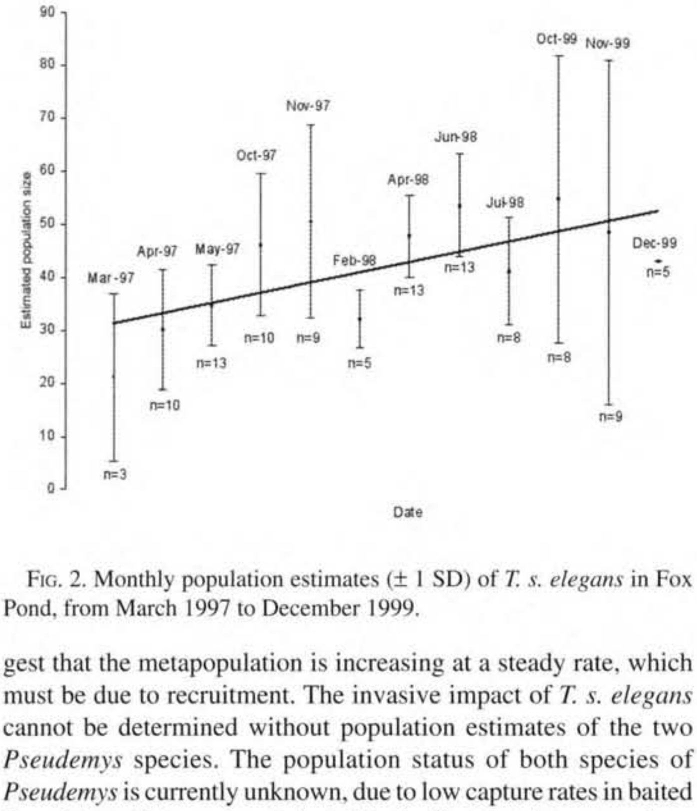

FIG. 2. Monthly population estimates (± 1 SD) of *T. s. elegans* in Fox Pond, from March 1997 to December 1999.

gest that the metapopulation is increasing at a steady rate, which must be due to recruitment. The invasive impact of *T. s. elegans* cannot be determined without population estimates of the two *Pseudemys* species. The population status of both species of *Pseudemys* is currently unknown, due to low capture rates in baited funnel traps that can be attributed to the fact that they are primarily herbivorous.

Acknowledgments—I thank Peter Meylan for his support and guidance throughout this study. Also, thanks to Ecology of Reptiles & Amphibians classes, and the Eckerd Herpetological Society for daily trap monitoring. I thank the Natural Sciences Collegium for their support, and Christopher Boykin and Matt Stone for guidance.

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TECHNIQUES

Herpetological Review, 2004, 35(1), 35–37.

Annual Formation of Growth Marks in a Tropical Amphibian

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Determining the age of individual animals is extremely important for demographic, population dynamics, or life history studies of amphibians (Castanet and Smirina 1990; Hemelaar and van-Gelder 1980; Kusano et al. 1995; Ryser 1988; Smirina 1994). Mark-release-recapture and skeletochronology are generally used for estimating the age of amphibians (Castanet and Smirina 1990; Hemelaar 1981; Halliday and Verrell 1988; Kusano et al. 1995; Smirina 1994). Counting of growth layers in the phalangeal bones is a non lethal (therefore, ideal for live samples) and a good alternative method for mark-recapture (Coles et al. 2001).

The recent reviews on aging of amphibians reveal that most of the skeletochronological studies on the estimation of age and longevity of amphibians emerge from temperate areas (Castanet and Smirina 1990; Esteban et al. 1996; Halliday and Verrell 1988; Smirina 1994). In these species, the marked seasonality in the ambient temperature is known to result in the formation of distinct annual growth rings consisting in broader growth zones (corresponding to faster bone growth in warmer months) and lines of arrested growth or LAGs (corresponding to arrested bone growth in colder months). Alternately, amphibian species inhabiting constant warmer areas or tropics are expected to express the growth marks inconspicuously or less clearly owing to uninterrupted osteogenesis (Castanet and Smirina 1990; Guarino et al. 1998;

Smirina 1994). However, the limited number of skeletochronological studies available on tropical anurans indicate that the growth marks are expressed in these species as clearly as in temperate species (Barbault et al. 1979; Guarino et al. 1998; Kumbar and Pancharatna 2001ab; Pancharatna et al. 2000). Whether these growth rings are formed annually and can be regarded as year rings for the estimation of age, needs experimental data (Esteban et al. 1996; Guarino et al. 1998; Halliday and Verrell 1988). This study is an attempt to determine whether the growth marks of *Bufo melanostictus* are annual. The common toad *B. melanostictus* inhabiting Dharwad, southern India (where annual variation in mean temperature does not normally exceed 10°C) shows growth marks in the phalanges and long bones of limbs (Kumbar and Pancharatna 2001a). Further, our preliminary studies on the frequency distribution of growth marks in randomly collected toads from natural population reveal that the toads belonging to body mass 8–45 g and SVL 4–7 cm (N = 41) showed no LAGs in phalangeal histology (Fig. 1). Therefore, toads belonging to this body size range were chosen for the present experiment.

Twenty-four young toads with body mass of 10–35 g and snout–vent lengths of 4.5–7.0 cm were collected from the Karnatak University campus, Dharwad (15°17'N, 75°3'E) in the last week of March 1999 (beginning of wet season) and were transported to the laboratory. In the first week of April each toad was anesthetized, body mass and length (SVL) were recorded, and the 4th (longest) toe of the right hind limb was clipped and fixed in 10% formalin and numbered serially. The toads were maintained in the laboratory in a shallow tank (210 x 60 x 30 cm) under room temperature (23.4–28.8°C), similar to ambient temperature (23.6–29.4°C). The laboratory has a glass windowpane through which light entered the room throughout the day (day length varied from 11.05 to 13.11 h). Rainfall in this region occurs principally between April and October and ranged from 15 to 161 mm and 44 and 504 mm in 1999 and 2000, respectively. The animals were fed live grasshoppers every alternate day.

The experiment lasted for one year. Twenty-two toads survived until the termination of the experiment. After one year, in the first week of April 2000, each toad was anesthetized, final body mass and SVL were recorded, and the 4th toe of the left hind limb was clipped and fixed in 10% formalin and numbered serially. All the toads were released at the site of capture. Clipped toes were cleaned and demineralized in 5% nitric acid and processed for paraffin embedding. Sections of 8 μm thick were cut on an ordinary microtome and stained with Harris hematoxylin. Mid-diaphyseal sections were chosen for observation under a compound microscope. Diameter of central medullary cavity (MC), endosteal bone (EB), LAGs and periosteal bone margin (PBM) of right and left phalanx of each toad were measured using an ocular micrometer. The extent of bone growth that occurred and the number of LAGs formed during the experimental period were determined by comparing the measurements of the phalanges clipped initially with those that were clipped one year later. Data were analyzed using Student t-test.

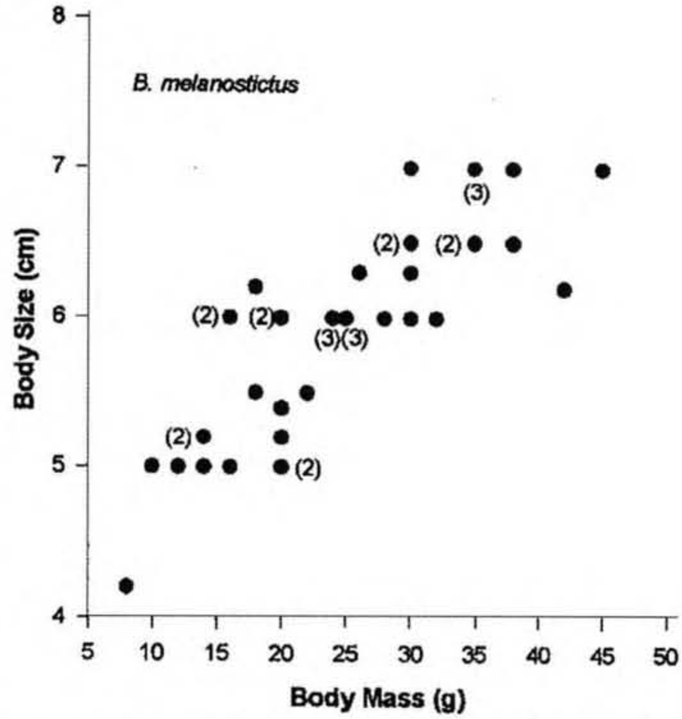

FIG. 1. Relationship between body size (SVL) and body mass (g) of *Bufo melanostictus* which exhibit no LAGs in the phalangeal histology.

At the beginning of the experiment the mean body mass of the toads was 17.2 ± 1.4 g (13 toads weighed between 10 and 15 g; 8 between 16 and 20 g; and 3 between 21 and 35 g), and their SVL ranged between 4.5 and 7 cm with a mean of 5.47 cm (Table 1). The phalangeal histology revealed that in 22 toads, LAGs were completely absent while two toads exhibited one LAG each (Table 1; Fig. 2A). At the end of the experiment, body mass, body length, diameter of MC, EB, PBM, and number of LAGs increased significantly in experimental toads (Table 1). Sixteen toads exhibited 1 LAG and the remaining 6 possessed 2 LAGs each in the cross-section of phalange (Table 1; Fig. 2). In the present study, 18 of 22

TABLE 1. Body mass (g), body size (cm), diameters (μm) of medullary cavity (MC), endosteal bone (EB), LAGs, and periosteal bone margin (PBM) of phalanx of experimental toads obtained at initial and final toe clippings. Values are mean ± $S\bar{x}$.

Toe clipping	Body mass (g)	Body size (cm)	MC	EB	LAG1	LAG2	PBM
Initial (24)	17.17 ± 1.44	5.47 ± 0.16	1039 ± 32	1095 ± 31	1380 ± 180 (2)	—	1588 ± 48
Final (22)	50.15 ± 3.28*	7.03 ± 0.15*	1172 ± 40*	1221 ± 38*	1643 ± 45* (16)	1900 ± 96 (6)	1947 ± 53*

Figures in the parenthesis indicate number of toads. *Significantly ($P < 0.05$) higher compared to corresponding values at initial toe clipping.

toads exhibited an additional LAG (since in two toads the first LAG was already present at the beginning of the experiment and the appearance of a second LAG was expected given the time elapsed). The appearance of a second LAG in the remaining four toads might be explained on the basis that these toads might have been included in the experiment just prior to the expression of first LAG and might have experienced two wet seasons after metamorphosing as adults. LAGs are known to be laid down in tropical species during rainy months (Kumbar and Pancharatna 2001b; Smirina 1994).

Annual formation of LAGs is well established for temperate species such as *Rana temporaria* (Smirina 1972), *Rana esculenta* (Francillon and Castanet 1985), *Bufo bufo* (Hemelaar and van-Gelder 1980), *Triturus cristatus* (Francillon 1980), and *Bufo calamita* (Tejedo et al. 1997). Our study suggests that LAGs are also formed annually in the phalanges of the tropical *Bufo melanostictus*, and therefore could be regarded as annual rings for estimating the age of this anuran.

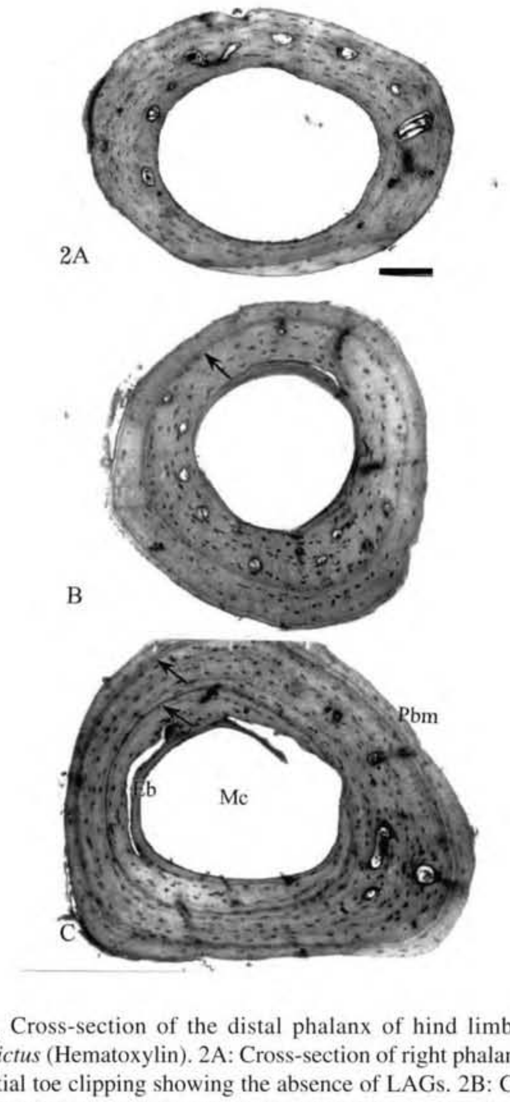

FIG. 2. Cross-section of the distal phalanx of hind limb of *Bufo melanostictus* (Hematoxylin). 2A: Cross-section of right phalanx of toad # 6 at initial toe clipping showing the absence of LAGs. 2B: Cross-section of the left phalanx of the toad # 12 at final toe clipping showing one LAG. 2C: Cross-section of the left phalanx of toad # 17 at final toe clipping showing two LAGs. (MC = medullary cavity, EB = endosteal bone; LAG = line of arrested growth and PBM = periosteal bone margin. Scale line = 100 μm).

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Evaluating Elastomer Marking and Photo Identification Methods for Terrestrial Salamanders: Marking Effects and Observer Bias

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Capture-recapture methods are commonly used in ecology and conservation biology to estimate population size and obtain demographic and life-history information on a wide variety of animals. Most capture-recapture methods require individual identification, and assume that: 1) marks are not lost or overlooked by the observer; and 2) there is no mark-induced mortality.

Amphibians are notoriously difficult to mark because of their sensitive skin, small size, and potential for limb and digit regeneration (Murray and Fuller 2000). Nevertheless, a wide variety of marking methods are available including toe-clipping, tattooing, branding, tagging, skin dying or dusting, and subcutaneous dye injection including Visual Implant Elastomer (Northwest Technology Inc., Shaw Island, Washington). Visual Implant Elastomer (VIE) was originally developed for fish, but has recently been used in studies on larval and adult amphibians (Anholt et al. 1998; Davis and Ovaska 2001; Marold 2001; Nauwelaerts et al. 2000). Less-invasive identification methods such as "pattern mapping" or photo identification are possible for some species, but are used less frequently than traditional marking methods (see Gill 1978; Tilley 1980). Few amphibian studies have evaluated marking effects on behavior and survival rates, or tested the additional assumptions of capture-recapture methods (no mark loss or observer bias). Many amphibian marking studies lack control animals, adequate sample sizes, or sufficient study duration to rigorously assess these marking issues (Donnelly 1994; Murray and Fuller 2000). Estimates of observer bias in mark recognition are exceedingly rare (but see Muths et al. 2000).

In a laboratory study, I evaluated the effectiveness of two marking techniques, VIE and photo-identification, to individually identify *Eurycea bislineata wilderae* salamanders. I documented VIE-mark retention, survivorship, and growth rates of marked vs. unmarked salamanders. I also tested observers' ability to correctly identify individuals using: 1) digital photographs of dorsal spot patterns; or 2) VIE marks viewed with two different lights provided by Northwest Technologies. VIE has never been formally tested on any southern Appalachian salamander species and *E. b. wilderae* is a good candidate due to its relatively small size (metamorphosed snout-vent length, SVL = 20–45 mm), dual life history strategy, and broad geographic range (Bruce 1988; Petranka 1998). Furthermore, *E. b. wilderae* has been designated as a Management Indicator Species (MIS) by the U.S. Forest Service for the southern region. As such, populations of *E. b. wilderae* will be monitored to assess the effects of forest management actions.

Materials and Methods.—In June 2001, 53 metamorphosed *E. b. wilderae* (8 sub-adults < 30mm SVL and 45 adults > 30 mm SVL) were collected from Sevier County, Tennessee, outside of Great Smoky Mountains National Park. Salamanders were temporarily stored in refrigerators at 4–5°C and then transported to a temperature-controlled research lab at the North Carolina Museum of Natural Sciences. I recorded the initial weight, length, age (sub-adult or adult), sex, and any abnormalities for each individual. Salamanders were housed individually in 0.71-liter plastic containers on a substrate of damp paper towels. Crumpled damp paper towels were provided as refuge. Each salamander was fed 6–8 small crickets per week and the substrate was replaced weekly. Fluorescent lights maintained a 12:12 L:D photoperiod and the temperature was maintained at 18°C.

Salamanders were allowed to acclimate for two weeks and on 10 July 2001, salamanders were randomly assigned one of two treatments: unmarked but digitally photographed (control, N = 23 individuals) or marked via VIE (N = 24 individuals). Each VIE-marked salamander was subcutaneously injected at 2 of 4 possible locations (anterior to either hind leg or posterior to either front leg) using 1 of 3 colors (red, orange, or yellow). Salamanders were placed individually in clear zip-loc bags and cooled for approximately 5–10 minutes to reduce movement. Salamanders were constrained against the edge of the bag and marks were administered through the bag with 0.3-cc insulin syringe and needles. Needles were cleaned with 95% ethanol between injections.

Every six weeks from June 2001 to September 2002 salamanders were measured and weighed to the nearest 0.01 g using an electronic scale. VIE-marked individuals were examined for mark migration or mark loss using polarized glasses and Northwest Technology viewing lights.

From mid-October to mid-December (ca. 3–5 months after marking), 15 observers were used to assess observer variation for each identification technique. Observers were primarily graduate students with no formal experience with either photographic or VIE marking techniques, but each observer was given a short 5-minute instruction on the VIE-mark identification. I purposely chose observers that were unfamiliar with salamanders and gave them minimal VIE training only. Therefore, results should represent lower limits of proficiency expected from professional biologists and technicians using VIE-marking techniques in field settings.

I tested the effectiveness of two lights manufactured by Northwest Technologies: a dive light with a blue filter lens and a deep blue 7-LED (light emitting diodes) flashlight. Prior to October 2000 the dive light, with halogen bulb, was included in VIE tagging kits, but Close (2000) found that aged VIE marks in fingerling fish were difficult to see when the batteries were not at full strength. Northwest Technologies has replaced the dive lights with the superior LED lights, but because our field studies were conducted using the dive lights (Bailey et al., *in press* a & b), I tested both lights' ability to detect marks in *E. b. wilderae* salamanders.

To mimic field conditions, salamanders were placed in individual plastic bags and viewed with polarized glasses under a rain poncho. We use the poncho in the field to block out ambient light. Each observer viewed 10 randomly chosen marked individuals with one light (randomly assigned), then lights were exchanged, and the 10 animals were re-randomized and presented to the ob-

server again. Observers were unaware that they were viewing the same individuals with both lights. They were not informed of the differences between the two lights, nor were they told how many marks would appear on each salamander. Observers were allowed to have a reference syringe of each color for comparison during the identification process. Data recorded included the marks observed and the time required to identify the marks.

The same 15 observers were used in the photo-identification experiment. Color printouts of the digital, dorsal view photographs were given to observers. The SVL for each individual was written below its picture to provide a size reference. Salamanders were placed in plastic bags and presented to observers who were asked to match the individual with the correct photograph. The time necessary to identify each individual was recorded for each observer.

Repeated measures analysis of variance was used to compare weight gain and growth among marked and unmarked animals. I tested for the main effects of marking, age (sub-adult or adult), sex, and time as well as the interactions of these factors (PROC GLM with repeated statement, SAS Institute 1999). I used a paired t-test to compare the proportion of correctly recognized VIE marks among the two different viewing lights, and a standard t-test to compare the proportion of correctly recognized salamanders between VIE and photo-identification methods. Because all photographed salamanders were presented to each observer, I constructed a capture history matrix for each photographed individual. Correct identification was denoted with a "1" and incorrect identification was given a "0." In this case, observer results are analogous to sampling occasions in traditional capture-recapture situations. Closed-population capture-recapture models were fit using program CAPTURE (Otis et al. 1978; Rexstad and Burnham 1991) and model selection procedures tested the following competing models: 1) no effects model, M_o (equal identification among salamanders and observers); 2) individual heterogeneity, M_h, (variation among salamanders, but not observers); 3) observer effect, M_t, (equal identification among salamanders, but variation among observers); and 4) variation among both salamanders and observers, M_{th}.

Results.—Six salamanders, 3 sub-adults and 3 adults, died during the two-week acclimation period. Following marking, 5 marked and 5 unmarked individuals died and 1 marked animal escaped. Fourteen of these 16 mortalities occurred within the first 6 weeks of captivity, and only 3 of 8 sub-adults survived to the end of the study. Thirty-six of the original 53 salamanders survived to the end of the study. None of the VIE-marks were lost and marks on surviving salamanders could be identified with either the blue filtered dive light or the 7-LED light.

Marked and control salamanders did not differ in their pre-marking weight (t_{45} = -0.85, P = 0.39) or length (t_{45} = -1.12, P = 0.27). Marking had no effect on either weight gain ($F_{1,27}$ < 0.01, P = 0.98) or growth ($F_{1,27}$ = 0.59, P = 0.45) and none of the interactions involving marking effect were significant (using either univariate and multivariate tests). Both weight and length changed over time (P < 0.01). There was a significant time x sex interaction for the weight response variable (Wilk's lambda = 0.42, $F_{9,19}$ = 2.86, P = 0.03, univariate $F_{9,243}$ = 7.24, G-G adjusted P < 0.01, Fig. 1A) and a significant time x age interaction for the length response variable (Wilk's lambda = 0.39, $F_{9,19}$ = 3.29, P = 0.01, univariate $F_{9,243}$ = 3.50, G-G adjusted P = 0.02, Fig. 1B). Females continued to gain weight throughout the study, but males stopped gaining weight after January 2002 (Fig. 1A).

Mark recognition by observers was high for all identification methods, especially photo-identification (Fig. 2). The type of light did not affect an observer's ability to correctly identify VIE-marked individuals (t_{14} = -0.69, P = 0.50), nor was there a difference between photo-identification and the currently marketed 7-LED light (t_{14} = -1.8, P = 0.08). Observers misidentified VIE-marked individuals on 39 of 300 identification opportunities (10 salamanders x 2 lights x 15 observers). Observers had difficulty finding marks on 3 marked salamanders resulting in 15 misidentifications. One salamander accounted for 10 of 15 missed marks, because one of its marks was quite small. The remaining mistakes consisted of color misidentification (21 occasions) and incorrect mark locations (3 occasions). Observer performance was better using photo-identification where salamanders were misidentified on only 16 of 270 possible occasions (18 salamanders x 15 observers). All observers correctly identified 7 salamanders, 7 salamanders were misidentified once, 3 were misidentified twice, and 1 was misidentified 3 times. Model selection procedure in program CAPTURE suggested that there was variation among observers and individuals (models M_t and M_{th} were equally likely). The proportion of salamanders correctly identified by observers ranged between 0.67–1.00 (mean = 0.94 ± 0.02, N =15 observers).

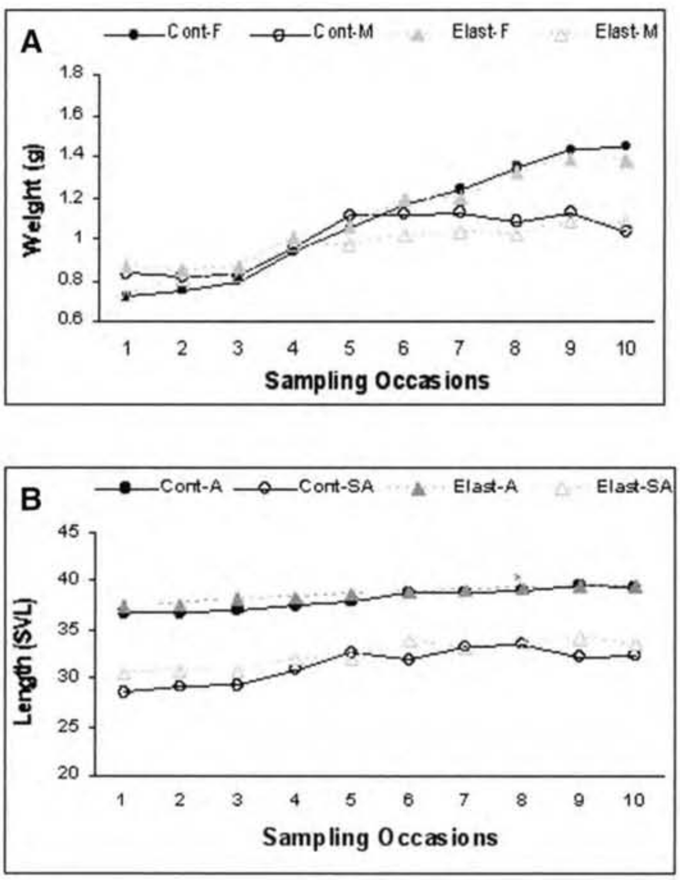

FIG. 1. Average weight (g) of male and female salamanders (A) and average snout-vent length (mm) of adult and sub-adult salamanders (B) sampled at 6-week intervals from July 2001 – May 2002. Cont = Control salamanders; Elast = salamanders injected with elastomer; M = Male; F = Female; A = Adult; SA = Subadult.

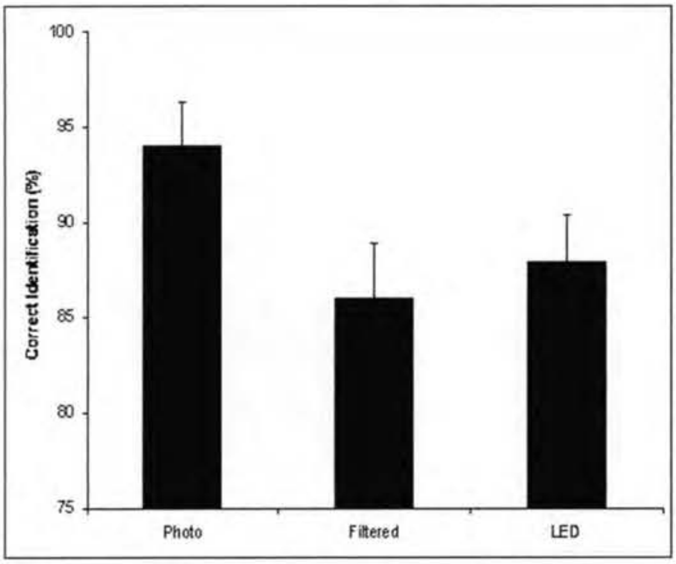

FIG. 2. Average percent of salamanders correctly identified by observers using 3 different methods: photo-identification, VIE-marks viewed with blue filtered dive light, and VIE-marks viewed with deep blue 7-LED light. N = 15 observers.

Observers were able to identify individuals using VIE-marks more quickly than by matching individuals to photographs (VIE mean [sec] = 18.0 ± 0.75, N = 298 identification attempts; Photo mean [sec] = 55.0 ± 3.15, N = 270 identification attempts). Some observers spent over 5 minutes matching individual salamanders to photographs.

Discussion.—Both VIE-marking and photo-identification methods were able to individually identify salamanders and met the critical assumptions necessary for capture-recapture studies. There was 100% VIE-mark retention over 11 months with little mark migration or mark reduction. Only 1 of 18 marked salamanders had a small mark that was consistently missed by observers. VIE marking had no effect on *E. b. wilderae* growth or weight gain, adding to similar findings from studies on western red-backed salamanders, *Plethodon vehiculum* (Davis and Ovaska 2001), and larvae of *Rana* species (Anholt et al. 1998). Marking did not inhibit reproductive development; most of our female salamanders developed eggs during the spring months. Presumably the significant time x sex interaction in the weight response variable was due to egg development. Mortality early in the study may have resulted from stress associated with handling or feeding prey that were too large for the smaller individuals.

There were no differences in observer's ability to detect specific VIE-colors, but observers needed practice to correctly identify the colors. Observers commonly commented that the polarized glasses and viewing lights were necessary to see the VIE-marks, but that the colors looked different when viewed with the lights: red VIE looked orange, orange VIE looked yellow, and yellow VIE looked green. Despite having reference syringes, color misidentification was the most common mistake among VIE-marked individuals (21/39 = 54% VIE misidentifications). When we mark salamanders in the field, the marks are always checked before the salamanders are released, thus new workers are exposed to hundreds of known color marks before they are required to read an unknown VIE-marked individual. This study purposely included minimal observer preparation, and the results represent a lower bound of observer proficiency. The results show that observers with little training can correctly identify about 85% of marked salamanders, and therefore field recognition rates with trained observers are likely much higher.

Photo-identification may be an underutilized identification technique in salamander studies. This technique was used in early salamander studies (Forester 1977; Gill 1978; Tilley 1980), but more recently it has only been used to verify other marking methods (Davis and Ovaska 2001). Advances in camera and computer technologies combined with good observer performance should encourage the use of photo-identification as a primary identification method for species with distinctive marking patterns. Photo-identification would presumably be much more difficult and less accurate with larger numbers of individuals without computer aided matching techniques. Furthermore, photograph quality has been shown to affect matching likelihood (Kelly 2001; Whitehead 1990). Observers in my study commented that picture clarity was good, but glare from the camera's flash and salamander positioning sometimes inhibited identification. It is important to note that observers in my study were not presented unmarked individuals for either marking technique (i.e., unmarked or non-photographed individuals). This is unlikely to affect VIE identification rates, but correct photo-identification rates may have been reduced if unphotographed individuals were also presented to observers. Finally, future studies that explore potential changes in spot patterns over time are still needed (Reaser 1995).

Individual marking or identification methods are rarely tested with adequate controls, sample sizes, or duration. We hope this study design serves as an example of steps that can be explored to assure capture-recapture assumptions are met, regardless of the identification method. This study contributes to the growing body of literature that supports using VIE-marking methods in terrestrial amphibian and reptile species. Future studies that focus on the retention of elastomer marks from larval to adult states would be extremely beneficial for long-term studies of pond and stream-breeding amphibians. Photo-identification also shows good potential as a non-invasive identification technique, especially if samples sizes are small or if computer-aided matching becomes available. Investigators could combine the two techniques in a double-marking format to test for VIE mark retention in field studies.

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Biology of the Rattlesnakes Conference

A conference on "Biology of the Rattlesnakes" will be held 16–18 January 2005 at the Wong Kerlee International Conference Center, Loma Linda, California, USA. Conference topics will include systematics, behavior, natural history, snakebite/toxicology, conservation/management, and research techniques relating to rattlesnakes. A peer-reviewed reference volume is planned, based on presentations at the conference. The conference will be hosted by Loma Linda University's Department of Natural Sciences and Loma Linda University Medical Center. Details can be found at <http://www.BiologyoftheRattlesnakes.org>.

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Fish and Company Smell After Three Days: Increasing Capture Rates of Carrion-Eating Varanid Lizards

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Fourteen of Australia's 44 varanid species are found in the tropical north (Cogger 2000) and are some of the most common and conspicuous predators in tropical ecosystems. Despite this, there is little information on the basic biology of many of these species. One of the factors that may be hindering such studies is the difficulty in obtaining large numbers of specimens from the field.

I describe here a passive trap design devised to increase capture rates of the mangrove monitor *Varanus indicus*, a species whose Australian distribution is restricted to coastal and estuarine mangrove forests of the Northern Territory and Cape York in Queensland (Cogger 2000). In suitable habitat, *V. indicus* can be quite abundant but difficult to sight and even more difficult to capture, because of their effective camouflage and a tendency to climb high into trees (sometimes 10 m or more) when alarmed (pers. obs.). To overcome this problem, a new pipe trap has been developed, providing a simple, sturdy and portable design, suitable for even the most difficult environments.

Many methods have been used to capture free-living monitors. Large monitor species that can be easily approached can be noosed (*Varanus mertensi, V. gouldii*, J. Koenig, pers. comm.) although this method can result in injury to the animal (pers. obs.). Monitors can also be dug from or trapped outside their burrows (e.g., *V. gouldii*, King 1980) but this method is somewhat labor-intensive and destructive to habitats. Some species (*V. tristis*) have been caught by following their tracks in the sand to their resting sites (Thompson et al. 1999). However, for large, wide-ranging species and those using habitats where it is difficult for humans to move about freely, conventional active capture techniques cannot be employed.

Passive capture methods have proved effective for some varanid species. Pitfall traps have been used to capture *Varanus brevicauda, V. eremius, V. gilleni, V. gouldii,* and *V. tristis* (Downey and Dickman 1993). Passive nooses (set in likely travel corridors) have been used for the elusive rock-dwelling species *V. glebopalma* and *V. glauerti* (Sweet 1999). While effective, these methods require constant monitoring (three times daily), a task unachievable over large areas, and are unsuitable in tidal environments such as mangrove systems.

To circumvent the problems posed by tides, Auliya and Erdelen (1999), after experimenting with many methods, devised a floating carrion trap (box trap) to capture the large water monitor *Varanus salvator*. These traps were baited with fish or chicken viscera and relied on a monitor entering the trap, grabbing the bait and triggering a mechanism to close the door behind it. Although effective, these traps were large, were erected on site and took 5–7 days to construct using local materials (bamboo and wood). Erecting large numbers of traps of this type is likely to prove prohibi-

tively expensive. In north Australian estuarine environments, the estuarine crocodile (*Crocodylus porosus*) may be attracted to and possibly interfere with carrion traps, as well as posing a risk to field workers.

To overcome the weaknesses of these previous designs, I devised a baited arboreal pipe trap. The traps were made from 1 m lengths of PVC stormwater pipe, sealed at one end with PVC push-on end caps. Traps are placed vertically with the sealed end at the bottom and rely on gravity and the smooth sides of the pipe to prevent escape of varanids entering them. Traps could be made with practically any diameter, depending on the size of the target species. To allow drainage of water after heavy rains and facilitate spread of bait odors, three 6 mm holes were drilled through the end caps and three near the base (ca. 100 mm from the end cap) at equal intervals around the pipe. The lip of each trap was filed smooth to remove the sometimes sharp edges created when cutting from a larger length of pipe. Depending on the availability of materials (new vs. secondhand pipe, etc.), these traps were quite inexpensive to produce.

Traps were strapped vertically on trees using 10 cm wide adhesive tape. Attachment was quick and the trap and animals readily removed by simply cutting the tape with a sharp knife. Brightly colored tape was used to increase the visibility of traps when searching for them in dense forest. If the traps were placed high enough in trees they could be left set, undisturbed by the raised water levels caused by tidal or seasonal influences. However, low-set traps present no risks to these semi-aquatic animals because they are able to escape the trap as water levels rise. High set traps were checked once each day with a small hand held mirror, used to peer into the entrance.

To test the effectiveness of the design, twelve pipe traps of two different diameters were used (six 150 mm and six 225 mm). These were set within a 2 ha patch of estuarine mangrove forest on the Adelaide River, 70 km E of Darwin. Trapping took place over six consecutive days in early August 2001. Traps were baited with a small amount of meat or fish and placed vertically on the main trunk of mature mangrove trees (predominantly *Avicennia marina*, *Sonneratia lanceolata* and *Xylocarpus mekongensis*).

Pipe traps of both sizes were found to be highly effective for this species, with an overall trap success rate of 50% (36 captures in 72 trap days). Daily trap success rates (from 12 traps) ranged from 8% (1 capture) to 75% (9 captures). These results compare very favorably with previous hand-noosing results for *V. indicus* from the same area, which on average yielded less than one successful capture per day. Traps were found to be safe, with no trap mortality and no obvious trap-related injuries. No trapped animals appeared to be agitated or exhausted on removal and release.

The effectiveness of these traps appears to be related to the pungency of baits used, as strong-smelling baits (rotting fish) tended to catch more individuals (Fig. 1). Traps set with less "smelly" food items (pork or lamb cuts, or recently bought fish) caught no animals. Animals were captured more frequently when fish had been in the traps for extended periods (i.e., once it had begun to decompose). Recaptures occurred both at the same trap and at different trap locations. On two occasions two animals were captured in the same trap.

As many other Australian varanids are attracted to carrion (*Varanus gouldii*, *V. panoptes*, *V. rosenbergii*; King and Green 1999;

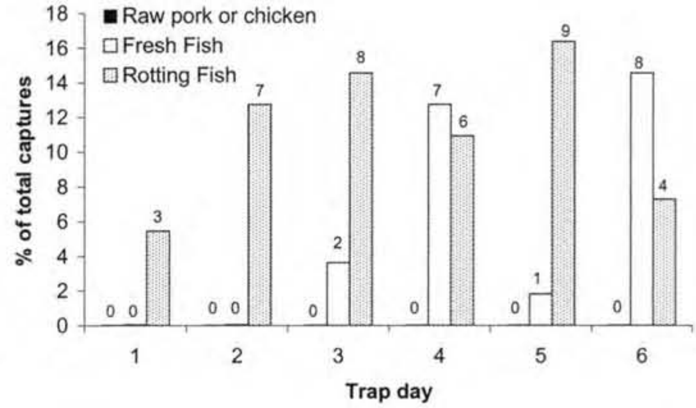

FIG. 1. Number of captures of *Varanus indicus* using different baits in pipe traps (12 traps, 6 trap days per session). Numbers above bars indicate actual numbers caught. Baits were retained unchanged for the 6-day sampling period. Raw pork or chicken caught no *V. indicus*.

pers. obs.), these traps may prove to be useful in other habitats where conventional methods cannot be applied. Care should be taken, however, to use the appropriate attractants. Decomposing fish was found to be most effective for this study, possibly due to the rancid odors that can be produced from small quantities of fish (Richards and Hultin 2001). While this trial used arboreal placement, the pipe trap design can readily be adapted for use in rocky environments or even in-ground use when matched with an auger of appropriate diameter. As in this study, consideration must always be given to the welfare of captured animals, to ensure that trapping does not expose them to risks of drowning, suffocation, temperature extremes or predation (particularly by insects). This may be done simply by appropriate trap placement, but in some circumstances other refinements will be necessary such as ant barriers, or rain hoods.

In conclusion, this new pipe trap design has provided an effective, yet affordable method for increasing capture rates of *V. indicus* and thereby enhancing research on this little-studied and secretive species. Baited pipe traps may also prove to be of similar utility in the capture of other carrion-eating varanids, allowing the establishment of highly informative mark-recapture survey and monitoring programs.

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Evaluation of Field Measurements of the American Alligator for Use in Morphometric Studies

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Long-term data typically are collected by different people under varying field conditions, resulting in data sets that are difficult to standardize. Several researchers have examined this problem in varied taxa, such as birds (Arendt and Faaborg 1989; Grant 1979; Yezerinac et al. 1992; Zink 1983), bats (Palmeirim 1998), and snails (Bailey and Byrnes 1990). However, they have used museum specimens or shells. Data for live animals are even more difficult to standardize. The most common data collected on crocodilians are morphometric measurements (e.g., head length, snout–vent length, total length, and mass). These measurements are used in a wide range of analyses, from ecological to taxonomic to evolutionary (Chabreck and Joanen 1979; Hall 1991; Hutton 1986). However, these analyses are only as accurate as the data from which they are derived.

We performed morphometric measurement trials on the American alligator, *Alligator mississippiensis*, to quantify inter-measurer error and determine which morphometric measurement had the least measurer error associated with it. This is necessary to increase confidence levels in future analyses.

Two trials were performed: 1) measurers were inexperienced volunteers; 2) measurers were experienced alligator biologists. The inexperienced trial was performed in the fall of 2000 using ten alligators captured at Arthur R. Marshall Loxahatchee National Wildlife Refuge (Loxahatchee) located in Boynton Beach, Florida (USA), with six groups of volunteers. Alligators were located by observing eye shines from an airboat in the marsh interior and captured using a wire snare. Alligators were secured in the boat and brought back to a covered area for measurement. Alligator size varied from 108 to 248 cm total length. The volunteers consisted of Loxahatchee staff, University of Florida employees, U.S. Geological Survey employees, and students from Palm Beach Atlantic Community College. Each group consisted of 4–6 people who were given both verbal and written measurement instructions. Each group measured every alligator. Different individuals within the group took measurements of each alligator, but measurements were agreed upon within the group before being recorded. Participants were allowed to collaborate within but not between groups. The following were measured by each group on every alligator: head length (HL), snout–vent length (SVL), total length (TL), right hind foot length (HFL), neck girth (NG), tail girth (TG), chest girth (CG), and mass. HL was measured dorsally, while SVL and TL were measured ventrally. A measurement kit was provided with every alligator that contained the following: a clipboard, pencil, string for measuring tail girth between scutes, a Pesola scale, and a flexible centimeter sewing tape. These kits stayed with the alligator so that the same equipment was used. Measurements were made with the flexible sewing tape to the nearest 0.1 cm. Mass was measured with 10–50 kg Pesola scales to the nearest 0.1 kg. The scales were calibrated before use using a weight of known mass. Before release, alligators were marked with individually numbered size 3 Monel tags in the webbing of the back left foot, and scute clipped for permanent identification.

The second trial was performed in fall 2001 with experienced alligator biologists. Nine alligators ranging from 156 to 255 cm TL were captured at Loxahatchee and used for the trial. Ten biologists measured each alligator using the same procedures and instructions as in the previous experiment with three exceptions: 1) each individual measured every alligator and was not allowed to discuss their findings; 2) the participants worked in groups of two to facilitate measuring; and 3) each person recorded their own measurements to reduce bias in and among groups.

Data were analyzed to determine which measurements were most reliable, or contained the least percent measurement error (%ME). Differences in reliability between experienced and inexperienced groups were evaluated using coefficient of variation. Standard deviation for each measurement was calculated and divided by the mean of that measurement for that alligator. A T-test was performed on the coefficients of variation to compare the reliability of experienced and inexperienced measurers. Six of the experienced measurers were randomly chosen so that the N in the T-test would be equal to the six groups of inexperienced volunteers.

The results of the T-test (Table 1) suggest that experienced indi-

TABLE 1. T-test results for coefficient of variation of experienced individuals versus inexperienced groups of volunteers. * Denotes significant value ($p < 0.05$).

Measurement	P-value
HL	0.046*
SVL	0.098
TL	0.129
HFL	0.758
CG	0.010*
NG	0.284
TG	0.015*
Mass	0.010*

viduals measure more accurately for HL, CG, TG, and mass than groups of inexperienced volunteers. There is no statistical difference for SVL, TL, HFL, and NG.

Percent measurement error was calculated for the experienced group to determine which measurements are more reliable for morphometric studies. Bailey and Byrnes (1990) pioneered the use of Model II ANOVA and ANCOVA to estimate within-individual and among-individual components of covariance and variance to predict percent measurement error. A Model II ANOVA and ANCOVA was run as a part of the SAS NESTED procedure (SAS Institute, Inc. 1988), according to the Bailey and Byrnes (1990) procedure. The among-individual variance was calculated by the following equation (Yezerinac et al. 1992):

$$s^2_{among} = (MS_{among} - MS_{within}) / m,$$

where MS is the mean squared deviation and m is the number of repeated measurements. Covariances were calculated as follows:

$$r_{x.y\ among} = (cov_{x.y\ among} / sx_{among}\ sy_{among}).$$

%ME was then determined by:

$$\%ME = 100\%\ (s^2_{within} / s^2_{within} + s^2_{among}).$$

TABLE 2. Within alligator variance and covariance components for length and volumetric measures. Diagonal elements are variance components represented by percent measurement error (%ME). The off-diagonal elements are covariance components represented by within-gator correlations (rwithin).

	HL	SVL	TL	HFL	NG	CG	TG	Mass
HL	0.79							
SVL	-0.07	1.52						
TL	0.02	0.01	3.88					
HFL	0.09	-0.15	0.01	49.53				
NG	-0.04	0.16	-0.15	0.14	7.64			
CG	-0.03	0.10	0.16	-0.22	0.31	4.89		
TG	-0.06	0.09	0.10	0.10	0.63	0.40	2.93	
Mass	-0.08	-0.08	0.09	0.04	-0.25	-0.10	-0.13	0.50

Percent measurement error ranged from 0.50 to 49.53% (Table 2). HFL had the highest %ME because the landmarks used for the measurement are not easily located. TL was also relatively high. TL should be one of the most reliable measurements, as it is the largest and allows for greater margin of error. It is interesting to note the high covariance that NG and CG share with the other volumetric measurements.

This assessment can be used as a guide for future crocodilian studies that use morphometric measurements, such as the analysis of growth rate and condition. If performing morphometric analysis using data obtained by inexperienced groups, it would be more accurate to use TL, SVL, or NG. For experienced individuals, HL, SVL, TG, or mass should be used. For example, condition factor analysis requires a skeletal measurement and a volumetric measurement. SVL would be adequate for the skeletal measurement regardless of who collected the data, but more care should be taken in choosing the volumetric measurement. If these trials were to be replicated, it would be useful to modify the design so that each individual would take three or more measurements of each measurement for each alligator. This would provide data to quantify intra-observer error.

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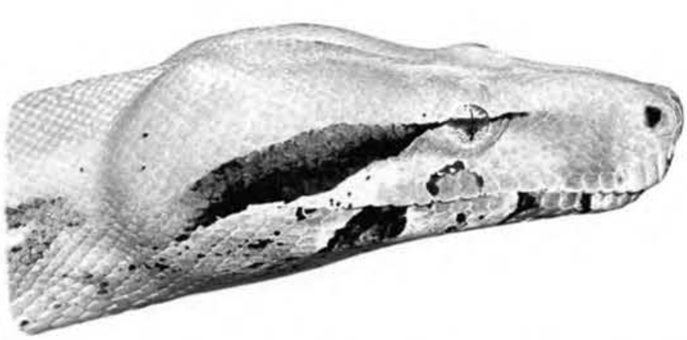

Boa constrictor (Common Boa). Captive specimen derived from Surinam stock. Photolithograph by Will Brown.

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Use of Artificial Egg Laying Substrate to Detect California Tiger Salamanders (*Ambystoma californiense*)

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Many techniques have been used when surveying for the presence of California tiger salamanders (*Ambystoma californiense*) and other amphibians. Night spot-lighting, dip nets, seines, cast nets, drift fences, pit-fall traps, cover boards, and visual and auditory observations have all been used to determine amphibian presence (Bean 1999; Brode 1997; Corben and Fellers 2001; Fellers and Freel 1995; Heyer et al. 1994; Langton 1989; pers. obs.). In 1997 a protocol was developed by the California Department of Fish and Game to survey for the California tiger salamander (Brode 1997). The protocol recommended using land transects for adults, and aquatic larval surveys using dip nets and seines. In 1999 an addition was made to the protocol, which included the use of minnow traps to detect larvae (Bean 1999). The minnow traps facilitated the detection of larvae in deep or heavily vegetated ponds and wetlands.

Although many amphibians demonstrate species-specific preferences with respect to oviposition sites (Beebee 1997), *A. californiense* may deposit its eggs on stones, twigs, submergent and emergent vegetation, and other debris on the bottom of ponds or wetlands (Stebbins 2003). This behavior offers the opportunity to supply artificial oviposition sites that can then be used to detect the presence of this salamander. Recommended here is a technique that allows for detection of *A. californiense* without risk of mortality to salamanders and other amphibian larvae, and with a great reduction in time expended.

A grid was constructed from 13-mm (1/2 inch) polyvinyl chloride (PVC) tubing and 3-mm (1/8 inch) nylon cord. Tubing was cut into two 1-m lengths and two 0.5-m lengths and joined together in a rectangular shape with PVC glue and fittings (Fig. 1.). Around the perimeter of the rectangle, 6-mm (1/4 inch) holes were drilled at intervals of 10 cm. The nylon cord was drawn through the holes, woven over and under one another, and tied at the ends to keep the cord in place. A 45-cm (18 inch) length of foam pipe insulation (used by plumbers to prevent 1/2 inch pipe from freezing) was glued around one of the shorter lengths of the grid tubing.

Egg grids were placed in perennial and ephemeral ponds prior to and during the breeding period for *A. californiense*. Typically the grid was placed within 2 m of the shoreline and secured to a small wooden stake with a length of nylon cord. One end of the grid floated while the other end sank toward the bottom (Fig. 2.). Grids were checked every 7–10 days and eggs were identified and counted.

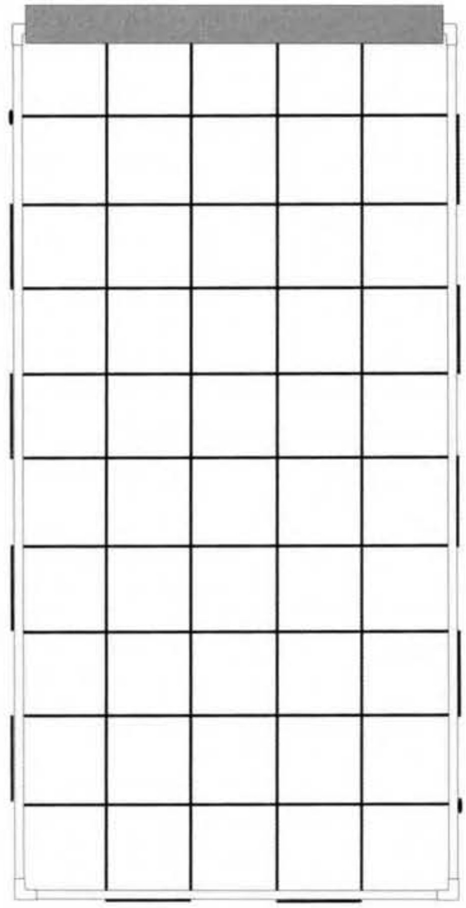

FIG. 1. Rectangular PVC egg grid with nylon cord alternately woven as shown. Foam insulation attached to the upper portion provides flotation.

At the Los Vaqueros Watershed, Contra Costa County, California, visual surveys, minnow traps, seines, and dip nets were used to determine the presence of *A. californiense* in (up to) 90 perennial and ephemeral ponds. Surveys for the presence of *A. californiense* were made during six different years between 1989 and 1999. Within those years, the number of ponds that were reported to have *A. californiense* ranged from 2 to 30 (average = 13.8 ponds). During the winter of 2000–2001, the same ponds were surveyed using egg grids and the presence of *A. californiense* was observed in 69 of 90 perennial and ephemeral ponds. Eggs

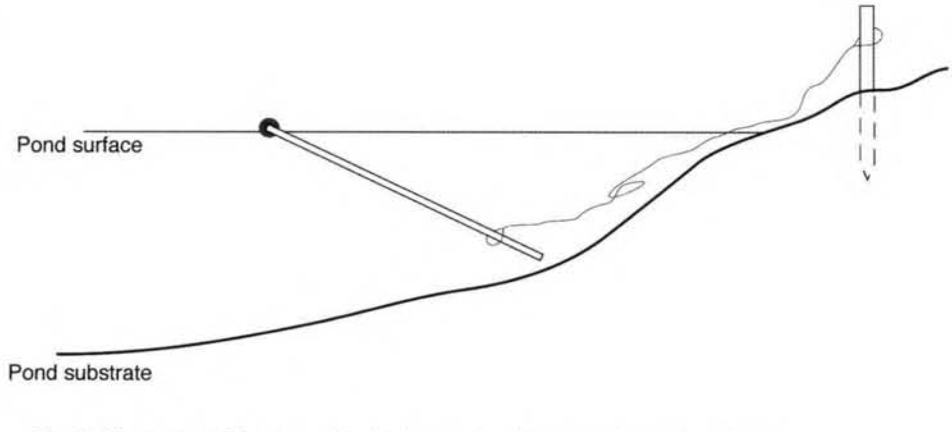

FIG. 2. Placement of the egg grid within a pond with an attachment to a stake.

were present on grids from mid-November through late-February. Presence of eggs on the egg grid was the sole or primary source of identification in 49 of the 69 ponds. Egg identification confirmation was made by the examination of larvae later in the season.

A note of caution: considerable care should be taken when examining habitat within the range of the introduced tiger salamander (*A. tigrinum*; Bean 1999). Under these circumstances neither eggs nor larvae should be used for species identification. Genetic testing should be used to discriminate between these species.

The addition of this technique to the survey protocol may increase detection of *A. californiense*, particularly in turbid water bodies. Additionally, it can reduce or eliminate the need for Federal 10(a)(1)(A) permit for take of California red-legged frog (*Rana aurora draytonii*) larvae that are sympatric with *A. californiense*. Further, many ponds can be surveyed simultaneously with relatively little time expended and a marked reduction in potential mortality.

Acknowledgments.—I thank W. K. Weber for her contributions to the design of the egg grids and for her helpful comments on the manuscript; M. van Hattem for his insightful observation and comments; and J. L. Alvarez for her helpful comments on the manuscript. I thank the Contra Costa Water District for support.

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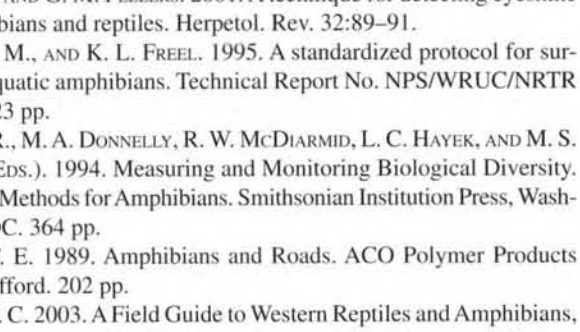

Eleutherodactylus verecundus. Female, 30 mm SVL, with clutch of 18 eggs. Colombia: Nariño, Reserva Natural La Planada. Illustration (from a photograph) by Fernando Vargas Salinas.

HERPETOLOGICAL HUSBANDRY

Herpetological Review, 2004, 35(1), 46–49.

Proximate Cues for Ovarian Recrudescence and Ovulation in the Brown Treesnake (*Boiga irregularis*) Under Laboratory Conditions

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The reproductive biology of the brown treesnake (*Boiga irregularis*), an invasive tropical species known primarily for the extensive ecological damage it has caused on the island of Guam (Savidge 1987), is poorly understood. This is not for lack of sampling effort by researchers—it is simply because reproduction apparently occurs in all months of the year (Rodda et al. 1999) and periodic sampling in such systems cannot detect the phenology of major reproductive events (e.g., ovarian recrudescence, ovulation, oviposition) and other important life history attributes (e.g., frequency of reproduction). In such systems, repeated observations of individuals may be the only recourse for obtaining such information. Accordingly, we recently established a captive colony of brown treesnakes at our facilities and were able to successfully induce reproduction in a number of females (Mathies and Miller 2003). Here, in our second effort to induce reproduction in this colony, we report on the phenology of ovarian recrudescence, the conditions that initiate this process, and the possibility that copulation may be necessary to induce ovulation.

Details on origin, husbandry, and procedures for mating of the snakes in this study are the same, or similar, to those given in Mathies and Miller (2003). Snakes in our colony (10 males, 15 females) were collected as adults on Guam and are the same individuals used in a previous breeding study (Mathies and Miller 2003). Because of space limitations, snakes were housed in two adjacent rooms. Temperatures in the rooms were thermostatically controlled and no other heat sources were available to snakes. Differences in air temperatures between the two rooms were unintended and due to equipment malfunction (Fig. 1). Overall mean temperatures during the study period, however, were similar (Room A: 22.8°C; Room B: 22.9°C). Relative humidity in both rooms was maintained at about 80%. Room lighting was provided by fluorescent bulbs and the photoperiod was 12L:12D. The time of year this study was conducted was chosen out of convenience. Dates provided herein should not necessarily be taken to imply that the brown treesnake is more likely to become reproductive at

this time of year than any other.

Mating trials were conducted by placing a female in the cage of a male and then observing the pair for at least 30 minutes for courtship behaviors. Trials were conducted in near darkness and pairs were observed using Sony CCD-TRV58 video cameras equipped with infrared light emitters (Sony Electronics Inc., New Jersey, USA.). Trials were conducted at approximately 14-day intervals beginning on 7 November 2001 and ending on 3 March 2002. Each female was placed with a male once during each group of trials and with a different male each time. In the majority of trials, males showed little or no interest in females. Males performed dorsal advances followed by tail searching behavior in only four trials with no one male or female participating more than once. These four trials were distributed fairly evenly throughout the period of mating trials. There were no successful intromissions. We assume the males were in adequate reproductive condition because these same males were highly attracted to females when kept under similar environmental conditions to those used here (Mathies and Miller 2003).

Females were palpated for the presence of enlarged ovarian follicles on one to two occasions within 30-day intervals beginning on 8 January 2002 and ending on 3 July 2002. The method for palpating females was quick and relatively unobtrusive; it simply involved lifting an individual from its cage and then feeling for follicles as it crawled back into its cage. We were first able to detect enlarged follicles in a few females approximately three months after the end of the cool period (Fig. 1). Within two weeks of that examination, all eight females in Room A had enlarged follicles and six of the seven females in Room B had enlarged follicles. At this time all such females contained follicles judged to be at least 30 mm in length, which is about the size of brown treesnake eggs (Mathies and Miller 2003; Rodda et al 1999). Thus, follicles were presumably at, or close to, ovulatory size. The number of follicles per female was not related to female body mass (Linear regression: $R^2 = 0.08$, $P = 0.35$), which was somewhat unexpected, but we did not measure snout–vent length, which is generally a better predictor of reproductive investment. There was no difference between rooms in the number of follicles per female (Mann-Whitney U-test: $P = 0.85$, $U = 22.50$). The modal (and maximum) number of follicles per female was nine. The frequency of females with respect to their follicle count is shown in Fig. 2. The numbers of follicles per female we observed are in line with clutch sizes reported for females from the Guam population (Mathies and Miller 2003; Rodda et al 1999) suggesting that these numbers are translatable to clutch sizes. The first examination where we noted females with either no palpable follicles, or flaccid-feeling follicles, occurred approximately two months from the date follicles were first detected. At about 12 weeks past the date follicles were first detected, no females had palpable follicles. That is, all follicles had apparently become atretic and had been, or were being, resorbed. The timing and durations of the events reported above would have been temperature dependent, thus, we do not know how representative they are of those on Guam.

The cue that initiates ovarian recrudescence in the brown treesnake has not been specifically identified. In the present, as well as a previous study (Mathies and Miller 2003), follicles became enlarged following a period of cool temperatures. However, in both studies, females were placed together with males following the cool periods and thus we cannot rule out the possibility that contact with a male was the cue. Studies on female red-sided garter snakes revealed that in some years, at least, copulation ini-

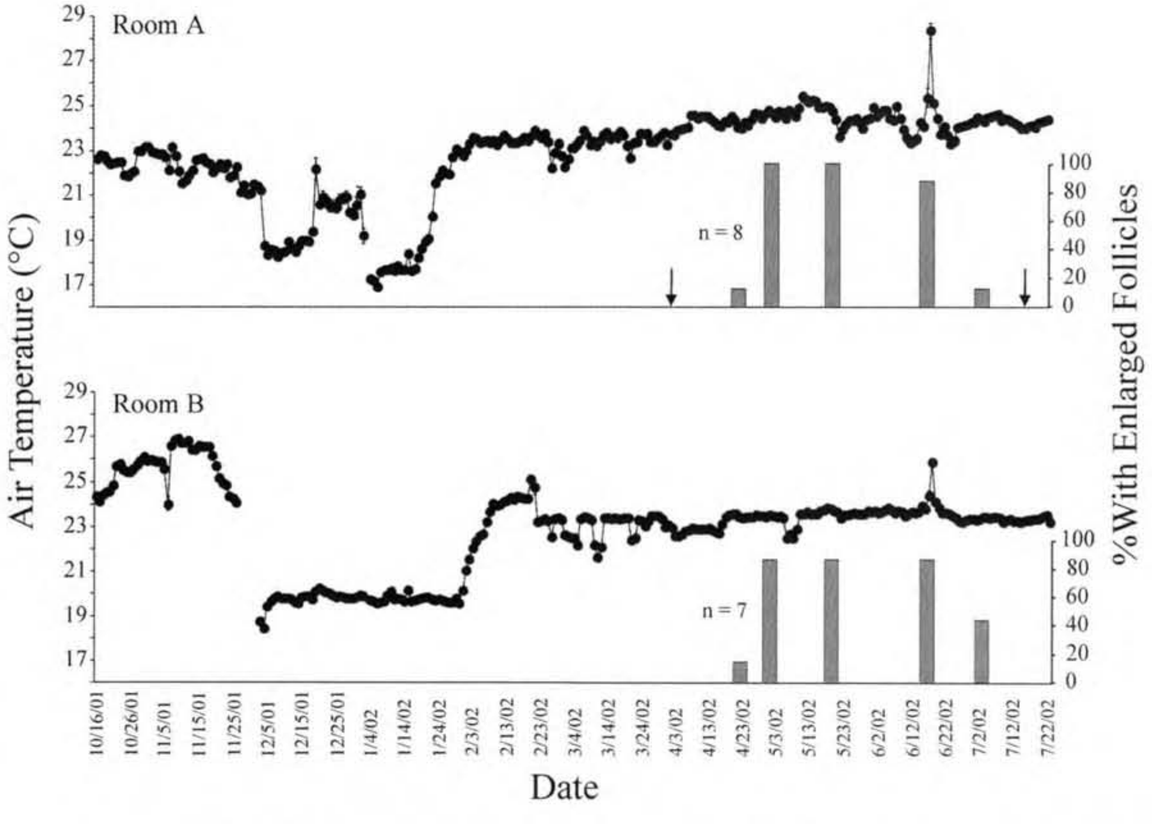

FIG. 1. Development of enlarged ovarian follicles by female brown treesnakes (*Boiga irregularis*) with respect to air temperature and date. The number of females (N) in each room is given. Palpating for the presence of enlarged follicles began 8 January 2001. Fourteen of the 15 females developed enlarged follicles. Arrows bounding the period when follicles were detected indicate the nearest examination dates (same for both rooms) where no enlarged follicles were found. Air temperatures are presented as daily means ± 1 SE. Periods of missing data were due to malfunction of data loggers.

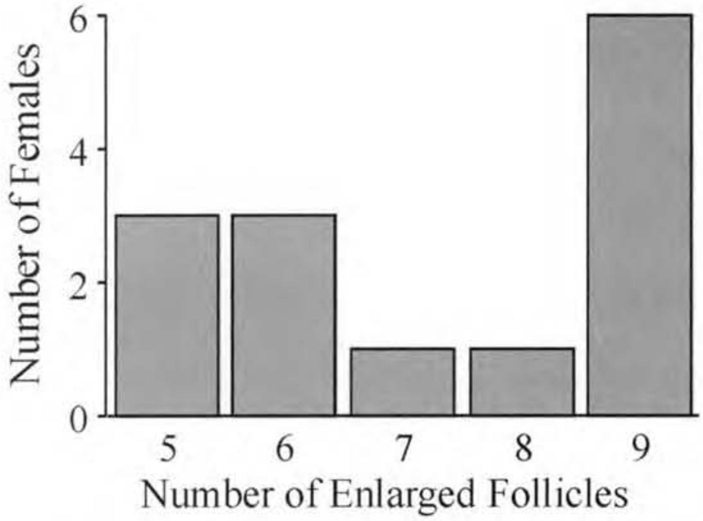

FIG. 2. Frequency distribution of the number of brown treesnake females (*Boiga irregularis*) with respect to number of enlarged ovarian follicles.

tiates a neuroendocrine reflex that is necessary for the initiation and maintenance of vitellogenesis, but this mechanism has not yet been documented in any other vertebrate species (Mendonça and Crews 1990). In the present study, it seems unlikely that the brief presence of mostly-uninterested males would induce ovarian recrudescence. In the majority of reptiles and other vertebrates, both temperate and tropical, the primary cues for ovarian recrudescence are environmental.

Why did none of our females ovulate? It is possible that palpating for follicles caused stress that resulted in resorption of follicles. Chronic exposure to stressors disrupted ovarian recrudescence in the lizard, *Mabuya carinata* (Ganesh and Yajurvedi 2002) and brown treesnakes exhibit a substantial increase in plasma levels of the stress hormone, corticosterone, in response to acute stress (Mathies et al. 2001). However, stress was an unlikely cause in the present study because females were long-term captives that appeared to be used to routine handling and cage maintenance and have previously produced viable eggs at our facilities (Mathies and Miller 2003). Thus, the stress that females experienced, if any, was presumably not appreciable or chronic. Second, if palpation was stressful, then it would have to have had a differential effect on follicular growth versus ovulation because it had no apparent effect on the former.

We suggest that follicles were not ovulated because the appropriate cue was lacking. The most likely cue would be the stimuli attendant with the physical act of mating. Induced ovulators, where coitus is thought to produce a reflex discharge of gonadotropin-releasing hormone and hence luteinizing hormone, occurs in a variety of vertebrates. Such a mechanism has not been reported in reptiles, but its presence/absence has not been well investigated. One reason mating did not occur in this study is that females may not have been in the appropriate stage of the reproductive process and thus may not have been attractive to males when we attempted to mate them. Observations from this and our other breeding studies collectively suggest that female brown treesnakes are at the height of sexually receptivity when they contain large, pre-ovulatory follicles. Recall that in the present study, mating trials were discontinued about 50 days before the first follicles were detected. Thus, females had not yet developed mature follicles when we attempted to mate them. In the first breeding attempt at our facilities, the three females that did produce eggs did so at about 35–40 days following a period when repeated successful intromissions for each female were observed (Mathies and Miller 2003), and in a third and most recent breeding attempt, we observed that ovulation (N = 6 females) occurred approximately 30 days prior to egg laying (Mathies and Miller, unpubl. data). Thus, the three females in the first study that laid eggs likely contained mature pre-ovulatory follicles when they copulated with males. Further support for the contention that male contact is necessary for ovulation comes from studies on captive reproduction of insular species of *Epicrates*. Tolson et al. (1985) demonstrated that female *Epicrates angulifer* initiate ovarian recrudescence in response to a period of cool temperatures but do not ovulate (i.e., follicles are resorbed) unless they experience extensive male courtship. This same phenomena have apparently also been observed in other species of *Epicrates* (Tolson 1994).

Induced ovulation might be expected in a system where males are common and continuously reproductive and where females do not store sperm. The Guam population of brown treesnakes meets at least two, and possibly all, of these criteria. Snakes occur at unusually high densities (Rodda et al. 1992) and no degree of seasonality of reproduction has been detected (Rodda et al. 1999). Although oviducts of Guam females have not been examined for sperm storage areas, a study on female brown treesnakes from southeastern Queensland detected no such structures (Bull et al. 1997). However, sperm storage has been inferred (but not demonstrated) in *Boiga dendrophila* (Groves 1973) and *Boiga multomaculata* (Kopstein 1938).

Induced ovulation in brown treesnake females would be adaptive in that vitellogenic individuals that go unmated would presumably be able to recoup much of their reproductive investment through follicular resorption. In our colony, females that have resorbed their follicles maintain body masses and abdominal fat body sizes similar to those when reproductive whereas females that have recently laid eggs have relatively low body masses and small abdominal fat bodies (Mathies and Miller, unpubl. data).

The hypothesis that female brown treesnakes are induced ovulators can be easily tested; one would only need to induce folliculogenesis in females and mate one group but not the other. Our findings suggest that the appropriate time to mate females (i.e., when females are most attractive to males) is when females have large, preovulatory follicles.

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Venomous Reptile Bites in Academic Research

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Many people work with venomous reptiles, both in the field and in captivity. Researchers generally have some understanding of the risks involved in working with these animals but might not have a full appreciation of the consequences of a venomous bite. Most venomous snakes have the ability to inflict temporary injury, permanent disfigurement, or death.

Card and Roberts (1996) surveyed the incidence of bites from venomous reptiles in North American Zoos. Thirty institutions maintaining venomous animals responded, 21 of which reported having staff that had been bitten by venomous reptiles, for a total of 31 bites during a 26-year period. Over 37% of the victims were between 20 and 25 years of age and had less than five years of professional experience working with venomous reptiles.

After discussions with several researchers affiliated with colleges and universities in the United States, we wondered if similar results would be found among academic institutions. In July of 2000, a questionnaire was distributed to 130 institutions across the United States. Data were gathered regarding bite frequency, bite circumstances, handling methods and protocols, bite emergency protocols, and knowledge about the availability of antivenom.

Seventy-four institutions responded, with 40 reporting research with live venomous reptiles. Eighteen reported 42 envenomations and six dry bites from a total of 20 reptile species, with two bites attributed to unnamed species (Table 1). Thirty-three of the bites were inflicted by vipers, 25 from pit vipers, while four came from elapids, 10 from colubrids, and one from an unnamed snake. Eighteen bites occurred in the laboratory and 30 in the field. Ten institutions conducted inquiries on the circumstances of the bites, which resulted in seven changing their handling protocols. A large majority of these bites (87.5%) were the result of using dubious capture and/or restraint methods, including deliberately picking up or free handling snakes, pinning snakes, handling snakes with gloves, and improper use of restraint tubes. Sixty-one percent of the bites occurred at institutions without training protocols.

Training of personnel varied widely in depth and detail. Although 23 institutions required that researchers demonstrate minimal competence with animal manipulation, 19 institutions performing research with venomous reptiles reported having no training program at all on venomous animal manipulation. Of the others with some type of training program, only 16 required physical practice and four provided a written text regarding this topic. Nineteen reported having no emergency response protocol, and 13 reported that antivenom was not kept at the institutions and that it was unavailable at local medical facilities.

Equally interesting to us are the methods by which venomous reptiles were manipulated. Thirty-one institutions reported using tongs, while 30 used hooks, and 22 employed tubes. Seventeen institutions reported pinning, and nine used leather gloves in the

TABLE 1. Species involved in bites (envenomations and dry bites).

Species	Number of bites
Agkistrodon contortrix	9 (8 envenomations/1 dry)
Agkistrodon piscivorus	1
Atheris nitschei	1
Atractaspis irregularis	1
Boiga irregularis	10
Bothrops asper	1
Boulengerina christyi	1
Causus maculatus	3 (1 envenomation/2 dry)
Crotalus atrox	4
Crotalus cerastes	3
Crotalus durissus terrificus	1 (dry)
Crotalus horridus	1
Crotalus lepidus	2
Crotalus sp.	1
Crotalus viridis	2
Crotalus willardi obscurus	1
Micrurus fulvius	1
Naja melanoleuca	1
Naja naja	1
Sistrurus miliarius	1
Trimeresurus borneensis	1 (dry)
Unnamed genus/species	1 (dry)
Totals	48 (6 dry)

*These numbers underestimate the actual number of bites that occurred at these institutions. We are aware of several bites that were not reported.

capture of venomous reptiles. Three reported that researchers free-handled (unrestrained) venomous reptiles.

The frequency of envenomation appears to exceed that of reptile keepers in public zoos and herpetaria, even though these latter institutions house a greater number and variety of venomous species, and keeper interaction with them is more frequent and extensive. The data suggest that the number and circumstances of bites in academia correlate with inadequate training programs at these institutions. In discussions with several researchers, we have learned that bites from venomous animals are regarded by some as an inevitable result of this type of research—a view that is both erroneous and dangerous.

The data also suggest that a cavalier attitude toward working with venomous reptiles might exist among some academic researchers and that they might not be familiar with all of the protocols currently employed to prevent envenomations. Considering that these individuals might also be responsible for training future herpetologists, we believe that most researchers would benefit from developing and imparting a more cautious attitude toward manipulating venomous wildlife. They would also profit from more knowledge and training in the areas of venomous animal manipulation, as well as greater diligence in developing and employing safety protocols.

Appropriate procedures for handling venomous reptiles and medical care procedures for bite victims should be developed by institutions involved in venomous animal research. Researchers should identify local physicians familiar with snakebite treatment, plot routes to the hospital, and contact emergency personnel beforehand so that they are aware of the type of venomous reptiles involved. In case medical advice or additional serum is needed, phone numbers for poison control centers should be listed, and antivenom stocks should be kept current. If venomous reptiles are maintained in a laboratory, consideration should be given to installation of an alarm system, and development of a snakebite protocol with contact numbers for snakebite consultants, including first aid measures to be administered by co-workers. The envenomation protocol in use at the Arizona-Sonora Desert Museum is available by contacting us.

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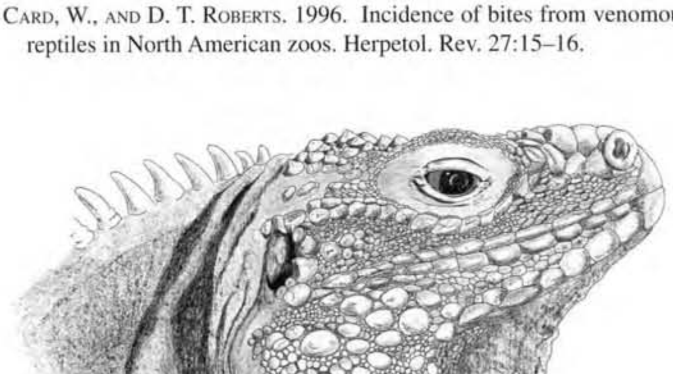

Cyclura lewisi (Blue Iguana), adult male. Grand Cayman. Illustration by John Bendon (Lizardwizard@btinternet.com).

NATURAL HISTORY NOTES

The Natural History Notes section is analogous to Geographic Distribution. Preferred notes should 1) focus on observations with little human intrusion; 2) represent more than the isolated documentation of developmental aberrations; and 3) possess a natural history perspective. Individual notes should, with few exceptions, concern only one species, and authors are requested to choose a keyword or short phrase which best describes the nature of their note (e.g., Reproduction, Morphology, Habitat, etc.). Use of figures to illustrate any data is encouraged, but should replace words rather than embellish them. The section's intent is to convey information rather than demonstrate prose. Articles submitted to this section will be reviewed and edited prior to acceptance.

Electronic submission of manuscripts is requested (as Microsoft Word or Rich Text format [rtf] files, as e-mail attachments). Authors without the ability to send manuscripts electronically may supply hard copy instead. Figures can be submitted electronically as JPG files, although higher resolution TIFF or BMP files will be requested for publication. If figures cannot be provided in this format, you may send them to the section editor for scanning. Additional information concerning preparation and submission of graphics files is available on the SSAR web site at: http://www.ssarherps.org/HRinfo.html. Manuscripts should be sent to the appropriate section editor: **Marc P. Hayes** (amphisbaenids, crocodilians, lizards, and *Sphenodon*; mhayesrana@aol.com); **Charles W. Painter** (amphibians; cpainter@state.nm.us); **Andrew T. Holycross** (snakes; holycross@asu.edu); and **James Harding** (turtles; hardingj@pilot.msu.edu).

Standard format for this section is as follows: SCIENTIFIC NAME, COMMON NAME (for the United States and Canada as it appears in Crother [2000. *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding*. Herpetol. Circ. 29:1–82; available online at <http://herplit.com/SSAR/circulars/HC29/Crother.html>]; for Mexico as it appears in Liner [1994, *Scientific and Common Names for the Amphibians and Reptiles of Mexico in English and Spanish*, Herpetol. Circ. 23:1–113]), KEYWORD. DATA on the animal. Place of deposition or intended deposition of specimen(s), and catalog number(s). Then skip a line and close with SUBMITTED BY (give name and address in full—spell out state names—no abbreviations). (NCN) should be used for common name where none is recognized. References may be briefly cited in text (refer to this issue for citation format).

Recommended citation for notes appearing in this section is: Lemos-Espinal, J., and R. E. Ballinger. 1994. *Rhyacosiredon leorae*. Size. Herpetol. Rev. 25:22.

CAUDATA

***AMBYSTOMA* SPP. (Mole Salamanders). LOTIC BREEDING.** Breeding in *Ambystoma* salamanders is commonly associated with lentic habitats such as forested pools, ponds, and wetlands throughout North America. However, a review of Petranka (1998. Salamanders of the United States and Canada. Smithson. Inst. Press, 587 pp.) indicates that reproduction also occurs in flowing water for numerous species. Here we report additional evidence of lotic reproduction by *Ambystoma* species collected from primary headwater streams (< 259 ha watershed size) in Ohio.

Ambystoma texanum larvae were collected 17 May 2000 from two channel modified streams with agricultural land use in Union County (Allen and Jerome townships). Total length of nine voucher specimens ranged from 20.2–29 mm for the Allen Township population; and 18–26.5 mm (N = 3) for Jerome Township. Larvae of *A. barbouri* were collected 20 July 2000 from a headwater stream with intact riparian zone in Warren County, Washington Township. Body length of three voucher specimens ranged from 34–39.0 mm. A larva with TL 36.2 mm had reduced gills, which suggests the population was close to metamorphosis. The stream substrate was dominated by cobble-gravel-boulders with pools of water connected by subsurface flow. In this stream, *A. barbouri* larvae were coexisting with larvae of the southern two-lined salamander, *Eurycea cirrigera*. A large (TL 62.3 mm) and uniformly dark *A.*

barbouri larva was collected 14 June 2000 from a headwater stream in Preble County. An egg mass of the spotted salamander, *Ambystoma maculatum*, was collected 6 April 2000 (hatched 19 April 2000 at the laboratory) from a channel modified headwater stream draining a wetland in Cuyahoga County (Westlake). The hatchling was TL 10.9 mm and possessed balancers. Diameter of egg envelope was 11.0 mm.

We view the frequency of these lotic captures (about 1.6/100 primary headwater streams surveyed) to be significant given that the selection of sample sites was random and not focused toward lentic breeding habitats of *Ambystoma*. The above observations, and literature cited by Petranka (1998), suggest that headwater streams may be more important for *Ambystoma* population dynamics than commonly recognized. Future studies are needed to determine the extent that *Ambystoma* species are using headwater streams for reproduction near known lentic breeding habitats, and the degree of genetic isolation between lotic and lentic breeding populations.

We thank R. A. Pfingsten for verification of larval identifications.

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AMBYSTOMA TEXANUM (Small-mouthed Salamander). **PREDATION**. On 23 May 2003 at ca. 1730 h I observed a Common Grackle (*Quiscalus quiscula*) pecking at an object in Coles County just W of Charleston, Illinois (T12N R9E NW1/4 Sec. 16). When I investigated, a dead *Ambystoma texanum* (56.9 mm SVL) was found in the grass with several obvious puncture wounds. Although I did not observe the grackle initiate the attack on this salamander, it was likely the cause of the salamander's death. The small-mouthed salamander otherwise looked to be unmolested. The skin was still moist as though the salamander had very recently died and may have been moving through the grass, possibly in the process of emigrating from a breeding location. It had rained the evening before and this would be the appropriate weather and season for this salamander to be moving to summer home ranges. The afternoon was warm and dry with a steady breeze.

Both species are common in this area and it is possible that this interaction occurs on a regular basis. I am unaware of any recorded observations of grackles predating small-mouthed salamanders. Dr. Chris Phillips encouraged me to report this observation. I would like to thank him for his interest and critical review of this report.

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ANEIDES AENEUS (Green Salamander) AND ***PLETHODON GLUTINOSUS*** (Slimy Salamander). **NESTING OBSERVATIONS**. *Aneides aeneus* is an inhabitant of rocky areas along the Appalachian Mountain chain extending south into northern Alabama and extreme northeastern Mississippi. There is a disjunct population in southwest North Carolina and adjoining areas of South Carolina and Georgia (Petranka 1998. The Salamanders of the United States and Canada. Smithsonian Inst. Press, 587 pp.). Petranka (1998, *op. cit.*) reports that green salamanders may breed anytime during the warmer months but the majority do so in May and June with a secondary season in September and October. In Alabama, the only nests have been found in July (Mount 1975. The Reptiles and Amphibians of Alabama. Auburn Printing, Auburn, Alabama, 345 pp.). The nests of green salamanders are located within crevices of sedimentary rocks where the eggs are laid on the ceiling.

Slimy salamanders also use natural cavities in which to lay their eggs (Petranka 1998. *op. cit.*). It is believed that most oviposit in crevices beneath ground since relatively few surface nests have been found (Highton 1956. Copeia 1956:75-93; Highton 1962. Copeia 1962:597-613; Petranka 1998. *op. cit.*).

Two green salamander nests were located on 8 and 11 Sept 2002, one on each date. Additionally, a slimy salamander nest was located on 15 Sept 2002. All nests were located within DeSoto State Park (Dekalb County) in northeast Alabama. The first green salamander nest was found in a sandstone boulder 500 m northwest of the campground entrance gate of DeSoto State Park. The brood crevice was on the west face of the boulder. The crevice itself was ca 1.0 m from the ground and 1.5 m in horizontal length. The entrance to the brood chamber was located at the northern end of the crevice. This entrance was horizontally oval with a depth of about 15.4 cm. The eggs were laid at a depth of about 5 cm. Only 8 eggs were visible. The second green salamander nest was located about 700 m west of the first nest. The brood chamber was located on the north face of a sandstone boulder. The chamber was tubular in overall shape and ca. 1.5 m from the ground. The chamber was ca. 12.7 cm deep and eggs were ca. 10 cm from the entrance. The overall shape of the egg masses of both green salamander nests was that of an upside down triangle, or a cluster of grapes.

From the first observations on 8 and 11 Sept 2002, to 28 Sept 2002 there was little change. A total of six observations on the first nest and five on the second were made. The females were always present and in contact with at least some of the eggs. On at least one occasion the female from the first green salamander nest was located on the ceiling of the crevice, otherwise all females were located on the brood chamber floor. On 28 Sept 2002, the eggs of the first green salamander nest started hatching. The larvae were fully formed and attempting to break free of the egg membranes. The larvae responded to touch by wriggling. It was not until 4 Oct 2002 that the larvae had hatched completely and were moving about the brood chamber. The female was present and actively attacked, with her snout, any probe presented to her. Prior to hatching she was more likely to retreat than attack probes presented to her. On 20 Oct 2002, a mature male was spotted at the southern end of the crevice of the first nest site. He was not observed at any other date. The female and hatchlings dispersed by 7 Nov 2002. There were at least 13 hatchlings from this brood.

The timetable for the second green salamander nest was slightly different. On 4 Oct 2002, 3 eggs were still present with fully formed larvae within. The larvae were completely hatched by 13 Oct. The female of this nest was not present by 20 Oct while the larvae remained. By 7 Nov, the larvae had also dispersed. At least 8

hatchlings were produced from this nest. A total of 12 observations were made at the first green salamander nest and 11 were made at the second.

The slimy salamander nest was first located on 15 Sept 2002 in a sandstone rock wall ca. 25 m north of the second green salamander nest. The crevice was ca. 1.5 m from the ground, horizontal, and ca. 1.0 m long. This crevice was about 45.7 cm deep. The eggs were laid at a depth of ca. 30 cm. The egg cluster was elongate, in the shape of an "L" lying on its "back." Ten eggs could be seen. The larvae had hatched by 6 Oct 2002, however due to the morphology of the crevice interior only one hatchling could be seen. The female had dispersed by 7 Nov, and the hatchling(s) were present until 22 Nov. No more that one hatchling was visible. A total of 12 observations were made at this nest.

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ANURA

COCHRANELLA ALBOMACULATA (NCN). **REPRODUCTION**. Centrolenids are neotropical riparian frogs that breed primarily throughout the wet season (Ibañez et al. 1999. The Amphibians of Barro Colorado Nature Monument, Soberanía National Park and adjacent areas, Editorial Mizrachi and Pujol, Panamá. 187 pp.). *Cochranella albomaculata* is found from Honduras to Colombia (Savage 2002. The Amphibians and Reptiles of Costa Rica, Univ. Chicago Press, Chicago 934 pp.). Here we report a shift in the reproductive behavior and oviposition site of *C. albomaculta* coinciding with the onset of the dry season. *Cochranella albomaculata* is very abundant in most of the smaller creeks that feed into the upper Río Jaris basin at the Reserve of the Universidad de la Paz (Costa Rica) in the rainy season. During the wet season males and egg clutches are distributed throughout the stream channel. Females deposit eggs on the upper surface of the vegetation over streams. At the beginning of the dry season of December 2001 and December 2002, we observed a shift at this site. A large aggregation of males and egg clutches (N = 53; Dec 2002) on rocks were seen in the splash area of two waterfalls. Calling males and two egg clutches were present on a big boulder in Río Jaris. These observations suggest that *C. albomaculata* utilizes these wet splash zones to prolong breeding during part of the dry season.

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RANA AURORA AURORA (Northern Red-legged Frog). **VOCALIZATION**. Leonard et al. (1997 Northwest. Nat. 78:73–74) described one instance of non-breeding season vocalization involving 2 male *Rana a. aurora* from a terrestrial location on the NW side of Fiander Lake, Pierce County Washington, USA on 1 Nov 1996. Confirmation of sex or terrestrial position was not possible as the frogs were not visually located (Leonard et al., *op cit.*). Such confirmation is important because *Rana a. aurora* calls can be highly ventriloquial (Licht 1969. Can. J. Zool. 47:1287–1299), and *Rana a. aurora* have been described as typically vocalizing from submerged positions during reproduction (Licht, *op. cit.*), a pattern that has even been used to support the systematic differentiation between red-legged frog taxa (Hayes and Miyamoto 1984. Copeia 1984:1018–1022). Further, the lone episode of non-breeding vocalizations that Leonard et al. (*op. cit.*) described for *Rana a. aurora* could be perceived as atypical. Here, we confirm male northern red-legged frog vocalization from terrestrial locations outside the reproduction season, and show that the pattern may be commonplace. All observations were made in the vicinity of Olympia, Washington.

At 0640 h on 20 Aug 2002, one of us (MPH) heard distinctive weak, clucking vocalizations matching those of male *R. a. aurora* advertisement calls (*fide* Davidson 1995. Frog and Toad Calls of the Pacific Coast. [audio compact disc]. Library of Natural Sounds, Cornell Laboratory of Ornithology, Ithaca, New York) coming from near a small rural pond in NW Olympia described elsewhere (Hayes and Hayes 2003. Herpetol. Rev. 34:45–46). Vocalizations, involving 4–8 note series made at irregular intervals during a 10-min observation period, were traced to a male *R. a. aurora* concealed under a sword fern (*Polystichum munitum*) 0.5 m from the pond. The male was identified from a unique toe clip as an individual that had been released in this pond on 5 May 2002 (Hayes and Hayes, *op. cit.*). At 1400 h on 24 Aug 2002, two of us (CBH, MPH) found this same male vocalizing over a roughly 12-min interval from a concealed position beneath another sword fern ca. 1.4 m from the pond. We heard this same male and a second marked *R. a. aurora* male, also described elsewhere (Hayes and Hayes, *op. cit.*), call on no fewer than 13 other occasions over the interval 31 Aug–23 Sept 2002 during daylight hours. On 11 of these occasions, calling males were traced to concealed positions in terrestrial locations under sword ferns 0.5–3 m from the pond.

A second set of observations was made between 1340–1510 h on 21 Sept 2002, along the margin of a 4-ha patch of red alder (*Alnus rubra*) with an understory of mostly dense sword ferns in west Olympia (47°04'06"N, 122°58'12"W; elev. 49 m). Almost immediately upon entering this alder grove, which was largely sheltered from significant noise, MPH heard the weak calls of *R. a. aurora*. During the 1.5-h search of a ca. 80-m diameter circular area of this grove, over 24 calling episodes were heard. Four were tracked to calling males, all of which were in entirely concealed calling stations, three under sword ferns and the fourth in a small space under small woody debris. The four males found were 52–57 mm SVL and had small, poorly developed nuptial pads. Each male found was also located within 8 m of the position of at least one of the others.

On 19 Sept 2002 at 1900, JPS also heard calls matching those of male *R. a. aurora* advertisement calls from a concealed terrestrial site in the Steamboat Island area ca. 10 km E of Olympia (47°06'16"N, 122°59'19"W; elev. 5 m). This site has a mature western red cedar-big leaf maple (*Thuja plicata-Acer*

macrophyllum) forest with a sword fern-dominated understory and was the site of an intensive study of *R. a. aurora* by JPS. In this case, the calling individual was audible from a distance of ca. 5 m, and was heard from the location of a second non-calling frog. Both were > 60 m from the nearest freshwater source. Notably, the vicinity of these 2 frogs had been regularly, thoroughly searched for *R. a. aurora* during the summer, with none found until 11 Sept, when the non-calling frog, (56 mm SVL, 19 g, sex undet.) was caught and pit-tagged. Finding the aforementioned 2 frogs on 19 Sept was followed by finding 4 frogs (including the tagged frog and 3 others [49-69 mm SVL; 10-34 g, sex undet.]) on 28 Sept in the same vicinity, suggesting some sort of staging.

Vocalization by male *R. a. aurora* from concealed locations outside of the breeding season may be commonplace. Northern red-legged frog males are well known to have weak vocalizations (Hayes and Krempels 1986. Copeia 1986:927-936; Leonard et al. 1993. Amphibians of Washington and Oregon. Seattle Aubudon Society, Seattle, Washington. 168 pp.; Licht, *op. cit.*) that have been described by some as barely audible at a distance of 0.5 m (Nussbaum et al. 1983. Amphibians and Reptiles of the Pacific Northwest. University Press of Idaho. 332 pp.), and as such, they may be easily missed. Several aspects of these observations warrant exploration. Both males from the NW Olympia pond were known to have become sexually mature within the month we heard the first calling (Hayes and Hayes, *op. cit.*) and the sizes and incompletely developed nuptial pads of the other calling males that were found implies that younger males were involved. Younger individuals may be easier to detect because of their presumably more limited predator experience, so understanding whether a younger age bias really exists in such terrestrial calling may be difficult. Second, context of terrestrial calling remains vague. Staging, which the Steamboat Island observation implies, may be a prelude to the poorly understood seasonal fall migration that northern red-legged frogs undertake (MPH, P. Ritson, JPS, unpubl. data). Terrestrial calling may facilitate this behavior. Lastly, awareness that vocalization from concealed terrestrial locations is not infrequent may require re-evaluation of *R. a. aurora* reproductive behavior. In particular, the ventriloquial nature of *R. a. aurora* calls (Licht, *op. cit.*) may require reassessment of the degree to which males call from submerged locations during the breeding season.

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SCAPHIOPUS HOLBROOKII (Eastern Spadefoot). **DIURNAL BREEDING.** *Scaphiopus holbrookii* is generally considered to be a nocturnal species (Bragg 1945. Am. Midl. Nat. 79: 52–72; Behler and King 1979. National Audubon Society Field Guide to North American Reptiles and Amphibians. A. A. Knopf, New York, 743 pp.). This is based both on behavioral observations and morphology (e.g. vertical pupils).

Heretofore, all of our observations of this species on Long Island had been at night. On 27 May 2003, we observed diurnal breeding congregations of *S. holbrookii* at the Brookhaven National Laboratory, Upton, Suffolk County, New York, USA (40°52'20"N, 72°52'04"W). At ca. 1030 h, the skies cleared after six days of cloud cover, cool temperatures (six day mean = 11.8°C), and 10 cm of rain, 7.3 cm of which fell on 26 May. By 1100 h, after 30 min of direct sunlight and rapidly increasing temperatures, the breeding calls of *S. holbrookii* initiated in nearly all the temporary wetlands within the 2,130 ha site. The temperature was 18.1°C when toads started calling. Intense breeding activity continued throughout the day, declined in late afternoon, increased again after sunset, and continued beyond 2100 h. The next morning no *S. holbrookii* were observed. The arrival of optimal breeding conditions subsequent to six days of heavy precipitation and suppressive temperatures (4.6°C below normal) coupled with extreme draught conditions the previous year likely contributed to this explosive-diurnal breeding episode. On 5 June 2003, after 5.8 cm of rain the prior day, JAF again heard the diurnal calls of male *S. holbrookii* coming from two wetlands.

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TESTUDINES

CHELONOIDIS CHILENSIS (Argentine Tortoise). **PREDATION.** *Chelonoidis chilensis* is one of three terrestrial Argentinian tortoises contained within the family Testudinidae. It is distributed from SW Bolivia and Occidental, Paraguaya to the Colorado River and the boundary of Rio Negro Province, Argentina (Cei 1993. Mon. 14 Mus. Reg. Sci. Nat. Torino, 949 pp.). This species has also been reported from the eastern portion of the San Juan Province, Argentina by the Departament of Valle Fértil (Avila et al. 1998. Cuad. Herp. 12:11–29). It has been recently designated as "Threatened" in Argentina (Lavilla et al. 2000. Asoc. Herp. Arg., 97 pp.) and has the status of "Maximum Priority of Conservation" in Ischigualasto Park, San Juan Province (Acosta and Murúa 1998. Multequina 7:49–59).

Here we report the first incidence of predation on *C. chilensis* in Provincial Ischigualasto Park, Valle Fértil Department, San Juan, Argentina (30°05'S, 67°55'W). On 10 April 2001, in the North Sector of Overo Mountain, an adult *C. chilensis* that had recently been killed was found. The puma (*Puma concolor*) and the fox (*Pseudalopex griseus*) are the primary predators within the park (Acosta and Murúa 1999. Multequina 8:121–129). The injuries on the carapace of the tortoise (size of canine mark, space between canine) indicate that they were made by *P. concolor*. The specimen was deposited in the Herpetological Collection of the Instituto y Museo de Ciencias Naturales, Universidad Nacional de San Juan, Argentina (IMCN-UNSJ 492).

We are grateful to J. Marquez for supplying us with the tortoise specimen.

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CLEMMYS INSCULPTA (Wood Turtle). **HATCHING FAILURE**. Hatchlings of many turtle species, instead of hatching and emerging from the nest before winter, may overwinter in the nest and emerge the following spring (Gibbons and Nelson 1978. Evolution 32:297–303). Wood turtle *(Clemmys insculpta)* hatchlings are not known to delay emergence and overwinter in the nest (Harding and Bloomer 1979. Bull. New York Herpetol. Soc.15:9–26; Lovich et. al. 1990. Can. J. Zool. 68: 672–677). This assertion is based on abundant records of wood turtle hatchlings emerging from nests in the months of August through October, and no records of hatching or recent hatchlings in spring or early summer. Here, we report that wood turtle embryos in a natural nest did not complete development before winter in a cool year and did not survive over winter.

On 15 June 1993, we observed a wood turtle creating a nest in St. Louis County, Minnesota, USA. The nest was located on a sandy cutbank, 3 m from the main channel of a river and 2 m above water, and on a fully exposed site with a 34° slope and southwestern aspect. Herbaceous cover surrounding the nest site was 50% red raspberry *(Rubus idaeus)*. We checked the nest site on 29 September, 5 October, 15 October, and 21 October 1993, and found no evidence of disturbance on the nest surface. We excavated the nest on 21 October 1993 and counted 11 eggs; 10 appeared viable and one was shriveled. One of the 10 apparently viable eggs was accidentally slit during excavation. This egg contained a live turtle embryo. This egg and the nine good eggs were returned to the nest cavity and recovered with sand. A wire basket was staked over the nest to exclude nest predators.

We revisited the nest on 9 May 1994, and found it and the basket exclosure intact. We removed the 10 eggs, some of which now appeared dead, placed them in moist sand, and transported them to a facility where they were stored at room temperature. On 9 June, we slit the shell of each egg and examined each embryo for signs of life but found none. One badly deteriorated egg was discarded. The nine remaining eggs were preserved in formalin. Upon close examination at a later date, all eggs appeared to have been decayed at the time of preservation. Two eggs lacked any evidence of development. These eggs could have been infertile, or their embryos could have died in the oviducts prior to laying. One egg appeared to contain an early embryo; however, it was too decayed to locate with precision. The egg appeared to have a subgerminal space, which is characteristic of fertile eggs. Two eggs contained Yntema stage 24 embryos, which are advanced but smaller than term embryos and probably incapable of surviving a premature hatching. The remaining four eggs contained stage 25 embryos; that is, they were very close to term size and almost ready to hatch and leave the nest.

Weather records were available from a nearby station for the period 1986 to 2001. Air temperatures from May through September in 1992 and 1993 were the coldest for this period. In 1993, most nests were constructed during the second week of June, many hatchlings did not leave their nest until the last half of September, and hatchlings from two nests left their nests during the first two weeks of October. Compared to other nests on the cutbank, the single nest we report on was clearly late in completing incubation. Inspection of photographs showed that this nest site had the most herbaceous vegetation near the nest site. Thus, in addition to 1993 being a cool year for incubation, this nest site was probably more shaded than all other nest sites.

Our observations of at least one live embryo on 21 October, as well as six advanced-stage embryos the following spring, suggest that 6 of the 10 eggs narrowly missed hatching before winter. Furthermore, the appearance of eggs in fall and the following spring, and their state of decay on 9 June suggest that none were alive by spring. Thus, overall, our observations corroborate other evidence, which suggests that wood turtle embryos must complete development and leave their nest before onset of winter to survive in more northern latitudes.

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EMYDOIDEA BLANDINGII (Blanding's Turtle). **MAXIMUM SIZE.** The maximum straight line carapace length (CL) for *E. blandingii* reported is 27.4 cm (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington. 578 pp.). Here, we report on the measurement of a larger individual. On 10 June 2001, an adult male *E. blandingii* was captured during a herpetological species inventory survey in Lake Maria State Park, Wright County, Minnesota, USA. The turtle was measured at 28.4 cm CL. The turtle was marked and released after data was taken. A slide of the record is deposited in the James Ford Bell Museum, University of Minnesota, Minneapolis (accession no. P-248).

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GOPHERUS BERLANDIERI (Texas Tortoise). **MORTALITY**. During mammalian wildlife research on ranches in Webb County, Texas (Engeman et al. 2002. Wildl. Res. 29:85–90), we observed two common sources of mortality for *Gopherus berlandieri* (listed as a threatened species in Texas) based on locations of shell remains. First, the ranches had a network of primary dirt roads crisscrossed by smaller one-lane roads/tracks. Shell remains (often in poor condition) were frequently discovered adjacent to the roads in this network, suggesting collisions with vehicles as the source

of mortality. Vehicles have been well-documented as hazards for the related *G. agassizii* (e.g., Luckenbach 1982. *In* Bury [ed.], North American Tortoises: Conservation and Ecology, pp. 1–38, USFWS Wildl. Res. Rpt. 12; Boarman and Sazaki 1996. *In* Evink et al. [eds.], Trends in Addressing Transportation Related Wildlife Mortality, pp. 179–184, State of Florida Dept. Transportation, Tallahassee, Florida). The other common location for discovery of tortoise shell remains was along fences constructed with woven field fencing at the bottom. The tortoises apparently became entangled in the fence wires and were unable to free themselves. We observed no shell remains away from these human constructions, despite extensive work in natural habitat.

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HEOSEMYS GRANDIS (Giant Asian Pond Turtle). **ANOPHTHALMIA**. Abnormalities and malformations are well documented in turtles from some regions but not others, especially Asia. Most reports are on shell deformities (e.g., Lynn, 1937. Amer. Nat. 71:421–426; Nixon and Smith 1949. Turtox News 27:28–29; Rhodin et al. 1984. Brit. J. Herpetol. 6:369–373; Saumure 2001. Chelonian Cons. Biol. 4:159). Others refer to abnormalities of the head, limbs, and shells of hatchlings (e.g., Ewert 1979. *In* Harless and Morlock [eds.], Turtles: Perspectives and Research, pp. 333–413, Wiley InterScience, New York). A large sample of *H. grandis* was among the 10,000 turtles putatively from Malaysia that was confiscated by Hong Kong authorities on 11 December 2001. Approximately 3900 turtles were shipped to the United States in January 2002 for processing and distribution to rescue centers, zoos, veterinarians, and university research programs (Hudson and Buhlmann 2002. Turtle and Tortoise Newslett. 6:11–14). A total of 355 *H. grandis* was received in the three shipments (Ades and Crow 2002. Turtle and Tortoise Newslett. 6:2–7). During the triage, marking, and measuring process we discovered that one unsexed adult (347 mm CL, 299 mm PL, 5.7 kg, marked 289) was missing its right eye. The abnormality appears to be congenital, as normally pigmented skin lies over the orbit and there was no evidence of injury or loss (Fig. 1). Palpation revealed the bony orbit but no eye mass. This is the first report of natural anophthalmia for this poorly known freshwater turtle.

FIG. 1. *Heosemys grandis* exhibiting congenital anophthalmia.

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PHRYNOPS GIBBUS (Gibba Turtle). **TRAP-HAPPY BEHAVIOR.** Most estimates for determining the size of a population using mark-recapture methods assume equal capture probability among individuals. Behavioral differences between or within species or flawed trap design or placement might bias sampling with regard to this assumption (Lindeman 1990. J. Herpetol. 24:78–81). Kazmaier et. al. (2001. J. Herpetol. 35:410–417) attributed a shift from biased to unbiased captures of *Gopherus berlandieri* from early to late summer to sexual differences in reproductive behaviors. Sampling biases have been reported in studies of *Chrysemys picta* (Ream and Ream 1966. Amer. Midl. Nat. 75:325–338; Frazer 1990. Copeia 1990:1150–1152) and *Terrapene carolina* (Langtimm 1996. Herpetologica 52:496–504). Koper and Brooks (1998. Can. J. Zool. 76:458–465) identified flaws in several different sampling techniques and population size estimators, and found no method that was completely unbiased.

The present study documents an apparent example of extreme trap-happy behavior, i.e. where previously-marked individuals are

TABLE 1. Dates of capture and recapture in 2001, sex, carapace length, and plastron length, for an Ecuadorian population of *Phrynops gibbus.*

	Sex	Carapace length (mm)	Plastron length (mm)	Date of first capture	Date(s) of recapture
Turtle #1	female	165	135	21 Jan	19 Feb
Turtle #2	male	163	143	21 Jan	23 Jan, 31 Jan, 4 Feb, 10 Feb, 22 Feb
Turtle #3	male	206	177	21Jan	10 Feb
Turtle #4	male	192	167	29 Jan	2 Feb, 8 Feb, 17 Feb
Turtle #5	female	185	159	10 Feb	

more prone to subsequent captures than unmarked individuals. The study was conducted in the upper Napo region of Ecuador near Tena (0°59'S, 77°49'W) at Jatun Sacha Reserva Biología during January–March 2001. A population of *Phrynops gibbus* was sampled using a hoop net baited with chicken parts. Measurements were taken of the carapace and plastron length of each individual. The sex of each turtle was determined by examination of pre-cloacal tail length. Turtles were marked using nail polish with the original intent of determining population size; however, no estimates were possible due to a high incidence of trap-happy behavior. Four of the five individuals captured were recaptured one to five times (Table 1). Potential trap-happy or trap-shy behavior needs to be taken into consideration for estimates based on an assumption of equal capture probability.

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TERRAPENE CAROLINA CAROLINA (Eastern Box Turtle). **POST MORTEM INVOLUNTARY RESPONSE**. Although the ability of turtles to respond to stimuli long after death has been reported in popular literature (Coniff 1999. National Geographic, Mar. 1999:118–129), to my knowledge no detailed accounts of such behavior exist in peer-reviewed literature.

On 18 October 2002 at ca. 1300 h an adult male box turtle was found on a road in Greene County, Virginia, USA. The anterior half of the head was crushed, presumably by the tire of a vehicle. The blood present on the road and around the trauma had not coagulated, indicating the wounds were recently inflicted. The turtle responded to my touch by quickly withdrawing limbs and tail into its shell and partially closing the plastral hinge. In an effort to end perceived suffering, the turtle was quickly decapitated and left in a shaded, outdoor area. At regular intervals I checked the turtle's headless body for response to stimuli by touching the rear limbs with a small twig. At 48 h post-decapitation, the turtle responded as strongly as it did before decapitation. Subsequent tests resulted in lessened response to stimuli, that is, limbs and tail being only partially retracted and at a slower rate of movement. More than five days after finding the turtle, the last perceptible movements were recorded at 122 h post-decapitation.

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TERRAPENE CAROLINA CAROLINA (Eastern Box Turtle). **DIET**. Hatchling box turtles typically retain a portion of their yolk sac externally upon hatching (Ewert 1985. *In* Gans et al. [eds.], Biology of the Reptilia. Vol. 14. Development, pp. 75–267, John Wiley and Sons, New York). This yolk sac is usually absorbed within a week post hatching and provides the hatchling with nourishment during its first few days of life and through the oncoming winter (Dodd 2001. North American Box Turtles, A Natural History. University of Oklahoma Press, Norman. 231 pp.). Here, I report a previously undocumented behavior that might provide hatchling box turtles with an additional source of nutrition before exiting the nest.

An adult *T. c. carolina* was observed nesting in Anne Arundel County, Maryland, USA, during a light rain in the early evening hours of 16 June 1999. A total of six eggs were deposited. Several days later, the nest was excavated in order to remove 3 eggs for artificial incubation. Using the natural nest as model, an artificial nest was constructed in a glass aquarium allowing for the hatching process to be observed and photographed. The eggs were incubated in this setup at 26°C. All 3 eggs pipped on 25 August 1999. During the hatching process, one hatchling was observed to repeatedly bite at and consume the clear, viscous, albumin surrounding it within the egg. While it is not clear if the biting was merely an effort to help free the turtle from the egg, albumin was consumed during this process and likely served as a source of nutrition.

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TERRAPENE CAROLINA CAROLINA (Eastern Box Turtle). **INJURIES.** The life history and ecology of a population of *Terrapene c. carolina* were studied from 1980–1998 at the Mason Neck National Wildlife Refuge, Fairfax County, Virginia, USA (38°67'N, 77°14'W) (Boucher 1998. Population, Growth and Thermal Ecology of the Eastern Box Turtle, *Terrapene carolina carolina* [L.], in Fairfax County, Virginia, Ph.D. Dissertation, George Mason University, Fairfax, Virginia, 228 pp.). Among the parameters noted for individual box turtles were injuries to the exposed shell and body. An injury is here defined as any unnatural physical damage to an individual that might have been caused by normal daily activity, encounters with predators, or resulting from refuge management practices. Developmental or genetic deformities, such as missing cervical scutes or subdivision of shell scutes were not considered. Chipped marginals, presumably resulting from normal movements or falls, were displayed by most adult box turtles in the population, and thus were omitted from the analysis.

Data on injuries were collected from 510 individual *T. carolina* at Mason Neck. Only 50 (9.8%) of the turtles were injured; 460 (90.2%) turtles were injury free. Analysis by sex showed that 22 (44%) of the injured turtles were females and 28 (56%) were males. Qualifying injuries, as outlined above, were placed into seven categories, here with the number of turtles showing that injury: predator teeth marks on any part of the turtle, 14 (2.75%); damaged shell, 9 (1.76%); missing legs, 6 (1.18%); swollen tympanum or cyst, 4 (0.78%); blind eye, 3 (0.59%); shell rot, 1 (0.19%); and other injuries (missing scutes or tails, abrasions, burns), 13 (2.55%). Up to 64% of the injuries (e.g., teeth marks, missing limbs, other shell damage) could have been caused by predation attempts. Raccoons (*Procyon lotor*) are common on the property and are known turtle predators, but other species are also possible suspects (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington, D.C., 682 pp.). Infections or parasitism (swollen tympanums; two recaptured later had recovered fully) accounted for another 4 (8%). Survivorship is difficult to ascertain because many of the injuries were not new when ob-

served. Assuming, however, those injured were residents with equal probability of recapture, and that recapture at least one year later indicated complete recovery (survivorship), possibly as many as 36% survived their injury. Box turtles are known to have great shell regenerative capabilities (Rose 1986. Southwest. Nat. 31:131–134; Smith 1958. Turtox News 36:234–235), and can apparently recuperate from other injuries as well.

Data on injury rates in a population are scarce in the literature (see Dodd 2001. North American Box Turtles: A Natural History. University of Oklahoma Press, Norman, 231 pp.). However, we can conclude from the Mason Neck data that injuries do occur in this population and that many box turtles are able to survive them.

Submitted by **TIMOTHY P. BOUCHER*** and **CARL H. ERNST**, Department of Biology, 3E1, George Mason University, Fairfax, Virginia 22030-4444, USA; e-mail: cernst@gmu.edu. *Present address: 678 Arimo Avenue, Oakland, California 94610, USA.

SERPENTES

ANTILLOPHIS ANDREAE (Black and White Racer, Jubito). **DIET.** Schwartz and Henderson (1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions and Natural History. Univ. Florida Press, Gainesville. 720 pp.) stated that the diet of *Antillophis andreae* includes frogs of the genus *Eleutherodactylus* in a frequency of 41.2 % (in sample of 17 prey items). Our observations confirm the statement of these authors and include a new prey genus to the diet of *A. andreae.*

The stomach contents of a specimen (368 mm SVL) collected in Altiplanicie de El Toldo, Holguín Province, Cuba, on 3 June 1997 contained two specimens of *Eleutherodactylus* sp. (10 and 15 mm SVL). Another specimen was observed from this locality on 26 September 1998 eating an adult specimen of *E. dimidiatus*, and a third individual (266 mm SVL) was collected in Sabana, Maisí, Guantánamo Province, Cuba, as it was swallowing an adult *E. atkinsi* (20 mm SVL) on 14 April 1998.

A similar observation was made in the San Juan River, Santa María, Santiago de Cuba Province, on 15 August 1997 when an adult specimen of *A. andreae* (ca. 300 mm SVL) was found swallowing a juvenile *Bufo peltacephalus* (ca. 20 mm SVL). The last species has not been recorded previously as prey of *A. andreai*.

Specimens were deposited in the herpetological collection of BIOECO, Santiago de Cuba (BSC.H 1011, 1729, 1757). I thank Luis F. de Armas and Yoenris Oliveros for the donation of specimens collected by them, Iliana Boza for English translation, and Renata Platenberg for reviewing this note.

Submitted by **ANSEL FONG G.**, Centro Oriental de Ecosistemas y Biodiversidad (BIOECO), Museo de Historia Natural "T. Romay," Enramadas #601, Santiago de Cuba 90100, Cuba; e-mail: ansel@bioeco.ciges.inf.cu.

ANTILLOPHIS ANDREAE (Black and White Racer, Jubito). **REPRODUCTION**. Schwartz and Henderson (1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions and Natural History. Univ. Florida Press, Gainesville. 720 pp.) reported the laying of three eggs (6.0 x 19.3 mm) by a female *Antillophis andreae* in April. On 3 June 1997 a female *A. andreae* was collected in Alto de la Calinga, Sierra de Moa, Holguín Province, Cuba. The specimen was kept in captivity and laid three eggs on 10 June 1997. The female had a snout–vent length of 310 mm and the egg measurements were 31.0 x 9.2 mm, 30.1 x 8.1 mm, and 31.2 x 8.6 mm, respectively. The coloration of the eggs was off-white. Another clutch of this species was observed in Altiplanicie de El Toldo, Moa, Holguín Province, Cuba on 14 November 1997. This clutch was comprised of four hatched eggs deposited under a stone measuring ca. 250 x 200 mm. The eggs were off-white with longitudinal apertures characteristic of colubrid eggs. The form, size, and coloration support assignment of this clutch to *A. andreae*.

The specimen was deposited in the herpetological collection of BIOECO, Santiago de Cuba (BSC.H 1012). I thank Iliana Boza for helping me with English translation and Renata Platenberg for reviewing this note.

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BOTHROPS CAMPBELLI (Campbell's Lancehead). **DIET**. The recently described pitviper, *Bothrops campbelli* Freire Lascano 1991, is distributed along the western versant of the Cordillera Occidental of the Andes in Colombia and Ecuador (Kuch 1997. Bull. Zool. Nomencl. 54:245–249) and inhabits lower montane wet and cloud forests. The genus *Bothrops* is widely distributed in most of Central and South America; however, reports on diet are few and mostly anedoctal (Campbell and Lamar 1989. The Venomous Reptiles of Latin America Comstock-Cornell University Press, Ithaca, New York, 425 pp.; Perez-Santos and Moreno 1991. Serpientes de Ecuador. Monografie Museo Regionale di Scienze Naturali, Torino XI, Italy, 538 pp.). Additionally, there is only one report on the diet of *B. campbelli*. That report documents *B. campbelli* preying on a rat-sized rodent (Freire and Kuch 2000. Herpetol. Rev. 31:45). Herein, I present an additional and exceptional prey item for *B. campbelli* and for the genus *Bothrops*.

Examining herpetological collections in Quito, I found an adult male *B. campbelli* from San Francisco de Las Pampas, province Cotopaxi, Ecuador, collected during December 1989 (ca. 0°25'S, 78°58'W, 1600 m elevation) measuring 550 mm snout–vent length, and 852 mm total length. The snake had swallowed an adult *Caecilia* sp. ca. 350 mm total length. The *Caecilia* sp. was folded within the snake's stomach and had its tail and head positioned toward the anterior portion of the snake's stomach. Gonads and internal organs of the *Caecilia* sp. were poorly preserved and thus prevented accurate sex determination. The *Caecilia* sp. specimen belongs to a taxon that is currently under revision (George Fletcher, pers. comm.). The snake (QCAZ 1087) and the *Caecilia* sp. (QCAZ 17917) are deposited in the Museo de Zoologia, Pontificia Universidad Catolica del Ecuador, Quito. The genus *Caecilia* is common in this region; however, it has never been reported as prey for pitvipers or other snakes.

Luis A. Coloma, Giovanni Onore, and Santiago R. Ron (PUCE) kindly provided logistic support. George Fletcher identified the caecilian. I thank the staff and the students of Departamento de Ciencias Biologicas for their friendship. Fernando Dini (DEEE, Pisa University) granted travel to Ecuador.

Submitted by **MARCO A. L. ZUFFI**, Museo di Storia Naturale e del Territorio, Università di Pisa, via Roma 79, 56011 Calci (Pisa) – Italy; e-mail: marcoz@museo.unipi.it.

BOTHROPS JARARACUSSU (Jararacussu). **OPHIOPHAGY**. Pitvipers of the genus *Bothrops* are diet generalists, feeding both on endothermic and ectothermic prey (Martins et al. 2002. *In* Schuett et al. [eds.], Biology of the Vipers, pp. 307–328. Eagle Mountain Publ., Eagle Mountain, Utah). The most important ectothermic prey are frogs, lizards, and centipedes, whereas snakes are unusual prey. At least nine species of *Bothrops*, including *B. jararacussu*, eat snakes occasionally (Martins et al., *op. cit.*). Here we report on a *B. jararacussu* found swallowing a snake in the wild.

A *B. jararacussu* female (SVL = 920 mm, tail = 121 mm, mass = 305 g, IB 63886) was found during the morning of 4 June 2001 on a dirt road crossing a stretch of Atlantic forest at Juquitiba, São Paulo (23°57'S, 47°03'W), southeastern Brazil. The collector (L. A. Kobata) related that a portion of the pitviper's prey (ca. 30 cm) protruded from its mouth and that its body was wrinkled. The pitviper was collected and put into a box, where it disgorged a male individual of the arboreal colubrid, *Chironius bicarinatus* (SVL = 950 mm, tail = 412 mm, mass = 220 g, IB 63887). The prey/predator mass ratio (0.72) was high (cf. Martins et al., *op. cit.*).

Although viperids have the ability to subdue and ingest enormous meals (Greene 1992. *In* Campbell and Brodie [eds.], Biology of the Pitvipers, pp. 107–117. Selva, Tyler, Texas), the snake prey was much longer than its predator. The excessive length of prey likely hindered the movements of the pitviper, and caused the wrinkles on its body. It is possible that due to the elongate form of this particular prey type, the predator had difficulty to assess the actual body length of its prey. The prey had signs of hemorrhage in five distinct parts of its body. Strike with bite and release is the usual tactic employed by snakes of the genus *Bothrops* when preying on rodents (Sazima 1992. *In* Campbell and Brodie [eds.], Biology of the Pitvipers, pp. 199–216. Selva, Tyler, Texas), whereas frogs are held after the initial strike until swallowed (Sazima 1991. Copeia 1991:245–248). Ectothermic prey such as lizards and snakes are presumably captured using the bite and hold tactic. *Chironius bicarinatus* is an agile and irritable snake that readily retaliates against attacks (Sazima and Haddad 1992. *In* L. P. C. Morellato [org.], História Natural da Serra do Japi: Ecologia e Preservação de uma Área Florestal no Sudeste do Brazil, pp. 212–236. Campinas, Editora UNICAMP) and is very hard to capture (pers. obs.). Thus, the snake preyed on by the *B. jararacussu* most likely struggled after the first hold and was bitten several times by its predator, which would explain the multiple hemorrhage marks.

We thank L. A. Kobata for the field observations, I. Sazima for critical reading, and the CNPq for financial support to OAVM. This note is part of the Project "História Natural, Ecologia e Evolução de Vertebrados Brasileiros" funded by the FAPESP (grant 00/12339-5).

Submitted by **OTAVIO A. V. MARQUES**, **CESAR A. FALCETTI**, **RICARDO A. K. RIBEIRO**, and **DONIZETE N. PEREIRA**, Laboratório de Herpetologia, Instituto Butantan, Av. Vital Brazil, 1500, CEP 05503-900, São Paulo, SP, Brazil.

CANDOIA ASPERA (Pacific Ground Boa). **DIET**. The diet of *Candoia aspera* from New Guinea is not well documented. Like other ground-dwelling boids, it has been assumed their prey includes frogs, small mammals, and lizards (O'Shea 1996. A Guide to the Snakes of Papua New Guinea. Independent Group Pty Ltd., Singapore. 239 pp.). On 17 March 1996, while hiking between the villages of Haia and Wabo, in Southern Highlands Province, Papua New Guinea (~ 145°03'E and 6°49'S), I found an adult *C. aspera* (SVL 75 cm) with a relatively large (600 g; ca. 50% of mass of the snake) and partially ingested White-bellied Forest Rat (*Melomys leucogaster*). At this time the snake did not attempt to flee or disgorge the rat, but moved slowly and just off the trail. After it had all but the tail tip swallowed, it again began to move slowly away from the trail. Ingestion was completed at 16 min from onset of the observation. Following ingestion, the snake did not appear to not be disturbed by my presence; it moved 5–6 m off the trail and curled up at the base of a large tree in a root buttress. The relatively large size of this rat may have been the reason why the snake did not move quickly or attempt to disgorge the prey item.

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CLONOPHIS KIRTLANDII (Kirtland's Snake). **REPRODUCTION**. Published literature on the reproductive biology of *Clonophis kirtlandii* is scant throughout its range (Conant 1943. Amer. Midl. Nat. 29:313–341; Ernst and Barbour 1989. Snakes of Eastern North America. George Mason University Press, Fairfax, Virginia. 282 pp.; Fitch 1970. Univ. Kansas Mus. Nat. Hist. Misc. Pub. 52:1–247; Minton 2001. The Amphibians and Reptiles of Indiana. Indiana Academy of Sciences, Indianapolis. 404 pp.; Powell and Parmerlee 1991. Bull. Chicago Herpetol. Soc. 26:32; Smith 1961. Illinois Nat. Hist. Surv. Bull. 28:1–298; Tucker 1976. J. Herpetol. 10:53–54; Wright and Wright 1957. Handbook of Snakes of the United States and Canada. Cornell University Press, Ithaca, New York. 1105 pp.). Life history data are also scarce or unpublished on northeastern Illinois populations of this Illinois state-threatened species

On 27 June 2002, at 1430 h, a female *C. kirtlandii* (SVL 390 mm, 40 g) was collected while partially concealed in a crayfish burrow under a plastic bottle at a preserve in eastern Will Co., Illinois. It was retained in captivity for potential reproductive data and housed in a fiberglass cage 30 x 16 x 20 cm on a paper towel substrate with water *ad libitum* and a ceramic shelter. The cage was subject to natural conditions (e.g., kept outdoors on a screened porch). The snake was offered 1–10 earthworms (*Lumbricus* sp.) once per week, and consumed all that were offered. It was allowed sufficient time to defecate (5–12 days) and then measured. It shed on 19 July and weighed 48 g on 10 August, a mass it maintained for 15 days. Between 25 August and 2 September, the snake weighed 2.5 g less before feeding on 2 September. After sufficient time for defecation elapsed, its mass on 6 September was 45.5 g.

On 8 September, between 1000 h and 1400h, the female pro-

duced 10 neonates and one undeveloped egg. Her post-partum mass was 22 g, and total litter mass was 12 g; afterbirth and undeveloped egg mass totaled 11.5 g. Combined mass (neonates, afterbirth, and undeveloped egg) was 23.5 g. The SVL and mass ranges of the neonates (4 males, 6 females) were 72–118 mm and 0.5–1.5 g. One neonate (female, SVL 85 mm, 0.5 g) died 9 September, and exhibited a prolapsed liver that protruded from the umbilical region. It was preserved in 95% ethanol and deposited in the herpetology collection of the Illinois Natural History Survey (INHS 18566). The smallest neonate (male) had a spinal kink in the posterior one-third of the body, but maintained an activity level similar to that of its littermates. The female and nine remaining neonates were released at the capture site on 13 September 2002.

We thank the Illinois Department of Natural Resources (Joe Kath) for permits. Alan Resetar made helpful comments on the manuscript.

Submitted by **THOMAS G. ANTON**, Division of Amphibians and Reptiles, Field Museum of Natural History, Roosevelt Road at Lakeshore Drive, Chicago, Illinois 60605, USA (e-mail: tanton2963@aol.com), and **DAVID MAUGER**, Forest Preserve District of Will County, 22606 South Cherry Hill Road, Joliet, Illinois 60434, USA.

CONOPSIS LINEATA (Lined Tolucan Ground Snake) and ***LEPTODEIRA MACULATA*** (Southwestern Cat-eyed Snake). **ENDOPARASITES.** *Conopsis lineata* ranges widely across the central Mexican Plateau (Flores Villela and Gerez 1994. Biodiversidad y Conservacíon en México: Vertebrados, Vegetación y Uso del Suelo. Comision Nacional para el Conocimiento y uso de la Biodiversidad y Universidad Nacional Autónoma de México, Ciudad Universitaria, México, D.F. 439 pp.); *Leptodeira maculata* occurs along the Mexican Pacific Coast from Sinaloa to Guerrero (Flores Villela and Gerez, *op. cit.*). There are, to our knowledge, no reports of endoparasites from *C. lineata* and *L. maculata*. The purpose of this note is to report the presence of larval spiny-headed worms (acanthocephalans) in both snake species. Sixty-two *C. lineata* and 46 *L. maculata* were examined from the Natural History Museum of Los Angeles County, Los Angeles (LACM). A mid-ventral incision was made in the body wall, and organ surfaces and mesenteries in the posterior portion of the body cavity were visually checked for helminths. One *C. lineata* from Hidalgo (LACM 127102), collected 5 January 1978 and one *L. maculata* from Sinaloa (LACM 7243) collected 21 July 1960 contained oblong whitish bodies, ca. 1 x 3 mm. On microscopic examination they proved to be oligacanthorhynchid acanthocephalan cystacanths. Prevalence of infection (infected snake/sample examined x 100) was 2% for both *C. lineata* and *L. maculata*. The specimens were deposited in the United States National Parasite Collection, Beltsville, Maryland as USNPC 91935 for *C. lineata* and USNPC 91978 for *L. maculata*.

Oligacanthorhynchid cystacanths have been previously found in Mexico (Baja California 1/8 [13%], Chihuahua 2/2 [100%], Coahuila 5/9 [56%], Durango 2/2 [100%], Sinaloa 2/6 [33%], and Sonora 9/26 [35%]) in the colubrid snake, *Rhinocheilus lecontei* (Goldberg et al. 1998. J. Helminthol. Soc. Washington 65:262–265). Acanthocephalans require at least two hosts in the life cycle; arthropods are the usual intermediate hosts in which the infective stage, the cystacanth, develops (Nickol 1985. *In* Crompton and Nickol [eds.], Biology of the Acanthocephala, pp. 307–346. Cambridge University Press, Cambridge, UK). When eaten by a definitive host, the cystacanth excysts and develops to maturity somewhere in the digestive tract of the definitive host. Paratenic hosts (transport hosts) are common; the cystacanth enters with prey and excysts, but if the host is inappropriate, it migrates from the intestine into the body cavity and again encysts. *Conopsis lineata* is known to eat insects (Sánchez-Herrera 1980. Bull. Maryland Herpetol. Soc. 16:9–18). Snakes of the genus *Leptodeira* eat lizards and anurans (Duellman 1958. Bull. Am. Mus. Nat. Hist. 114:1–152) and infection is most likely secondary, i.e., re-encystment of cystacanths originally in lizards or anurans. Infected snakes likely serve as paratenic hosts. *Conopsis lineata* and *L. maculata* are new host records for oligacanthorhynchid acanthocephalan cystacanths. Hidalgo is a new locality record.

We thank David A. Kizirian (Natural History Museum of Los Angeles County) for permission to examine *C. lineata* and *L. maculata*.

Submitted by **STEPHEN R. GOLDBERG,** Department of Biology, Whittier College, Whittier, California 90608, USA (e-mail: sgoldberg@whittier.edu), and **CHARLES R. BURSEY,** Department of Biology, Pennsylvania State University, Shenango Campus, Sharon, Pennsylvania 16146, USA (e-mail:cxb13@psu.edu).

CONOPSIS LINEATA (Lined Tolucan Ground Snake). **REPRODUCTION.** *Conopsis lineata* ranges widely across the central Mexican Plateau (Uribe-Peña et al. 1999. Anfibios y Reptiles de las Serranías del Distrito Federal, México. Cuadernos 32, Instituto de Biología, Universidad Nacional Autónoma de México, México, D.F. 119 pp.). Information that *C. lineata* is viviparous was reported by Greer (1966. Copeia 1966:371–373). Four *C. lineata* in the Museum of Comparative Zoology from Hidalgo (no dates) contained 2, 3, 3, 3 embryos and two collected from Veracruz in January contained 3 and 5 embryos (Greer, *op. cit.*).

A histological examination was performed on gonadal material from 37 *C. lineata* in the herpetology collection of the Natural History Museum of Los Angeles County (LACM). Specimens were from the Mexican states of Hidalgo, Michoacán, Oaxaca, Puebla, Tlaxcala, and Veracruz. The study was limited to adults. A total of 18 females, mean snout–vent length, SVL = 212 mm ± 30 SD, range 176-258 mm; 17 males, SVL = 191 mm ± 26 SD, range = 150–234 mm were examined. The left testis or left ovary was removed, dehydrated in ethanol and embedded in paraffin. Histological sections were cut at 5 µm and stained with Harris' hematoxylin followed by eosin counterstain. Enlarged ovarian follicles or oviductal eggs were counted but were not examined histologically.

The males exhibited the following testicular conditions: January (1) recrudescent (renewal of germinal epithelium); April (1) spermiogenesis (sperm formation); July (3) spermiogenesis; August (9) 7 spermiogenesis, 2 early regression (germinal epithelium exhausted, small amounts of sperm remain); September (2) spermiogenesis; December (1) advanced recrudescence. The smallest reproductively active male (spermiogenesis) measured 150 mm SVL (LACM 59117). Females exhibited the following ovarian conditions: January (2) 4 enlarged follicles > 6 mm length (LACM

127104) SVL 206 mm, Puebla; 3 oviductal eggs (LACM 121891) SVL 188 mm, Veracruz; 30 June–1 July (1) 6 well-developed embryos (LACM 130664) SVL 257 mm, Oaxaca; August (15) 11 no yolk deposition, 4 early yolk deposition. The smallest reproductively active female (early yolk deposition in progress) measured 176 mm SVL (LACM 69078). The mean litter size for the six litters from Greer (*op. cit.*) and the three litters from LACM (3, 4, 6) is 3.6 ± 1.2 SD, range = 2–6.

The lack of monthly samples does not allow a description of the seasonal testicular cycle, however the presence of one April spermiogenic male, spermiogenic males from July–September and one male in advanced recrudescence from December and January suggests a prolonged period of sperm production. Four of 15 August females in early yolk deposition suggests that females commence reproductive activity during this month. The six embryos from LACM 130664 is a new maximum litter size for *C. lineata*. I thank D. Kizirian (Natural History Museum of Los Angeles County) for permission to examine *C. lineata*.

Submitted by **STEPHEN R. GOLDBERG,** Department of Biology, Whittier College, Whittier, California 90608, USA; e-mail: sgoldberg@whittier.edu.

CROTALUS CATALINENSIS (Santa Catalina Island Rattleless Rattlesnake). **DIET**. *Crotalus catalinensis* is endemic to Isla de Santa Catalina (25°39'N, 110°49'W), Baja California Sur in the Gulf of California (Beaman and Wong 2001. Cat. Am. Amphib. Rept. 733.1–733.4), 24 km from the peninsular coast. The loss of the rattle has been hypothesized to increase hunting efficiency (Greene 1997. Snakes: The Evolution of Mystery in Nature. Univ. California Press, Berkeley. 351 pp.; Rubio 1998. Rattlesnake: Portrait of a Predator. Smithsonian Inst. Press, Washington. 272 pp.; Grismer 2002. Amphibians and Reptiles of Baja California, Including Its Pacific Islands and the Islands in the Sea of Cortés, University of California Press, Berkeley, California, 409 pp.). Because of its propensity to climb on shrubs, it has been speculated that this rattlesnake preys mainly on birds (Grismer 2002, *op. cit.*).

As part of a broad ecological project on *C. catalinensis*, during two visits to the island 16 adult individuals (10 males, 6 females) and 1 neonate were palped in order to obtain stomach contents. Only two of the snakes (11.7%) presented food items, and both were identified as the endemic rodent species of the island, Santa Catalina Deer Mouse, *Peromyscus slevini* (Hall 1981. The Mammals of North America, John Wiley and Sons, New York. Vol II. 1181 pp.).

On 25 August 2002, at 1900 h, an adult male *C. catalinensis* (SVL 510 mm, TL 554 mm, mass 110 g, live mass with prey item) was found coiled under an Iron Tree (*Ebenopsis confinis*) on the west part of the island. The stomach contents were obtained by forced regurgitation and a partially digested *P. slevini* (3.5 g), swallowed head-first was found.

On 18 October 2002, at 2135 h, on the south part of the island an adult male *C. catalinensis* (SVL 572 mm, TL 621 mm, mass 126 g, live mass with prey items) was found coiled on an outer branch of a Red Elephant Tree (*Bursera hindsiana*) at a height of 0.6 m from the floor. Two *P. slevini* were obtained by forced regurgitation. The first food item was a minimally digested male (TL 155 mm, T 87 mm, HF 19 mm, 9 g). The second item (1.5 g) was considerably more decomposed (e.g., two thirds of the body). Both mice were swallowed headfirst.

We observed many *P. slevini* climbing on shrubs, and perhaps this could be another reason for the arboreal hunting habits of *C. catalinensis*, in addition to searching for bird prey.

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CROTALUS HORRIDUS (Timber Rattlesnake). **ARBOREALITY, DIET.** Although rattlesnakes are typically terrestrial animals, recent studies have demonstrated that arboreal activity is a regular aspect of timber rattlesnake behavior (see Coupe 2001. Herpetol. Rev. 83–85). Possible motives ascribed to such activity include thermoregulation, ecdysis, courtship, and foraging. Although arboreal animals such as squirrels and song birds have been reported in timber rattlesnake diets, arboreal foraging has not been confirmed. Here, we report on an instance of arboreal predation by a timber rattlesnake on a male Yellow-bellied Sapsucker (*Sphyrapicus varius*). The observation was made by Steven and Lucille Mitchell during the summer of 1981. Details were obtained by an interview with Mrs. Mitchell in 2001. The incident occurred on a clear, warm mid-summer afternoon (1600

FIG. 1. Timber rattlesnake holding male sapsucker.

h). Steven, at that time 5 years old, heard a bird calling loudly from a large American Elm tree in their back yard (IOWA: Allamakee Co: Lansing Township: T100N, R4W, Sec 34, NW 1/4 of SE 1/4). Looking up he saw the bird moving about and calling loudly in front of the snake on a branch ca. 4.5– 6 m above ground. While he watched, the snake struck and held the bird, both falling from the branch onto another branch ca. 1–1.5 m above ground. He ran into the house and Mrs. Mitchell returned with him, took photos (Fig. 1) and killed the snake. No measurements were taken on the snake. Mrs. Mitchell states that the bird was no longer moving when she arrived.

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CROTALUS HORRIDUS (Timber Rattlesnake). **ARBOREALITY, COURTSHIP**. Arboreal courtship in timber rattlesnakes has only been reported once (Coupe 2001. Herpetol. Rev. 32:83–85). Here we report a second instance of arboreal courtship, from a site in Crawford County, Wisconsin. On 16 Aug 2001 a radio-implanted male rattlesnake (100.5 cm SVL, 7.5 cm tail, 966 g) was observed coiled together on the ground with a large pre-shed female (98.0 cm SVL, 6.0 cm tail, 835 g). Four days later (20 Aug) the male was observed 1 m above ground coiled together with the same female. They were observed together in the same posture and location on each of the next five days. On 26 Aug the male had moved to the ground 5 m from the female, who remained in the tree. They were observed in these same separate locations through 28 Aug. On the morning of 29 Aug the male had moved to 2 m from the female. On the morning of 30 Aug he was observed 2 m up in a sapling 1.75 m from the female who was 1.5 m above ground at the same location she had been since 20 Aug. At 1500 h that afternoon both snakes were in the same locations. At 1800 h the male had joined the female again (Fig. 1) where they remained together through 1550 h on 1 Sept.

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CROTALUS HORRIDUS (Timber Rattlesnake). **DEFENSE AND BLACK BEAR DEATH.** There has been no record, to the best of our knowledge, of a Timber Rattlesnake (*Crotalus horridus*) killing a Black Bear (*Ursus americanus*) in defense. On 9 June 2000 personnel of the Cooperative Alleghany Bear Study confirmed the mortality of a 4-month-old female *U. americanus* on the George Washington and Jefferson National Forest in western Virginia. It was found in a mixed hardwood-pine stand lying on its left side in a fetal position with its chin positioned upward. The cub (3.3 kg) was from a litter of four (2 males: 2 females), and had been radio-collared in the den on 15 March 2000.

A necropsy performed at the Virginia-Maryland Regional College of Veterinary Medicine indicated swelling of the proximal caudomedial aspect of the left hind limb that was associated with a locally extensive area of demarcated and discolored skin (necrosis) with extensive subcutaneous edema that extended into the underlying muscle. The distance between the prominent punctures was 11.35 mm (Fig.1). There was moderate post-mortem autolysis of the carcass, including all organs. Gross pathological findings were consistent with a venomous snakebite (Duncan and Shoieb 2001. Necropsy Report 2001-303. Virginia Maryland Regional College of Veterinary Medicine, Virginia Polytechnic Institute and State University, Blacksburg).

In western Virginia, venomous snakes include the Copperhead (*Agkistrodon contortrix*) and Timber Rattlesnake (*Crotalus horridus*) (Mitchell 1994. Smithsonian Institution Press, Washington). Identification of the snake species responsible in this incident by the bite pattern is difficult because pitvipers have fangs that rotate not only forward but also laterally, leaving the bite wounds up to 112% wider than the resting inter-fang distance (Zamudio et al. 2000. Toxicon 38:723–728). Given the small distance of the fang width (11.35 mm), both snake species were con-

FIG. 1. Male and female rattlesnakes coiled together at 1920 h on 30 Aug 2001. Male's head is resting on the female's head.

FIG. 1. Snakebite pattern found on the inner thigh of the left hind leg of a 3.3 kg black bear (*Ursus americanus*) cub in Rockingham County, Virginia, 9 June 2000.

sidered possible candidates for the bite. The inter-dental space between fangs was measured in two archival skull specimens derived from *A. contortrix* (TL 81 cm) and *C. horridus* (TL 121 cm) that were prepared and mounted in an open-mouth, extended-fang position. The inter-dental spaces were 7 mm and 12 mm, respectively. Mitchell (*op. cit.*) reported that both *A. contortrix* and *C. horridus* are found in mixed hardwood-pine forests, which characterizes the habitat where the dead bear was found. Based on the extent of localized tissue damage and documentation of punctures with an 11.35 mm intervening space, a bite from *C. horridus* was considered more likely. The venom of *C. horridus* is more toxic and can cause more extensive tissue damage; however, due to the size of the cub it is possible that a bite from *A. contortrix* delivered the fatal bite. Even though we cannot definitively determine which snake species caused this mortality, the observation remains unique in reported cases of mortality in juvenile *U. americanus*.

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CROTALUS LEPIDUS KLAUBERI (Banded Rock Rattlesnake). **MORPHOLOGY**. Klauber (1972. Rattlesnakes. Their Habits, Life Histories, and Influence on Mankind. Univ. Califonia Press, Berkeley, California. 740 pp.) reported the congenital absence of rattles in three species of rattlesnakes, *Crotalus cerastes, C. horridus,* and *C. pricei*. Subsequently, congenital absence of the rattle has been reported for *C. atrox* (Painter et al. 1999. Herpetol. Rev. 30:44; Holycross 2000. Herpetol. Rev. 31:177–178) and *C. viridis* (Holycross 2000. Herpetol. Rev. 31:177). Herein we report a rattleless female *Crotalus lepidus klauberi* with an abruptly tapered tail that was collected 28 Sept 2002 in the Animas Mountains, Hidalgo County, New Mexico, USA. Of 165 specimens (male and female) examined in the Animas (N = 81), Peloncillo (N = 60), and Chiricahua (N = 24) mountains (1991–2002), this was the only rattleless specimen. The rattleless specimen had 13 subcaudals, below the range observed (16–22, mean = 18.6 ± 0.2 SE) for 56 females for which we have data from these mountain ranges. The absence of scarring or injury suggests the condition

FIG. 1. Congenital lack of rattle in an adult female *Crotalus lepidus klauberi*.

might be congenital. The tail of the snake was photographed prior to release (Fig. 1).

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CROTALUS LEPIDUS (Rock Rattlesnake). **DIET**. *Crotalus lepidus* is a widely distributed rattlesnake that occurs from southeastern Arizona, southern New Mexico, and southwestern Texas through most of the Sierra Madre Occidental and northern portion of the Mexican Plateau, and the northern portion of the Sierra Madre Oriental (Campbell and Lamar 1989. The Venomous Reptiles of Latin America. Comstock Publ. Assoc., Ithaca, New York. 425 pp.). Holycross et al. (2002. J. Herpetol. 36:589–597) summarized the published dietary records for this species. Most of these dietary records were obtained from snakes north of Mexico. Only one prey item has been recorded for the endemic Mexican subspecies *C. l. morulus*. Klauber (1972. Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind. 2 Vols., 2nd ed. Univ. California Press, Berkeley. 1533 pp.) reported one specimen of *C. l. morulus* contained lizard scales (unidentified species). Herein we provide dietary records for *C. l. lepidus* and *C. l. morulus* from Nuevo León, Mexico.

In July 2001, while conducting a herpetofaunal inventory of the Sierra San Antonio Peña Nevada in the municipality of Zaragoza, Nuevo Leon, we collected three individuals of *C. l. morulus*. They were found in an oak-agave forest at ca. 2700 m elevation. Mass of all animals was taken immediately after capture but no length measurements were made. After defecation in the lab, fecal remains were analyzed. The fecal material of one adult male *C. l. morulus* (UANL 5801, 118 g) contained scales of the anguid lizard *Barisia imbricata ciliaris*. Bryson et al. (2003. Herpetol. Rev.

34:65–66) found *B. i. ciliaris* remains in the fecal matter of a *C. pricei miquihuanas* from Coahuila, Mexico. Fecal matter from a juvenile female *C. l. morulus* (UANL 5802, 19.7 g) contained *Eumeces brevirostris pineus* scales and bone fragments. Fecal matter from a juvenile male (UANL 5804, 22.9 g) contained *Sceloporus grammicus disparilis* scales. Gloyd and Smith (1942. Bull. Chicago Acad. Sci. 6:231–235) documented *S. g. disparilis* (reported as *S. microlepidotus disparilis*) as a prey item of *C. l. lepidus* from the Sierra del Carmen in Coahuila, México.

On 22 August 2002 we found a juvenile male *C. l. lepidus* (UANL 6181, 354 mm TL) dead on the road west of San Isidro, Municipio Santiago, Nuevo León, Mexico. The snake had a juvenile *Sceloporus minor* in its mouth, and both it and lizard were badly crushed. We were thus unable to determine if the snake had been run over while consuming the lizard that it had killed, or if the snake had been scavenging an already dead-on-road lizard. DeVault and Krochmal (2002. Herpetologica 58:429–436) reviewed reports of scavenging in snakes and reported that 31% of unprovoked scavenging incidents from field observations were by rattlesnakes. The road on which the *C. l. lepidus* was found runs through a canyon (ca. 1600 m elevation at the base) characterized by steep limestone walls covered with agave, sotol, and scrub oak. On 3 October 2002 we found a large male *C. l. lepidus* (UANL 6199, 740 mm TL) dead on a dirt road near Laguna de Sanchez, Municipio Santiago, Nuevo León, Mexico. Dissection of the specimen revealed that it had consumed a large *Sceloporus torquatus binocularis* (116 mm SVL, 128 mm tail length).

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CROTALUS MOLOSSUS MOLOSSUS (Black-tailed Rattlesnake). **MALE-MALE FIGHTING**. Observations of male-male fighting in free-ranging rattlesnakes are rarely published. Male-male fighting has not been published for *Crotalus m. molossus*. Here we describe a case of male-male fighting at Parker Creek, Sierra Ancha Mts., Gila Co., Arizona, USA.

On 1 August 1999 at 1100 h, we found a pair of *C. m. molossus* entangled with each other in the water of a running creek. Both had about three-fourths of their bodies immersed in the water. They had apparently fallen into the creek, as they were at the bottom of a steep dirt slope. The snakes were about the same body length (ca. 140 cm SVL). One was considerably paler and somewhat smaller, and had a less contrasting black and yellow dorsal color. The snakes were wrestling, at times twisting together the full lengths of their bodies. They also raised their heads above the ground to their full extents. Their movements appeared sluggish and uncoordinated, possibly because of the immersion in water, which was considerably cooler than the air. The fight moved out of the water ca. 1 min. after we began our observations (Fig. 1). Both snakes seemed oblivious to 8 students observing them from a distance of 4 m. The interaction ended ca. 45 min. later, with the duller colored, smaller individual retreating.

FIG. 1. Male combat in *Crotalus molossus*.

Although male fighting in snakes commonly occurs in the presence of a female (e.g., Schuett 1997. Anim. Behav. 54:213–224), no other snakes were seen in the area. However, the area was not intentionally searched for other snakes.

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CROTALUS RAVUS (Mexican Pygmy Rattlesnake). **DIET**. The feeding habits of *Crotalus (= Sistrurus) ravus* have not been thoroughly documented. Uribe-Peña et al. (1999. Anfibios y Reptiles de las Serranias del Distrito Federal, México. Cuadernos, IB UNAM 32:82) refer to a paper by Sánchez-Herrera (1980. Bull. Maryland Herpetol. Soc. 16:9–18) indicating that this species consumes vertebrates, such as lizards (*Sceloporus grammicus* and *Sceloporus megalepidurus*), mammals (*Mus musculus* and *Microtus mexicanus*), and insects. Nevertheless, data on the diet of *C. ravus* are not contained in Sánchez-Herrera (*op. cit.*). In fact, *S. megalepidurus* does not occur in the mountains surrounding Distrito Federal (Smith 1939. Zool. Ser. Field. Mus. Nat. Hist. 26:204; Sites et al. 1992. Bull. Amer. Mus. Nat. Hist. 213:45). The reference cited by Uribe-Peña et al. (1999) is from the unpublished bachelors thesis of O. Sánchez-Herrera (1980. Herpetofauna de Tlaxcala. Fac. de Ciencias, UNAM, México, 155 pp.).

Here we report on a juvenile female *C. ravus* collected on 17 August 2002 in the vicinity of Mexico City, in the mountains surrounding the Valley of Mexico (Huixquilucan, Zacamulpa, State of Mexico). This specimen was deposited in the Museo de Zoologia, Facultad de Ciencias (MZFC 14287). Measurements were obtained before dissection (SVL 167 mm, TL = 186 mm, HL

= 15.1 mm, and HW = 10 mm). Upon dissection, a partially digested adult *S. grammicus* and a specimen of the Order Hemiptera (possibly a member of Pentatomidae, head and wings) were in the stomach. O. Sánchez-Herrera (*op. cit.*) refers to four specimens of *C. ravus* collected by him in the Mexican State of Tlaxcala. He found the lizards and mice cited above, and also noted that one small individual (TL 216 mm) contained a large (27.3 x 10.4 mm) cricket (Orthoptera, Gryllidae). Our observations confirm that, in addition to lizards and small mammals, certain insects constitute a portion of the diet of juvenile *C. ravus*.

We thank Enrique González-Soriano for his help determining the hemipteran.

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DABOIA RUSSELII RUSSELII (Sri Lankan Russell's Viper). **LARGE PREY**. *Daboia russelii* is a highly venomous, terrestrial viperid that preys on a variety of vertebrates and invertebrates, including rodents (Wüster 1998. Hamadryad 23:33–40). The Sri Lankan population, previously known as *Daboia russelii pulchella*, recently was synonymized with *D. russelii russelii* (Wüster et al. 1992. Biol. J. Linn. Soc. 47:97–113; Rage and Toriba 1993 *In* Golay et al. [eds.], Endoglyphs and Other Major Venomous Snakes of the World: A Checklist, pp. 267–688. Azemiops, Geneva, Switzerland; Wüster 1998, *op. cit.*)

A preserved (unaccessioned) juvenile *D. r. russelii*, from the vicinity of Nikaweratiya, North Western Province, ca. 90 km NNE of Colombo, in the care of one of us (SAMK), was examined by MOS and ADS for stomach contents. The specimen had fed just prior to being killed and was found to contain a single, murid rodent (House Mouse; *Mus musculus*) of considerable size in relation to the snake (Fig. 1). The snake measured 180 mm SVL (210 mm TL) and was 21 g. The mouse measured 66 mm SVL (109 mm TL) and was13.5 g. Rodents often constitute a 'Type III' prey item, which is typical for viperids (Cundall and Greene 2000. *In* Schwenk [ed.], Feeding: Form, Function, and Evolution in Tetrapod Vertebrates, pp. 293–333. Academic Press, San Diego, California), the prey/predator body length ratio of 0.37 and mass ratio of ca. 0.64 are considerable, even when taking into consideration the presence of preservative fluid in both specimens.

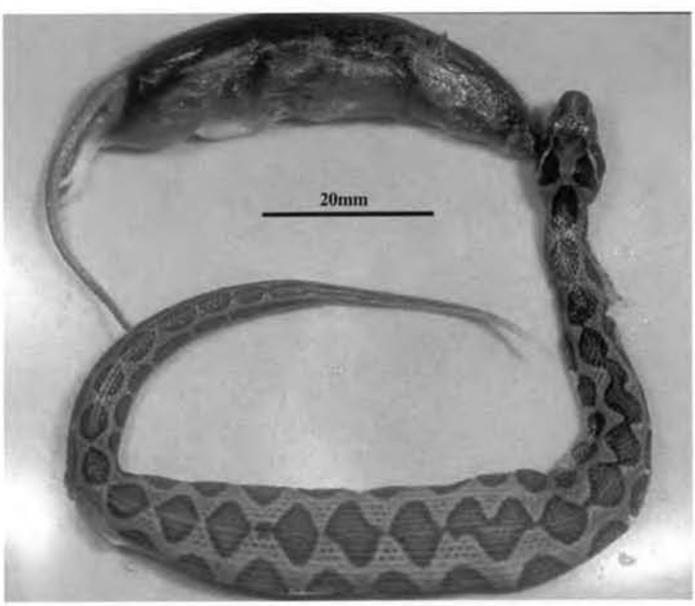

FIG. 1. A juvenile *Daboia russelii russelii* and the prey item (*Mus musculus*) it consumed; the relative predator/prey mass of this food item was 0.64.

We thank C. Wijesundara of the Faculty of Science, Peradeniya University, Sri Lanka, for the identification of the mouse, and YAP Films and Animal Planet for funding and support of the project 'O'Shea's Big Adventure Series 3': "Venom" in Sri Lanka.

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DIADOPHIS PUNCTATUS (Ring-necked Snake). **ENDOPARASITES.** Twenty-four *Diadophis punctatus* (Colubridae) from the herpetology collection of the University of Arizona (UAZ; all specimens from Arizona, USA) were examined for endoparasites. A mid-ventral incision was made in the body wall and organ surfaces and mesenteries in the posterior portion of the body cavity were visually checked for helminths. Three *D. punctatus* contained oblong whitish bodies measuring ca. 1 x 3 mm; upon microscopic examination they were proved to be larvae (cystacanths) of Spiny-headed Worms (Acanthocephala, Oligacanthorhynchidae) (UAZ 36293, Santa Cruz County) (N = 5), (UAZ 36293, Pinal County) (N = 6), and (UAZ 37837, Santa Cruz County) (N = 1). Prevalence of infection (infected snake/sample examined x 100) was 13%. The helminths were deposited in the United States National Parasite Collection. Beltsville, Maryland (USNPC 92282).

The occurence of oligacanthorhynchid cystacanths in North American reptiles is summarized by Bolette (1997. Southwest. Nat. 42:232–236), who states that snakes are paratenic (transport) hosts. Additional cystacanths of rattlesnakes were listed by Goldberg and Bursey (1999. Herpetol. Rev. 30:44-45; 2000. Herpetol. Rev. 31:104). Only one other colubrid snake species, *Rhinocheilus lecontei* from Arizona, has been reported to harbor cystacanths (Goldberg et al. 1998. J. Helminthol. Soc. Washington 65:262–285). *Diadophis punctatus* represents a new host record for oligacanthorhynchid cystacanths.

We thank George Bradley (University of Arizona) for permission to examine *D. punctatus*.

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DINODON RUFOZONATUM RUFOZONATUM (Red Banded Snake). **INSECTIVORY**. The genus *Dinodon* consists of about eight species that occur in an area that extends from eastern Himalayas, eastward through Burma, southern China and northern Indo-China to Japan.

Dinodon r. rufozonatum is the only member of this genus that naturally occurs in Taiwan (Lue et al. 2002. The Transition World—Guidebook of Amphibians and Reptiles of Taiwan. SWAN, Taipei. pp. 182–183 pp. [in Chinese]). This nocturnal species is fairly common in Taiwan, where it inhabits areas not far from water in a wide variety of habitats (Tu and Lin 1999. Nature Conservation Quarterly Issue 28:26–29 [in Chinese]; Kuntz 1963. Snakes of Taiwan. Quart. J. Taiwan Mus. 16:42–44). Known food items include frogs, loaches, small snakes, skinks, and hatchling birds (Kuntz, *op. cit.*; Lee and Lue 1996. Biol. Bull. NTNU 31:119–124 [in Chinese]; Lee and Lue 1996. J. Taiwan Mus. 49[2]:137–138; Lin et al. 1995. Newsletter of Wildlifers. 3:19–21 [in Chinese]; J. Mao, unpubl. data).

On the 14 July 2002 at 2249 h, a DOR adult *Dinodon r. rufozonatum* was found alongside a road at 23°26.995'N, 120°28.102'E, near Santzepu, Shuisan District, Chiayi County, 50 m elev. Dissection revealed that the snake was infested by an internal parasite and the stomach contained a hard, dark-colored object. The stomach was removed and was found to contain some grass blades, a small stone, and a 13.4 mm long beetle (*Cosmopolites sodidus*; Fig.1). Because the insect was virtually undigested and very little other material was found in the stomach, we believe that the snake preyed on the beetle.

We believe this is the first report of *D. r. rufozonatum* feeding on an coleopteran insect.

FIG. 1. A beetle, *Cosmopolites sodidus*, after it was removed from the stomach of the *Dinodon r. rufozonatum*.

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ELAPHE BAIRDI (Baird's Rat Snake). **PREDATION**. Like many rat snakes, *Elaphe bairdi* is a generalist predator with a cosmopolitan diet known to comprise lizards, rodents, birds and their eggs, and bats (Werler and Dixon 2000. Texas Snakes: Identification, Distribution, and Natural History, Univ. Texas Press, Austin. 544 pp.). It is a powerful constrictor and a good climber, easily able to negotiate the rocky, limestone cliffs and outcrops of its preferred habitat. This note documents an incident of diurnal predation of a small avian by this snake.

On 18 May 2000, between 1245 and 1330 h, I witnessed a large *E. bairdi* methodically take several cliff swallows *(Hirundo pyrrhonota)* from their nests under a limestone ledge in Real County, Texas, USA. The locality is immediately adjacent to the Frio River and within the H. E. Butts Foundation Camp. This location is on Texas State Highway 83 ca. 26 km N of Leaky, Texas, USA.

The sky was clear, the air temperature ca. 37.0°C, and the wind calm. Humidity was relatively high, ca. 75%. The barometric pressure was rising. The habitat surrounding the river in this location comprises a series of Cretaceous limestone bluffs and outcrops varying in height from 20 to nearly 200 m. The dominant vegetation is *Juniperus ashei*, *Quercus sinuata*, *Sophora secundiflora*, and *Juglans major* on the elevated terrain, with *Platanus occidentalis* and *Taxodium distichum* along the river bottom.

A limestone cliff on the south side of the river, near a vehicle pull out, rises precipitously at nearly 90° for ca. 30 m at which point an overhanging shelf of ca. 1 m forms. This shelf, which rises outward, away from the vertical surface at ca. 50°, offers substantial overhead protection from the effects of sun and weather for a considerable number of gourd-shaped cliff swallow nests made of mud. The nests, 36 of which appeared to be in use, were built on the cliff where the vertical surface joins the overhang at a 90° angle. Many adult swallows were observed flying in the immediate vicinity of the nests. In fact, it was their loud alarm calls that drew my attention to the nest site.

After observing the site for several minutes without detecting a cause for the birds' alarm, my attention was drawn to what at first appeared to be a dark root growing from a crack in the limestone. Examining the "root" with binoculars revealed a large *E. bairdi*. The snake was draped over the cliff and had curled its body underneath the overhang in an attempt to attack the cliff swallows.

Two thirds of the snake's body was completely under the overhang, the posterior one third remaining on the slanting, upper surface of the cliff where the tail had obtained purchase on some surface irregularity in the rough limestone. Under the overhang, the snake had looped a coil of its mid-section into the enlarged opening of an obviously empty swallow nest. From this forward anchor point, it was using the anterior 40 cm or so of its body to methodically search all nests within its reach. Each time its head entered a nest it stayed for several minutes. While it was impossible to observe any actual predation, it was quite obvious that the snake was eating the contents of the nests for periodically it would swallow an object that could easily be seen as the snake's muscular contractions passed it down the esophagus. The objects swallowed were undoubtedly young birds. The snake did not constrict this prey in the typical manner of rat snakes, as juvenile cliff swallows are small and probably offered little resistance to the snake's attack.

In the 45 minutes that it was under observation the snake searched six nests, consuming the contents of each. Nest contents varied, but at least two birds were swallowed from each nest and, in one case, as many as four.

After searching the last nest, and being able to reach no others, the snake withdrew its body from the empty nest and swung down,

supported only by its tail. The mid-section was visibly swollen with prey, but this condition did not appear to hinder mobility. The snake slowly elevated its body above the overhang. Once on top, it crawled higher on the cliff to disappear under a large sotol plant *(Dasylirion texanum)*.

While the snake was present, the swallows maintained an erratic flight pattern in front of the cliff, giving alarm calls. They did not attempt to attack the snake. Only when the snake disappeared from view did their calls stop.

Evidence of similar predatory behavior has been recorded in a specimen of *E. bairdi* collected in Brewster County, Texas (Olson 1967. Texas J. Sci. 19:99–106). Approximately 33 km SSW of Alpine, Texas, a male of the species, ca. 136 cm long, was observed resting inside two or three cliff swallow nests it had apparently broken open. While this Brewstser County snake was not observed hunting and preying on the swallows, its stomach contents were examined after it was collected and found to comprise five adult cliff swallows.

Returning to this Frio River location on the same date in 2001, I found no active nests and only two or three empty nests from the previous year. However, ca. 100 m downstream, swallows had established a new nesting site that contained many nests. This downstream location had been uninhabited the year prior during the time the above incident was witnessed.

The Real County snake described here was not collected, so measurement data are unavailable. However, based on measurements of the cliff obtained with an optical laser range calculator, the length of the snake was estimated at well over 132 cm.

While *E. bairdi* is said to be chiefly "day-active" (Werler and Dixon, *op. cit*), the incident cited above is unique in my experience for taking place during the middle of a bright, sunny day. Of the perhaps two-dozen *E. bairdi* I have observed in the last four years, all were active after dark, or just at dusk.

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EPICRATES SUBFLAVUS **(Jamaican Boa). FORAGING BEHAVIOR.** The endemic Jamaican Boa (*Epicrates subflavus*), locally known as "Yellowsnakes," are known from three cave systems: Windsor (Trelawney), Green Grotto (St. Ann), and St. Clair (St. Catherine) (Prior and Gibson. 1997. Herpetol. Rev. 28:72–73). Bat predation has only been observed at Windsor Great Cave (Koenig and Schwartz 2003. Herpetol. Rev. 34:374–375; Vareschi and Janetzky 1998. Jamaica Nat. 5:34–35). Here we report field observations of *E. subflavus* roosting and foraging on bats in two additional cave systems in Jamaica.

We surveyed Ratbat Hole (Botany Bay, St. Thomas) on 16 December 2001 and 25 March 2002. This cave, known among local guano collectors, is about 4 km E of the satellite dish of Jamaican Communications on the main road from Kingston to Morant Bay, and can be reached after a 20-min steep hike north from Botany Bay. The main entrance is 5 m wide and about as tall, leading to a 15–20 m vertical passage. This cave is surrounded by karst, interspersed with low secondary dry scrub, and contains at least four bat species that have sharp seasonal variations in population density (Dávalos and Eriksson 2003. Caribb. J. Sci. 39:140–144). On our first visit we found an adult *E. subflavus* on the cave entrance, with a bat in its digestive tract. During our second visit we found a *E. subflavus* foraging for bats as they emerged and thereafter, from 1830 h to 2100 h. The boa made numerous unsuccessful attempts to capture bats identical to those described by Prior and Gibson (*op. cit.*).

We visited Monarva Cave (Revival, Westmoreland) on 5 December 2001 and 21 March 2002. Monarva is a locally well-known dry passage cave in the Negril Hills and is known to harbor populations of at least seven bat species (Dávalos and Erickson, *op. cit.*). Monarva is surrounded by the hamlet of Revival, pasture fields, and secondary vegetation. On our first visit we found an adult *E. subflavus* on the cave wall, 20 m along the steep passage that funnels thousands of bats from the inner chambers to the two-meter wide cave entrance. This animal remained in the same place throughout our visit, from 1900–1945 h. On our second visit, ca. 2000 h, we found a juvenile *E. subflavus* 3 m into the cave and moving out toward the vegetation at the entrance.

These observations confirm the presence of this threatened species (Hilton-Taylor 2000. IUCN Red List of Threatened Species. IUCN, Gland. xviii + 61 pp.) in the parishes of Westmoreland and St. Thomas, where previous reports claimed they were abundant but remained unvouchered (Gibson 1996. Dodo, J. Wildl. Preserv. Trusts 32:143–155). We also add two new localities to the handful of records of *E. subflavus* in Jamaican cave systems and confirm bat predation at Ratbat Hole. The dearth of observations on the ecology of this boine and the possible threat of human intervention in these cave systems warrant further research to determine the importance of the caves for both bats and snakes.

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EUNECTES MURINUS **(Green Anaconda). SUBDUING BEHAVIOR.** Constricting snakes coil around their prey preventing the prey from breathing. Additionally, they may cause circulatory arrest in their prey by applying pressure to the thoracic cavity that prevents the prey's heart from beating (Hardy 1994. Herpetol. Rev. 25:45–47). Here, I present evidence that when a constrictor handles potentially dangerous prey, the violence of the attack, and method of constricting might produce structural damage to the prey that reduces its ability to defend itself or escape. The following observations were taken in the Venezuelan llanos, Distrito Muñoz, Apure State (7°30'N, 69°18'W).

On 26 April 1992, a female anaconda (455 cm total length, 46 kg mass), during the process of killing a young capybara (2.5 kg mass) dislocated the capybara's spine at the cervical level. The snake did not eat her prey because apparently other capybaras attacked her. The capybara was found floating in the river the next

day and examination of the body showed that the capybara had a dislocated spine and evidence of anaconda teeth marks on its skin, matching the size of the snake's head.

On 24 March 1992, I found a female anaconda (413.5 cm TL; 40 kg mass) that regurgitated a female white-tailed deer (*Odocoileus virginianus*) weighing 10 kg. Upon examination of the regurgitated deer, I found that it had two broken ribs. I assume that the constriction process caused the deer's ribs to break.

On 27 January 2001, a female anaconda (460 cm TL) regurgitated a full-grown male white-tailed deer (*O. virginianus*) that had a disjointed spine at the cervical level.

In May 1999, a large anaconda (ca. 450 cm TL) was observed constricting a large (ca. 180 cm TL) spectacled caiman (*Caiman crocodilus*). During the process of constriction, it was apparent because of the angle between the caiman's tail and body, that the caiman's spine was broken (Fig.1).

In a recent account, an anaconda constricted a white collared peccary (*Tayassu tajacu*) (Valderrama and Thorbjarnarson 2001. Herpetol. Rev. 32:46–47) and the authors reported that: "At some point, a muffled crackling sound was heard, resembling that of many bones breaking all at once." It is uncertain if the bones (e.g., ribs) of the peccary were actually breaking or if the sound was that of vertebrae being dislocated. The following statement by the authors: " ...the snake coiled itself round the peccary's torso and squeezed, visibly stretching the peccary length-wise..." suggests the latter rather than the former.

The evidence presented here demonstrates that constriction by anacondas can produce structural damage to prey in the form of broken bones and dislocated vertebrae. Hardy (*op. cit.*) argues that the violence and pressure exerted on the prey is higher than what is needed to cause suffocation and contends that the violence and excessive pressure serves the purpose of producing circulatory arrest. While I do not disagree with Hardy's interpretation, I believe the extra pressure and violence of the strike might also serve the purpose of disjointing the spine or breaking ribs to reduce a prey's ability to escape or defend itself and to expedite death.

I thank the Wildlife Conservation Society, National Geographic Society, and Asociaccion para la Conservacion y Recate Ecologico ACRE, Zoo de Doue la Fontaine-France for financial and logistic support. I also thank COVEGAN, Estación Biologica Hato El Frío, for permits to work on their properties. I thank Tony Crocceta for providing photographic material. I am also in debt to M. Quero, P Azuaje, Mirna Quero, J. Thorbjarnason, M, Muñoz for their cooperation in the development of this research.

FIG. 1. Female Green Anaconda (ca. 450 cm TL) found constricting a large Spectacled Caiman (ca. 180 cm TL) in the Venezuelan Llanos. It is apparent that the spine of the caiman has been dislocated.

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FORDONIA LEUCOBALIA (Yellow-Bellied Mangrove Snake) and ***MYRON RICHARDSONII*** (Richardson's Mangrove Snake). **DIURNAL FEEDING and PREY TYPE.** Snakes of the Homolopsinae, a lineage of aquatic colubrids, are found throughout southern Asia and northern Australia. Most species are piscivorous and ingest prey head first to assist digestion (Mori 1998. J. Herpetol. 32:40–50). All species in Australia are considered to be nocturnal (Gow 1989. Graeme Gow's Complete Guide to Australian Snakes. Angus and Robertson Publishers, North Ryde. 171 pp.). *Fordonia leucobalia* is reported to feed predominantly on Fiddler Crabs (*Uca* spp.), and occasionally on the Mud Lobster (*Thalassina anomala*) and shrimps (Shine 1991. Copeia 1991:120–131). Very little is documented regarding the feeding habits of *Myron richardsonii* apart from Shine (1991, *op. cit.*) who suggested it feeds on a variety of fish. We report herein several observations (MN) of these two species feeding by day in the mangroves of Ludmilla Creek, Darwin Harbour, Australia (12°25'S, 131°50'E) during 1998, with additional notes on prey consumed and methods of ingestion.

On 3 March, at ca. 1400 h, a snake (ca. 40 cm TL), identified as *F. leucobalia* according to Gow (1989, *op cit.*), was observed within the mangrove forest. The snake was wrapped around a large male Fiddler Crab (*Uca flammula*). The snake did not consume the crab and left it alive before moving down a nearby crab burrow, perhaps as a result of being disturbed by the observer.

On 3April, at ca. 1200 h, a *F. leucobalia* (brown dorsally and yellow ventrally) was observed on a creek bank ingesting a *T. anomala*. After ca. 10 min the snake ingested the lobster's tail, biting firmly down to displace the head, creating a clearly audible crunching sound. The snake consumed only the tail of the lobster, leaving the head in the mud.

On 13 April, at ca. 1500 h, a reddish-black *F. leucobalia* was observed within a channel ingesting a *T. anomala* as described above. On this occasion a second *F. leucobalia* (black and white morph) approached and began to coil around the first. The first snake then consumed the tail of the mud lobster as described above and moved away from the second snake rapidly.

On 2 March, at ca. 1500 h, a *M. richardsonii* was sighted on an exposed track. On close inspection, there appeared to be a black-colored nudibranch (Gastropoda) in the snake's mouth. The species could not be determined because it was almost completely encased in the snake's mouth.

The above observations report several previously undocumented phenomena. First, these observations document diurnal feeding in both *F. leucobalia* and *M. richardonii*. Both species had been regarded as strictly nocturnal (Gow 1989, *op. cit.*). Although observed active by day throughout the year (MN, pers. obs.), feeding activities were only observed from March to April, presumably when prey are most abundant (Davis 1985. *In* Bardsley et al.

[eds.], Coasts and Tidal Wetlands of the Australian Monsoon Region, pp. 297–312, NT branch of the Australian Marine Sciences Association, and the North Australia Research Unit of the Australian National University, Darwin; Nobbs 1999. Ph.D. Thesis, Northern Territory University, Darwin). Second, our observations suggest that *F. leucobalia* disengage the tails of their crustacean prey prior to ingestion. It has been reported that homolopsines ingest certain prey whole (e.g., fish, frogs), head or tail first, depending on initial bite position (Mori 1998, *op. cit.*), although Jayne et al. (2002. Nature 418:143) suggested that *F. leucobalia* remove and consume parts of their crab prey, such as the legs, if they are too large to consume whole. Third, these observations document *F. leucobalia* coiling around a crab. It seemed that this coiling behavior served as a prey holding technique, rather than an attempt at constriction to enable the snake to bite the enlarged claw of the male *U. flammula*, thereby subduing it prior to ingestion (D. Lawson, pers. comm.). This observation agrees with those of Shine and Schwaner (1985. Copeia 1985:1067–1071) and Jayne et al. (2002, *op. cit.*) who noted a similar coiling and prey consumption behavior in *F. leucobalia*. Finally, we document for the first time the consumption of a nudibranch by *M. richardsonii*. More observations would confirm whether or not this prey is uncommon for *M. richardsonii*. Homolopsine snakes of Darwin Harbour may partition prey among the three species, as described for Singapore homalopsines (Jayne et al., *op cit.*), with the Dog-faced Mangrove Snake (*Cerberus rhynchops*) consuming principally fish, *F. leucobalia* consuming principally crustaceans, and *M. richardsonii* consuming a combination of fish and gastropods.

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LACHESIS STENOPHRYS (Bushmaster). **REPRODUCTION.** The Bushmaster is unique among neotropical pit vipers in that it lays eggs rather than giving birth to live young. On 15 May 1995, a gravid female *Lachesis stenophrys* from Penshurt, Limon, Costa Rica, was received by Instituto Clodomiro Picado. The snake was individually housed in a cage, where it was offered water and mice. On 14 August 1995, the female laid 11 eggs averaging 40.29 ± 0.14 mm in diameter (range 40.1–40.5 mm), 64.15 ± 5.0 mm in length (range 60.3–70.9 mm) and 71.55 ± 1.47 g in weight (range 69.7–74.2 g). Hatching occurred in November and the duration of incubation averaged 106.63 ± 1.12 days (range 105–108 days). The 11 neonates were weighed and measured immediately and averaged 55.1 ± 2.3 g in weight (range 52.6–59.3 g) and 486.67 ± 5.7 mm in total length (range 480–490 mm). This clutch had a longer incubation time and greater mean total length and weight than a clutch reported by Ripa (1999. Bull. Chicago Herpetol. Soc. 34:45–92). Ripa (*op. cit.*) reported an incubation time of 75–77 days at 24°C, mean neonate total length of 406 mm, and weight of 45 g for a clutch of *L. stenophrys*.

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LAMPROPELTIS GETULA (Common Kingsnake). **ENDOPARASITES.** Thirty-seven *Lampropeltis getula* (Colubridae) from the Natural History Museum of Los Angeles County, Los Angeles (LACM) were examined for endoparasites. A mid-ventral incision was made in the body wall and organ surfaces and mesenteries in the posterior portion of the body cavity were visually examined for helminths. One male (LACM 102538) from Riverside County, California, USA, collected 16 May 1958 contained 7 tetrathyridia (tapeworm larvae) of *Mesocestoides* sp. embedded in mesenteries. Prevalence of infection (infected snake/sample examined x 100) was 3%. The helminths were deposited in the United States National Parasite Collection, Beltsville, Maryland as USNPC 92016.

The occurrence of tetrathyridia of *Mesocestoides* sp. in snakes of the world has been summarized by McAllister et al. (1991. J. Parasitol. 77:329–331). Additional records of *Mesocestoides* sp. in the North American colubrids *Arizona elegans, Masticophis lateralis,* and *Rhinocheilus lecontei* are listed in Goldberg and Bursey (2001. Bull. So. California Acad. Sci. 100:109–116) and for the North American viperids *C. atrox, C. mitchellii, C. molossus, C. pricei, C. ruber, C. viridis,* and *C. willardi* are listed in Mankau and Widmer (1977. Jap. J. Parasitol. 26:256–259); Bolette (1997. J. Parasitol. 83:751–752); Goldberg and Bursey (1999. Herpetol. Rev. 30:44–45); Goldberg and Bursey (2000. Herpetol. Rev. 31:104). *Lampropeltis getula* represents a new host record for tetrathyridia of *Mesocestoides* sp.

We thank D. Kizirian (Natural History Museum of Los Angeles County) for permission to examine specimens.

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LAMPROPELTIS PYROMELANA (Sonoran Mountain Kingsnake). **ACTIVITY**. Most authors suggest that *Lampropeltis pyromelana* is primarily diurnal (Fowlie 1965. The Snakes of Arizona, Azul Quinta Press, Fallbrook, California). In his unpublished master's thesis, Woodin (1956. The Ecology and Geographic Variation of the Arizona Mountain Kingsnake *Lampropeltis pyromelana*. Univ. of California Berkeley) indicated activity between 0700 and 1800 h (N = 15 observations), and concluded "*L. pyromelana* is a distinctly diurnal species." Woodin (*op. cit.*) also noted "no specimens have been found active at night."

Following Woodin's publication, Bowker (1994. Herpetol. Rev. 25:124–125) reported on 11 individuals from Camp Geronimo

(Gila Co., Arizona), noting activity between 1140 and 1810 h, with a peak capture rate between 1500 and 1600 h.

In the Animas Mountains (Hidalgo Co., New Mexico), we logged 6651.3 h searching for snakes in April through November (1994–1999, 2002). We recorded 54 *L. pyromelana* captures (44 male, 10 female), for a mean search effort of 123.2 h per specimen. These data evidence activity between 0712 and 2015 h (all times 7 h offset GMT) at 1798–2326 m elevation. Generally, capture rates (Table 1) prior to 1500 h were substantially lower than the overall mean, whereas capture rates after 1500 h were higher. Additionally, capture rates tended to be lowest at mid-day hours (ca. 1100–1500 h), when temperatures are usually highest. Because daylight hours vary across seasons, capture times were compared to sunrise and sunset times to better assess diel activity. No captures were recorded within 1.0 h after sunrise, and only one capture was recorded within 2.0 h after sunrise (1.5 h after sunrise). However, we recorded seven captures within 1.0 h of sunset, and 10 captures within 2.0 h of sunset. One capture occurred 2.3 h after sunset. These data suggest that *L. pyromelana* in the Animas Mountains may be most active in the late afternoon, evening, and dusk hours. However, activity patterns inferred from these capture data may also reflect collecting bias: approximately 88% of the search hours fell between 0800 and 1800 h, and 89% of the search effort occurred from July through October.

Observations of *L. pyromelana* from Municipio Namiquipa (Chihuahua, Mexico) suggest that *L. pyromelana* may be nocturnal under certain conditions. On 09 August 2002, we found a *L. pyromelana* crawling on the surface at 2130 h, approximately 2.6 h after sunset, at an elevation of 2185 m and an ambient temperature of 18.3°C. This individual was an adult female (SVL 740 mm, TL 910 mm) that had recently ingested a *Sceloporus jarrovii* (SVL 68 mm). Together, predator and prey were 137 g. On 10 August 2002 we observed another *L. pyromelana* crawling on the surface at 0024 h, approximately 5.5 h after sunset, at an elevation of 1743 m and an ambient temperature of 16.6°C. This individual was an adult female (SVL 760 mm, TL 940 mm, mass 145 g). These Mexican specimens were deposited at the Herpetological Collection of Unidad de Biología, Tecnología y Prototipos (UBIPRO 10172, 10190). We also report activity for a tricolor *Lampropeltis* (unvouchered), identified as *L. pyromelana*, from Municipio Tlahualilo (Durango, Mexico). The specimen was observed active at 2134 h (2.8 h after sunset) on 9 June 2000 at 1099 m elevation. However, this record seems problematic because the topography and vegetation of this area do not resemble those typically associated with *L. pyromelana*.

TABLE 1. Diel distribution of search efforts and capture rates for *Lampropeltis pyromelana* in the Animas Mountains (Hidalgo Co., New Mexico). Data were collected from April through November (1994–1999, 2002); 89% of the search effort occurred from July through October.

Hour	Total Search Effort (h)	Captures	Per Capita Search Effort (h)
0700	237.0	1	237.0
0800	460.6	4	115.2
0900	639.8	5	128.0
1000	726.5	6	121.1
1100	688.5	2	344.3
1200	635.5	5	127.1
1300	565.0	0	>565.0
1400	526.5	2	263.3
1500	528.5	6	88.1
1600	483.5	12	40.3
1700	387.0	4	96.8
1800	257.8	2	128.9
1900	125.5	4	31.4
2000	22.5	1	22.5

Collectively, the observational data presented here support earlier conclusions of a generally diurnal activity pattern for *L. pyromelana*, but further suggest that *L. pyromelana* may be most active in the late afternoon and dusk hours at certain latitudes. We also document nocturnal activity in *L. pyromelana*.

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LIOPHIS POECILOGYRUS (NCN). **ENVENOMATION.** This species has been reported recently from Venezuela (Dixon and Markezich 1992. Texas J. Sci. 44:131–166; Fuentes and Barrio 1999. Herpetol. Rev. 30:54; Rivas et al. 2002. Herpetol. Rev. 33:68). All species of the genus *Liophis* are known as quiet and inoffensive snakes, but presenting rear fangs. Handling by me and collaborators never resulted in a bite before the incident reported herein. We believe that this is the first reported case of envenomation by this species in Venezuela.

On 11 July 1999, in the summer camp Wai Tuna (km 303 along the road El Dorado-Santa Elena de Uairén, Gran Sabana, Bolívar State) some tourists under my care cornered a 55 cm TL snake, and called me quickly. I captured the snake by hand, being familiar with this species. The instinctive reaction of the snake being handled was to bite at the conjunction of the two first phalanges of the fourth finger of my left hand. It had its jaws clamped around my finger for approximately 3 min. I did not free myself or shake it off because I preferred to wait in order to let the snake release its grip on its own. The finger showed two small wounds, but both corresponded to the same right fang. After washing the wound with soap, I applied a "Aspivenin" suction device, albeit probably too late to be effective, although some blood was removed. Immediately, the two phalanges became swollen, and exhibited a severe dark purple color in the bitten area. Several minutes later, the third phalange was swollen. The general sensation was not pain, but numbness. Only if the finger was touched did I feel some pain. Twenty minutes later the swelling expanded to the third finger. I experienced an increasing pulsation as well as a rather bothersome tingling sensation. 1.5 h later the swelling had extended to the dorsum and palm of the hand. Some swelling also took place on the third phalanges of the rest of the fingers, except for the thumb.

There, it stabilized and stopped.

I made the decision to consult a person with experience in snake bites in the Santa Elena de Uairén-El Paují- Ikabarú area (Luis Scott). He had never seen a similar case. He, along with the doctors of Hospital Rosario Vera Zurita at Santa Elena de Uairén decided to prescribe an intravenous steroid (hydrocortisone in lieu of an antihistamine), an analgesic (Ibuprofen), and an antibiotic to prevent infectious complications.

The medical report four hours post bite, with the patient in good general condition, was as follows: bite by a snake (*Liophis poecylogyrus*, Colubridae) at the junction of the first and second phalanges of the fourth finger on the left hand (signs of coloration, temperature, edema and local congestion) with pain when touched and/or moved.

15 h post bite, the situation was unchanged, with a slight extension of the edema.

19 h post bite (after a short sleep of 4 h) the dorsum and palm inflammation was considerably reduced. A slight discomfort was noted in the left axilla.

22 h post bite, the general situation continued to improve (the inflammation goes down) but there was still pain to touch and movement.

48 h post bite, the swollen fourth finger and hand in general remitted considerably, the edema having extended to the dorsal and ventral parts of the first phalange notwithstanding.

60 h post bite, the finger recovered some mobility and the inflammation went down further.

72 h post bite, the finger recovered its mobility to ca. 60% and the inflammation was reduced to a minimum. The edema, however, was still in the first phalanx, especially in the dorsal region around the nail.

96 h post bite, the finger recovered its mobility further with the edema still present. Ibuprofen administration is suspended.

120 h post bite, the finger regained almost complete mobility with the edema still present. The antibiotic administration is reduced to one dose per day.

After one week, the finger was fully mobile, although some pain was felt when touched for yet another week when the edema disappeared completely.

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LYSTROPHIS DORBIGNYI (Nariguda) and ***HELICOPS INFRATAENIATUS*** (Cobra-D'Água). **PREDATION.** Despite the great variety of taxa known to prey on snakes, records of predation on Neotropical species remain scarce. Current information about predation on *Lystrophis dorbignyi* consists of only one record, reporting the presence of juvenile specimens found in the stomach of predatory birds, such as the Limpkin, *Aramus guarauna* (Aves: Aramidae) (Orejas-Miranda 1966. Copeia 1966:193–205). No data addressing predation on *Helicops infrataeniatus* exist. Here we describe several instances of predation on *L. dorbignyi* and *H. infrataeniatus* by a pair of Burrowing Owls, *Speotyto cunicularia* (Aves, Strigidae).

Observations were made in an area of sand dunes located in the Municipality of Balneário Pinhal (30°17'30"S, 50°15'55"W), on the coastal plain of Rio Grande do Sul, Brazil. At 0830 h on 12 December 2001, we found three individuals of *L. dorbignyi* associated with the burrow of a pair of *S. cunicularia*. One of the individuals (male, 235 mm SVL) was found dead inside the burrow whereas the others (female, 226 mm SVL; male, 238 mm SVL) were severely injured, but still alive, just outside the burrow entrance. At 1100 h, we re-inspected the burrow, and found yet another injured *L. dorbignyi* (female, 238 mm SVL) next to it. At 1000 h on the next day, we found yet another dead *L. dorbignyi* (male, 230 mm SVL), and nine days later, a small part of the body of a sixth individual was found.

At 1000 h on 3 January 2002, when we were approaching the same burrow, one of the birds released the posterior portion of a female *H. infrataeniatus*. The tail length allowed us to estimate its size as ca. 325 mm SVL. The other bird was on a nearby dune and also abandoned the posterior portion of a female *H. infrataeniatus*, whose size was estimated at 245 mm SVL.

The time when we found the recently captured (still alive) individuals of *L. dorbignyi* coincides with that of the activity of this exclusively diurnal species (Oliveira 2001. Dissertação de Mestrado, Depto. de Zoologia da Universidade Federal do Rio Grande do Sul. 96 pp.) and led us to believe that the snakes were captured while active on the ground. As *H. infrataeniatus* has nocturnal and diurnal activity, as do Burrowing Owls (Sick 1977. Ornitologia Brasileira. Editora Nova Fronteira, Rio de Janeiro. 912 pp.), the finding of dead specimens doesn't allow us to infer the period in which they were captured. *Helicops infrataeniatus* is a highly aquatic species, but occasionally individuals are found on the ground. In January, when the observations were made, all local ponds were dry, suggesting that the snakes were captured out of water.

The length of the five measured specimens of *L. dorbignyi* is similar to that of the smallest specimens recorded in December in the sand dunes of Balneário Pinhal (Oliveira 2001, *op. cit.*). Individuals measuring less than 250 mm correspond to 14.5% of all individuals collected in that month (N = 69). Thus, it is possible that *S. cunicularia* selects this kind of prey by its size, targeting small individuals.

Four specimens of *L. dorbignyi* and two *H. infrataeniatus* are deposited in the collection of the Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul (MCP 12668–71, 12734–35). We thank Douglas A. Rossman (Luther College, Iowa) for suggestions on this manuscript, and Carla Suertegaray Fontana (PUCRS) for information on the owls. One of us (RBO) benefited from a graduate fellowship from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

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NATRIX MAURA (Viperine Snake). **MARINE INHABITATION.** Natricine snakes generally occupy habitats near freshwater. One of the few exceptions is the North American species *Nerodia fasciata*, which includes populations adapted to brackish waters of estuaries and seacoasts (Zug et al. 2001. Herpetology. Academic Press, 630 pp.). In southern Europe and northwestern Africa, *Natrix maura* is commonly found in habitats near riverbanks, lagoons, and freshwater ponds; it feeds mostly on fish and amphibian larvae (Braña 1998. *In* Salvador and Ramos [eds.], Fauna Ibérica, Vol. 10: Reptiles, pp. 440–454. Museo Nacional de Ciencias Naturales, CSIC). Also, it has been reported to occasionally occupy pools of seawater in intertidal coastal zones (Cabot and Olea 1978. Doñana, Acta Vertebrata 5:107; Galán 1987. Mustela 3:64–69; Pino et al. 1998. *In* Santos et al. [eds.], Inventario de las Areas Importantes para los Anfibios y Reptiles en España, pp. 161–163, Ministerio de Medio Ambiente). In 2000 and 2001 several specimens of *N. maura* were found near the sea on islands and islets off the Galician Coast (NW Spain). These snakes belonged to populations that would appear to depend solely on prey from the marine habitat. In July 2001 two large adult females (one animal: SVL 857 mm, TL 164 mm) were discovered at the foot of a cliff on the islet of Onza (UTM 29T NG08). This islet, with an area of 32 ha and located 6 km from the nearest coast, has no permanent fresh water. These aquatic snakes thus depend solely on food derived from marine waters. In August 2001, on the nearby island of Ons (UTM 29T NG09), with an area of 414 ha and located 3 km from the nearest mainland, four specimens of *N. maura* were sighted on the coast among the large boulders at the foot of the cliffs, in the rocky intertidal zone, and on the beach close to the sea. One of the snakes, which measured 445 mm TL, disgorged a marine fish, *Blenius pholis*, 83 mm TL.

On the Island of San Martiño (archipelago of the Cíes Islands, UTM 29T NG07), with an area of 146 ha and 3 km from the mainland, in August 1986, an individual of *N. maura* was found swimming in the sea 2 m from the shoreline. On this same island, in June 2000, an individual of *N. maura* was observed among the boulders on the seashore.

Additional research is needed to determine if occupation of marine environments has been accompanied by physiological adaptations in *N. maura*.

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OXYRHOPUS RHOMBIFER RHOMBIFER (NCN). **DIET.** *Oxyrhopus r. rhombifer* is a terrestrial, mainly nocturnal, pseudoboine snake from southeastern and southern Brazil to northeastern Argentina and Uruguay (Bailey 1970. U.S. Nat. Mus. Bull. 297:229–235). Known prey items are small or ophiophorm lizards (Cei 1993. Reptiles del Noroeste, Nordeste y Este de la Argentina. 950 pp. Museo Regionale di Scienze Naturali, Torino; Yanosky et al. 1996. Herpetol. Nat. Hist. 4:97–109; Maschio et al. 2003. Herpetol. Rev. 34:71), rodents (Lema et al. 1983. Comun. Mus. Ci. PUCRS 26:41–121), and anurans (Yanosky et al., *op. cit.*). With regard to lizards, recorded prey include representatives of the families Anguidae (Maschio et al., *op. cit.*) and Gymnophthalmidae (Cei 1993, *op. cit.*).

We dissected one adult male of *O. r. rhombifer* (Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, MCP 2698; SVL 458 mm, mass 31.9 g) from the municipality of Porto Alegre (30°01'S, 51°13'W), southern Brazil; its stomach contained a nearly complete tail of a Tropical House Gecko (*Hemidactylus mabouia*) (MCP 1244 - prey items collection). This is the first record of *H. mabouia*, and the family Gekkonidae, as prey of *O. r. rhombifer*, although this species of lizard was previously cited as prey for *O. guibei* (Andrade and Silvano 1996. Revta. Bras. Zool. 13:143–150). These data provide further evidence that pseudoboine snakes feed primarily on small lizards and mammals (Duellman 1978. Misc. Publ., Univ. Kansas Mus. Nat. Hist. 65:1–352; Martins and Oliveira 1998. Herpetol. Nat. Hist. 6:78–150).

We thank Robert A. Thomas (Loyola University New Orleans) and John Measey (Laboratoire d'Écologie des Sols Tropicaux, IRD / Université Paris) for making useful comments on earlier versions of this manuscript. One of us (GFM) benefited from a graduate fellowship from Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).

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PYTHON RETICULATUS (Reticulated Python). **SITE SELECTION, SLEEPING, and ESCAPE BEHAVIOR**. *Python reticulatus* is frequently encountered in many natural and man-made habitats, from sea-level to 1500 m, in Southeast Asia (Cox et al. 1998. A Photographic Guide to Snakes and Other Reptiles of Thailand and South-East Asia. Asia Books, Bangkok. 144 pp.). Although large and heavy adults are primarily terrestrial (Cox, *op. cit.*), juvenile *P. reticulatus* are highly arboreal. Numerous authors also report that this species is often found near water (Boulenger 1912. A Vertebrate Fauna of the Malay Peninsula from the Isthmus of Kra to Singapore. Reptilia and Batrachia. Taylor and Francis, London xiii + 294 pp.; de Rooji 1917. The Reptiles of the Indo-Australian Archipelago II Ophidia. E. J. Brill, Leiden xiv+ 334 pp.; Tweedie 1957. The Snakes of Malaya. Govt. Printing Office, Singapore. 143 pp.). Although an apparently well studied species, most references concern the prodigious size and dietary capabilities, together with reproductive and distributional data. Little is written about their activities, habits, and behavior in the wild. For example, *P. reticulatus* is often encountered coiled and resting ("sleeping") during daylight hours.

Herein we report on the behavior of 13 *P. reticulatus*. Two of us (MOS and YT) obtained data for eight 1.0–2.0 m TL individuals along Lo Po Creek, Tarutao Island, Satun Province, southwestern Thailand, and three of us (MOS, YT, and AJL) obtained data on

four 1.0–2.0 m TL individuals and a single 3.0 m TL specimen along the Phetchaburi River, Kaeng Krachen National Park, Phetchaburi Province, western Thailand. All observations were made during daylight hours. The 3.0 m TL individual was found under a fallen tree on a bend in the Phetchaburi River, and was in pre-ecdysis. But all of the smaller individuals were found sleeping, curled on branches overhanging a tidal, mangrove-fringed Lo Po Creek (Tarutao Island) or in the Phetchaburi River (KKNP). The sleeping pythons were at heights ranging from 2 to 15 m above the water, most being at the greater heights.

Both the Phetchaburi River and Lo Po Creek contained stretches of shallow water and sporadic deeper pools, particularly on the outer curve of bends. Lo Po Creek was also subject to a regular cycle of widely varying water depths because of its tidal nature.

All of the pythons were found over deeper water; none was observed sleeping over shallow stretches on either watercourse. Campden-Main (1970. A Field Guide to the Snakes of South Vietnam. Smithsonian Inst. Press, Washington. vi +114 pp.) indicated that he found pythons at Bien Hoa "under bridges over rapidly flowing streams" but he did not record the depth of the water at these locations. All pythons we disturbed (10 of 12) immediately uncoiled and dove from their branch, plunging into the water where they were easily caught. No python attempted to escape by moving along the branch or bridging to another branch. This escape behavior ("diving") would suggest why perches over relatively deep water were selected rather than those above shallow stretches. Large lizards (*Iguana*, *Varanus*) also escape in this manner but the eyes of most snakes, including those of pythons, lack foveae, and therefore high visual acuity (Tansley 1965. Vision in Vertebrates. Chapman & Hall, London. vii + 132 pp.). Young pythons appear to be deliberately selecting suitable perches over sufficiently deep water for safe escape, but their means of determining suitability of perches remains a mystery.

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REGINA SEPTEMVITTATA (Queen Snake). **DIET.** Adult *Regina septemvittata* are thought to feed almost entirely on recently molted crayfish (Branson and Baker 1974. Tulane Stud. Zool. Bot. 18:153–171; Burghart 1968. Copeia 1968:732–737; Conant 1951. The Reptiles of Ohio. University of Notre Dame Press. 284 pp.; Minton 1972. Amphibians and Reptiles of Indiana. Indiana Acad. Sci. 346 pp; Penn 1950. Amer. Midl. Nat. 44:643–658; Wood 1949. Amer. Midl. Nat. 42:774–750). Adler and Tilley (1960. J. Ohio Herpetol. Soc. 2:28–29) reported a mudminnow and snail in the stomach of a *R. septemvittata*. Minton (*op. cit.*) also reported a catfish (as did Wood, *op. cit.*) and a dragonfly larva in the stomachs of *R. septemvittata*. Branson and Baker (*op. cit.*) reported the fantail darter, *Etheostoma flabellare*, to comprise 1.4% (N = 2) of the total stomach contents from their study. We are unaware of any published records for neonates.

On 9 May 2001, while performing a mark-recapture study of a snake community in Sandusky Bay, Ohio, USA (41°29'N, 82°49'W) the stomach contents of three neonate *R. septemvittata* were noted. All neonates appeared to be born the season before, making them ca. 8 months old. One female (15 cm TL, 4 g), regurgitated a 37.75 mm long by 7.30 mm wide crayfish cheliped. A second female (13.9 cm TL, 4 g), regurgitated a 21.75 mm long by 4.85 mm wide crayfish chela. A male neonate (16 cm TL, 4 g), regurgitated a zebra mussel, *Dreissena polymorpha* (shell, 8.55 mm L x 6.7 mm W), a dominant introduced member of the bivalve fauna, and an additional very digested crayfish chela. Wood (*op. cit.*) witnessed *R. septemvittata* feeding on dead crayfish. Our observations may substantiate that neonates feed on some crayfish carrion. Branson and Baker (*op. cit.*) had several neonates killed and consumed by crayfish in the laboratory. It is doubtful a neonate could feed on a portion of an active adult hard-shelled crayfish. It is unknown whether the neonates removed the appendage from a freshly molted crayfish or scavenged them. As these were the only stomach contents collected from neonates, crayfish chelae and chelipeds may make up an appreciable proportion of the neonatal diet. It is difficult to believe the bivalve was an incidental ingestion, as it was several times the size of the neonate's head and appeared broken at the site of attachment.

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SISTRURUS CATENATUS (Massasauga). **AGGRESSIVE BEHAVIOR**. *Sistrurus catenatus* has been described as a sluggish and mild-mannered species (Klauber 1972. Rattlesnakes: Their Habitat, Life Histories, and Influence on Mankind. Univ. of California Press, Berkeley. 1533 pp.), and one of us (RAS) has even stepped on an individual without it even rattling. Others suggest that *S. catenatus* is rather irritable (Ernst 1992. Venomous Reptiles of North America. Smithsonian Institution Press, Washington, D.C. 236 pp.). The temperament of a particular species can vary from individual to individual, and both endogenous and exogenous factors have been reported to influence snake behavior (e.g., sex, body condition, reproductive status, and the thermal environment [Stevenson et al. 1985. Am. Nat. 1985:362–386; Reinert 1988. Copeia 1998:964–978]). Herein, we report on an unusually aggressive male *S. catenatus* (65.8 cm TL, 58.3 cm SVL, 210 g).

On 18 December 2002 while relocating snakes implanted with Holohil SI-2T transmitters at the Squaw Creek National Wildlife Refuge in NW Missouri, one of us (JRL) noted snake 046 to be surface active at 1319 h. The snake appeared to be basking from within a clump of dead reed canary grass (*Phalaris arundinacea*), with only a loop of its body exposed to direct sunlight. As I approached to ca. 3 m the clump of grass began to shake and a faint buzz from the rattle was heard. When I approached to within 1.5 m the snake emerged from its basking location, slowly approached

to within 0.15 m while I remained motionless and proceeded to strike at my boot two times before it withdrew and returned to its basking location. The entire incident took place over a period of not longer then five minutes. The snake's internal body temperature of 11.5°C was considerably higher then either the ambient air temperature 1 m above the soil surface (5.6°C) or the soil temperature 10 cm below the soil surface (4.7°C). When this same individual's pre-hibernation measurements were taken on 20 November 2002, it appeared to be in good condition and no external signs of infection were observed. The fact that the snake was surface active was not surprising considering the five days of warm weather prior to the observation; average high for 14–18 December 2002 1 m above the soil surface = 16.85°C. Out of hundreds of encounters with *S. catenatus* at this site, this is the first individual that has appeared to go out of its way to strike at a human. Whether this unusual behavior was an artifact of transmitter implantation (on 14 August 2002), a predatory defense, or a result of some environmental or physiological factor is unknown.

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TANTILLA WILCOXI (Chihuahuan Black-headed Snake). **REPRODUCTION.** Information on reproduction in *T. wilcoxi* is that 1–3 eggs are laid in spring and summer (Behler and King 1979. The Audubon Society Field Guide to North American Reptiles and Amphibians. Alfred A. Knopf, New York. 743 pp.). The purpose of this note is to present additional data on one clutch and the first information on the testicular cycle. Two females, mean snout–vent length, SVL = 267 mm ± 45 SD, and eight males, SVL = 213 mm ± 34 SD, range = 168–261 mm were examined from the herpetology collection of the University of Arizona, Tucson. The left gonad was removed, dehydrated in ethanol, cleared in toluene, and embedded in paraffin. Histological sections were cut at 5 µm and stained with Harris' hematoxylin followed by eosin counterstain.

One female, UAZ 40402, SVL = 298 mm, collected 22 September from Santa Cruz County, Arizona, USA contained one oviductal egg that measured 27 x 8 mm (no histology was performed). Another female, UAZ 46148, SVL = 235 mm, collected 22 August from Sonora, México was not undergoing yolk deposition.

All males examined were undergoing spermiogenesis (sperm formation). This included two July males UAZ 26450, SVL = 261 mm from Cochise County, Arizona, USA, and UAZ 42234, SVL = 217 mm from Nuevo León, México, four August males: UAZ 28201, SVL = 230 mm, from Sonora, UAZ 39600, SVL = 168 mm (minimum size for spermiogenesis) from Cochise County, UAZ 42687, SVL = 208 mm from Durango, México, UAZ 48780, SVL = 251 mm from Cochise County, UAZ 50383, SVL = 195 mm from Cochise County, and one September male: UAZ 46338, SVL = 170 mm from Nuevo León.

Histological examinations of testes from *T. wilcoxi* males collected in spring will be needed before the monthly duration of spermiogenesis can be known.

I thank George Bradley (University of Arizona) for permission to examine specimens.

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THAMNOPHIS BRACHYSTOMA (Short-Headed Gartersnake). **MAXIMUM SIZE.** On 13 June 2002 I found a female *Thamnophis brachystoma* that was 458 mm SVL and 578 mm TL under trash next to the Penn Central railroad tracks, immediately northwest of the intersection of East 26th and Elm Streets in Erie, Pennsylvania, USA. This exceeds the maximum total length record of 559 mm (Conant and Collins 1998, Peterson Field Guide to Reptiles and Amphibians of Eastern and Central North America, 3rd ed. Expanded. Houghton Mifflin, Boston, Massachusetts, xviii + 616 pp.). Verified by Peter V. Lindeman. This urban population of *T. brachystoma* is outside of its natural range (Hulse et al. 2000, Amphibians and Reptiles of Pennsylvania and the Northeast, Cornell University Press, Ithaca, 419 pp.). Color slides of the specimen were deposited in the Carnegie Museum of Natural History (36995-1–2). This individual is currently being maintained in captivity, and will be deposited in the Carnegie Museum upon its death.

Submitted by **MARK LETHABY**, 535 East 29th Street, Erie, Pennsylvania 16504, USA.

THAMNOPHIS CYRTOPSIS (Black-necked Garter Snake). **ATTEMPTED PREDATION**. At 1735 h on 5 July 2000, at Cottonwood Creek (Yavapai Co., Arizona, USA), a permanent, intermittent Sonoran Desert stream, I observed an adult *Lethocerus medius* (giant water bug, total length 61 mm) attempt to prey on a neonate *Thamnophis cyrtopsis* (SVL 300 mm, tail length 70 mm). The *L. medius* was perched on a rocky ledge submerged ca. 20 cm in a shallow pool, and had grasped the snake mid-body. I observed the two for several minutes. The snake coiled around the insect tightly, and therefore I was unable to determine if the insect's proboscis was embedded into the snake. After I captured both individuals, the *L. medius* released the snake. Several scales were damaged, exposing the dermis on the ventral side of the snake near the region where the *L. medius* had grasped it. The snake was marked by scale clipping, and released as part of a long-term population study. The *L. medius* is preserved at Grand Canyon University.

I thank Robert L. Smith, Department of Entomology, University of Arizona for *Lethocerus* species identification. I also thank Thomas R. Jones and Frank R. Hensley for review of a previous draft of this note.

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THAMNOPHIS GODMANI (Godman's Garter Snake). **DIET**. Members of the genus *Thamnophis* consume a wide variety of vertebrates and invertebrates, including small mammals, amphib-

ians, fish, lizards, slugs, earthworms, and leeches (Rossman et al. 1996. The Garter Snakes: Evolution and Ecology. Univ. Oklahoma Press, Norman, Oklahoma. 332 pp.). Venegas-Barrera and Manjarrez (2001. Herpetol. Rev. 32:187) provided the first published record of ophiophagy in *Thamnophis*. Few data exist on the natural history and diet of *T. godmani*. Rossman et. al. (*op. cit.*) reported that after collection an individual regurgitated a mouse.

On 12 July 2002 we collected a male *T. godmani* (TL 562 mm , 36 g) 3 km E of Omilteme, Guerrero, Mexico (~ 2000 m elev.). It was found at the edge of a cleared field in a rock pile, near the base of a heavily forested mountain slope. This individual had a noticeable mid-body bulge, and after palpation regurgitated a large *Rhadinaea taeniata aemula* (TL 465 mm, 13 g). This represents the second recorded prey item for *T. godmani*, and the second record of ophiophagy in *Thamnophis*.

We thank James R. Dixon and Jonathan A. Campbell for their help with the identification of the snakes. Emerenciano R. Rivera provided valuable assistance in the field. James M. Mueller and Jonathan A. Campbell kindly reviewed the manuscript and provided additional comments.

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THAMNOPHIS SIRTALIS CONCINNUS (Red-spotted Garter Snake). **PREDATION**. Many anecdotes detail failed predation by snakes because prey were too large and/or awkward (e.g., Barton 1949. Copeia 1949:147; Sazima and Martins 1990. Mem. Inst. Butantan 52:73–79; Tamarck and Doherty 1993. Herpetol. Rev. 24:62). More rare are field observations in which prey approach the size limit of a predator. Such data are important in understanding foraging behavior and providing empirical links to experimental studies that address foraging theory (Arnold 1993. *In* Seigel and Collins [eds.], Snakes: Ecology and Behavior, pp. 87–115. McGraw Hill, Inc., New York). Herein we detail one such report for *Thamnophis sirtalis concinnus*.

Two of us (BKM, MAH) made these observations in the Halfway Creek drainage, Stillman Basin, Willapa Hills (southwestern Washington State, USA; 46°30'42"N, 123°08'53"W), a low-elevation (122 m) site on a Weyerhaeuser-managed Douglas-Fir (*Pseudotsuga menziesii*) tree farm. Observations were made along the riparian margin of a small (< 1 m wide), second-order tributary of Halfway Creek with a scattered Red Alder (*Alnus rubra*) overstory and a dense Sword Fern (*Polystichum munitum*) understory.

On 30 August 2002, at 1400 h, while collecting physical data during a stream survey of this tributary, we found an adult (SVL 65 cm) *T. s. concinnus* (lying near the base of a sword fern next to water) that had captured an adult Northern Red-legged Frog (*Rana aurora*) (SVL 80 mm). Based on size alone (Storm 1960. Copeia 1960:251–259; Licht 1986. Can. Field-Nat. 100:22–31), the frog was likely a female. When first encountered, the snake had a firm grasp on the shoulder of the frog, which was belly-up with its right foreleg inside the snake. We noted that the frog was engaged in serial inflation of its throat, which appeared to be a defensive response rather than typical breathing movements. During this initial observation period, other than throat inflation, the frog showed no signs of struggling, implying that it had tired from the initial encounter as it appeared otherwise healthy and robust. Further, the snake made little noticeable gain in its attempt to swallow the frog during the 15-min observation interval. As the snake was not advancing significantly, we left.

Upon completion of fieldwork at 1530 h, BKM returned to the location. The snake, still with the frog, had moved ca. 0.5 m to a more concealed location near an overhanging log and had made substantial progress in swallowing the frog. About two-thirds of the frog was now inside the snake. The frog was still positioned mostly belly-up but the hind legs stuck straight out together. The snake was compressing the frog to such an extent that the still exposed lower abdomen was now at least 20% larger than the original maximum girth of the frog. As BKM stepped down the bank to obtain a better view, he saw that the skin and underlying tissue on the frog's back was so stretched that it had ruptured, resulting in protrusion of viscera in a small pile extending ca. 4 cm. Following 10 min of observation, BKM measured the snake, which thrashed somewhat during measurement but made no effort to regurgitate the frog. During this second observation period, the snake had progressed a few millimeters further in swallowing the frog. Observations were terminated before the snake completely consumed the frog.

Extreme compression needed to swallow the frog suggests that, for its size, the *T. s. concinnus* was near its limit for the prey shape involved. The nature of the observation prevented us from precisely determining frog length, but a mass-SVL regression of *R. a. aurora* from Washington (MPH, unpubl. data) suggests that the female could be expected to have a mass of at least 40 g. Long time intervals characterize handling of awkward prey near the limiting size (e.g., Kupferberg 1994. Herpetol. Rev. 25:95–97). The 1.5-h interval over which observations were made underestimates handling and ingestion time, but total time might not be much longer as the snake had completed the difficult swallowing phase and the unobserved early portion of the bout was likely not lengthy as the frog would be expected to tire quickly (Pough et al. 1992. *In* Feder and Burggren [eds.], Environmental Physiology of Amphibians, pp. 395–436. The University of Chicago Press, Chicago). Time spent in predatory activities might be costly if those activities make a predator vulnerable (Arnold, *op. cit.*) as this *T. s. concinnus* seemed to be while ingesting the frog.

Weyerhaeuser (through Douglas E. Runde, Research Wildlife Biologist) facilitated studies on their lands. Forest and Fish Adaptive Management funding supporting the Science Division of the Habitat Program of the Washington Department of Fish and Wildlife (WDFW) that addresses headwater stream research made this contribution possible; WDFW personnel handling amphibians are permitted for this work.

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THAMNOPHIS SIRTALIS PARIETALIS (Red-sided Garter Snake). **ENDOPARASITES**. In the only study of the coccidia of *Thamnophis sirtalis parietalis*, Wacha and Christiansen (1974. J. Protozool. 21:483–489) described two species of *Eimeria* (Apicomplexa: Eimeriidae) from individuals collected in Iowa, USA. Herein we report on one of these species (*E. iowaensis*) from *T. s. parietalis* collected in southeastern Nebraska, USA.

During June–September 2001, six road-killed and five live *T. s. parietalis* were collected in Richardson and Nemaha counties, Nebraska. SVL was measured when possible (mean: 460 mm; range: 280–655 mm; N = 9) and fecal or intestinal samples from each snake were placed in 2.5% aqueous potassium dichromate ($K_2Cr_2O_7$) solution and kept at 20–23°C) for four weeks to allow coccidian oocysts to sporulate. Samples were screened for coccidia by centrifugal flotation in modified Sheather's solution (Duszynski and Wilber 1997. J. Parasitol. 83:333–336) that had been diluted with 2 parts water to retard wrinkling of the oocyst wall. Sporulated oocysts were measured under 1000x magnification and identified using characteristics in Wacha and Christiansen (*op. cit.*).

Two of the 11 samples (18%) contained oocysts of *E. iowaensis*; both hosts were from Richardson County. Oocyst measurements (N = 32) and structural features were consistent with those previously reported for *E. iowaensis* by Wacha and Christiansen (*op. cit.*). This is the first report of *E. iowaensis* from *T. s. parietalis* in Nebraska. *Eimeria iowaensis* has been previously reported from one of 25 *T. s. parietalis* in Iowa (Wacha and Christiansen, *op. cit.*), and from one (of one tested) *T. elegans vagrans* in New Mexico, USA, and one of 13 *Nerodia fasciata confluens* in Arkansas, USA (McAllister et al. 1995. J. Parasitol. 81:63–68).

Submitted by **JOHN A. HNIDA**, Department of Natural Sciences, Peru State College, Peru, Nebraska 68421, USA (e-mail: jhnida@oakmail.peru.edu), and **REBECCA J. CARPENTER**, 6234 Robin Lane #71, Manhattan, Kansas 66502, USA (e-mail: rcarpent@vet.k-state.edu).

THAMNOPHIS VALIDUS (Mexican Pacific Lowlands Gartersnake). **ENDOPARASITES.** Herein we provide the first report of endoparasites from *Thamnophis validus* which ranges in Baja California del Sur and portions of coastal Sonora, Sinaloa, Nayarit, Jalisco, Michoacán, and Guerrero, Mexico (Rossman et al. 1996. The Garter Snakes: Evolution and Ecology, Univ. Oklahoma Press, Norman. 332 pp.).

Thirty-two *T. validus* (mean SVL: 525 ± 112 mm SD; range: 323–745) from the Mexican states of Sonora, Sinaloa, and Nayarit were examined from the herpetology collections of the Natural History Museum of Los Angeles County, California (LACM) and the University of Arizona, Tucson (UAZ). Snakes were collected from 1960–1977. A mid-ventral incision was made in the posterior third of the body wall, and the coelomic cavity and visceral organs were visually examined for parasites. One of the snakes (LACM 7121) from Sonora harbored five larval nematodes in cysts in the mesentery, and a second specimen (LACM 58963) from Sinaloa harbored 41 metacercariae (larval trematodes) and one larval nematode in the mesentery. Nematodes were separated from the surrounding connective tissues, placed on a microscope slide, cleared in a drop of concentrated glycerol, and identified as larval *Porrocaecum* sp. Prevalence of infection (number of infected snakes/number of snakes examined x 100) was 2/32 (6%); mean (± 1 SD) intensity of infection (number of nematodes/number of infected snakes) was 3.0 ± 2.8 SD. They were placed in a vial of 70% ethanol and deposited in the United States National Parasite Collection, Beltsville, Maryland (USNPC) as 92783. Metacercariae were separated from the surrounding tissue, regressively stained in Delafield's hematoxylin, dehydrated in an ethanol series, cleared in xylene, mounted in balsam and identified as members of the superfamily Strigeoidea. The slide was deposited in the USNPC as 92782.

Adults of *Porrocaecum* sp. typically are found in the intestines of birds; eggs are ingested by earthworms, hatch and develop to third stage larvae (Anderson 2000. Nematode Parasites of Invertebrates: Their Development and Transmission, 2nd ed., CABI Publishing, Oxon, United Kingdom. 650 pp.). Animals that consume earthworms serve as paratenic (transport) hosts which transfer the nematode to the definitive avian host (Anderson, *op. cit*). In Mexico, in the state of Veracruz, the frogs *Eleutherodactylus rhodopsis* and *Leptodactylus melanonotus* have been reported to harbor larvae of *Porrocaecum* (Goldberg et al. 2002. Southwest. Nat. 47:293–299). Although *T. validus* is known to eat frogs and toads, and perhaps earthworms (Conant 1969. Bull. Amer. Mus. Nat. Hist. 142:1–140), the small number of larvae found in this study and the fact that two cysts were beginning to calcify suggest that *T. validus* was most likely an accidental host. *Thamnophis validus* represents a new host record for *Porrocaecum* sp. Sinaloa and Sonora, México are new locality records.

Adults of the Strigeoidea are parasites of birds and mammals; fishes and tadpoles often serve as intermediate hosts (Schell 1970. How to Know the Trematodes. Wm C. Brown Publishers, Dubuque, Iowa, 355 pp.). In Mexico, *Thamnophis eques* from the state of Mexico, and *Thamnophis melanogaster* from the state of Michoacán, have been reported to harbor metacercariae of *Diplostomum* sp., a strigeoid trematode (Pérez-Ponce de León et al. 2001. Comp. Parasitol. 68:9–20). *Thamnophis validus* is most likely an accidental host (calcified cysts were present), but does represent a new host record for strigeoid metacercariae. Sinaloa, Mexico is a new locality record.

We thank D. Kizirian (LACM) and G. Bradley (UAZ) for permission to examine *T. validus*.

Submitted by **STEPHEN R. GOLDBERG,** Department of Biology, Whittier College, Whittier, California 90608, USA (e-mail: sgoldberg@whittier.edu), and **CHARLES R. BURSEY,** Department of Biology, Pennsylvania State University, Shenango Campus, Sharon, Pennsylvania 16146, USA.

VIRGINIA STRIATULA (Rough Earth Snake). **PREDATION**. There are few published accounts of predation on *V. striatula*. Palmer and Braswell (1995. Reptiles of North Carolina, UNC Press, Chapel Hill, North Carolina. 412 pp.) report three colubrid snakes (*Coluber constrictor*, *Lampropeltis calligaster*, and *L. triangulum elapsoides*) to be predators. The Nine-banded Armadillo (*Dasy-*

pus novemcinctus) is known to consume *V. stiatula* (Breece and Dusi 1995. *In* Montgomery [ed.], The Evolution and Ecology of Armadillos, Sloths, and Vermilinguas. Smithsonian Inst. Press, Washington. 451 pp.). The only record concerning avian predation on *V. striatula* that I am aware of involves the Eastern Screech Owl (*Otus asio*; Gehlbach and Baldridge 1987. Oecologia 71:560–563).

On 2 December 2002 at 1130 h, air temperature 13°C, I observed a Northern Mockingbird (*Mimus polyglottos*) holding a *V. striatula* in its beak. The event took place in the yard of a rural farmhouse 4.6 km (air) N of Waverly, in Chambers Co., Alabama, USA. The bird was grasping the snake by the tail, immediately posterior to the vent. Upon my approach, the bird flew from the stone terrace where it was perched and sought refuge behind dense shrubbery. When I saw the bird again, it had dropped the snake at its feet and took flight when I came within 4 m of it. At this point I collected the snake, which was entirely limp with the exception of an occasional twitch of its head. The subcaudal portion of the snake was bloody, and there was a single wound at mid-body. These injuries were presumably inflicted by the bird's beak. Additionally, I noted a slight abrasion on the snake's head and assume that the bird had subdued its prey by thrashing it against the stonework.

The snake (AUM 35662) is female, 197 mm SVL, 225 mm TL, and 3.4 g. The Northern Mockingbird is characterized as omnivorous, and is known to take *Anolis* lizards (Derrickson and Breitwisch 1992 *In* Poole et al. [eds.], The Birds of North America, No. 7, Northern Mockingbird (*Mimus polyglottos*), pp. 1–26. American Ornithological Union, Washington, D.C. and the Academy of Natural Sciences, Philadelphia, Pennsylvania). I believe this to be the first record of ophiophagy by *M. polyglottos*.

Thanks to S. M. Boback, and C. Guyer for constructive comments.

Submitted by **GEOFFREY G. SORRELL**, Department of Biological Sciences, 331 Funchess Hall, Auburn University, Alabama 36849-5414, USA; e-mail: sorregg@auburn.edu.

GEOGRAPHIC DISTRIBUTION

Herpetological Review publishes brief notices of new geographic distribution records in order to make them available to the herpetological community in published form. Geographic distribution records are important to biologists in that they allow for a more precise determination of a species' range, and thereby permit a more significant interpretation of its biology.

These geographic distribution records will be accepted in a **standard format** only, and all authors *must* adhere to that format, as follows: SCIENTIFIC NAME, COMMON NAME (for the United States and Canada as it appears in Crother 2000. *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding*. SSAR Herpetol. Circ. 29:1–82, available online at <http://herplit.com/SSAR/circulars/HC29/Crother.html>; for Mexico as it appears in Liner 1994, *Scientific and Common Names for the Amphibians and Reptiles of Mexico in English and Spanish*. Herpetol. Circ. 23:1–113), LOCALITY (use metric for distances and give precise locality data), DATE (day-month-year), COLLECTOR, VERIFIED BY (*cannot* be verified by an author—curator at an institutional collection is preferred), PLACE OF DEPOSITION (where applicable, use standardized collection designations as they appear in Leviton et al. 1985, *Standard Symbolic Codes for Institutional Resource Collections in Herpetology and Ichthyology*, Copeia 1985[3]:802–832) and CATALOG NUMBER (required), COMMENTS (brief), CITATIONS (brief), SUBMITTED BY (give name and address in full—spell out state or province names—no abbreviations).

Some further comments. This geographic distribution section does not publish "observation" records. Records submitted should be based on preserved specimens which have been placed in a university or museum collection (private collection depository records are discouraged; institutional collection records will receive precedence in case of conflict). A good quality color slide or photograph may substitute for a preserved specimen *only* when the live specimen could not be collected for the following reasons: it was a protected species, it was found in a protected area, or the logistics of preservation were prohibitive (such as large turtles or crocodilians). Color slides and photographs *must* be deposited in a university or museum collection along with complete locality data, and the color slide catalog number(s) must be included in the same manner as a preserved record. Before you submit a manuscript to us, check Censky (1988, *Index to Geographic Distribution Records in Herpetological Review: 1967–1986*; available from the SSAR Publications Secretary) to make sure you are not duplicating a previously published record. The responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extensions unless a thorough literature review has been completed.

Please submit any geographic distribution records in the **standard format only** to one of the Section Co-editors: **Alan M. Richmond** (USA & Canadian records only); **Jerry D. Johnson** (Mexico and Central America, including the Caribbean islands); **Hidetoshi Ota** (all Old World records); or **Gustavo J. Scrocchi** (South American records). Short manuscripts are discouraged, and are only acceptable when data cannot be presented adequately in the standard format. **Electronic submission of manuscripts is required** (as Microsoft Word or Rich Text format [rtf] files, as e-mail attachments). Refer to inside front cover for e-mail addresses of section editors.

Recommended citation for new distribution records appearing in this section is: Schmitz, A., and T. Ziegler. 2003. Geographic distribution. *Sphenomorphus rufocaudatus*. Herpetol. Rev. 34:385.

CAUDATA

AMBYSTOMA TIGRINUM MELANOSTICTUM (Blotched Tiger Salamander). USA: SOUTH DAKOTA: ROBERTS CO.: wetland adjacent to South Dakota Hwy 25, ca. 1.6 km W Hammer (45°50' 55.6"N; 97°02' 21.3"W). 8 September 2003. Laurs Bryan Williams. Verified by Stanlee Miller. Campbell Museum, Clemson University (CUSC 2167). County record. Previously reported in adjacent Marshall, Day, and Grant counties (Fischer et al. 1999. A Field Guide to South Dakota Amphibians. South Dakota Agric. Exp. Sta. Bull. 733. South Dakota State University, Brookings. 52 pp.).

Submitted by **LAURS BRYAN WILLIAMS** and **STEVEN G. PLATT**, Department of Math and Science, Oglala Lakota College, P.O. Box 490, Kyle, South Dakota, 57752-0490, USA.

GYRINOPHILUS PORPHYRITICUS (Spring Salamander). USA: TENNESSEE: COFFEE CO: seep flowing into Davidson Branch, ca. 1.1 km SW of Ward Chapel, ca. 250 m N of Riley Creek Rd (35°28'02.5"N, 86°11'17.6"W). 19 April 2003. Matthew L. Niemiller. Verified by Addison Wynn. Smithsonian National Museum of Natural History, USNM-FS 186610. Larva found under rock within seep. Tissue sample collected; salamander was photographed and released. First record from Coffee County and southernmost record on the Eastern Highland Rim (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.). Tissue sample collected under authorization of the Tennessee Wildlife Resources Agency (permit no. 1724-03B).

Submitted by **MATTHEW L. NIEMILLER**, Middle Tennessee State University, Murfreesboro, Tennessee, 37130, USA; e-mail: mln2a@mtsu.edu.

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HERPETOLOGICAL REVIEW

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SOCIETY FOR THE STUDY OF AMPHIBIANS AND REPTILES

www.ssarherps.org

The Society for the Study of Amphibians and Reptiles, the largest international herpetological society, is a not-for-profit organization established to advance research, conservation, and education concerning amphibians and reptiles. Founded in 1958, SSAR is widely recognized today as having the most diverse society-sponsored program of services and publications for herpetologists. Membership is open to anyone with an interest in herpetology—professionals and serious amateurs alike—who wish to join with us to advance the goals of the Society.

All members of the SSAR are entitled to vote by mail ballot for Society officers, which allows overseas members to participate in determining the Society's activities; also, many international members attend the annual meetings and serve on editorial boards and committees.

ANNUAL DUES AND SUBSCRIPTIONS: Annual membership dues for the year 2004 in the Society for the Study of Amphibians and Reptiles are as follows: **REGULAR** membership US$60 (Student $30)—includes *Journal of Herpetology* and *Herpetological Review*; **PLENARY** membership US$80 (Student $45)—includes *JH*, *HR*, and annual subscription to the *Catalogue of American Amphibians and Reptiles*; **INSTITUTIONAL SUBSCRIPTION** $115—includes JH and HR. Additional fee for airmail postage outside USA $35 for one year. Additional membership categories available on the SSAR webpage: http://www.ssarherps.org/pages/membership.html.

All members and institutions receive the Society's primary technical publication, the *Journal of Herpetology*, and its news-journal, *Herpetological Review*; both are published four times per year. Members also receive pre-publication discounts on other Society publications, which are advertised in *Herpetological Review*.

Payment must be made in USA funds, payable to "SSAR," or by International Money Order, or with VISA or MasterCard (account number and expiration date must be provided). Payment should be sent to: Theodora Pinou, SSAR Treasurer, Peabody Museum of Natural History, P.O. Box 208118, New Haven, Connecticut 06520-8118, USA. Fax: (203) 432-5176; e-mail: theodora.pinou@yale.edu

Future Annual Meetings

2004 — University of Oklahoma, Norman, Oklahoma, 26–31 May (with ASIH, HL)
2005 — University of South Florida, Tampa, Florida, 7–11 July (with ASIH, HL)

About Our Cover: *Coloptychon rhombifer*

There are six genera of anguid lizards in the subfamily Gerrhonotinae (Good 1988. Univ. California Publ. Zool. 121:1–139). They share several characteristics, the most distinct being an hourglass-shaped frontal bone and the most obvious being a lateral fold. They are called alligator lizards and they range collectively from the Pacific Northwest region of North America south to Panamá. There are about forty species, including some that are critically endangered, and some that rank among the most beautifully colored reptiles. Until recently, one of these, the Isthmian Alligator Lizard (*Coloptychon rhombifer*), was known from only three specimens. Not only is it surpassingly rare, but also it can reach half a meter in total length. Its habits and microhabitat are unknown. Understandably the Isthmian Alligator Lizard has assumed almost mythic proportions in the minds of field biologists. Now, 128 years after Peters named it, another has been found.

Alejandro Solórzano, one of Costa Rica's most active herpetologists and Director of its National Serpentarium, received a call from Golfito, a community in the southwestern part of the country. The caller had found a strange lizard wandering on the ground in his neighborhood and had put it into a cardboard box. Judging by the description of a long, snaky lizard with small limbs, Solórzano decided it might be *Coloptychon*. Elated at the luck, he set about organizing a trip to Golfito, but the lizard died before he could depart San José. He got lucky a second time because the caller informed him of the news immediately. Some biologists might have despaired but Solórzano saw opportunity.

Fortunately, the caller was willing to follow instructions to freeze the carcass in water. Solórzano retrieved the specimen and carefully defrosted it, taking care to relax the body thoroughly. He arranged the lizard meticulously toe-by-toe and took photographs, some for reference and some for aesthetics. He then extracted tissues for DNA analysis, retrieved the stomach contents, and carefully preserved the specimen. Ongoing studies will tell us more but we know the lizard had fed on an arthropod, and indications are that *Coloptychon* is basal to all gerrhonotines (J. A. Campbell, pers. comm.).

One of the most exciting things associated with this specimen is its size. It is a male, 505 mm in total length, nearly 50% larger than the known maximum. *Coloptychon rhombifer* is recorded from southwestern Costa Rica and adjacent Panamá, and the specimens have come invariably from moist, lowland forest. The tropics hoard their secrets, yet one wonders why no more of these impressive lizards have appeared. The region has seen botanical and zoological investigation for years. Is it simply because the Isthmian Alligator Lizard is rare? Could they dwell in the canopy? Do they live in burrows?

The long, likely prehensile tail makes an arboreal life seem possible, but the coloration is indicative of a terrestrial mode. Yet, if it is terrestrial one would expect more specimens to have turned up. It may be facultatively arboreal (H. Greene, pers. comm.) and there is anecdotal evidence from Costa Rica's Península de Osa that supports this contention. The scarcity of specimens may well indicate true rareness rather than something seen rarely by humans. The Isthmian Alligator Lizard remains an enigma, but Alejandro Solórzano's quick thinking has given the herpetological community a glimpse of a legendary reptile. He took the photograph under natural light using a Canon EOS Rebel with Canon 100mm macro lens on Fujichrome Provia film. Solórzano's book, *Snakes of Costa Rica*, will be published in a bilingual edition by InBio in March.

PHOTO BY WILLIAM W. LAMAR

Editor's note.—Special thanks to Bill Lamar for preparation of the foregoing text, and to Louis Porras and John Crawley (Focus Design, Inc.) for preparing Solórzano's image for publication.

SSAR BUSINESS

Announcing the 2004 Joint Meeting of Ichthyologists and Herpetologists 26–31 May 2004

The annual meeting of the Society for the Study of Amphibians and Reptiles, The Herpetologists' League, and the American Society of Ichthyologists and Herpetologists will be held 26–31 May 2004, hosted by the University of Oklahoma at the National Center for Employee Development/ Marriott Conference Center, Norman, Oklahoma (USA). Please refer to the Joint Meeting website (www.dce.ksu.edu/2004jointmeeting) for information on how to register for the meeting. All material normally included in the Call for Papers is now accessible on the Joint Meeting website. **In contrast to past years, the Call for Papers will only be mailed if requested**. Members who lack access to the internet may request paper copies from William J. Matthews, Department of Zoology, University of Oklahoma, Norman, Oklahoma 73019, USA (e-mail: wmatthews@ou.edu; fax 405-325-6202).

SSAR Election Results

Results of the 2003 SSAR election are as follows:

Board of Directors (Class of 2006)
.... David Hardy Sr., Richard Wassersug

Constitutional Ammendments
Article II, Section 1a: .... Approved
Article II, Section 3: .... Approved
Article III, Section 1: .... Approved

Thanks to all of the nominees who agreed to stand for positions and to Maureen Kearney (Elector).

NEWSNOTES

Kentucky Reptile Zoo Internships for 2004

The Kentucky Reptile Zoo, a nonprofit organization, is seeking student interns for the 2004 season. The zoo is an educational exhibit, reptile breeding, and venom research facility located near Kentucky's Red River Gorge and Natural Bridge State Park. The intern will assist in the captive maintenance of the zoo's reptile collection, collect admissions to the exhibit, give interpretive talks and interact with the public, assist with educational outreach programs, and perform other duties as assigned. In addition, the intern will be responsible for the completion of at least one research project related to the field of herpetology. The intern will **not** be involved in the handling of any venomous species.

Desirable qualifications include a willingness to handle snakes and other reptiles on a daily basis, ability to communicate effectively with people, writing skills, orientation to details, and self-motivation. The intern will be required to work Saturday and Sunday, with days off during the week. Students majoring in the biological or natural sciences are preferred. Interns are required to be either college students or recent graduates. Former interns have arranged for academic credit with their institutions. Benefits include experience with one of the most extensive and diverse collection of snakes in the United States, housing, and $55/week to cover expenses. Interns have been successful in finding zoo keeper positions; over 95% hire rate! Personal transportation recommended. Valid driver's license required. Starting dates are flexible, but a minimum of three months covering spring (April–June), summer (June–August), and fall (September–November) is required.

Deadlines are **February 1** for spring, **March 1** for summer, and **June 1** for fall. To apply, send a cover letter, résumé, transcript, and at least two (preferably three) references to: *Kristen Wiley, Internship Coordinator, Kentucky Reptile Zoo, 200 L&E Railroad, Slade, Kentucky 40376, USA or e-mail to: kyreptil@pop.mis.net.*

Biology of Boas, Pythons, and Related Taxa

A satellite symposium on the biology of boas and pythons is currently in planning stages for the 2005 SSAR meeting in Tampa, Florida. We must, however, have a list of contributors and tentative titles for presentations. The deadline for the proposal is prior to the SSAR meeting in 2004.

The main goal of the symposium is to exchange new information on the ecology, evolution, behavior, physiology, and conservation of boas, pythons, and related taxa. The format will be similar to the conference, **Biology of the Vipers**, held in 2000 at the Oldagården Conference Centre in Marielund, Sweden. Eagle Mountain Publishing, LC will publish a peer-reviewed book (*Biology of the Boas and Pythons*) that will follow the format of the recently published *Biology of the Vipers*. Editors will be Robert W. Henderson, Robert Powell, and Gordon W. Schuett.

At this time we are soliciting full-length manuscripts (book chapters) and color images (high quality slides or digital images) for the book. Manuscripts must be written in English and submitted in quadruplicate, including sets of figures and tables. In preparing manuscripts, authors should follow the general style of *Biology of the Vipers*. A formal guide for authors will be made available for accepted manuscripts. The editors are seeking original research and syntheses of important problems in the biology of members of Boinae, Erycinae, and Pythoninae, but also in the taxa *Xenopeltis*, *Loxocemus*, *Bolyeria*, *Casarea*, *Exiliboa*, *Trachyboa*, *Tropidophis*, *Ungaliophis*, and *Xenophidion*. No substantial portion of the work can be published or under consideration of publication elsewhere. Participation in the symposium does not guarantee manuscript acceptance. Conversely, manuscripts and/or slides intended for the book may be submitted irrespective of attendance at the symposium.

Please send manuscripts and slides/digital images to: *Robert W. Henderson, Section of Vertebrate Zoology, Milwaukee Public Museum, Milwaukee, Wisconsin 53233-1478, USA.*

Questions should be directed to Bob Henderson at rh@mpm.edu (voice mail: 414-278-2775; fax: 414-278-6100).

Kansas Herpetological Society Annual Meeting

The Kansas Herpetological Society held its 30th Annual Meeting at Emporia State University in Emporia, Kansas, on 8–9 November 2003. Over 90 participants attended scientific paper sessions to listen to 21 talks by scientists and students from across the nation. Featured speaker was Steven Beaupre, professor at the University of Arkansas in Fayetteville.

During the Society business meeting, Sean M. Daly, former graduate student at Emporia State University, received the 2003 Howard K. Gloyd/Edward H. Taylor Scholarship, honoring the memory of two great biologists with strong ties to Kansas. Dustin Wilgers, graduate student at Kansas State University, and James A. Daniel, graduate student at Pittsburg State University, received Alan H. Kamb Grants for Research on Kansas Snakes.

At the Saturday night auction and social, Larry Miller, Northern Hills Junior High School, Topeka, was chosen as the sixth recipient of The Suzanne L. & Joseph T. Collins Award for Excellence in Kansas Herpetology, based on his image of an Eastern Racer at Castle Rock selected as the best photograph of native Kansas herpetofauna.

MEETINGS

Meetings Calendar

9–10 April 2004—27th Annual All Florida Herpetology Event. Gainesville, Florida, USA. Information available at: www.flmnh.ufl.edu/herpetology/herpsconference/afhc.htm.

22–23 April 2004—Squamate Evolution and Systematics: A Conference in Honour of Garth Underwood. Linnean Society of London, UK. For information, contact: janet@linnean.org.

11–15 May 2004—Biodiversity and Management of the Madrean Archipelago II: Connecting Mountain Islands and Desert Seas. Tucson, Arizona, USA. Information available at: http://www.skyislandalliance.org/madreanconference/.

26–31 May 2004—47th Annual Meeting, Society for the Study of Amphibians and Reptiles, together with The Herpetologists' League and the American Society of Ichthyologists and Herpetologists. University of Oklahoma, Norman, USA. http://www.dce.ksu.edu/2004jointmeeting/.

10–13 August 2004—28th International Herpetological Symposium, Daytona Beach, Florida, USA. Information: http://www.kingsnake.com/ihs/.

15–20 November 2004—VI Symposium of Zoology, Topes de Collantes, Sancti Spiritus, Cuba. Information: www.geocities.com/zoologiacubana/simposio or by e-mail: zoologia.ies@ama.cu.

OBITUARIES

Herpetological Review, 2004, 35(1), 3.

Henri Cerét Seibert (1915–2003)

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Henri C. Seibert, who served SSAR and its predecessor, The Ohio Herpetological Society, in several official capacities for 28 years, died at the age of 88 on 6 October from complications following a stroke, in West Grove, Pennsylvania. Although he was an ornithologist by training and inclination, his professional career was spent in southeastern Ohio, an unglaciated, hilly region rich in salamanders which drew him more closely to herpetology and to an early association with the society.

Seibert (being French, his family pronounces it SEE-bert) was born in Caen in Normandy but emigrated to the USA and to Baltimore with his family at the age of six. He attended Haverford College (B.A. 1937 *cum laude* in biology) where one of his professors was the herpetologist Emmett R. Dunn. After a masters in human biology (1940) with Raymond Pearl at Johns Hopkins, he entered the doctoral program at the University of Illinois in 1941. Like several young biologists of his era, Seibert soon interrupted his studies to study the effects of radiation on living organisms as part of the then-secret Manhattan Project. He completed his dissertation in 1947 on the effects of photoperiod and temperature on weight and molt in birds, under the supervision of S. Charles Kendeigh and Victor E. Shelford. During the next years (1947–1951) he published several important papers on snake population biology in *Copeia*.

Henri C. Seibert, about 1958 (left); in 1992 (above).

After receiving his Ph.D., Seibert was appointed assistant professor of zoology at Ohio University in Athens, Ohio. He also became curator of the zoology department's vertebrate collections and served as department chair (1962–1967). The main courses he taught were herpetology, ecology, and ornithology. He supervised 23 masters students, among them two salamander biologists who went on to notable careers as amphibian researchers: Ronald A. Brandon and David M. Sever. It was with Brandon that Seibert published his major herpetological treatise, in 1960, "The Salamanders of Southeastern Ohio." His last herpetological contributions were species accounts in the book *Salamanders of Ohio*, edited by Ralph Pfingsten and Floyd Downs and published in 1989.

Seibert joined The Ohio Herpetological Society during its inaugural year, 1958. He soon became active in its affairs and by 1962 had become a member of the Board of Directors. One cannot overemphasize the importance of his joining the board at a time when most of the officers were college students. This was a generous and selfless act that was not without a certain professional risk. His reputation throughout Ohio immediately gave the young society credibility and a new status that helped it to expand its scope. Seibert's contributions to the organization's growth continued in many capacities, as Publications Secretary (1967–1976), Treasurer (1970–1987), and finally as President (1989).

As publications secretary, Seibert stored the society's rapidly-growing back stocks of journals and books. He personally handled all sales, which provided critical income to the society beyond dues and subscriptions and this allowed expansion of the society's program. As treasurer, he oversaw annual budgets that grew more than ten-fold, from about $8,000 to $90,000. At annual meetings of the Board of Directors, Seibert was always the final step in any discussion of new projects. "Henri, can we afford it?" He would reply, "We'll find a way to do it." He would simply adjust and re-adjust the proposed budget—adding here, subtracting there—until there were funds to cover the new project. He always tried to be a facilitator, not a roadblock. And so the society's publications, meetings, and other activities would grow, with a membership of 740 when he took over as treasurer in 1970 and 2257 when he stepped down 18 years later. When new members joined during any given year, it was Seibert who personally packed up all the back issues for that year and mailed them out. Seibert was instrumental in arranging for budding herpetologists and especially would-be members from overseas to join, by finding sponsors who could pay their initial dues costs. He carried on a voluminous correspondence with society members, answering questions, making referrals, etc. To many members, Henri Seibert *was* the society.

In gratitude for his long and dedicated service to OHS and SSAR, the society created The Henri C. Seibert Award in 1990 to recognize the most outstanding student papers presented at SSAR's annual meetings. His record of service to the society and thus to the development of herpetology as a discipline will be long remembered and honored.

CURRENT RESEARCH

The purpose of **Current Research** is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, **Eli Greenbaum** or **Omar Torres-Carvajal**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can be found at: http://www.herplit.com/contents.

Tuataras and the Phylogeny of Reptiles

Numerous hypotheses of higher-level phylogenetic relationships among reptiles have been suggested by previous analyses of morphological and molecular data sets. Depending on the study, the sister group of the genus *Sphenodon* has ranged from squamates to archosaurs and turtles. To examine the phylogenetic position of *Sphenodon* further, the authors sequenced the entire mitochondrial genome of *S. punctatus* and compared the data to homologous genes in other reptiles, mammals, and birds. A second analysis used *Sphenodon* as an outgroup to assess the phylogenetic position of snakes to other squamates. Genes for ND5, $tRNA^{Thr}$, and $tRNA^{His}$ were missing from the *Sphenodon* genome. The first group of analyses were performed on 14 taxa, either with or without the only snake *(Dinodon semicarinatus),* which has an unusually rapid rate of mtDNA evolution. The second analysis was limited to *Sphenodon* and six other taxa. Data were analyzed with Bayesian inference and maximum parsimony (latter method mainly for comparison); alternate trees were tested with the approximately unbiased (AU) and Shimodaira-Hasegawa (SH) tests. Lineage-divergence dates were assessed with truncated Newton optimization and calibrated with fossil data. The overall optimal tree from the first analysis placed tuataras as sister to squamates; eight of 13 alternate trees were rejected by the AU test, whereas three were rejected by the SH test. The second analysis placed snakes within the Anguimorpha (legless lizards + varanids) clade. Estimates of divergence times for major clades are discussed.

Rest, J. S., J. C. Ast, C. C. Austin, P. J. Waddell, E. A. Tibbetts, J. M. Hay, and D. P. Mindell. 2003. Molecular systematics of primary reptilian lineages and the tuatara mitochondrial genome. Molecular Phylogenetics and Evolution 29:289–297.

Correspondence to: David P. Mindell, Department of Ecology and Evolutionary Biology and Museum of Zoology, University of Michigan, Ann Arbor, Michigan 48109-1079, USA; e-mail: mindell@umich.edu.

Sea Turtle Behavior and Habitat Use in Coral Reefs

Electronic devices have been used to study diving and migration behavior of sea turtles, but direct observations are preferred to minimize errors and provide improved data. The authors studied the foraging and diving behavior of hawksbill turtles *(Eretmochelys imbricata)* from five sites in the granitic Seychelles. Mock-up carapaces were used to estimate turtle size *in situ.* Observers tended to overestimate carapace size. A total of 51 turtles were observed in 120 h of monitoring; average size of these turtles was much smaller than adult nesting females. In general, turtles foraged at shallow depths (< 3 m) and rested at relatively greater depths (6–9 m). The absence of adult turtles from the study site might be explained by results of previous studies that documented continuous travel (3–5 days) of females after nesting. Relatively deeper dives by resting juveniles are probably a way to maximize resting duration.

Houghton, J. D. R., M. J. Callow, and G. C. Hays. 2003. Habitat utilization by juvenile hawksbill turtles (*Eretmochelys imbricata,* Linnaeus, 1766) around a shallow coral reef. Journal of Natural History 37:1269–1280.

Correspondence to: Jonathan D. R. Houghton, Marine Turtle Research Group, School of Biological Sciences, University of Wales Swansea, Singleton Park, Swansea SA2 8PP, UK; e-mail: Bdhought@swansea.ac.uk.

Reproductive Behavior in *Edalorhina perezi*

Frogs often utilize small ponds, pools, or host plants for oviposition, but avoid sites where the risk of predation or competition to larvae is high. Murphy studied how site-choice behavior varied in a Peruvian leptodactylid *(Edalorhina perezi)* according to multiple risk factors, sex, and season. The author observed behavior in Manu National Park, Peru during the 1996–97 rainy season. Data were collected regarding male calling and female oviposition in three paired field experiments: 1) tadpole predators present or absent (repeated late in seven-month breeding season); 2) tadpole competitors present or absent; 3) tadpole predators or tadpole competitors present. Results suggested that males called more often at predator-free and competitor-free pools, although the latter result was not statistically significant. Females avoided pools with predators and competitors for oviposition. In general, both sexes favored pools with competitors to pools with predators. Late in the rainy season, females reproduced in control pools about as often as pools with predators. When restricted to low-quality sites, males called less frequently and females tended to delay oviposition. The change in female behavior during the latter part of the breeding season might be explained by impermanence of breeding pools.

Murphy, P. J. 2003. Context-dependent reproductive site choice in a Neotropical frog. Behavioral Ecology 14:626–633.

Correspondence to: Peter J. Murphy, Department of Biological Sciences, Box 8007, Idaho State University, Pocatello, ID 83204-8007, USA; e-mail: pjmurphy@isu.edu.

Intraspecific Phylogeny and Historical Biogeography of a Salamander

Allopatric fragmentation and range shifts occurred as a result of global Pleistocene climate changes in many taxa. Two competing hypotheses (one dispersal, the other vicariance) have been proposed in previous studies to explain phylogenetic affinities of sev-

eral biota in the Central Highlands of North America. The authors tested these hypotheses by examining the intraspecific phylogeny of the ambystomid salamander *Ambystoma maculatum.* Samples were collected from 85 localities. Two mitochondrial gene regions (ND4-tRNA and control regions) were analyzed in PAUP* 4.0b4a with maximum parsimony (MP) and maximum likelihood (ML). Geographic and genetic structure was assessed with statistical parsimony and nested-clade analyses. MP and ML analyses resulted in concordant topologies. Two widely distributed lineages (interior and coastal clades) are consistent with two phylogroups identified in a previous study of this species. Genetic structure analyses suggested each lineage experienced fragmentation followed by range expansion and reduced gene flow in certain regions. Analyses in this study support a Central Highland dispersal hypothesis rather than a vicariance hypothesis.

ZAMUDIO, K. R., AND W. K. SAVAGE. 2003. Historical isolation, range expansion, and secondary contact of two highly divergent mitochondrial lineages in spotted salamanders *(Ambystoma maculatum).* Evolution 57:1631–1652.

Correspondence to: Kelly R. Zamudio, Department of Ecology and Evolutionary Biology, Cornell University, Ithaca, New York 14853, USA; e-mail: krz2@cornell.edu.

The Oldest Known North American Colubrid

Present knowledge about the snake fauna of the Late Eocene is poor. The oldest known colubrids are documented from the Late Eocene in Thailand and Early Oligocene of North America, Europe, and Asia. The authors report a vertebra from the extinct genus *Nebraskophis* from the Late Eocene (36.0–34.2 Ma) of central Georgia, USA. Previous to this discovery, Asia had been noted as the most probable source for early colubrid evolution. However, because Georgian *Nebraskophis* were present in North America at the same time as the Asian colubrids, the origin of colubrids (in general) must predate the Late Eocene. The new discovery also bolsters evidence for a Cenozoic biogeographic connection between the Great Plains and the southeastern region of North America for colubrid snakes. The authors suggest *Nebraskophis* originated in southeastern North America (and not as a Eurasian immigrant), and then dispersed westward.

PARMLEY, D., AND J. A. HOLMAN. 2003. *Nebraskophis* Holman from the Late Eocene of Georgia (USA), the oldest known North American colubrid snake. Acta zoologica cracoviensia 46:1–8.

Correspondence to: Dennis Parmley, Department of Biological and Environmental Sciences, Georgia College & State University, Milledgeville, GA 31061, USA; e-mail: dparmley@mail.gcsu.edu.

Spatial Overlap of African Tree Agamas

Female mate choice has been correlated with male territory quality and phenotypic characteristics in several species of lizards. The authors studied female *Acanthocercus atricollis* spatial patterns as they related to male and home range quality. Observations were conducted during the breeding season (September–November 2000) in Mountain Sanctuary Park, South Africa. Lizards were noosed, measured, weighed, marked, fitted with transmitters (in four cases), released, and observed with binoculars to minimize disturbance. Estimates of male mating success were determined from several factors that were analyzed in a Principal Components Analysis (PCA). In general, males had larger home ranges than females, male home range size was not correlated with male body condition, and female home range size was negatively correlated with SVL. Home range space was shared between males and females, but not among males. Results of the PCA suggest male quality, prey number, and tree size affect female overlap with male home ranges. It is difficult to separate the effects of male traits and territory quality on female mate choice and reproductive success.

REANEY, L. T., AND M. J. WHITING. 2003. Are female tree agamas *(Acanthocercus atricollis atricollis)* turned on by males or resources? Ethology, Ecology and Evolution 15:19–30.

Correspondence to: M. J. Whiting, Communication and Behaviour Research Group, School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Private Bag 3, Wits 2050, South Africa; e-mail: martin@gecko.biol.wits.ac.za.

A New Ancient Family of Frogs

Studies on the early evolution of neobatrachian frogs have been hampered by the dearth of Mesozoic fossils in this group. The authors report a new genus and species of burrowing frog from the Western Ghats in India. This frog, *Nasikabatrachus sahyadrensis,* shares some osteological characters in common with other neobatrachian frogs, but also has a unique combination of external and skeletal characters that suggest its recognition as a new family (Nasikabatrachidae). Skeletal and molecular data (2.8 kb of mitochondrial and nuclear DNA) identify the Seychellian Sooglossidae as the sister taxon to the new family. The finding supports the hypothesis that Sooglossidae were present on Indo-Madagascar during the Late Jurassic/Early Cretaceous and subsequently became extinct in India and Madagascar. The Nasikabatrachidae/Sooglossidae clade diverged before the split between India and the Seychelles at the Cretaceous/Tertiary boundary. Additional Cretaceous fossils are needed to understand fully the phylogeny and biogeography of early Indo-Madagascar neobatrachians.

BIJU, S. D., AND F. BOSSUYT. 2003. New frog family from India reveals an ancient biogeographical link with the Seychelles. Nature 425:711–714.

Correspondence to: S. D. Biju, Tropical Botanical Garden and Research Institute, Palode, Thiruvananthapuram, 695562 Kerala, India.

Life History Characters of Amphibians

An understanding of amphibian life-history characters is the first step toward understanding global amphibian declines. The authors review patterns in life-history characteristics of amphibian populations at different geographic localities, including development and growth rates, body size, sexual maturity, length of breeding season, number of egg clutches produced annually, and clutch/egg size. In general, as altitude and latitude increase, breeding season length, number of clutches (per season), and growth and development rates decrease. However, body size, age at maturity,

clutch size, and egg size generally increase at higher altitudes and latitudes. Temperature seems to be the most important factor in these cases, but notable exceptions include competition, food, habitat permanency, and predation, especially for growth and development. Increased generation time and lower fecundity at high altitude/latitude amphibians make their populations more prone to extinction following a disturbance to their equilibrium. Because many declining populations have been noted from the tropics, altitude seems to affect amphibian life-history characteristics to a greater extent than latitude.

Morrison, C., and J. -M. Hero. 2003. Geographic variation in life-history characteristics of amphibians: a review. Journal of Animal Ecology 72:270–279.

Correspondence to: Clare Morrison, Institute of Applied Science, University of the South Pacific Suva, Fiji; e-mail: morrison_c@usp.ac.fj.

Ultraviolet Radiation and Amphibian Embryos

Increased levels of ultraviolet-B (UVB) radiation to Earth has been hypothesized to be a cause of global amphibian declines in numerous studies. Species that reproduce in aquatic areas exposed to direct sunlight are presumed to be most at risk, but several factors can reduce this risk and include: 1) water color and depth, which attenuate UVB; 2) melanin of eggs that block UVB; 3) photolyase, which can repair DNA damaged by UVB; and 4) egg capsules that absorb UVB. Licht discusses previous studies that demonstrated the effectiveness of the above four factors to prevent UVB damage to amphibian embryos. Because some protection is lost upon hatching, post-hatching and larval amphibians are relatively more sensitive to UVB radiation. However, they possess increased mobility and can move to areas shaded from direct sunlight, which decreases the importance of studies that restricted the movement of larval amphibians exposed to artificially high levels of UVB radiation. Numerous studies have cited detrimental effects to embryos, but experimental conditions often did not account for natural circumstances that shielded eggs from UVB exposure (e.g., laying eggs on the underside of rocks). Moreover, some studies used acetate filters, which are known to be toxic to hatchling amphibians. Licht concludes that realistic environmental factors are not sufficient to link UVB radiation and amphibian population declines.

Licht, L. E. 2003. Shedding light on ultraviolet radiation and amphibian embryos. Bioscience 53:551–561.

Correspondence to: Lawrence E. Licht, Department of Biology, York University, Toronto, Ontario M3J 1P3, Canada; e-mail: lel@yorku.ca.

Apateon and the Origin of Salamanders

Because of large gaps in the fossil record, the origin and interrelationships of Lissamphibia (frogs, salamanders, and caecilians) remains a contentious issue. Three major hypotheses are currently debated in the literature: 1) a monophyletic Lissamphibia originating from temnospondyls; 2) a monophyletic Lissamphibia originating from lepospondyls; and 3) a diphyletic origin of Lissamphibia with caecilians allied to lepospondyls, frogs with temnospondyls, and salamanders related to either lepospondyls or temnospondyls. The authors argue that lepospondyls (larvae absent in fossil record) are not likely to be ancestors of frogs and salamanders, both of which possess gilled larvae among their primitive members. However, temnospondyls have extraordinarily well-preserved ontogenetic series represented in German Carboniferous fossil beds (e.g., *Apateon caudacus),* which makes comparisons to modern Lissamphibia larvae possible. The authors compared the sequence of ossification of the dermal skull in *A. caudacus* with extant hynobiid, ambystomid, and salamandrid salamanders. Numerous similarities were documented, and the authors suggest that modern salamander skulls could have evolved by terminating ossification prior to formation of the circumorbital bones, which distinguish most Paleozoic amphibians.

Schoch, R. R., and R. L. Carroll. 2003. Ontogenetic evidence for the Paleozoic ancestry of salamanders. Evolution and Development 5:314–324.

Correspondence to: Rainer R. Schoch, Staatliches Museum für Naturkunde, Rosenstein 1, D-70191 Stuttgart, Germany; e-mail: schoch.smns@naturkundemuseum-bw.de.

Molecular Phylogeny of Pelobatoidea

The monophyly and phylogenetic relationships of primitive frogs included in Pelobatoidea and their relationships to other anurans have been debated in several previous studies. To address this problem, the authors sequenced 520 bp of 16S and 385 bp of cyt *b* for most species of Pelobatidae and Pelodytidae, *Leptolalax pelodytoides, Brachytarsophrys feae,* and *Megophrys lateralis;* outgroups from every major clade of frogs were included in the anlaysis. Phylogenetic analyses (maximum parsimony, maximum likelihood, and Bayesian) were performed independently and on the combined data sets in PAUP* and Mr. Bayes 2.0. ML and Bayesian analyses produced trees with identical ingroup topologies. Pelobatoidea formed a monophyletic group, as did all genera examined. Relationships among genera were not consistent with previous hypotheses; monophyletic Pelodytidae and Megophryidae were supported, but not Pelobatidae. The authors suggest fossoriality evolved independently in Scaphiopodidae and Pelobatidae.

García-París, M., D. R. Buchholz, and G. Parra-Olea. 2003. Phylogenetic relationships of Pelobatoidea re-examined using mtDNA. Molecular Phylogenetics and Evolution 28:12–23.

Correspondence to: Mario García-París, Museo Nacional de Ciencias Naturales, CSIC, José Gutiérez Abascal, 2, 28006 Madrid, Spain; e-mail: mcnp505@mncn.csic.es.

A Morphological and Molecular Phylogeny of Emydid Turtles

Currently, the turtle family Emydidae contains 40 species in 10 genera. Previous phylogenetic studies of this group agreed on recognition of two subfamilies (Emydinae and Deirochelyinae), but numerous other conflicts remained. The authors combined 237 morphological characters and 547 parsimony-informative characters (cyt *b,* control region, 16S, and ND4 genes) for 39 of 40 emydid species to conduct a comprehensive phylogenetic analy-

sis. Parsimony analyses of morphological data, and maximum likelihood (ML) and equally weighted parsimony analyses of molecular data were conducted in PAUP* 4.0b1. Four hypotheses of ecological diversification were explored within the context of the resulting phylogeny from the combined analysis of morphological and molecular data sets. Results supported the monophyly of Emydidae, both emydid subfamilies (in most cases), and the majority of ingroup genera. Overall, results support a "limited-diversification hypothesis" of ecological diversification, which argues against simultaneous changes on one or more ecological axes. The authors propose that recent speciation events in emydids have been a result of allopatric speciation between ecologically similar taxa.

Stephens, P. R., and J. J. Wiens. 2003. Ecological diversification and phylogeny of emydid turtles. Biological Journal of the Linnean Society 79:577–610.

Correspondence to: Patrick R. Stephens, Department of Ecology and Evolution, State University of New York at Stony Brook, Stony Brook, New York 11794-5245, USA; e-mail: pstephens@life.bio.sunysb.edu.

Systematics of North American Chorus Frogs

Frogs of the genus *Pseudacris* are distributed from the southern tip of Florida to northern Canada along both coasts of North America. The authors examined the phylogenetic relationships of 38 populations of *Pseudacris,* representing 23 of 28 known species and subspecies. Approximately 2.4 kb of a mtDNA region (incorporating 12S, tRNAval, and 16S rRNA) was sequenced for each taxon; maximum parsimony, maximum likelihood, and Bayesian analyses were performed. A published allozyme dataset was re-analyzed to calculate Manhattan distances between taxa. Results of the mtDNA analyses identified four major clades within a monophyletic *Pseudacris:* (1) West Coast Clade (*regilla* and *cadaverina);* (2) Fat Frog Clade (*ornata, streckeri,* and *illinoensis);* (3) *Crucifer* Clade (*ocularis* and *crucifer);* and (4) Trilling Frog Clade (all remaining species). The mtDNA phylogenetic hypothesis is mostly incongruent with those of the re-examined allozyme dataset, and other published allozyme, morphological, and behavioral datasets. Geographic boundaries of some *Pseudacris* species are difficult to determine because of broad sympatry with other taxa, hybridization, and dearth of clearly diagnostic characters; some currently recognized distributions are not consistent with the results of this study. The taxonomic status of some species and subspecies are discussed.

Moriarty, E. C., and D. C. Cannatella. 2004. Phylogenetic relationships of the North American chorus frogs (*Pseudacris:* Hylidae). Molecular Phylogenetics and Evolution 30:409–420.

Correspondence to: Emily C. Moriarty, Section of Integrative Biology and Texas Memorial Museum, University of Texas, 24th and Speedway, Austin, Texas 78712, USA; e-mail: chorusfrog@mail.utexas.edu.

Roger Conant (1909–2003)

Roger Conant passed away in the early morning hours of 18 December 2003 in Albuquerque, New Mexico, at the age of 94. A full obituary will appear in the June 2004 issue of *HR*.

ZOO VIEW

Carl F. Kauffeld (1911–1974) at the Staten Island Zoo in New York was a pioneer zoo herpetologist and his influence on many in the profession has been considerable. He started as Curator of Reptiles in 1936 and began building the reptile collection. Kauffeld became Zoo Director in 1963 and retired a decade later. The rattlesnake collection was world famous; the collection reached 34 forms in 1963.

Some of his publications listed below will give a sense of his importance to captive management and husbandry. His inspirational writings of collecting adventures throughout the United States at his favorite sites such as Okeetee Preserve in South Carolina, Ajo Road and Ramsey Canyon in Arizona, and Lake Okeechobee and Payne's Prairie in Florida were the impetus needed for enthusiastic collectors to hop in their cars and speed quickly to these places.

Kauffeld's importance to his zoo has been described in detail in a new book by Ken Kawata, general curator, called *New York's Biggest Little Zoo. A History of the Staten Island Zoo*. This is a loving treatment, filled with anecdotes about the history of the Zoo, Kauffeld's unique personality and remarkable career, and Patricia O'Connor, the first full-time woman zoo veterinarian in the United States. I recommend it highly, the perfect read for a quiet afternoon.

Historical Overview

Adler, K. 1989. Herpetologists of the past. *In* K. Adler (ed.), Contributions to the History of Herpetology, pp. 5–141. SSAR Contributions to Herpetology, Volume 5, Oxford, Ohio. [biographical sketch of Carl Kauffeld].

Card, W., and J. B. Murphy. 2000. Lineages and histories of zoo herpetologists in the United States. Herpetol. Circ. 27:1–45. [portrait of Kauffeld].

Conant, R. 1975. Obituary: Carl Frederick Kauffeld, April 17, 1911–July 10, 1974. Herpetol. Rev. 6:27–28.

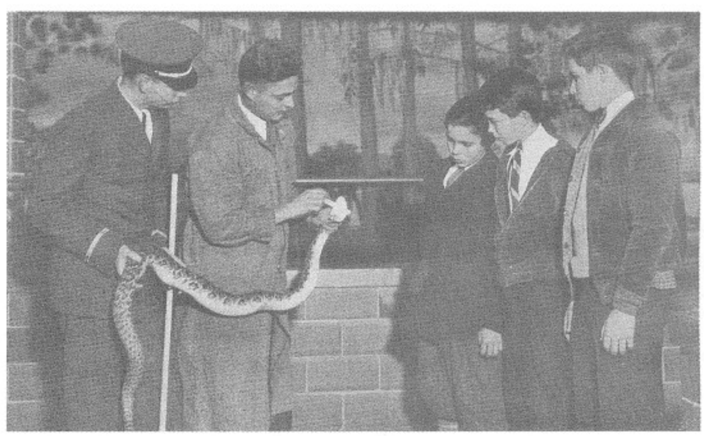
———. 1997. A Field Guide to the Life and Times of Roger Conant. Selva, Tyler, Texas [portrait of Kauffeld, p. 466].

Kawata, K. 2003. New York's Biggest Little Zoo. A History of the Staten Island Zoo. Kendall/Hunt Publishing Co., Dubuque, Iowa.

1984. Carl F. Kauffeld memorial issue. HERP 18(1). [collection of Kauffeld articles from various publications].

Systematics & Taxonomy

Gloyd, H. K., and C. F. Kauffeld. 1940. A new rattlesnake from Mexico. Bull. Chicago Acad. Sci. 6(2):11–14. [description of *Crotalus durissus*



Carl F. Kauffeld (holding snake head) pictured in *News Bulletin of the Staten Island Zoological Society* in March 1937. Each issue cost 5 cents. Courtesy of Staten Island Zoological Society and Ken Kawata.

totonacus from northeastern Mexico].
KAUFFELD, C. F., AND H. K. GLOYD. 1939. Notes on the Aruba rattlesnake, *Crotalus unicolor*. Herpetologica 1(6):156–160.

BOOKS BY CARL KAUFFELD

CURRAN, C. H., AND C. KAUFFELD. 1937. Snakes and Their Ways. Harper & Brothers, New York. [reprinted 2003 by Krieger Publ. Co.].

KAUFFELD, C. 1957. Snakes and Snake Hunting. Hanover House, Garden City, New York. [reprinted 1995 by Krieger Publ. Co., now out-of-print].

———. 1969. Snakes: The Keeper and the Kept. Doubleday, Garden City, New York. [reprinted 1995 by Krieger Publ. Co., limited copies available].

HUSBANDRY

KAUFFELD, C. F. 1943. Growth and feeding of newborn Price's and green rock rattlesnakes. Amer. Midl. Natur. 29:607–614.

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———. 1953. Removal of abnormal snake eggs by sectioning. Herpetologica 9:161–163.

———. 1954. Mites and ticks in captive snakes with remarks on cage sanitation. Herpetologica 10:103–107.

———. 1954. Manipulation of odor as an aid in feeding captive snakes, with special reference to king cobras. Herpetologica 10:108–110.

———. 1969. The effect of altitude, ultraviolet light, and humidity on captive reptiles. Inter. Zoo Yearb. 9:8–9.

GENERAL

KAUFFELD, C. F. 1943. Field notes on some Arizona reptiles and amphibians. Amer. Midl. Natur. 29:342–359.

———. 1960. The search for *subocularis*. Bull. Philadelphia Herpetol. Soc. 8(2):13–19. [in two parts, second installment in 8(3):9–15].

———. 1961. Massasauga land. Bull. Philadelphia Herpetol. Soc. 9(3):7–13.

———. 1963. More at home with cobras. Bull. Philadelphia Herpetol. Soc. 11(1–2):49–52.

———. 1965. The rattlesnake collection at Staten Island Zoo. Inter. Zoo Yearb. 5:168–170.

BOOKS OF NOTE

In 2002, R. Frankham, J. D. Ballou, and D. A. Briscoe published "Introduction to Conservation Genetics" (Cambridge University Press, Cambridge), an exceptional book summarizing the history of genetic management. Jonathan Ballou is a population biologist at Smithsonian National Zoological Park (SNZP). Twenty-three years earlier, Jon and his colleagues published a landmark paper on inbreeding and juvenile mortality in small populations of ungulates (1979. Science 206:1101–1103) which has led to a major change in the captive management of zoo animals.

Elliott Jacobson, veterinary pathologist at the University of Florida, has edited a book on green iguanas (2003. Biology, Husbandry, and Medicine of the Green Iguana. Krieger Publishing Co., Malabar, Florida 2003) which includes chapters by zoo workers. Allison Alberts and John (Andy) Phillips from the Center for Reproduction of Endangered Species at the San Diego Zoo in California and Nancy Pratt-Hawkes from Disney's Animal Kingdom in Lake Buena Vista, Florida describe the ontogeny of captive and wild iguanas by focusing on hormonal, morphological, and behavioral changes from birth to first reproduction. Mary Allen and Olav Oftedal from SNZP cover nutrition in captivity, based in large part on research conducted at the Zoo. They evaluate the quality of commercial diets, importance of ultraviolet light, and recommend nutritionally balanced diets. Frederick Antonio, general curator at the Central Florida Zoological Park in Lake Monroe, joined several other authors in outlining husbandry and management protocols. Kelly Helmick from the El Paso Zoo in Texas coauthored a chapter on drug dosages and chemotherapeutics.

In the new SSAR book "Islands and the Sea: Essays on Herpetological Exploration in the West Indies," Allison describes her experiences working with the reptiles of Guantanamo Bay, Cuba. Retired curator Richard Sajdak from the Milwaukee County Zoo details his experiences in studying vine snakes (*Uromacer*) on Hispaniola in 1980. Charles Knapp from the John G. Shedd Aquarium in Chicago writes about his work with iguanas (*Cyclura*) in the Bahamas.

—*James B. Murphy, Section Editor*

Herpetological Review, 2004, 35(1), 8–13.

Johann Matthäus Bechstein: The Father of Herpetoculture

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"HOWEVER, I BELIEVE THAT HERE IT MUST BE ATTEMPTED TO PRESENT EVERYTHING FOR EVERYONE, AND THERE ARE PROBABLY ENOUGH READERS WHO, ATTRACTED BY SUCH A BOOK, WILL WANT TO SEEK THE PLEASURE OF OBSERVING AN AMPHIBIAN [HERE INCLUDING REPTILES] AND A FISH, YEA, EVEN AN INSECT OR A WORM WHICH CAN TOLERATE THE AIR IN A ROOM, AND WHO ENJOY THE STUDY OF NATURE."

TRANSLATED FROM JOHANN MATTHÄUS BECHSTEIN (1797)

Johann Matthäus (or Matthaeus) Bechstein was born on 11 July 1757 in Waltershausen in Thuringia (today, part of Germany) and was interested in nature at an early age. He studied at the "*Gymnasium Illustre*" in Gotha, where languages and natural science, physics and mathematics were taught. After completing his studies at the *Gymnasium* he studied theology from 1778 to 1781 at the University of Jena. Four years later, he taught mathematics and natural history in his native Schnepfenthal, but focused on teaching forestry after 1793. After Bechstein completed a public examination in the spring of 1795, conducted by senior forestry master Friedrich August Ludwig von Burgdorf (1747–1802) at the Forestry School in Berlin, he founded a private re-

FIG. 1. Portrait of Johann Matthaeus Bechstein. Courtesy of Kraig Adler.

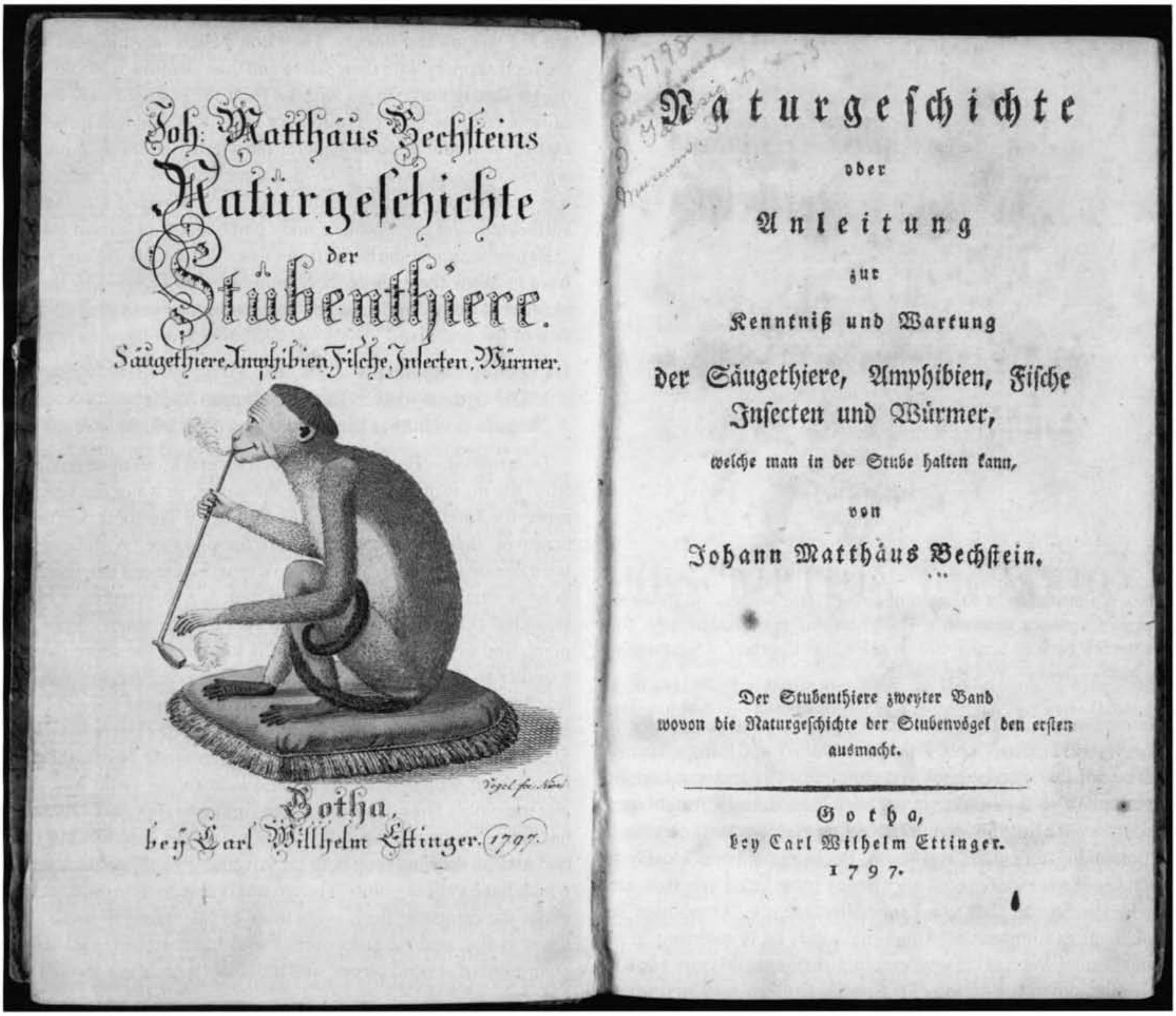

FIG. 2. Engraved title page and printed title page of "Naturgeschichte; oder, Anleitung zur Kenntniss und Wartung der Säugethiere, Amphibien, Fische, Insecten und Würmer, welche man in der Stube halten kann" by Johann Matthaeus Bechstein in 1797. Courtesy of Smithsonian Institution Libraries, Washington, DC.

search institute and the "Society for Forestry and Hunting Lore" in Waltershausen. Because of insufficient financial support, his institute closed in 1799. That year Duke Georg von Meiningen installed him as forestry councilor with the purpose of creating the forestry school in Dreissigacker; it was opened in 1801 and elevated in 1803 to the status of a forestry academy. In 1806 the University of Erlangen bestowed on him the degree of a doctor of philosophy. Bechstein died 23 February 1822 in Dreissigacker bei Meiningen, Thuringia.

Bechstein was a prolific author and some of his translated titles are as follows: "Natural History of Germany for the Common Use in all Three Kingdoms" (published between 1789 and 1795); "Natural History of Birds for the Home" (1795); "Natural History or Guide to Knowledge and Care of Mammals, Amphibians, Fishes, Insects and Worms which can be Kept at Home" (1797); translation of the Natural History of the Amphibians by B. G. E. de Lacepéde under the title "Mr. de la Cepede's Natural History of the Amphibians or the Oviparous Four-legged Animals and the Snakes—a Continuation of Buffon's Natural History (1800–1802)," in five volumes; and "The Science of Forestry and Hunting in all its Parts" (32 volumes between 1818 and 1835). His book "Cage and Chamber-Birds, Their Natural History, Habits, Food, Diseases, Management, and Modes of Capture" was translated from the German in 1864.

Bechstein's book on captive care of reptiles and amphibians was entitled "Naturgeschichte; oder, Anleitung zur Kenntniss und Wartung der Säugethiere, Amphibien, Fische, Insecten und Würmer, welche man in der Stube halten kann." In it, he covered five herp taxa: European pond turtle (*Testudo orbicularis*, now *Emys orbicularis*), common tree frog (*Rana arborea*, now *Hyla*

FIG. 3. Illustration of common tree frog (*Hyla arborea*) in Reverend Gregory Climenson Bateman's "The Vivarium," published in 1897. This was the first book on herpetoculture in English. Courtesy of Smithsonian Institution Libraries, Washington, DC.

arborea), sand lizard (*Lacerta agilis*), great crested newt (*Lacerta palustris* and *lacustris*, now *Triturus cristatus*), and European grass snake (*Coluber Natrix*, now *Natrix natrix*). The terms aquarium, terrarium, or vivarium had not yet been coined, so Bechstein used descriptors like little boxes, buckets, sugar glasses, containers made of porcelain, stoneware, and so on. Bechstein adheres closely to the rules of systematic zoology already introduced 40 years earlier by the Swede Carl von Linné. Bechstein's "Amphibien" is equivalent to Linnaeus's "Amphibia"; thus he is referring to all herpetofauna. We had the opportunity to examine this rare book in the Smithsonian Institution (SI) Special Collections Department of the Joseph F. Cullman 3rd Library of Natural History and an English translation of the section called "Amphibien" is provided below.

TRANSLATION OF "AMPHIBIANS, WHICH MAY BE KEPT IN THE HOUSE"

Introduction.—There are also amphibians which the amateur can keep in his room for his pleasure; to be sure, in contrast to birds and mammals, only very few. Also, they offer the pleasure not for long and are kept mainly because of their rarity or beauty; a few show some capacity for training, and only the tree frog is raised to serve as weather prophet.

Generally speaking, the exterior of the amphibians—even of the most beautiful forms and colors—has something repellant and suspicious about it so that they must be struck from the list of beautiful and inviting creatures. However, this results usually from an error in upbringing as careful observations show.

The characteristics of these animals differs in the wild, therefore also in the room, since some live in dry climates, others in the water; thus there is a difference also in the home, and since they are few in number, it is best to describe each animal in a few words. Just as different as their environment is also:

The nourishment of the household amphibians. Most of them are fed worms and insects. They don't chew anything but make the food slippery with their saliva and then swallow it whole. They digest slowly and can go without food for extraordinary lengths of time because they perspire very little. It is said that turtles can fast for a whole year. In general the vitality of these animals is admirably great, so much so that some still live after their heart has been ripped out; some die only very slowly if they are not suffocated, and even replace body parts cut off or almost lost.

Reproduction in the home is unthinkable; in that case one would have to allow the eggs of these animals to be brooded by the sun in order to discover the step-by-step development toward completion of the organism.

I. Crawling Amphibians

1. The Ordinary River Turtle (European Turtle)
[*Testudo orbicularis* Lin., now *Emys orbicularis*]

Description.—People usually keep several kinds of turtles, even from the most distant regions of the world, in water buckets, but more for food than pleasure. In Middle or Northern Germany, however, these are kept preferably for pleasure. With head and tail extended, the animal grows to a length of about one foot. The head is small, and when it is retracted, it is covered by a black, wrinkled skin which seems to form a cap. The snout comes to a point, and even though the mouth is toothless, the sharp jaws fit together so perfectly that the animal is thus enabled to crush and tear apart its food. The tail is relatively long, round and gradually ends in a point; while the feet are webbed, they clearly have toes. Such turtles are called *river turtles* to differentiate them from other families, of which some are named *land turtles* (with true toes) and the others *sea turtles* (with feet similar to flippers). Our turtle has four toes (aside from the webbing) on the fore feet but only two toes on the hind feet; both are covered with shiny black scales which have yellow points. The animal is able to hide head and tail under the carapace; for it is enclosed in two roundish shells. The lower is flat, yellow, and covered with black stripes; each one is composed of several pieces, and the edges thereof are smooth and not serrated.

Sojourn

a) At liberty: This turtle is encountered in the southern and moderate parts of Europe. It is but rarely found in Germany. It lives in fresh water on the bottom in the mud and spends the winter asleep.

b) In captivity: They are placed either in small ponds in gardens, or in the house and courtyard in buckets.

Nourishment

a) At liberty: They feed on water insects, snails, and foliage, etc.

b) In captivity: Here one can feed them for long times with bran, flour, bread, and other remnants from the kitchen.

Reproduction

They lay hard-shelled eggs similar in size to pigeon eggs and bury them in the ground.

Capture

They are fished with a net from the fresh water mud.

Commendable Characteristics

It cannot be said that their movements are varied or beautiful, or that these animals may be counted among those which are en-

tertaining; however, their very rarity, and the desire to have something alive also from this class of animals under one's care and supervision makes them attractive to the amateur. They can also be fattened up so as to make use of their tasty (even though hard to digest) meat, once the eyes have been satisfied by their sight. Already clever experiments have been made with these animals: Mr. Merz in Paris shut the mouth of one with wire and closed up the nostrils with sealing wax; nevertheless the animal lived another 30 days without food or breathing. This reveals the tenacious vitality which these animals possess.

2. The Tree Frog (Ordinary Tree Frog)
[*Rana arborea* Lin., now *Hyla arborea*]

Description.—This pretty little frog, which is particularly attractive because of the rare cleanliness of its skin, its coloration, and the delicate body structure, measures about 1.5 inches[1] in length. The upper body is green; the lower parts yellowish-white. The latter are covered with small raised warts which are nothing other than glands containing a caustic fluid; if you catch a tree frog with bare hands and then touch your eyes without first washing them (which happened to me frequently) this moisture irritates painfully for a long time. In complete condition the green color of the body is grass-green; however, once the mucous skin has been shed—as these amphibians frequently do—the body color changes to blackish or dark reddish-gray with white spots and thereupon becomes yellowish-green and is separated from the lighter lower body by a light yellow stripe with brown edges. We recognize the males by their yellowish throat which, when they croak, they blow up into a round bubble nearly as large as the entire body. Instead of nails, the toes bear little plates shaped like shields which enable them to attach themselves to the underside of leaves and to glass.

Sojourn

a) At liberty: During the summer we encounter this little frog on shrubs, trees, in the grass and in grain. When the sun is shining, they hang from the underside of leaves. In the fall they wander into ponds and swamps and mate there until June, and then climb up again to the trees and shrubs. During the evenings in May and June we can hear over a distance of half an hour the timorous croaking from the swamps where these animals mate in innumerable quantities. From far away this sounds like the ringing of sled bells.

b) In the room: The animals are placed in the window—but in such a way that they are not exposed to direct sunlight—in water glasses equipped with a small ladder and tied at the top with paper with holes in it, or they are put in clear wire cages laid out with moist sod or grasses. Both the water in the glasses as well as the sod and grass in the cages must be changed from time to time so that these little creatures can feel well.

Nourishment

a) At liberty: Here they catch with amazing speed flies and other insects from the leaves of trees, bushes, and weeds and grasses.

b) In the room: There they are given from time to time a living fly. However, they hesitate to touch dead insects.

Reproduction

These frogs sometimes mate for as long as three days. Like all our frog species, the female lays small eggs; these first develop into tadpoles without, and later then with feet; finally the tail falls

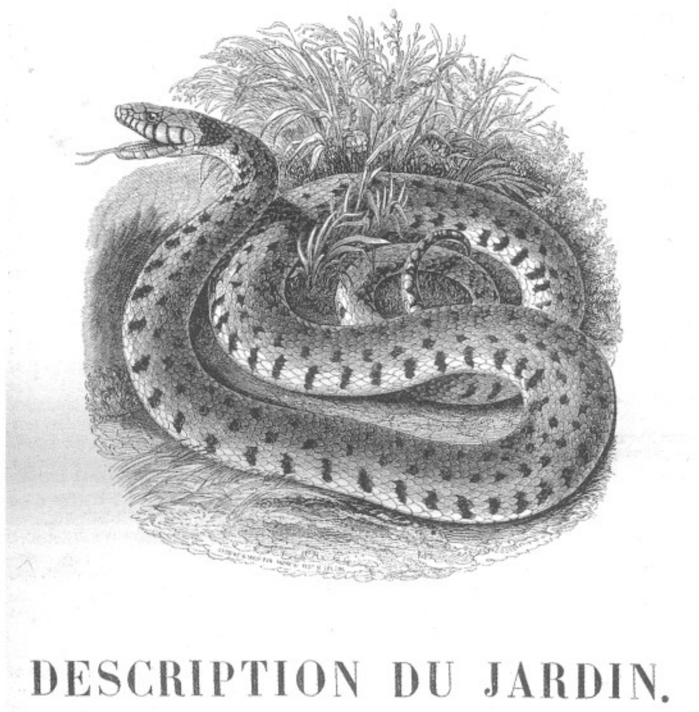

FIG. 4. Illustration of common ring-snake of Europe (*Natrix natrix*) in M. Boitard's "Le Jardin des Plantes. Description et Moeurs des Mammifères" in 1845. Courtesy of Smithsonian Institution Libraries, Washington, DC.

off, and the small, graceful little tree frog is complete. The animal remains in the water until full development; only as a true frog it climbs up on trees and shrubbery.

Commendable Characteristics

We usually employ the frog as weather forecaster. It announces changes in the weather a considerable time in advance; preferably through loud crowing and croaking. Also, when rainy or otherwise bad weather is about to occur, it goes into the water and behaves there in a restless manner; when the frog anticipates pleasant, dry weather, it climbs to the higher region of the glass or up the ladder. Its croaking makes it rather unpleasant.

3. The Green Lizard
(Common Lizard, Copper Lizard, Leaper)
[*Lacerta agilis* Lin.]

Description.—A commonly known, very agile and beautifully marked animal. It measures between 5 and 10 inches. Its color varies. As a rule they should be of golden hue on top, with brown and black spots on the sides, and copper-colored or yellowish-white on the lower body. The scales on the throat are longer than the norm and more pointed, and they form kind of a double necklace; the shields on the belly are square; the thick hind legs bear a row of horny warts, and the long tail is ringed and sharply scaled. In catching these animals, it is necessary to proceed with caution so as not to injure the tail which breaks so easily. The tail also possesses great reproductive power, for if it is cut off, a new one grows, albeit very incomplete. The feet have five toes with sharp nails.

Sojourn

a) At liberty: These lizards inhabit the warmer climates of Eu-

rope as well as both Indies and the South Sea islands. The further south they are found, the larger, more colorful and more beautiful they are. They remain in the forested regions, and in gardens, walls and rocks which are found in such regions. In the summertime they seek a cave under a shrub, root, or stone; in the winter they retreat further into holes, especially in dense shrubbery and in hedges where they are covered by a heavy blanket of leaves and grass.

b) In the house: Here one may either allow them to run around freely by setting a small box into a corner equipped from time to time with moist substrate and makes sure that they don't escape from the room by the door. Normally one places them into a wide sugar glass and adds moist moss and soil.

Nourishment

a) At liberty: Flies and other insects, worms, snails, small frogs, and other little lizards, even of their own species. In front of low beehives they often also prey on bees in the sunshine.

b) In the room: They may be given only one of the above-named foods in order to maintain them for a long time; even if they are only occasionally given a fly, they are content.

Reproduction

The female lays eight and more dirty white, blunt-round eggs, which shine for a while in the darkness under the rocks, often in the midst of large black ants which, however, do not attack them. The young are brooded by the warmth of the sun, with each egg containing only one animal, hatch in August and even as late as September; for two years they look green and multicolored brown.

Positive Properties

It is only a matter of becoming accustomed to the sight of these: Like all amphibians, we will undoubtedly find them appealing and beautiful. They are also distinguished by exceptional vitality, speed, and alert appearance. Finally they get to know the amateur, and he is able to play with them as with other animals in the house. These animals also lead us to admire the great reproductive force of nature, as entire limbs grow anew (even if not completely). It is also noteworthy that this harmless little animal has the characteristic to reveal the most subtle and concealed poison of the animals from this class in that it dies with cramps of the whole body if it has been bitten by another.

4. The Marsh Salamander
(Water Salamander, Water Newt, Water Lizard)
[*Lacerta palustris* and *lacustris* Lin., now *Triturus cristatus*]

Description.—The appearance of these animals is not exactly appealing; yet they can be kept easily in a glass in the room, often changing the water, and occasionally throwing in a fly as nourishment. The reproductive urge of these animals is notable by such phenomena: as soon as they are placed in a larger vessel, their gentle motions in swimming and the flatteries and caresses exchanged by males and females. Usually we don't know these animals well enough and mistake males, females, and young for different species. Hence I want to describe them somewhat more specifically:

Males: The length measures five inches from the tip of the mouth to the end of the tail. Up to the ears the head measures 1/2 inches, flat on top, rounded bluntly in front, blown up on the cheeks; the round nostrils are located in front, far distant from each other; the eyes are large, the iris golden-yellow but divided by a dark-brown circle so that it appears to consist of two rings. The eyebrows are raised. The eyes are closer to the mouth than to the ears. The raised skin back seam begins between the eyes and ends on the hind feet; it is serrated in the shape of a saw, most profoundly in the middle of the back, most finely at the end of the back and in the neck; between the hind feet one feels only the seam without the skin; the raised skin begins again with the tail, but it is bluntly serrated. This skin can float and adheres again immediately when the animal is not in the water but looks beautiful in swimming. The front feet have four toes with two spheres [dumbbell-shaped phalanges]; small warts and dull points, and the back five also with such round warts and points. The forelegs measure 3/4 inches to the toes, and the hind ones are almost 1 inch long. The entire upper body and the sides are covered with small raised warts; the lower body more with fine seams and furrows. The upper body is dark-olive green; from a distance it looks black, with isolated, catered black spots. The sides begin at the lower jaws; they are black with fine white points. The lower body is orange-yellow, on the chest from the vent and on the sides large black spots with all kinds of longitudinal figures. The throat and the soles of the feet are light yellow; the form spotted dark brown and spotted in white and can be blown up to a large size; the pointed half of the toes are also yellow with black bands. Other than that, the feet are like the upper body: The broad tail is shaped like a lancet, has a yellow spot behind the vent, is olive-brown above and below with white points on the sides of the root; nearly in the center marked on both sides with a bluish-white stripe which becomes pure-white after the point. In the water appears beautifully light, almost transparent.

The female is larger than the male by nearly one third, with a length of 7.5 inches; the head is somewhat thicker and engorged, especially at the point; the entire body somewhat thicker and more plump, especially in April and May, when the belly contains eggs; the color of the back is somewhat lighter, hence the black points are more prominent; the lower body is of a beautiful orange-yellow color and also marked with beautiful broad black spots of various shapes and forms; this yellow color continues uninterrupted to the tip of the tail. The serrated back skin is missing, and only the tail has several flat notches. The blue-white center stripe is not clearly visible because in fact it is mixed in a dirty-dark-ash-like manner with the other colors. The bands above the toes are not visible everywhere; other than that, everything is the same.

As for the two-year-old male, 2.5 inches long, the back skin starts in the neck and is dull; the upper body is olive-green, beautifully spotted with black and olive-brown spots; from the top and the sides the head has similar stripes; the throat is dirty-white with olive-brown spots; the remaining lower body has the color of egg yolk all the way to the end of the tail with isolated similar round spots. The narrow blue-white stripe runs along the sides of the yellow lower underbody. In relation to the adult (older) male the tail is somewhat broader, and the toes of the hind legs are also somewhat broader; the points of the front foot toes are black, and the legs are only vaguely formed.

The two-year-old female, somewhat exceeding the above-described male in size, matches the older female in every detail but deviates strongly in color; for this reason it is often taken for a different species. The upper body is olive green with a fine dark-brown line along each side of the back; throat, sides and legs are

dirty-yellow; the belly butter-yellow.

Oddities

In April and May the females lay their eggs in the water, where old and young permanently stay; especially in stagnant swamps, ponds, and fountains. At times these eggs are of a jelly- or glasslike consistency containing the white-yolk-looking like a white radish seed.

These animals feed on flies and on all manner of water insects; they do not inflict the great damage on the fish harvest of which they are accused; they prefer to eat their own brood rather than fish. In the spring, when one fishes muddy ponds, especially in forested areas, one can catch these animals in large quantities.

II. Crawling Amphibians

5. The Ringed Snake (House Snake)

[*Coluber Natrix* Lin., now *Natrix natrix*]

Description.—This is the most common native species of snake, and completely harmless; for this reason one may see swindlers walk around with them; they put them in their mouths and cause them to perform all manner of tricks under the pretense that these are poisonous snakes which they are able to control in such a way that they can do no harm. I have seen them at a length of four feet and longer. The female is always larger and thicker than the male. Normally one counts 170 broad belly plates and 60 ventral tail scales but the number is not so exact. The upper body is either blue-green, iron gray, or rust-gray; on the sides spotted in white with individual blackish points; the lower body is black, with white interruptions along the sides and under the belly so that it gives the impression of having black stripes. On both sides of the neck the male has a yellow spot and the female a whitish-yellow spot in the shape of a necklace or neck ring; hence the name.

Sojourn

a) At liberty: We find them in the highest mountains as well as the lowest valleys, in dry as well as swampy places—in places where they can never enter the water as well as sites where they can swim daily in the water, on the banks of ponds and rivers. Usually they seek out shady spots because they love the warmth of the sun only at certain times, e.g., when they have shed the old skin. They like to stay in stables, cellars, and garbage dumps.

b) In the house: In the room one allows them to run around and gives them a little box with wheat bran where they go to sleep.

Nourishment

a) At liberty: Their food consists of toads, frogs, lizards, snails, mice, worms, etc. Often I have cut open a snake which had swallowed a frog, and the frog jumped out again.

b) In the house: In the room the snake is content with milk and wheat bran.

Reproduction

The ringed snake deposits its eggs in compost beds, garbage dumps, stale places in stables. The gray-white-skinned eggs are linked together like pearls. At mating time the male and female exude an unpleasant odor, some say like a billygoat, but I cannot agree; I find it a unique, sweetish odor. Each egg contains one young the length of a finger when it hatches and looks cute.

Capture

They can be caught anywhere, especially when they are young when they also look their best—in compost heaps, also the heaps of garden trash which are raked together in the spring in gardens and meadows. Here they are often found by the hundreds.

Positive Properties

These are certainly endearing animals which can be trained to dance with a stick and the pipe, and to play dead.

My friend Mr. D. Vognetz has a ringed snake which is so tame that she crawls up and down in the room like a domestic bird, often climbs up on him, crawling up the arms and into the bosom. But it does not easily approach anyone else. He puts it in his pocket, goes into the garden with it and as soon as he emits a loud whistle, similar to the tone with which at mating time they call their mates, it comes to him, crawls up on him, lets him put it in his pocket and remains there without moving until he takes it out again. Since these crawling amphibians often grow exceptionally large, this has provided opportunity for all kinds of fables.

They can go for long periods without food but also grow extremely slowly.[2]

Footnotes:

[1] The old German Zoll, translated here as inch, seems to have been slightly longer than the American inch, but we have not been able to determine the exact ratio. - Translator

[2] It is also possible to tame the common viper (*Coluber berus*, now *Vipera berus*) and at times to remove their venom by letting them bite a cloth or piece of leather, so that it does not easily damage its master who feeds them. But I advise against it because one can never be sure; hence I also have not added a description.

Acknowledgments.—In 2001, Werner Rieck wrote a comprehensive biography of Johann Matthäus Bechstein and much of our material on his life and importance to the history of maintaining captive amphibians and reptiles is excerpted from that publication.

Smithsonian National Zoological Park Librarian Alvin Hutchinson was instrumental in arranging a meeting with Leslie Overstreet and Daria Wingreen of the Joseph F. Cullman 3rd Library of Natural History from the SI Special Collections Department so that we could see Bechstein's book. Judith Block and Kraig Adler reviewed early drafts of this manuscript. We are indebted to the staff of SI Behind-the-Scenes Volunteer Program, especially Amy Lemon, for courtesies extended to us. Dale Miller from the SI Office of Imaging and Photographic Services provided the image of the title page from Bechstein's book.

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ARTICLES

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Effect of Temperature and Storage Duration on the Stability of Steroid Hormones in Blood Samples from Western Diamond-backed Rattlesnakes (*Crotalus atrox*)

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Studies of field behavioral endocrinology permit researchers to examine the relationship between hormones and an organism's behavior under natural conditions. For analyses of circulating steroid hormones, blood harvested in the laboratory is typically centrifuged immediately to obtain plasma, which subsequently is stored frozen (e.g., ultra-low freezing, -80ºC). Collection of blood samples outside of a laboratory setting, however, poses potential problems with respect to proper short-term storage. When conducting research in remote field sites, several hours or even days may pass before samples can be centrifuged and the resultant plasma stored (e.g., -80ºC). Prior to processing, steroids in blood samples may be metabolized (e.g., degraded, converted), leading to erroneous values derived from quantitative analyses such as radioimmunoassays. Alternately, hormones may remain stable under the above-mentioned conditions. There are few published data on the stability of steroids in blood samples collected under field conditions, and no studies are published on reptiles.

Levels of steroids in blood samples may be sensitive to temperature, and this sensitivity may differ among lineages (e.g., mammals versus reptiles). Circulating steroids associated with binding proteins degrade more slowly than free steroids (Pardridge and Mietus 1979), and at high temperatures the rate of steroid dissociation from their binding proteins increases (e.g., Ho et al. 1987). Consequently, metabolism of bound and free steroids may be accelerated at high temperatures. Reptiles have higher circulating concentrations of steroids and binding proteins than mammals, and steroid binding proteins from these two amniote lineages seem to be inherently different both in their specificity and affinity for steroids (e.g., Callard and Callard 1987; Jennings et al. 2000). These facts raise the possibility that blood samples from mammals and reptiles show differences in temperature-sensitive metabolism of steroids.

Research on stability of steroid hormones has been primarily conducted to evaluate the proper storage of mammalian blood and serum in veterinary clinics and hospitals. These results indicate that steroids in plasma and serum are relatively stable when frozen (Bolelli et al. 1995; Kley and Rick 1984; Kley et al. 1985). Refrigeration of plasma samples also yields relatively high stability of steroids (Key et al. 1996; Kley and Rick 1984; Olson et al. 1981; Reimers et al. 1982), although Behrend et al. (1998) reported a significant decline from baseline in cortisol levels in dog serum stored at 4ºC for five days. Storage of plasma at higher temperatures (22–37ºC) often leads to increased steroid hormone metabolism (Behrend et al. 1998; Olson et al. 1981; Reimers et al. 1982, 1983).

It is apparent that the method of choice for storing plasma samples for later hormone analysis is ultra-low freezing (-80ºC), and that storage at higher temperatures for protracted periods can have negative effects on the concentrations of steroid hormones. The conditions to which the samples were exposed in the aforementioned experiments were representative of the various storage methods available in veterinary or clinical laboratories (e.g., ultra-low freezing, refrigeration) rather than the conditions typically encountered in the field, especially in deserts. Because researchers may have no choice but to delay processing blood for 24 h or more, it is critical to determine the effects of sample storage under those temperature and duration conditions.

We were motivated to address the above question for our own studies of seasonal steroid hormone levels of rattlesnakes (*Crotalus* spp.) in the Sonoran Desert (Arizona). Typically, we obtain blood samples and immediately store them in a cooler filled with ice (0ºC), but other times we are forced to carry them on our person (25–40ºC) in the course of sampling animals until we can store them on ice. Centrifugation, collection of plasma, and ultra-low freezing (-80ºC) of these blood samples is done in a laboratory within 6–24 h. In this experiment, we tested whether steroid hormone levels are stable in blood samples from rattlesnakes stored at two temperatures (0°C and 40ºC) for two durations (6 h and 24 h).

Materials and Methods

Subjects.—Twenty (10 male, 10 female) adult Western Diamond-backed Rattlesnakes (*Crotalus atrox*) were used in this study. All subjects were long-term (3–4 years), healthy captives (housed in the Animal Care Facility, Department of Life Sciences, Arizona State University West) that originated from several areas in central Maricopa County, AZ, near the vicinity of Phoenix. Snout–vent length and mass of males (SVL: mean = 89.1 ± SE 2.39 cm, range 74.0–98.0 cm; mass: mean = 480.45 ± 32.81 g, range 278.80–639.3 g, N = 10) and females (SVL: mean = 86.4 ± 1.65 cm, range 78.0–92 cm; mass: mean = 534.65 ± 47 g, range 323.0–773.80 g, N = 10) were similar (SVL: $F_{1,18} = 0.864$, $p = 0.365$; mass: $F_{1,18} = 0.891$, $p = 0.358$). Subjects were housed individually in glass enclosures, and offered laboratory rodents weekly during the active season (March through October). Water was available in glass bowls *ad libitum*. Blood collection occurred on a single day (late morning) in March 2000.

Study design.—Blood harvested from each subject (see below) was partitioned into five treatment groups (split-plot design; Quinn and Keough 2002):

$\mathbf{T_0}$: Blood was immediately centrifuged and plasma stored in an ultra-low freezer (-80ºC). This treatment served as the control.
$\mathbf{T_1}$: Whole blood was placed on ice in a cooler (0ºC) for 6 h, then

centrifuged and stored (-80°C).

T_2: Whole blood was placed in an incubator (40°C) for 6 h, then centrifuged and stored (-80°C).

T_3: Whole blood was placed on ice in a cooler (0°C) for 24 h, then centrifuged and stored (-80°C).

T_4: Whole blood was placed in an incubator (40°C) for 24 h, then centrifuged and stored (-80°C).

Collection of blood and plasma.—Subjects were gently removed from their individual enclosures using hooks and/or tongs, then quickly restrained in a standard squeeze-box. After snakes were secured (1–3 min), 3.0 ml of blood was harvested from their tails (within 1 min) using heparin-treated syringes. All snakes were returned to their enclosures within several minutes of restraint. The blood from each subject was immediately partitioned (0.6 ml) into five 1.5 ml sterile centrifuge tubes, and placed in one of the five treatment groups. Following the respective treatment, blood samples were centrifuged for 4 min at 1200 g, and plasma was collected and placed into 1.5 ml sterile centrifuge tubes and immediately stored at -80°C until radioimmunoassays could be performed (<6 months).

Radioimmunoassay of plasma sex steroids.—Radioimmunoassays (RIAs) of sex steroids examined in this study [testosterone (T) and 17β-estradiol (E2)] were performed on plasma using commercial kits.

RIAs of T followed Schuett et al. (1997), including validation (quantitative recovery and parallelism). Samples in the present study were run in duplicate (N = 200) in two RIAs. The intra-assay coefficients of variation (CV) for T was 9.1% and 11.1%, and the inter-assay CV was 11.9%. The T values are presented as arithmetic means ± SE (ng/ml).

For RIAs of E2, radio-labeled E2, antibody, and a precipitating solution were purchased from Diagnostic Products Corporation (Los Angeles, California; catalog numbers E2D1, E2D2, and N6). Standards were prepared by serial dilutions in methanol of a stock solution. The anti-estradiol antibody was diluted 1:3 in phosphate buffered saline (PBS) containing 1:400 rabbit serum. One hundred microliters of snake plasma (with 300 µl of PBS) was extracted in 5.0 ml of diethyl ether (Fisher Scientific). After removing and saving the diethyl ether layer, the sample was heated to 90°C for 5 min, extracted with an additional 5.0 ml of diethyl ether and 200 µl of PBS. Gelatin (1%) was added to the extract following evaporation of the diethyl ether. Extraction recovery of ^{3}H-estradiol (New England Nuclear, Boston, Massachusetts; NET-381) was 78%. For the RIA, 100 µl of diluted antibody, 100 µl of ^{125}I-E2, and 1.0 ml of precipitating solution were used. A 24 h incubation (4°C) period followed each step. Antibody-bound ^{125}I was separated by centrifugation at 1600 g. Validation involved quantitative recovery and parallelism. Quantitative recovery of E2 added to snake plasma was 100%, and parallelism was demonstrated between the inhibition curve for the standards and dilutions. Samples were run in duplicate (N = 200) in two RIAs. The intra-assay CVs were 7.9% and 12.5%, and the inter-assay CV was 11.9%. The E2 values are presented as arithmetic means ± SE (pg/ml).

Statistical analyses.—Data were subjected to inspection for outliers, normality (skewness and kurtosis), and equality of variance prior to performing statistical tests. Outliers were not detected, and conditions for normality and equality of variance were met. To determine whether or not body size influenced mean hormone levels, we ran simple regressions of body mass versus steroid levels (dependent variable). In those tests we detected a significant relationship between body mass and plasma steroids in males (T: $r^2 = 0.084$, $F_{1,48} = 5.502$, $p = 0.023$; E: $r^2 = 0.241$, $F_{1,48} = 15.218$, $p = 0.0003$); in

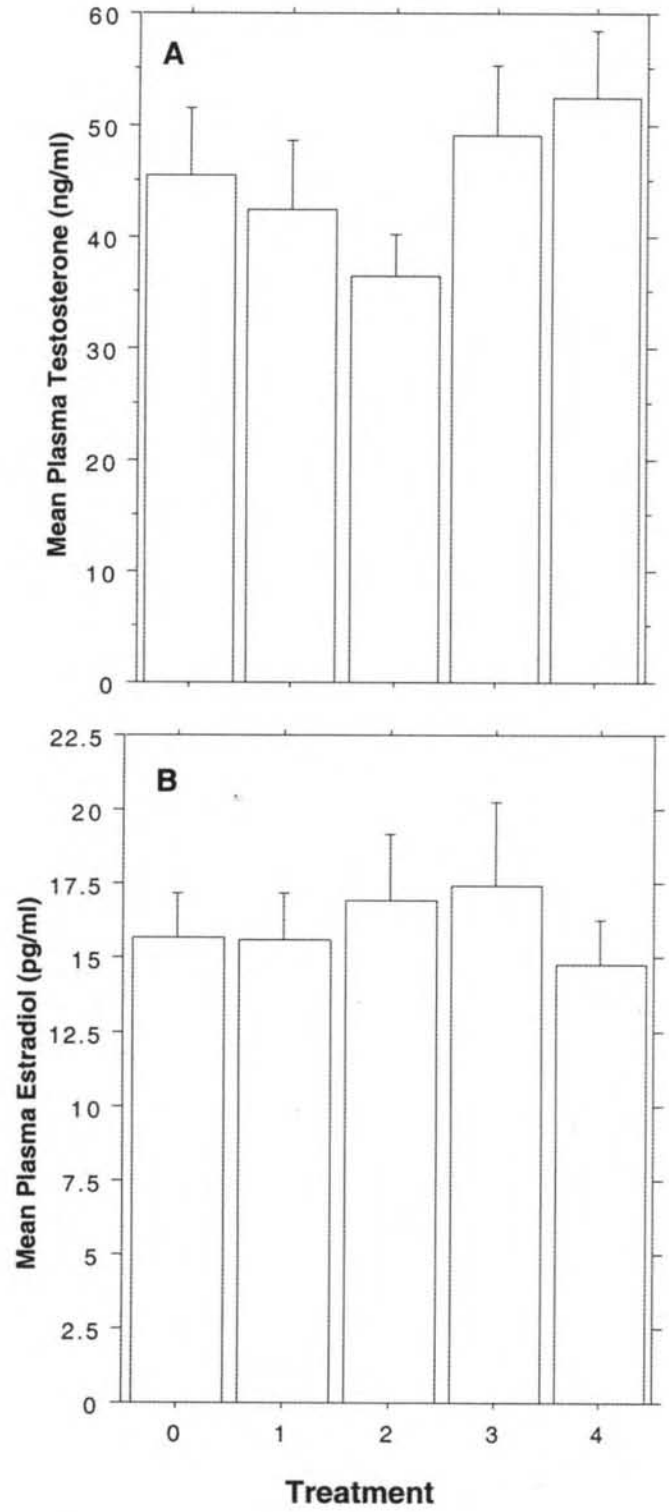

FIG. 1. Mean (± 1 SE) plasma levels of (A) testosterone and (B) 17β-estradiol for adult male *Crotalus atrox* (N = 10) resulting from blood exposed to five treatments (split-plot design). Treatments: 0 = control; 1 = 0°C for 6 h; 2 = 40°C for 6 h; 3 = 0°C for 24 h; and 4 = 40°C for 24 h. See text for details of the statistical analysis.

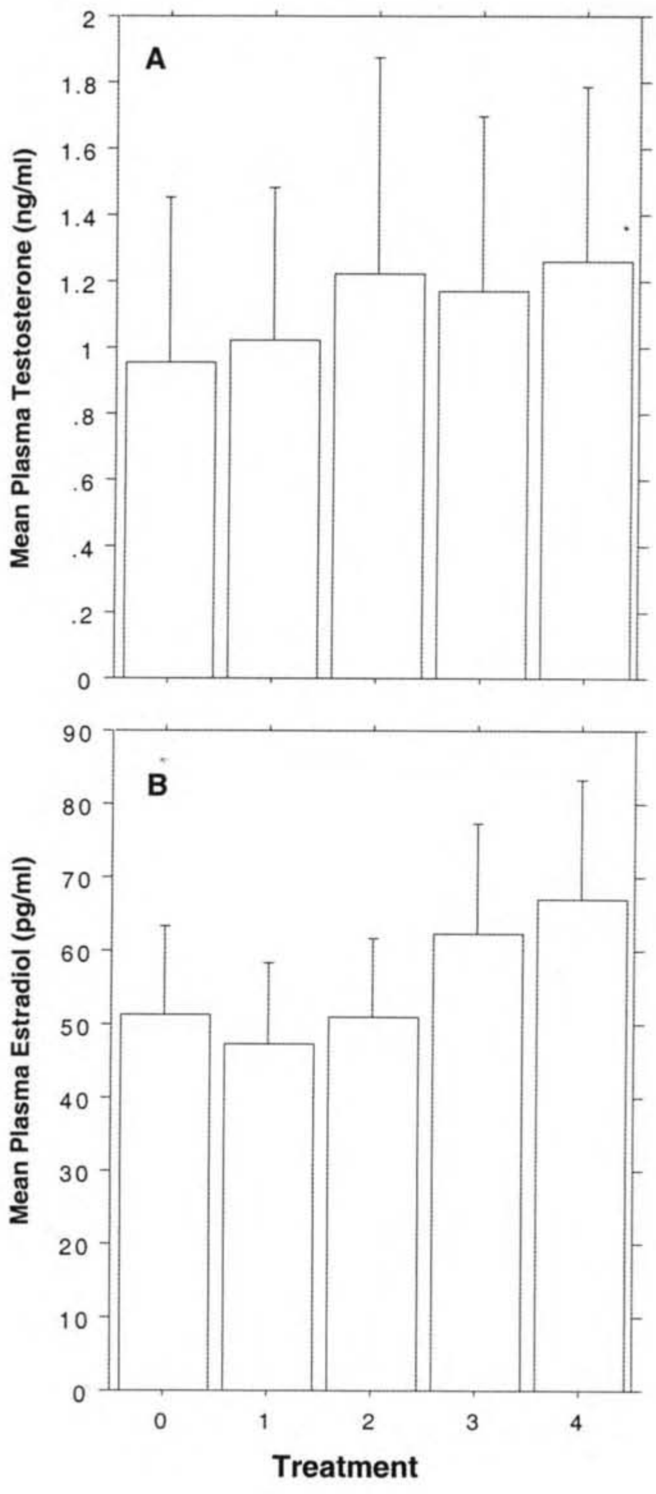

FIG. 2. Mean (± 1 SE) plasma levels of (A) testosterone and (B) 17β-estradiol for adult female *Crotalus atrox* (N = 10) resulting from blood exposed to five treatments (split-plot design). Treatment: 0 = control; 1 = 0°C for 6 h; 2 = 40°C for 6 h; 3 = 0°C for 24 h; and 4 = 40°C for 24 h. See text for details of the statistical analysis.

females, that relationship was significant for T ($r^2 = 0.267$, $F_{1,48} = 17.506$, $p = 0.0001$), but not for E2 ($r^2 = 0.267$, $F_{1,48} = 2.928$, $p = 0.0936$). We thus chose to use body mass as a covariate in subsequent statistical analyses.

Data were analyzed with a three factor split-plot multivariate analysis of covariance without replication, where sex and treatment are crossed fixed factors, subject is a random factor nested within sex, and body mass is the covariate. We achieved an unsaturated model by omitting the test for the treatment*subject (sex) interaction. The α-level of significance was set at 0.05. All tests were performed using SAS (SAS Institute 1999).

RESULTS AND DISCUSSION

We found that steroid hormone levels were significantly different in samples from males and females (sex main effect: $F_{2,63} = 6.03$, $p = 0.004$) (Figs. 1 and 2). There were, however, no differences in hormone levels among treatments (treatment main effect: $F_{8,32} = 0.05$, $p = 0.999$). Also, there was no significant interaction between treatment and sex (treatment*sex effect: $F_{8,128} = 0.74$, $p = 0.659$), indicating that samples from males and females do not respond differently to the treatments.

Our results show that exposure of blood samples from adult male and female *C. atrox* to 0ºC or 40ºC, for two different durations (6 h or 24 h), does not change concentrations of plasma T and E2 (Figs. 1 and 2). Our results agree with the few studies that have investigated the stability of E2 and T in blood and plasma (serum) samples from mammals. Prior to our study, and to the best of our knowledge, the stability of T and E2 in samples from any animal had not been reported at temperatures higher than room temperature (22–25ºC). Because our blood samples can potentially be exposed to temperatures in excess of 30ºC, it was important for us to show that these high temperatures do not lead to steroid hormone degradation/reduction or conversion.

In this study, we tested the effects of storage temperature and duration on the stability of levels of two sex steroids, T and E2, known to be important in the reproductive biology of a range of reptilian species. Although all steroid hormones share a common cholesterol-based backbone and thus may exhibit similar responses to temperature, it is possible that other steroid hormones (e.g., corticosterone, progesterone) could respond differently to storage conditions. There is, moreover, the possibility that desert-adapted reptiles have plasma (and plasma components) that are more durable to conditions of high temperatures for protracted periods. Although we do not have data on other species of reptiles to compare our results, these ideas are important and need to be tested in a range of species, especially in those that are cold-adapted.

In conclusion, we have demonstrated that in Western Diamond-backed Rattlesnakes (*C. atrox*) from Arizona, blood samples exposed to high temperatures for short time periods (≤ 24 h) do not show significant changes in levels of plasma T and E2. Although we recommend that blood samples collected in the field be immediately placed on ice (0ºC) and processed in ≤ 24 h, our data show that negative consequences of short-term storage of blood under the above-discussed conditions are at most minimal.

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Morphological Variation, Diet, and Vocalization of *Eleutherodactylus eugeniae* (Anura: Leptodactylidae) with Notes on its Reproduction and Ecology

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Eleutherodactylus eugeniae was described by Lynch and Duellman (1997) from a small area of cloud forest, at elevations of 1700–2010 m in Provincia Pichincha in northwestern Ecuador. These authors examined very few specimens from the type locality. We collected 29 new individuals (7 juveniles, 9 females, 13 males), 7 from the type locality, and the rest from two new localities (see Appendix I). Herein, we describe aspects of the diet, vocalization, morphological variation, ecology, and reproductive biology of this species.

MATERIALS AND METHODS

Ecological, reproductive, and morphological data were gathered on *Eleutherodactylus eugeniae* from three localities of cloud forests in northwestern Ecuador between 1994 and 2001. This region has an annual precipitation of 2600 mm, with a rainy season from December to May, and moderate rains from July to November; mean annual temperature is 15.6°C (Cañadaz-Cruz 1983). The localities and specimens examined are listed in Appendix I.

We recorded 12 individuals and collected four of them (Appendix I). Calls were recorded from 14–28 February and 10–24 September 1998, and from 27 February–11 March and 13–17 August 1999 in Bosque Integral Otonga reserve (BIO) with a Sony WM D6C Professional Walkman tape recorder and an Optimus Unidirectional Condenser Microphone. Calls were digitized at a sampling rate of 22 kHz at 8-bit precision with the built-in A/D converter on Power Macintosh 7100/80 AV computer and the software Canary 1.1 (Charif et al. 1993). Waveforms and spectra were analyzed with Canary 1.1. Acoustic terminology follows that de-

FIG. 1. *Eleutherodactylus eugeniae*, QCAZ 16041, adult female, SVL 38.4 mm.

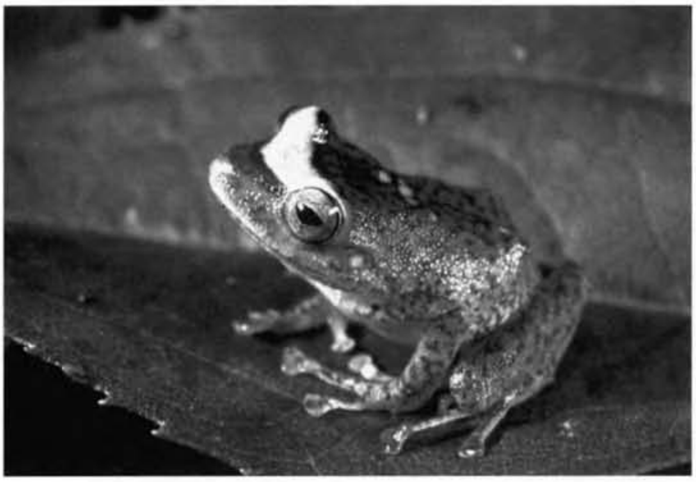

FIG. 2. *Eleutherodactylus eugeniae*, QCAZ 16040, subadult female, SVL 30.3 mm.

scribed in Heyer et al. (1990).

Morphological measurements were taken with digital calipers to the nearest 0.1 mm, and follow the methodology described in Gray and Cannatella (1985) and Lynch and Duellman (1980). Additionally, we measured: internarial distance—distance between nostrils; snout to eye distance—distance from tip of snout to anterior margin of eye; and radio-ulna length—length of flexed forearm from elbow to proximal border of palmar tubercle.

We examined the intestine and stomach contents of 10 females and 10 males (Appendix I). Prey items were identified to the lowest possible taxonomic level. Adults and larvae were analyzed separately because of their differences in body form. The volume of each complete prey item was estimated using the formula for a prolate spheroid (i.e., Volume = $4/3\pi$ [greatest length of prey/2] [greatest width of prey/2]^2; Dunham 1983). The trophic niche breadth, was estimated using the reciprocal of Simpson's (1949) diversity measure

$$(\text{i.e., } B = 1/ \sum_{i=1}^{n} p_i^3).$$

Frog habitat and microhabitat were recorded. Sexual maturity was recognized by the presence of eggs or convoluted oviducts in females and by the presence of vocal slits and enlarged testes in males. Abbreviations as follows: SVL = snout-vent length; IOD = interorbital distance; BIO = Bosque Integral Otonga reserve; REG = Reserva Florística Ecológica Río Guajalito; QZ = Quebrada Zapadores; QCAZ = Museo de Zoología, Pontificia Universidad Católica del Ecuador.

RESULTS

Variation in measurements and proportions are presented in Tables 1 and 2. In addition to the coloration pattern described in Lynch and Duellman (1997) (Fig. 1), a cream-yellow interorbital bar occurs in five individuals (QCAZ 11691, 13119, 13120, 16039, 16040; Fig. 2). Contrary to Lynch and Duellman (1997), we found that the tympanic annulus, described as indistinct externally in males (N = 1), is evident in all the males we sampled (N = 13).

Fifty-nine prey items, corresponding to 18 prey categories, were found (Table 3). The diet of *Eleutherodactylus eugeniae* consisted mainly of insects (86%), followed by spiders (10.2%), and Acari (3.4%). Most of the insects consumed were adult Coleoptera (32%), followed by Araneae (10%), and Hemiptera (8%) (Table 3). Within the identified Coleoptera, the family Chrysomelidae is the most important prey category (Table 3). Volumetrically, the most important items are Coleoptera (adult 26%, larvae 20%) and adult Orthoptera (19%) (Table 3).

In females, the most common prey category is adult Coleoptera (49%), followed by Araneae (14%), and Hemiptera (11%) (Fig. 3); the volume ingested by females consists of adult Coleoptera (32%), Orthoptera (20%), and Dermaptera (14%) (Fig. 3).

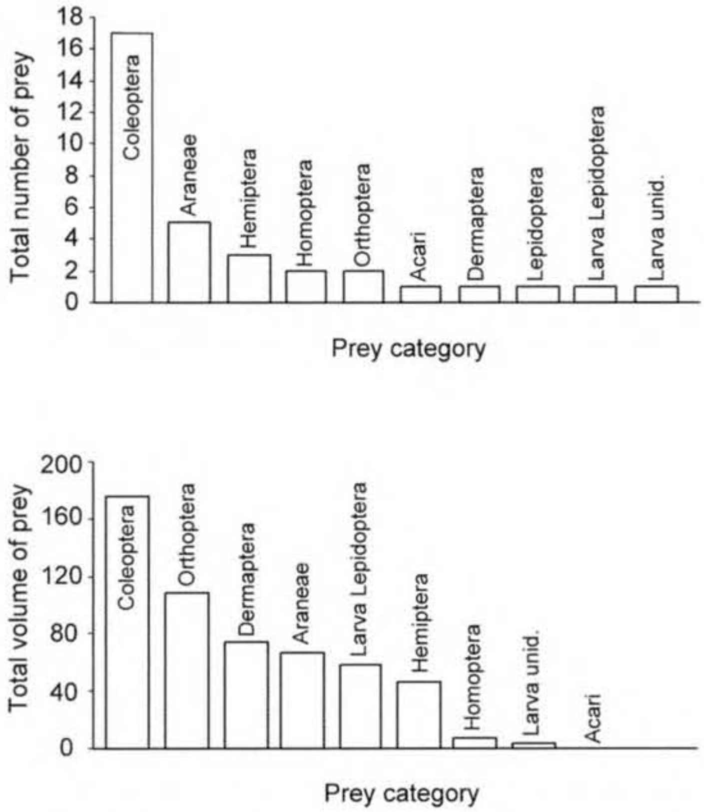

FIG. 3. Numeric (top) and volumetric (bottom) importance of prey categories in females of *Eleutherodactylus eugeniae.*

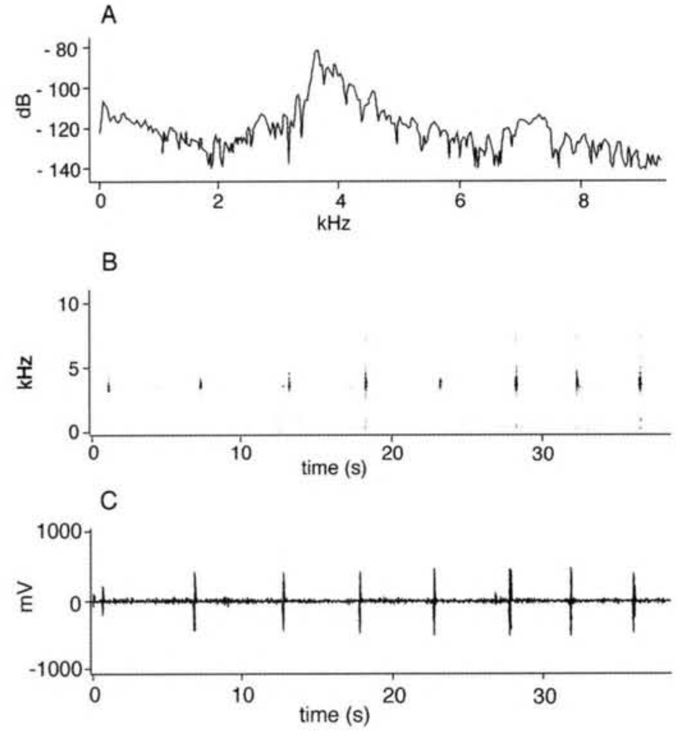

FIG. 4. Call group of *Eleutherodactylus eugeniae*, QCAZ 13199, SVL 27.1 mm. (A) Spectrum, (B) Spectrogram, and (C) Waveform.

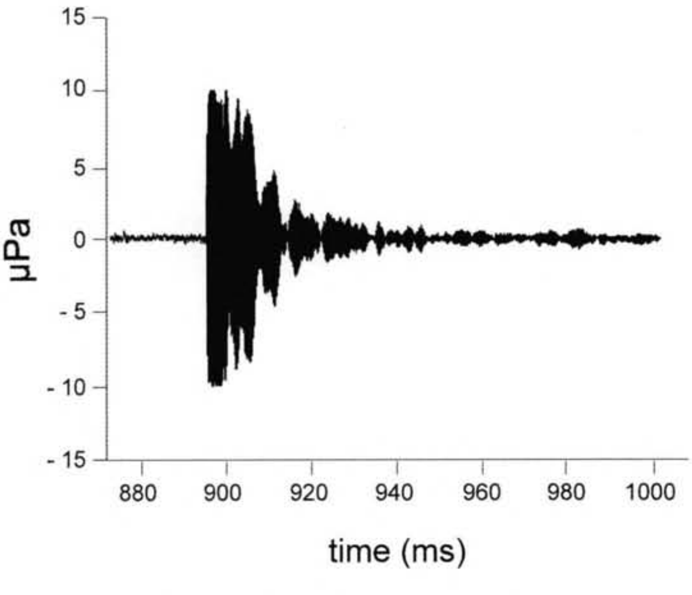

FIG. 5. Expanded waveform of a single call of *Eleutherodactylus eugeniae*, QCAZ 13199, SVL 27.1 mm.

In males, we found only nine prey items (3 Coleoptera, 2 Orthoptera, 1 Acari, 1 Araneae, 1 Hemiptera, 1 Formicidae); this low number prevent us from generalizing about the composition of their diet. On average, we found fewer prey items in males (1.3 prey items per individual) than in females (3.7 items per individual).

We found 66 to 149 ovarian eggs in different developmental stages in six of the eight females examined. They are covered by a membrane pigmented with minute dark brown spots, and have a diameter of 0.1–3.9 mm. Variations in number and size of eggs for

TABLE 1. Measurements of 21 adults of *Eleutherodactylus eugeniae* (range followed by mean ± standard deviation; in mm).

	SVL	Tibia length	Foot length	Head length	Head width	IOD	Upper eyelid width	Internarinal distance	Eye to nostril distance	Snout to eye distance	Eye diameter	Tympanum diameter	Radio-ulna length	Hand length	Finger I length
Females	30.6–38.6	15.5–19.3	13.8–18.0	11.1–13.9	11.3–14.3	3.4–4.5	2.7–3.4	2.3–3.0	3.2–4.6	5.2–6.5	3.3–4.3	1.3–2.0	7.2–8.5	9.7–12.4	5.5–7.4
(N = 8)	35.5 ± 2.7	17.8 ± 1.3	16.1 ± 1.4	12.9 ± 0.9	13.3 ± 1.0	4.1 ± 0.3	3.1 ± 0.3	2.7 ± 0.2	4.2 ± 0.5	6.0 ± 0.5	3.8 ± 0.3	1.8 ± 0.3	8.1 ± 0.4	11.3 ± 0.9	6.6 ± 0.7
Males	22.5–28.9	11.3–14.2	9.5–12.8	8.5–10.9	8.7–10.9	2.6–3.5	2.1–2.9	1.7–2.3	2.6–3.3	4.0–5.1	2.8–3.7	0.9–1.5	5.0–6.5	6.9–9.0	3.7–5.1
(N = 13)	26.1 ± 1.9	13.4 ± 0.7	11.6 ± 0.8	9.8 ± 0.7	9.9 ± 0.6	3.1 ± 0.2	2.6 ± 0.3	2.0 ± 0.2	2.9 ± 0.2	4.5 ± 0.3	3.2 ± 0.3	1.2 ± 0.2	6.1 ± 0.4	8.0 ± 0.5	4.5 ± 0.4

TABLE 2. Morphological proportions (in percentages) in adults of *Eleutherodactylus eugeniae* (range followed by mean ± standard deviation).

	Tibia length/ SVL	Foot length/ SVL	Foot length/ tibia length	Head width/ SVL	Head length/ SVL	Head width/ head length	Eye to nostril distance/ eye diameter	Upper eyelid width/ IOD	Tympanum diameter/ eye diameter	Radio-ulna length/ SVL	Hand length/ radio-ulna length	Thumb length/ hand length
Females	43.2–48.7	43.4–54.3	82.9–109.7	36.5–38.8	35.2–35.7	101.5–104.6	97.0–124.3	62.2–82.9	39.4–54.1	21.4–25.5	124.4–149.4	55.3–61.8
(N = 8)	45.5 ± 2.0	50.4 ± 3.5	90.7 ± 8.6	37.4 ± 0.7	36.2 ± 0.8	103.1 ± 1.3	109.9 ± 8.9	76.4 ± 6.2	46.4 ± 5.0	22.8 ± 1.6	139.7 ± 7.7	58.5 ± 2.2
Males	41.2–48.1	47.4–59.1	81.2–92.8	35.8–40.9	36.2–40.9	98.1–105.2	75.7–103.4	65.6–93.5	29.7–45.5	20.9–26.7	123.3–152.5	51.3–59.0
(N = 13)	44.4 ± 2.1	51.6 ± 2.9	86.2 ± 3.4	38.1 ± 1.4	37.6 ± 1.4	101.5 ± 2.2	90.2 ± 8.0	83.9 ± 8.3	38.6 ± 5.2	23.4 ± 1.5	132.4 ± 7.4	55.9 ± 2.1

the six females, associated with SVL, locality, and collection date of specimens are summarized in Table 4.

We heard males calling during all of our fieldwork (February and September, 1998; March and August, 1999; June and July, 2001). In *Eleutherodactylus eugeniae,* calls are organized into groups, which are emitted approximately every 15–30 min. Call groups (Fig. 4) are no frequency modulated; they have a duration of 4.7–63.7 s (mean = 32.507 ± 15.547, N = 12), and contain 3–16 calls (mean = 7.694 ± 3.344, N = 12). Each call is formed by one note. Notes have a length of 0.008–0.403 s (mean = 0.131 ± 0.061, N = 12); internote length is 0.473–23.361 s (mean = 5.264 ± 2.578, N = 12); notes are pulsed, with pulses decreasing in amplitude through note (Fig. 5); notes with no noticeable frequency modulation. Fundamental frequency (when evident) is distributed between 99 and 190 Hz (mean = 160 ± 31.224, N = 4) and dominant frequency is between 3370 and 3776 Hz (mean = 3514 ± 117.745, N = 12). The frequency of the first harmonic lies between 6669 and 7415 Hz (mean = 6926 ± 298.771, N = 8) and that of the second harmonic (when evident) between 10257 and 10594 Hz (mean = 10479 ± 119.169, N = 3).

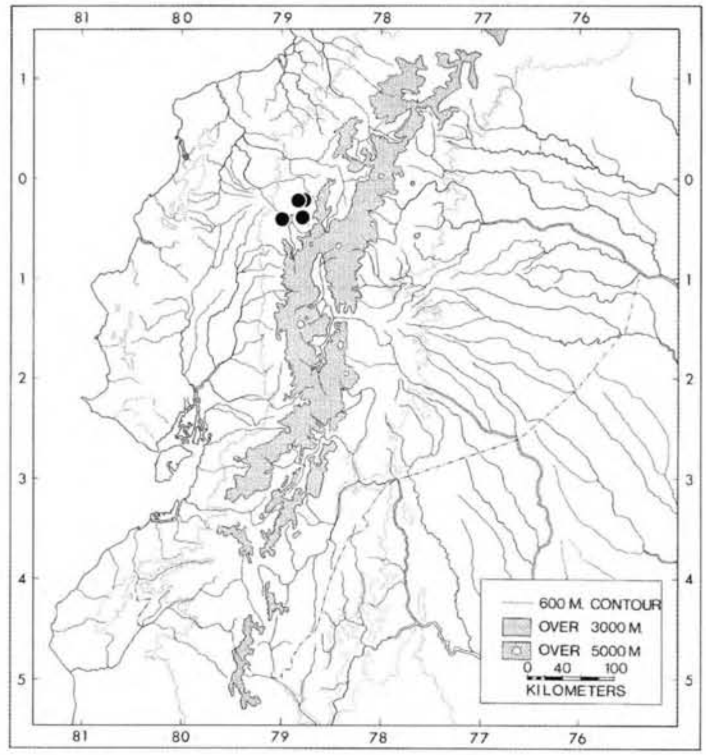

FIG. 6. Distribution of *Eleutherodactylus eugeniae* in Ecuador (circles).

Eleutherodactylus eugeniae was mainly found in disturbed (45.8%, N = 24) and undisturbed primary forests (41.7%, N = 24), but few individuals were found in secondary (8.3%, N = 24) and gallery forests (4.2%, N = 24). Individuals were collected at night, on vegetation between 40 and 340 cm (mean = 180 ± 79.3, N = 26) above ground, but several calls originated near the forest canopy (at least 8 m high). In BIO, we found one individual in a bromelia 50 cm above ground on three consecutive mornings. We also recovered one individual of *Eleutherodactylus eugeniae* (QCAZ 13424) from the bill of a Striped Wood-haunther, *Hyloctistes subulatus* (Aves: Furnariidae), which had been trapped in a mist net placed near its nest.

The known altitudinal distribution and range is here expanded. The species has a known altitudinal distribution of 1700–2200 m and has been recorded from four localities in western Ecuador—viz., QZ, REG, and 6.3 km E Tandapi (ca. 00° 24' S, 78° 47' W) in Provincia Pichincha (Lynch and Duellman 1997); and BIO in Provincia Cotopaxi (Fig. 6).

DISCUSSION

The description of *Eleutherodactylus eugeniae* (Lynch and

TABLE 3. Diet and niche breadth of *Eleutherodactylus eugeniae* based on 20 individuals. No = Total number of prey items found in all individuals examined; No % = Percentage of prey item number in relation to total number of items found in the species; Vol = Total volume of prey category in all individuals examined; Vol % = Percentage of prey item volume in relation to total volume of items found in the species; * = Number of prey items used to calculate volume, this value is used because not all prey were found complete; Frequency = Number of individuals containing prey item.

Prey category	No	No (%)	Vol (mm^3)	Vol (%)	*	Frequency
Acari	2	3.39	0.450	0.06	2	2
Araneae	6	10.17	67.105	8.81	6	6
Coleoptera	11	18.64	108.594	14.25	11	4
Brentidae	1	1.70	19.055	2.50	1	1
Chrysomelidae	7	11.86	71.863	9.43	7	4
Staphylinidae	1	1.70	1.431	0.19	1	1
Dermaptera	1	1.70	74.810	9.82	1	1
Formicidae	1	1.70	0.190	0.03	1	1
Hemiptera	4	6.78	47.019	6.17	4	4
Lygaeidae	1	1.70	3.337	0.44	1	1
Homoptera	2	3.39	7.405	0.97	2	2
Hymenoptera (Formicidae)	1	1.70	0	0	0	1
Larva unidentified	**1**	**1.70**	**3.953**	**0.52**	**1**	**1**
Larva Coleoptera	1	1.70	150.773	19.79	1	1
Larva Lepidoptera	1	1.70	57.955	7.61	1	1
Lepidoptera	1	1.70	0	0	0	1
Orthoptera	4	6.78	141.873	18.62	4	4
Plant material	13	22.03	6.216	0.82	13	8
TOTAL	**59**	**100**	**762.029**	**100**	**57**	**—**
Niche breadth	—	8.191	—	7.643	—	—

Duellman 1997) is adequate, but it does not address the range of morphological variation (Table 1; Fig. 2). This information is especially relevant to males, which originally were described on the basis of a single individual.

Eleutherodactylus eugeniae is a nocturnal, sit-and-wait forager; once a prey item is sighted, individuals of *E. eugeniae* have been observed to pursue it for a short distance (< 30 cm) before capture (D. F. Cisneros-Heredia and A. León-Heredia, pers. comm.). Our results (Table 3) agree with the hypothesis that the sit-and-wait foraging strategy might favor capture of relatively large, highly mobile prey (e.g., Coleoptera, Orthoptera, solitary spiders), rather than small prey species with predictable patterns of movement and clumped distributions (e.g. ants, termites, social spiders; Eckhardt 1979; Huey and Pianka 1981; Krebs 1978). Moreover, because *E. eugeniae* principally inhabits the upper strata of the forest, its diet might depend mostly on those arthropods that either fly or climb to the forest canopy; this is supported by the high frequency of Coleoptera, Araneae, and Hemiptera in their stomachs (Table 3). The presence of plant material in the stomachs of eight specimens is considered to be accidental and related to the ingestion of animal prey (Lajmanovich 1995; Zug and Zug 1979).

TABLE 4. Number and size of ovarian eggs in six adult females of *Eleutherodactylus eugeniae* associated with SVL, locality and collection date of specimens. REG = Reserva Florística Ecológica Río Guajalito; BIO = Bosque Integral Otonga reserve; QZ = Quebrada Zapadores; Max = Maximum; Min = Minimum.

	Collection Year					
	1994		1999		2001	
Collection month	April	March	August	August	August	April
QCAZ no.	6559	13117	13424	13425	13426	16041
Locality	REG	BIO	BIO	BIO	BIO	QZ
SVL	36.8	36.7	35.7	33.6	38.6	38.4
Egg no. ≥ 2 mm	18	1	0	0	25	1
Egg no. < 2, ≥ 1 mm	8	9	15	18	25	12
Egg no. < 1 mm	68	67	51	131	74	77
Total egg no.	94	77	66	149	124	90
Max egg size (mm)	3.1	2.6	1.9	1.8	2.5	2
Min egg size (mm)	0.1	0.1	0.2	0.1	0.2	0.1

Appendix I

Specimens examined of *Eleutherodactylus eugeniae*. J = Juvenile; JF = Juvenile female; AF = Adult female; JM = Juvenile male; AM = Adult male; SAF = Subadult female; REG = Reserva Florística Ecológica Río Guajalito (00°14' S, 78°48' W, 1800–2200 m, near Chiriboga, Provincia Pichincha); BIO = Bosque Integral Otonga reserve (00°25' S, 79°00' W, 1800–2200 m, near San Francisco de Las Pampas, Provincia Cotopaxi); QZ = Quebrada Zapadores, type locality of *E. eugeniae* (00°14' S, 78°45' W, 1700–2010 m, 5 km ESE Chiriboga, Provincia Pichincha).

Museum No. QCAZ	Sex	Diet	Morphology	Reproduction	Call	Locality	Collection Date
6551	J	—	—	—	—	REG	October 1994
6559	AF	x	x	x	—	REG	April 1994
11691	J	—	—	—	—	BIO	February 1998
11692	AF	x	x	—	—	BIO	February 1998
11693	AM	x	x	—	—	BIO	February 1998
11694	AM	x	x	—	—	BIO	February 1998
11695	AM	—	x	—	—	BIO	February 1998
12228	AM	—	x	—	—	BIO	June 1998
12304	JF	x	—	—	—	BIO	September 1998
12305	AM	x	x	—	x	BIO	September 1998
12306	AM	x	x	—	x	BIO	September 1998
12307	AM	x	x	—	x	BIO	September 1998
12308	AM	x	x	—	—	BIO	September 1998
13117	AF	x	x	x	—	BIO	March 1999
13118	AM	—	x	—	—	BIO	March 1999
13119	AM	x	x	—	x	BIO	March 1999
13120	AM	x	x	—	—	BIO	March 1999
13424	AF	x	x	x	—	BIO	August 1999
13425	AF	x	x	x	—	BIO	August 1999
13426	AF	x	x	x	—	BIO	August 1999
16036	AF	—	x	—	—	QZ	April 2000
16037	JF	—	—	—	—	QZ	April 2000
16038	JM	—	—	—	—	QZ	April 2000
16039	J	—	—	—	—	QZ	April 2001
16040	SAF	x	—	—	—	QZ	April 2001
16041	AF	x	x	x	—	QZ	April 2001
16042	JF	x	—	—	—	QZ	April 2001
16935	AM	x	x	—	—	BIO	February 2000
16936	AM	x	x	—	—	BIO	February 2000

Males eat fewer prey items than females; this might be a consequence of differences in size (SVL = 30.6–38.6 mm in females; 22.5–28.9 in males), and/or behavior. Several studies have shown a positive relation between the number and size of prey items with the SVL in anurans (Menéndez 2001; Parmelee 1999). Additionally, reproductive effort in calling males might restrict the time spent in feeding activities (Jenssen 1972; Lamb 1984; Woolbright and Stewart 1987). This might be exacerbated in *Eleutherodactylus eugeniae*, in which males seem to call throughout the year. The results of our diet study might be biased toward hard-bodied prey. Specimens collected were not preserved immediately and, surely, many soft-bodied prey were digested (Caldwell 1996; Parmelee 1999). Another variable that probably influenced our results is the spatial and temporal fluctuations of arthropod populations.

Females with eggs larger than 2 mm in April and August (Table 4), and males calling in February, March, June, July, August, and September (Appendix I), suggest that *Eleutherodactylus eugeniae* breeds throughout the year. This mode of reproduction could be sustained by the high humidity of the region and by the reproductive strategy of *Eleutherodactylus:* terrestrial eggs with direct development (Duellman and Trueb 1994; Lynch and Duellman 1997).

The calls of *Eleutherodactylus* are poorly known. The only other call description available for the 61 species of *Eleutherodactylus* that inhabit western Ecuador is of *E. achatinus* in Provincia del Carchi, Ecuador (Lynch and Myers 1983). This lack of information prevents us from comparing the vocalization of *E. eugeniae*

with sympatric or related species.

Our records document the distribution of the species within the Montane Cloud Forest formation as described by Valencia et al. (1999). We collected specimens as high as 340 cm above ground, but most calling individuals were in sub-canopy and canopy. These data suggest, as mentioned by Lynch and Duellman (1997), that *Eleutherodactylus eugeniae* primarily inhabits the upper strata of the forest. Field observations suggest that this species might have site fidelity to diurnal retreats; *E. eugeniae* might depend on trees with epiphytic vegetation (e.g., bromeliads) for diurnal retreats as part of its habitat requirements. The species tolerates habitat disturbance (45.8% of individuals in disturbed primary forest). Individuals have been heard calling in forest patches < 3 m^2 and in solitary trees with bromeliads (D. F. Cisneros-Heredia and A. León-Heredia, pers. comm.), however, it seems to be susceptible to drastic habitat modification (only 8.3% where found in secondary forest, and none in grasslands).

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Occurrence of Loggerhead Sea Turtles (*Caretta caretta*) in the Gulf of California, México: Evidence of Life-History Variation in the Pacific Ocean

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Loggerhead turtles, *Caretta caretta*, are highly migratory and use a wide range of broadly separated localities and habitats during their lifetime. In the Pacific, most loggerheads carry out an extensive developmental migration, traveling from nesting areas in Japan and Australia to distant developmental and foraging habitats in the eastern Pacific (Bowen 1995; Bowen et al. 1995; Uchida and Teruya 1988; P. Dutton, unpubl. data). After spending years foraging in the eastern Pacific, these turtles return to their natal nesting beaches for reproduction (Nichols et al. 2000; Resendiz et al. 1998) and remain in the western Pacific for the remainder of their life cycle (Hatase et al. 2002; Kamezaki et al. 1997; Sakamoto et al. 1997). At least some loggerhead turtles, however, apparently do not undertake trans-Pacific migrations and instead remain in the western Pacific for their entire life cycle (Limpus et al. 1994).

Loggerhead sea turtles in the Pacific are adversely impacted by a variety of activities including incidental capture in commercial fisheries, boat strikes, debris ingestion, and intentional harvest (Gardner and Nichols 2001; Suganuma 2002; Wetherall 1996). These have contributed, at least in part, to declines in annual nesting populations in Japan (Suganuma 2002) and Australia (Limpus and Couper 1994; Limpus and Reimer 1994). These reductions have prompted calls for increased research and protection (National Marine Fisheries Service and U.S. Fish and Wildlife Service 1998). However, the development of appropriate management strategies has been hindered by the paucity of data on the biology of loggerhead turtles.

Knowledge of regional size-class distributions of loggerhead turtles can help determine the importance of different marine habitats for various life stages, and provide insights into the geographic variability in life history patterns (Bjorndal et al. 2000; Bolten 2003; Witzell 2002). An important component of this understanding is the size at which juveniles depart the oceanic zone (i.e., seafloor depth > 200 m; Lalli and Parsons 1993) and recruit to neritic foraging habitats (i.e., seafloor depth ≤ 200 m; Lalli and Parsons 1993). Size-at-recruitment to the neritic zone is an important element in the development of sea turtle population models (Bjorndal et al. 2000; Bolten 2003; Crouse et al. 1987) but is poorly understood in the Pacific: current knowledge is based solely on Limpus et al. (1994) who report a neritic recruitment size of 70 cm curved carapace length in Australia based on in-water research. However, the vast size and substantial variation in coastal bathymetry of the Pacific (Briggs 1974) combined with potential life-history differences between Japanese and Australian nesting stocks suggest that the size-at-recruitment for loggerhead sea turtles in Australia might not be representative of the entire Pacific. In the Atlantic, for example, some loggerheads might recruit to neritic habitats at substantially smaller sizes (starting at 25.0 cm curved carapace length along the US Atlantic coast; Musick and Limpus 1997). The purpose of this report is to present information on the size of loggerhead sea turtles in neritic habitats of the Gulf of California. This will provide researchers with a small data set with which to compare demographic data from other locations in the Pacific Ocean.

From 1996 to 2002 we documented the presence of loggerhead turtles at two study areas in the central Gulf of California: Bahía de los Angeles (BLA) and the Infiernillo Channel (CIN), along the coasts of Baja California and Sonora, México, respectively (Fig. 1). These areas are neritic feeding grounds for green turtles, *Chelonia mydas* (Cliffton et al. 1982; Seminoff 2000), and the large abundance of invertebrate fauna (Brusca 1980) suggest they are potential foraging areas for loggerhead turtles. Efforts to document loggerhead turtle presence included: (1) in-water capture of live turtles (2) beach surveys for dead carcasses, and (3) documentation of turtle consumption in human coastal communities.

We attempted to capture loggerhead turtles with entanglement nets (100 m x 8 m, mesh size = 50 cm stretched) placed along the shallow perimeter of each study area. Distance from shore and water depth of netting sites ranged from 50 m to 500 m, and 2 m to 27 m, respectively. Nets were set during both day and night and monitored regularly. Turtles were removed immediately upon capture and held captive up to 24 h. We calculated catch per unit effort (CPUE) with each unit effort equaling the deployment of one 100-m net for 24 h. At BLA and CIN we recorded straight carapace length (SCL; ± 0.1 cm) and curved carapace length (CCL; ± 0.1 cm), respectively, from the nuchal notch to the posterior-most portion of the rear marginals. We converted all CCL measurements to SCL using the conversion equation: CCL = 1.388 + (1.053) SCL (Bjorndal et al. 2000). Prior to release each turtle was double tagged with Inconel tags (Style 681; National Band and Tag Company, Newport, Kentucky); one tag in the first large proximal scale of each front flipper.

To quantify the occurrence of deceased loggerheads we conducted beach surveys along coastal perimeters of each study area. Each survey of the Infiernillo Channel coast covered 16 km of coastline. Surveys were conducted quarterly in March, June, September, and December, 1999–2001 (N = 12). At Bahía de los Angeles each survey encompassed 5 km of shoreline, and surveys were performed monthly from June to September, 1996–2002 (N = 26). In addition, we searched fish camps and refuse dumps near

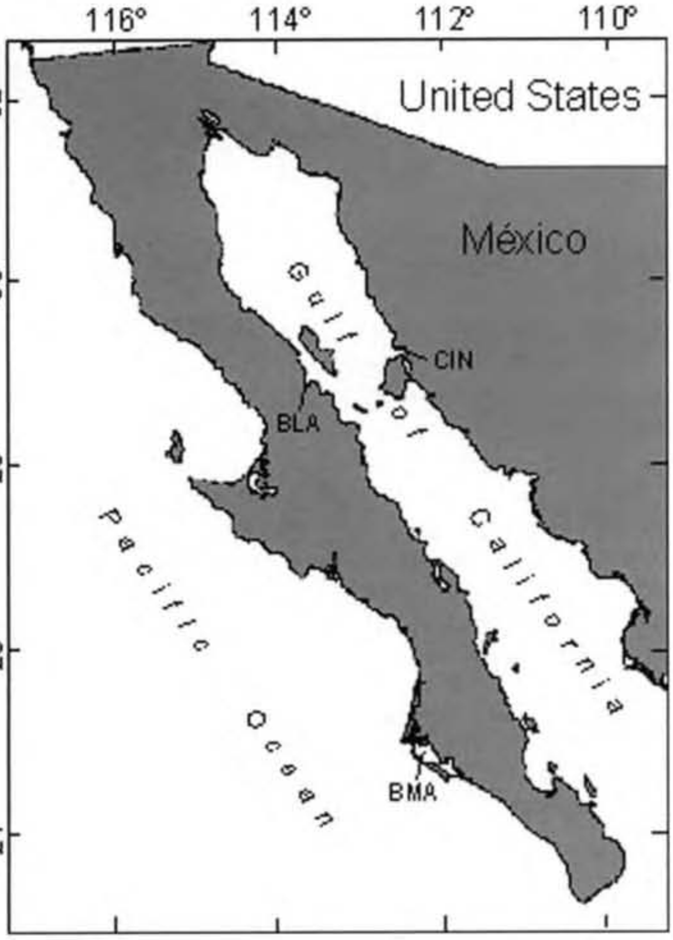

FIG. 1. Map of northwestern México showing Bahía de los Angeles (BLA) and Infiernillo Channel (CIN) regions in the Gulf of California, and Bahía Magdalena (BMA) along the Pacific coast of the Baja California peninsula.

each study site once each year ($N_{BLA} = 7$; $N_{CIN} = 3$). Data were recorded on each sea turtle carcass found, following Gardner and Nichols (2001). Measurements followed the same procedure as that for live-captured turtles. We described presence of external abnormalities, carried out necropsies when possible (Work 2000), and recorded cause of death when known. After each carcass was examined, it was marked with all-weather spray paint or collected to avoid duplicate counting.

We recorded a total of 15 loggerhead turtles during this study: 10 (seven live-captured, two floating dead, and one at a dumpsite) at BLA and five (all at dumpsites) at CIN. Mean straight carapace length of loggerhead turtles was 61.9 (SE = 2.1; range = 43.5–92.7 cm). There was no difference in the mean SCL between the two sites (t = 0.35; $P = 0.73$), nor was there a difference in the mean SCL of live and deceased turtles (t = 0.54; $P = 0.29$). A summary of the size and manner of collection for each turtle is presented in Table 1.

We could not determine the cause of death for the six loggerheads found at dumpsites; however, the fact that all had meat removed and were actively discarded suggests human consumption was likely. For the two loggerhead turtles encountered floating near BLA, mortality might have been from incidental capture in local fisheries: gillnets are commonly utilized in the region for harvest of a variety of finfish species (JAS, pers. obs.). We saw no evidence of contact with oil or tar, no turtles had boat collision or propeller damage, and necropsies of these turtles revealed that both had full stomachs at the time of death.

Overall, the seven live-captured loggerheads from BLA represent 3.2% of all live-captured sea turtles (including *Chelonia mydas*, *Eretmochelys imbricata*, and *Lepidochelys olivacea*) at that area over the same time period (Seminoff 2000). The CPUE for the seven live turtles captured at BLA was 0.014, or one loggerhead capture every 1699 h of netting effort. At CIN, no live loggerhead turtles were captured despite 624 h of netting effort. The eight dead loggerhead turtles represent 6.6% of all deceased turtles found at the two areas (Seminoff 2000; Seminoff, unpubl. data).

We are unaware of the habitats from which deceased turtles originated, but the capture of live turtles provides useful information on the distribution of loggerheads. In the Gulf of California some loggerhead turtles seemingly shift from the oceanic juvenile phase to the neritic juvenile phase at a size that is smaller than that reported for populations in the western Pacific Ocean. While Limpus et al. (1994) report settlement sizes starting at 65.2 cm SCL (70.0 cm CCL) in the southern Great Barrier Reef of Australia, the smallest live loggerhead turtle encountered during this study measured 43.5 cm SCL. Olguin-Mena (1990) and Resendiz et al. (1999) reported minimum sizes of 37 cm SCL and 29.9 cm SCL, respectively, for loggerheads in similar habitats within the Gulf of California. Based on these data, the sizes at which some loggerheads recruit to neritic habitats in the Gulf of California seem more similar to those for loggerheads along the US Atlantic coast (25-46 cm CCL; Bjorndal et al. 2001; Musick and Limpus 1997).

Although the mechanisms of dispersal into the Gulf of California are unclear, our study illustrates the potential variability of loggerhead life-history in the Pacific Ocean. The factors that contribute to apparent differences in neritic recruitment size are poorly understood and caution should be exercised in formulating theo-

TABLE 1. Summary of *Caretta caretta* recorded from the Gulf of California 1996 to 2002. Disposition codes include: L – live captured; F – floating in water; D – found dead at dumpsite.

Date	Size (cm SCL)	Disposition
	Bahía de los Angeles	
1 January 1996	47.7	F
4 September 1997	69.4	L
31 October 1997	49.7	L
22 August 1998	75.4	F
4 February 1999	92.7	L
6 September 1999	43.5	L
19 September 1999	63.0	L
26 June 2001	61.1	L
2 August 2001	57.7	D
2 July 2002	67.4	L
	Infiernillo Channel	
1 June 2000	49.0	D
18 June 2000	67.1	D
7 March 2001	63.3	D
9 March 2001	60.9	D
4 June 2001	61.2	D

TABLE 2. Comparison of size data for loggerhead turtles (*Caretta caretta*) in the Gulf of California and Pacific coast of the Baja California Peninsula, México.

Site	Gulf of California[a]	Pacific Coast of Baja California[b]	Pacific Coast of Baja California[b]
Mean SCL ± SE	61.9 ± 2.1	58.5 ± 11.1	46.9 ± 1.3
Range (cm)	43.5 – 92.7	26.6 – 83.4	32 – 58
N	15	180	39

[a] this study.
[b] Data from Gardner and Nichols (2001). Data are for stranded turtles only. Mean is reported with Standard Deviation.
[c] Data from Ramirez Cruz et al. (1991). Data are for live-captured turtles.

ries about neritic recruitment patterns based on the few studies that have occurred to date. Moreover, as reported for Atlantic loggerheads by Witzell (2002), the shift from pelagic to coastal habitats might be flexible. Some immature turtles might remain in the pelagic habitat longer than hypothesized, and some might move back and forth between pelagic and coastal foraging habitats. These variable data underscore the need for additional comparative studies of intrinsic and environmental effects on loggerhead turtles to assess their relative influence on habitat preference.

Considering that most sea turtles attain maturity at or near mean nesting size (Chaloupka and Musick 1997), the size range in this study (43.5–92.7 cm SCL) is indicative of a population consisting primarily of juveniles and sub-adults. All but one turtle encountered during this study was smaller than the mean nesting size in Japan (89.0 cm SCL; Uchida and Nishiwaki 1982). A preponderance of juvenile sizes has also been reported for loggerheads along the Pacific Coast of Baja California (Nichols 2003; Olguin-Mena 1990; Ramirez Cruz et al. 1991). These findings are consistent with the prevailing life-history model that depicts the eastern Pacific as an important juvenile developmental habitat (Bowen et al. 1995).

The mean size of loggerheads examined in this study (61.9 ± 2.1 cm SCL) is significantly larger than that reported by Ramirez Cruz et al. (1991) for live loggerheads from the Pacific coast of the Baja California Peninsula ($t = 6.029$, $P < 0.0001$; Table 2; Fig. 1). Moreover, the maximum SCL in this study (92.7 cm) is larger than that reported for both live (58 cm; Ramirez Cruz et al. 1991) and stranded (83.4 cm; Gardner and Nichols 2001) loggerhead turtles from the Pacific. Consistent with our results, Márquez (1969) reported that the larger of two loggerheads found in the Gulf measured 92.0 cm SCL. Although the greater size of loggerheads in the Gulf of California relative to the Pacific coast of the Baja California peninsula might be because of small sample sizes, we believe this difference might result from the semi-enclosed nature of the Gulf of California. Perhaps the Baja California peninsula acts as a land barrier, delaying the westward journey of loggerheads in the Gulf of California. Nichols et al. (2000) reported that a loggerhead turtle returning to Japan from Baja California maintained a westward bearing regardless of surface current patterns. If bearing-specific homing is characteristic of all Pacific loggerheads, then return movements of individuals in the Gulf of California, that must first move south to depart the Gulf, might be delayed relative to those of loggerheads on the west side of the Baja California peninsula that have an unimpeded westbound route. We encourage additional studies to substantiate the comparatively large mean size observed in this study. Moreover, satellite telemetry might be a useful tool to investigate this 'peninsular barrier' hypothesis and establish the route taken by loggerheads as they depart the Gulf of California.

The low capture per unit effort in this study suggests that the Gulf of California might not provide critical habitat for loggerhead turtles in the eastern Pacific. Nevertheless, given consideration of the recent population decline for Pacific loggerheads, the Gulf region should be included as a target area for efforts to protect this endangered marine species.

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The Gender of the Genus *Scinax* Wagler, 1830 (Anura, Hylidae)

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Johann Georg Wagler (1800–1832), German naturalist with a special interest in herpetology and ornithology, produced major treatises in his short life (Adler 1989). Among them, his "Natürliches System der Amphibien" (1830) is a comprehensive classification, in which the first 129 pages were dedicated to mammals and birds, and the remainder to the "Amphibia" (reptiles included). Higher taxa (order, family, genus) were diagnosed, species were listed with synonymies (some also diagnosed), and footnotes with comments on identification and etymology of the names are provided (Vanzolini 1977).

In this work, Wagler proposed the generic name "*Scinax*, Schnellfrosch" (= "*Scinax*, quick frog") with the following diagnosis, freely translated from Latin: "Similar to preceding [*Phyllomedusa*]; body somewhat long; head narrow and snout somewhat long; fingers slender, cylindrical, ending in globulous disc, without webbing; foot half webbed, except the free first toe. (Throat in not inflatable vesicle.) America." The species included in the new genus were *Hyla aurata* Wied-Neuwied, *Hyla variolosa* Spix, and *Hyla bipunctata* Spix. *Hyla variolosa*, currently a junior synonym of *Hyla punctata* (Schneider), was also placed as a species belonging to the genus *Auletris* Wagler. In a footnote, the

etymology is quoted as "Scinax agilis ad subsiliendum" (= *Scinax* agile to leap).

Wagler provided no evidence on the gender of the name *Scinax* and did not combine his genus with any of the included species, which appeared as feminine names associated with the feminine genus *Hyla*. The same is observed for the currently masculine genera *Dendrobates* (included *Hyla nigerrima* Spix, *Hyla tinctoria* Daudin, and *Hyla trivittata* Spix), *Phyllodytes* (included *Hyla luteola* Wied-Neuwied), and *Hemiphractus* (included *Rana scutata* Spix), for example.

The first combination of a species name with *Scinax* appears in Tschudi (1838), in the list of synonyms of *Hypsiboas luteola*, as "*Scinax aurata, variolosa, bipunctata* Wagl." The gender adopted was intentionally feminine whereas in the same list the combination "*Auletris variolosus* Wagl." is also present, denoting clear utilization of *Auletris* in masculine gender, although it had been treated in the same inexplicit way by Wagler (1830) as he did for *Scinax*. Fitzinger (1843) confused the situation by including *Scinax* Wagler as a synonym of *Hypsiboas* Wagler, with *Hyla punctata* Daudin as its type species ("typus"). This designation is invalid according to the International Code of Zoological Nomenclature (ICZN 1961, 1964, 1985, 1999), because *Hyla punctata* was not originally included in the genus *Scinax*.

Günther (1858) placed *Scinax* (and *Calamites*, *Hypsiboas*, *Auletris*, *Hyas*, and *Phyllodytes* Wagler) in the synonymy of *Hyla* Laurenti, 1768, and this arrangement was followed by subsequent authors (e.g., Boulenger 1882; Nieden 1923), or only *Phyllodytes* was excluded as a valid genus (e.g., Bokermann 1966; Gorham 1974; Duellman 1977; Frost 1985, 2002).

Reviewing Spix's specimens of anurans housed in the Royal Cabinet of Natural History in München, Peters (1872) used the combination *Scinax bipunctata* Wagler, 1830 as a synonym of *Hyla bipunctata* Spix, 1824. He did not discuss that combination nor present any reason to consider *Scinax* feminine. Apparently, he simply followed the combination derivative of Wagler (1830).

Stejneger (1907), by subsequent designation, defined *Hyla aurata* Wied-Neuwied as the type species for *Scinax* Wagler. Although Stejneger's studies were characterized by a critical, scholarly approach, with detailed descriptions of identifiable specimens and careful designations of type species and type localities (Adler 1989), he did not express clearly the new combination nor his opinion on the gender of *Scinax*.

The *Hyla rubra* group was defined by León (1969) to accommodate a set of species occurring in Mexico and Central America; this group was recognized by Cochran and Goin (1970) and Duellman (1970). Several phenetic subgroups were proposed subsequently for the *H. rubra* group by Duellman (1972) and Lutz (1973).

The genus *Ololygon* Fitzinger, 1843 (type species, by monotypy, *Hyla strigilata* Spix, 1824) was resurrected by Fouquette and Delahoussaye (1977) to accommodate the species formerly included in the *Hyla rubra* group (*sensu lato*). *Ololygon* is neutral in gender (*cf.* ICZN 1964, 1965), but the authors made no attempt to combine grammatically the several names of species to the genus, treating them irrespectively as feminine, directly transposed from *Hyla*. They included 48 species in five species groups of *Ololygon* and referred ten other species to the genus. The generic arrangement of Fouquette and Delahoussaye (1977) was disputed explicitly or implicitly by employing *Hyla* instead of *Ololygon* (see references in Faivovich 2002) or adopted (e.g., Caramaschi and Kisteumacher 1979; Hoogmoed and Gorzula 1979; Harding 1983; Frost 1985; Duellman 1986; Peixoto 1987, 1988a,b; Peixoto and Weigoldt 1987; De la Riva 1990; Heyer et al. 1990; Henle 1991).

Pombal and Gordo (1991) noted that *Scinax* Wagler, 1830 has priority over *Ololygon* Fitzinger, 1843, but they did not make taxonomic changes and conservatively adopted the genus *Hyla* to accommodate two new species that currently are associated with *Scinax* (*S. jureia* and *S. littoralis*).

Duellman and Wiens (1992) followed Pombal and Gordo (1991) in recognizing the seniority of *Scinax* over *Ololygon*. These authors presented a comprehensive approach to the problem, by resurrecting and diagnosing the genus *Scinax* and discussing the nomenclature relevant to the genus, by designating and describing a neotype (KU 125383) for *Hyla aurata*, the type species of that genus, and thereby placing its type locality to Maracás (13°27'S, 40°26'W), State of Bahia, Brazil. They also hypothesized intra- and intergeneric relationships and tentatively updated the species composition of the genus. These authors considered the generic name *Scinax*, from the Greek "*skinos*" meaning quick or nimble, an appropriate name for these agile frogs, and clearly stated that the gender is feminine.

Köhler and Böhme (1996) argued that there is no Greek word "skinos," as presented by Duellman and Wiens (1992), and that the proper etymology given by Wagler (1830) was "***Skinax*** *agilis ad subsiliendum*." Quoting a bio-etymological dictionary, they stated that "scinac - Gr. *skinax*, genit. *skinakos*, quick, nimble. Ex.: *Scinaco-pus* (Ins.), *Scinax* (Rept.)" Moreover, they affirmed that the Greek word *skinax* has been rarely used in the classic literature; they cited the hellenistic poet "***Nikander*** (200 b.Ch.) used it as an attribute for the hare (Gr. - lagos)." Besides they considered that the linguistic derivation is not clear, but most likely derived from "*kindax*" resp. "*kinein* - G. to move", they stated that, in any case, its gender is clearly masculine. So, according to Article 11g of the International Code of Zoological Nomenclature (ICZN 1985), they concluded that "*Scinax* has therefore to be treated as a noun of masculine gender." Following this conclusion, Köhler and Böhme (1996) cited 29 species names as masculine, following the valid species names associated previously with the genus *Scinax* as feminine by Duellman and Wiens (1992, 1996). The masculine gender was adopted by Kwet and Di-Bernardo (1999), Izecksohn and Carvalho-e-Silva (2001), and Lescure and Marty (2001) in studying regional anuran faunas, by Peixoto (2002) in describing a new species (*Scinax arduous*) and treating all species referred and included in the *Scinax perpusillus* species group by him, and by Alves and Carvalho-e-Silva (2002) in describing the tadpoles of *S. alter* and *S. cuspidatus*.

According to Gow and Scholfield (1953), Nikandros of Kolophon (ca. 140 BC) was a Greek priest of Apollo, didatic poet, grammatist, and chronicler, author of the "Theriaka" and of the "Alexipharmaka," currently known only by fragments, and of a "Georgica," lost but later imitated by Virgil. The reference to the hare is in the "Theriaka" but there is no evidence that he utilized "*skinax*" as a masculine or a feminine adjective. It is noteworthy that Wagler selected such a rare word for the generic name.

Reactions to the proposition of Köhler and Böhme (1996) appeared early in 2000. Guix et al. (2000), in a nomenclatural note,

mentioned that they opted for the feminine gender of *Scinax* because this word comes from the Greek "skinax" (= agile), which can be utilized as masculine or as feminine, and that Wagler (1830) originally combined *Scinax* to three species in feminine gender. Therefore, according to the Article 30.1.4.2 of the International Code of Zoological Nomenclature (ICZN 1999), they concluded that this gender must prevail (but, they stated, see also Köhler and Böhme 1996). The nomenclatural position of Guix et al. (2000) was followed by Langone (2001) and Faivovich (2002) without additional comments.

Duellman (2001) discussed the etymology and the gender of *Scinax*, referring that Duellman and Wiens (1992) considered that the generic name is feminine, and that Köhler and Böhme (1996) incorrectly argued for a different interpretation with the gender being masculine. To corroborate that proposition, Duellman (2001) cited the Fourth Edition of the International Code of Zoological Nomenclature (ICZN 1999; Article 30.1.4.2), which clearly states: "A genus-group name that is or ends in a word of common or variable gender (masculine or feminine) is to be treated as masculine unless its author, when establishing the name, stated that it is feminine or treated it as feminine with an adjectival species-group name." Arguing that Wagler (1830), when proposing the generic name *Scinax*, treated it as feminine by using its combination with three feminine specific names (*aurata*, *bipunctata*, and *variolosa*), Duellman (2001) concluded that the suggestion of Köhler and Böhme (1996) that specific names of *Scinax* should have *-us* endings must be disregarded. In fact, Duellman (2001) should have referred to the 1985 edition of the Code because this was in effect when Köhler and Böhme (1996) proposed their ideas. Fortunately, there is no difference in Article 30.a.i contained in the 1985 and 1999 editions of the Code, and thus no change is required of Duellman's proposition.

Cannatella (in Frost 2000) stated that *Scinax* is a third declension noun, and those ending in *-x* are usually feminine, although there are several exceptions. This is true for names ending in *-nx* (-gx, in Greek) and *-ix* (-ix, in Greek), which are feminine, but not for *-ax* (-ax, in Greek), which is masculine (see Appendix D in the editions 1961 to 1985 of the Code). Again according to Cannatella, "the etymology provided in the original coining of the name ('*agilis ad subsiliendum*') is of no help. *Agilis* is a two-ending adjective and so could be masculine or feminine. *Ad subsiliendum*, despite the neuter implication of the *-um* ending, is a gerund expression in the accusitive case (usually used with *ad* in this form), denoting a sense of purpose. 'Agile or light for the purpose of leaping' would be a translation. But this modifying phrase provides no clue about gender, other than it is not neuter." In fact, in Greek, according to the meaning, most words designating actions are feminine (Papavero 1994), but this also does not clarify unequivocally the gender of *Scinax*.

Frost (2000) considered that the argument for masculine gender is weak as is the argument for feminine gender. Therefore, he assumed "*Scinax* to be a common gender and have taken the first combination of *Scinax* as analogous to the first revisor action in setting gender, which is, in this case, feminine, based on the first use in combination by Peters, 1872 (*Scinax bipunctata*, now in *Hyla*), which has also been the predominant usage." He apparently overlooked that the first usage of the combination of *Scinax* with a specific name was by Tschudi (1838), as feminine (see above); thus, Peters (1872) cannot be accepted as analogous to a first revisor action. In fact, if applicable, the work of Duellman and Wiens (1992) is a real first revision of the genus *Scinax*, and there its gender is also feminine.

Kwet (2001) presented a brief history of the problem and agreed with Köhler and Böhme (1996) by concluding that *Scinax* is a name of variable gender. Consequently, according to Article 30.1.4.2 of the current Code (ICZN 1999), which states that "a genus-group name that is or ends in a word of common variable gender (masculine or feminine) is to be treated as masculine unless its author, when establishing the name, stated that it is feminine or treated it as feminine in combination with an adjectival species-group name," Kwet (2001) determined that *Scinax* is masculine. On the other hand, respecting the application of the Article 24.2 (ICZN 1999), which rules the Principle of the First Reviser, Kwet (2001) correctly argued that it does not concern the determination of gender of names and rejected Frost's (2000) proposition. Finally, arguing that *Scinax* was not in use over more than a hundred years until its revalidation by Duellman and Wiens (1992) and, after that, both masculine and feminine spellings of *Scinax* were widely used in current literature, without a clear predominance of one or another, the masculine gender should have priority.

Savage (2002) argued that the Greek word *skinax* (plural *skinakos*) would actually be an adjective used to modify both masculine and feminine nouns with no change in termination. In the case of the generic name, *scinax* would be an adjective used as a noun ("the nimble one"), and contrary to Köhler and Böhme (1996) would not be "clearly" of masculine gender. By citing the Article 30.1.4.2 of the current Code (ICZN 1999), which stated that when a generic name is based on a word of variable gender and was not clearly indicated as feminine by the author establishing the name, it is to be treated as masculine, notwithstanding the reference of Peters (1872) to *Scinax bipunctata*, he concluded that *Scinax* must be regarded as of masculine gender.

Noting that the gender of *Scinax* is controversial, but resolved arbitrarily by Article 30.1.4.2 of the Code (ICZN, 1999) and that Köhler and Böhme (1996) suggested that the gender of the name *Scinax* is masculine, Frost (2002) reinstated the observations of D. Cannatella presented in Frost (2000) and that the first action applying a specific gender to *Scinax* was that of Peters (1872), who treated it as feminine (as *Scinax bipunctata*, now in *Hyla*). He considered this first action in keeping with at least one interpretation of the gender of *Scinax* and that it has been the predominant usage subsequently. Nonetheless, as Frost (2002) noted, contrary to this purportedly predominant usage, the Code (ICZN 1999) does set the gender of *Scinax* to be masculine; Kwet (2001) is referred to as discussing the gender and the Code. Thus, Frost (2002) recognized 84 valid species names for *Scinax*, combining them as masculine when appropriate.

In conclusion, by considering: (1) that Wagler (1830) did not use *Scinax* in combination and therefore did not demonstrate the intended gender of his genus; (2) that Greek words ending in *-ax* are normally masculine and according to its meaning part of the words designating actions, as is *Scinax*, are masculine; (3) that the Principle of the First Reviser does not apply to determination of gender of names; (4) that there is no clear predominance of masculine or feminine usage for *Scinax* in the current literature; (5)

that the Code (ICZN 1999) clearly states that a name of common variable gender is to be treated as masculine; and (6) that in the checklist of amphibian species by Frost (2002) the gender is now consistently used as masculine, I hereby reassert that the gender of the genus *Scinax* should be considered masculine.

Currently the genus *Scinax* is composed by 84 species, as recognized by Frost (2002), plus *Scinax arduous* Peixoto, 2002. However, a number of species currently placed in *Hyla* probably belong in the genus *Scinax* (Frost 2002), several nominal species currently in the synonymy of other species are actually valid species, and a number of new species are waiting description.

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Literature Citations for Slider Turtle (*Trachemys scripta*) Requested

Carl Ernst and Michael Seidel are preparing the species account (Catalogue of American Amphibians and Reptiles) for *Trachemys scripta*. In an effort to be thorough and because the literature on this turtle is so voluminous, they are seeking the assistance of anyone (author, bibliophile, reader) who is aware of publications on this species which might be overlooked by a routine search of the literature. References to publications in non-U.S. or technical journals would be especially helpful. Citations can be forwarded to: *Michael E. Seidel, Department of Biological Sciences, Marshall University, 400 Hal Greer Boulevard, Huntington, West Virginia 25755-2510, USA; tel. (304) 696-7262; fax (304) 696-7136; e-mail: seidel@marshall.edu.*

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Sexual-Size Dimorphism in *Emydura krefftii* (Testudines: Chelidae) from Ross River, Townsville, Australia

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Krefft's River Turtles, *Emydura krefftii*, inhabit many of the rivers and streams along the eastern Queensland coast (Cogger 2000), yet its ecology in the wild is poorly understood, particularly within tropical populations (Cann 1998). Previous studies on *E. krefftii* (Georges 1982a, b; Georges 1983) were conducted on Fraser Island, Southeast Queensland. However, the Fraser Island population might be genetically distinct from the mainland populations and might be an undescribed species (Cann 1998). There are no studies on the ecology of *E. krefftii* from mainland populations (Cann 1998).

Many freshwater turtles, including *Emydura* spp. exhibit sexual size dimorphism, with females being larger than males (Cann 1998; Chessman 1978; Georges 1982a; Spencer 2000). Larger female body size might be the result of selection for increased fecundity (Ernst et al 1994; Gibbons and Lovich 1990; Viosca 1933). In addition, females of a number of species including *E. krefftii* have relatively larger heads than males, with both sexes undergoing macrocephaly with increasing age (Cann 1998). Greater head size in females might function to increase the size range of food items, perhaps in response to calcium depletion after oviposition (Cann 1998; Chessman 1978).

This study describes sexual dimorphism in a population of *E. krefftii* from Ross River. The Ross River is located in the seasonal wet-dry tropics of North Queensland, Australia. The study site was a 360 m portion of the Ross River, downstream of the Aplins Weir, (19°15'59"S, 146°45'6"E) at Douglas, Townsville. Sampling was carried out between the 13 August and 10 October 2001 in the late dry season when river flow and water levels are lowest. Turtles were trapped using modified crab pots (8 x 8 cm mesh) baited with chicken carcasses, following the hoop trap design of Legler (1960). In addition, a few turtles were collected with dip nets. There were 22 days in which traps were set. Each day, four traps were set for a three-hour period and checked hourly.

From each individual, shell dimensions were measured to the nearest mm with a flexible tape. Mass was recorded to the nearest 20 g using Elson spring balance scales with 1000 g or 5000 g capacity. Carapace length was measured as curved carapace length along the midline and carapace width was measured as the curved horizontal distance across the highest point of the carapace. Plastron length was measured as the curved distance along the ventral midline, and plastron width was measured across the proximal end of the femoral plates. Cranial measurements were made to the

nearest mm using Unimax dial calipers. Cranial length was measured, from the snout tip to the posterior edge of the quadrate bones. Cranial width was measured at the widest point, across the tympanic membranes.

Turtles were sexed based on the marked sexual dimorphism in tail morphology. Male *E. krefftii* have considerably broader and longer tails than females (Cann 1998). Each turtle was given a unique mark (Cagle 1939) and released at the original site of capture.

Data were log-transformed prior to analysis so as to meet assumptions of normality and homogeneity of variance. Intersexual comparisons of mass were made using univariate ANOVA. In order to describe differences in body shape, or relative morphology, the effects of body size were removed using standardized residuals calculated from regressions of each morphological character against body mass. These measures of relative morphology were then compared between sexes, using univariate ANOVA.

A total of 126 *Emydura krefftii* were marked (72 females and 54 males). Mass frequency distributions seemed to be normally distributed in both males and females (Fig. 1). The greater frequency of females, compared to males, in the larger size classes is clearly evident. Mean body mass was significantly greater in females than in males ($F = 17.25$, $P < 0.001$, Table 1). Additionally, mean carapace length and width, plastron length and width, and head length and width were also greater in females (Table 1).

Significant linear relationships, on a log-log scale, were evident between body mass and all other measurements (Fig. 2). The slope of each of these relationships approximated isometry (slope = 0.33), indicating generally proportionate growth over most of the size range. However with differences in body mass removed, females still had significantly larger cranial length, cranial width, and carapace width (Table 2).

Female *E. krefftii* are significantly larger than males. In addition, with the effects of body size removed, female *E. krefftii* have relatively greater carapace widths than males. These results are consistent with those from other genera of freshwater turtles from around the world, with sexes usually significantly differing in aspects of their morphology (Aresco and Dobie 2000; Cann 1998; Chessman 1978; Ernst et al 1994; Gibbons and Lovich 1990;

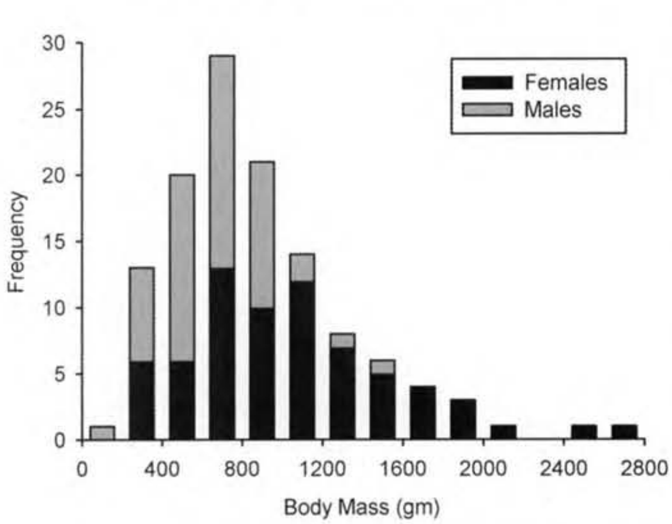

FIG. 1. Frequency distribution of body mass for male and female *Emydura krefftii* (N = 126).

TABLE 1. Mean ± SE of eight morphological parameters for male and female *Emydura krefftii*.

Parameter	Male	Female
Carapace Length (mm)	183.5 ± 3.95	208.9 ± 4.26
Carapace Width (mm)	148.1 ± 2.90	173.3 ± 3.70
Plastron Length (mm)	143.7 ± 3.05	164.5 ± 3.33
Plastron Width (mm)	56.9 ± 1.25	66.6 ± 1.49
Cranial Length (mm)	33.9 ± 0.64	39.4 ± 0.86
Cranial Width (mm)	27.8 ± 0.50	33.4 ± 0.84
Body Mass (grams)	650 ± 37.8	1010 ± 61.7

TABLE 2. ANOVA results for six relative morphological parameters with the effects of mass differences removed (calculated utilizing residuals) comparing male and female *Emydura krefftii*.

Parameter	F (d.f = 1,120)	Significance
Relative Carapace Length	0.368	0.545
Relative Carapace Width	9.910	0.002
Relative Plastron Length	0.280	0.598
Relative Plastron Width	3.066	0.083
Relative Cranial Length	4.670	0.033
Relative Cranial Width	11.428	0.001

Viosca 1933). Sexual dimorphism in turtles often has been attributed to differences in reproductive strategies (Gibbons and Lovich 1990). Greater mass, and relative width, might increase fecundity in female *E. krefftii* because they can accommodate more eggs. In contrast, larger body sizes (and the associated energetic and resource costs) are generally regarded as not advantageous for males in terms of reproductive success.

In addition to attaining greater overall body size, female *E. krefftii* also had larger heads than males. The muscular and bony development associated with greater cranial size is likely to have important functional and ecological consequences. In particular, greater head size might increase niche breadth in female *E. krefftii*. However, dietary studies in the genus *Emydura* do not support a niche breadth hypothesis. Studies of *E. macquarii* have found little difference between the diets of males and females (Chessman 1978). These turtles were omnivorous, but the majority of their diet consisted of terrestrial and aquatic plants (Chessman 1986). Similarly, Georges (1982b) found no difference in diet between sexes in *E. krefftii* on Fraser Island. These turtles were utilizing aquatic insects, with an ontogenic shift to larger insects and crustaceans.

We have described marked patterns of morphological variation between sexes in *E. krefftii*. Further work is required to examine the functional and ecological implications of this variation. In particular, dietary differences between sexes, as well as ontogenic shifts in dietary habits of *E. krefftii* need to be explored. Additionally, the hypothesis that reproductive success is related to body size in female *E. krefftii* remains to be examined.

Acknowledgments.—Sincere thanks to Diane Barton and Simon Fearn for much logistic support, and to the Queensland National Parks and Wild-

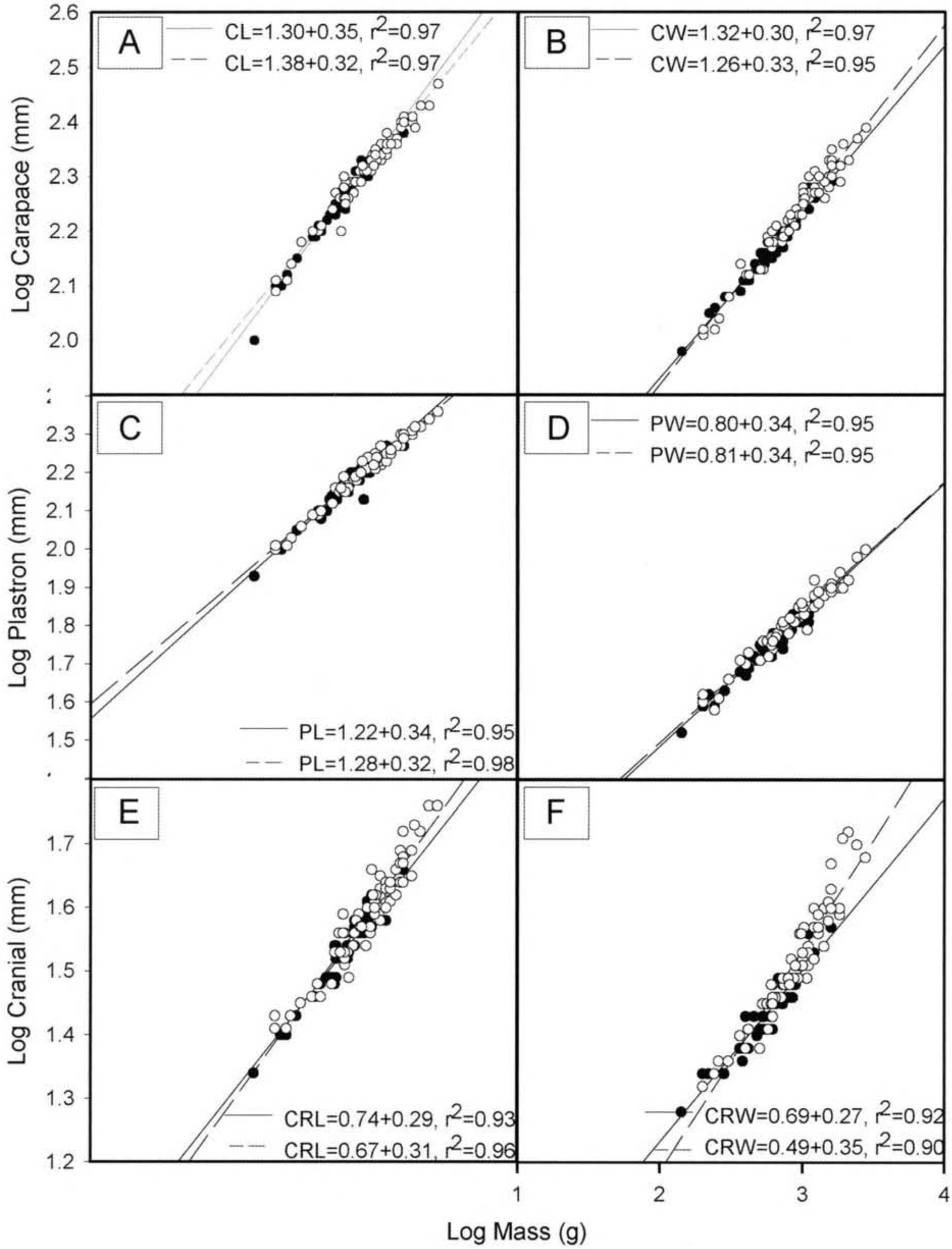

FIG. 2. Linear regressions of log carapace length (A), log carapace width (B), log plastron length (C), log plastron width (D), log cranial length (E), and log cranial width (F) on log body mass. The solid dots and lines represent males and the open dots and dashed lines represent females.

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Growth of an Introduced Population of *Trachemys scripta elegans* at Fox Pond, Eckerd College, Pinellas County, Florida

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The native distribution of *Trachemys scripta elegans*, the red-eared slider, is limited to the Mississippi Valley from Illinois to the Gulf of Mexico (Ernst et al. 1994). For decades, *T. s. elegans* has been the most popular turtle in the pet trade worldwide. Furthermore, large numbers of adults have been shipped around the world as laboratory animals. From these sources, *T. scripta* has been introduced into many areas outside of its native range. Introduced populations have been reported worldwide in Japan, Germany, Israel, South Africa, and the Mariana Islands (Ernst et al. 1994), and in the U.S. in Michigan, Arizona, Hawaii, Pennsylvania, New Jersey, Washington D.C., and Virginia (Conant 1975; Ernst et al. 1994; Mitchell 1994). In Florida, introduced populations have been reported in Dade Co. (Wilson and Porras 1983), Orange Co. (Bancroft et al. 1983), and in Pinellas Co. at Coquina Key, Gulfport, Sawgrass Lake Park, Boyd Hill Park, and Eckerd College (Hutchison 1992; P. Meylan, pers. comm.; G. Heinrich, pers. comm.).

Hutchison (1992) reported a reproducing population of *T. s. elegans* at Fox Pond, Eckerd College. This species inhabits all Eckerd College campus ponds, which it shares with two native species, *Pseudemys floridana* and *P. nelsoni*. All of these ponds are connected through a storm sewage system. Fox Pond, a 1.21-ha body of water, is separated from Chapel Pond by a 1-m wide sidewalk, but the two ponds are connected by a storm pipe that runs under the sidewalk. Similarly, Fox Pond is connected to Front Gate Pond (0.567 ha) by a 415-m storm pipe, and to ELS Pond (0.243 ha) by a 455-m storm pipe. This report is an update of the status of the reproductively active population of *T. s. elegans* in Fox Pond.

Fox Pond was sampled 12 times over a 34-month period between September 1997 and December 1999 using funnel traps baited with sardines. Four 1.0 m by 0.75 m funnel traps (mesh size 2.5 cm) were placed near vegetation, approximately two-thirds submerged to allow captured turtles to surface. Captured turtles were marked by drilling the marginal scutes following the coding system of Gibbons (1988), and by insertion of AVID™ PIT tags. A variety of data were recorded from each turtle at each capture, but for the purposes of this paper we report only sex and straight midline plastron length (MPL). Adult female turtles were also x-rayed for the presence of eggs. The Jolly-Seber model (Pollock et al. 1990) was used to make 12 consecutive population and survivorship estimates. The population estimates were examined via regression analysis for evidence of population growth.

A total of 35 *T. s. elegans*, 20 males and 15 females, were captured 104 times over the 34-month study period. Female MPL ranged from 135–222 mm, with a mean ± SD of 183 mm ± 28 mm (Fig. 1). Male MPL ranged from 126–199 mm, and averaged 162 mm ± 19 mm (Fig. 1). Four females were gravid, with clutch sizes of 8, 9, 10, and 12 eggs.

Monthly population estimates ranged from 21.0 ± 15.9 to 54.7 ± 27.1 turtles (Fig. 2). Regression analysis demonstrated a slope of 0.532, which is significantly greater than zero ($t = 2.46$, $P < 0.05$), indicating a growing population. Survival rate was estimated as 97.5% for one of the monthly samples, and 100% for the remaining 11 samples, indicating that individuals are not being removed from the population.

Hutchison (1992) estimated the number of *T. s. elegans* in Fox Pond to be 25.7 individuals. The current estimate of 54.7 ± 27.1 individuals suggests an increase of greater than 100% in population size over the past eight years. By comparison, *T. scripta* population estimates for a newly constructed pond (0.3 ha) in Clay Co., Mississippi were determined to be one turtle in 1981, and 26 by 1983, an increase which may have been due to immigration (Parker 1990). The increase in the number of individuals in Fox Pond, which is similar to the increase at the Clay Co. Mississippi site, is at least in part due to immigration. Turtles captured in other campus ponds during an initial short-term trapping project have been recaptured in Fox Pond. I have documented the immigration of five turtles to Fox Pond from surrounding ponds, and the emigration of four turtles from Fox Pond to other campus ponds. Extensive trapping in the other campus ponds is necessary to accurately determine emigration/immigration frequencies.

Although the individuals inhabiting Fox Pond belong to a metapopulation, the continuous, slow increase in numbers sug-

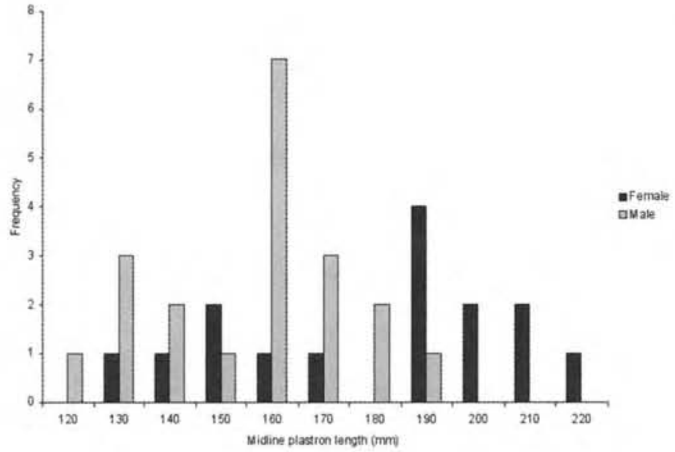

FIG. 1. Size frequency distribution of female and male *T. s. elegans* in Fox Pond.

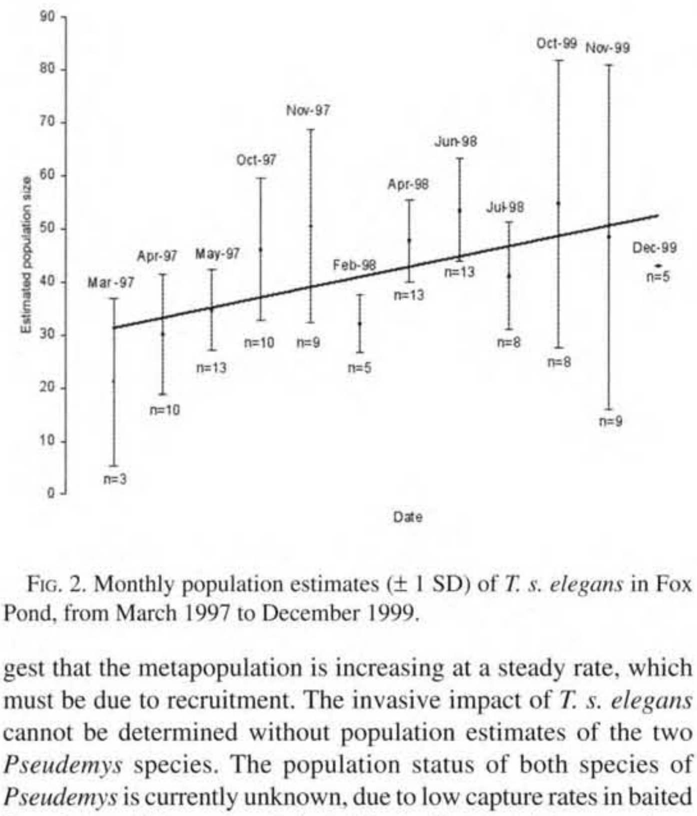

FIG. 2. Monthly population estimates (± 1 SD) of *T. s. elegans* in Fox Pond, from March 1997 to December 1999.

gest that the metapopulation is increasing at a steady rate, which must be due to recruitment. The invasive impact of *T. s. elegans* cannot be determined without population estimates of the two *Pseudemys* species. The population status of both species of *Pseudemys* is currently unknown, due to low capture rates in baited funnel traps that can be attributed to the fact that they are primarily herbivorous.

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TECHNIQUES

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Annual Formation of Growth Marks in a Tropical Amphibian

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Determining the age of individual animals is extremely important for demographic, population dynamics, or life history studies of amphibians (Castanet and Smirina 1990; Hemelaar and van-Gelder 1980; Kusano et al. 1995; Ryser 1988; Smirina 1994). Mark-release-recapture and skeletochronology are generally used for estimating the age of amphibians (Castanet and Smirina 1990; Hemelaar 1981; Halliday and Verrell 1988; Kusano et al. 1995; Smirina 1994). Counting of growth layers in the phalangeal bones is a non lethal (therefore, ideal for live samples) and a good alternative method for mark-recapture (Coles et al. 2001).

The recent reviews on aging of amphibians reveal that most of the skeletochronological studies on the estimation of age and longevity of amphibians emerge from temperate areas (Castanet and Smirina 1990; Esteban et al. 1996; Halliday and Verrell 1988; Smirina 1994). In these species, the marked seasonality in the ambient temperature is known to result in the formation of distinct annual growth rings consisting in broader growth zones (corresponding to faster bone growth in warmer months) and lines of arrested growth or LAGs (corresponding to arrested bone growth in colder months). Alternately, amphibian species inhabiting constant warmer areas or tropics are expected to express the growth marks inconspicuously or less clearly owing to uninterrupted osteogenesis (Castanet and Smirina 1990; Guarino et al. 1998;

GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 34, Number 2 (June 2003). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extensions unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA TALPOIDEUM (Mole Salamander). USA: ARKANSAS: PIKE Co: Hwy 301, 12.9 km SE Murfreesboro, Sec. 6 T9S R24W. 5 May 2002. Brian Caldwell. Henderson State University collection 1276. HOWARD Co: 5.2 km W of jct. Hwys 26 and 369, Sec. 30 T8S R27W. 27 April 2003. Brian Caldwell. Henderson State University collection 1297. Verified by Stan Trauth. First record for each county, both records are nonpaedomorphic larvae collected from swampy, lowland areas without fish. Howard Co. record extends known distribution in Arkansas in the West Gulf Costal Plain 63 km W from Clark Co. (Tumlison and Campbell 2002. Herpetol. Rev. 33:143–144) and 65 km SW from Garland Co. (Trauth et al. 1993. Proc. Arkansas Acad. Sci 47:154–156). Records also narrow the gap between previous records from Arkansas and those in Oklahoma (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 587 pp.).

Submitted by **BRIAN CALDWELL** and **RENN TUMLISON**, Department of Biology, Henderson State University, Arkadelphia, Arkansas 71999, USA.

EURYCEA LONGICAUDA LONGICAUDA (Long-tailed Salamander). USA: VIRGINIA: FAIRFAX Co: TNC Fraser Preserve. 10 June 1999. T. Akre. GMNH accession 49213, Georgia Museum of Natural History, University of Georgia. Verified by Carl H. Ernst. Adult of unknown sex found active at night on remains of an abandoned beaver lodge in a wet, intermittent stream ravine. County record. Carlin (1997. Herpetologica 53:206–217) reported that length of the mid-dorsal stripe discriminated *Eurycea guttolineata* from *E. longicauda* with 100% accuracy when compared to genetic analyses. However, Mitchell and Reay (1999. Atlas of Amphibians and Reptiles in Virginia. Virginia Dept. Game Inland Fisheries, Spec. Publ. No. 1:v + 122 pp.) considered individuals from streams in Fairfax Co. to be *E. guttolineata* with unusual phenotypes or offspring of hybridization with *E. longicauda*. This individual has no linear mid-dorsal pattern, complete or broken, though it was found ca. 50 km E of the nearest *E. longicauda* record, and within the distribution of *E. guttolineata* (Mitchell and Reay 1999, *op. cit.*).

Submitted by **THOMAS S. B. AKRE**, Savannah River Ecology Laboratory, University of Georgia, Drawer E, Aiken, South Carolina 29802, USA, and **KERRY A. HANSKNECHT**, Department of Biology, Central Michigan University, Mt. Pleasant, Michigan 48859, USA.

HEMIDACTYLIUM SCUTATUM (Four-toed Salamander). USA: INDIANA: RIPLEY Co: Big Oaks National Wildlife Refuge (formerly Jefferson Proving Ground) in the SE 1/4 of Sec. 22 of Shelby Township. 5 April 2003. Scott L. Skilbred. Verified by Joseph T. Collins. University of Kansas Natural History Museum (KU Color Transparencies 11904–11905). First county record (Minton 2001. Amphibians and Reptiles of Indiana, rev. 2nd ed., Indiana Academy of Science, Indianapolis, Indiana).

Submitted by **SCOTT L. SKILBRED** and **VICKY J. MERETSKY**, School of Public and Environmental Affairs, Indiana University, Bloomington, Indiana 47405, USA.

ANURA

AGALYCHNIS CRASPEDOPUS. BRAZIL: AMAZONAS: Municipality of Castanho, km 22 on the BR319 road (3°21'16.8"S and 59°51'37.9"W). 19 February 2003. A. Pimentel Lima, V. M. L. Guida, and W Hödl. Amphibian and Reptile Collection of the Instituto Nacional de Pesquisas da Amazônia, Manaus. A male SVL 56.1 mm (INPA–10936) and female SVL 62.5 mm (INPA–10937). Verified from photographs by M. S. Hoogmoed. The pair was found in amplexus at 0500 h on a hollow log above a water-filled cavity, and stayed in the same place until 1200 h when we captured them. The species is known from Chicherota, Montalvo, and Limoncocha (Ecuador), and Rio Santiago, Tambopata Reserve, and Cocha Cashu (Peru) (Hoogmoed and Cadle 1991. Zoologische Mededelingen 65:129–142). Present record extends the range of this species and of the genus *Agalychnis* 1400 km to the east.

Submitted by **ALBERTINA PIMENTEL LIMA** and **VÂNIA MARÍLIA L. GUIDA**, Instituto Nacional de Pesquisas da Amazônia - INPA, C.P. 478, 69011-970 Manaus - Amazonas, Brazil, and **WALTER HÖDL**, Institute of Zoology, University of Vienna, Althanstrasse 14, A-1090 Wien, Austria.

APARASPHENODON BOKERMANNI. BRAZIL: SANTA CATARINA: Guaramirim Municipality, Atlantic Rain Forest (Restinga), 26°27'S, 49°00'W, 1 October 2002. Germano Woehl Jr. KU CT 11893–94. Verified by Jose Peres Pombal, Jr. First record for the state and Atlantic forests of southern Brazil.

Submitted by **GERMANO WOEHL, JR.** and **ELZA N. WOEHL**, Instituto Rabugio para Conservacao da Biodiversidade, Estrada Rioda Prata, 89270–000 Guaramirim, Santa Catarina, Brazil; e–mail: germano@ieav.cta.br.

BATRACHYLA ANTARTANDICA (Marbled Wood Frog), CHILE: REGION DE AYSEN: Reserva Nacional Katalalixar: Juan Stuven Island (47°55'S; 74°52'W), 10 February 2003. H. Díaz-Páez and S. Young. Adult male (36.8 mm SVL), Museo de Zoología Universidad de Concepcion, Concepcion (MZUC 27615). Verified by J. C. Ortiz. Specimen was collected in temperate, moist deciduous austral forest of Cipres (*Pilgerodendron uviferum*) and Ñirre (*Nothofagus antartandica*). Species inhabits austral forests of Chile and Argentina. In Chile the range extends from Cerro Mirador (Valdivia) to the El Correntoso River (Aysén). This is the first record for this island and extends the southern range of this species to the SW by ca. 315 km (Cei 1980, Amphibians of Argentina, Monit. Zool. Ital. [N.S.], Monogr. 2:i–xii + 1–609). Specimen was found calling inside mosses on small pond (1 m diam. and ca. 0.6 m deep), with several eggs around him, and a tadpole in the pond. This area is also inhabited by *Bufo variegatus* and *Eupsophus calcaratus*.

Submitted by **HELEN DÍAZ-PÁEZ** and **SUE YOUNG,** Laboratorio de Herpetología, Facultad de Ciencias Naturales y Oceanográficas, Universidad de Concepción. Casilla 160-C, Concepcion, Chile, and Durrell Institute of Conservation and Ecology (DICE), University of Kent, Canterburry, UK CT2.

BUFO DEBILIS INSIDIOR (Western Green Toad). USA: NEW MEXICO: SIERRA Co: White Sands Missile Range, earthen tank at Martin Ranch hdqs., ca. 45 air mi NE Truth or Consequences, T10S R4E NW1/4 Sec 6. 31 July 1997. L. K. Kamees and D. W. Burkett. University of New Mexico Museum of Southwestern Biology (MSB 60800). Verified by B. G. Fedorko. County record (Degenhardt et al. 1996. The Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque, xix + 431 pp.).

Submitted by **LARRY K. KAMEES** and **DOUGLAS W. BURKETT,** MEVATEC Corporation, P.O. Box 399, White Sands Missile Range, New Mexico 88002, USA.

BUFO PUNCTATUS (Red-spotted Toad). USA: NEW MEXICO: RIO ARRIBA Co: Artesian Spring, Arroyo del Cobre, 7 mi (11.2 km) NNW of Abiquiu, ca. 2040 m (36°18'29"N, 106°21'16"W). 12 June 1998. John E. Ubelaker. University of New Mexico Museum of Southwestern Biology (MSB 66533–36). Verified by William Degenhardt. New county record (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque, xix + 431 pp.). Extends the distribution by ca. 45 km N of Pajarito Canyon, Los Alamos Co., the nearest verified locality (MSB 36397).

Submitted by **TOM GIERMAKOWSKI**, Museum of Southwestern Biology, MSC03 2020, University of New Mexico, Albuquerque, New Mexico 87131–0001, USA (e–mail: tomas@unm.edu); **JAMES N. STUART**, New Mexico Department of Game and Fish, Santa Fe, New Mexico 87504–5112, USA; and **JOHN E. UBELAKER**, P.O. Box 750376, Southern Methodist University, Dallas, Texas 75275-0376, USA.

CHIASMOCLEIS HUDSONI (NCN). VENEZUELA: ESTADO AMAZONAS: non-flooded rainforest near the confluence of the Pamoni River with the Casiquiare River, 2°50'N, 65°43'W, ca. 80 m elev., inside a soil profile pit in early morning hours after a rainy night. W. Schargel. 30 February 2000. Museo de Historia Natural La Salle, Caracas, Venezuela (MHNLS 16112). Verified by C. Señaris. Second state record, and first voucher specimen in a Venezuelan museum. The species is distributed through the Guianas (Surinam, French Guiana, Guyana; Lescure and Marty 2000. Atlas des Amphibiens de Guyane. Museum National d' Histoire Naturelle, Paris) and Venezuela. *Chiasmocleis hudsoni* was reported (without voucher number) from Venezuela from the base of Serranía de la Neblina, a few km from the border with Brazil, and ca. 110 km from Colombia's border (Zweifel 1986. Amer. Mus. Novitates 2847:1–24). This species has not been reported from either of these countries. The Neblina locality is 200 km S of the Casiquiare record.

Submitted by **CÉSAR LUIS BARRIO AMORÓS**, Fundación ANDÍGENA, Apartado 210, 5101–A Mérida, Venezuela (e–mail: atelopus@andigena.org), and **WALTER E. SCHARGEL**, Department of Biology, University of Texas at Arlington, Box 19498, Texas 76019, USA (e–mail: wschargel@yahoo.com).

CHIRIXALUS NONGKHORENSIS (NCN). MALAYSIA: PENINSULAR MALAYSIA: Kedah (northern state): Ulu Muda forest reserve (06°00'N, 100°58'E; near political border of Thailand). 21 April 2003. Boo Liat Lim et al. Raffles Museum of Biodiversity Research: Zoological Reference Collection (ZRC.1.10802, SVL 26.9 mm; 10803, SVL 27.2 mm). Verified by Kelvin K. P. Lim. New country record and southerly range extension for the species, which is known from Vietnam, Laos, Cambodia, Myanmar, and Thailand (Orlov et al. 2002. Russian J. Herpetol. 9[2]:81–104). Also first representative of the genus *Chirixalus* for the country.

Submitted by **TZI MING LEONG**, Department of Biological Sciences, National University of Singapore, Singapore 119260 (e–mail: scip0132@nus.edu.sg), and **BOO LIAT LIM**, Department of Wildlife and National Parks (Peninsular Malaysia), Km 10, Jalan Cheras, 561000 Kuala Lumpur, Malaysia.

COLOSTETHUS HUMILIS (Sapito Niñera Humilde). VENEZUELA: ESTADO TÁCHIRA: Doradas, Uribante rivers (precise locality not stated), 1500 m. 18 June 1985. Proyecto Uribante-Caparo. Colección de Vertebrados, Universidad de los Andes (CVULA 3790). Verified by A. Orellana. First state record, southernmost and westernmost for the species, ca. 215 km from the type locality, at Boconó, Trujillo state (Rivero 1978. Mem. Soc. Cien. Nat. La Salle, 38 [109]:95–111). The new record is in the same Andean piedmont considered to be an Amazonian corridor (Barrio-Amorós 1998. Acta Biol. Venez. 18[2]:1–93).

Submitted by **CÉSAR LUIS BARRIO-AMORÓS,** Fundación AndígenA, Apartado Postal 210, Mérida 5101-A, Venezuela (e-mail: cesarlba@yahoo.com), and **JOAN GARCIA-PORTA**, Societat Catalana d' Herpetologia, Museu de Zoologia, passeig Picasso s/n. 08003 Barcelona, Spain.

EUPSOPHUS CALCARATUS (Chiloé Island Ground Frog). CHILE: REGION DE AYSEN: Reserva Nacional Katalalixar: Merino Jarpa Island (47°52'S; 73°51'W). 1–2, 4 February 2003. H. Díaz-Páez and S. Young. Museo de Zoología Universidad de Concepción, Concepción (MZUC 27597–98, 27602–03). Reserva Nacional Katalalixar: Berta Island (47°49'S; 73°47'W). 3 February 2003. H. Díaz-Páez and S. Young. (MZUC 27600–01). Reserva Nacional Katalalixar: Juan Stuven Island (47°55'S; 74°52'W). 10–11 February 2003. H. Díaz-Páez and S. Young. (MZUC 27616–17, 27621–22). All specimens verified by J. C. Ortiz. The individuals were collected in temperate, moist, austral forest of Mañio (*Podocarpus nubigena*), Cipres (*Pilgerodendron uviferum*) and Tepú (*Tepualia stipularis*). Species inhabits austral forests of Chile and Argentina. It ranges from Valdivia to Wellington Island (49°08'S; 74°26'W) in Puerto Edén, Chile to Tromen Lake and Puelo Lake in Argentina (Nuñez et al. 1999. Studies of Neotropical Fauna and Environment. 34:150–155). First record for these islands and the westernmost record for the species.

Submitted by **HELEN DÍAZ-PÁEZ, PATRICIA BERRIOS,** Laboratorio de Herpetología, Facultad de Ciencias Naturales y Oceanográficas, Universidad de Concepción. Casilla 160-C, Concepción, Chile, and **SUE YOUNG,** Durrell Institute of Conservation and Ecology (DICE), University of Kent, Canterbury, UK CT2.

GASTROTHECA OVIFERA (Marsupial Frog). VENEZUELA: ESTADO FALCÓN. Municipio Jacura, Cerro Los Caracoles, 10º52'17"N, 69º01'39"W. 1000 m elev. 4 September 2002. J. Latke. Museo de la Estación Biológica de Rancho Grande, Ministerio del Ambiente y de los Recursos Naturales (EBRG 4618–19). Verified by R. Rivero. First state record (Mijares-Urrutia and Arends 2000. Smithson. Herpetol. Infor. Serv. 123, 30 pp.). Northernmost and westernmost record for the species (Barrio 1999. Herpetol. Rev. 30:106.

Submitted by **JESÚS MANZANILLA** and **DINORA SÁNCHEZ**, Museo del Instituto de Zoología Agrícola, Facultad de Agronomía, Universidad Central de Venezuela, Aragua, Venezuela (e-mail: manzanillaxxi@hotmail.com; sanchezdinora@hotmail. com).

HYLA CRUZI (NCN). BOLIVIA: DEPARTAMENTO SANTA CRUZ: PROVINCIA VELASCO: 14 km (road) W of La Mechita (close to the border of P. N. Noel Kempff Mercado), 14°33'S, 61°29'W, 270 m elev. 7 December 1998. Stefan Lötters and Steffen Reichle. Verified by Wolfgang Böhme. Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany (ZFMK 72672–673). First record for the country. Westward range extension of ca. 1400 km. The species was formerly known only from the type locality (16°38'S, 48°38'W) and a nearby location in the Estado de Goiás, Brazil (Pombal and Bastos 1998. Bol. Mus. Nac., N.S. Zool. Rio de Janeiro 390:1–14). This is the third locality known for the species. The range extension documented is remarkable, but not unexpected from a biogeographical point of view, since several other central Brazilian anuran species occur at the aforementioned Bolivian locality (e.g., *Hyla albopunctata, H. multifasciata, Physalaemus centralis*). The two males from Bolivia (SVL 19.4 and 19.6 mm) agree perfectly with the original species description. It seems very probable that *Hyla cruzi* also inhabits the area in between these known localities, since minute species of *Hyla* are often overlooked or misidentified.

Submitted by **JÖRN KÖHLER**, Zoologisches Forschungsinstitut und Museum Alexander Koenig, Adenauerallee 160, 53113 Bonn, Germany; e–mail: j.koehler.zfmk@uni-bonn.de.

HYLOMANTIS GRANULOSA (NCN). BRAZIL: PERNAMBUCO: Timbaúba, Usina Cruangi, in forest adjacent to Engenho Água Azul (7°36'S, 35°22'W, 300–500 m. elev). 24 May 1999. A. Carnaval and S. Roda. Coleção de Anfíbios, Laboratório de Anfíbios e Répteis, Instituto de Biologia, Universidade Federal do Rio de Janeiro (ZUFRJ 7879). Jaqueira, Usina Frei Caneca, in forest at Mata da Serra do Quengo (8°42'S, 35°50'W, 550–750 m elev). 7 June 1999. A. Carnaval and J. Vicente Filho (ZUFRJ 7925). Brejo da Madre de Deus, in forest at Sítio Bituri (8°12'S, 36°24'W, 850–1050 m. elev). 10 June 2001. M. Silva and A. Carnaval (ZUFRJ 8672). São Lourenço da Mata, Estação Ecológica do Tapacurá, in forest at Mata do Toró (8º07'S, 34º60'W, 10–100 m. elev.). 28 May 2000. E. Santos. Coleção Eugenio Izecksohn, Departamento de Biologia Animal, Instituto de Biologia, Universidade Federal Rural do Rio de Janeiro (EI 9589). All verified by Carlos A. G. Cruz. The species was previously known from its type locality only (Horto Zoobotânico Dois Irmãos, Recife, Pernambuco, 8°00'S, 34°57'W, 10–100 m elev.) (Cruz 1988. Arq. Univ. Fed. Rur. Rio de J. 11:39–44; Cruz 1991. Rev. Bras. Biol. 50:709–726). These records extend the species' known distribution ca. 60 km northward, 70 km southward, and 125 km westward within the state of Pernambuco, and broadens its altitudinal range.

Submitted by **ANA CAROLINA O. Q. CARNAVAL**, Field Museum and Committee on Evolutionary Biology, University of Chicago, 1025 East 57th Street, Culver Hall 402, Chicago, Illinois 60637, USA, **OSWALDO L. PEIXOTO**, Universidade Federal Rural do Rio de Janeiro, Instituto de Biologia, Departamento de Biologia Animal, BR 465, Seropédica, RJ, CEP 23851-970, Brazil, and **EDNILZA M. DOS SANTOS**, Universidade Federal do Rio Grande do Norte, Pós- Graduação em Psicobiologia, Departamento de Fisiologia, Natal, RN, CEP 59078-970, Brazil.

OSTEOPILUS SEPTENTRIONALIS (Cuban Treefrog). USA: FLORIDA: LEVY CO: Fowlers Bluff, County Road 347 ca. 30 km N of Cedar Key, on house at 4111 NW 154th Avenue (29.388°N, 83.030°W). 26 May 2003. Steve Barlow. Verified by Kenneth L. Krysko. Florida Museum of Natural History, University of Florida, Gainesville (UF 137016). One adult female (92 mm SVL) collected by local resident and brought to Lower Suwannee National Wildlife Refuge (LSNWR) headquarters. The resident reported that he has seen these frogs for the past several years. This apparently is the first published record of *O. septentrionalis* from Levy Co., but there are specimens from Cedar Key (Levy Co.) dating to 2001. Three frogs from Cedar Key, all road-killed specimens, are in the UF herpetology collection. They were collected by Dale Henderson on 4 November 2001 (UF 133927), 29 June 2002 (UF 133928), and 13 July 2002 (UF 133929). It is likely that a breeding population is established at Cedar Key. The Fowlers Bluff record extends the known range of *O. septentrionalis* on Florida's Gulf coast ca. 30 km N of Cedar Key in Levy Co. and ca. 80 km N of a published record for Citrus Co. (Meshaka 1996. Herpetol. Rev. 27:37–40).

Submitted by **STEVE A. JOHNSON**, **JENNIFER S. STAIGER**, **WILLIAM J. BARICHIVICH** , US Geological Survey, Florida Integrated Science Center, 7920 NW 71st Street, Gainesville, Florida 32653, USA, and **STEVE BARLOW**, US Fish and Wildlife Service, Lower Suwannee National Wildlife Refuge, 16450 NW 31st Place, Chiefland, Florida 32626, USA.

PHYLLOMEDUSA PALLIATA (NCN). BOLIVIA: DEPARTMENTO SANTA CRUZ: PROVINCIA ICHILO : La Chonta, Parque Nacional Amboró (17°39'36"S, 63°42'6.6"W). R. O. de Sá and J. M. Padial. 22 April 2003. One adult and two juveniles collected on low vegetation (ca. 1.5 m above ground) in an Amazonian rainforest. Museo de Historia Natural Noel Kempff Mercado, Santa Cruz (NKA 6502). Verified by S. Reichle. First record from Departamento Santa Cruz and southernmost record for the species, enlarges known distribution ca. 500 km NW (airline) from the nearest record: Valle Totaizal (14°38'S,66°18'W, Reichle and Köhler 1996. Herpetofauna 18[101]:32–34).

Submitted by **JOSÉ M. PADIAL,** Museo de Historia Natural Noel Kempff Mercado, Área de Zoología, Sección Herpetología, PO Box 2489, Santa Cruz de la Sierra, Bolivia (e-mail: jmpadial@yahoo.com), and **RAFAEL O. DE SÁ,** Department of Biology, University of Richmond, Richmond, Virginia 23173, USA (e-mail: rdesa@richmond.edu).

RANA GRYLIO (Pig Frog). USA: TEXAS: ORANGE Co: South of Interstate of Highway 10 on the Tony Houseman State Park and Wildlife Management Area (30°06'44.2"N, 93°42'44.8"W). 15 July 2003. TCWC 86524. Collected by KJ Lodrigue, Jr., Derrick Wolter, and Willis Sylvest. Verified by James R. Dixon. New county record. (Dixon 2000. Amphibians and Reptiles of Texas, Second edition, Texas A&M Univ. Press, College Station. 421 pp.) Fills gap in distribution between Calcasieu Parish, Louisiana, and Jefferson County, Texas. Specimen collected in submerged aquatic vegetation.

Submitted by **KJ LODRIGE, JR.**, Texas Parks and Wildlife Department, 10 Parks and Wildlife Drive, Port Arthur, Texas 77640, USA, and **DERRICK WOLTER**, Texas Parks and Wildlife Department, 1201 Childers Road, Orange, Texas 77630, USA.

RANA MAGNAOCULARIS (Bug-eyed Leopard Frog). MEXICO: CHIHUAHUA: Batopilas (27°1'34.1"N, 107°45'44.5"W), 435 m elev. 8–12 July 2002. Julio A. Lemos-Espinal. Herpetological Collection of Unidad de Biología, Tecnología y Prototipos (UBIPRO 9294–9312, 9314–16, 9336–37, 9339, 9440). Arroyo El Camuchil (same coordinates, elevation and collector as the preceding). 5 July 2002. UBIPRO 9244–5, 9427–34. Verified by Alan deQueiroz. First record for Chihuahua, extending the known range eastward ca. 85 km from Río Chuchijáqui, 7 mi E Alamos, Sonora (Hale 1989. Tucson Herpetol. Soc. Newsl. 2:98).

Submitted by **JULIO A. LEMOS-ESPINAL**, under CONABIO Projects U003, XOO4 and AE003, Laboratorio de Ecología, UBIPRO, Facultad de Estudios Superiores Ixtacala, UNAM, Apartado Postal 314, Avenida de los Barrios s/n, Los Reyes Iztacala, Tlalnepantla, Estado de México, 54090 México (e-mail: lemos@servidor.unam.mx), **DAVID CHISZAR** and **HOBART M. SMITH**, University of Colorado Museum, Boulder, Colorado 80309-0334, USA (e-mail: hsmith@buffmail.colorado.edu).

RANA PALUSTRIS (Pickerel Frog). USA: INDIANA: JENNINGS Co: Crosley Fish and Wildlife Area, CR 300 S, 9.0 km E of Hwy 3. 15 March 2002. Florida Museum of Natural History, University of Florida (UF 134736–737). Stesha Pasachnik. Verified by John Iverson. New county record (Minton 2001. Amphibians and Reptiles of Indiana. Indiana Acad. Sci., Indianapolis, 406 pp.).

Submitted by **STESHA A. PASACHNIK**, Earlham College, Richmond, Indiana 47374, USA; e-mail: pasacst@earlham.edu.

RANA SYLVATICA (Wood Frog). USA: GEORGIA: UPSON Co: Woodland pool near confluence of Turkey Creek and Flint River at Sprewell Bluff, 11.3 km W of Thomaston. Carlos Camp and Alex Pyron. Eggs collected 23 February 2003 and raised to metamorphosis. Verified by E. McGhee. Two newly metamorphosed frogs deposited in Georgia Museum of Natural History (GMNH 49216–17). Site is surrounded by steep bluffs associated with Flint River with mesic hardwoods of oak (*Quercus* spp.) and beech (*Fagus grandifolia*) on lower slopes. Upper slopes and ridge-tops with xeric mixed forest of post oak (*Quercus stellata*) and long-leaf pine (*Pinus palustris*). Site is on lower Piedmont < 30 km N of Fall Line. Represents 145 km southerly extension of range in Georgia (Rubio et al. 2003. Herpetol. Rev. 34:78–80) and southernmost record for species (Davis and Folkerts 1986. Brimleyana 12:29–50).

Submitted by **CARLOS D. CAMP** and **R. ALEX PYRON**, Department of Biology, Piedmont College, PO Box 10, Demorest, Georgia 30535, USA.

RANA SYLVATICA (Wood Frog). USA: KENTUCKY: CAMPBELL Co: Melbourne, NE intersection Rt. 8 and Anderson Rd. 26 June 2002. John Ferner, Brian King, and Eric Chapman. Thomas More College Herpetology Collection (TMC A201). Verified by Jeffrey G. Davis. New county record based on Conant and Collins (1991, A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Houghton Mifflin Co. Boston, Massachusetts, 450 pp.).

Submitted by **JOHN W. FERNER**, **ERIC CHAPMAN**, **BRIAN KING**, and **PAUL KRUSLING**, Department of Biology, Thomas More College, Crestview Hills, Kentucky 41017, USA.

TESTUDINES

CHELYDRA SERPENTINA (Snapping Turtle). USA: NEW MEXICO: TORRANCE Co: DOR north side of Interstate 40, near Osita Draw, 5.7 km W Clines Corners, ca. 2100 m elev. (35°00'16"N, 105°43'52"W). 1 June 2003. Tom Giermakowski and Aaron Lamb. Verified by Charles Painter. University of New Mexico Museum of Southwestern Biology (MSB 66531). New county record (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. Univ. of New Mexico Press, Albuquerque, xix + 431 pp.). Documents presence at a relatively high altitude water body outside of both the Pecos and Rio Grande drainages (to the east and west, respectively). It is unlikely this specimen was a released individual given the locality and proximity to water sources.

Submitted by **TOM GIERMAKOWSKI** (e-mail: tomas@unm.edu) and **AARON LAMB** (e-mail: awlamb5@yahoo.com), Museum of Southwestern Biology, MSC03 2020, University of New Mexico, Albuquerque, New Mexico 87131–0001, USA.

CHELYDRA SERPENTINA SERPENTINA (Eastern Snapping Turtle). USA: TEXAS: MARION Co: 9.7 km NW Jefferson off FM 728, on Berea 3. 12 June 2003. D. I. Moore. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 27919). Verified by Stanley E. Trauth. New county record completely filling hiatus in northeastern Texas of the Arkansas-Louisiana-Texas junction (Allen and McAllister. 2001. Herpetol. Rev. 32:191; Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station. 421 pp.). Also reported previously from adjacent Caddo Parish, Louisiana (Dundee and Rossman 1989. The Amphibians and Reptiles of Louisiana. LSU Press, Baton Rouge. 300 pp.).

Submitted by **DAWN I. MOORE** and **CHRIS T. McALLISTER,** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA; e-mail: chris.mcallister@tamut.edu.

TRACHEMYS GAIGEAE (Big Bend Slider). USA: New Mexico: DONA ANA Co. Rio Grande, ca. 13 km SE of Hatch (T19S, R2W, SE1/4 Sec 27). 11 May 2003. Michael (Mischa) Larisch and Laura J. Larisch. Digital photograph (UTEP 18838). Verified by Douglas

W. Burkett and C. W. Painter. First record for Dona Ana County and southernmost record for New Mexico (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque, xix + 431 pp.). The turtle was caught by fishing in a small pool in the river.

Submitted by **MICHAEL (MISCHA) LARISCH** and **LAURA J. LARISCH**, 517 Cain Drive, Silver City, New Mexico 88061, USA; e–mail: larischm@yahoo.com.

CROCODYLIA

CROCODYLUS ACUTUS (American Crocodile). USA: FLORIDA: Glades Co.: ca. 10.3 km E of Venus (27°04.513'N, 81°14.927'W). 10 May 2000. Kevin M. Enge and Rodney T. Felix. Verified by Paul E. Moler. UF 137132 photographic voucher. New county record and extends the species range ca. 109 km inland from the Atlantic Coast. *Crocodylus acutus* that were presumably released individuals have been reported farther N from Vero Beach, Indian River Co., on the Atlantic Coast and Lake Tarpon, Pinellas Co., on the Gulf Coast (Behler 1978. S. Florida Res. Cent. Rep. T-509, Homestead, Florida. 94 pp.). Juvenile (90 cm TL) captured in a freshwater ditch connecting Jerry Marsh to the headwaters of Gator Slough, which drains into Fisheating Creek. In the 1970s, *C. acutus* frequently escaped from Gatorama (Behler, *op cit.*; Campbell 1979. American Crocodile Recovery Plan. U.S. Fish and Wildl. Serv. 24 pp.), an alligator farm and tourist attraction on US Hwy 27 near Palmdale located ca. 20 km (> 27 km by water) S of the capture site. Gatorama successfully bred and once housed ca. 200 *C. acutus*, but only ca. 45 were observed in 1977 (Behler, *op cit.*). *Crocodylus acutus* up to 4 m long were captured or observed in Fisheating Creek in the late 1970s, and females were observed nesting beyond Gatorama's unburied, chain-link perimeter fence (Tim Breault, pers. comm.). All *C. acutus* at Gatorama were thought to have come from Jamaica (Behler, *op cit.*; Campbell, *op cit.*), but mtDNA sequence data indicate that this specimen had a Florida mother (Michael J. Forstner, pers. comm.). Because the species is endangered and the specimen was of Florida origin, it was released into Fisheating Creek. Fisheating Creek drains into Lake Okeechobee, where *C. acutus* might have occurred infrequently in the past (Willoughby 1898. Across the Everglades: A Canoe Journey of Exploration. J. B. Lippincott Company, Philadelphia, Pennsylvania, 192 pp.; Kushlan and Mazzotti, *op cit.*; Romulus Whittaker, pers. comm.). This specimen was captured ca. 8 km N of the 17°C average January air isotherm, which occurs farther S inland and is considered to generally represent the northern range extent of this tropical species (Kushlan and Mazzotti 1989. J. Herpetol. 23:1–7). The northern extent of the historical nesting distribution was apparently on the Atlantic Coast at Lake Worth, Palm Beach Co. (Campbell, *op cit.*), ca. 47 km S of the capture site. *Crocodylus acutus* are occasionally found up to 50 km inland (Paul E. Moler, pers. comm.), and individuals are capable of making long-distance movements exceeding 100 km (Kushlan and Mazzotti, *op cit.*), but the small size of this specimen suggests that a breeding population consisting of at least one native female might occur in the Fisheating Creek area. Alternately, the specimen could be an escapee from some facility.

Submitted by **KEVIN M. ENGE**, Florida Fish and Wildlife Conservation Commission, Joe Budd Wildlife Field Office, 5300 High Bridge Road, Quincy, Florida 32351, USA.

LACERTILIA

ANOLIS ORTONII (NCN). VENEZUELA: ESTADO BOLÍVAR: Forest at the left margin of Cucurital River (06°00'32"N, 62°46'52"W), 390 m elev. 16 April 1999. E. La Marca. Museo de Historia Natural La Salle, Caracas (MHNLS 14412). Forest at the left margin of Cucurital River, ca. 1550 m from the shores of the small blackwater stream known as Orowapá, at the ornithology base camp "Pipra 2" (5°55'00"N, 62°43'50"W), 450 m elev. 4 February 2000. C. Molina. (MHNLS 14904). 2 May 2002. V. Romero. (MHNLS 15716–17). Indigenous Pemon trail, ca. 200 m from the shores of caño Zamuro, Canaima National Park (6°18'13"N, 62°49'47"W), 400 m elev. 22 July 2002. C. Molina. MHNLS 15815. All verified by G. Rivas. *Anolis ortonii* was first listed for Venezuela by La Marca (1997. Vertebrados Actuales y Fósiles de Venezuela. Serie Catálogo Zoológico de Venezuela. Vol. 1. Museo de Ciencia y Tecnología de Mérida, Venezuela) based on a misidentification. The MHNLS specimens are the first definite records for Venezuela (Peters and Donoso-Barros 1970. Catalogue of the Neotropical Squamata: Part II. Lizards and Amphisbaenians. U.S. Natl. Bull. 297:62; Hoogmoed 1973. Notes on the Herpetofauna of Surimam IV. The Lizards and Amphisbaenians of Surinam. Junk, The Hague; Avila-Pires 1995. Lizards of Brasilian Amazonia [Reptilia: Squamata], Zool. Verh. Leiden 299:1–706; Gorzula and Señaris 1999. Contribution to the Herpetofauna of the Venezuelan Guayana I. A Data Base. Scientiae Guaianae 8: xviii + 1–268, 32 pls.). The new records extend the known range more than 450 km W of the nearest reported locality, near the confluence of the Cuyuní and Essequibo rivers (Avila-Pires, *op. cit.*: 95, map 25), an area between Venezuela and Guyana.

Submitted by **CÉSAR MOLINA**, Museo de Historia Natural La Salle, Sección de Herpetología, Apartado Postal 1930, Caracas 1010–A, Venezuela (e–mail: washaema@hotmail.com), **ENRIQUE LA MARCA**, Laboratorio de Biogeografía, Universidad de Los Andes, Mérida, Venezuela (e–mail: lamarca1@telcel.net.ve), and **CELSA SEÑARIS**, Museo de Historia Natural La Salle, Sección de Herpetología, Apartado Postal 1930, Caracas 1010-A, Venezuela (e–mail: celsa35@hotmail.com).

ASPIDOSCELIS COSTATA COSTATA (Balsas Basin Whiptail). MÉXICO: TLAXCALA: Municipality of Nativitas near Cacaxtla ruins (19°14'33"N, 98°20'40"W), 2293 m elev. 20 May 2000. Lorena López-González and Felipe Rodríguez-Romero. Colección Nacional de Anfibios y Reptiles, Universidad Nacional Autónoma de México (IBH–13795). Verified by Fausto R. Méndez. First record for Tlaxcala (Duellman and Zweifel 1962. Bull. Amer. Mus. Nat. Hist. 123:159–210; Maslin and Secoy 1986. Contrib. Zool. Univ. Colorado Mus. No. 1:1–60).

Submitted by **FELIPE RODRÍGUEZ-ROMERO, OSWALDO HERNÁNDEZ-GALLEGOS,** and **LORENA LÓPEZ-GONZÁLEZ**, Departamento de Zoología, Instituto de Biología, Universidad Nacional Autónoma de México, A.P. 70-153, C.P. 04510, México D. F., México; e-mail: felipe r@ibiologia.unam.mx.

CROTAPHYTUS COLLARIS COLLARIS (Eastern Collared Lizard). USA: OKLAHOMA: LeFlore Co: 14 km W Choctaw Historic State Line Monument site, off OK St. Hwy 1 (Talimena Scenic National Byway), Rich Mountain, 795 m elev. 27 May 2003. C. T. McAllister. Arkansas State University Museum, Herpetological Collection (ASUMZ 27979–80, adult male and female). Verified by S. E. Trauth. First record from Rich Mountain; previously reported from other more distant sites in LeFlore County (Webb 1970. Reptiles of Oklahoma. Univ. Oklahoma Press, Norman, Oklahoma, 370 pp; Secor and Carpenter 1984. Oklahoma Herpetol. Soc. Spec. Publ. 3:1–57; McGuire 1996. Bull. Carnegie Mus. Nat. Hist. 32:1–143; Oklahoma Biological Survey's Distribution of Oklahoma Amphibians and Reptiles by Recorded Sightings, DOKARRS [http://www.biosurvey.ou.edu/dokasdesc.html]). Extends the known range 7.7 km SSW from the Spring Mountain, LeFlore County, Oklahoma site (Webb 1970, *op cit.* p. 152). In this part of their range, valleys do not provide sufficient habitat to support the species, effectively creating isolated mountain island populations. Trauth et al. (In press. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville) reported an historical record for *C. c. collaris* from a "valley" site near the Eagleton and Rich Mountain Communities, in adjacent Polk County, Arkansas. This site is ca. 9 km due E of the site herein. However, no lizards have been found on the Arkansas side of Rich Mountain during recent surveys.

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HELODERMA HORRIDUM HORRIDUM (Mexican Beaded Lizard). MÉXICO: MÉXICO: Municipio de Luvianos, Barranca Peña Blanca (18º51'45"N, 100º18'18"W), 1529 m elev. 26 Aug 2002. A. Hernández Saint-Martin. Colección Nacional de Anfibios y Reptiles del Instituto de Biología, Universidad Nacional Autónoma de México (IBH 13986). Verified by Fausto R. Méndez de la Cruz. First valid record for the state of México. An earlier specimen (MVZ 16434) has locality data attributing it to District Temascaltepec, Tejupilico, Mexico, Mexico (actually Temascaltepec and Tejupilco are separate municipalities). However, Bogert and Martín del Campo (1956. Bull. Amer. Mus. Nat. Hist. 109:1–238) restricted it, without comment, to Tejupilco, México.

Submitted by **XOCHITL AGUILAR MIGUEL, OCTAVIO MONROY VILCHIS**, Centro de Investigación en Recursos Bióticos, Fac. Ciencias, Univ. Autón. Edo. México, Instituto Literario #100, 50000, Toluca, Estado de México, México, and **GUSTAVO CASAS-ANDREU**, Instituto de Biología, UNAM Apdo. Postal 70–x153, 04510 México, D.F. México (e-mail:gcasas@servidor.unam.mx).

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). USA: ARKANSAS: Washington Co.: greenhouse and physics buildings on the campus of the University of Arkansas, junction of Duncan and Dickson streets, Fayetteville, Arkansas (36°03'59"N, 94°10'15"W). 5 September 2001. Glenn J. Manning and Jeffrey T. Briggler. University of Arkansas Museum (adult: ARK 2001–10–1 and juvenile: ARK 2001–10–2). Verified by James M. Walker. Three juvenile geckos were first seen in the physics building on 18 October 1999. A juvenile gecko was collected in October 2000 on the sidewalk near the physics building. On 5 September 2001, investigation of physics building and surrounding buildings resulted in the observation of three adult geckos on the outside of the greenhouse (one was taken for a voucher), and two geckos on the outside of the physics building (one juvenile and one adult). The juvenile was taken as a voucher. The adult had a SVL of 50 mm and weighed 3.0 g, and the juvenile had a SVL of 26 mm and weighed 0.5 g. This record extends the range of *H. turcicus* ca. 97 km N from the nearest known population at University of Arkansas–Fort Smith (formerly Westark Community College), Sebashian Co. (Paulissen and Buchanan 1990. Herpetol. Rev. 21:22). It has been determined that this is an established population that was introduced through the greenhouse.

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LEIOCEPHALUS CARINATUS (Northern Curly-tailed Lizard) USA: FLORIDA: Lee Co.: Cape Coral: on patio at 1434 SE 20th Street (26°36'51"N, 81°56'43"W). 10 July 2003. T. S. Campbell and G. S. Klowden. Verified by Kenneth Krysko, University of Florida Museum of Natural History (UF 137383). County record. One female collected, numerous males and females observed on driveways and landscaping at nearly every residence on the 1400 block of 20th Street, two observed on the 1300 block of 20th Street, and one seen on the 1400 block of SE 19th Lane. First record of this species on the west coast of Florida, extending its range southwest ca. 100 km from populations established in Highlands County (Layne 1987. Herpetol. Rev. 18:20) and west and northwest ca. 200 km from the populations established in Palm Beach, Miami-Dade, and Martin counties (King and Krakauer 1966. Quart. J. Florida Acad. Sci 29:144–154; Wilson and Porras 1983. Univ. Kansas Mus. Nat. Hist. Spec. Publ. 9:1–89; Hauge and Butterfield 2000. Herpetol. Rev. 31:53).

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LEPIDODACTYLUS LUGUBRIS (Mourning Gecko). NEW CALEDONIA : D'ENTRECASTEAUX REEFS: The Surprise and Huon Islands: Surprise Island : northern meteorological station and south beach. MNHN 2002.750–751, 2002.753–756, all clone A except for MNHN 2002.755 which was clone C. 11–12 November 2002. Olivier Lorvelec. Verified by Roger Bour. First confirmed island record. Huon Island : western beach. MNHN 2002.752, clone A. 13 November 2002. Olivier Lorvelec. Verified by Roger Bour. First island record. Recorded in New Caledonia from mainland New Caledonia, Isle of Pines, Loyalty Islands and Chesterfield Reefs (Bauer and Sadlier 2000. The Herpetofauna of

New Caledonia, SSAR, Ithaca, New York. xii + 1–310). An unidentified gecko from Surprise Island is tentatively referred to that species by Bauer and Sadlier (*op. cit.*) but no voucher specimens were previously available to support this identification.

Submitted by **IVAN INEICH**, Muséum national d'Histoire naturelle, Département d'Ecologie et de Gestion de la Biodiversité, FRE 2632 - Conservation des Espèces, Restauration et Suivi des populations, 25 rue Cuvier, F-75005 Paris, France (e–mail: ineich@cimrs1.mnhn.fr), and **OLIVIER LORVELEC**, Equipe Gestion des Populations Invasives (ex. Faune Sauvage et Biologie de la Conservation), INRA–Unité SCRIBE, Campus de Beaulieu, F–35042 Rennes Cedex, France.

NOROPS BIPORCATUS (NCN). VENEZUELA: ESTADO MÉRIDA: Hacienda Mesa de Los Negros, Las Virtudes, 600 m elev. Museo de Historia Natural La Salle, Caracas, Venezuela (MHNLS 8012 and 8491, both adult females, each with one enlarged oviductal egg). S. Boher. 30 December 1979 and 15 August 1980. Verified by C. R. Molina. First state record and easternmost for the species, extending its distribution 170 km NE from the nearest locality, La Fría in Táchira state (Williams 1966. Breviora 239:1–14). This green anole has a wide distribution in Central America, from México to Panamá (Savage 2002. The Amphibians and Reptiles of Costa Rica: a Herpetofauna Between Two Continents, Between Two Seas. University of Chicago Press, Chicago, Illinois. 934 pp.) and extending to northern South America, through Chocoan Colombia and Ecuador, west of the Andes, but also extending to northeast Colombia, reaching the Maracaibo Basin in Venezuela. In Venezuela the species was formerly known from two localities in two different states, Zulia (Perijá: Kasmera and misión El Tokuko) and Táchira (see Williams 1966, *op. cit.*).

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SCELOPORUS OCHOTERENAE (Ochoterena's Spiny Lizard). MÉXICO: PUEBLA: Mixteca Poblana, 4.6 km SE Izúcar de Matamoros, 1100 m elev. 17 July 1955. F. G. Thompson. UMMZ 112578. 1.6 km E Raboso. Additional records for this species (e.g., RKU 37736, LSU 6417, EBUAP 2044–45, MZFC 6845–46) exist, all within 10 km of the first locality. First records for the state, extending its range eastward ca. 36 km from 2 km S of Jonacatepec, Morelos (TCWC 6529, 6547). All the above Puebla localities are situated on the extreme western edge of the state, and represent the northwestern extreme of the known range of the species (personal data of HMS).

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SCELOPORUS TORQUATUS MELANOGASTER (Black-bellied Crevice Swift). MÉXICO: MÉXICO: Municipio de Polotitlán, 1.5 km W of Taxhié (20°13'49"N, 99°54'36"W), 2191 m elev. 29 October 2002. Oswaldo Hernández, Felipe Rodríguez, and Gustavo Casas. Colección Nacional de Anfibios y Reptiles del Instituto de Biología, Universidad Nacional Autónoma de México (IBH 13968–70). Verified by Fausto R. Méndez de la Cruz. First record for the state of México (Camarillo and Smith 1992. *In* Strimple and Strimple [eds.], Contributions in Herpetology, pp. 39–41. Greater Cincinnati Herpetological Society, Cincinnati, Ohio; Casas et al. 1997. Anfibios y Reptiles, Lista Taxonómica de los Vertebrados Terrestres del Estado de México. Univ. Autón. Edo. México, Cienc. Tec. No. 32:9–53).

Submitted by **OSWALDO HERNÁNDEZ-GALLEGOS** (e–mail: oswaldo@ibiologia.unam.mx), **FELIPE RODRÍGUEZ-ROMERO** and **GUSTAVO CASAS-ANDREU**, Instituto de Biología, UNAM, Apdo. Postal 70-153, México, D.F. 04510, México.

SPHENOMORPHUS RUFOCAUDATUS (Red-tailed Groundskink). VIETNAM: VINH PHUC: Tam Dao. June 1985. Vazlav Lanka. Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany (ZFMK 59216). CHINA: HAINAN: Wuzhishan. April 1995. Peter Heimes. Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany (ZFMK 61734). All verified by Wolfgang Böhme. *Sphenomorphus rufocaudatus* was previously only known from its type locality, Gia Lai Province, Tai Nguyen Plateau, Buon Luoi, 60 km N of An Khe, South Vietnam (Darevsky and Nguyen 1983. Zoologicheskii Zhurnal 62:1827–1837). The new finding from Vinh Phuc in northern Vietnam represents the northernmost record of the species both in Vietnam and in general. It extends the known distribution by ca. 900 km air distance to the north. The specimen from Hainan was caught at 700 m elev. and is the first record for China. Besides coloration and pattern, its 60 scales between the second pair of chinshields and the preanal scales are characteristic of *S. rufocaudatus*. Both specimens are males (ZFMK 59216: SVL 42 mm; ZFMK 61734: SVL 49 mm, testes length 5.1 mm). The gastrointestinal tract of the specimen from Vinh Phuc contained remains of about 10 ca. 3.5 mm long bugs (Heteroptera); the specimen from Hainan had eaten one unidentified insect of 15 mm length as well as a cockroach and a grasshopper of 11 mm head–body length each.

Submitted by **ANDREAS SCHMITZ,** Zoologisches Forschungsinstitut und Museum Alexander Koenig, Adenaueralle 160, D-53113 Bonn, Germany (e-mail: A.Schmitz.ZFMK@uni-bonn.de), and **THOMAS ZIEGLER**, Zoologischer Garten Köln, Riehler Str. 173, D-50735 Köln, Germany (e-mail: tziegler@zoo-koeln.de).

STENOCERCUS DUMERILII (NCN). BRAZIL: MARANHÃO: São Pedro da Água Branca Municipality (05°08'S, 48°15'W). 05 May 1998. G. V. Andrade. Museu Paraense Emílio Goeldi, Belém, Pará, Brazil (MPEG 21370). Adult male collected on a branch 1 m above the ground in a secondary forest. Urbano Santos Municipality (ca. 40 m elev.); Fazenda Bacelar (03°12'15"S, 43°09'23"W). 12 March 2003. A. O. Maciel. MPEG 21371. Juvenile specimen captured with pitfall trap in gallery forest. All

verified by T. C. Ávila-Pires. Published distribution (Avila-Pires 1995. Lizards of Brazilian Amazonia [Reptilia: Squamata]. Zoologische Verhandelingen 299, 706 pp.) is restricted to northeastern Pará state, in the northern region of Brazil, between Baía de Marajó in the east, and Gurupi River in the west, and from the coast to ca. 40 km S of Guamá River. These new records for the state of Maranhão extend range ca. 316 km eastward, and ca. 416 km southward. Occurrence of this species in the amazonic secondary forest in São Pedro da Água Branca would be expected, but its presence in the gallery forest in Urbano Santos expands the distribution to the Cerrado domain.

Submitted by **GILDA V. ANDRADE** (e-mail: gandrade@ufma.br), **JUCIVALDO D. LIMA** (e-mail: jucivaldo@yahoo.com), and **ADRIANO O. MACIEL**, Universidade Federal do Maranhão, Departamento de Biologia, Campus do Bacanga, CEP 65080-040, São Luís, Maranhão, Brazil.

URACENTRON AZUREUM WERNERI (NCN). VENEZUELA: AMAZONAS: Quebrada Coromoto, Tobogan de la Selva (05°23'36"N, 67°36'22"W, 120 m elev.). 21 April 1985. P. Lau. Museo de la Estación Biológica de Rancho Grande, Maracay (MEBRG 4157); Santa Barbara, Macuruco (03°54'N, 67°00'W, 100 m elev.). 14 August 2002. A. L. Ulloa. (MEBRG 4213); Isla Tiriquin, Río Guainia (02°16'N, 67°02'W, 120 m elev.). 11 March 1991. E. León. Museo de Historia Natural la Salle, Caracas (MHNLS 11608); Surumoni, near La Esmeralda (03°10'N, 65°40'W, 105 m elev.). July 1998. N. Jerome, G. Schlatte, and N. Ellinger (MHNLS 14097–99, 14106). All verified by G. Rivas. *U. a. werneri* was known from only two localities in Venezuela, one of them the type locality—Alto Orinoco, south of Venezuela—and the other in the Río Mavaca, near Mrakapiwei, Amazonas state (02°10'N, 65°10'W, 130 m elev.) (Avila-Pires 1995. Zool. Verh. Leiden 299:1–706). The record from Quebrada Coromoto extends the known range for the species ca. 440 km N of the closest reported locality (Avila-Pires 1995, *op. cit.*).

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SERPENTES

BOTHROPS NEUWIEDI DIPORUS (Yarará chica). ARGENTINA: NEUQUÉN: Añelo Department: Fortín de la Piedra, near Neuquén River, 45 km S Añelo. 1 August 2003. Museo de Ciencias Naturales, La Plata (MLP 1797). Verified by J. C. Acosta. First verified province record (Giraudo and Scrocchi 2002. Smithson. Herpetol. Infor. Serv. 132) and southwesternmost record for the species in Argentina. The nearest record for this species is ca. 180 km E in Río Negro Province (Pérez and Avila 2000. Herpetol. Rev. 31:254). Adult specimen (88 mm total length) collected 700 m from Neuquén River in a typical southern Monte habitat. Second *Bothrops* species found in Neuquén province, with *B. ammodytoides* previously reported for this region.

Submitted by **DANIEL R. PEREZ**, Catedra Bioecología, Universidad Nacional del Comahue, Calle Buenos Aires 1400-, Neuquén, CP: 8300, Argentina, **LEOPOLDO R. MARTINEZ**, Painamal 168, B° 11 de Octubre, Centenario, Provincia de Neuquén, CP: 8309, Argentina, and **LUCIANO JAVIER AVILA**, CONICET/Integrative Biology, Brigham Young University, 401 WIDB, Provo, Utah 84602, USA (e-mail: luciano_javier@hotmail.com).

BOTHROPS NEUWIEDI LUTZI (Neuwied's Lancehead). BRAZIL: BAHIA: Camaçari (12°41'51"S, 38°19'27"W). 05 July 1995, Centro de Informações Anti-Veneno da Bahia-CIAVE, Universidade Federal da Bahia-serpentes (UFBA–ser 985); 08 March 1995, UFBA-ser 986. Dias D´Ávila (12°36'45"S, 38°17'49"W). 18 April 2000, CIAVE, UFBA-ser 1191. Verified by M. Trefault. This subspecies is known only in northern Bahia, Brazil where it is found in dry or warm regions of Serra de Monte Santo, Jaguarari and Itiuba (Bahia), and the nearby S. Francisco River, at ca. 300–500 m elev. (Campbell and Lamar 1989. The Venomous Reptiles of Latin America. Cornell Univ. Press, Ithaca, New York). In addition to a range extension of ca. 325 km E (Campbell and Lamar, *op. cit.*), this is the first documented occurrence of *B. neuwiedi lutzi* at sea level.

Submitted by **REJÂNE MARIA LIRA-DA-SILVA, YUKARI FIGUEROA MISE**, Núcleo Regional de Ofiologia e Animais Peçonhentos da Bahia, Departamento de Zoologia, Instituto do Biologia, UFBA, Campus Universitário de Ondina, 40170-210, Salvador, Bahia, Brazil; **GIUSEPPE PUORTO** Instituto Butantan, Av. Vital Brazil, 1500, 05504-900, São Paulo, São Paulo, Brazil, and **VINÍCIUS XAVIER**, Centro Universitário Federal de Alfenas, Rua Gabriel Monteiro da Silva, 714, 37130-000 , Alfenas, Minas Gerais, Brazil.

CONTIA TENUIS (Sharp-tailed Snake). USA: WASHINGTON: Yakima Co: Terrace Heights (T13N R19E S17 and T13N R19E S15). Verified by R. Steven Wagner. Two specimens (CWU 1077–78) were collected on 28 March 2002, one adult and one juvenile. The juvenile was collected inside a utility closet of a nearby residence and the adult was collected near the porch of another. In addition to these specimens, two adults (CWU 1079–80) were found near another residence at the second locality. These were found in the backyard of the home near some small garden stones in July 2002 (precise date not available). The area surrounding these localities is very different from the habitat usually associated with this species. The nearby hillsides are dominated by introduced cheat grass, with some rabbit brush and big sage. The only permanently available water source is a small irrigation canal flowing through the area. However, the yards and gardens of nearby homes could provide suitable microhabitats. Adjacent to these residential collection sites are numerous commercial properties and a small industrial complex. These localities represent new county records for this species and are a 32.5 km range extension S of the nearest confirmed locality in nearby Kittitas County (Storm et. al. 1995. Reptiles of Washington and Oregon. Seattle Audubon Society, Seattle, Washington. 176 pp.). However, given the lack of precise knowledge of this species' distribution in central Washington, it might be found throughout the Yakima River drainage basin.

Submitted by **ROBERT E. WEAVER** (e-mail: weaverr@cwu.edu) and **DAVID M. DARDA** (e-mail:

dardad@cwu.edu) Department of Biological Sciences, Central Washington University, Ellensburg, Washington 98926–7537, USA.

CROTALUS ATROX (Western Diamond-backed Rattlesnake). USA: ARKANSAS: Hot Spring Co: 6.5 km NE Bismarck, SE1/4 Sec. 27 T4S R20W. 15 April 2003. Mark Karnes. Henderson State University collection 1292. Verified by Stan Trauth. First record for Hot Spring Co., extends known range ca. 30 km SE from the nearest record from Montgomery Co., still within the Ouachita Mountains Physiographic Region (Trauth and Cochran 1992. Bull. Chicago Herpetol. Soc. 27[4]:89–94).

Submitted by **MARK KARNES**, The Ross Foundation, Arkadelphia, Arkansas 71923, USA, and **RENN TUMLISON**, Department of Biology, Henderson State University, Arkadelphia, Arkansas 71999, USA.

CROTALUS HORRIDUS (Timber Rattlesnake). USA: ARKANSAS: Little River Co: 3.9 km NW Billingsleys Corner off St. Hwy. 41 on county road 801, vic. Little River bottoms. 21 June 2003. A. D. Burns. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 27937). Verified by Stanley E. Trauth. New county record partially filling hiatus in extreme southwestern Arkansas (Trauth et al. In press. Amphibians and Reptiles of Arkansas, Univ. of Arkansas Press, Fayetteville). Also reported previously from nearby Bowie County, Texas (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station. 421 pp.; Werler and Dixon 2000. Texas Snakes: Identification, Distribution, and Natural History. Univ. of Texas Press, Austin, 437 pp.), Caddo Parish, Louisiana (Dundee and Rossman 1989. The Amphibians and Reptiles of Louisiana. LSU Press, Baton Rouge. 300 pp.) and McCurtain County, Oklahoma (Webb 1970. Reptiles of Oklahoma. Univ. Oklahoma Press, Norman, Oklahoma, 370 pp.; Secor and Carpenter 1984. Oklahoma Herpetol. Soc. Spec. Publ. 1:1–57; Oklahoma Biological Survey's Distribution of Oklahoma Amphibians and Reptiles by Recorded Sightings, DOKARRS [http://www.biosurvey.ou.edu/dokadesc.html]).

Submitted by **ANGELA D. BURNS** and **CHRIS T. McALLISTER,** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA; e-mail: chris.mcallister@tamut.edu.

CROTALUS HORRIDUS (Timber Rattlesnake). USA: VIRGINIA: Hanover Co. , 4.3 km ESE Old Church, jct. Co. rts 606 and 693. 18 September 2002. N. Evans. USNM 559001. Verified by Don Schwab. Extension of known range in Virginia 82 km NE of nearest location in York County, Virginia (Mitchell and Reay 1999. Atlas of Amphibians & Reptiles in Virginia. Virginia Dept. Game & Inland Fisheries, Richmond, Virginia). County record. Verifies observation on upper Coastal Plain by Lederer (1672. The Discoveries of John Lederer in Three Marches from Virginia to the West of Carolina. Trans. from Latin by Sir W. Talbot, London. Reprinted G. P. Humphrey, Rochester, New York) in present-day adjacent New Kent County and supports the assumption that this species occurred historically throughout Virginia (Mitchell 1994. The Reptiles of Virginia. Smithsonian Inst. Press, Washington, DC.).

Submitted by **JOSEPH C. MITCHELL**, Department of Biology, University of Richmond, Richmond, Virginia 23173, USA.

CROTALUS LEPIDUS (Rock Rattlesnake). USA: NEW MEXICO: Socorro Co: White Sands Missile Range. Western bajada of Mockingbird Mountains in boulder field. T9S R4E NW 1/4 Sec 13. 29 August 2000. D. Black and D. W. Burkett. Verified by C. W. Painter. University New Mexico Museum Southwestern Biology (MSB 62003). First record from Mockingbird Mountains and most eastern distribution record for Socorro Co. (Degenhardt et al. 1996. The Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque).

Submitted by **DAVID BLACK** and **DOUGLAS W. BURKETT**, MEVATEC Corporation, P.O. Box 399, White Sands Missile Range, New Mexico 88002, USA.

CROTALUS LEPIDUS LEPIDUS (Mottled Rock Rattlesnake). MÉXICO: SAN LUIS POTOSÍ: Municipio de Guadalcázar, Las Lagunas (22°43'N, 100°26'W), 2099 m elev. 6 June and 22 October 1999. Xóchitl Hernández-Ibarra and Ricardo Torres-Cervantes. Colección Nacional de Anfibios y Reptiles, Instituto de Biología, Universidad Nacional Autónoma de México (IBH 13991, 13992). Las Lagunas (22°43'N, 100°23'W), 2088 m elev. 13 September 1999. Omar Ramos-Flores. IBH 13993. All verified by Edmundo Pérez-Ramos. Extends the documented range ca. 90 km SE from Charcas, San Luis Potosí (Klauber 1952. Bull. Zool. Soc. San Diego 26:1–144) and represents the southeasternmost locality for this subspecies. All three snakes were found in mesquite-grassland.

Submitted by **XÓCHITL HERNÁNDEZ-IBARRA,** Laboratorio de Ecología, Unidad de Biología, Tecnología, y Prototipos (UBIPRO), Facultad de Estudios Superiores-Iztacala, Universidad Nacional Autónoma de México, Av. de Los Barrios 1, Los Reyes Iztacala, Tlalnepantla, Estado de México, C.P. 54090, A.P. 314, México, **ROBERT W. BRYSON, JR.,** Department of Herpetology, San Antonio Zoo, 3903 North St. Mary's Street, San Antonio, Texas 78212, USA (e-mail: rob_bryson2002@yahoo.com), and **AURELIO RAMÍREZ-BAUTISTA,** under CONABIO project R045 and CONACYT project No. 27618-N, Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo, A.P. 1-69 Plaza Juárez, C.P. 42001, Pachuca, Hidalgo, México.

CROTALUS MOLOSSUS NIGRESCENS (Mexican Black–tailed Rattlesnake). MEXICO: TLAXCALA: Municipio de Tlaxco, Ejido Lagunillas (19°41'46"N, 98°15'86"W), 2774 m elev. 14 September 2002. Jesús Fernández and Claret Sánchez. Departamento de Agrobiología, Universidad Autónoma de Tlaxcala (RO 258, RO 272) and Colección Nacional de Anfibios y Reptiles, UNAM (IBH–13967). Verified by Gustavo Casas-Andreu. First verified record for the state (Campbell and Lamar 1989. The Venomous Reptiles of Latin America. Cornell Univ. Press. 425 pp.).

Submitted by **JESÚS ABRAHAM FERNÁNDEZ FERNÁNDEZ** (e-mail: jaff@ibiologia.unam.mx), and **GABRIEL BARRIOS QUIROZ**, Instituto de Biología UNAM., 3er Circuito Ext. s/n Ciudad Universitaria, Coyoacan, México, D.F., A.P. 70–153, C.P. 04510, **CLARET SÁNCHEZ AGUILAR** and **MOISÉS MINOR**, Departamento de Agrobiología, Universidad Autónoma de Tlaxcala, Ixtacuixtla, Tlaxcala, C.P. 90120, México.

DIPSAS VARIEGATA (NCN). VENEZUELA: ESTADO BARINAS: Barinitas City, 650 m elev. August 2002. D. Calcaño. Colección de Vertebrados, Universidad de los Andes, Mérida, Venezuela (CVULA 6532). Verified by A. Orellana. First state record, second from the Andean piedmont, 90 km SSW from the closest record from Portuguesa state (Markezich 2002. Herpetol. Rev. 33:71). The species seems to be distributed through all of northern South America and Panama, although the limits are not well defined (Cunha and Nascimento 1993. Bol. Mus. Paraense Emilio Goeldi 9:1–191). In Venezuela it is only known from the Coastal Range (Roze 1966. La Taxonomía y Zoogeografía de los Ofidios de Venezuela. Ediciones de la Biblioteca, Universidad Central de Venezuela, Caracas). The former known distribution and the new record suggest a corridor between the coastal range and the Andean foothills, as has recently been demonstrated for other snakes—*Dipsas latifrontalis* (Manzanilla et al. 2001. Herpetol. Rev. 32:195) and *Stenorhina degenhardti* (Barrio and Calcaño 2001. Herpetol. Rev. 32:280).

Submitted by **DANIEL CALCAÑO,** Serpentarium Los Llanos, Barinitas, Barinas, Venezuela (e–mail: serpentariolosllanos@hotmail.com), and **CESAR L. BARRIO-AMORÓS,** Fundación AndígenA, Apartado Postal 210, Mérida 5101-A, Venezuela (e–mail: cesarlba@yahoo.com).

ELAPHE FLAVOLINEATA (Yellow-striped Ratsnake). WEST MALAYSIA: PAHANG: PULAU TIOMAN: Kampung, Tekek (2°48.942'N, 104°09.289'E). 17 March 2003. Female, SVL 369 mm, TL 468 mm. Perry L. Wood, Timothy M. Youmans, L. Lee Grismer. Verified by Jesse L. Grismer. La Sierra University Photographic Collection 3752. Previously known from Thailand south through west Malaysia and its western islands to Singapore. Also known from Andaman and Nicobar Islands of India and the Indonesia islands of Sumatra, Java, Borneo, Bangka, Billiton and the Indonesian archipelagos of Mergui, Mentawai, and Riau (Schulz 1996. A Monograph of the Colubrid Snakes of the Genus *Elaphe* Fitzinger. Koeltz Scientific Books, Würselen, 439 pp.). This specimen is a new record for Pulau Tioman.

Submitted by **PERRY L. WOOD** (e-mail: perrwood@lasierra.edu), **TIMOTHY M. YOUMANS**, and **THOMAS SZUTZ,** Department of Biology, La Sierra University, Riverside, California 92515–8247, USA.

ELAPHE OBSOLETA (Western Ratsnake). USA: TEXAS: GREGG CO: Near small unnamed creek on private land, ca. 1 km E of Kilgore (32°23'39"N, 94°49'45"W). 20 April 2003. Shelby C. Braman. The University of Texas at Arlington (UTA R–52380). Verified by Ronald L. Gutberlet, Jr. Specimen was a juvenile female (16.7 g, 360 mm SVL, 433 mm total length) collected in a wooden nest box containing Carolina chickadee (*Poecile carolinensis*) nestlings. First county record (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M University Press, College Station, Texas. 421 pp.).

Submitted by **SHELBY C. BRAMAN** (shelbycbraman@stemail.uttyl.edu) and **BRIAN E. FONTENOT**, Department of Biology, The University of Texas at Tyler, Tyler, Texas 75799, USA.

ELAPHE SLOWINSKII (= Elaphe guttata guttata in part*)* (Slowinski's Cornsnake). USA: LOUISIANA: CALCASIEU PARISH: State Highway 12, 13.8 km E US Route 190 in Stark, Louisiana (30°23'09"N, 93°32'37"W). 9 May 2003. TCWC 86520. Collected by KJ Lodrigue, Jr., and Ted M. Royer. Verified by Jeff Boundy. New parish record partially fills the distributional hiatus between Jefferson Davis Parish, Louisiana, and known southeast Texas specimens (Dundee and Rossman 1989. The Amphibians and Reptiles of Louisiana, Louisiana State University Press, Baton Rouge. 300 pp.)

Submitted by **KJ LODRIGUE, JR.**, Texas Parks and Wildlife Department, 10 Parks and Wildlife Drive, Port Arthur, Texas 77640, USA.

HYDROPHIS COGGERI (Cogger's Sea Snake). NEW CALEDONIA: LOYALTY ISLANDS: Lifou: Baie du Santal, 20°46'S, 167°06'E. Observed by Philippe Borsa on 26 January 2002, at 2000 h local time from the research vessel *Alis* of Institut de Recherche pour le Développement (IRD). The bottom was ca. 25 m in depth, and the vessel was anchored with its motor stopped. The snake was captured using a band-net, hauled on the deck, examined, photographed, and released. Total length was ca. 80 cm. Three pictures were taken by J.-L. Justine (Muséum national d'Histoire naturelle, Paris [MNHN]) and P. B. (MNHN Photo collection ine-hydcog 1, ine-hydcog 2, and ine-hydcog 3). Verified by Roger Bour. Also, scales were taken from the tail region using scissors, stored in 90% ethanol, and deposited as tissue sample at Laboratoire Reptiles et Amphibiens, MNHN. First record for Loyalty Islands. This species was previously reported from the waters around New Caledonia's Grande Terre and Chesterfield Reefs (Bauer and Sadlier 2000. The Herpetofauna of New Caledonia. SSAR, Ithaca, New York. 310 pp.; Ineich and Laboute 2002. Sea Snakes of New Caledonia. MNHN and IRD editions, Paris. 302 pp.).

Submitted by **IVAN INEICH**, Muséum national d'Histoire naturelle, Département Ecologie et Gestion de la Biodiversité, FRE 2632 Conservation des espèces, Restauration et suivi des populations, 25 rue Cuvier, F-75005 Paris, France (e-mail: ineich@cimrs1.mnhn.fr), and **PHILIPPE BORSA**, Institut de Recherche pour le Développement, Département des Ressources Vivantes, BPA5, 98848 Nouméa cedex, Nouvelle-Calédonie (e-mail: Philippe.Borsa@noumea.ird.nc).

LIOPHIS TAENIOGASTER (NCN). BRAZIL: PARÁ: Itaituba (4°17'S; 55°59'W), left margin of the Tapajós River, N. Viana, 1996. Linha de Pesquisa em Herpetologia da Amazônia, Faculdades Integradas do Tapajós (LPHA 1321, male, 322 mm). Verified by A. G. Guedes. The species was known from northeastern Brazil from the State of Bahia to Amapá; west through the Amazon Basin to Lomalinda, Colombia, south to Buena Vista, Bolivia, east to the State of Mato Grosso, Brazil (Fernandes et al. 2002. Bol. Mus. Nac., N. S., Zool., Rio de Janeiro [481]:1–14). First record for middle Tapajós River (western Pará), fills the gap between previously known localities. Specimen was collected ca. 234 km airline from Santarém, the nearest previous record (Frota 2001. Herpetol. Rev. 32:123).

Submitted by **JOSSEHAN GALÚCIO DA FROTA** (e-mail: jgfrota@mailbr.com.br) and **ALFREDO PEDROSO DOS**

SANTOS-JR, Laboratório de Herpetologia, Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), Av. Ipiranga, 6681, Porto Alegre, RS, Brazil, CEP: 90619-900.

MICRURUS AVERYI (Black-headed Coral Snake). BRAZIL: PARÁ: Instituto de Pesquisa Agropecuária do Norte (IPEAN), Municipality of Belém (01°27'21"S, 48°30'16"W). September–October 1973. L. Carlos. Museu Nacional, Rio de Janeiro, Brazil (MNRJ 7362, juvenile female 399 mm SVL, 40 mm TL). Verified by R. Fernandes. First state report, and easternmost record (Roze 1996. Coral Snakes of the Americas: Biology, Identification, and Venoms. Krieger Publ., Malabar, Florida. 328 pp.); extends known range ca. 1245 km from eastern Manaus, State of Amazonas, Brazil (Vanzolini 1985. Pap. Avuls. Zool., São Paulo 36[8]:77–85), 1000 km from southwestern Suriname (Brongesma 1967. Mem. Inst. Butantan 33[1]:73–79), and 1343 km from northwestern Claudia, State of Mato Grosso, Brazil (Callefo 1997. Herpetol. Rev. 28:210).

Submitted by **PAULO PASSOS,** Departamento de Vertebrados, Museu Nacional, Universidade Federal do Rio de Janeiro, Quinta da Boa Vista s/n, Rio de Janeiro, Rio de Janeiro, 20940-040, Brazil; e–mail: ppassos@mn.ufrj.br.

OPHEODRYS VERNALIS (Smooth Greensnake). USA: VIRGINIA: SHENANDOAH Co: 0.5 km (by road) SE of West Virginia state line on Co. Rd 691; 640 m elev. 25 July 1996. T. Akre. Georgia Museum of Natural History, University of Georgia (GMNH 49215). Verified by Carl H. Ernst. Gravid female found on soil under 0.1 m flat rock on south-facing slope of a rocky, pine-oak woodland frequently disturbed by camping activity. County record. New locality extends known Virginia geographic range northward by ca. 50 km (Mitchell and Reay 1999. Atlas of Amphibians and Reptiles in Virginia. Virginia Department of Game and Inland Fisheries, Spec. Publ. No. 1:v + 122 pp. Richmond, Virginia).

Submitted by **THOMAS S. B. AKRE**, Savannah River Ecology Laboratory, University of Georgia, Drawer E, Aiken, South Carolina 29802, USA.

OPHEODRYS VERNALIS (Smooth Greensnake). USA: VIRGINIA: FREDERICK Co: George Washington National Forest. 39°04'40"N, 78°30'36"W. 579 m elev. 1 June 2001. T. Akre and T. Robison. Georgia Museum of Natural History, University of Georgia (GMNH 49214). Verified by Carl H. Ernst. County record. New locality extends known Virginia geographic range to the northeast by ca. 22 km. (Akre 2003. Herpetol. Rev. 34:389); Mitchell and Reay 1999. Atlas of Amphibians and Reptiles in Virginia. Virginia Department of Game and Inland Fisheries, Spec. Publ. No. 1:v + 122 pp. Richmond, Virginia).

Submitted by **THOMAS S. B. AKRE**, Savannah River Ecology Laboratory, University of Georgia, Drawer E, Aiken, South Carolina 29802, USA, and **TONY F. ROBISON**, 5340 Holmes Run Parkway #312, Alexandria, Virginia 22304, USA.

PAREAS VERTEBRALIS (Mountain Snail Snake). MALAYSIA: WEST MALAYSIA: Pahang: Pulau Tioman (02°46.040'N, 104°10.483'E). 21 March 2003. Timothy M. Youmans and Perry L. Wood. La Sierra University Photo Collection (LSUPC–S3696–4000). Verified by Jesse L. Grismer. New island record. Up to the present, *P. vertebralis* is recorded from Bukit Larut, Cameron Highlands and Bukit Fraser of the Malay Peninsula, West Malaysia, and Mt. Kinabalu of Sabah, East Malaysia (Manthey and Grossman 1997. Amphibien und Reptilien Südostasiens. Natur und Tier, Münster. p. 378). This specimen was found at 814 m elev., near the cave Gua Tengkok Air. The snake was climbing on the branch of a rattan palm at night, ca. 2 m above the ground.

Submitted by **TIMOTHY M. YOUMANS** (e–mail: timoyoum@lasierra.edu), **PERRY L. WOOD**, and **THOMAS R. SZUTZ**, Department of Biology, La Sierra University, Riverside, California 92515-8247, USA.

PORTHIDIUM LANSBERGII (Landsberg's Hognosed Pitviper). VENEZUELA: ESTADO BOLÍVAR. Municipio Piar, El Retumbo, 7°59'N, 62°44'W. November 2001. A. Bermúdez and J. Manzanilla. Museo de la Estación Biológica de Rancho Grande, Ministerio del Ambiente y de los Recursos Naturales (EBRG 4277); ESTADO DELTA AMACURO, Municipio Casacoima, Los Castillos de Guayana, 8°31'N, 62°23'W. 50 m elev. January 1952. J. R. García. Museo del Instituto de Zoología Agrícola, Universidad Central de Venezuela (MIZA 16-152). Both verified by D. Sánchez. First record for Bolivar and Delta Amacuro states, southernmost known locality for the genus and species in Venezuela and first record from the southern margin of the Orinoco River (Gorzula and Señaris 1998. Scientia Güaianae 8:1–268). Extends known distribution 241 km airline from previous records in the Oriental Region of Venezuela (Roze 1966. Taxonomía y Zoogeografía de los Ofidios de Venezuela. Edición de la Biblioteca, Universidad Central de Venezuela, p. 89; Kornacker 1999. Checklist and Key to the Snakes of Venezuela. PaKo-Verlag, Germany, pp. 176–177).

Submitted by **JESÚS MANZANILLA,** Museo del Instituto de Zoología Agrícola, Facultad de Agronomía, Universidad Central de Venezuela, Aragua, Venezuela (e–mail: manzanillaxxi@hotmail.com), and **MARCO NATERA**, Universidad Rómulo Gallegos, San Juan de Los Morros, Guárico, Venezuela.

PSEUSTES SHROPSHIREI (NCN). VENEZUELA: ESTADO BARINAS: Barinitas City, sector El Cacao, 600 m elev. 14 May 2003. D. Calcaño. Colección de Vertebrados, Universidad de los Andes, Facultad de Ciencias, Mérida (CVULA 6533). First state record, 300 km SW of Valencia, the closest locality east of the Andes (Rivas and Molina 1998. Herpetol. Rev. 29:178). ESTADO TÁCHIRA: La Trampita, between Pregonero and Fundación, Uribante Dam. 7 October 1985. Proyecto Faunístico Uribante-Caparo (CVULA 4575). La Trampita, between Pregonero and Fundación, Uribante Dam. July 1986. Proyecto Faunístico Uribante-Caparo (CVULA 4745). Recently reported by Rivas and Molina (1996. Resúmenes del IV Congreso Latinoamericano de Herpetologia, Santiago de Chile: 292) from Táchira state but at the western side of the Andes or Maracaibo Lake basin, but only 50 km airline through the Andes. Rivas and Molina (*op. cit.*) also reported the species from central and western Venezuela. The two Táchira records are the first from the eastern slopes of the Andes. The species is distributed from Costa Rica to Ecuador west of the Andes (Peters and Orejas-Miranda 1986. Catalogue of Neotropical Squamata, Part I. Snakes. Smiths. Inst. Press. Washington, D.C.), reaching western Venezuela at its eastern limit, very much like the

recently reported toad *Bufo haematiticus* (Barrio 2001. Herpetol. Rev. 32:189). This is another northern species, known from the "región orocostense" and "región del lago de Maracaibo" (Barrio-Amorós 1998. Acta Biol. Venezuelica 18:1–93), that supports the hypothesis that the eastern Andean piedmont acts as a corridor for some northern species, e.g., *Stenorhina degenhardti* (Barrio and Calcaño 2001. Herpetol. Rev. 32:280) and *Dipsas latifrontalis* (Manzanilla et al. 2001. Herpetol. Rev. 32:195).

Submitted by **DANIEL CALCAÑO,** Serpentarium Los Llanos, Barinitas, Barinas, Venezuela (e-mail: serpentariolosllanos@hotmail.com), and **CESAR L. BARRIO-AMORÓS,** Fundación AndígenA, Apartado Postal 210, Mérida 5101-A, Venezuela (e–mail: cesarlba@yahoo.com).

RHADINAEA FLAVILATA (Pine Woods Littersnake). USA: FLORIDA: Brevard Co: Melbourne, Royal Poinciana Boulevard, 1.4 km E of Brevard Co. Rd. 509 (Wickham Rd.), on screened porch of residence in Lansing Ridge subdivision, across street from disturbed marsh and artificial pond, on land formerly a transition area between sand pine ridge and slash pine/scrub. 24 August 1993. Richard L. Turner. Verified by David L. Auth. Florida Museum of Natural History, University of Florida (UF 89309). New county record (Ashton and Ashton 1988, Handbook of Reptiles and Amphibians of Florida. Part 1. The Snakes. Second ed. Windward Publ., Miami, 176 pp.). This is the first new county record for *R. flavilata* along the Atlantic Coast of Florida since Ashton and Ashton (1988). Gottlieb's (1984, Herpetol. Rev. 15:21) earlier record for Palm Beach Co. on the Atlantic coast of Florida was overlooked by Ashton and Ashton (1988) and by Reichling and Louton (1989, Herpetol. Rev. 20:76).

Submitted by **RICHARD L. TURNER**, Department of Biological Sciences, Florida Institute of Technology, 150 West University Boulevard, Melbourne, Florida 32901, USA; e–mail: rturner@fit.edu.

SALVADORA DESERTICOLA (Big Bend Patch-nosed Snake). USA: NEW MEXICO: Otero Co: White Sands Missile Range. 13.5 mi. E White Sands Missile Range Main Post on Range Road 2. T22S R7E SW1/4 Sec 8. 7 August 2000. D. W. Burkett. Verified by C. W. Painter. University New Mexico Museum Southwestern Biology (MSB 62002). County record (Degenhardt et al. 1996. The Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque).

Submitted by **DOUGLAS W. BURKETT,** MEVATEC Corporation, P.O. Box 399, White Sands Missile Range, New Mexico 88002, USA.

SIPHLOPHIS WORONTZOWI (NCN): BRAZIL: PARÁ: Município de Santarém (54º42'W and 22º6'S), right bank of the Tapajós River. P. Figueira. 12 December 2002. Linha de Pesquisa em Herpetologia da Amazônia, Laboratório de Pesquisas Zoológicas, Faculdades Integradas do Tapajós, Santarém, Pará State (LPHA 2548). Verified by R. N. Yuki. In Brazil, this species is known from the Amanã River in Amazon State (type locality), from the area of the Samuel Hydroelectric and from Espigão do Oeste Municipality in Rondônia State (Peters and Orejas-Miranda 1970. USNM Bull. 297:1–347; Silva-Jr 1993. Herpetol. Nat. Hist. 1:37–86; Zaher and Prudente 1999. J. Herpetol. 33:698–702). First state record, extends eastern distribution ca. 368 km from Amanã River.

Submitted by **ALFREDO PEDROSO DOS SANTOS-JR** (e-mail: alphredojr@hotmail.com), **ANDREI GUIMARÃES GUEDES** (e-mail: agguedes@pucrs.br), Laboratório de Herpetologia, Faculdade de Biociências, Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS). Av. Ipiranga, 6681 – C.P. 1429, CEP 90619-900, Porto Alegre, Rio Grande do Sul, Brazil, and **FRANK RAYNNER VASCONCELOS RIBEIRO** (e-mail: fraynner@hotmail.com), Laboratório de Ictiologia, Faculdade de Biociências, Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS). Av. Ipiranga, 6681 – C.P. 1429, CEP 90619–900, Porto Alegre, Rio Grande do Sul, Brazil.

STORERIA VICTA (Florida Brownsnake). USA: FLORIDA: Brevard Co: Melbourne, Florida Institute of Technology campus, on sidewalk between drainage swale and mown field (28°03'45"N, 80°37'28"W). 19 March 2003. Richard L. Turner. Verified by Kenneth L. Krysko. Florida Museum of Natural History, University of Florida (UF 135789). New county record (Ashton and Ashton 1988, Handbook of Reptiles and Amphibians of Florida. Part 1. The Snakes. Second ed. Windward Publ., Miami, 176 pp.). This is only the second new county record in the last 15 years for this species of peninsular Florida.

Submitted by **RICHARD L. TURNER**, Department of Biological Sciences, Florida Institute of Technology, 150 West University Boulevard, Melbourne, Florida 32901, USA; e–mail: rturner@fit.edu.

TANTILLA BOIPIRANGA (NCN). BRAZIL: MINAS GERAIS: Municipality of Caratinga: Reserva Particular do Patrimônio Natural Feliciano Miguel Abdala, (19°44'S, 41°49'W; ca. 450 m elev.). 14 January 2001. J. Cassimiro. Herpetological collection, Universidade Federal de Minas Gerais, Minas Gerais, Brazil (UFMG 1402). Verified by Ricardo J. Sawaya. Known only from the type locality: montane fields ("campos rupestres"), of the Serra do Cipó, Minas Gerais, southeastern Brazil (Sawaya and Sazima 2003. Herpetologica 59:119–126). There are no reports of this recently described species from any other kind of habitat. The specimen was found active on the ground, crossing a land road, in a primary area of Atlantic rainforest. This work extends the known distribution about 190 km airline and associates it with an area covered by Atlantic rainforest.

Submitted by **JOSÉ CASSIMIRO**, Departamento de Zoologia, Instituto de Ciencias Biológicas, Universidade Federal de Minas Gerais, 30123-970, Belo Horizonte, MG, Brazil; e-mail: j_cassimiro@hotmail.com.

TANTILLA NIGRICEPS (Plains Black-headed Snake). USA: TEXAS: Blanco Co: 12.9 km W, 28.9 km S Dripping Springs. 1 April 1961. G. R. Brooks. Virginia Museum of Natural History Collection (VMNH 8877). Verified by C. T. McAllister. New county record. Partially fills distributional hiatus along eastern border of Balcones Escarpment of Edwards Plateau (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station. 421 pp.; Werler and Dixon 2000. Texas Snakes: Identification, Distribution, and Natural History. Univ. of Texas Press, Austin. 437 pp.).

Submitted by **CHRIS T. McALLISTER,** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA; e-mail: chris.mcallister@tamut.edu.

THAMNODYNASTES CHAQUENSIS (NCN). URUGUAY: DPTO. COLONIA: Colonia del Sacramento (34°27'S, 57°50'W). June 1998. E. Caballero. Colección Zoología Vertebrados, Reptiles, Facultad de Ciencias, Montevideo, ZVC-R 5622 (adult male). Verified by F. Achaval. First country record. Believed to be a natural transient having rafted on floating vegetation from Argentina (through Paraná River), and thus it remains to be determined if this species is established in Uruguay. The nearest population is in northeastern Santa Fe, Argentina (Bergna and Alvarez 1993. Facena 10:5–18). The range of the species includes Salta, Santa Fe, Chaco, Corrientes, and Formosa in Argentina and Pilar, Ñeembucú in Paraguay (Giraudo 1996. Herpetol. Rev. 27:215; Giraudo 2001. Serpientes de la Selva Paranaense y del Chaco Húmedo. L.O.L.A., Buenos Aires, 328 pp.; Giraudo and Scrocchi 2002. Smithson. Herpetol. Infor. Serv. 132: 53 pp.).

Submitted by **SANTIAGO CARREIRA,** Sección Zoología Vertebrados, Facultad de Ciencias, Iguá 4225, CP 11400, Montevideo, Uruguay; e–mail: carreira@fcien.edu.uy.

THAMNOPHIS MARCIANUS (Checkered Gartersnake). USA: NEW MEXICO: LINCOLN CO: White Sands Missile Range. Near a small pond at Oscura Range Camp ca. 1 mi. S of the eastern terminus of Range Road 8. T9S R7E NW1/4 Sec 25. 04 September 2000. D. W. Burkett and David Black. Verified by C. W. Painter. University of New Mexico Museum Southwestern Biology (MSB 62001). County record (Degenhardt et al. 1996. The Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque).

Submitted by **DOUGLAS W. BURKETT** and **DAVID BLACK,** MEVATEC Corporation, P.O. Box 399, White Sands Missile Range, New Mexico 88002, USA.

Sibon sartorii (UMRC 85-18). México: Campeche: Nicholas Bravo. Illustration by Julian C. Lee.

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Three Snakes New to the Herpetofauna of Honduras

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Continuing fieldwork in the Mosquitia of Honduras has demonstrated the presence of three species of snakes hitherto unknown from the country. In recent years, this lowland region in the eastern portion of the country has produced a number of additions to the known snake fauna of Honduras (McCranie et al. 2001; Wilson et al. 2003).

A recent update of the reptile fauna of Honduras (Wilson and McCranie 2002) listed 113 species of snakes from the country. Wilson et al. (2003) reported an additional two species, bringing the total to 115 species. The three species reported in this paper increase the total to 118 species. This figure is only 15 species fewer than the number (133) reported by Savage (2002) from Costa Rica, well known for its speciose herpetofauna.

Specimens of the three species reported below came as a result of fieldwork we conducted in the eastern portion of the Mosquitia during May and June of 2003. As in the year 2002 (Wilson et al. 2003), we surveyed three proposed or recognized protected areas, i.e., the Río Kruta Biological Reserve, the Rus Rus Biological Reserve, and the Tawahka-Asangni Biosphere Reserve. We worked in the area of the Tawahka-Asangni Biosphere Reserve adjacent to the Río Coco from 16–21 May at localities along one of its tributaries, the Caño Awalwás. Our campsite and areas in which we collected still remain in essentially pristine lowland broadleaf rainforest, although recent illegal deforestation is now evident at the mouth of Caño Awalwás and in adjacent areas along the Río Coco, and is expected to spread inward to the area of our work in the not too distant future, i.e., into an area recognized as a protected area of global significance, both from a biological and a cultural perspective. From 26 May to 2 June, we collected in the vicinity of a locality, also in essentially undisturbed lowland broadleaf rainforest in the proposed Rus Rus Biological Reserve known as Bodega de Río Tapalwás, a hunting camp along the Río Tapalwás, a tributary of the Río Rus Rus. Finally, we surveyed localities along the Río Kruta, located within the proposed Río Kruta Biological Reserve, from 8–14 June, collecting in fresh water marshes and disturbed lowland broadleaf swamp forest. All localities are within the department of Gracias a Dios.

The colors in life reported below follow the colors (capitalized) and codes (in parentheses) of Smithe (1975–1981). All specimens

are deposited in the Florida Museum of Natural History at the University of Florida (UF).

Enuliophis sclateri (Boulenger)

Two specimens of this snake were collected. One is a female (UF 137175) collected on 20 May 2003 at 100 m elevation in leaf litter at Caño Awalwás. The other is a male (UF 137177) found on 1 June 2003 at 190 m elevation in leaf litter at Bodega de Río Tapalwás. Both specimens were active at night. Color in life of UF 137175 was as follows: dorsum Blackish Neutral Gray (82) to second dorsal scale row; first dorsal scale row and venter Pale Neutral Gray (86); underside of tail Pale Neutral Gray with brownish gray smudges scattered along midline; dorsum of head Blackish Neutral Gray from tip of snout to level of posterior edge of supraoculars; side of head Blackish Neutral Gray above supralabials to posterior edge of eye, rest of head and first three and one-half dorsal scales posterior to parietals ivory white; chin same color as rest of venter; iris black. The coloration of the other specimen is essentially the same as that described for UF 137175. Both of these specimens are of the dark-headed type, as described by Savage (2002). The scutellational data on these two specimens are consistent with those reported for the species by McCranie and Villa (1993), except that UF 137177 has 6-6 supralabials (an error in the number of infralabials for this species occurs in Savage 2002). These specimens represent range extensions of approximately 230 km NNE and 265 km NE, respectively, from the nearest locality in Nicaragua (Matagalpa, Depto. Matagalpa; Köhler 2001).

Sibon annulatus (Günther)

A single male specimen of this snake (UF 137178) was collected while active at night in the top of a small tree in slightly disturbed broadleaf swamp forest on the outskirts of Swabila at 5 m elevation along the Río Kruta on 10 June 2003. Color in life of UF 137178 was as follows: dorsum with 28 Sepia (119)-edged Walnut Brown (221B) crossbands on body and 17 on tail, Sepia edging of bands coalesces ventrally and extends onto venter to join or alternate with ventral extension on other side; interspaces Flesh Ocher (132D) middorsally grading to Grayish Horn Color (91) laterally, in turn grading to white on lowermost dorsal scale rows; venter white except for Sepia crossbands; head Burnt Sienna (132) above with Sepia blotching; lateral portion variegated with Burnt Sienna, Sepia, and white; chin white with Sepia blotching; iris grayish brown. UF 137178 has a single preocular on either side of the head, a condition heretofore unreported for this species (Savage 2002), which usually has no preoculars. The other scutellational data are consistent with those given by Savage (2002). This specimen represents a range extension of approximately 225 km NE of the nearest locality in Nicaragua (Reserva Biosfera Bosawas, Depto. Jinotega; Köhler 2001). Savage (2002:630) stated that the distribution of this snake extended to "the Atlantic versant of eastern Honduras." However, UF 137178 is the first specimen collected in Honduras.

Urotheca decipiens (Günther)

A single female specimen of this snake (UF 137176) was collected at the edge of our camp at dusk at 190 m elevation along the Río Tapalwás at Bodega on 29 May 2003. Color in life of UF 137176 was as follows: middorsum Sepia (219), lateral portion of dorsum Hair Brown (119A), two areas separated by narrow Straw Yellow (56) stripe on middle of scale row 5, lateral area of dorsum bounded below by zigzag white stripe on adjacent portions of rows 1 and 2; ventrolateral area Hair Brown (lower portion of row 1) confluent with similarly-colored blotch on lateral edge of ventrals; remainder of venter white; dorsum of head Burnt Sienna (132) to mid-parietal level, followed by Chrome Orange (16) nuchal band extending two scales posterior to parietals; supralabials pinkish white, bounded above by dark brown line; lateral and ventrolateral stripes continue to end of tail; iris brown. The ventral count for this specimen is 143, which is three scales higher than the high end of the range (122–140) reported by Myers (1974) and repeated by Savage (2002). The locality of this specimen represents a range extension of approximately 470 km N of the nearest locality in Costa Rica, which appears to be the La Selva region in Heredia Prov. (Savage 2002, supplied no locality data to support his distribution maps).

Acknowledgments.—We thank F. Wayne King, Max A. Nickerson, Fred G. Thompson, and the Reptile and Amphibian Conservation Corps (RACC) for granting funds to support our field work. Collecting and export permits were issued by Conrado González and Martha Moreno of COHDEFOR, Tegucigalpa. Valuable assistance with securing these permits was provided by Mario R. Espinal. Ruben Castro Lobo (COHDEFOR) and Siyyid Aly Romero (PROBAB) of Puerto Lempira were helpful in providing transportation and logistical support. We were assisted in the field by Tomás Manzanares Ruís, John Slapcinsky, Froylán Llezett, Luís Lacuth, Volven Graham R., and Antonio D. Coello.

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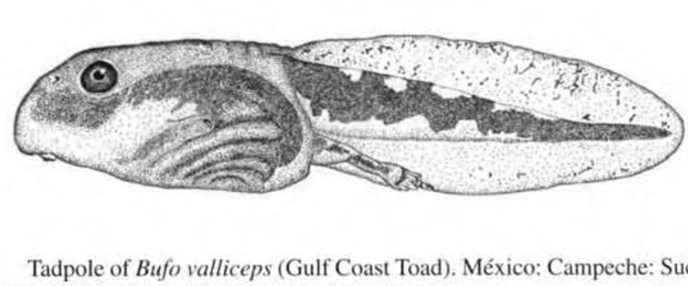

Tadpole of *Bufo valliceps* (Gulf Coast Toad). México: Campeche: Suc Tuc. UMRC 93-9. Illustration by Julian C. Lee.

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New Distributional Records for the Gray-banded Kingsnake (*Lampropeltis alterna*) in Texas

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The gray-banded kingsnake, *Lampropeltis alterna*, is a medium-sized colubrid endemic to the Chihuahuan Desert regions of western Texas and southeastern New Mexico in the United States. Based on preserved museum specimens, *L. alterna* have been documented from ten counties in Texas (Werler and Dixon 2000). Numerous gaps exist between documented populations. Specimens have been collected from these gaps and maintained in captive collections for years but few were deposited in museum collections. Herein we report on several cataloged museum specimens that document new county records and fill in gaps between previously documented populations. Specimens verified by Jonathan A. Campbell (UTACV), James Mueller (SRSU), and Kenneth Wray (UF).

New County Records

Crane Co: UTACV R–40419: on US 385, ca. 100 m N of Upton Co. line. DOR. July 1994. Rudy Aguillar.

Crockett Co: Several specimens are available. UTACV R–40371: on FM 2083, 17.5 miles S jct I-10. DOR. 2 May 1993. Pat Cherryhomes. SRSU R-6521–22: on FM 2083, 1.5 miles S of Howard Draw. 6 June 1996. Mike Price. UF 106718: Ozona, on US Hwy 290. Intact head and skin, DOR(?). 13 May 1966. E. Ross Allen.

New Distributional Records

Brewster Co: UTACV R–38781: on US 90, 6.5 miles W of Alpine. DOR. 1 August 1995. Thomas Barlow. SRSU R–6483: Hwy 90, 5 miles W of Alpine. 03 September 1994. Deron Hartman. First documented specimens from Paisano Gap. UTACV R–40365: on TX 118, 20.5 miles S of Alpine. 18 August 1995. Norman Nunley. Southernmost record for Del Norte Mountains. UTACV R–51451: on US 90, 11 miles W of Marathon. DOR. June 1999. Alan Tennant. First record for western slopes of the Glass Mountains.

Culberson Co: UTACV slide–26756: Beach Mountains, 3.3 miles NW of Van Horn. 14 July 1993. Toby Hibbitts. Fourth specimen for the county and the first specimen from the Beach Mountains.

Terrell Co: UTACV R–51452: on FM 2400, 1 mile W jct TX 349. 1 May 1998. Sam MacAdams. Fills a distributional hiatus reported in Werler and Dixon (2000) between specimens from near Iraan in Pecos Co. and specimens from southern Terrell Co. in the vicinity of Palma Canyon.

Upton Co: UTACV R–42518: East boundary of Castlegap Park. 1981. Vince DeMarco. Represents the museum deposition of a specimen previously reported by Dixon (1987). UTACV-R 40418: King Mountain, McCamey Oilfield, ca. 5 miles NE of McCamey. DOR. September 1994. Dan McAdams. Second documented specimen from this county.

Acknowledgments.—We thank Thomas Barlow, Pat Cherryhomes, Michael Price, Norman Nunley, Toby Hibbitts, Deron Hartman, and Alan Tennant for providing specimens.

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New Distributional Records for Amphibians and Reptiles from Quintana Roo on the Yucatán Peninsula, México

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During the course of fieldwork from 1992 through 2000 in Quintana Roo, México, several amphibians and reptiles were found that represent either distributional range extensions on the Yucatán Peninsula, or new state records for Quintana Roo. All records are from the Municipality of Othón P. Blanco in the southern portion of the state, unless indicated otherwise. The authors collected all specimens, except for those identified in the text. This account reports a range extension for one amphibian, and six state records and 16 range extensions for reptiles. All voucher specimens are deposited in the Herpetological Collection of the Museo de Zoología, El Colegio de la Frontera Sur, Unidad Chetumal, Quintana Roo (ECO-CH-H). Oscar Flores-Villela verified all specimens, except *Ctenosaura alfredschmidti*, which was verified by Gunther Köhler. Former distributional records, except for *C. alfredschmidti*, are based on Lee (1996).

New State Records

Claudius angustatus (Narrowbridge Musk Turtle). La Unión (17°53'47"N, 88°52'34"W). 01 July 1993. Máximo Suárez Salas. ECO-CH-H 0341. This new state record closes the gap between previously known localities in southeastern Campeche and northeastern Belize.

Ctenosaura alfredschmidti (Alfredschmidt's Spinytail Iguana). Municipality of Felipe Carrillo Puerto, Dzulá village (19°36'09"N,

88°24'56"W). 15 May 1999. Carlos Gracida. ECO-CH-H 1321. An adult female captured in secondary tropical forest. This locality extends the range of the species about 215 km from the type locality at Pablo Garcia, Campeche (Köhler 2000), and represents the northeasternmost record on the Yucatán Peninsula.

Norops pentaprion (Lichen Anole). Chetumal (18°29'57"N, 88°18'57"W). 19 September 1999. ECO-CH-H 1437-1618. A new state record that extends the range of the species ca. 200 km NE of the closest known localities in Belize and Guatemala.

Celestus rozellae (Rozella's Lesser Galliwasp). 15 km SE Tres Garantías, Campamento la Pirámide (18°10'N, 88°52'W). 13 October 1999. Luis Antonio Mora and Roger Braga. ECO-CH-H 1634. New state record and a range extension of about 170 km N of the nearest records in Belize and Guatemala.

Ramphotyphlops braminus (Braminy Blind Snake). Chetumal (18°31'05"N, 88°19'36"W). 12 April 1998, 14 June 1999. ECO-CH-H 0530, 1429. These are the first records for this species on the Yucatán Peninsula. The specimens were both found in separate backyards within the city.

Tantillita lintoni (Linton's Dwarf Short-Tailed Snake). Chetumal (18°29'57"N, 88°18'57"W). 06 August 1998. ECO-CH-H 1120. A new state record that extends the range ca. 225 km NE from the closest locality in Guatemala.

Range Extensions

Physalaemus pustulosus (Tungara Frog). Km. 7, Carretera a San José de la Montaña (18°24'45"N, 89°00'25"W). 28 September 1999. Luis A. Mora. ECO-CH-H 1468. Extends the range ca. 65 km SW from the only previous state record.

Sphaerodactylus glaucus (Dwarf Gecko). Bahía de Chetumal, Punta Mainada (18°23'21"N, 87°55'07"W). 4 September 1998. ECO-CH-H 1138. First record for southeastern Quintana Roo, and extends the range ca. 50 km E from the nearest record.

Hemidactylus frenatus (Common House Gecko). Chetumal (18°29'57"N, 88°18'57"W). 18 February 1998. ECO-CH-H 0902-0903. These specimens represent the southernmost records for Quintana Roo, and extend the range 250 km S from the closest record. This species is very common in Chetumal and surrounding areas.

Corytophanes cristatus (Smooth-headed Helmeted Basilisk). 8 km N La Unión (17°56'57"N, 88°52'13"W). 7 April 1993. Humberto Bahena-Basave. ECO-CH-H 0277. This record extends the range ca. 100 km N from the closest record in Belize.

Corytophanes hernandezii (Hernandez's Helmeted Basilisk). 8 km N La Unión (17°56'57"N, 88°52'13"W). 7 April 1993. Humberto Bahena-Basave. ECO-CH-H 0278. This record extends the range of this species ca. 100 km N from the closest record in Belize.

Iguana iguana (Green Iguana). La Unión (17°53'47"N, 88°52'34"W). 24–25 November 1992. Humberto Bahena-Basave. ECO-CH-H 0169–0170. First mainland records for Quintana Roo, as the previous state records were from Cozumel Island. These specimens extend slightly the range northward from the closest records in northern Belize.

Sceloporus lundelli (Lundell's Spiny Lizard). Bahía de Chetumal (18°48'13"N, 88°06'31"W). 2 September 1998. ECO-CH-H 1135–1136. This record extends the range 250 km southward from the only previous state record and closes the reported gap between the northern and southern populations on the Yucatán Peninsula.

Sphenomorphus cherriei (Brown Forest Skink). San Felipe Bacalar (18°42'N, 88°23'W). 6 May 2000. Pedro Mis. ECO-CH-H 1648. Extends the range ca. 100 km NE from the closest record in northern Belize.

Masticophis mentovarius (Neotropical Whipsnake). La Unión (17°53'47"N, 88°52'34"W). 23 June 1993. Humberto Bahena-Basave. ECO-CH-H 0333. This is the first record for southern Quintana Roo and a 30 km range extension from the nearest locality in Belize.

Scaphiodontophis annulatus (Guatemalan Neckband Snake). Kohunlich Archaeological Site (18°25'50"N, 88°48'45"W). 16 June 1994. ECO-CH-H 0483. 15 km NW Bacalar, Ejido La Laguna (18°42'N, 88°23'W). 18 July 2000. J. Enrique Escobedo Cabrera. ECO-CH-H 1649. Extends the range ca. 100 km N from the closest record in Belize and closes the distributional gap between the northern and southern populations on the Yucatán Peninsula.

Symphimus mayae (Yucatan White-lipped Snake). Chetumal (18°29'57"N, 88°18'57"W). 07 August 1998. ECO-CH-H 1121. This record closes the distributional gap on the Yucatán Peninsula between the northern populations in México and southern populations in Belize.

Thamnophis marcianus (Checkered Garter Snake). 4.5 km S San Pedro Peralta (18°42'N, 88°53'W). 24 August 1994. J. Enrique Escobedo Cabrera. ECO-CH-H 0416. This is another isolated record for this species on the Yucatán Peninsula, and the first from southern Quintana Roo.

Urotheca elapoides (False Coral Snake). Kohunlich Archaeological Site (18°25'50"N, 88°48'45"W). 12 June 1994. ECO-CH-H 0482. This is the only known record in southern Quintana Roo and extends the range ca. 150 km N from closest localities in Belize, and closes the distributional gap between northern and southern Yucatán Peninsula populations.

Xenodon rabdocephalus (False Fer-De-Lance). Kohunlich Archaeological Site (18°25'06"N, 88°47'54"W). 18 June 1994. ECO-CH-H 0485. This is the only known record for southern Quintana Roo and confirms the range proposed by Lee (1996) for the eastern portion of the Yucatán Peninsula.

Typhlops microstomus (Yucatecan Blind Snake). Chetumal (18°29'57"N, 88°18'57"W). 7 September 2000. ECO-CH-H 1652. This is the only known record for southern Quintana Roo and extends the range by ca. 100 km N from the closest record in Belize.

Agkistrodon bilineatus (Cantil). Chetumal (18°29'57"N, 88°18'57"W). 21 September 1993. J. Enrique Escobedo Cabrera. ECO-CH-H 0418. Cocoyol (18°09'53"N, 88°41'28"W). 12 April 1997. Photographic Collection, ECO-CH-H, R 0016. These are the only known records for southern Quintana Roo and extend the range by ca. 50 km N and 20 km W from the nearest records in northern Belize.

Acknowledgments.—We are indebted to Oscar Flores for verifying specimens and encouraging us to publish these distributional accounts. We also thank the collectors and the staff of the Museum of Zoology from El Colegio de la Frontera Sur, Unidad Chetumal for helping with fieldwork. We are also grateful to Sophie Calmé for reviewing the manuscript.

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Urban Herpetology I: New Distribution Records of Amphibians and Reptiles from Hendricks County, Indiana

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The Indianapolis International Airport (IIA) is located near the southwestern edge of Indianapolis, Indiana, USA. South and west of IIA is a series of properties purchased by IIA as part of a noise reduction plan, and to preserve habitat for the federally endangered Indiana bat (*Myotis sodalis*). These properties consist of many small, fragmented residential areas and woodlands surrounded by a matrix of agriculture and industry (Sparks et al. 1998; Foster et al., *ms. submitted*). The properties extend south from U.S. 40 to U.S. 67 along the East Fork of White Lick Creek, and westward from IIA to Indiana 267 (IN-267). Interstate 70 (I-70) bisects the study site from east to west, and many smaller roads dissect the interior of the study area. Permanent water is available in the form of a perennial stream (East Fork of White Lick Creek), many recently constructed retaining ponds (concentrated in a warehouse district N of I-70), farm ponds, and a wetland complex developed to mitigate for wetlands lost during IIA expansion.

Hendricks County is one of the least studied counties in Indiana with only 15 species of reptiles and amphibians having been previously documented (Minton 2001). The absence of even baseline information about the herpetofauna of the area limits the ability of land managers to protect those species that are present. In this paper we report 10 new county records encountered while surveying the herpetofauna of the IIA properties, while a sister paper describes the overall amphibian and reptile community (Foster et al., *ms. submitted*). Voucher specimens were deposited in the Indiana State University Vertebrate Collection (ISUVC). Identifications were verified by J. O. Whitaker, Jr., Professor of Life Sciences and director of ISUVC.

Anura

Bufo americanus (American Toad). 4 km S, 1.2 km E of jct of I-70 and IN–267 (ISUVC 3594). 8 August 2000. Captured in mitigation wetlands.

Hyla chrysoscelis (Cope's Gray Treefrog). 3.12 km S, 1.5 km E of jct of I-70 and IN–267 (ISUVC 4019). 7 June 2001. Identification was verified by call prior to collection. Captured in mitigation wetlands.

Pseudacris crucifer (Spring Peeper). 3.12 km S, 1.5 km E of jct of I-70 and IN-267 (ISUVC 4021). 7 June 2001. Captured in mitigation wetlands.

Pseudacris triseriata (Western Chorus Frog). 2.9 km N, 3.7 km E of jct of I-70 and IN-267 (ISUVC 4022). 9 July 2001. Captured while calling in a roadside ditch.

Testudines

Apalone spinifera (Spiny Softshell). 0.75 km N, 3.25 km E of jct of I-70 and IN-267 (ISUVC 4108). 18 July 2002. Taken while swimming in the East Fork of White Lick Creek.

Chrysemys picta (Painted Turtle). 0.74 km S, 1.08 km E of jct of I-70 and IN-267 (ISUVC 4035). 26 April 2001. Found dead beside a farm pond.

Terrapene carolina (Eastern Box Turtle). 0.75 km S, 1.25 km E of jct of I-70 and IN-267 (ISUVC 4107). 23 May 2001. Found dead on county road 800S.

Trachemys scripta (Red-eared Slider). 3.12 km S, 1.5 km E of jct of I-70 and IN-267 (ISUVC 4033). 30 May 2001. Found dead along the edge of mitigation wetlands.

Serpentes

Thamnophis sirtalis (Eastern Garter Snake). 0.48 km S, 2.54 E of jct of I–70 and IN–267 (ISUVC 3596). 30 July 1998. Captured beneath debris.

Elaphe obsoleta (Black Rat Snake). 1.25 km S, 0.75 km E of jct of I–70 and IN–267 (ISUVC 4105). 4 June 2002. Found dead on county road 750S.

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BOOK REVIEWS

Herpetological Review, 2003, 34(4), 396–399.

A Field Guide to the Reptiles of East Africa, by Stephen Spawls, Kim Howell, Robert Drewes, and James Ashe + consultants Alex Duff-MacKay and Harald Hinkel. 2002. Academic Press, San Diego (title subsequently acquired by Princeton University Press, Princeton, New Jersey; www.pup.princeton.edu). Hardcover. 543 pp. US $49.50. ISBN 0-126-56470-1.

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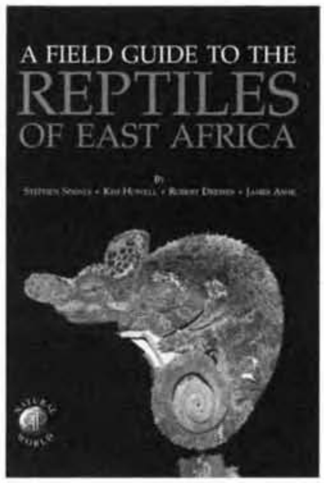

This book (abbreviated here to *FGEA*) covers all East African reptiles in the countries of Kenya, Uganda, Tanzania, Burundi, and Rwanda. It is a collaborative effort among six herpetologists, each with many years of field experience in East Africa.

It is a thick book, measuring 250 x 180 x 35mm, so it is unwieldy as a field guide. In fact it is not really a field guide at all, containing much more information than is relevant for field identification. The first 32 pages are devoted to the Preface, Sources and Acknowledgements, Further Reading on East African Reptiles, and several introductory essays, including an illuminating one on The Zoogeography of the East African Reptile Fauna, and others on Reptiles in the East African Environment, Observing and Collecting Reptiles, Reptile Conservation—The Role of National Parks and Museums, Identifying Reptiles, Common Names, Photographing Reptiles, Notes on the Husbandry of East African Reptiles, and What are Reptiles? A similar generous series of appendices occur at the back, including Reptile Biology Illustrations (19 pictures in 3+ pp.), Habitats (3 pp.), Notes on Snakebite (8 pp.), Local Names in Swahili and 20 tribal languages (3+ pp.), a comprehensive and very useful Gazetteer with full co-ordinates (12+ pp.), Glossary (6 pp.), and References (1 p.).

As pleased as I am as a curator to get such a useful gazetteer I am not sure it and all the other pages allocated to these topics repay the space. Especially as the *FGEA* is pushing the upper limit of a field companion. A leaner book would help reduce the price and thus make it more affordable in Africa and I would certainly encourage plans to produce an additional thinner true field guide.

The Species Accounts are divided into five sections covering: 1. Chelonians (pp. 34–65); 2. Lizards (pp. 66–255); 3. Worm Lizards (pp. 256–266); 4. Crocodiles (pp. 268–277) and 5. Snakes (pp. 278–496), with keys to families, genera and species. Each species account provides the available information on Identification, Habitat and Distribution, Natural History, and Venom (where relevant for snakes). Most are illustrated with color photographs taken by numerous contributors, but the majority are by Stephen Spawls. A small distribution map gives the range of each species in East Africa. The apparently disjunct populations of many species probably reflect poor collecting in the intervening areas.

The quality of the photography is generally good, with individual pictures ranging from excellent to poor. The latter include many of the pickled museum rarities, which might have been better illustrated by simple drawings showing diagnostic features and reference to pictures of commoner species of similar habitus. The series of color photographs of representative habitats I would have preferred in the front section, and many of the reptile biology illustrations should have been excluded, particularly the shots of the "snake man free-handling" boomslang and black mamba. They serve no useful purpose and send the wrong message that simply perpetuates the "Crocodile Dundee" stereotype that blights so many of today's TV reptile 'documentaries.'

I have to congratulate the Natural History section of Academic Press for the quality of the *FGEA*. As an author I envy the use of glossy paper throughout that allows the presence of color on nearly every page, the surfeit of color photographs, and the hardcover! It is a far-sighted publisher that invests so much in what many others seem to consider a speciality market. Having said that, however, the *FGEA* contains too many silly editorial mistakes and also shows evidence of confused layout, presumably resulting from its multi-authored nature and from what appear to be last-minute amendments to the book.

An example of the latter is the confused treatment of the Eublepharidae. This family has been distinguished from true geckos for some time (e.g., Grismer 1988), but it is not included in the total of lizard families found in East Africa (p. 70). A brief description of the family and its only East Africa representative (*Holodactylus africanus*), however, is included between the accounts for *Ebenavia* and *Stenodactylus*, i.e. in the middle of the Gekkonidae. Because of this last minute update the second couplet in the key to lizard families in East Africa (p. 71; "2a: Eyelids absent, eye cannot close. Geckoes, Gekkonidae. p.72") is almost immediately contradicted in the first couplet in the key to East African gecko genera (p. 73; "1a. Eyelids present, moveable. *Holodactylus africanus*"). The authors may well debate the status of the family Eublepharidae (although this has received subsequent support; e.g., Ota et al. 1999; Kratochvíl and Frynta 2002), but the current treatment in the *FGEA* is hybrid and confusing.

Editorial overview is also poor with respect to standard fonts for headings (e.g. *Family* GEKKONIDAE, p. 72), scientific names not in italics (e.g., A. vauereselli, p. 170), and generic names without leading capital (e.g., *elapsoidea*, p. 447). The Natal Province in South Africa, mentioned in the text, has been renamed KwaZulu-Natal for nearly 10 years.

The layout of Family and Suprafamily headings is also inconsistent. Higher order relationships of reptile families are rarely discussed, which is fair enough given ongoing conflict over the various hypotheses that have been proposed. However, within the snake section there is an orphan heading 'Infraorder Scolecophidia' (p. 280) without subsequent headings heralding the lineages Henophidia or Cenophidia. Although subfamily headings are used within the Boidae, these are not used for the Causinae within the Viperidae, even though the subfamily is recognized in the

introductory section to the family.

In his review, Broadley (2002) has given an extensive Corrigenda and Addenda that should be consulted for many oversights and omissions, as well as a number of misidentified photographs. These will not be repeated below, but a number of additional corrections are noted. Although the familial and generic relationships of many African snakes remain problematic, a number of reassignments have been made in the literature. Acceptance of some of these changes remain controversial (e.g., recognition of *Python natalensis* as a full species, proposed by Broadley 1999, but not adopted by others, e.g., Joger and Lambert 2002; generic splitting of African *Coluber* (e.g., Schätti and Utiger 2001), and species boundaries in *Echis*, see below). Treatment of many of these changes in the *FGEA* is inconsistent; some changes have been adopted (e.g., *Buhoma* for African '*Geodipsas*', Ziegler et al. 1997; incorporation of *Gastropyxis* into *Hapsidophrys*, p. 363), whereas others have not. In the latter case it is not obvious whether the authors reject these changes or have overlooked them.

Feylinia contains six not three species and the population from Pointe Noire, Uganda, displays morphological variation that might merit further study (Brygoo and Roux-Estève 1983). The reduced eyes of these fossorial skinks are also best described as degenerate not "primitive." *Feylinia currori* remains the only species occurring in East Africa, but midbody scale counts range from only 22 to 28.

Thankfully the authors have not followed Klaver and Böhme (1986, 1997) in referring a number of East African chameleons to *Bradypodion*. This problematic transfer has not received much favor in Africa (e.g., Branch 1998) or subsequent morphological (Bauer 1997) or genetic support (Townsend and Larson 2002; Tolley et al. 2003). Despite this, new taxa such as a subspecies of *C. tavetanus* from the Taita Hills, Kenya, continue to be assigned to *Bradypodion* (Lutzmann and Neças 2002).

Many issues regard snakes. Sand boas of the genus *Eryx* have been revised, with the revival of *Gongylophis* for *G. colubrinus* (Tokar 1996). The Spotted Cape Wolf Snake (*Lycophidion capense vermiculatum*, p. 323) was placed in synonymy of typical *L. capense* by Broadley (1996). The illustration of *Hormonotus modestus* (p. 329) is not this species, but probably the Forest File Snake, *Mehelya poensis*. Tongue-in-cheek, I note that the authors seem still to be troubled by the class-struggle—why else the confusion of Ruspoli's Shovel-snout (p. 347) and Prince Ruspoli's Shovel-snout on the very next line!

Generic assignment and species boundaries in Old World *Coluber* sensu lato remain problematic. Blanket assignment of African *Coluber* to *Hemorrhois* (Welch 1983), or for some species (e.g., *algirus* and *dorri*, Chippaux 2001) is premature (Schätti and Utiger 2001; Pauwels and Branch 2003). Although it has long been known that *Coluber* sensu lato is unwieldy, its partitioning into monophyletic units has been problematic (e.g., Schätti 1986, 1987) and most authors (e.g., Largen and Rasmussen 1993 and *FGEA*) have continued to use *Coluber*, whilst others show the proposed reassignments in brackets, although not as explicit subgenera (e.g., Baker et al. 2002). Recently Schätti and Utiger (2001) have partitioned *Coluber* into a number of genera, although at least nine Old World racers remain unassigned (and best treated as *Coluber* sensu lato). The taxonomic status of *Coluber smithi* (not *smithii* as in the *FGEA*) is particularly confused. The *FGEA* notes that it was revived as a full species from *C. florulentus* (Schätti 1988), however, it was subsequently treated as a subspecies of *C. brevis* by Lanza (1988). Along with a number of other Old World racers (e.g. *florulentus, largeni, taylori*, etc.), and on the basis of morphological and molecular analysis, *brevis* (including *smithi*) has been transferred to the genus *Platyceps* (Schätti and Utiger 2001).

The illustration of *Hemirhagerrhis nototaenia* from Watamu (p. 394) is of the newly revived *H. hildebrandtii* (Broadley and Hughes 2000), which in Kenya is known only from Mombasa. The species is rupicolous and appears more closely related to *H. viperina* of northern Namibia, and might represent another example of vicariance associated with the proposed arid corridor postulated to have connected southwest and northeast Africa (Balinsky 1962). The gender of the sea snake genus *Pelamis* Daudin 1803 (Hydrophiidae) is feminine, and the correct name for the yellow-bellied seasnake becomes *Pelamis platura* (Lanza and Boscherini 2000).

Saw-scaled vipers (*Echis*) are an important medical risk in the northern scrublands of Africa, so it is important that their underlying taxonomy be resolved. This is complicated by regional variation and patchy material, and two recent controversial papers (Cherlin 1990a, 1990b) have proposed numerous changes to our understanding of African and Near East *Echis*, including the description of new species. A number of recent taxonomic (Golay et al. 1993) and geographic (Largen and Rasmussen 1993) checklists have grappled with these problems and have presented different interpretations. The taxonomic status of populations in northern Kenya is thus difficult, and the treatment in the *FGEA* reflects this. Two populations have been named in northern Kenya, *aliaborri* from the Wajir region, and *leakeyi* from northwest Kenya. Although both were initially described as races of *E. carinatus*, the *FGEA* follows Golay et al. (1993) and treats both as races of *E. pyramidium*. However, taxonomic conflict remains and Largen and Rasmussen (1993) treat both as races of different species (*E. varius* and *E. pyramidium*, respectively). Initially, the *FGEA* illustrated both as *E. carinatus aliaborri* and *E. c. leakeyi*, although this has been corrected in subsequent reprints.

The taxonomy of many African groups is being drastically revised, following more extensive surveys and the application of molecular studies. A number of important papers that affect the taxonomy of a number of species have appeared subsequent to the guide's publication. I discuss these only to aid the interested reader, and to highlight where additions and corrections will be needed in future editions of the guide.

Another new dwarf forest chameleon (*Rhampholeon moyeri*) has been described from the Udzungwa Mountains, Tanzania (Menegon et al. 2002). In a study that has wide implications, *Mabuya* is now restricted to the Neotropical radiation (Mausfeld et al. 2002). *Trachylepis* has been shown to be the earliest available name for the African radiation of "*Mabuya*" (Bauer 2003), albeit that the status of some species, e.g., *ivensi*, may require further assessment. Broadley (2001) revised the genus *Thelotornis*, describing a new species (*T. usambaricus* from Tanzania) and treated *T. mossambicanus* as a valid species (to which the illustration on p. 391 is referable). Subsequently, Broadley and Wallach (2002) revised the Dispholidini, describing a new genus and species (*Xyelodontophis uluguruensis*) from the Uluguru Mountains, Tanzania. They also considered *Thrasops schmidti* as

a valid species, restricted to the forests of the Kenya highlands from Mount Kenya south to Nairobi. No races of *Rhamnophis aethiopissa* or *Dispholidus typus* are now recognized. Rasmussen (2002) reviewed the genus *Micrelaps,* validating *M. bicoloratus* as a full species, relegating *M. boettgeri* to a junior synonym of northern *M. vallanti,* and describing a new subspecies, *M. bicoloratus moyeri*, from Tanzania. The distribution of *Naja pallida* no longer occurs into northern Sudan or Egypt, where it is replaced by the newly-described *Naja nubiae* (Wüster and Broadley 2003).

Finally I should stress that reviews are always personal assessments and I fully acknowledge that many of my comments might be individual idiosyncrasies. The mistakes I have noted, like those outlined by Broadley (2002), are made to assist the many people who have purchased or will buy the *FGEA*. Good field work requires dependable equipment and field guides, like good hiking boots, are indispensable. Both usually need a period in which they are broken-in and later, as they become scuffed and show signs of age, need constant care and upkeep. But the good ones soon come into their own and become trusted companions. The *FGEA* is well on its way to such a status. But these are early days and it requires a bit of a polish (as do all field guides). For anyone wanting to identify or understand the biology of East African reptiles the *FGEA* is *the* book to have, and I congratulate all the authors.

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Although many publications are available on the herpetofauna of the West Indies in general (e.g., Schwartz and Henderson 1991) and on that of the Greater Antilles in particular, the Lesser Antilles have not been treated in such detail. Malhotra and Thorpe (1999) considered the region as a whole, providing short accounts of each island group, and the amphibians and reptiles of Anguilla have recently been the focus of a small book by Hodge et al. (2003) but comprehensive illustrated treatments are lacking for most islands. The area of coverage of this contribution includes Guadeloupe itself, with its two main components, Basse-Terre and Grande-Terre, along with nearby satellites Marie-Galante, Les Saintes, La Désirade, Iles de la Petite Terre, Kahouanne, Fajou, and Tête à l'Anglais as well as Saint-Barthélemy and the northern portion of Saint-Martin (the southern portion, Sint Maarten, is a Dutch possession). The latter two islands are separated from Guadeloupe by about 200 km (and by Antigua, Saint Kitts, Montserrat, and other non-French islands), but are administered as dependencies of Guadeloupe.

The book begins with a fascinating historical review of herpetological studies in the region from 1647 through the 20th Century, with coverage of the contributions of naturalists such as L'Herminier and Plée, as well as French and American workers of modern times. This historical perspective is maintained throughout the book, which frequently quotes the observations of early explorers and naturalists and is liberally illustrated by maps and plates from 17th to 19th century natural history works. A short chapter provides a brief geological overview of Guadeloupe and characterizes vegetation types by a combination of elevation and rainfall regimes. The introductory portion of the book closes with the author's consideration of the herpetofauna as a whole. This includes a discussion of the origin of the Lesser Antillean herpetofauna and of the Guadeloupean fauna in particular, an overview of changes to the Pre-Columbian fauna brought about by translocations, extinctions, and extirpations, and finally, a review of threats to the herpetofauna and conservation measures. As elsewhere in the Caribbean, major threats include habitat destruction and introduced species. Some species, including the extinct lizards *Leiocephalus* cf. *cuneus*, *Ameiva cineracea*, and *A. major*, have disappeared since the arrival of Europeans and others, among them endemics, are threatened by the very recent arrival and spread of exotics such as *Osteopilus septentrionalis* and *Iguana iguana*.

The bulk of the volume consists of species accounts for the six frogs, five turtles, 21 lizards and seven snakes occurring in the region. Each species account provides a wealth of information. Under the heading "systématique" the types are identified by museum number and type localities are cited verbatim. The original name and any synonyms are also noted and extensive comments regarding taxonomic and nomenclatural issues are provided. Remaining subsections include: description, répartition, habitat, biologie-écologie, reproduction, and protection. Each account is accompanied by two maps, one showing distribution by island in the Lesser Antilles (with extinctions and extirpations noted) and one providing point localities within the Guadeloupean region. Further, the latter maps distinguish between modern records and those dating from the 19th and early 20th centuries. Fossil localities and unconfirmed records are, likewise, differentially plotted.

Each account is illustrated by color photos of the species as well as line drawings when appropriate. A representative account, that of *Eleutherodactylus johnstonei*, a frog species widespread in the Lesser Antilles, is 12 pages long and includes 17 color photos, a black and white illustration showing stages of development, and a sonogram. In constrast, the relatively recently described endemic *E. pinchoni* is treated in only four pages, with five color photos. *Iguana delicatissima*, a species of special interest to the author, is covered in 20 pages with 26 color photos (including a copulating pair, a specimen swimming under water, and several *I. delicatissima* x *I. iguana* hybrids) and a reproduction of an illustration from the 18th century work of Seba. In all, the book contains hundreds of color illustrations. Many of the photographs were taken in the field and are not as well composed as would be ideal, but all are nonetheless adequate for their purposes.

In general the accounts are detailed and well referenced. Espe-

cially in the case of *Anolis*, up-to-date phylogenetic hypotheses and models of taxic differentiation and faunal assembly are presented and supplemented by illustrations. Many of the natural history observations are original and most of the localities are published here for the first time. As I have recently reviewed the literature on *Thecadactylus rapicauda* (Russell and Bauer 2002) I used this taxon to evaluate the thoroughness of Breuil's accounts. Several Lesser Antillean islands where the species has been recorded (e.g., Sombrero and several of the Grenadines) have not been indicated on the map, and one synonym has been omitted. These minor issues aside, the account cites the relevant sources and adds interesting information on color variation and natural history in the Guadeloupean region. It also identifies some 40 point localities, in comparison with approximately six in the previously published literature.

The fauna is an interesting mixture of endemics (including *Anolis marmoratus*, with six recognized subspecies on Guadeloupe, *Sphaerodactylus fantasticus* with eight subspecies, and *Typhlops annae*, known only from the holotype from Saint Barthélemy), more widespread Lesser Antillean or Caribbean species (e.g., *Gymnophthalmus underwoodi*, *Iguana delicatissima*, *Mabuya sloanii*), and introduced species (e.g., *Osteopilus septentrionalis*, *Pelusios castanea*, *Ramphotyphlops braminus*).

An appendix provides a species list by island along with an indication of the date of each first record. A second appendix lists all Guadeloupean specimens in the collection of the Muséum National d'Histoire Naturelle in Paris. A short glossary defines 47 terms and there are separate indices to the Latin names of amphibians and reptiles, French common names of amphibians and reptiles, other animal names, and plant names. More than 575 references are cited in the bibliography, including many governmental reports and archival sources.

The book is the outcome of 66 weeks of field work by the author since 1987. However, it is much more than this. Breuil has done as thorough a job in his review of the literature and his preparation of maps as he has in the field. The result is a handsome volume that provides an excellent introduction to the amphibians and reptiles of the northern French West Indies and leaves the reader with a sense of both the geological and human factors that have shaped and continue to modify composition of the herpetofauna. The new distributional records, comprehensive bibliography, and detailed natural history data presented by Breuil make this an indispensable reference for anyone interested in Caribbean herpetology. The combination of a two-page English summary and the clear organization of the book should facilitate its effective use by even non-speakers of French.

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A Guide to the Snakes of Pakistan, by Muhammed Sharif Khan. 2002. Edition Chimaira, Frankfurt am Main (www.chimaira.de). 265 pp., 155 figs. Hardcover. US $49.95. ISBN 3-930612-44-5.

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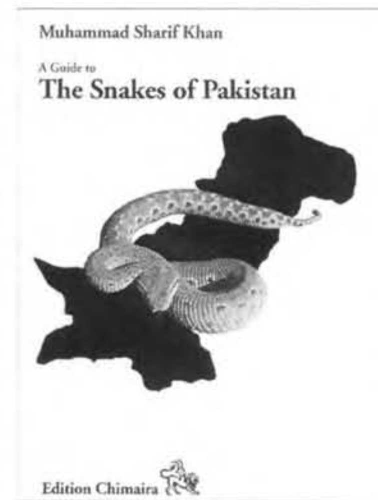

Until now, except for those who read Urdu (Khan 1993), no recent comprehensive treatment was available for the ophiofauna of Pakistan. As a consequence, most of us had to rely on Malcolm Smith's 60-year old *Fauna of British India*, vol. III, several papers by Mertens from the 1970s, Latifi's (1991) *Snakes of Iran*, and some more recent articles by Khan. This handy-sized guide (15 x 21 cm) with many color pictures, drawings, maps, and keys was thus a much-welcomed publication. However, my initial expectations soon turned into annoyance and amazement at so much sloppiness in one book.

Many diagrams of head scalation (see below) and all distribution maps are poorly executed. The hand-drawn symbols on the charts greatly distract from the potential distributional insight. These illustrations are in sharp contrast to the numerous, mostly excellent snake photos, frequently even of different color phases, shot by various photographers. Another worry is whether the level at which this book is written really serves its principal audience. According to the Introduction the book is aimed at biology and medical students, people concerned with agriculture, forestry and mining departments, and foreign visitors. It would be applauded if all these groups developed a strong ophiological interest, but I suspect that nature-loving tourists and the briefly mentioned (p. 43) amateur herpetologists and terrarium enthusiasts from Europe and the USA will compose the largest section of prospective buyers. They will initially be attracted by the photographs that unfortunately depict only 54 of the 70 species given in Khan's chapter Systematic Checklist of Snakes of Pakistan. More advanced users would welcome a good synonymy which, except for the citation of the original description, is lacking. Such detail may not be required in a field guide, nevertheless, several critical remarks concerning the taxonomy and nomenclature are called for, because the reader does need to know which species is really being discussed.

It is quite a job to distill from this book how many snake species occur in Pakistan. For instance: "In Pakistan, Family Colubridae is represented by 18 genera of 31 species" (p. 76). However, I count 16 genera and 35 species in Khan's Systematic Checklist (pp. 44–46) and there are 15 genera and 33 species discussed in

the text. The problems with the treatment of subspecies (discussed below) aggravate this puzzle. Even though mentioned in Khan's Checklist, *Spalerosophis atriceps* is missing from the species accounts. Only the note about 80 pages later ("Doubtful species of snakes for Pakistan") explains that "*atriceps*" is assumed to be the old-age form of *S. diadema*. *Telescopus rhinopa*, included in the Checklist, is listed as unlikely for Pakistan in "Doubtful species of snakes for Pakistan" (p. 206).

Throughout the text are numerous statements which are at least partially erroneous or simply meaningless. On p. 73: "Pythonidae (Pythons) ... Inhabit thick jungles of southeast Asia, Africa and South America." Well, forget about South America; only *Loxocemus* inhabits Mexico and it is not considered a true python. Or on p. 76 with regard to the Colubridae: "Moderately large snakes with typical snake morphology." What other morphology is there to expect? Further, many colubrids are small, only some are large. Khan reports of *Ramphotyphlops braminus* (p. 62) that "Almost nothing is known about the natural history of this miniature, secretive snake." In reality a great deal is known, including much about its natural history (e.g., Ota et al. 1991). Neither is the body of worm snakes < 150 mm; a dozen species reach > 300 mm, with *Leptotyphlops macrolepis* at 400 mm. On page 69 the author states that "Boas are snakes of moderately dry, more or less sandy areas." This is possibly correct for erycines, but certainly not for boas in general. For *Amphiesma platyceps* "head with large shields," a characteristic of colubrids in general, is provided as a distinctive characteristic of the species. Finally, on page 76: "...colubrids universally share some characteristics: head, neck, trunk and tail are distinct...." This is perhaps so in Pakistan, but not across the world. For example, the large genus *Calamaria*, in which this is definitely not so, springs to mind. This raises the general question if all the data given pertain to Pakistani snakes, or if not, which other sources were consulted.

A strong critique of Khan's *Typhlops* species (Wallach 2000) is listed in the bibliography but not mentioned in the text and Khan, regrettably, uses his original nomenclature rather than Wallach's corrections. Many other species also suffer from nomenclatural and taxonomic problems. *Boiga melanocephala* has previously been considered a subspecies of *Boiga trigonata*. Thus, who elevated it to full species—Khan? Khan (1994) separated *Boiga melanocephala* from *B. trigonata* in his key, whereas earlier (Khan 1982) he regarded it as a subspecies. Confusing. *Coluber rhodorachis* (Jan, 1865) should be attributed to (Jan in Filippi, 1865) as Filippi was the author of Viaggo Persia. *Coluber ventromaculatus* was described by Gray, not Gray & Hardwicke. The common name of *Natrix tessellata* is usually given as Dice Snake, not Blotched water snake (p. 130). The single, almost century old, report for Pakistan of this snake by Wall (1911) should have been fully investigated. On page 206 *Natrix tessellata* is called *Xenochrophis tessellata* by Khan, and Wall (1923) is referenced. This is one of the many cases in which a proper synonymy would be helpful, but alas "In present work, such delicate taxonomic matters are avoided" (p. 76). Wall (1923:604) referred to this species as *Nerodia tessellata*, and the only *Xenochrophis* listed by him was *cerasogaster* on p. 600, so this must be a *lapsus* by Khan. Typically *Pseudocerastes bicornis* is listed as a synonym of *Pseudocerastes persicus* (e.g., Golay et al. 1993; Joger 1984); not here, so who elevated it to full species? Khan? And if so, where was the action published? Several forms previously treated under *Naja naja* are indeed now considered to be distinct species, such as *Naja oxiana*. It would have been advisable to mention who recognized these as species (Wüster and Thorpe 1992; Wüster 1996), and that Deraniyagala (1960, 1961) came to the same conclusion even earlier.

Khan has difficulties with the gender of genera: (p. 79): *Argyrogena fasciolatus* = *Argyrogena fasciolata* (*Argyrogena* is of the feminine gender); on p. 46 in *Spalerosophis schirazianus* the masculine form of the species name is correctly used, but on p. 151 we find *S. schiraziana*. *Pseudocyclophis persica* = *Pseudocyclophis persicus* (masculine gender) and the original reference is incorrect; it is not *Pseudocyclophis walteri* Boettger, 1888, but *Cyclophis persicus* Anderson, 1872. Oddly, the listing is correct—including the original author—in the Systematic checklist, but incorrect elsewhere in the book (e.g., pp. 119–120). The use of subspecies is inconsistent and confusing: at first it appears that subspecific names are not given when only the nominate form occurs in Pakistan (for example *Python molurus*), but *Xenochrophis piscator piscator* and *Bungarus caeruleus caeruleus*, for example, contradict this, as does the caption to Fig. 27: "*Python m. molurus*." Though both forms are mentioned in the checklist, it remains unclear what characters differentiate *Coluber k. karelini* and *Coluber k. mintonorum*. Neither is the subspecies *Coluber rhodorachis ladacensis* treated. In the key (p. 185) to species and subspecies of *Echis*, *E. multisquamatus* and *E. pyramidum* are treated as species, but in the species accounts the former is dealt with as a subspecies of *E. carinatus* (on p. 186 and in map 18), and the latter has completely disappeared.

It is nice to see type localities mentioned, though contradictory if the book is focused on non-taxonomists as the author's remarks seem to imply. However, information is lacking from some of the type data. For example, the type locality of *Coluber rhodorachis* is not just "Persia (Iran)," as this was restricted forty years ago to Shiraz (Kramer and Schnurrenberger 1963:501). And when such a restriction has been noted, as in *Lytorhynchus paradoxus*, we would like to know the author responsible, otherwise it suggests an action by Khan in this book.

Though not being a native English speaker, I often stumbled across pieces of very awkward English. Sometimes an unintended pun occurs ("...catching a hooded cobra alive needs much experience, it is advised to be killed before catching one") (p. 33), but mostly the problems are spelling or phrasing errors such as "pray" instead of "prey" (p. 73), or "with 2–3 supralabials in eye," rather than "contacting the eye" or "entering the orbit" (this slip occurs often). In other places there are strange sentences like "Young ones are hatched after 58–60 days of." (p. 73; one assumes that the word "incubation" is missing here), and "The authority of Dr. Wall is sufficient to included this species in the fauna of Pakistan" (p. 206). The definite and indefinite articles are often missing in sentences (e.g., p. 76: "They are heterogeneous assemblage of snakes, status of several species is hotly debated," "In present work, such delicate taxonomic matters are avoided," and "Family Pythonidae is represented..."

Except for Figs. 6b and 12, all lateral views of head pholidosis sketches are called "Head: latrum" (in Fig. 8 and Fig. 10 the lateral view is even labelled "ventrum!"), and the dorsal view "Head: dorsum." While the latter might be acceptable, "latrum" is an

incorrectly formed, semi-Latin word.

Typographical errors abound; here I give just a few examples. The layout of the keys is fairly confusing with sentences inexplicably jumping to the next line (Key to the families [p. 49]: first couplet of question 1, 4, 7 and 8; Key to the genera [pp. 50–51]: both couplets of the first question; and in various places in Key to the species [pp. 53–57]). The alignment in the Checklist is erratic. Because of such mistakes the key with which body fragments of snakes can be identified (an interesting addition) is practically useless. Incorrectly used italics also occur: (p. 73) *Coluber molurus Linnaeus*, (p. 104) species names in the legends of Table 4 not in italics, (p. 215) *Boiga trigonata ands B. melanocephala*, as do simple slips: (p. 75) Thid [=This], (p. 112) "…and In Pakistan…" [unjustified use of capital letter], (p. 175) infral-abials, (p. 175) *Pelamis s platurus*, and (p. 211) 9. 1Subcaudals. Editorial lapses are suggested by mistaken use of small capital letters in localities of, for example, *Lytorhynchus maynardi* – "Koh-Malik-do-KHAND" (p. 109) and *Echis carinatus sochureki* "Band Kushdil KHAN near Pishin" (p. 186).

In the Bibliography, which uses small caps for authors names, Christy, Cogger, Schmidt, FitzSimons and Wall all have only initial caps. Khan & Khan (1996) is listed twice (p. 246 and 247) and this section, like the rest of the book, contains numerous other typos. Are such slips so terrible? No, but they add to the general inaccuracy and greatly undermine confidence in the biological data presented. Only in the rarest cases are citations to different works by the same author in the same year distinguished in the text (e.g., Khan & Tasnim 1986b on p. 133), and this system is never used in the Bibliography. It is unclear whether all the publications listed in the Bibliography were actually used in the book (I became tired of scrutinizing all the mistakes), but certainly a number of those mentioned in the text are not found in the list of references. Having checked pp. 13–17, I find seven citations lacking: Burton (1973), Vogel (1926), Gharpurey (1962), Buffetaut & Ingavat (1985), Powal (1979), Adamson & Shaw (1986), and Jaeger et al. (1989), and one misspelled (Mahinder vs. Mahendra).

The Index indicates that the account of the colubrid *Enhydris pakistanica* is found on p. 173 where, however, the unrelated sea snake *Enhydrina schistosa* is actually treated. *Coluber v. ventromaculatus*, *C. v. bengalensis*, and *C. v. indusai* are missing from the index all together.

While leafing through the book for the first time, several of the black-and-white scalation drawings looked vaguely familiar. It soon became clear why: the great majority were traced in an amateurish way, without any acknowledgment, from Smith (1943). I did not recognize them immediately because the details of pholidosis and patterning were frequently given in separate drawings, the latter often especially clumsily executed as compared to the fine originals (e.g., Figs. 44c, 51b, c, 52c, 54c). In the following cases Khan's figures could be directly attributed to an original in Smith (1943): Figs. 9a, b from Smith's Fig. 35 (lateral and dorsal views; Smith (1943) acknowledged Boulenger (1890) for this figure, but Khan even had the audacity to add his monogram MSK to his tracings); 10a, b from 33 (here the heat-sensitive pits are lost!); 44a, b, c from 111C; 47 from 89; 51a, b, c from 76A and 77A; 52 from 115; 54 from 49; 56 from 51; 57a, b from 100B, C; 58 from 96A, B; 59 from 96C or D; 122b from 145 (middle drawing); 124 a, b from 151A, B; 127a, b from 153A; 128b from 154B; 128c from 154C; 128d from 154 (in Smith's fig. 154 Boulenger is again acknowledged); 129a from 156A; 129b from 156C; 130a from 155B (but, admittedly, the rest of the head pholidosis has been newly added); 130b from 155A; 130c from 155C; and 131 from 157 (again acknowledged by Smith as derived from Boulenger 1890), in which the addition in Khan's tracing is a line pointing to the heat-sensitive pit (although this is not identified in either the text or the figure legends). The remaining black-and-white figures might be originals (but one is understandably suspicious). They are Figs. 11, 12, 45 (containing the monogram MSK; these drawings are good!), 46, 48, 49, 50, 53, 55 (one of the poorest drawings), 61, 121, 125 and 126. The book would have been much improved had the older original drawings of Boulenger (1890), Pope (1935), and Smith (1943) been included rather than bootlegged.

It is disappointing that photos for about one fifth of the snakes are absent. This is particularly surprising where local forms recently described by Khan are concerned (e.g., *Typhlops ahsanai* [should be spelled *ahsanuli*], *Coluber rhodorachis kashmirensis*, *C. ventromaculatus indusai*, *Bungarus sindanus razai*). In the case of Khan's *Typhlops ductuliformes* and *T. madgemintonai* (misspelling of *madgemintonae*) barely recognizable preserved specimens are depicted. Two photographs seem to be of species other than those mentioned in the legends: Fig. 14 is not *Ramphotyphlops braminus* (it looks like an African *Typhlops*), and Fig. 148 is a *Macrovipera lebetina*. The latter photo is taken from Fig. 3, opposite page 48 of Trutnau (1981), where it is also misidentified. It is unclear why Figs. 150–152 depict two different subspecies of *M. lebetina* (viz. *cernovi* and *obtusa*) while the ambiguity on the status of the eastern forms of the species (David et al. 1999) has not yet been clarified; here Khan just adds to the confusion.

The numbering and placement of the maps throughout the book is rather curious. Partly this is caused by including the data of more than one species per map and reprinting the map near the species concerned. Thus map 5 is found on pages 80 and 120 (there following map 12), map 19 is on pages 188 and 190, and map 20 on pages 183 (following map 17 and preceding map 18) and 205. Incomprehensibly, map 10 (p. 130), presenting distributional data for *Xenochrophis sanctijohannis* and *Natrix tessellata* (text on pp. 129–130) is in between map 15 (p. 126) and map 16 (p. 135). There are two different maps numbered 13 (on pages 122 and 125); the latter one should have been numbered 14 (which is otherwise missing) and is indicated as such in the text. On map 4 *Amphiesma platyceps* is either lacking (no separate symbol) or is lumped under *A. sieboldii*.

Despite my many criticisms, there are positive sides to the guide. The notes contain breeding data that are often new and pertinent to the region, although juicier natural history data could have been included. For instance, it is nice to know that *Naja naja* lays 12–30 eggs but as this is the only snake that makes a real nest, why not mention it here? Another plus is the indication of the species' ranges in Pakistan. This will likely stimulate further faunal research. Finally, pages 218–231, with information on snake folklore, contain interesting ethnological information, which is often sadly ignored in similar regional works.

Summarizing: a laudable attempt, poorly executed. Much more information can be found in Smith (1943), which provides much

better original drawings, plus lots of data on pholidosis. It is unclear whether Khan's data on sizes and pholidosis stem from actual measurements on Pakistani snakes, or if these are just transcribed from other works. If the former, the book's inherent value would be increased. A major lack of editorial control is apparent, concerning scientific content, figures, proof reading, and a disregard for proper English. Perhaps for the latter aspects the publisher is as much to blame as the author.

Nonetheless, the book has nice production values and decent species accounts, and considering what is currently available on the Pakistani snake fauna, it probably should be bought by anyone with an interest in the region. However, given the sea of inaccuracies it contains, the volume should not be used as a work of reference. Still, one should appreciate Khan for his mission to make his fellow man understand (p. 8) that "Snake is man's friend, do not kill it!"

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Wide distribution gaps of several taxa reflect our poor knowledge of the herpetofauna of central Peru. In an attempt to improve our understanding of the diversity of amphibians and reptiles in this region, Edgar Lehr presents in this book the results of his field work in Peru between 1997 and 2001. Lehr surveyed 42 localities along a 470 x 50 km transect extending from the Pacific coast to the Amazonian lowlands at 10° south latitude and passing through four Departamentos (Ancash, Huánuco, Pasco, and Ucayali) and five ecological regions.

The introductory chapter includes a general overview of Peru's megadiversity and a brief, but informative, outline of the history of herpetology in Peru, including major contributions since the 19th century (e.g., Tschudi 1845; Werner 1901). As shown in figure 1 (p. 10), the number of publications on Peruvian herpetofauna has increased dramatically during the last quarter of the 20th century. The chapter then focuses on Peruvian geography, physiography, climate, and geology, and includes short descriptions of the ecological regions included in the transect. More than 20 good-quality landscape pictures reveal to the reader the great variety of habitats in which the species included in this book were collected. Lehr continues with a detailed description of materials and methods including a list of all collecting sites (pp. 25–27). Political units, coordinates, elevations, life zones, and collection dates are provided for each of the 42 localities included in the transect. In addition, collecting and preservation techniques, as well as methods of data analysis are described.

With 120 pages, the third chapter constitutes the main section of the book. It includes accounts of species and a number of large tables. Table 3.2 (6 pp.) contains a list of all species collected with their respective ecological region, elevational distribution, and other collection data. Table 3.4 (9 pp.) provides eight scale counts for all collected specimens of snakes, and Table 3.5 (10 pp.) includes yet another list of species with their distribution among the 42 localities of the transect. Most species accounts are very short and contain general information on distribution, remarks, and color photographs. Accounts of some species (e.g, *Bufo spinulosus*, *Proctoporus*) are more extensive than others and contain informative diagnoses and/or information on natural history and ecology. Except for a few poorly-taken photographs and some minor spelling errors (the name *Phyllomedusa* is misspelled in the figure captions of all photographs on p. 54; caption "*Phrynopus dagmarae*, ..." does not correspond to the figure on p. 63), the color pictures make this book a useful guide for anyone working with amphibians or reptiles from central Peru. Additionally, good-quality drawings of *Bufo chavin*, *Phrynopus dagmarae*, *P. horstpauli*, *P. heimorum*, *P. kauneorum*, four new species of *Proctoporus*, and *Leptotyphlops alfredschmidti* are provided. General information on 15 new species (9 amphibians and 6 reptiles) is included, although these species are not formally described in this book. An update to previous lists of amphibians and reptiles in Peru (Carrillo de Espinoza and Icochea 1995; Morales 1995; Rodríguez et al. 1993) is also provided on pages 113–114. In addition, 51 new records of reptiles and amphibians are reported for Departamentos Ancash, Huánuco, and Ucayali. This chapter ends with a brief discussion on biogeography. Number of species and endemism are compared among all different life zones included in the transect at the specific, generic, and familial levels.

The last chapter is a discussion that mainly addresses the necessity for more studies on diversity of the Neotropical herpetofauna. Several surveys in previously unexplored areas in Peru have led to the discovery of 63 species of amphibians and 22 species of reptiles in the last eight years. This increase in the number of species of amphibians (379) and reptiles (387) probably modifies the ranking of Peru among the megadiversity countries. With 241 species of amphibians and 298 reptiles, Peru was ranked number 7 and 12 for amphibian and reptilian diversity, respectively (Mittermeier et al. 1997). There are still many regions to be explored in Peru, and it is very likely that unknown species occur in these areas. This book is a great contribution to the study of biodiversity in South America and it will be very useful to students, amateur biologists, ecotourists, or anyone interested in Peruvian herpetofauna.

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Herpetological Review, 2003, 34(4), 404–405.

Die Amphibien und Reptilien eines Tieflandfeuchtwald-Schutzgebietes in Vietnam, by Thomas Ziegler. 2002. Natur und Tier – Verlag GmbH, Münster (www.ms-verlag.de). 342 pp., hardcover. 88.00 € (approx. US $92.00). ISBN 3-931587-54-1.

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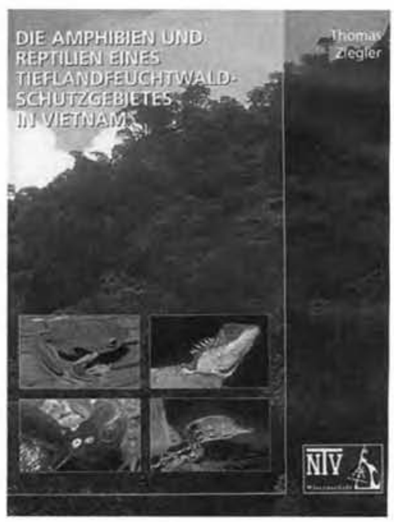

The increasing interest in the herpetology of Indochina over the last two decades has led to a growing number of publications reflecting the results of faunistic and taxonomic research. Indeed, we are witnesses to a new era in Southeast Asian herpetological research. In addition to numerous papers presenting new records and descriptions of new species, several large-scale monographs on the herpetofauna of Southeast Asia have also appeared (e.g., Nguyen and Ho 1996; Manthey and Grossmann 1997; David and Vogel 1997). The rich and diverse fauna of amphibians and reptiles of Vietnam is no exception. Ziegler's book on the amphibians and reptiles of a protected area of lowland rainforest in Ha Tinh Province is a valuable addition to this literature.

The introductory chapter starts with a detailed description of the history of herpetological research in Vietnam and an explanation of the main goals of the study. In the following text readers learn about the geography, physiography, climate, vegetation, and biogeography of Vietnam in general, and of the Ky Anh-Ke Go protected area of Ha Tinh Province in particular. This is one of the most endangered wilderness areas in Vietnam and served as the site of the author's field work and collecting during the periods of June–September 1997 and August–October 1998.

The Material and Methods chapter includes a description of all of the collecting, preservation, voice recording, and molecular techniques employed. The main part of the text consists of individual species accounts detailing the characteristics of 31 species of amphibians and 58 species of reptiles. Species accounts contain the following information: Latin name, describer, year, reference and

type locality, common name in German, specimens examined, general distribution, description, ecological notes, sonogram (for frogs), and taxonomic comments. All species accounts are accompanied by excellent color photos. The systematic section is followed by several short chapters with general considerations on biodiversity (species richness and abundance), ecological diversity (comparative analysis of spatial, temporal and trophic distribution, general patterns of reproductive biology), and zoogeography. The last chapter is devoted to the very real problem of amphibian and reptile trade and its role in the decline of these animals in Southeast Asia.

This monograph is a perfect example of a detailed characterization of the herpetofauna of a restricted region based on intensive and efficient research. The comprehensive inventory is enriched by detailed documentation of such features as hemipenis structure for male squamates and vocalizations for frogs and geckos. It is also necessary to point out that the technically superb and very attractive photos are themselves important sources of information and can be used for field identification. They illustrate important species characteristics and include biologically relevant field shots, such as those of frogs calling and in amplexus, and snakes in sleeping positions (e.g., Fig. 348, p. 224).

We have only a few critical remarks. Firstly, strictly speaking, the book deals not only with lowland rainforest, as the title implies, but also with foothill forests. In addition, a number of taxa have been identified only to the generic level (e.g., pp. 42, 209, 219, 243). Obviously future resolution of these identifications would be desirable and we have no doubt that the author is continuing his investigation of these species. Nonetheless, we suspect that the species list is incomplete and that further field work would add to the documented diversity of the site. For example, megophryids are very poorly represented (only one species) as are microhylids. The latter group of frogs was probably incompletely sampled because field work was not conducted during all seasons of the year. It is also likely that more scincids, colubrids, and elapids (e.g., *Calliophis*) may be present. Finally, the frog on page 60 (Fig. 69) identified as *Microhyla* cf. *annamensis* is most probably *M. berdmorei*.

Despite these minor corrections and complaints, we conclude that Ziegler's monograph is a valuable supplement to the herpetofaunal literature of Indochina. It will be useful for anyone concerned with the amphibians and reptiles of Vietnam or other regions of tropical Asia.

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TECHNIQUES

Herpetological Review, 2003, 34(4), 345–348.

A Radio Transmitter Belt for Small Ranid Frogs

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Radio telemetry is a useful technique for gathering information about amphibians when associated caveats are applied (Bartelt and Peterson 2000). A number of designs for transmitter attachment are available for larger anurans including a harness-type attachment (van Nuland and Claus 1981) and various belt designs (Bartelt and Peterson 2000; Rathbun and Murphey 1996; Waye 2001). Attaching radios to small anurans is particularly problematic because of their mass, shape, and delicate skin. Small radios, 0.61 grams or less, are available, although battery life is usually only 2–3 wks (e.g., Holohil Systems Ltd; Carp, Ontario, Canada[1]). The issues remaining are the weight and longevity of the attachment system, ease of application to the animal, and effect on the behavior and health of the animal.

Here I describe an attachment assembly tested in the laboratory on juvenile leopard frogs (*Rana pipiens*) and used on wood frogs (*Rana sylvatica*) in the field.

The goal of the field study was to fit radio assemblies to 8 wood frogs (4 males and 4 females) and to follow them for approximately 2 wks (the life of the battery) during and immediately after the breeding season (May–early June). Male wood frogs generally breed in their second spring when they are between 34 and 40 mm snout–vent length (SVL); females generally breed in their third spring when they are between 45 and 54 mm SVL (Hammerson 1999). Currently available attachment methods were unacceptable for these small ranid frogs.

I used Holohil BD-2A transmitters (0.61 g). The transmitters were configured so that the battery was placed on top of the transmitter rather than in front of it (Fig. 1b). In earlier trials, using the belt system described by Bartelt and Peterson (2000) and the original, linear arrangement of the transmitter, frogs were unable to properly orient themselves in the water. This was because the length of the assembly system made the transmitter ride too far up on the frog's back and because the belt material was too bulky.

I used very fine craft elastic (gossamer floss, B. Toucan, Inc., US $1.64 for 5 yds) and size 14 Japanese glass seed beads in olive

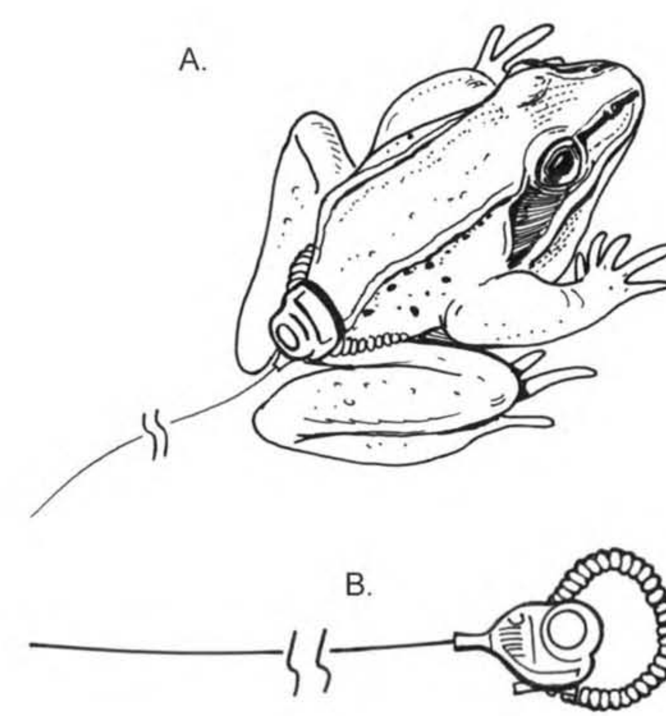

FIG. 1. (A) Male wood frog with transmitter and belt assembly. (B) Sketch of belt assembly with radio for small ranid frogs.

matte (F458, US $3.45 for thousands) to make the belt. The elastic was threaded through the small attachment tube on the transmitter pack and beads were strung on the elastic. The elastic was tied in a knot and the knot stuffed into the tube on the pack. This small belt (Fig. 1a) was able to stretch enough to be held open by 2–3 fingers while the back legs of the frog were pushed through with the other hand. It was easy to determine if the belt fit correctly: too tight and the frog's skin was pinched and it was unable to move naturally, too loose and daylight was visible between the frog and the belt. When fitted properly, the belt should roll easily when manipulated. Because we were interested only in relatively small movements, in and near the breeding pond, I shortened the 14 cm whip antennae to 9.5 cm. This reduced the range of the transmitter and the mass of the assembly (slightly), but more importantly, reduced the possibility of entanglement for the frog.

I used 2 captive, juvenile leopard frogs to test the harness prototype before the 2002 field season. Both animals were ca. 9 g. Animals were housed together in a 15 gal. aquarium with rocks, plants, and an upturned plastic tub for shelter. The aquarium was set on an angle to provide aquatic and non-aquatic habitat. Frogs were fed small crickets, ca. 8 per animal per week.

After a number of fitting trials, a belt assembly (22 beads) with dummy transmitter (0.73 g total mass), was placed on leopard frog 1 (ca. 9 g, 41.3 mm SVL) on 10 March. The other frog was approximately the same size and was not fitted with a belt. The frogs were checked 2–4 times daily. Hiding and feeding behaviors were noted and frog 1 was assessed visually for abrasions. The assembly was removed on 14 and 18 March to check for abrasions manually and then replaced. I isolated frog 1 to confirm that it was eating and defecating 18–25 March. The assembly was removed on 7 April.

Pilot data collected in 2001 provided an estimate for our expected size of individuals: mean mass = 8.7 g, mean SVL = 43.1 mm (N = 8). Our criterion for selecting individuals to carry the transmitter was adult animals ≥ 8.5 g. This follows the general rule that transmitters and assembly systems should not exceed 10% of total body mass (Richards et al. 1994).

Neither the movements of the two leopard frogs around their environment, nor their appetites appeared to be affected by the assembly on frog 1. Both belted and non-belted frogs consumed crickets (7 and 8 crickets, respectively) and produced approximately equal amounts of waste (3 and 4 pellets, respectively), when housed together and separately. On 7 April, a small (2–3 mm) cut was found underneath the belt on frog 1. The assembly was removed and the cut cleaned. The assembly was not refitted. The leopard frog tolerated the belt assembly for 4 wks, about 2x longer than I expected the batteries to last. It was not until the fourth week that there were any signs of abrasion. After the belt was removed, the wound healed within 2 days.

In May we fitted 11 different wood frogs with transmitters (Table 1, Fig. 1) at the field site. The smallest frog fitted was 8.5 g and the complete belt assembly with 22 beads weighed 0.73 g, 8.6% of the frog's mass. Of these, 5 frogs (3 M and 2 F) shed the belts soon after they were fitted (≤ 4 days) and 6 frogs retained the belt assembly from 7 to 30 days (mean = 21 days, males; 16 days, females). There is a relationship between mass and the number of beads needed for the belt ($R^2 = 0.81$) (Fig. 2), but there are too few data to build a reliable predictor.

Animals were located 3 times daily (1200, 1800 and 2400 h), but inspected visually (for abrasions or problems with the belts) only once per 24 h period. In 4 of 5 cases the animals that shed their belt assemblies within 24 h of attachment were smaller than their counterparts that retained their belts of the same number of beads. Detectability of the transmitter signal was not related to the length of the whip antennae although transmitters varied in battery life (Table 2). All females fitted with belt assemblies were gravid and lost appreciable mass (0.9–4 g) over the course of the study after their eggs were deposited. Males either lost or gained minor amounts (± 1–1.5 g) except for one. This male retained the belt assembly for 22 days before any abrasions were noted. At that point, the belt was removed, the frog weighed and the small abrasion was treated with Bactine®, and a second belt was attached. When the assembly was removed on 31 May, 10 days later, the

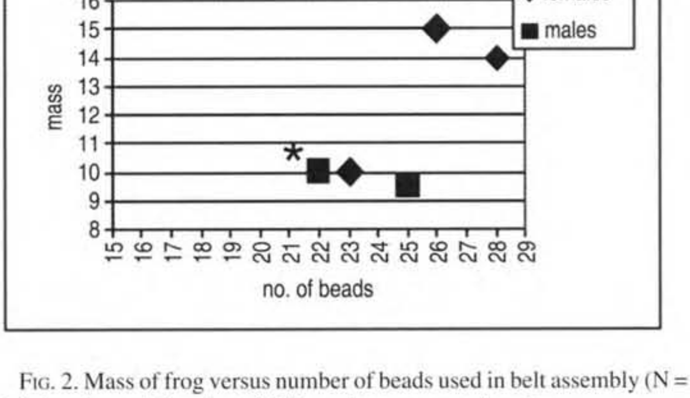

FIG. 2. Mass of frog versus number of beads used in belt assembly (N = 6: 3 females and 3 males). * This point represents 2 males.

TABLE 1. Animals that received radio transmitter belt assemblies, sex, SVL, mass, belt construction and length of time belt worn.

Animal i.d.	Frequency	Sex	SVL (mm)	Initial mass (g)	Final mass (g)	Number of beads on belt	Date transmitter attached	Date transmitter removed/lost	Reason transmitter removed/lost	Number of days with belt on	Number of locations
212	164.048	M	—	8.5	—	22	7 May	8 May	Shed by frog	1	2
222	164.048	F	49	14 (gravid)	13.1	28	16 May	1 Jun	Battery dead/ transmitter removed	16	24
233	164.143	F	47.8	10	—	23	22 May	28 May	Battery dead/ transmitter removed	7	6
202	164.170	M	—	10.5	—	28	2 May	3 May	Shed by frog	1	3
214	164.170	F	44.3	15 (gravid)	11.0	—	9 May	23 May	Battery dead/ transmitter removed	15	22
214	164.007	F	44.3	15 (gravid)	11.0	—	23 May	4 Jun	Shed by frog	13	18
221	164.007	F	—	13 (gravid)	—	29	16 May	17 May	Shed by frog	1	1
43	164.007	F	—	17.5 (gravid)	—	—	18 May	21 May	Shed by frog	4?	1
1811	164.085	M	41.9	10	10.5	22	4 May	20 May	Battery dead/ transmitter not recovered	15	30
210	164.119	M	—	9.0	—	22	3 May	6 May	Shed by frog	4	1
55	164.248	M	43	10.5	11.0	22	1 May	22 May	Battery dead/ transmitter removed	22	40
55	164.119	M	43	11.0	8.5	22	22 May	31 May	Battery dead/ transmitter removed	8	16
53	164.207	M	43	9.5	9.5	25	1 May	21 May	Battery dead/ transmitter not recovered	19	45

TABLE 2. Battery life of BD-2A transmitters, antennae length, and fate.

Transmitter No.	Frequency	Battery life* (days)	Antennae length: Original = 14 cm Modified = 9.5 cm	Number of detections (= frog locations)	Fate of transmitter: Received = R Lost = L
70643	164.007	18	O	20	R
70644	164.048	17	O	26	R
70645	164.085	15	M	30	L
70646	164.119	12	O	17	R
70647	164.143	7	O	6	R
70648	164.170	16	M	25	R
70649	164.248	22	M	40	L
70650	164.207	19	M	45	R

* transmitter was turned off with magnet when not on frog.

frog had lost 2.5 g (23% of its mass determined on 22 May).

Advantages to this system are its weight, flexibility in sizing, and low cost. Secondarily, the color can be adjusted easily for the target species given the wide variety of bead colors available. The belt also has the potential to tear away if the frog becomes entangled in vegetation, although this was not tested in the field.

The weight of the assembly depends on the number of beads used in the belt. The difficulty in fitting the belt was in estimating the number of beads to use. The relationship between mass and number of beads serves as a rough guideline to determine the length necessary for the belt (Fig. 2).

The process of assembling the belt system requires the use of tweezers or a fine needle to thread the beads. This can be a disadvantage when ambient air is cold enough to make numb hands an issue. Collars can be assembled before the field session, but a certain amount of fine-tuning when the frogs are captured should be expected.

This belt assembly is recommended for relatively brief studies where long-distance movements are not expected. We found no frogs with skin irritations or abrasions during the first three weeks of this study.

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[1]Product use does not imply endorsement by USGS and is present for informational purposes only.

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Estimating the Population Size of an Endangered Population of *Rana porosa brevipoda* Ito (Amphibia: Ranidae) from Photographic Identification

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To clarify the status of an endangered species, it is necessary to estimate population size. Blaustein et al.(1994) recommended mark and release as the best method for assessing populations. Toe clipping is commonly used as a mark-recapture method for mammals, reptiles, and amphibians (Demaynadier and Hunter 1998; Dole 1965; FitzGibbon 1997; Lips 1998; Loredo and Van Vuren 1996). However, Clarke (1972) found the probability of recapture decreases as the number of toes removed increases in *Bufo woodhousei fowleri*. Golay and Durrer (1994) marked 96 *Bufo calamita* and found that 12 out of 66 recaptured animals had infections arising from toe-clipping. Lemckert (1996) pointed out that generalities about the effects of toe-clipping on anurans are difficult to make. Because of these problems we regarded the toe-clipping method as unsuitable for endangered species.

Recently, a photographic technique that identifies individuals from their spot pattern has been used for spotted salamanders, *Ambystoma maculatum* (Loafman 1991), and leatherback turtles, *Dermochelys coriacea* (McDonald et al. 1996). This technique has several advantages, as the animals are not injured, the technique is easy to use, and it is inexpensive (Doody 1995). Therefore, this method should be useful for endangered populations.

The Japanese Environment Agency recognized the daruma pond frog, *Rana porosa brevipoda*, as a threatened, vulnerable species in 1997. Moreover, the Forestry Department, Hiroshima Prefecture Office, recognized *Rana porosa brevipoda* which live in Hiroshima as an endangered species in 1995. In the Hiroshima prefecture, *R. p. brevipoda* occurs only in a few sites, where the population was reduced by conversion of its habitat to new rice paddy fields. A population that was reintroduced after the reclamation of the rice paddies is being monitored (Okochi et al. 1997). To avoid hurting the frogs, Okochi et al.(1997) used direct counts of individuals in fields as an index of population size. However, this method is unlikely to provide an accurate estimate. To solve this problem, we estimated the population size by photographic

identification of individuals, and compared this estimate to that of the direct count.

The study was carried out in rice fields in Kisa Town, Hiroshima prefecture, southern Japan (132°59'E, 34°42'N). The study site is a typical rice paddy in a drainage basin, and contains many rod-row plots surrounded by levees and concrete ditches. The site is dry from harvest in September until planting in May. On 4 and 11 October 1998, after reaping, seven to eight people walked through the study paddies and searched for *Rana porosa brevipoda* under the rice straws in each rice rod-row plot. Some of us have studied this species since the 1980s, and confirmed that the dot pattern does not change over several days. Because individual frogs have a distinctive pattern of black dots on the body, the pattern can be used to identify individual frogs. The pattern on each frog was photographed from three sides (the right and left flanks, and the back) and the individual was then released back into the rice paddy where it was captured. After these field surveys, we checked the pictures directly three times, and identified recaptured frogs. Each of the tests were evaluated entirely by different people, and each of their estimation from the photographs corresponded to the other.

We found 76 froglets on 4 October and 114 froglets and 6 adults on 11 October. Fourteen froglets were recaptured on the second occasion. Of these, nine were recaptured in the same paddy rod-row plot as in the first survey, three were found in the adjacent plot, and two were found two plots away from the original site. No recaptured frogs crossed the 30–40 cm deep concrete ditches in the fields (Fig. 1). This suggests that the concrete ditches might be barriers for froglets. Therefore, the number of young frogs in each group of rice plots enclosed by concrete gutters was calculated separately using the simple average and Bailey's estimate (Donnelly and Guyer 1994).

Bailey's estimate =

$$\frac{(\text{Froglets captured on 4 Oct})(\text{froglets captured on 11 Oct} + 1)}{(\text{Recaptures} + 1)}$$

For three groups of rice paddies, the simple average of the direct count on the two survey days was 19.5, 49.5, and 26 froglets and the overall average was 95. The estimated populations were 133.3 ± 61.5, 197.8 ± 52.3, and 232 ± 109.9 (± 1SE). The total estimated population was 563.2, which is 5.9 times larger than the simple average.

The photographic technique was used successfully to recognize individual *R. p. brevipoda* by their spot patterns and thus to estimate population size. We found 196 uniquely-patterned individual frogs. Such a population-size difference means that the true population may be bigger than estimates based on a direct count. Because the spot pattern of *R. p. brevipoda* changes with growth, the photographic technique is only useful for identification in the short term, and how long it is effective has not yet been determined.

It is important to determine the results of conservation efforts and to develop better conservation programs. We believe that this photographic identification technique based on spots is suitable for monitoring endangered populations.

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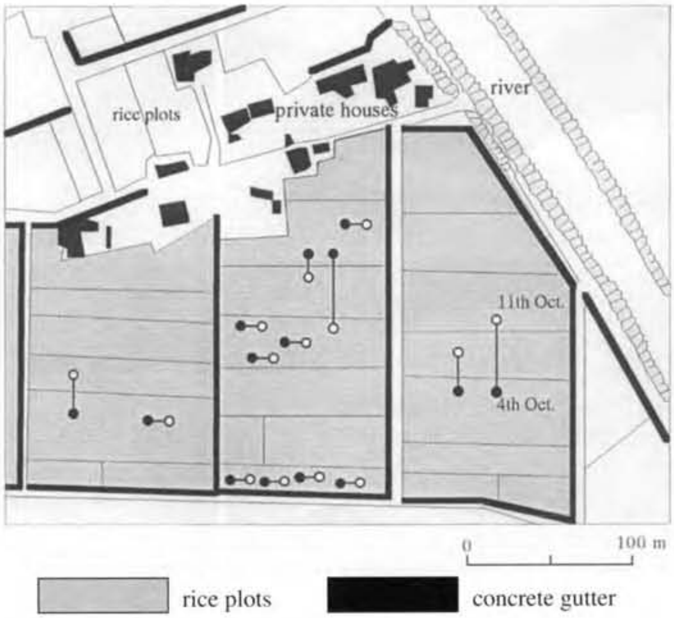

FIG. 1. Movements of 14 froglets in study rice fields.

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RECENT POPULATION CHANGES

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Decline and Local Extinction of the Western Toad, *Bufo boreas*, on Southern Vancouver Island, British Columbia, Canada

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Concern over the decline and loss of amphibian populations has lead to repeated calls for 1) routine long-term monitoring of amphibian populations and 2) more detailed studies of their autecology (Alford and Richards 1999; Blaustein et al. 1994c; deMaynadier and Hunter 1995; Pechmann and Wilbur 1994). These approaches are complementary because long-term data are necessary to unambiguously identify unusual declines, and detailed species-specific knowledge of life history, behavior, and population ecology is needed to identify the causes, likely outcomes, and means by which such declines might be mitigated should they occur (Alford and Richards 1999; Blaustein et al. 1994c). Detecting trends in amphibian populations is notoriously difficult because annual recruitment is highly variable, and the distribution of individuals fluctuates seasonally as breeding aggregations form and microhabitat availability changes (Alford and Richards 1999; Pechmann et al. 1991). Also, many, perhaps most, amphibian populations persist because of metapopulation dynamics, and temporary local stochastic extinctions might be common (Alford and Richards 1999; Blaustein et al. 1994c). Furthermore, a population might be a reproductive source or sink, but its status in any particular year unpredictable and ephemeral (Hanski 1999; Pulliam 1988). A site with apparently suitable habitat but lacking a particular species might represent a temporary local extinction, a disruption of metapopulation dynamics, may have never been occupied because of its isolation, or might be deficient in some essential combination of resources and conditions.

One approach to resolving these problems is to use historical records as a baseline for comparison with current patterns of distribution and abundance (e.g., Corn et al. 1989; Drost and Fellers 1996; Fisher and Shaffer 1996). Historical records are typically limited in scope. However, when combined with knowledge of specific human-induced alterations of habitat they can help identify declines and extinctions, focus monitoring and research efforts, and suggest which actions might be effective in restoring populations and preventing additional losses. Here we report on a local extinction of the western toad, *Bufo boreas*, at a relatively undisturbed site on southern Vancouver Island, British Columbia, Canada. Based on field notes and other information, this site supported a population of *B. boreas* in the 1970s, but no toads have been seen since 1983, despite intensive searching in 1997–2002. The reasons for this loss are unknown, but the introduction of exotic fish and habitat fragmentation may have been contributing factors. Although there is abundant evidence that population declines and local extinctions of *B. boreas* have occurred throughout much of the southern part of its range (see below), this is the first such report from Canada.

Of the several amphibian species that have suffered population losses or declines in western North America, the Western Toad, *B. boreas*, represents one of the most dramatic and best-documented examples (Corn 1994). Corn et al. (1989) failed to find *B. boreas* at 49 of 59 (83%) historical sites in Colorado and Wyoming in 1986–1988, although toads were found at two sites where they had not been recorded previously. Carey (1993) reported that 11 populations of *B. boreas* disappeared between 1974 and 1982 in central Colorado. Other surveys in Colorado found fewer populations than existed previously (Corn 1994; Corn and Vertucci 1992), and the elevational range of breeding sites appears to have been reduced in Colorado and Wyoming (Livo and Yeakley 1997). Olson (1992) described declines of two *B. boreas* populations in the Oregon Cascades, and Blaustein and Olson (1991) described mass mortality of toad eggs at a third site. In Yosemite National Park, surveys in 1915 and 1919 described *B. boreas* as "exceedingly abundant," but only small numbers were found in 1992, and of eight historical sites, *B. boreas* was found at only one (Drost and Fellers 1996). Similarly, Fisher and Shaffer (1996) described the decline of *B. boreas* in California's Central Valley. Disease, habitat modification, susceptibility to UV radiation, acid precipitation, and predation have been suggested as possible causes for these declines, but unequivocal evidence is lacking (Blaustein et al. 1994a,b; Carey 1993; Corn and Vertucci 1992; Olson 1989). Despite these reports from the United States, there are no published reports of population trends of *B. boreas* in Canada.

Jordan Meadows (48°34'N, 123°53'W) is an undisturbed marshland adjacent to Weeks Lake (elevation 518 m), ca. 40 km NE of Victoria, British Columbia. These extensive wetlands (ca. 0.5 x 4.5 km) support abundant wildlife and are dominated by plants typical of marshlands on southern Vancouver Island, especially hardhack (*Spiraea douglasii*) and Labrador tea (*Ledum groenlandicum*). Jordan Meadows proper appears to be undisturbed, and the forest immediately surrounding the meadows was uncut until 1999. However, an extensive network of logging roads exists throughout the area, and logging activities and clearcuts are common. Recent (1999) logging has extended to the edge of the meadows.

From 1975 to 1979, one of us (PTG) saw 1–5 *B. boreas* on each of 16 visits he and his companions made to Jordan Meadows (July 1974: 1 visit, 3 h; May–July, 3 visits, 14.5 h; June–September 1976, 2 visits, 3.75 h; April–September 1977, 7 visits, 12.8 h; May–September 1978, 3 visits; 13.4 h; April–June 1979, 3 visits; 8.2 h; total search effort: 19 visits, 53 h). During this period, toads were found at the rate of at least 0.8 toads h^{-1}. Toads were found in the meadows proper and in forested upland areas near the meadows. From 1980 to 1994, fewer visits were made to the meadows (5 visits, 6 h), and during this period, only one juvenile toad was found.

Despite intensive daytime searching in Jordan Meadows in 1997–2001, including monitoring six pitfall traps in 1997, no toads

were seen. TMD and assistants used visual encounter surveys (Heyer et al. 1994), walking back and forth across meadows and making thorough searches of the margins of streams and ponds. We also searched small ponds and streams for tadpoles and looked for toads basking on logs. We searched the same areas where PTG found toads in the 1970s, but the search effort in 1997–2002 was much more intensive (April–August 1997: 11 visits, 38.5 h; May–July 1998: 7 visits, 19 h; May–August 1999: 6 visits, 14.3 h; May–July 2000: 3 visits, 13.5 h; May–July 2001: 3 visits, 6.6 h; June–July 2002: 2 visits, 4.3 h; total search effort: 32 visits, 96.1 h). Furthermore, toad sightings in the 1970s were incidental to searches for garter snakes (*Thamnophis* spp.), whereas the searches in 1997–2002 were focused on amphibians, particularly *B. boreas*. Egg masses and larvae of the northwestern salamander (*Ambystoma gracile*), Pacific treefrog (*Hyla regilla*), and red-legged frog (*Rana aurora*) were common in 1997–2002, and adult *H. regilla* and *R. aurora* were seen frequently.

Weeks Lake (0.4 km^2 surface area) is the main water source for Jordan Meadows and was probably the primary reproductive site for the Jordan Meadows *B. boreas* population. In 1971, Oliver (1973) observed "several dozen" amplexing pairs of *B. boreas* in Weeks Lake. This lake has been stocked with about 1000 rainbow trout (*Oncorhynchus mykiss*) each year since 1984 (L. Friis, pers. comm.).

From 1997 to 2002, we searched the entire shoreline of Weeks Lake by boat on 22 separate occasions (total search time: 14.6 h). We scanned logs and the water for adult toads, and looked for tadpoles in shallow water. No *B. boreas* were seen, but other amphibians were common, especially the rough-skinned newt (*Taricha granulosa*) and *R. aurora*. Also, when conditions appeared to be favorable for toad activity, we searched along logging roads in the vicinity of Weeks Lake by motor vehicle on three nights in 1998 and one night each in 1999 and 2002 (total search time: 8.03 h). Again, no toads were seen, but other amphibians were common. In contrast, toads were routinely found using this method at another site 15 km east of Jordan Meadows (TMD, unpubl. data).

Because *B. boreas* is likely to exhibit dramatic year-to-year population fluctuations typical of r-selected species, it is important to continue to monitor Jordan Meadows to distinguish between a true local extinction and a temporary decline due to routine natural population fluctuations. Despite this caveat, our searches in Jordan Meadows suggest that recovery of this population is highly unlikely without recolonization and there are no known source populations. We do not know whether this extinction occurred because of adult mortality, failure of recruitment, or both, so it is difficult to assign causation. However, terrestrial habitat loss, road mortality, acid precipitation and chemical pollution are unlikely causes because the area has experienced little disturbance until recently. The introduction of exotic pathogens, either as a consequence of the introduction of rainbow trout to Weeks Lake or other human activities, is a more likely explanation.

Salmonid species probably are not responsible for declines of toad populations directly because *B. boreas* tadpoles are unpalatable to them (Drost and Fellers 1996; Kiesecker et al. 1996). However, these fish are highly susceptible to an oomycete pathogen, *Saprolegnia* spp., which can be introduced into lakes and ponds during fish stocking (Kiesecker and Blaustein 1997). The pathogen can either be reintroduced with each stocking or can become established as the result of a single stocking event. Infection of toad eggs and developing embryos by *Saprolegnia* spp. can cause significant embryo mortality (Blaustein et al. 1994b; Kiesecker and Blaustein 1997; Kiesecker et al. 2001b). The infection rate is increased by higher levels of UV radiation, to which *B. boreas* eggs are susceptible (Blaustein et al. 1994a,b; Kiesecker and Blaustein 1995; Kiesecker et al. 2001a). There are no other exotic vertebrate species known from this area, so synergistic effects as the result of multiple exotic species are unlikely to have occurred (e.g., Kiesecker and Blaustein 1998). Avoidance of introduced fish by tadpoles could have some negative effects on tadpole growth and development, although such behavior in *B. boreas* has not been investigated systematically. However, even if avoidance behavior does occur, it is unlikely to result in significant mortality or decreased growth rates because the preferred tadpole microhabitat is in shallow shoreline areas devoid of fish (TMD, pers. obs.).

Another possible cause of the extinction at Jordan Meadows is the introduction of bacterial or fungal diseases into the adult segment of the population. Populations of *B. boreas* in Colorado are thought to have disappeared as the result of infection with *Aeromonas hydrophila*, the bacterium that causes red-leg disease (Carey 1993). Other closely related species of *Bufo* are subject to a variety of fatal fungal infections, some of which have only recently been identified (Berger et al. 1998; Carey 2000; Carey et al. 1999; Taylor et al. 1999a,b,c,d). However, there is no direct evidence of any epidemic disease at Jordan Meadows, and whether or not such an epidemic occurred at this site is unknown.

The extinction at Jordan Meadows may be part of an overall decline of *B. boreas* on Vancouver Island. From 1995 to 1999, TMD failed to find *B. boreas* in lakes near Victoria, British Columbia for which there are historical museum specimens. Similarly, extensive amphibian surveys of lakes in the greater Victoria region in 1998–1999 failed to detect *B. boreas* (P. Govindarajulu, pers. comm.). Individual toads, dispersing metamorphs, and small schools of tadpoles were found in the Greater Victoria Watershed (GVW) in 1997–1999, 30 km NW of Victoria near Sooke Lake (48°34'N, 123°40'W), but GVW employees recall much denser breeding aggregations in the past.

Given the decline of this species in the southern part of its range, these observations from Vancouver Island highlight the need to assess and routinely monitor extant, apparently robust, populations of *B. boreas*. Although *B. boreas* is common at many locations in British Columbia, we have few data on the location of populations, their spatial distribution, or the numbers of individuals within populations. Without this information we are unlikely to detect population trends of *B. boreas*, or to identify the causes of local or regional extinctions.

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NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 34, Number 1 (March 2003).

CAUDATA

AMBYSTOMA GRACILE (Northwestern Salamander). **EGG PREDATION**. Northwestern salamanders (*Ambystoma gracile*) share breeding ponds with roughskin newts (*Taricha granulosa*) throughout their ranges in the Pacific Northwest, USA (Nussbaum et al. 1983. Amphibians and Reptiles of the Pacific Northwest. Univ. Idaho Press, Moscow. 353 pp.). *Taricha granulosa* and closely related California newts (*T. torosa*) are known to prey extensively on aquatic amphibian eggs, including those of conspecifics, foothill yellow-legged frog (*Rana boylii*), and Pacific treefrog (*Pseudacris regilla*) (White 1977. Northwest Sci. 51:114–118; Evenden 1948. Copeia 1948:219–220; Kats et al. 1992. Herpetol. Rev. 23:7–8). However, to my knowledge there are no published observations of field predation by *Taricha* on *A. gracile* eggs, nor reports of *A. gracile* eggs in *Taricha* stomach contents. Herein, I report a field observation of attempted egg predation by

T. granulosa on an *A. gracile* egg mass in the Willamette Valley, Oregon.

On 28 Feb 2002, I observed a mature male *T. granulosa* (ca. 65 mm SVL, 155 mm TL) swimming around an *A. gracile* egg mass in a semi-permanent pond on the W. L. Finley National Wildlife Refuge, 15 km S of Corvallis. The egg mass was an elongated globe ca. 7 cm diam x 13 cm height attached to a submerged spikerush (*Eleocharis* sp.) in ca. 60 cm of water, which is a typical oviposition site for *A. gracile* in this region. During 15 min of observation, the *T. granulosa* repeatedly propelled itself against the egg mass nose-first, continually adjusting its location around the periphery of the mass. I did not observe the *T. granulosa* gleaning items off the egg mass surface, and it did not appear affected by the presence of the observer. The *T. granulosa* was observed swimming away from the egg mass after all apparent attempts to penetrate the mass failed.

The heavy gelatinous matrix of *A. gracile* egg masses is known to allow embryos to survive exposure to air associated with receding water levels (Marco and Blaustein 1998. Herpetol. J. 8:207–211). These field observations suggest that an additional benefit of the heavy gelatinous matrix of *A. gracile* egg masses may offer protection from their oophagous pond associate, *T. granulosa*.

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AMBYSTOMA MACULATUM (Spotted Salamander) and ***RANA SYLVATICA*** (Wood Frog). **HABITAT**. Regular extinction and recolonization in well-defined habitat patches, small relative to a matrix of lesser quality, are distinguishing characteristics of metapopulations (Hanski 1997. *In* Tilmand and Kareiva [eds.], Spatial Ecology: The Role of Space in Population Dynamics and Interspecific Interactions, pp. 21–45. Monographs in Population Biology 30, Princeton, New Jersey). For vernal pool-breeding amphibians, such as *Rana sylvatica* and *Ambystoma maculatum*, the patch consists of the breeding pool itself and the surrounding forest. These appear to be rarely unoccupied (Marsh and Trenham 2001. Cons. Biol. 15:40–49). We report on what seems to be an empty patch: a peninsular area with apparently suitable upland, several pools having optimal hydroperiod, and no evidence of breeding by wood frogs or spotted salamanders. The neighboring mainland has almost 90% pool occupancy and 100% occupancy of all optimal hydroperiod pools randomly surveyed. For comparison we describe a similar peninsular land mass farther north along the coast that does maintain breeding populations of these two species.

Two land masses connected to the mainland by causeways in coastal Maine have, by chance, been included in intensive studies of pool-breeding amphibian species: Biddeford Pool ("the Pool") (N43°26.76', W70°20.67), and Sears Island (N44°26.66', W68° 52.88'). The land masses are remarkably similar in size and connection to the mainland. Biddeford Pool (100 ha) is 1.4 km from the mainland. Sears Island (380 ha) is 0.80 km from the mainland. Sears Island was historically connected to the mainland by a sandbar that emerged twice daily at mid to low tide. A causeway and paved road were built in 1984. Biddeford Pool has a causeway of dune and marsh on which a road was recorded in 1803. It was improved in the 1920s and now is paved, connecting a year-round human community to the mainland. The Pool was settled in the 1600s. Prior to the 1930s Sears Island was used for timber harvesting and grazing, and has been largely uninhabited since then. The most significant difference between the two land masses for amphibian population dynamics appears to be the greater historical and current human use of the Pool.

Evidence collected during the spring and summer of 2002 strongly indicates that Biddeford Pool has no breeding by wood frogs or spotted salamanders, even though it has at least four suitable breeding sites and about 20 ha of the forest is undeveloped. The Pool does support breeding by green frogs (*Rana clamitans*). Occupancy was determined by multiple searches for egg masses and breeding animals, and larval trapping using minnow traps, April–August.

Ninety-three randomly selected vernal pools surveyed on the mainland adjacent to Biddeford Pool revealed that 88% of them were used for breeding. Those not used were at the shortest end of the hydroperiod—small, shallow pools (R. Baldwin, unpubl. data). However, 4 pools of the 6 identified by 1:12000 aerial photo interpretation on Biddeford Pool were visited 4 times during the season, from egg-laying to metamorphosis, and only breeding green frogs were detected, indicating that the land mass is devoid of wood frogs and spotted salamanders. The Pool pools were long-hydroperiod temporary pools (mean 140 days from egg laying). On the mainland the density of wood frog (Pearson's $r = .269$) and spotted salamander ($r = .507$) egg masses increased with hydroperiod ($N = 93$, $\alpha = .05$). Based on these mainland trends, if these animals were present on the Pool, one would expect them to be breeding in the pools surveyed.

In contrast, Sears Island maintains significant breeding populations of wood frogs and spotted salamanders, as well as green frogs. Amphibian sampling was conducted at three created pools on the island from 1999 to 2002 using 100% enclosure drift-fences and pitfall traps. Adults of all three species bred in each pool, with thousands of wood frog and hundreds of green frog and spotted salamander juveniles produced in most years (D. Vasconcelos, unpubl. data). A survey in 1975 documented the pre-causeway presence of wood frogs and spotted salamanders on the island.

In conclusion, it appears that there is an empty patch for pool-breeding amphibians on the coast of Maine—Biddeford Pool. However, given the presence of pool-breeding amphibians on Sears Island, a land mass of similar size and orientation to the mainland, it seems unlikely that unoccupied patches are a common occurrence. All pools with optimal hydroperiod in the sample on the mainland adjacent to the Pool are used intensively for breeding by wood frogs and spotted salamanders. It seems that the same would be true in the Pool, if the area were occupied. It is not surprising that the animals have been unable to colonize or recolonize the patch by walking down a busy road with ocean and bay on either side. However, the mainland is fully occupied and,

as Sears Island shows, similarly isolated land masses can and do have breeding populations.

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PLETHODON CINEREUS (Eastern Red-backed Salamander). **CANNIBALISM**. It has been hypothesized that the risk of adult cannibalism of juveniles is an important force affecting the socioecology of some plethodontid species (Jaeger and Forester 1993. Herpetologica 49:163–175; Camp and Lee 1996. Copeia 1996:78–84; Jaeger et al. 1995. Ecology 76:533–543). However, evidence of cannibalism by plethodontids is limited, particularly in wild populations. It is hypothesized that juvenile red-backed salamanders, *Plethodon cinereus*, reside within the territories of related adults (presumably their parents) in part to reduce the risk of cannibalism from other adults (Jaeger and Forester 1993, *op. cit*; Jaeger et al. 1995, *op. cit.*). Adult cannibalism of juvenile *P. cinereus* has been reported in staged laboratory encounters (Bachmann 1984. Herpetologica 40:436–443; Wareing 1997. Honor's Thesis, State Univ. New York at Binghamton, Binghamton, New York); however, in published studies that summarized thousands of *P. cinereus* diets there is not a single report of cannibalism. Prior to this report, the lead author had sampled thousands of adult *P. cinereus* diets from 20 sites in New York and Pennsylvania, through all seasons, and under a variety of conditions, and never found a single event of cannibalism.

On 9 May 2001, within 24 h of rain, we conducted a routine survey of artificial coverboards at a long-term mark-recapture study site in Syracuse, New York. During the survey we collected diet samples from 52 *P. cinereus* by stomach flushing (*sensu* Fraser 1976. Ecology 57:459–471). We recovered a juvenile *P. cinereus* from the stomach of an adult male conspecific. The juvenile was a striped morph 11 mm in length between the fore and hind limbs (could not determine SVL because of state of digestion), which indicates the juvenile was a young of year that hatched in August 2000. The head of the juvenile was almost completely digested, and the forelimbs were partially digested with all the skin gone. From mid-trunk posteriorly the animal was slightly digested with most of the skin intact and the stripe clearly visible except the juvenile's tail was detached and well digested. This suggests that the male attacked once, causing the juvenile's tail to autotomize. After the male consumed the tail, he attacked the juvenile a second time, apparently toward the head, and swallowed the juvenile headfirst.

The male that consumed the juvenile was a lead morph, 39 mm SVL, reproductively active, and a recurring resident under the coverboard. We captured him under the same board on 18 April, 26 April, 9 May, and 27 July 2001. On 9 May, the day we recovered the cannibalized juvenile from the male, we also found another *P. cinereus* young of year and a 35 mm SVL, immature *P. cinereus* under the same coverboard. In addition to the juvenile *P. cinereus*, the male's stomach contained a centipede (1.46 x 0.67 mm), an isopod (1.83 x 1.28 mm), a small dipteran (1.55 x 1.01 mm), and part of an earthworm (4.66 x 0.94 mm). The number and volume of prey in the male's diet was normal to above average (Maerz 2000. Ph.D. Diss., State Univ. New York at Binghamton, Binghamton, New York). Based on the amount of other prey in the male's stomach and that the sample was collected within 24 h of rain when access to prey is generally not limited for *P. cinereus* (Jaeger 1980. Oecologia 44:335–341), it is unlikely that the male was food-limited at the time he cannibalized the juvenile.

Our observation of adult *P. cinereus* cannibalism of a juvenile in a wild population is the first such observation of which we are aware. Because the diets of *P. cinereus* have been studied extensively, it is unlikely that the rarity of cases of cannibalism in wild populations is the result of limited observation. Rather, it is likely that behavioral adaptations reduce the real occurrence of cannibalism in the wild. Adult *P. cinereus* can identify (probably chemically) and avoid cannibalizing their own offspring (Jaeger et al. 1995, *op. cit.*; Waering 1997, *op. cit.*; Wareing 1998. Master's Thesis, State Univ. New York at Binghamton, Binghamton, New York), and some juvenile *P. cinereus* can use chemical cues to avoid unrelated adults and their territories (Wareing 1997, *op. cit.*; Forester and Anders 2000. *In* Bruce et al. [eds.], The Biology of Plethodontid Salamanders, pp. 407–416, Kluwer Academic/Plenum Publishers, New York). Our observation shows that cannibalism does occur in wild *P. cinereus* populations, and, though such observations are rare, when considered in the context of laboratory studies, supports the hypothesis that cannibalism is a force shaping *P. cinereus* social behaviors.

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PLETHODON ELONGATUS (Del Norte Salamander). **FEMALE-FEMALE AGGRESSION**. Behavioral aggression appears to be widespread among terrestrial plethodontid salamanders (Jaeger and Forester 1993. Herpetologica 49:163–175; Maerz and Madison 2000. *In* Bruce et al. [eds.], The Biology of Plethodontid Salamanders, pp. 395–405. Kluwer Academic/Plenum Publishers, New York), however this behavior has not been reported for *Plethodon elongatus*. In this paper we report a field observation of two *P. elongatus* found under an 18 cm rock; the two salamanders ("A" and "B") were twisted around and biting one another. Animal A was biting animal B's tail, while in turn B was biting A's trunk at midbody. This observation was made on 5 Nov 2000 under weather conditions optimal for surface activity (9.5°C air temp, 10°C soil temp, and 82% relative humidity). Both individuals appeared to be adult females (by their short and swollen tails, swollen bodies, and rounded snouts) and both released one another after being disturbed. Closer examination revealed fresh, non-lethal, surface wounds at the bite locations on both animals. This observation of aggressive biting in *P. elongatus* occurred within the courtship season for this species and is consistent with the period of increased aggressiveness seen in *P. cinereus* (Livezey 1959. Herpetologica 15:41–42; Stebbins 1962. Amphibians of Western North America. Univ. California Press, Berkley and Los Angeles, California. 539 pp.; Welsh and Lind 1992. *In* McCullough and Barrett [eds.], Wildlife 2000, pp. 419–437. Elsevier Applied Science, New York).

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ANURA

ACRIS CREPITANS BLANCHARDI (Blanchard's Cricket Frog). **BEHAVIOR**. *Acris crepitans blanchardi* is a common inhabitant of permanent bodies of water in the midwestern USA where it is associated with many terrestrial ambush predators such as bullfrogs and leopard frogs and aquatic predators such as fish. During early February 2002 in a non-farm pond near Pella, 45 miles SE of Des Moines, Iowa, I observed 3 individual *A. c. blanchardi* leap from hidden basking sites into 10–11°C water containing much recently shed and floating cattail (*Typha*) litter. Each frog initially landed on a piece of cattail litter, gradually sliding off during shoreline wave action and then floating freely. The frogs assumed a rigid body posture with knees held distally. Air bubbles adhered to each frog's dorsal bumps making each buoyant. Over a time span of ca. 5 minutes the bubbles gradually detached from the frogs. Each frog remained static as it sank, becoming briefly active on contact with submerged spikerush (*Eleocharis*). Frogs grasped the spikerush and remained static for ca. 20 minutes. Cricket frogs away from cattail litter dove directly to the bottom and clasped vegetation, remaining static for 17 to 23 minutes. Neither of these responses matches the shoreline orientation escape strategy as it is described for *A. crepitans* (Stebbins and Cohen. 1995. A Natural History of Amphibians. Princeton University Press, Princeton, New Jersey). The floating cryptic and direct diving behaviors were no longer seen by spring when all cattail litter was submerged and decaying, and when water temperatures reached 18°C. By that time all cricket frogs followed shoreline orientation strategy. The floating behavior appears to be associated with cool water temperatures and the presence of floating cattail litter.

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ATELOPUS VARIUS (Harlequin Frog). **FUNGAL INFECTION.** The chytrid fungus *Batrachochitryium dendrobatidis* (Longcore and Nichols 1999. Mycologia 91:219–227), which affects the amphibian integument, has been associated with mass mortality in amphibian populations around the world (Berger et al. 1998. Proc. Natl. Acad. Sci. USA 95:9031–9036). Previous studies have found the fungus in tissues of *Atelopus* specimens collected in Panama (Lips 1999. Cons. Biol. 13:117–125), close to the Costa Rican border.

I examined specimens of *Atelopus varius* collected in Costa Rica from the Museum of Zoology at the University of Costa Rica. This species was previously widely distributed in Costa Rica, and it is well represented in the collection. It has been found infected in Panama, near the Costa Rican border, but the genus *Atelopus* (Bufonidae) now seems to be extinct in Costa Rica, where it was represented by four species (F. Bolaños, pers. comm.).

A small (ca. 1 cm^2) section of the skin in the groin area was removed, and processed for histological examination. After paraffin embedding, 3–4 mm sections were stained with hematoxylin and eosin. I examined 37 *A. varius* specimens, 14 collected between 1990 and 1996, 16 collected between 1986 and 1988, and 6 collected between 1979 and 1985. Two were infected. The first infected specimen was collected in 1992, already dead and dried out, in Rivas, San Isidro del General (UCR 11403) in the Talamanca Mountain Range. Many sporangia were present. This was the only specimen used in this study that was not alive when collected, and a second individual found in a nearby area was alive and clear of infection. These were the only specimens of *Atelopus varius* located on an expedition in the southern part of Costa Rica in 1992 (H. Pröhl, pers. comm.). The second individual is from San Ramón, Sarapiquí in the Cordillera Central Mountain Range (UCR 13303); it was collected in 1986. Only a small focal infection with few sporangia was present.

These data demonstrate that a potentially harmful fungus has been present in Costa Rican *Atelopus varius* since at least 1986. Further research will be needed to determine its possible impact on the local amphibian communities.

This study would not have been possible without the help of Idea Wild, Lee Berger, Maria del Carmen Obando, Joyce Longcore, Ana Victoria Lizano, Federico Bolaños, William Eberhard, and the Pathology Department of the National Children's Hospital of Costa Rica.

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BUFO BUFO (Common Toad), ***ALYTES OBSTETRICANS*** (Midwife Toad), and ***RANA TEMPORARIA*** (Common Frog). **TREE CLIMBING**. No information on tree climbing activity in European anurans belonging to non-climbing families has been published. In July 2000 I observed numerous individuals utilize the tabular roots and low oak-trunks section of a centenary oakwood at the Natural Recreative Area of the Orgi Wood (42°57'N, 1°40'W), a protected area in Lizaso, Navarra province (Northern Spain). Since then I have collected more than 200 observations of this climbing behavior. *Bufo bufo* (N = 129) reaches 39 cm average height, maximum height recorded 197 cm; *Alytes obstetricans* (N = 66) 34 cm average height, maximum height 135 cm; *R. temporaria* (N = 9) 14 cm average height, maximum height 30 cm. The search for moisture on the epyphitic moss colonizing the tree bark may help explain this arboreal activity, as 79% of the anurans are observed on this moss or other substratum (AG, unpubl.). During the wet season (March to early June) the climbing activity observed was scarce. However, during the dry period (September–October), 72–82% of the climbing anurans observed were on the absorbent substrate. Thus, this climbing behavior could be related to searching for moisture when soil surface dries. Furthermore, these anurans repeatedly used the same trees, where they were recaptured over three months later. They are active all night, and at dawn seek shelter in burrows excavated at the base of the tree.

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BUFO HOUSTONENSIS (Houston Toad). **GROWTH**. To determine behavior and development, emergent juvenile *Bufo*

houstonensis were followed during post-emergence at the Griffith League Ranch, Bastrop County, Texas, USA during the early summers of 2001 and 2002. The data for juveniles reported herein were collected from 12 March to 17 June 2001 and from 18 April to 25 June 2002. Observations were made in the morning (ca. 0700–1000 h), weather conditions were generally hot and/or humid with occasional rain.

Three *Bufo houstonensis* egg strands were each surrounded by three concentric aluminum fences placed 2 m, 5 m, and 8 m from the water line to capture juveniles upon emergence. Pitfall traps (2.5 L plastic paint buckets) were placed every 2 m along the fences. However, most juveniles were collected throughout the vegetation encircled by the traps rather than in the pitfall traps. Standard measurements were taken at the time of capture. Weight (WT) was measured to the nearest 0.001 g with an Acculab portable scale (model PP2060D). Snout–vent length (SVL), and head width (HW) were measured to the nearest 0.01 mm with 20 cm vernier calipers. Juvenile *B. houstonensis* were marked as a cohort, with each cohort receiving the same toe clip pattern. Juveniles were released 10 minutes after capture on the other side of the fence in which they were trapped in an attempt to determine movement and dispersal patterns.

Over the 68-day period, 336 juvenile Houston toads were captured, measured, and marked with 509 recaptures during the same period. Because of the cohort marking, individual identity could not be determined and, therefore it is unknown how many times an individual was recaptured.

Our data are compared with the results of work performed at the Houston Zoo (Quinn 1981. Final Report of the Captive Propagation/Release Program of the Houston Toad, *Bufo houstonensis*. Unpubl. Rept. to the U.S. Dept. of Interior, Fish and Wildlife Service, Office of Endangered Species. Submitted by Dept. of Herpetology, Houston Zoological Gardens. 51 pp.). Those data have not been published, however the authors have made those data available for these comparisons. Development of the Houston toad is poorly understood especially in the juvenile stage. Quinn and Mengden's (1983. Unpubl. ms.) summary of the measurement of Houston toad growth between 1981 and 1982 is one of the few data sets that can be compared in examining Houston toad development. However, those studies were performed in captive animals and thus may be only loosely comparable to results from the wild.

The span of 68 days was broken up into three periods to determine a more exact growth rate. SVL was determined to be an important indicator for growth. For the first period (18 April–10 May), SVL ranged from 7 to 14 mm (mean 8.6 mm; SD ± 1.28 mm). For the second period representing a second cohort emerging from 11 May to 2 June, SVL ranged from 8 to 13 mm (mean 9.8 mm; SD ± 1.59 mm). For the final cohort, during the period from 3 to 25 June, SVL ranged from 8 to 19 mm (mean 13.4 mm; SD ± 4.43 mm).

Captive juveniles (Quinn and Mengden, *op. cit.*) were not significantly larger than the wild-caught *B. houstonensis* reported herein. At age 1.8 months the captive juveniles measured 9–13 mm SVL (mean 11 mm; SD 1 mm); at 2.4 months 21–24 mm (mean 23 mm; SD 2 mm). Thus the growth rates determined in captivity (Quinn and Mengden, *op. cit.*) are very nearly those found for *B. houstonensis* in the wild.

Body weight was also determined to be an important indicator of growth and development. Quinn (1981) did not measure weight until 11.4 months of age, and therefore weight measurements cannot be compared between the two studies. However, in the wild for the first period, mean weight was 0.084 g (SD ± 0.048 g) and average growth rate was 0.004 g/day; for the second period average growth rate was 0.006 g/day with a mean weight of 0.113 g (SD ± 0.046 g). During the last period mean individual weight was 0.382 g (SD ± 0.321 g) with an average growth rate of 0.019 g/day. Considerable variation was found among individuals over the time period for both size and weight within a cohort.

Quinn (1981) determined that growth was most rapid during the first few weeks of life and then gradually declined as the toads reached adult size during the first year for males and second year for females. During the past two years, we have collected and observed juveniles during the first months of the year (Jan–Mar). This is important given the belief that breeding maturation can occur during the first year of life. Such parameters are critical for efficient population modeling of the species.

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BUFO OCELLATUS (Ocellated Toad). **DIET.** *Bufo ocellatus* occurs in Minas Gerais, Mato Grosso, Goiás, and Pará in Brazil (Frost 1985. Amphibian Species of the World. Allen Press, Inc. and Assoc. Systematics Collections. Lawrence, Kansas. 732 pp.). Aspects of the trophic ecology of this species have been little investigated in natural populations from central Brazil. We analyzed the stomach contents of 13 specimens (43.3 ± 4.3 mm SVL) collected during the Corumbá I Hydroelectric Power Plant reservoir formation (17°59'S, 48°31'W), Caldas Novas municipality, Goiás State, between Sept 1996 and April 1997. Although isolation of populations, and therefore variation in food resource availability may occur during reservoir formation (Paiva 1999. Conservação da Fauna Brasileira. Ed. Interciência. Rio de Janeiro. 260 pp.), these analyses indicated the most frequently taken prey items were Coleoptera (N = 16; 3.6%), Hemiptera (N = 2; 0.45%), Hymenoptera (N = 298; 67.1%, Formicidae), Isoptera (N = 124; 27.9%), and miscellaneous (N = 3; 0.7% plant material; N = 1; 0.2% stones).

The volume of the items were: Coleoptera 418.4 mm^3, Hemiptera 17.8 mm^3, Hymenoptera (ants) 7045 mm^3 and Isoptera 4893.3 mm^3. Coleoptera were present in nine stomachs, Hemiptera in one, Hymenoptera (ants) in thirteen, Isoptera in five, plant matter in three, and stones in one. The diet of the 13 *B. ocellatus* was dominated numerically and volumetrically by Hymenoptera (Formicidae).

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BUFO PARACNEMIS (Cururu Toad). **DIET.** Although aspects of trophic ecology of *Bufo paracnemis* were discussed by some authors (Guix 1993. Rev. Esp. Herpetol. 7:65–73; Lajmanovich 1995. Alytes 13:87–103; Dure and Kehr 1996. Herpetol. Rev. 27:138), in natural populations of Cerrado region, Central Brazil, the diet has been little investigated. Stomach contents of 24 specimens (males: N = 5, 134.5 ± 5.6 mm SVL; females: N = 19, 114.25 ± 10.75 mm SVL,) collected between September 1996 and April 1997during the Corumbá I Hydroelectric Power Plant reservoir formation (17°59'S, 48°31'W), Caldas Novas municipality, Goiás State, were analyzed. The diet was represented most numerically and volumetrically by Formicidae. Table 1 summarizes data collected during this study.

TABLE 1. Prey consumed by *Bufo paracnemis* (N = 24) from Corumbá I Hydroelectric Power Plant Reservoir, Brazil.

Items	N	% Total	Vol (mm^3)	% Vol.	Freq.
ARACHNIDA					
Araneae	3	0.48	43.67	0.02	3
Araneae (Mygalomorphae)	2	0.32	9914.59	6.43	1
Scorpiones	1	0.16	1144.12	0.74	1
INSECTA					
Apidae	2	0.32	48.89	0.03	2
Coleoptera	32	5.15	9133.05	5.92	16
Coleoptera (Tenebrionidae)	59	9.50	41121.71	26.68	7
Dermaptera	3	0.48	412.05	0.26	3
Formicidae	340	54.75	50159.20	32.55	10
Formicidae (*Atta* sp.)	39	6.28	54.33	0.03	4
Hemiptera	2	0.32	8.36	0.005	2
Isoptera	115	18.51	2523.94	1.63	1
Orthoptera	3	0.48	73.77	0.04	2
Larva	5	0.80	27 .55	0.18	1
MYRIAPODA					
Diplopoda	1	0.16	463.71	0.30	1
Chilopoda	1	0.16	295.92	0.19	2
VERTEBRATA					
Aves (Passeriformes)	1	0.16	11255.90	7.30	1
PLANT MATERIAL	10	1.61	0	0	8
UNIDENTIFIED MATERIAL	2	0.32	27151.09	17.62	2
TOTAL	621				

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DERMATONOTUS MUELLERI (Mueller's Narrow-mouthed Frog). **DIET.** *Dermatonotus muelleri* has a wide distribution in northern Argentina, Paraguay, southeastern Bolívia, and southeastern, central, and northeastern Brazil, from Maranhão State to São Paulo State (Frost 1985. Amphibian Species of the World. Allen Press, Inc. and Assoc. Systematics Collections. Lawrence, Kansas. 732 pp.; Silva et al. 2002. Herpetol. Rev. 33:144). We investigated the diet of 27 specimens (males: N = 15, 56.9 ± 4.0 mm SVL; females: N = 12, 64.1 ± 10.9 mm SVL,) collected 23–25 October 2000, in Minaçu municipality (13°34'32"S, 48° 06'94"W), Goiás State, Central Brazil. The diet was composed of Hymenoptera and Isoptera; the following termites were identified: *Nasutitermes kemneri*, *Constrictotermes cyphergaster*, *Cornitermes snederi*, *Grigiotermes* sp., and *Ruptitermes* sp. Although other authors have reported ants and termites in the diet of this species (Cei 1980. Amphibians of Argentina. Monitore Zoologico Italiano [NS] Monog. 2:609; Norman and Naylor 1994. Amphibians and reptiles of Chaco Paraguayo. Ed. San José, 1:281), this is the first report of the diet from populations of the Cerrado region in central Brazil.

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ELEUTHERODACTYLUS NOBLEI (NCN). **REPRODUCTION AND PARENTAL CARE.** The genus *Eleutherodactylus* contains ca. 600 species of New World frogs that comprise a substantial component of many neotropical herpetofaunas (Savage 2002. The Amphibians and Reptiles of Costa Rica. Univ. Chicago Press, Chicago, Illinois, 934 pp.). Although data on reproduction are lacking for most species, all species for which data are available are characterized by terrestrially-deposited eggs and direct development of the embryos. Most species exhibit parental care in the form of nest attendance by either the female or male. Few data on reproduction are available for members of the exclusively mainland subgenus *Craugastor*, and reproduction and parental care have not been described for any of the 11 species in the *gollmeri* species group. *Eleutherodactylus noblei* belongs to the subgenus *Craugastor*, and is a member of the *gollmeri* species group. Herein we describe a clutch of eggs, nest site, and presence of parental care in *E. noblei* from a lowland tropical forest in northeastern Costa Rica.

On 03 May 2000, we found one adult female *E. noblei* (46.6 mm SVL) sitting on a clutch of 29 eggs at La Selva Biological Station, Heredia Province, Costa Rica. The nest was deposited beneath leaf litter between the buttresses of a large tree. There was no nesting cavity, but the eggs were located in a shallow depression (< 10 mm deep). Although we witnessed no direct parental behaviors, *E. noblei* is relatively uncommon at this site, and direct association of a female with embryos of such a late

developmental stage strongly indicates nest attendance.

The eggs measured ca. 5 mm in diameter and were yellowish-cream below. We used a staging table for development of embryos in *E. coqui* (Townsend and Stewart 1985. Copeia 1985:423–436) in order to estimate developmental stage of embryos. Although this staging table is specific to *E. coqui*, we believe it may be useful to provide a rough estimate of developmental stage in *E. noblei*. We estimated that the eggs were at Stage 5– 6 of 15 stages: the embryos had evident front and hind limbs, conspicuous eyes, and were observed moving within the eggs.

We collected four eggs from the clutch and placed them in a plastic container filled with leaf litter in the laboratory to observe development. We monitored the remaining eggs in the field periodically, but never saw the female at the nest site again, possibly because of our disturbance of the nest site. The remaining eggs in the field were depredated between 4–7 May. One of the four eggs in the laboratory began to mold by 13 May and was removed; the remaining three eggs hatched on 22 May. Only one hatchling was measured (9.1 mm SVL). Given the advanced developmental stage in which the eggs were found, development time for this species must be considerably longer than 19 days.

While there is considerable variation in the sex of the parent providing parental care throughout this genus, nest attendance by the female is typical for the subgenus *Craugastor* (Townsend 1996. *In* Powell and Henderson [eds.], Contributions to West Indian Herpetology, a Tribute to Albert Schwartz, pp. 229–239. SSAR Contrib. Herpetol. Vol. 12. Ithaca, New York, 457 pp.). The data provided herein for *E. noblei* suggest that reproduction in the *gollmeri* species group may be similar to other species within the subgenus *Craugastor*.

Submitted by **STEVEN M. WHITFIELD**, Florida International University, Department of Biological Sciences, U.P. Campus, OE 167, Miami, Florida 33199, USA (e-mail: steven.whitfield@fiu.edu), and **MAYA S. F. PIERCE**, The Evergreen State College, Olympia, Washington 98505, USA (e-mail: maya_pierce@hotmail.com).

HYLA VERSICOLOR (Gray Treefrog). **BEHAVIOR.** The Chinese tallowtree, *Triadica sebifera* (Euphorbiaceae), is an introduced noxious weed (USDA, NRCS. 2002. The PLANTS database, ver. 3.5 [http:plants.usda.gov]; National Plant Data Center, Baton Rouge, Louisiana) that has become extremely common in disturbed habitats and along the banks of waterways in Louisiana. It is a deciduous tree that reaches > 10 m in height, and often contains tree-holes that are produced as the branches rot. The branches are very porous, and dead branches are apparently particularly vulnerable to fungi and insects. Herein I describe the use of these cavities and aggregate behavior in *Hyla versicolor*, neither of which has been previously reported to my knowledge.

On 25 January 1998 (1400 h), while removing a Chinese tallowtree (75 cm diam at breast height [DBH]), I discovered three *H. versicolor* within a tree-hole cavity (ca. 10 cc) in a 15 cm diam branch. The branch was 3 m above the ground before the tree was felled. The tree was located 5 km W of Hammond, Louisiana (Tangipahoa Parish). The temperature was 13°C, weather was overcast with a 10 km/h north wind, and all frogs were apparently in good condition, nestled on top of one another in the bottom of the cavity.

In a similar situation involving tree removal on 10 January 2002 (1100 h, weather clear, wind calm, temp. 16°C), 2 km E of Ville Platte, Louisiana (Evangeline Parish), I discovered four *H. versicolor* in a tree-hole cavity in the trunk of a Chinese tallowtree (85 cm diam DBH), 2.5 m above the ground. In this case, the frogs began emerging from the cavity once the tree was felled, and were also apparently in good condition.

These observations are significant as they document the use of an introduced tree species as microhabitat, as well as aggregate (potentially overwintering) behavior in *H. versicolor*. These tree-hole cavities may represent an introduced resource to treefrogs (and other cavity dwelling species), as tree-hole cavities may be generally limited in abundance, and shelter defense is widespread in anurans (Duellman and Trueb 1986. Biology of Amphibians. Johns Hopkins Univ. Press).

Submitted by **CLIFFORD L. FONTENOT, JR.**, Department of Biological Sciences, Southeastern Louisiana University, Hammond, Louisiana 70402, USA; e-mail: cfontenot@selu.edu.

LEPTODACTYLUS FALLAX (Mountain Chicken). **OPHIOPHAGY.** *Leptodactylus fallax* is one of the world's largest frog species. Adults commonly reach 190 mm SVL and often weigh in excess of 600 g. They are now found only on the West Indian islands of Dominica and Montserrat, though are believed to have occurred on Martinique, St. Kitts, Nevis, Antigua, and St. Lucia.

On 27 Aug 2001 at 2129 h during a population assessment of the mountain chicken in the Centre Hills of Montserrat, an adult female mountain chicken (175 mm SVL, 510 g) was caught consuming a Montserrat black racer *Alsophis antillensis manselli* (female; 650 mm TL, 75 g).

The frog was sitting, partially concealed in leaf litter, to one side of a trail through the forest. Dangling from its mouth was ca. 150 mm of snake tail. Upon capture, the frog immediately started to regurgitate its dead prey. The 500 mm of snake which had been inside the frog had presumably been there for some time, as the frog's digestive juices had reduced it to little more than a skeleton. The posterior portion not ingested remained largely intact, though it had started to decompose.

From what is known of the feeding behavior of *L. fallax* observed in captivity (pers. obs.), it is unlikely the racer was eaten dead. Most likely the frog pounced on movement in the leaf litter, seized the head of the snake and then started to ingest it. The stomach of the frog was unable to accommodate the entire length of the animal—hence the protruding tail. It is possible that the frog would have succeeded in ingesting the remaining portion of the snake, once the anterior part had been sufficiently digested.

There is one earlier report of *L. fallax* eating a snake. Brooks (1982. Biotropica 14:301–309), in his analysis of prey consumed by mountain chickens in Dominica, found a specimen that had eaten a blind snake, *Typhlops dominicana*. Unfortunately the size of the prey item was not recorded, although *T. dominicana* do not exceed 385 mm TL (Schwartz and Henderson 1991. Amphibians and Reptiles of the West Indies. University of Florida Press, Gainesville). It is likely that other voracious anurans (e.g., *Ceratophrys ornata*, *Discodeles guppyi*, and *Rana catesbiana*) are regular predators of large prey, including snakes (Duellman and

Trueb 1986. Biology of Amphibians. The John Hopkins University Press, Baltimore). However, I cannot find any previous records of an anuran attempting to ingest such a large snake prey item as reported herein.

My thanks to the staff of the Forestry Department of Montserrat, in particular Calvin Fenton and Lloyd Martin, also to Siân Buley for constant help, advice, and knowledge during the fieldwork, and to Mark Stanley-Price and Anna Feistner for comments on the manuscript.

Submitted by **KEVIN R. BULEY,** Department of Herpetology, Durrell Wildlife Conservation Trust, Les Augres Manor, Trinity, Jersey, Channel Islands, JE3 5BP, British Isles; e-mail: kevin.buley@durrell.org.

LEPTODACTYLUS LABYRINTHICUS (Labyrinth Frog). **DIET.** *Leptodactylus labyrinthicus* occurs in cerrados and caatingas of northern (Roraima), northeastern and central Brazil, coastal Venezuela, eastern Paraguay, and southeastern Brazil (Frost 1985. Amphibian Species of the World. Allen Press, Inc. and Assoc. Systematics Collections. Lawrence, Kansas. 732 pp.). Some aspects of the ecology of *L. labyrinthicus* were discussed by Cei (1980. Amphibians of Argentina. Monitore Zoologico Italiano [NS]. Monogr. 2, 609 pp.), but the diet has been little investigated in natural populations from Brazil. We analyzed the stomach contents of four specimens (male: 158 mm SVL, N = 1; females: 144.9 ± 14.7 mm SVL, N = 3) collected during the Corumbá I Hydroelectric Power Plant reservoir formation (17°59'S, 48°31'W), Caldas Novas municipality, Goiás State, between September 1996 and April 1997. Table 1 summarizes data collected during this study.

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TABLE 1. Prey consumed by *Leptodactylus labyrinthicus* (N = 4) from Corumbá I Hydroelectric Power Plant reservoir, Brazil.

Items	N	% Total	Vol (mm^3)	% Vol.	Freq.
ARACNIDA					
Araneae	1	2.32	24.45	0.02	1
INSECTA					
Coleoptera	2	4.65	1024.30	1.20	3
Coleoptera (Tenebrionidae)	5	11.62	7536.12	8.86	1
Hymenoptera (Formicidae)	9	20.93	387.48	0.45	1
Isoptera	4	9.3	21.31	0.02	3
Orthoptera	2	4.65	40.96	0.04	2
VERTEBRATA					
Amphibia (*Physalaemus nattereri*)	4	9.3	34487.34	40.58	2
Amphisbaenia (*Amphisbaena vermicularis*)	2	4.65	695.75	0.81	1
Sauria (*Ameiva ameiva*)	2	4.65	30545.67	35.94	2
Serpentes (*Typhlops brongersmianus*)	1	2.32	358.85	0.42	1
Serpentes (*Leptothyphlops koppesi*)	3	6.97	1093.68	1.28	1
Mammalia (Muridae)	1	2.32	8758.17	10.30	1
INCIDENTAL INGESTION					
Plant matter	4	9.3	—	—	4
Stones	3	6.97	—	—	3
TOTAL	43				

PHYSALAEMUS NATTERERI (NCN). **MALE-MALE COMBAT**: *Physalaemus nattereri* has a wide distribution in central and southeastern Brazil and Eastern Paraguay (Frost 2002. Amphibian Species of the World: An Online Reference.V2.20. American Museum of Natural History). Despite this wide distribution, little data are available concerning its behavior. Herein we describe agonistic interactions between two male *P. nattereri* in a temporary pond ca. 1 m deep and 4 m diameter at Patrocínio, Minas Gerais State, Brazil (1008 m elev.) (18°59'47" S, 40°48'13" W).

The observations took place during the night of 9 Oct 2001 when many species of anurans were vocalizing and *P. nattereri* were observed in amplexus. We observed two male *P. nattereri* from 1910 to 2005 h. The agonistic interactions followed these steps: while emitting an advertisement call male A moved to a stump and stood partially submersed in the water for ca. 10 min; male B, also emitting advertisement calls, approached male A but was expelled, this caused an increase in the call rate of male B; male A then moved to a small round hole under the stump and continued to emit advertisement calls; ca. 15 minutes later male B moved and sat next to the hole, emitting advertisement calls for 4 min, while male A remained calling; male B entered into the hole and sat beside male A; both males began an acoustic duel by alternatively emitting advertisement calls; male A pushed male B out of the hole, but male B returned and was pushed under the water where it was held for ca. 20 seconds by male A; male B then emerged behind male A, which turned and again pushed male B away from the hole; male B persisted in trying to return to the hole but was once again pushed away; after a third attempt, male B finally left male A's territory and moved to the edge of the pond ca. 3 m from the stump where it resumed calling. During physical combat, both males emitted calls. After this agonistic encounter, observations continued for 30 minutes but additional interactions were not observed.

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PHYSALAEMUS RIOGRANDENSIS (NCN). **DIET.** In Argentina, *Physalaemus riograndensis* occurs in Corrientes, Entre Ríos, and Santa Fe provinces, and otherwise ranges from southern Brazil to Uruguay, inhabiting marshy, hygrophilous wood and wet pasture lands. This frog is often found during daylight hours floating on the water's surface or in vegetation beside lagoons at night. Although select aspects of the ecology of this leptodactylid were discussed by Gallardo y Varela de Olmedo (1992. Fauna de agua dulce de la República Argentina. 1:116) and Langone (1994. Museo Damaso Antonio Larrañaga, N° 5:123), the diet has not been described.

Thirteen individuals were collected in a pristine reserve "Parque General San Martín" (31°40'S; 60°30'W, Entre Ríos province, Argentina), (7 males, mean = 20.37 mm ± 0.09; and 6 females, mean = 19.98 mm ± 0.14 SVL). The individuals were captured with "wet pitfall traps" between the first week of December 1999 and 14 March 2000 following the Vogt and Hine (1982) criterion.

Table 1 summarizes dietary data of *P. riograndensis*; 110 prey items belonging 10 prey categories were identified (7 Insecta, 2 Arachnida and 1 Miriapoda items). The minimum sample (H_k) calculated was 11 individuals, and the trophic diversity (H) was 1.48 (± 0.38). The most frequently taken prey items were arachnids (N = 40; 36.39 %), followed by hymenopterans (N = 20; 18.23 %), collembola (N = 17; 15.45 %), and coleopterans (N = 16; 14.54%). The values of the index of relative importance (IRI) revealed that the main diet of *P. riograndensis* is made up of arachnids (IRI = 4038) and hymenopterans (IRI = 2564). The results showed that *P. riograndensis* is a non-specialised "sit-and-wait" predator.

We thank Norberto Muzzachiodi for his assistance in the field survey.

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TABLE 1. Prey items consumed by *Physalaemus riograndensis*. N = total number of organisms found in 13 gastrointestinal tracts; Freq. = absolute frequency in the gastrointestinal tracts; % N = percentage of each category in the total number of prey; % Vol. = percentage of each prey volume (mm^3); % FO = occurrence frequency percentage; IRI = index of relative importance.

Prey Items	N	Freq.	% N	% Vol.	% FO	IRI
INSECTA						
Collembola	17	6	15.45	8.06	46.15	1084.99
Coleoptera	16	6	14.54	12.80	46.15	1261.74
Diptera			1.8	1.66	15.38	53.21
Dixidae	1	1				
Muscidae	1	1				
Hemiptera			1.8	7.11	15.38	137.03
Corixidae	1	1				
Homoptera			0.9	1.89	7.69	21.45
Unidentified Homoptera	1	1				
Cichadelidae	1	1				
Orthoptera			3.6	6.16	23.08	225.26
Arcridiidae	1	1				
Gryllotalpidae	2	1				
Gryllidae	1	1				
Hymenoptera			18.23	12.08	84.62	2564.83
Apidae	1	1				
Formicidae						
Acromyrmex sp.	3	1				
Solenopsis sp.	2	2				
Crematogaster quadriformis	4	3				
Unidentified ants	10	4				
Miriapoda						
Chilopoda	5	2	4.54	6.63	15.38	171.79
ARACHNIDA						
Araneae	40	10	36.39	16.11	76.92	4038.3
Opilionidae	3	3	2.75	2.84	23.08	129.02
Unidentified animal material	–	11	–	24.66	84.62	–
TOTAL	110	–	100.00	100.00	–	–

PSEUDACRIS CRUCIFER (Spring Peeper). Predation. General surveys of the herpetofauna of the upper Midwest (e.g., Vogt 1981. Natural History of Amphibians and Reptiles of Wisconsin, Milwaukee Public Museum, Milwaukee, Wisconsin; Oldfield and Moriarty 1994. Amphibians & Reptiles Native to Minnesota, University of Minnesota Press, Minneapolis, Minnesota) do not mention specific predators of spring peepers, although Harding (1997. Amphibians and Reptiles of the Great Lakes Region, University of Michigan Press, Ann Arbor, Michigan) stated that fish will eat them readily. On 20 April 2001, the remains of a *P. crucifer* were found in the gut of a brown trout (*Salmo trutta*), 21.9 cm in total length, collected by angling in Beaver Creek ca. 2 km upstream from its confluence with the Whitewater River, Winona Co., Minnesota (T108N, R10W, Sec 16). The creek is bordered by springfed marshes, where *P. crucifer* were calling on 20 April. Harding (op. cit.) suggested that the habit of spring peepers to breed in cool waters in early spring reduces contact with many potential predators. However, brown trout may be more likely than most other fish species to prey opportunistically on spring peepers because they actively feed in relatively cool temperatures.

Submitted by **PHILIP A. COCHRAN** and **JOSEPH A. COCHRAN**, Biology Department, Saint Mary's University, Winona, Minnesota 55987, USA.

RANA CATESBEIANA (Bullfrog) **PREDATION.** *Rana catesbeiana* is known to eat a variety of small vertebrates including snakes (Bury and Whelan 1984. Ecology and management of the bullfrog. U.S. Dept. Interior, Fish Wildl. Serv., Resource Publ (155):1-23, and references therein).

Table 1 provides data on bullfrogs from the San Mateo Canyon Wilderness Area on the upper portion of the San Mateo

TABLE 1. Bullfrog, *Rana catesbeiana*, and prey, *Thamnophis hammondii*, collected in Riverside County, California, during 2001.

Date collected	Bullfrog sex	Bullfrog mass (g)	Bullfrog SUL (mm)	Snake mass (g)	Snake SVL (mm)
20 June	female	402.1	140	35.2	501
24 July	—	154.7	108	3.38	220
24 July	female	223.5	130	2.97	197
22 Aug	male	51	86	2.82	185

Creek drainage, in the Cleveland National Forest, Riverside County, California (T7S, R5W) that contained *Thamnophis hammondii* in the stomach contents. The condition of the prey items collected on 20 June and 24 July suggested they had been recently consumed.

In the examination of the stomach contents of over 500 bullfrogs collected from three California drainages no other snake species was observed. While anecdotal information may exist on bullfrogs consuming native California snakes, to the best of our knowledge this report is the first repeated account of bullfrog consumption of the two-striped garter snake, *T. hammondii*, a species of special concern for the State of California.

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RANA ZWEIFELI (Zweifel's Frog) **DIET**. On 11 May 2001 at 2045 h, in a pond in tropical low forest at Nuevo Urecho, Michoacan, Mexico (19°09'03"N, 101°47'17"W) at an elevation of 650 m, we observed *Rana zweifeli* (9.6 cm SVL) devouring a crab (Decapoda: *Pseudothelphusa dilatata*). Most amphibians are considered opportunistic feeders and their diet generally reflects food availability. The *R. zweifeli* and the crab were photographed, collected, and deposited in the Colección Nacional de Anfibios y Reptiles (CNAR; IBH-13761), and Colección Nacional de Crustaceos of the Instituto de Biología, Universidad Nacional Autónoma de México.

Submitted by **GABRIEL BARRIOS QUIROZ** (e-mail: gabrielb@ibiologia.unam.mx) and **GUSTAVO CASAS-ANDREU** (e-mail: gcasas@servidor.unam.mx), Instituto de Biología, UNAM, Laboratorio de Herpetología 3er Circuito Ext. s/n Ciudad Universitaria, Coyoacan, México, D.F.A.P. 70-153 C.P. 04510.

TESTUDINES

EMYDOIDEA BLANDINGII (Blanding's Turtle). **MATING BEHAVIOR**. This report documents *E. blandingii* mating behavior in New Hampshire, and notes variations in mating between New Hampshire *E. blandingii* and other populations. We recorded data on 24 *E. blandingii* (7 female, 16 male, 1 juvenile) within 5 wetland complexes in Rockingham and Strafford counties, New Hampshire. These complexes included freshwater marshes, scrub-shrub and forested wetlands, permanent open water, temporary wetlands, and riparian areas. Five radio-tagged *E. blandingii* (2 females, 3 males) were observed mating on 10 occasions. *Emydoidea blandingii* exhibit a mounting-type courtship display where almost all courtship motor patterns leading to successful copulation are performed during the mounting phase, with only a brief chase proceeding mounting (Baker and Gillingham 1983. Herpetologica 39:166–173; Bels and Crama 1994. Copeia 1994:676–684). We defined a mating occurrence when we observed a male mounted on a female in a plastron to carapace position with the claws and digits of the male grasping the carapacial margins of the female. Mating pairs were completely or partially submerged in water. Male carapacial emergence during mating was noted in 63% (2 not recorded) of the cases described here. Other studies describe mating pairs in union underwater (e.g., Graham and Doyle 1979. J. Herpetol. 13:125–127), but few studies mention partially emerged mating pairs. A photograph in Vogt (1981. Natural History of Reptiles and Amphibians of Wisconsin. Milwaukee Public Museum, Milwaukee, Wisconsin. 205 pp.) exemplifies male carapacial emergence in this species. In this study, the average substrate and water depth for mating pairs was 13 cm and 29 cm, respectively (range: substrate 3–34 cm; water 15–55 cm), and unconsolidated but firm organic substrates predominated. The significance of water and substrate depth as a factor in the initiation of courtship in this species is unknown but Baker and Gillingham (1983, *op. cit.*) describe obligatory breathing periods during courtship, and shallow water depths may facilitate respiration during mating.

Mating activity was observed within emergent marshes (N = 5), scrub-shrub wetlands with an emergent marsh component (N = 3), a forested wetland with an emergent marsh component (N = 1), and a pond (N = 1). A radio-tagged male observed mating on 5 November 2001 apparently entered dormancy soon after and overwintered at the site. *Emydoidea blandingii* have been shown to aggregate in overwintering sites in some populations (Ross and Anderson 1990. J. Herpetol. 24:6–12), and as a result chance meetings and mating opportunities may be enhanced.

Mating activity was observed throughout the day (range: 0930 h to 1830 h) from 18 June to 5 November with the following monthly distribution: June (1), July (1), August (3), October (4), and November (1). Ernst et al. (1994, Turtles of the United States and Canada, Smithsonian Institution Press, Washington, D.C.) note that field observations of mating are most common from March to July although *E. blandingii* mating activity has been recorded in every month from March to November. The potential importance of late season mating in the reproductive success of *E. blandingii* is unknown but may serve to increase mating oppotunities, especially in peripheral populations where chance encounters are decreased by small population size and discontinuity. Female *E. blandingii* can store viable sperm over the winter, and for up to three years after a mating (J. Harding, unpubl. data).

Emydoidea blandingii in this population were promiscuous. We observed a radio-tagged female with different partners in August and October, and a radio-tagged male with different partners in October and November. In addition, multiple mating was observed in the same mating pair at various times throughout the field season. For example, a radio-tagged pair was observed mating at two different times in October, and another pair was observed mating

in June, July, and August. Moreover, the male from the latter pair was observed mating in August with another female residing in a separate wetland.

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GLYPTEMYS INSCULPTA (North American Wood Turtle). **DIET**. It has been reported that *Glyptemys (=Clemmys) insculpta* is an opportunistic omnivore and consumes a wide variety of vegetative and animal materials. Recorded vegetative items in their diet include mushrooms, algae, mosses, grasses, violets (*Viola* spp.), cinquefoil (*Potentilla canadensis*), strawberry leaves (*Fragaria virginiana*), blackberries and raspberries (*Rubus* sp.), blueberries (*Vaccinium* sp.), greenbrier (*Smilax* sp.) and willow (*Salix* sp.) leaves, and sorrel, while animal items noted include earthworms, leeches, slugs, snails, insects, fishes (*Caprinus carpio* and *Castastomus commersoni,* probably as carrion), tadpoles, frogs (*Rana clamitans*), and newborn mice (Ernst 2001. Chelon. Cons. and Biol. 4:94–99; Farrell and Graham 1991. J. Herpetol. 25:1–9; Niederberger and Seidel 1999. Chelon. Cons. Biol. 3:414–418; Surface 1908. Zool. Div. Zool. Pennsylvania Dept. Agric. 6:105–196). Here we document additional food items not previously reported. All observations were made in the vicinity of a Delaware River tributary in Warren County, New Jersey, USA. On 1 August 2001, at 1148 h, we observed an adult male *G. insculpta* (CL = 198.5 mm) eating corn (*Zea mays*) in an agricultural field. The turtle had torn away the husk and was eating the corn directly off the cob. Fecal material collected from two additional *G. insculpta* contained corn, indicating that the former observation was not isolated. In the study area, the foraging activities of black bears (*Ursus americanus*) and beavers (*Castor canadensis*) in cornfields adjacent to *G. insculpta* riparian habitat appear to increase the accessibility of corn to the turtles. Black bears pull down large stands of mature corn while feeding, and beavers cut large numbers of mature corn stalks and drag them to the nearby stream. Numerous corncobs were observed along the stream bank and bottom during the late summer in 2000–2002.

On 6 July 2000, at 1145 h, we observed an adult male *G. insculpta* (CL = 210.5 mm) consume the stem and leaves of a 1 m tall milkweed plant (*Asclepias* sp.). Additionally, on 4 June 2002, at 1530 h, we observed a gravid female (CL = 174.7 mm) consume the stem of a young milkweed plant emerging in an agricultural field. The stems, leaves, and roots of *Asclepias* contain steroid glycosides and toxic resinous substances reported to be moderately to severely toxic for some herbivores (Aiello [ed.] 1998. The Merck Manual, 8th ed. Merck & Co., Inc., Whitehouse Station, New Jersey).

On 2 October 2001, at 1410 h, we observed a juvenile *G. insculpta* (CL = 153.5 mm) consuming the berries of a pokeweed plant (*Phytolacca americana*). This individual was foraging at the base of the plant and eating the fallen berries. The turtle's beak was covered with the berries' scarlet juice. All parts of the pokeweed plant contain oxalic acid and a saponin (phytolaccotoxin) which may cause death in domestic livestock (Aiello [ed.] 1998, *op. cit.*). Pokeweed is also consumed by the sympatric Eastern Box Turtle (*Terrapene carolina*), and passage of pokeweed seeds through the Box Turtle's digestive tract (and presumably that of *G. insculpta*) may increase the germination rates for this species (Braun and Brooks 1987. Amer. Midl. Nat. 117:312–318).

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MACROCHELYS TEMMINCKII (Alligator Snapping Turtle). **REPRODUCTION.** We are aware of only one published observation of natural nesting by this species in Georgia, USA. Powders (1978. Copeia 1978:154–156) discovered a female completing a nest (clutch of 10 eggs) on 3 June 1975 30 m from Muckalee Creek (Flint River drainage) in Sumter Co. Additionally, Redmond (in Pritchard 1989. The Alligator Snapping Turtle: Biology and Conservation. Milwaukee Publ. Mus., Milwaukee, Wisconsin. 104 pp.) reported that slaughtered females from Terrell County (Flint River drainage) contained shelled eggs from 15 May to 15 June, and at least some captive females there nested in late May 1982. Here we report two additional observations of nesting in nature.

On 12 May 1999, Georgia Department of Natural Resources ranger Danny Bishop observed an alligator snapping turtle nesting in an open wildlife food plot ca. 70 m from Muckaloochee Creek (Flint River drainage), ca. 10 km N of Leesburg, Lee Co. Seven hatchlings were found emerging 26 August, but others may have emerged earlier or later. Photographs of the nesting female and resulting hatchlings were provided to JBJ.

On 24 April 2000, a hunter (G. Timmons) reported to DRJ the accidental excavation of an alligator snapping turtle nest from an open wildlife food plot situated ca. 30 m upslope from the Ochlockonee River, 1 km upstream of the confluence of Tired Creek, Grady Co. (30°44'31"N, 84°12'55"W). The site was ca. 7 km N of the Florida state line and 11 km N of the northernmost Florida nesting observed 10 May 1973 by Ewert (Ewert 1976. Herpetologica 32:150–156). The turtle had walked only 3 m into the food plot before nesting. The clutch of 42 eggs was salvaged and incubated. Forty eggs hatched 27 July–6 August, and all hatchlings (documented by color slide UF 134684, Florida Museum of Natural History Herpetology Dept. photographic archive) were released 24 August.

These new observations suggest that nesting in southernmost Georgia may begin nearly as early as in northern Florida (Ewert and Jackson 1994. Florida Game and Freshwater Fish Commission Nongame Wildl. Progr. Final Rpt. NG89-20), where reproduction has been much better studied, and that clutch sizes are comparable. Data summarized here also suggest that nesting occurs somewhat later as one moves only a small distance northward.

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PSEUDEMYS CONCINNA SUWANNIENSIS (Suwannee Cooter). **REPRODUCTION, LIFE SPAN.** Data on reproductive longevity are scant for many freshwater turtles, particularly those that normally lack visible growth annuli. Such is the case for the Suwannee Cooter, the largest North American emydid, whose reproductive biology was delineated by Jackson and Walker (1997. Bull. Florida Mus. Nat. Hist. 41:69–167) based on a six-year study at Wakulla Springs State Park (WSSP), Wakulla County, Florida. On 28 April and 30 June 1999, 28 June 2000, and 7 April and 29 June 2001, an attempt was made to recapture nesting female cooters that had been marked by shell-notching during 1988–1993 at WSSP (Jackson and Walker, *op cit.*). An additional observation from 18 May 2002 was provided by R. Franz. Eleven of 31 emergent females were confirmed as having first been observed nesting in 1988(4), 1989(4), 1990(2), or 1991(1). Minimum reproductive life spans ranged from 10 to 15 years. It is unknown how many years these females had nested prior to being marked. Given that minimum age to maturity is at least 10 years (Jackson and Walker, *op cit.*), all of the females were > 20 years old upon recapture. Growth rates of these females (plastron lengths, PL = 335–365 mm; carapace lengths, CL = 372–417 mm; carapace widths, CW = 277–301 mm; shell heights, SH = 143–165 mm; N = 10, all measurements maximal) were extremely low, with annual mean increases of 0.5 mm (PL), 0.8 mm (CL), 0.6 mm (CW), and 0.5 mm (SH).

I thank Carla McGowan, Dick Franz, and George Heinrich and his turtle workshop students for assisting with field work.

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RHINOCLEMMYS RUBIDA (Mexican Spotted Wood Turtle). **DIET**. *Rhinoclemmys rubida* occurs along the west coast of México from Jalisco to Chiapas and in the lowlands of the Río Balsas Basin. Little is known about its feeding habits. Ernst and Barbour (1989. Turtles of the World. Smithsonian Institution Press, Washington, D.C. 313 pp.) state that "one was caught while eating a large caterpillar, but captives also eat plant foods." Here we report on feeding observations of wild and captive individuals of this species.

On 10 August 2001 at 1315 h., while conducting a herpetofaunal survey in the Cuixmala-Chamela Biosphere Reserve on the coast of Jalisco, México, one individual of *R. rubida* (130 mm CL) was observed feeding on a ripe fruit of *Carica mexicana* that was lying on the forest floor. Two other individuals (96, 112 mm CL) were within 2 m of the fruit, presumably attracted to it.

In captivity, three individuals of this species (149, 106, 119 mm CL) have accepted a variety of fruits, showing preference for *Carica papaya*. They have also eaten lettuce leaves, snails and earthworms.

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TRACHEMYS DECUSSATA ANGUSTA (North Antillean Slider). **LONGEVITY.** Documented records of natural (non-captive) longevity in aquatic turtles are relatively scarce. Extensive research on the Yellow-bellied Slider, *Trachemys scripta scripta*, in South Carolina (Gibbons 1990. Life History and Ecology of the Slider Turtle. Smithsonian Inst. Press, Washington, D.C. 368 pp.) has provided the best estimates. Gibbons and Semlitsch (1982. J. Anim. Ecol. 51:523–527) reported that this temperate climate species has a maximum lifespan of 35 years. However, little is known about longevity of slider turtles (*Trachemys*) in the tropics. Moll and Legler (1971. Bull. Los Angeles Co. Mus. Nat. Hist.11:1–102) studied a population of *T. venusta* in Panama and identified a large female (323 mm carapace length, CL) which was only 13–14 years old. They speculated that 30 years is a logical estimate of longevity for that population, but were unable to provide any direct evidence.

As an adjunct to a larger population study of slider turtles (*T. decussata angusta*) on Grand Cayman B.W.I. (Seidel 1990. J. Herpetol. 24:191–196), a small freshwater pond was sampled for turtles in 1983. The pond, locally known as "mud hole" at Newlands, is 8.5 km E. of George Town, Grand Cayman. The island has a tropical climate with daily mid-temperatures which peak at 28.4°C in July and fall to a minimum of 24.8°C in February (Burton 1994. *In* Brunt and Davies [eds.], The Cayman Islands, Natural History and Biogeography, pp. 51–60. Kluwer Acad. Publ., Netherlands). From 1 April–2 May 1983, 28 adult *T. decussata* were captured in baited hoop-nets; then measured, sexed, marked, photographed, and released. Each turtle was numerically coded by notching the marginal scutes (and underlying peripheral bones) according to a system modified from Cagle (1939. Copeia 1939:170–173). Their size ranged from 149–271 mm CL (plastron length, PL, 129–230 mm).

During a return visit to Grand Cayman 15 years later (1998), three baited hoop-nets were set at "mud hole" on 28 March. Among five adult sliders captured, one female and one male were recaptures marked in 1983. The notches on these two turtles were very worn, but discernable, and positive identification was also verified by comparison to photographs. When initially captured in 1983, the female was a young adult (165 mm PL, 189 mm CL) and at least 5–6 years old (Seidel, *op. cit.*). Upon recapture in 1998 she demonstrated considerable growth over 15 years (reaching 214 mm PL, 251 mm CL) and was ca. 21 years old. Eggs were not detectable by palpation. The recaptured male was older than the female when they were initially marked in 1983. At that time he was 159 mm PL and 189 mm CL, showed evidence of melanism

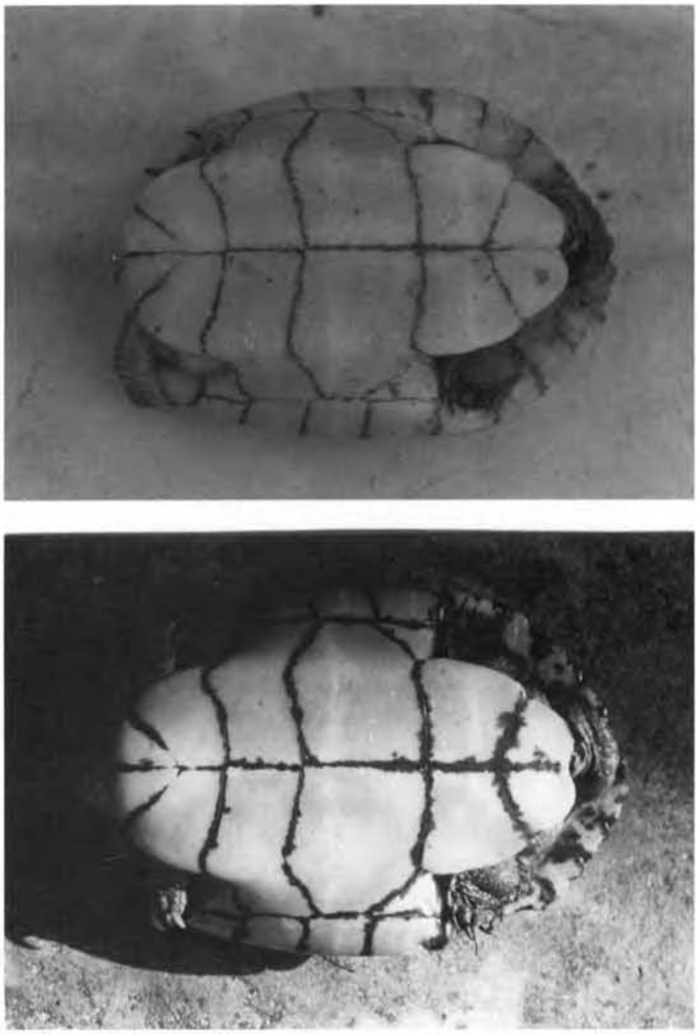

FIG. 1. Ventral views of a male *T. decussata* on Grand Cayman captured in 1983 (above) and recaptured in 1998 (below). The narrow dark areas evident along plastral seams in both photographs are typical of the melanistic pattern for this species (Seidel 1988. Amer. Mus. Novitates 2918:1–41).

(Fig. 1), and was probably more than 12 years old (Seidel, *op. cit.*). Although variable, male *T. scripta* in South Carolina generally exhibit signs of melanism after 10–14 years (Gibbons, *op. cit.*), similar to the approximate age melanism develops in *T. decussata* on Grand Cayman (Seidel, *op. cit.*). Upon recapture in 1998, the male was 169 mm PL, 204 mm CL, and at least 27–30 years old. Maximum longevity for sliders on Grand Cayman is probably >30 because Seidel (*op. cit.*) reported that males reach plastron lengths of 191–210 mm, and females 251–270 mm PL.

The natural history of slider turtles in the tropics shows a number of parallels to temperate populations, including similar reproductive strategies (Moll and Legler *op. cit.*). Nevertheless, an eminent difference in temperate climates is that turtles remain dormant (torpid) and demonstrate arrested growth for three to six months each year due to low environmental temperatures. There has been speculation that these turtles may remain physiologically "younger" compared to tropical turtles (which are active and growing over a longer portion of the year) and therefore reach greater chronological ages (Sacher 1978; cited in Gibbons 1987. BioScience 37:262–269). Data from the two *T. decussata* recaptured on Grand Cayman provides some evidence that tropical sliders may live as long in natural populations as their temperate relatives.

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LACERTILIA

CALLOPISTES PALLUMA (Chilean Racerunner, Iguana Chilena). **CANNIBALISM**. Intraspecific predation is well documented in lizards (Mitchell 1986. Cannibalism in Reptiles: A Worldwide Review. SSAR, Oxford, Ohio. 37 pp), but rarely reported among South American teiids. *Callopistes palluma* is a moderate-sized (81.5–173.0 mm SVL) teiid that inhabits extended sand burrows in scrubland habitats of northern Chile (Donoso-Barros 1966. Reptiles de Chile. Ediciones de la Universidad de Chile, Santiago, Chile. 458 pp.). Dietary data indicate that *C. palluma* feeds mostly on plants and invertebrates (Fuentes 1976. Ecology 57:3–17). In Fray Jorge National Park, a diet of small rodents (*Abrothrix olivaceus*), lizards (*Liolaemus*), and invertebrates has been reported (Mellado 1982. Acta Vertebrata 9:372–373). However, as intraspecific predation is unrecorded in *C. palluma*, we describe an instance here.

At 1725 h on 6 November 2002, during a study of *C. palluma* thermal ecology, we collected an adult male (123.3 mm SVL; 45.1 g; 20.1 mm head width) at Chacrita, Vallenar, Provincia de Atacama, Chile (28°23'39.3"S, 70°42'49.4"W; elev. 644 m). The habitat is a scrubland with the shrubs *Encelia canescens* (Asteraceae) and *Skytanthus acutus* (Apocynaceae) as dominants. While processing the lizard and recording temperature data, it regurgitated a juvenile female (86.2 mm SVL; 11.7 g; 13.4 mm head width) of the same species (Fig. 1). *Callopistes palluma* is sexually dimorphic in ventral color (females white, males red)

FIG. 1. Male of *Callopistes palluma* regurgitating a juvenile female of the same species.

(Donoso-Barros, *op. cit.*), so we were certain of the smaller lizard's gender. This observation represents the first record for cannibalism in this species.

This specimen was deposited in the herpetological collection of the Museum of Zoology at the University of Concepción (MZUC27485). We thank Viviane Jerez and Jaime Pizarro for field assistance.

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CNEMIDOPHORUS ALPINUS (Mexican Alpine Whiptail Lizard). **REPRODUCTION.** *Cnemidophorus alpinus*, the least understood gonochoristic species in the genus, is known only from small areas in the states of Puebla, Tlaxcala, and Veracruz in southern México (Maslin and Walker 1965. Univ. Colorado Stud., Series in Biol.19:1–8; Walker 1980. J. Herpetol. 14:353–359; Sanchez-Herrera and Lopex-Garcia 1987. Herpetol. Rev. 18:41). Here, I report on 3 additional specimens of this rare whiptail and include preliminary data on its reproductive characteristics.

I recently discovered 3 adults of *C. alpinus* in the Texas Cooperative Wildlife Collection (TCWC) provisionally identified as *C. septemvittatus* that were collected 13 May 1973 by J. R. Dixon and F. S. Hendricks in Tlaxcala, at the upper altitudinal limits known for the genus. Two specimens (TCWC 38308–09) were collected 2.9 km (1.8 mi) E of Huamantia at 2377 m (7800 ft); the remaining animal (TCWC 38312) was from 7.5 km (4.7 mi) E of Huamantia at 2468 m (8100 ft). The sexually mature male (84 mm SVL; TCWC 38312) has swollen testes 7.5–8.0 mm in length. One adult female (84 mm SVL; TCWC 38308) has 3 yolked eggs 8–10 mm in diameter in each ovary. The remaining individual (82 mm SVL; TCWC 38309) has 7 eggs (7.5–8.5 x 13–14 mm), 3 in the left oviduct and 4 in the right oviduct.

These data, the only available on clutch size in *C. alpinus*, reveal an unexpectedly high fecundity in this medium-sized highlands whiptail. In the giant species *C. sacki sacki* at 500–1600 m in Puebla and Oaxaca (Walker 1981. J. Herpetol. 15:321–328), females must be 105–120 mm to produce clutches of 6–7 oviductal eggs 10 x 16 mm in size that match the numbers of eggs in the two much smaller *C. alpinus* females from Tlaxcala reported here. In *C. gularis colossus* at 500–1550 m in Queretaro (Dixon et al. 1971. Herpetologica 27:244–354), the largest females (84 mm SVL) had clutches of 5 or fewer eggs.

I thank Kathryn Vaughan (TCWC Collection Manager) for permission to study specimens in her care.

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CNEMIDOPHORUS COSTATUS BARRANCARUM (Barranca Whiptail Lizard). **HABITAT**. *Cnemidophorus costatus barrancarum* (corrected spelling of *barrancorum* on advice of HMS) is one of many named, but biologically unknown, reptiles in remote areas of México. Information on the habitat of this whiptail lizard is limited to a remark by Zweifel (1959. Bull. Amer. Mus. Nat. Hist. 117:57–111) that it occurs in Tropical Deciduous Forest. We describe habitat characteristics for *C. c. barrancarum* based on the observations and collections made by the first author on 13–17 July 2000 and 16–19 June 2001 at lowland sites at 435–687 m in the Barranca Region, Municipality of Batópilas, southwestern Chihuahua, México. Voucher specimens of the taxon obtained in the municipality are: El Duraznito, 27°0'32.4"N, 107°46'3.6"W [16 July 2000 (JLE 5918)]; N of Batópilas near km 50.5 on Chihuahua Hwy 75 from Samachique to Batópilas, 687 m, 27°6'53.8"N, 107°39'52.4"W [16 June 2001 (JLE 7316); 17 June 2001 (JLE 7317–7319)]; Río Batópilas near Batópilas [18 June 2001 (JLE 7373)]; Batópilas (town), Arroyo El Camuchil, 435 m, 27°1'34.1"N, 107°45'44.5"W [17 July 2000 (JLE 5940); 19 June 2001 (JLE 7369)]; Satevo, 567 m, 26°59'25.8"N, 107°45'52.9"W [18 June 2001 (JLE 7328–7330)]; Satevo Church, 26°59'19.4"N, 107°42'52.7"W [15 July 2000 (JLE 5910)]; along road to Satevo [15 July 2000 (JLE 5908, 5909)]. *Cnemidophorus costatus barrancarum* is the only known whiptail lizard inhabitant of the tropical lowland intrusion into the Barranca Region of southwestern Chihuahua. This area consists of deep canyons with steep sides eroded out of the Sierra Madre Occidental by several river systems. In the vicinity of the old mining town Batópilas (pop. ca. 2000), situated in a side canyon on the Río Batópilas, the entire canyon floor is arid with vegetation that corresponds to the Tropical Deciduous Forest of Rzedowski (1983. Vegetación de México. Limusa, México. 432 pp.) and the Short Tree Forest of Gentry (1942. Carnegie Institution of Washington. Publ. 527). Trees in this habitat are short to medium height (2–7 m), the most conspicuous species being *Pithecellobium dulce* (Guamúchil), *Gauzuma ulmifolia* (Guásima), *Ipomoea arborescens* (Palo Santo), and *Acacia* sp. (Acacia). There is little available land for cultivation in the region because of the steep canyon walls, human population density is low, and resulting environmental damage to the area is moderate in the context of México. Not unlike most species of whiptail lizards, *C. c. barrancarum* prefers disturbed habitats with open patches of substrate for basking, foraging, and escape sprints. It is easily the most ubiquitous and abundant ground-dwelling saurian species on the playas and roadsides near the Río Batópilas, as well as in many pig, donkey, and cattle corrals (averaging about 1 ha) in the area. This lizard was also observed in abundance along the road from Batópilas to La Bufa (air distance 17.3 km). The most conspicuous saurians observed with *C. c. barrancarum* were *Sceloporus clarkii*, *S. nelsoni*, *Urosaurus bicarinatus*, and *Ctenosaura macrolopha*. The small total sample size (N = 14) for *C. c. barrancarum* resulting from several days of collecting by JLE in 2000 and 2001 in the Barranca Region was not by choice. Despite its abundance, it was possible to collect only an occasional individual of this wary lizard with rubber bands, the use of handguns being prohibited in México.

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CNEMIDOPHORUS COSTATUS BARRANCARUM (Barranca Whiptail Lizard). **REPRODUCTION**. Information on the reproductive biology of *Cnemidophorus costatus barrancarum* is limited to these comments published by Zweifel (1959. Bull. Amer. Mus. Nat. Hist. 117:57–111): clutch size, three oviductal eggs in each of two females of 71 mm SVL collected at Guirocoba, Sonora, México, on 10 and 11 August 1950; maximum size of females, 87 mm SVL; and maximum size of males, 107 mm SVL. We dissected 14 specimens of this teiid lizard collected by one of us on 15–17 July 2000 (JLE 5908–5910, 5918, 5940) and 16–19 June 2001 (JLE 7316–7319, 7328—330, 7369, 7373) at lowland sites at 435–687 m in the Barranca Region in the Municipality of Batópilas in southwestern Chihuahua, México. Complete locality data for this small sample of *C. c. barrancarum*, an abundant and wary lizard that is difficult to collect using a rubber band, are included in Lemos-Espinal et al. (2003. Herpetol. Rev. 34:365–366). The three males in the sample (JLE 5910, 7319, 7373 of 70, 81, 91 mm SVL) contained enlarged testes of 6.5–7.0 mm in length indicating sexual readiness when the lizards were collected. Nine females contained the following numbers of vitellogenic ovarian follicles (size range within the sample 3.5–9.0 mm): 67 mm SVL (potential for a clutch of 2 eggs); 71 mm (4); 75 mm (3); 78 mm (4); 78 mm (4); 83 mm (4); 83 mm (5); 86 mm (5); and 95 mm (7). Two females contained the following numbers of oviductal eggs (size range 9 x 14–8.5 x 14.5 mm): 73 mm SVL (3 eggs) and 77 mm (4). Data for our specimens combined with the report of Zweifel (*op. cit.*) established these reproductive characteristics for *C. c. barrancarum*; clutch size, 3.92 (2–7, N = 13) eggs; size of oviductal eggs, approximately 9 x 14 mm; size of reproductive females, 77.5 (67–95 mm) SVL; size range of mature males, 70–107 mm SVL; reproductive season, minimally June–August and probably much longer; and reproductive potential, likely multiple clutches given the maturation of both sexes at a small body size (67–70 mm SVL) within tropical regions of southwestern Chihuahua and southeastern Sonora. No individuals of *C. c. barrancarum* were observed by JLE during a visit to southwestern Chihuahua in the first half of April 2001, though *Sceloporus* lizards were active, suggesting that this teiid lizard may not be active throughout the year.

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CNEMIDOPHORUS COSTATUS BARRANCARUM (Barranca Whiptail Lizard). **COLOR PATTERN**. Information on the color pattern of females of *Cnemidophorus costatus barrancarum* is limited to these remarks by Zweifel (1959. Bull. Amer. Mus. Nat. Hist. 117:57–111): "...all have the primary six stripes distinct. In none is the spotting well defined, and one as large as 78 mm, has only faint traces of light areas in the dark fields." We present a more complete description of the color pattern in females of this teiid lizard based on three males and 11 females collected by one of us on 15–17 July 2000 (JLE 5908–5910, 5918, 5940) and 16-19 June 2001 (JLE 7316–7319, 7328–7330, 7369, 7373) at lowlands sites (elev. 435–687 m) in the Barranca Region in the Municipality of Batópilas in southwestern Chihuahua, México. Complete locality data for this sample are included in Lemos-Espinal et al. (2003. Herpetol. Rev. 34:365–366). Data for the number of granules (scales) between the paravertebral stripes (PV) and percentage of the number of granules around midbody located between the paravertebral stripes (PV/GAB x 100) in 11 gravid females of *C. c. barrancarum* are: PV, 13.4 (12–15) and PV/GAB, 13.8 (11.8–16.8). All females have a pair of incomplete ventrolateral stripes, one on each side of the body from beneath the ear to the postaxillary region, and six complete primary stripes configured in three bilateral pairs which subdivide the dorsal ground color on each side of the body into lower lateral, upper lateral, and dorsolateral dark fields. On each side of the body there is a wide lateral stripe from below the eye onto the anterior surface of the thigh, an intermediate width dorsolateral stripe from the superciliary scales onto the tail, and a narrow paravertebral stripe from the lateral parietal scale to the base of the tail. The vertebral (middorsal) field between the paravertebral stripes is either occupied by a brown band or two thinly divided secondary stripes. In JLE 7369 (67 mm SVL), which is very similar to the smallest mature male in the sample (JLE 5910, 70 mm SVL), the vivid stripes are hues of off-white to dull cream, the fields are black-brown (except for gray-tan near the ventral scales), and faint incipient spots are apparent in the posterior parts of the dorsolateral fields. Only one female (JLE 5940; 83 mm SVL) differs markedly from having the sharply contrasting pattern of stripes and fields apparent in JLE 7369. In JLE 5940, contrast between the fields and stripes is much reduced, incipient spots are present in all fields except the middorsal, and there is evidence of spot formation on the primary stripes. The largest individual of *C. c. barrancarum* (JLE 7330, 95 mm SVL) verified that females of this form undergo marked ontogenetic changes in color pattern from the striped dorsum in juveniles and young adults to development of spots on the stripes, hind legs, base of the tail, and in the upper lateral and dorsolateral fields. Apparently, complete loss of the stripes does not occur in females of *C. c. barrancarum.* Tail colors among the females in the sample are: basal third, brown to dark tan and distal part, buff-tan. Ventrally, these females vary from cream to dull blue-green with no evidence of the black pigment that is present in large males of the subspecies.

Incomplete knowledge of color pattern in females of *C. c. barrancarum* contributed to Zweifel's (*op. cit.*) uncertainties about its separation from parthenogenetic *C. exsanguis* and gonochoristic *C. gularis scalaris* in Chihuahua. Both of these species are now known to be allopatric to *C. c. barrancarum* and, because of their greater profusion of vivid dorsal spots and much lower PV and

PV/GAB numbers (Walker, unpubl. data; Walker et al. 2001. Copeia 2001:747–765), should not be confused with the Barranca Whiptail.

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CYCLURA PINGUIS (Stout Iguana, Anegada Rock Iguana). **JUVENILE BEHAVIOR**. Following its repatriation in 1986, *Cyclura pinguis* is flourishing on Guana Island, British Virgin Islands (Lazell 2002. Ecol. Restor. 20:179–185). Recently hatched juvenile iguanas are now frequently encountered in early October, but their behavior remains unstudied. As part of a census effort, the marking of iguanas during October 2002 afforded the opportunity to follow animals and individually identify them. Here, we provide preliminary observations on agonistic behaviors of juvenile *C. pinguis* from Guana Island.

During the month-long study, a white water-based latex paint was used to individually mark iguanas throughout the 340-ha island. Sightings occurred throughout Guana Island (18°38'N, 65°25'W), though most were near the hotel area (for additional information on Guana see Lazell 1996. Guana Island. The Conservation Agency, Jamestown, Rhode Island, 20 pp.). We observed no obvious adverse effects from the marking. Recently hatched individuals were repeatedly sighted, typically within a 10-m radius of previous sightings. Overall, we observed 13 marked and an unknown number of unmarked juvenile *C. pinguis* during the month. Many of them were observed on multiple occasions, resulting in over 35 sightings. All observations were made between 0800 and 1700 h.

On four separate occasions, a juvenile *C. pinguis* was seen displaying aggressive behaviors towards two other juveniles seen in the same area. Agonistic behaviors were varied. Head bobs and push-ups were seen in all interactions and were the most common aggressive behaviors observed. In one case, biting occurred during the display stage. During one lengthier interaction that lasted > 10 min, we also observed full apposition (the lizards were parallel to one another with their heads pointing in the same direction) and lateral compression of the bodies such that the side facing the other lizard appeared larger than normal. Chasing typically followed up to 10 min of displays, lasted less than 1 min, and covered less than 5 m. The loser left the area following each interaction, though the distance it traveled is not known. In the case of one pair of lizards, the lizard subsequently returned and interactions were observed daily for three days. In the other case, we never saw the loser again following the interaction.

Cyclura pinguis adults are known to avoid the centers of activity of conspecifics (Mitchell 1999. *In* Alberts [ed.], West Indian Iguanas: Status Survey and Conservation Action Plan, pp. 45–70. IUCN/SSC West Indian Iguana Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK) and display aggression towards both adults and juveniles that approach them (N. Mitchell, unpubl. observ.). Our observations imply that juvenile *C. pinguis* begin establishing territories early in life, and that aggressive encounters may be important in determining the boundaries of these nascent territories.

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CYCLURA PINGUIS (Stout Iguana, Anegada Rock Iguana). **JUVENILE PREDATION**. *Cyclura pinguis* was repatriated to Guana Island, British Virgin Islands, in 1986. Its population has since expanded considerably (Lazell 2002. Ecol. Restor. 20:179–185), and sightings, especially of hatchlings, have become increasingly common. Nevertheless, the ecology of this critically endangered species remains poorly understood. Since 2000, our regular observations of recently hatched iguanas in early October have afforded the opportunity to better understand their ecology. In particular, predation on *C. pinguis* by other than exotic predators (feral cats; Mitchell 2000. *In* Reading and Miller [eds.], Endangered Animals: A Reference Guide to Conflicting Issues, pp. 22–27. Greenwood Press, Westport, Connecticut) has not been recorded. Here, we describe three predation events on juvenile *C. pinguis* involving the native fauna of Guana Island (18°38'N, 65°25'W).

Two observations involved the locally abundant Puerto Rican racer, *Alsophis portoricensis*. On 12 October 2001 at 1530 h, we were told by Guana Hotel staff that an adult snake had been seen attempting to swallow a juvenile iguana and had the head of the lizard in its mouth. When we arrived, the snake was gone, and the juvenile iguana (106 mm SVL), already dead, had been left by the snake. The sighting occurred on a road, in an area containing both ornamental and native scrub flora. The dead iguana was preserved, tagged, and catalogued (JL F-4890), but remains in the British Virgin Islands because of CITES regulations.

We made the second observation on 9 October 2002, in an area characterized by ornamental vegetation in the Guana Hotel area. At ca. 1840 h, the snake was coiled around the midsection of the lizard and biting the lizard's chest. The lizard (ca. 100 mm SVL) was still struggling weakly, but appeared to have already been envenomated. We took photographs and video footage of the ingestion process, which was completed at ca. 2040 h. The snake, subsequently caught, measured 68 cm SVL (tail length = 35 cm). *Alsophis portoricensis* primarily preys on lizards (Henderson and Sajdak 1996. *In* Powell and Henderson [eds.], Contributions to

West Indian Herpetology: A Tribute to Albert Schwartz, pp. 327–338. SSAR, Ithaca, New York); these are the first records of iguanas in its diet.

We observed a third predation event on 8 October 2002 around 1530 h. A female kestrel (*Falco sparverius*), locally abundant on Guana (Lazell 1996. Guana Island. The Conservation Agency, Jamestown, Rhode Island, USA. 20 pp.), was observed feeding on a freshly killed juvenile iguana (ca. 110 mm SVL), which it had carried up to a tree perch. We recorded the feeding process, which began at the head of the lizard, for ca. 15 minutes with photographs and videotape. At the end of this period, the bird flew off with the partially consumed lizard in its talons. Much of the head was gone by this time, but the body and tail of the lizard remained mostly untouched.

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ELGARIA MULTICARINATA (Southern Alligator Lizard) **BEHAVIOR**. Mating behavior in alligator lizards has been described or illustrated for *Elgaria coerulea* (Svihla 1942. Copeia 1942:54; Vestal 1940. Copeia 1940:51; Vitt 1973. Herpetologica 29:176–184), *E. kingi* (Bowker 1986. Herpetol. Rev. 17:20), and *E. multicarinata* (Fitch 1935. Trans. Acad. Sci. St. Louis 29:1–38; Stebbins 1959. Reptiles and Amphibians of the San Francisco Bay Region, University of California Press, Berkeley, California. 72 pp.), but available data address only interactions between one male and one female. Herein, we report an observation involving two males and one female *Elgaria multicarinata*.

On 12 April 2002 at 1614 h, one of us (DJR) observed 3 adult *E. multicarinata* (1 female, 2 males) that were actively engaged in a succulent garden in La Cañada-Flintridge, Los Angeles County, California, USA (34°14'05"N, 118°13'29"W). Sex was determined by comparing observed behavior and morphology with that illustrated in the literature (e.g., Bowker 1986, *op. cit.*; Fitch 1935, *op. cit.*; Vestal 1940, *op. cit.*). One male (A, middle, Fig. 1) was gripping the female by the head while the other male (B, bottom, Fig. 1) was attached in the same way to male A. Male A had oriented his body alongside the female and was rotating his tail over the female in an attempt to position his cloaca for copulation. Male B was exhibiting similar body posturing, and because of their positioning, posturing appeared directed towards male A (Fig. 1) instead of the female. After ca. 10 minutes in this position, the lizards became aware of the observer, disengaged from each other, and moved off into nearby vegetation, negating further observations.

The head-gripping posture of male A on the female agrees with

FIG 1. Three interacting *Elgaria multicarinata* (Top: female; Middle: male A; Bottom: male B).

descriptions of copulation or attempted copulation for *E. multicarinata* (e.g., Fitch 1935, *op. cit.*; Stebbins 1959, *op. cit.*). The positioning of the lizards implied that male A had initiated contact with the female when male B arrived. It is unclear whether the behavior of male B was copulatory, agonistic toward male A, or both.

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HEMIDACTYLUS MABOUIA (Tropical House Gecko). **MORTALITY**. Predation episodes involving potentially lethal prey provide insights into the risks to which predators may be exposed. Here, we report a lethal predatory episode involving the house gecko, *Hemidactylus mabouia*.

On 2 July 2002 at 0930 h, one of us (DGL) saw a female house-gecko (59 mm SVL) attack a male spider (11.5 mm body length) of the genus *Ctenus* (Ctenidae; identification to species was not possible as both palps were missing) on a rough-textured wall in the Museum of Zoology Profesor Mello Leitão in Santa Teresa (19°56'S, 40°36'W), state of Espirito Santo, Brazil. Seconds after capturing the spider and attempting to swallow it, the gecko began to fall, but kept hanging on the wall by its midbody with all four legs limp and spread apart. The gecko, which remained motionless except for a few spasms, was picked up and placed on a table, where it made no attempt to move. After ca. 30 min, the gecko ceased to show signs of life (i.e., no breathing and heartbeat). The spider, apparently injured (examination revealed a dent in its cephalothorax and some broken legs), remained inside its mouth until we removed it.

The spider probably bit the gecko inside its mouth in self defense, and we assume that its venom killed the lizard. Symptoms exhibited by the gecko following the attack on the spider strongly suggest

the action of a neurotoxic venom (R. Baptista, pers. comm.). Some ctenid spiders, particularly members of the genus *Phoneutria*, are known to have potent venom with neurotoxic effects and can be deadly even to humans (e.g., Bücherl 1969. Am. Zool. 9:157–159; Schenberg and Pereira Lima 1978. *In* Bettini [ed.], Arthropod Venoms, pp. 217–245. Springer-Verlag, New York). Members of the genus *Ctenus*, which are generally much smaller, apparently lack venoms potent enough to harm large vertebrates, but may present a significant risk to arthropods and small vertebrates (Massary and Ineich 1997. Rev. Fr. Aquariol. 24:3–4; Massary 1999. Herpetol. Rev. 30:167). This episode indicates that house geckos can be at risk during predation attempts on ctenid spiders.

The gecko along with the spider (MNRJ 9802) were deposited at the Museu Nacional, Rio de Janeiro. We thank Renner Baptista for identifying the spider, critically reading this note, and giving helpful suggestions.

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MABUYA UNIMARGINATA (Central American Mabuya). **ENDOPARASITES.** *Mabuya unimarginata* (= *M. mabouya*), *sensu* Wilson and McCranie (2002. Herpetol. Rev. 33:90–94) occurs from sea level to ca. 1100 m in a variety of forest habitats in Honduras, Central America (Meyer and Wilson 1973. Contr. Sci. Nat. Hist. Mus. Los Angeles County 244:1–39). To our knowledge, this is the first report of helminths from *Mabuya unimarginata*.

Our report addresses 8 *M. unimarginata* (mean SVL = 70.4 mm ± 3.2 SD, range = 66–76 mm) from the Los Angeles County Natural History Museum (LACM 47741–47745, 47747, 47748, 47750). Lizards were collected 29 July 1967 at Coyoles (14°58'N, 86°41'W), Department of Yoro, Honduras, fixed in 10% formalin then preserved in 70% ethanol. The abdominal cavity of each lizard was opened, the gastrointestinal tract removed, slit longitudinally, and examined under a dissecting microscope. Helminths were removed to a drop of undiluted glycerol for identification.

One species of Nematoda, *Physalopteroides venancioi* (Physalopteridae) was found lying free in the stomach or large intestine. Specimens were placed in a vial of 70% ethanol and deposited in the United States Parasite Collection (USNPC), Beltsville, Maryland as USNPC 92624. Prevalence of infection (number infected/sample examined x 100) was 4/8 (50%), mean intensity ± 1 SD (number of nematodes/number of infected lizards) was 4.8, range was 1–10.

Hosts of *P. venancioi* include *Bufo paracnemis* of Paraguay (Lent et al. 1946. Mem. Inst. Oswaldo Cruz 44:195–214), *Ameiva ameiva* of Brazil (Vrcibradic et al. 2000a. J. Parasitol. 86:1163–1165), and *Mabuya agilis*, *M. macrorhyncha*, and *Tropidurus torquatus* also of Brazil (Vrcibradic et al. 2000b. Amphibia-Reptilia 21:307–316). *Physalopteroides venancioi* has been found in the stomach, small and large intestines of its hosts (Vrcibradic et al. 2000b, *op. cit.*), but most likely, like other physalopterids (Anderson 2000. Nematode Parasites of Vertebrates: Their Development and Transmission 2nd Edition. CABI Publishing, Oxon, UK. 650 pp.), it is a stomach parasite and those found in the intestines are dead or dying, soon to be passed in the feces. *Mabuya unimarginata* represents a new host record for *P. venancioi*; Honduras is a new locality record. This is the first report of *P. venancioi* from Central America.

We thank D. Kizirian (Natural History Museum of Los Angeles County, Los Angeles, California) for permission to examine *M. unimarginata*.

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NOROPS HETEROPHOLIDOTUS (NCN). **DEWLAP COLORATION**. Dewlap color in anoles plays a pivotal role in species recognition and intraspecific interactions (e.g., Macedonia and Stamps 1994. Ethology 98:246–264), and as a consequence, biologists often use it to identify species. *Norops heteropholidotus*, an anole in the *crassulus* species group known from isolated highlands in El Salvador and Honduras (Köhler and McCranie 2002. Herpetofauna 20:12–13), has had its dewlap color described as "erdbeerrot" (strawberry red) (Mertens 1952. Abh. Senckenberg Naturforsch. Ges. 487:1–120) and "rot mit hell-bis dunkelbraunen schuppen" (red with light to dark brown scales) (Köhler 2000. Reptilien und Amphibien Mittelamerikas. Band 2: Krokodile, Schildkröte, Echsen. Herpeton Verlag, Offenbach, Germany. 158 pp). However, these descriptions were solely based on preserved specimens, and *N. heteropholidotus* has remained poorly known. Here, we provide the first reports on *N. heteropholidotus* dewlap coloration in life, female dewlap coloration, and the striking change in gorgetal scale color in the male dewlap.

In December 2001, during fieldwork on Cerro las Nubes, Departamento Chalatenango, El Salvador (14°23'33"N, 89°6'17"W; elev. 2090 m) we observed > 25 *N. heteropholidotus* and collected 9 (YPM 12422–23, 12379–85). Adult females consistently displayed a small orange-yellow dewlap, the rear margin of which extended posteriorly to the point of forelimb insertion. Males had a large strawberry red dewlap in life (maroon in preservative), the rear margin of which extended a distance posteriorly to the axilla roughly the diameter of the forelimb. The large gorgetal scales of the male dewlap displayed a striking color change depending on time of collection. In most specimens these scales were white, sometimes with a light speckling of gray pigment. However, males observed roughly before 1000 h had uniformly dark gray gorgetals. Five out of seven lizards caught before about 1000 h would have dark, slate gray gorgetals that would change to almost perfectly white in 3–4 min, while lizards were being held or kept in collecting bags. Male *N. heteropholidotus* caught after 1000 h generally displayed white gorgetals, although some traces of darker pigmentation might be present. When preserved in 70% ethanol, with or without previous fixation in 10% formalin, gorgetal scales

on the male dewlap are white, occasionally with a pink or tan hue, and their melanophore density varies.

Anoles of the genus *Norops* are capable of considerable color change, but gorgetal scale coloration is generally not variable (Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas. University of Chicago Press, Chicago. 934 pp.). Darkening of the gorgetal scales in *N. heteropholidotus* may play a thermoregulatory role since these anoles inhabit high elevation (> 1800 m) cloud forest zones. During the period of field work at Cerro las Nubes, the minimum temperature would drop to 7°C at night, and the lizards would become active when the daytime temperature exceeded ~18°C. Other Central American highland lizards are known to display metachrosis, possibly as a way to help absorb solar radiation (Robinson 1983. *In* Janzen [ed.], Costa Rican Natural History, pp. 421–422. University of Chicago Press, Chicago, Illinois).

Specimens of *N. heteropholidotus* were collected under permits from the Ministerio de Medio Ambiente y Recursos Naturales, San Salvador, El Salvador (MARN-DGPN-AIMA-8-01 and MARN-DGPN-AIMA-01-2002) and are deposited in the herpetology collection of the Yale Peabody Museum of Natural History.

Submitted by **TWAN A.A.M. LEENDERS** and **GREGORY J. WATKINS-COLWELL**, Division of Vertebrate Zoology, Yale Peabody Museum of Natural History, 170 Whitney Avenue, P.O. Box 208118, New Haven, Connecticut 06520-8118, USA; e-mail: (TAL) twanleenders@scinax.com, (GJW) gregory.watkins-colwell@yale.edu.

PANTODACTYLUS SCHREIBERSI (NCN). **HABITAT AND DIET**. *Pantodactylus schreibersi* is a small (to 2 cm total length), common gymnophthalmid lizard widespread in southeastern South America. It inhabits a wide range of habitats from montane scrublands and rocky hillsides to grasslands of the pampas, trashpiles, and gardens (Achaval and Olmos 1997. Anfibios y Reptiles del Uruguary. Facultad de Ciencias, Montevideo, Uruguay. 128 pp.; Cei 1993. Reptiles del Noroeste, Nordeste y Este de la Argentina. Mus. Reg. Scien. Natur. Torino, Monogr. XIV, Turin, Italy. 949 pp.). Despite this broad pattern of habitat use, association with water, as occurs in some microteids (e.g., *Neusticurus*: Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas. University of Chicago Press, Chicago, Illinois. 934 pp.), is unknown. Hence, we provide a preliminary report of *P. schreibersi* use of semi-aquatic habitat.

Our observations took place near midday on 21 July 2001, while using a 3.5 m x 1.2 m drag seine as a bag to lift floating mats of camalotes (water hyacinths, *Eichhornia crassipes*) out of the Paraguay River near Fuerte Olimpo, Departamento Alto Paraguay, Paraguay (21°02'30"S, 57°53'10"W; elev. 75 m). During this effort, we were surprised to capture two female *P. schreibersi*, one from each of two different floating mats. When each individual was briefly placed in water to observe their behavior, both swam with ease using a snake-like undulating motion, which suggests that they were not in this semi-aquatic habitat simply by accident.

Stomach contents of these animals reinforced the notion of semi-aquatic habitat use. The stomach of one specimen (32.5 mm SVL) contained an orthopteran nymph (Gryllidae), a homopteran (Fulgoridae), a moth (Lepidoptera), and a nematode parasite. The other lizard (41.9 mm SVL) contained 4 spiders (Araneae), an empty spider egg case, and plant material. Similar prey were common in our camalote seine-hauls. Fifty-six percent of prey in 8 *P. schreiberi* from Brazil were similar (Milstead 1961. Copeia 1961:493–495), including a corresponding preponderance of arachnids.

Specimens (MNHNP 10008–09) and stomach contents are deposited in the Museo Nacional de Historia Natural del Paraguay. We thank Ignacio Avila for help collecting, Bolivar Garcete for identification of the stomach contents, and Norman Scott for his advice.

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UMA EXSUL (Fringe-toed Sand Lizard). **PREDATION**. *Uma exsul* is endemic to the sand dune systems in Viesca, 70 km SE Torreón (State of Coahuila), Mexico. Its biology and status have been moderately well studied (Gadsden et al. 2002. Bol. Soc. Herpetol. Mex. 9:51–66), and *Gambelia wislizenii* is the only lizard species in this dune system that was considered a predator. Here, we add the teid *Cnemidiphorus tigris marmoratus* to the list of predators on *U. exsul*.

At 1530 h on 24 July 2002, during a survey of the sand dune system, we encountered an adult (180 mm SVL) male *C. t. marmoratus* chasing a young-of-the-year (32 mm SVL) *U. exsul*. We observed the *C. t. marmoratus* pursuing the *Uma* up a dune 1.8 m high in a chase that lasted < 30 seconds. The young *Uma* was caught by the neck, ingested head first, and swallowed with undulatory movements of the body; the entire process lasted about 3 minutes.

At 1200 h on 25 July 2002, we saw another adult *C. t. marmoratus* chasing a young-of-the-year *U. exsul*, but this time the *Uma* managed to scape. Predation on hatchling lizards, including their own young, has been reported for some *Cnemidophorus* (Berrian and Banta 1979. Bull. Maryland Herpetol. Soc. 15:61; Etheridge and Wit 1982. Herpetol. Rev. 13:19; Galina et al. 1998. Herpetol. Rev. 29:237) and failed predation on larger individuals (Lichtenstein and Lichtenstein 1987. Herpetol. Rev. 18:73) may indicate that opportunities for predation are largely restricted to hatchlings.

We thank Ivonne Rivera for her help in the field.

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CROCODYLIA

CROCODYLUS ACUTUS (American Crocodile). **CANNIBALISM.** Cannibalism is presumed to be common in crocodilians and may be an important population regulating mechanism in this group (e.g., Hutton 1989. Amer. Zool. 29:1033–1049; Polis and Myers 1985. J. Herpetol. 19:99–107). Cannibalism has been observed in a few species (e.g., *Alligator mississippiensis*: Delany 1986. J. Wild. Manage. 50:348–353; *Crocodylus niloticus*: Cott 1961. Trans. Zool. Soc. Lond. 29:211–357), but no published reports exist for the American crocodile (*Crocodylus acutus*). Here, we report cannibalism by juvenile *C. acutus*.

Our first observation was made 2 August 2000, while radio-tracking hatchling *C. acutus* at the Florida Power and Light Company's Turkey Point Power Plant in southeastern Dade Co., Florida, USA (25°26'14"N, 80°20'17"W). We tracked a transmitter signal to an unmarked juvenile crocodile of undetermined sex (80 cm total length [TL], 1.2 kg). Examination of this juvenile upon capture revealed that the transmitter was in its gut; we had originally attached it to a hatchling crocodile (26.6 cm TL, 60 g) on 20 July 2000. We then scanned the juvenile's abdomen for the identifying microchip (AVID Identification Systems, Inc., Norco, California) used to tag the transmitted hatchling and detected 8 microchips, each originally placed in a different *C. acutus* hatchling in 1999 or 2000, including that of the transmitted individual. This hatchling had been radio-tracked successfully for 5 days until on 1 August 2000 it made an unusually long move (262 m) from the previous day's location. This and a sudden reduction in transmitter signal strength motivated us to attempt to sight or capture the transmitted hatchling. Two of the other microchips detected in the juvenile crocodile's abdomen had been placed in hatchlings released at the same time and place as the radio-transmitted individual. The remaining 5 microchips were originally used to tag hatchlings in July 1999. We do not know the gut residence time of a microchip, so we cannot distinguish whether these hatchlings were recently (days to weeks) cannibalized by this juvenile, or whether these microchips had been retained as gastroliths for up to a year.

Our second observation involved a 117.5 cm TL (4.6 kg) *C. acutus* of undetermined sex captured in the cooling canal system of the Turkey Point power plant. This individual had been initially captured and marked by tail scute clipping on Key Largo and was later recaptured and microchipped in the cooling canal system of the Turkey Point power plant on 26 April 2000. On 19 April 2001, we recorded a microchip from its abdomen originally used to tag a 33.7 cm TL (100.8 g) *C. acutus* hatchling. That hatchling had been captured and released in the cooling canal system of the Turkey Point power plant on 12 August 2000.

The Florida Power and Light Company provided financial support, equipment, logistical support, and allowed us to work on their property. The University of Miami Department of Biology, the Army Corps of Engineers, the Department of Interior's Critical Ecosystem Studies Initiative, administered by the National Park Service, and the USGS's Florida Caribbean Science Center funded PMR as part of cooperative agreement number 1445-CA09-95-0111 with the University of Miami.

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SERPENTES

BOTHROPS ATROX (Common Lancehead). **DIET**. In July 2001, a male *B. atrox* (LPHA 1789; 1040 mm total length) was collected by S. Claudino on the right bank of the Tapajós River, Itaituba (55°59'W, 4°17'S), Pará State, Brazil. The specimen was verified by Rubens Nobuo Yuki and was deposited in the scientific collection of the Linha de Pesquisa em Herpetologia da Amazônia in the Laboratório de Pesquisas Zoológicas (LPZ) of the Faculdades Integradas do Tapajós (FIT). The stomach contents were examined and found to contain a male *Mastigodryas boddaerti* (LPHA 1790; ca. 670 mm total length). The body of the *M. boddaerti* was contorted and apparently had been ingested head-first because its anterior region was oriented toward the intestine of the *B. atrox*, and was in an advanced stage of digestion. *Bothrops atrox* eat species of lizards (*Ameiva*, *Gonatodes*, *Tropidurus*, and *Cnemidophorus*) (Cunha and Nascimento 1982. Bol. Mus. Para. Emílio Goeldi, sér. Zool. 112:1–58), small birds, rodents (Cunha and Nascimento 1975. Bol. Mus. Para. Emílio Goeldi, nov. sér. Zool. 83:1–42), amphibians, and snakes ("*Leimadophis typhlus*" [= *Liophis typhlus*] and *Atractus torquatus*) (Egler et al. 1996. Herpetol Rev. 27:22–23; Greene 1997. Snakes: The Evolution of Mystery in Nature. Univ. California Press, Berkeley. 351 pp.).

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CHIRONIUS FLAVOLINEATUS (NCN). **PREDATION.** *Chironius flavolineatus* is a medium-sized colubrid snake with a wide distribution, from northern Brazil to northeastern Paraguay and central Bolivia, but little is known about its natural history (Dixon et al. 1993. Revision of the Neotropical Snake Genus *Chironius* Fitzinger [Serpentes, Colubridae]. Monografie XIII. Museo Regionale di Scienze Naturali. 279 pp.). It is a semiarboreal species (pers. obs.), and feeds mainly on frogs (Dixon et al., *op. cit.*). On 9 December 2001, during a diurnal road sampling of snakes at about 1030 h, we observed a white-tailed hawk, *Buteo albicaudatus*, perched on a tree branch ca. 2 m above ground, holding a snake. The observation was made on an unpaved road in a pristine shrubby grassland of Cerrado (savanna-like vegetation) at Itirapina Ecological Station (IES; 22°13'24"S, 47°54'03"W; ca. 750 m elev.), southeastern Brazil. Just after we spotted the hawk, it flew away with the snake in its talons. We followed the hawk by car and foot, whereupon the hawk released the snake and flew away. We found the dead snake on the ground. It was an adult female *Chironius flavolineatus* (estimated SVL 680 mm; SVL remaining 564 mm; tail length 375 mm; 155 remaining ventral scales) lacking the head and anterior portion of the body. The snake had several cuts and punctures along the body (N = 20) and a puncture on the tail, indicating that the hawk might have fought with the snake to subdue it. On the anterior portion of the body there were only cuts, and on the posterior portion there were

punctures and cuts, indicating that the hawk directed its strikes to the snake's head, probably to minimize the risk of injuries.

The voucher specimen of *C. flavolineatus* is deposited in the Museu de História Natural, Universidade Estadual de Campinas (ZUEC 2650). D. Zanchetta and the staff of Instituto Florestal allowed and facilitated our fieldwork at IES. FAPESP provided funds (00/12339-2) and grants to RJS (99/05664-5) and CAB (99/06245-6). We thank M. Martins and C. Nogueira for suggestions on the manuscript. This is publication number 9 of the project Ecology of the Cerrados of Itirapina.

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CRISANTOPHIS NEVERMANNI (Black Road Guarder). **SIZE.** The record total length known for *Crisantophis nevermanni* is 82.8 cm (female, 66.0 cm SVL, 16.8 cm tail length) (Wellman 1963. Univ. Kansas Publ. Mus. Nat. Hist. 15:251–295; Villa 1971. J. Herpetol. 5:173–177). Here we report a female *C. nevermanni*, University of Costa Rica Museum of Zoology (UCR 16037), collected by MS on 13 October 2001, in Palo Verde National Park, in Cañas, Guanacaste (northwestern Pacific versant), Costa Rica, with total body length of 100.7 cm (85.2 cm SVL, 15.5 cm tail length, ca. 2 cm of tail missing). The specimen was found during the morning in the abandoned airstrip adjacent to the Palo Verde Lagoon. A large *Masticophis mentovarius* was also captured in the spot simultaneously. From the observed wounds on the *C. nevermanni*, it seems that the large snake was trying to prey on it.

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CROTALUS ADAMANTEUS (Eastern Diamondback Rattlesnake). **WINTER FEEDING.** The optimum temperature range for quickest, most complete digestion of prey items by snakes is usually between 27–29°C (Rubio 1998. Rattlesnake: Portrait of a Predator, Smithsonian Institution Press, Washington). Generally, digestion is completely inhibited and snakes regurgitate food at temperatures less than 10°C (Lillywhite 1987. *In* Seigel et al. [eds.], Snakes: Ecology and Evolutionary Biology, pp. 422–477. Macmillan Publishing, New York). An oversized bolus and lower than preferred temperatures may result in putrefaction of prey.

In the Coastal Plain of southeastern Georgia, adults of two large snake species, the Eastern Indigo Snake (Colubridae: *Drymarchon corais couperi*) and the Eastern Diamondback Rattlesnake (Viperidae: *Crotalus adamanteus*), are frequently surface-active during the winter (December–February) when air temperatures exceed 12.7°C (Timmerman 1995. Bull. Florida Mus. Nat. Hist. 38, Pt. I[5]:127–158; D. Stevenson, unpubl. data). Both species use Gopher Tortoise (*Gopherus polyphemus*) burrows, nine-banded armadillo (*Dasypus novemcinctus*) burrows, stump holes, or similar retreats for winter dens. When found on the surface during the winter, individuals are typically close to their dens (Timmerman *op. cit.*; Moler 1992, *In* Moler [ed.], Rare and Endangered Biota of Florida, Volume III: Amphibians and Reptiles, pp. 181–186, Univ. Press of Florida, Gainesville). To what extent *C. adamanteus* or *D. c. couperi* feed during the winter is unknown. In this note, I discuss observations of winter feeding by adult *C. adamanteus* in Georgia.

An adult *C. adamanteus* collected 1 January 2002, 8.0 km SW of Glennville, Tattnall County, Georgia (31°55'N; 82°00'W) possessed a distinct bolus near midbody. The snake was found coiled on the surface in direct sunlight at 1230 h (air temperature of 9°C). The snake was held in captivity until 6 January at which time it was euthanized because of severe injuries it experienced while being captured. The snake, a post-parturient female (139.7 cm SVL, 148.6 cm TL, 3.12 kg with prey item) contained a partly digested, but essentially intact, adult eastern cottontail (*Sylvilagus floridanus*) in its stomach.

The snake probably ate the rabbit during unseasonably warm (19–27°C) weather 13–29 December 2001. During the first week of January 2002, southeastern Georgia experienced local snow flurries and ice on 2 January, and a low temperature of –7.2°C was recorded on 5 January. Although warm, sunny conditions with daytime highs ca. 22°C are common in winter in southern Georgia, extended blocks of cold weather or sudden cold snaps associated with passing fronts likely force all snakes underground and may compromise their ability to digest prey. Average high and average low winter (December–February) temperatures for the Glennville, Georgia area are 16.6°C and 4.4°C, respectively (NOAA 2001. Climatological Data Annual Summary, National Oceanic and Atmospheric Administration, Asheville, North Carolina).

Similar to the above observation, I found an adult *C. adamanteus* with a large bolus on the surface near a Gopher Tortoise burrow on 23 December 1992 in nearby Bryan County, Georgia. This snake was subsequently observed coiled on the surface near the burrow, probably basking to facilitate digestion, on warm days in early January 1993. However, during cold weather with daytime temperatures about 8°C (in early January) the snake evidently moved underground, as it was observed 1.5 m deep within the burrow or not found at all under these conditions.

Winter feeding has been reported for *C. adamanteus*, but not at a latitude this far north. Timmerman (*op. cit.*) reported that a male *C. adamanteus* (SVL = 135 cm) found dead 13 January 1998 (probably killed by a white-tailed deer) in northern Florida contained the remains of a mouse in its small intestine. Adult *C. adamanteus* with stomach boli have been found throughout the winter in central Florida (Martin 2003. *In* Timmerman and Martin, The Eastern Diamondback Rattlesnake Conservation Guide. SSAR Herpetol. Circ.), and adult snakes with boli have been found on two occasions during the winter in the Lower Coastal Plain of South Carolina (Jeff Humphries, pers. comm.).

C. adamanteus that take prey during the coldest months of the year may be individuals with low fat reserves—such as post-parturient females, males whose energy demands are stressed by mate-searching followed by unsuccessful foraging, or fast-growing juveniles (Timmerman and Martin, *op. cit.*). Snakes with boli observed on the surface may be attempting to maintain or attain

optimum temperatures for digestion, and basking could potentially expose the snakes to increased risk of predation (Lillywhite, *op. cit.*). An adult *C. adamanteus* (ca. 122 cm TL) I observed coiled on the surface 2 m from an armadillo burrow on a cool morning (12ºC, 22 December 1997; Liberty County, Georgia) did not exhibit typical defensive behavior or try to escape when prodded, but instead hid its head beneath its coiled body and remained in this position for over a minute. Slow movements or an inability to mount a typical defensive posture may leave surface-active *C. adamanteus* vulnerable to predation.

I thank Terry Norton, Beth Willis-Stevenson, Tommy Hilliard, Jeff Humphries, and W. H. Martin for help with this note.

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CROTALUS ADAMANTEUS (Eastern Diamondback Rattlesnake). **DIET**. In the course of nuisance snake removal and relocations in Alachua County, north central Florida (USA) during September 2000, we observed, on two separate occasions, evidence of predation on *Felis catus* (domestic house cat) by *Crotalus adamanteus*.

The first *C. adamenteus* was captured in a homeowner's front yard. The snake was ca. 130 cm. in length, and it had ingested a meal so large as to become effectively immobile. The snake was retained at our holding facility to allow the meal to be digested before relocation. Over night, the snake regurgitated a partially digested, large black house cat.

A few days later, at a different location, we captured a second *C. adamenteus* in a gopher tortoise (*Gopherus polyphemus*) burrow. This snake was also grossly engorged, and it made little attempt to escape. It also was taken to our holding facility prior to relocation. Ten days later, the snake defecated a large amount of feces containing black fur, teeth, and claws identified as belonging to *F. catus*. On a side note, the burrow where we captured the snake had, radiating away from its entrance, the first-shed skins of nine newborn *C. adamenteus*.

In the past twelve years we have noted two other possible incidents of cat predation by *C. adamenteus*. In these cases, missing pet cats and fat snakes were observed. All of these snakes were subsequently released into safer habitats.

Our thanks to Paul Moler, Wildlife Biologist, Florida Fish and Wildlife Conservation Commission, for his welcome input.

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CROTALUS PRICEI (Twin-Spotted Rattlesnake). **REPRODUCTION**. On 1 September 2002, a pair of *Crotalus pricei* was observed in copulation on a shaded area of talus and soil from the Barfoot talus slide in the Chiricahua Mountains, Cochise County, Arizona, USA (31°55'09"N, 109°16'43" W, 2560 m). The air temperature was 23–24°C, and it was cloudy following recent rain. The total length of the female was ca. 46 cm; the male snake was 41 cm. The male was on top of the dorsal surface of the female with their tails obviously intertwined. The male made pulsating movements while crawling over the female. The snakes continued mating for about an hour when the flash of a camera startled the pair and the female retreated under a rock. The male immediately pursued her and quickly resurfaced about 30 cm away looking for the female. The male was apparently unaware of our presence.

Little is known about the reproductive behavior of *C. pricei*. What is known has focused primarily on the fecundity of females and the size of their offspring (Goldberg 2000. West. N. Am. Nat. 60:98–100; Lowe et al. 1986. The Venomous Reptiles of Arizona. Arizona Game and Fish Department, Phoenix, 115 pp.; Mahaney 1997. Herpetol. Rev. 28:205). Male and female *C. pricei* have been found in close proximity to each other between mid-August and mid-September (Prival 2000. Sonoran Herpetol. 13:14–18). There is one report of captives mating in summer/autumn (Schuett 1992. *In* Campbell and Brodie [eds.], Biology of the Pit Vipers. Selva, Tyler, Texas). These reports suggest that these snakes breed during the monsoon season and the females retain sperm over the winter.

We thank Dave Hardy and Gordon Schuett for helpful comments on this note.

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DIPSAS CATESBYI (Catesby's Snail-eater). **PREY**. Snakes of the genus *Dipsas* are highly specialized moluscivores. Data on the diet of *Dipsas* have been reported almost exclusively for the Amazon region despite the wide occurrence of the genus in the Atlantic forest. The diet includes mollusks in general but there are also records for insects (Beebe 1946. Zoologica 31:24–25; Cunha and Nascimento 1978. Publ. Avul. Mus. Par. Emílio Goeldi 31:74). In the stomach of an individual of *D. pavonina* from Santarém, Pará, a lizard's foot was found (Martins 1999. Herpetol. Nat. Hist. 2:78–150). Here we present data on the diet of a probably isolated population of *D. catesbyi* in the Atlantic forest in the state of Bahia, Brazil. The specimens were captured in cocoa groves (Alves 2000. Biologia reprodutiva das serpentes do gênero *Dipsas* Laurenti, 1768 do sudeste da Bahia. Dissertação de Mestrado, Universidade Estadual Paulista, Botucatu, São Paulo. 106 pp.), which is traditionally cultivated under the shade of the forest in a system locally called "cabruca." All specimens are housed in the Coleção Zoológica Gregório Bondar (CZGB), of the Centro de Pesquisas do Cacau, in Ilhéus, Bahia, Brazil. An examination of the stomach of 194 specimens at different ages showed that *D. catesbyi* preys primarily on slugs ($N = 85$) rather than snails ($N = 5$). The slugs can be ingested by any extremities of their body. There is no correlation between the number of ingested prey and snout–vent length (SVL) ($r = -0.031$, $p > 0,05$) or between prey length and SVL ($r = 0.38$, $p > 0,05$). One female (470 mm SVL, 174 tail length; CZGB 5942) had a gekkonid lizard ingested headfirst; it was positioned in the anteriormost portion of the stomach near the mouth, suggesting difficulties in swallowing it. Besides the lizard we also found a leg from an orthopteran. These

are the first published data on the natural history of *D. catesbyi* from the Atlantic forest.

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EPICRATES SUBFLAVUS (Jamaican Yellow Boa). **DIET**. Bat predation has been documented for *Epicrates* boids on the Caribbean islands of Cuba (Hardy 1957. Copeia 1957:151–152) and Puerto Rico (Rodriguez-Duran 1996. J. Herpetol. 30:533–536). On Jamaica, *E. subflavus* has been observed hanging from vegetation at the entrances of caves, striking at bats as they emerge at dusk, but to the best of our knowledge, no successful strike-captures have been reported in the literature for this species (Vareschi and Janetzky 1998. Jamaica Nat. 5:34–35).

On 7 April 2000, during monthly monitoring of the resident bat colony of Windsor Great Cave, Trelawny, Jamaica (18°21'N, 77°39'W, elevation 120 m), we observed a juvenile female boa (94 cm SVL, 345 g) successfully capture and swallow a Jamaican fruit bat (*Artibeus jamaicensis*). At 1700 h we hung a single-frame harp trap (1.5 x 1.5 m^2 frame constructed of 5 cm PVC tubing, tensioned 8# nylon monofilament strung at 25 mm spacing) at the lower entrance of Windsor Great Cave. Bats began emerging from the cave at 1820 h and the first bat was captured in the trap at 1835 h. The bat colony of Windsor Great Cave includes: *Pteronotus parnellii* (forearm 54 mm, 14 g), *P. macleayii* (forearm 39 mm, 7 g), *P. quadridens* (forearm 44 mm, 8 g), *Mormoops blainvillii* (forearm 45 mm, 10 g), *Macrotus waterhousii* (forearm 55 mm, 20 g), *Glossophaga soricina* (forearm 38 mm, 11 g), *Monophyllus redmani* (forearm 40 mm, 13 g), *Artibeus jamaicensis* (forearm 60 mm, 52 g), *Erophylla sezekorni* (forearm 48 mm, 16 g), and *Tadarida brasiliensis* (forearm 41, 10 g) (unpubl. data). The total bat population is estimated to be 50,000–100,000 (Vogel 1997. Report to NRCA).

At 1915 h, we noticed a boa hanging from a medium-sized liana at the upper portion of the cave opening. The boa's body position was similar to what other researchers, who have observed this phenomenon, have described: her tail was coiled around the vine and about two thirds of her body length was hanging down, with a slight S-shape. Her ventral surface faced inwards to the cave chamber. As the stream of bats flew past, the boa struck, with mouth agape, at those bats that appeared to make contact with her. At 1925 h we approached the cave entrance to remove the harp trap and, at 1930 h, while continuing to remove bats from the trap's holding bag, we heard a "squeak," signaling the successful capture of a bat by the boa. We did not observe the actual strike. We removed the catch bag from the harp trap to enable any additionally-captured bats a means of escape, and repositioned ourselves 4 m from the cave entrance to observe the snake's manipulation of her prey. We used dimmed headlamps and periodic photographic flashbulbs to record the events, which did not appear to disturb the snake.

The boa maintained constriction for ca. 4 min. She then relaxed her coils while grasping the bat by its neck in order to re-orient the body for head-first ingestion (Fig. 1). The wings of the bat, which splayed outwards from the shoulders, clearly made intraoral transport difficult. The snake spent ca. 35 min. working her head over the bat before she was able to close her mouth completely. The final positioning of the bat's body and appendages as the snake completed oral manipulation was: left wing and head, body, and right wing trailing with the rump. After closing her mouth, the boa coiled her body three times and slid her head and neck up through her coils to assist in pushing the meal towards her digestive tract.

At 2025 h we captured the boa for further observation. The following morning, 10 April 0800 h, the "bat bulge" was visible half way down the length of her body. On 15 April 0800 h, we collected a fecal pellet, which contained numerous mammal hairs. We completed collecting morphometric data, which included weight at time of capture (365 g), weight after passing fecal pellet (345 g), weight of fecal pellet (20 g), skull length (34.8 mm), and skull width (26.5 mm). Using photointerpretation techniques, we used the dimensions of the boa's skull to estimate the length of the bat's forearm (ca. 55–60 mm). Forearm length, coupled with the weight of the fecal pellet, the bat's facial features and reduced interfemoral membrane, lead us to identify the bat as *Artibeus jamaicensis*. The thoracic cavity of a live, adult *A. jamaicensis* measures 37 x 25 mm (dorso-ventrally compressed).

After permanently marking the boa with caudal scale clipping, we returned her to the capture site on 16 April 1930 h. We have continued with one-night-per-month trapping of bats at the cave entrance and on 26 May 2001 captured another juvenile female boa (85 cm SVL, 195 g), which had positioned herself on the top bar of the harp trap. We have also observed juvenile boas at Windsor Great Cave on two previous occasions. On 19 July 1999 2300 h, SK captured, marked, and released a juvenile female (92 cm SVL, 395 g) found on the ground at a larger, upper opening of the cave. In 1996 MS observed a small boa in the rear of the first cave chamber, approaching the second chamber, where one of the bat

FIG. 1. Following constriction, a juvenile female *Epicrates subflavus* re-orients a Jamaican fruit bat (*Artibeus jamaicensis*) for head-first consumption.

roosts is located.

It is interesting to note that the boas that others and we have observed at Windsor Great Cave have all been relatively small animals. We have encountered larger adults in the Windsor environs (e.g., female, 148 cm SVL, 2000 g), but hunting for bats appears restricted to juveniles. Whether this is because of physical constraints of the hunting perch (Chandler and Tolson 1990. J. Herpetol. 24:151–157), the imposition gravity poses to blood circulation when larger snakes hang vertically (Lillywhite and Henderson 1993. *In* Siegel and Collins [eds.], Snakes: Ecology and Behavior, pp. 1–48, McGraw-Hill, New York), or because the bats represent low- or marginal-energy prey items for adult snakes, particularly as they weigh less than predicted for their maximum diameter because of their protruding wings (Cundall and Greene 2002. *In* K. Schwenk [ed.], Feeding: Form, Function, and Evolution in Tetrapod Vertebrates, pp. 293–332. Academic Press, San Diego, California), is unknown. While the large bat roost of Windsor Great Cave represents a predictable, high density but localized prey resource, we still lack information on hunting success under natural conditions, when a trap is not in place that disrupts the bats' flight. Prior and Gibson (1997. Herpetol. Rev. 28:72–73) recorded > 200 unsuccessful strikes by a juvenile *E. subflavus* during a period of 1 h 45 min. Research into the energetic costs and benefits of opportunistic bat predation would improve our very limited understanding of the foraging ecology of Jamaica's endemic boa as well as ensure adequate protection for critical habitat and food resources of this vulnerable snake.

The bat research that "assisted" the boa was supported by a student scholarship to S. Koenig from Bat Conservation International and additional funding from the Jamaica Conservation and Development Trust. Research was conducted under Natural Resources Conservation Authority permit Ref No. 18/47. We thank Harry W. Greene for his helpful comments, particularly on prey types and gape diameters in snakes.

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LAMPROPELTIS GETULA NIGRA (Black Kingsnake). **MAXIMUM SIZE.** The maximum size record reported for *Lampropeltis getula nigra* by Conant and Collins (1998. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Houghton Mifflin Co., Boston, Massachusetts. 616 pp.) is 58 in (147.3 cm). On 4 July 1999 a recent DOR specimen was collected by Brainard Palmer-Ball near the Franklin School in Washington County, Indiana, USA. ca. 2.2 km N of Blue River (38°32.7'N, 85°56.3'W). Before preservation, this large male specimen measured 1480 mm in total length. Additional morphometric and meristic data are as follows: snout–vent length 1309 mm, tail length 171 mm, ventrals 203, and caudals 48. This specimen is deposited in the vertebrate collections at Morehead State University (R4682). Examination of 27 additional male *L. g. nigra* from Kentucky gave the following ranges and mean values: total length 736–1211 mm (mean 981.9 mm); snout–vent length 654–786.7 mm (mean 675 mm); tail length 158–188.7 mm (mean 176 mm); ventrals 198–213 (mean 205.9); and caudals 41–57 (mean 49.6) (Meade 1993. Kentucky Snakes: Their Systematics, Variation and Distribution. Ph.D. dissertation, Univ. of Southern Mississippi, Hattiesburg, Mississippi. 609 pp.).

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MASTICOPHIS BILINEATUS (Sonoran Whipsnake). **PREY.** *Masticophis bilineatus* is generally regarded as a generalist forager, and snakes occasionally are reported as food items (e.g., Grismer 2002. Amphibians and Reptiles of Baja California, Including its Pacific Islands and the Islands in the Sea of Cortés. Univ. California Press, Berkeley, California. 399 pp.). A study by Camper and Dixon (2000. Texas J. Sci. 52:83–92) found no snakes in the stomachs of 335 *M. bilineatus*, but Enderson (1999. Sonoran Herpetol. 12:72–73) reported the predation of a neonate *Crotalus molossus* by a very large (1679 mm) specimen. Klauber (1972. Rattlesnakes. Univ. California Press, Berkeley, California, p. 1105) also relates a story of an adult *M. bilineatus* consuming a *C. molossus*. Here, I document a snake species not previously observed as prey for *M. bilineatus*.

On 20 August 2002, while at Peck Canyon in southern Arizona (31°29'N, 111°04'W) at 1300 h, I observed an adult *M. bilineatus* (ca. 100 cm SVL) consuming a smaller *Salvadora hexalepis* (Fig. 1). I did not attempt to separate the two snakes, but estimate the size of the *Salvadora* to be ca. 40–55 cm in total length. The *Salvadora* was being swallowed headfirst, and was approximately two-thirds consumed when I first found the snakes. I watched and photographed the snakes for ca. 10 minutes before leaving. During that time period neither snake moved; it appeared that the

FIG. 1. *Masticophis bilineatus* consuming *Salvadora hexalepis*.

Masticophis was aware of my presence, and the *Salvadora* may have already been dead. This record is the first documentation of *S. hexalepis* in the diet of *M. bilineatus*. The ambient shaded air temperature was ca. 35°C at 1 m off the ground, cloud cover was less than 10%, and the ground was saturated from recent rains. A voucher slide has been accessioned at the University of Arizona Collection of Amphibians and Reptiles (UAZ 54678-PSV).

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MASTICOPHIS FLAGELLUM (Coachwhip). **PREY.** The diet of the diurnally active, swift-moving *Masticophis flagellum* includes rodents, birds and their eggs, a variety of lizards, young turtles, some insects, and also snakes (e.g., Stebbins 1985. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin Co., Boston, Massachusetts). Beaman and Harris (2002. Herpetol. Rev. 33:214–215) recently summarized seven species of snakes previously reported as prey of *M. flagellum*, as well as their own account of a gopher snake (*Pituophis catenifer*) as prey. Herein, I report another incidence of *P. catenifer* being eaten by *M. flagellum*. On 30 August 2002 at 1230 h, while conducting a rare plant survey in a Sonoran desertscrub/semidesert grassland habitat, I chanced upon a *P. catenifer* being eaten by a black-phased *M. flagellum*. The observation took place on Tohono O'odham Nation, San Xavier District lands leased by ASARCO Inc., about 21 km SW of downtown Tucson in Pima County, Arizona, USA (32.021547°N, -111.039105°W). The *P. catenifer* was the first to be observed. It was located next to a clump of bush muhly (*Muhlenbergia porteri*), and the snake appeared undisturbed at my presence. Upon closer inspection, I noticed that a *M. flagellum* had hold of the *P. catenifer* and that it had been swallowed headfirst slightly more than halfway. The *M. flagellum* was loosely coiled and fully shaded from the overhead sun by the grass cover, while the portion of the *P. catenifer* not yet swallowed was completely exposed to the sun on the western-side of the grass cover. Soon after the encounter the ambient air temperature (taken at 1 m with a Shultheis-type thermometer) was 38.1°C, and the ground temperature beneath the *M. flagellum* in the shade was 33.8°C and 42.2°C under the exposed *P. catenifer*. I inadvertently disturbed the snake when taking the temperature beneath its coil and it proceeded to regurgitate the partly digested *P. catenifer*, with only the gopher snake's mid- and tail sections being recognizable. It was not known exactly how long the *M. flagellum* had hold of its prey, but the *P. catenifer* was discolored and internally yielding, which indicated the onset of autolysis. I did not disturb the *M. flagellum* any further and it remained beneath the clump of grass, briefly shaking its tail as I departed. Because I did not try to catch the *M. flagellum*, I could only estimate its total length at ca. 110 cm. The *P. catenifer* being partially eaten was more difficult to gauge but appeared to have been about the same size as the *M. flagellum*. The two snakes were photographed as the one was consuming the other and a color slide was deposited in the University of Arizona herpetological collection (currently uncatalogued).

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MICRURUS FULVIUS TENER (Texas Coral Snake). **DIET**. The diet of *M. fulvius* generally consists of small lizards and snakes (Greene 1984. Univ. of Kansas Mus. of Nat. Hist. Spec. Publ. 10:147–162). On 20 October 2001 a female *M. f. tener* (SVL 734 mm; weight 64 g) was captured on the Griffith League Ranch in Bastrop County, Texas, USA. The snake was taken to the lab for measurements. During transport, the snake regurgitated a male *Masticophis flagellum* (SVL 476.3 mm; weight 32 g) and died. The *M. flagellum* was 64.9% of the *M. f. tener*'s length and 50% of its weight, which is slightly higher than the mean body mass relationship for coral snakes and their prey determined by Greene (*op. cit.*). There are few records of coral snakes eating larger colubrids (Neill 1968. Florida Wildlife 21:22–25; Greene, *op. cit.*), and we were unable to locate references to *M. flagellum* being eaten by *M. fulvius*. Both were deposited in the Texas Wildlife Cooperative Museum at Texas A & M University (*Micrurus*: TCWC84720; *Masticophis*: TCWC84719).

We thank Rob Bryson and Jeff Mink for their assistance capturing the snake, and Martha Dollar for expediting the delivery of Greene's paper.

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MICRURUS STEWARTI (Panamanian Coral Snake). **COLOR VARIATION**. Color patterns in snakes of the genus *Micrurus* are relevant for comprehending coral snake mimicry systems (e.g., Greene and McDiarmid 1981. Science 213:1207–1212), and for an adequate identification of these potentially harmful snakes.

On 23 January 2002, at night, FAS and RID found an adult male *M. stewarti* (619 mm TL, 531 SVL) active on the ground along the margins of a stream at Quebrada Peñalosa, Cuatro Callitas, Distrito de Donoso, Provincia de Colón (ca. 8°58'0.86"N, 80°33'9.16"W, 40 m elev.), within a stream reach flowing through a mixture of forest and humanly disturbed areas. The snake was essentially bicolored black and white, having a white head with a black snout, a rather long black nuchal ring, and a series of alternating white and black rings throughout the body and tail. The black rings were more than twice the length of the white rings. The white rings have a very faint pinkish tint, somewhat more noticeable on the head and first two body rings, and dorsally with black tipped scales. The specimen was collected and tagged, Círculo Herpetológico de Panamá (CH 5348), and later deposited in the Museo de Vertebrados de la Universidad de Panamá (MVUP 1797).

M. stewarti is a poorly known, rare species (Roze 1996. Coral Snakes of the Americas, Krieger Publishing Co., Malabar, Florida). No specimens of this species were known to have the exclusively black and white coloration reported herein, being previously regarded as a bicolor snake with black and red rings (Campbell and Lamar 1986. The Venomous Reptiles of Latin America, Comstock Publishing Associates, Ithaca, New York; Roze 1996, *op. cit.*). In addition, we have observed 8 live specimens of *M.*

stewarti from other localities in central Panamá, all of them having black and bright red rings. Therefore, in this species, the black and white ringed color variant is present in a low frequency.

In central Panamá, two other species of bicolored coral snakes occur in sympatry with *M. stewarti: M. multifasciatus*, also with black and red rings, and *M. mipartitus* with black and white body rings, the white color replaced by orange red on the head and tail (Campbell and Lamar 1986, *op. cit.*; Roze 1996, *op. cit.*; pers. obs.). Hence, the black and white ringed color variation, observed in *M. stewarti*, conforms to the geographic concordance in color pattern expected among presumed coral snake models as Müllerian mimics.

The reported observation was made during the project "Recopilación y Presentación de Datos de Recursos Ambientales y Culturales en la Región Occidental de la Cuenca del Canal de Panamá," funded by the Autoridad del Canal de Panamá, and performed by The Louis Berger Group Inc., Universidad de Panamá and Smithsonian Tropical Research Institute consortium.

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NERODIA SIPEDON SIPEDON (Northern Watersnake). **DIET**. On 15 July 2001, while conducting a herpetological survey of Shenandoah National Park, Virginia, USA (Research Permit number: SHEN-2001-SCI-0005), we captured a female *N. sipedon* (350 mm SVL, 103 mm TL, 31g) at coordinates 38°14'26"N; 78°41'24"W (NAD 27) that regurgitated a larval *Gyrinophilus porphyriticus* (74 mm SVL, 50 mm TL, 8.25 g) upon capture. Habitat consists of mixed deciduous woodland on Doyle's River with a two-step cascade of water 8.5 m high, the animal being found in a rocky pool at the bottom of the waterfall. This is the second documentation of predation on *G. porphyriticus* by *N. sipedon* (Uhler et al. 1939. Trans. 4th North Am. Wildl. Conf. 1939:605–622). Prey body mass accounted for 26.6% of the predator's body mass. The larval salamander was consumed head-first and was still alive upon being regurgitated by the snake. Our observations provide the first predator-prey morphometric and orientation data on these two species. We thank Boripat Siriaroonrat and Shelley C. Hickman for field assistance and logistical support during the survey.

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PORTHIDIUM NASUTUM (Hog-nosed Pitviper). **PREY**. *Porthidium nasutum* ranges from southern Mexico to Ecuador and has been documented to feed on a variety of vertebrates. Prey items of *P. nasutum* include species of birds, rodents, lizards, and anurans (Greene 1997. Snakes: The Evolution of Mystery in Nature. University of California Press, California, 351 pp.; Alvarez del Toro 1983. Los Reptiles de Chiapas, 3rd ed. Instituto de Historia Natural, Tuxtla Gutierrez, Chiapas, Mexico, 248 pp.). Juveniles are also known to feed on a variety of invertebrates (Campbell 1998. Amphibians and Reptiles of Northern Guatemala, the Yucatan, and Belize. University of Oklahoma Press, Norman, Oklahoma, 380 pp.). However, detailed accounts of most prey items of *P. nasutum* are lacking. We report an anuran prey item of *P. nasutum* that has not been previously documented.

On 18 May 1998, we encountered a *Porthidium nasutum* on the side of the western trail (Sendero Occidental) at trail marker 50 at La Selva Biological Station, Costa Rica (2015 h). We observed the snake for ca. 30 minutes and left. One of us (DAW) returned to the same location 1 h later with a camera and discovered a dead *Rana warszewitschii* next to the snake. This observation suggests that the snake struck and envenomated the frog and then released it. After watching for about 5 minutes, the snake began to ingest the frog. Approximately 30 minutes later, the snake moved deeper into the forest with the frog half way in its mouth.

We thank H. Greene and C. Guyer for encouraging us to publish our observation, and C. Guyer for identifying the *Rana warszewitschii* from photographs. Thanks to J. Raich and O. Rocha for giving us the opportunity to study in Costa Rica.

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PTYAS CARINATUS (Keeled Rat Snake) **PREY.** There are few data available on the feeding habits of *Ptyas carinatus* in the tropical forests of Southeast Asia (Cox 1991. The Snakes of Thailand and Their Husbandry. Krieger Publishing, Malabar, Florida. 564 pp.). On 10 July 2001 (1100 h) along the trail from Kampung Mukut to Sungai Raya on Pulau Tioman, West Malaysia, a juvenile *P. carinatus* was observed eating a juvenile *Gongylosoma* sp. The habitat was coastal forest (Latiff et al. 1999. Raffles Bull. Zool. 6:11–72) with dense leaf litter. Immediately after the sighting, the *Gongylosoma* sp. was released and both snakes fled. The *Gongylosoma* sp. had bite marks on its body from the attack. Both snakes were captured, preserved, and deposited in the Zoological Reference Collection (ZRC) of the National University of Singapore; *Ptyas carinatus* (ZRC 2.5142), *Gongylosoma* sp. (ZRC 2.5143).

Submitted by **RAUL E. DIAZ, SAUL GUERRERO, COLBY LEDBETTER**, and **SHANNA NEWBOLD**, Department of Biology, La Sierra University, Riverside, California 92515, USA (e-mail [RED]: Frog_diaz@hotmail.com).

RHINOBOTHRYUM BOVALLII (Coral Cat-eyed Snake). **SIZE.** The maximum total body length reported for *Rhinobothryum bovallii* is 130.2 cm (Wilson and Meyer 1985. The Snakes of Honduras. Milwaukee Publ. Mus., Publ. Biol. Geol. 6, 159 pp.). Here I report a male *R . bovallii* from Costa Rica with a total body length of 176.2 cm (135.0 cm SVL, 41.2 cm tail length). The specimen, University of Costa Rica Museum of Zoology (UCR-14916), was captured by Miguel and Norberto Solano in Guayacán de Siquirres, Limón province (northeastern Caribbean versant) on the night of 14 December 1997, while moving slowly on the floor in primary rainforest.

I thank Louis W. Porras and William W. Lamar for comments on this note, and Federico Bolaños and Gerardo Chaves for allowing me to examine specimens at the School of Biology and Museum of Zoology at the University of Costa Rica.

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THAMNODYNASTES STRIGATUS (Corredeira). **DIET**. Amphibians have been reported as prey of *T. strigatus* (Cei 1993. Mon. XIV Boll. Mus. Reg. Sci. Nat. Torino, 949 pp.; Achaval and Olmos 1997. Anfibios y Reptiles del Uruguai. Série Fauna N°1, 128 pp.; Marques et al. 2001. Serpentes da Mata Atlântica: Guia ilustrado para a Serra do Mar. Holos Ed., 184 pp.). However, the specific amphibian species have not been reported.

On 9 March 2000, we collected three *T. strigatus,* on the eastern bank of the Uruguai River (28°23'43"S, 52°29'59"W), near the municipality of Itá, in the State of Santa Catarina, Brazil. One specimen (CEPB/NAT 2848; male SVL 546.3 mm) contained the posterior limbs of a specimen of *Odontophrynus americanus* (tibia: 23.0 mm; tarsus: 18.6 mm). The second specimen (CEPB/NAT 2497; female SVL 668.5 mm) contained most of the posterior limbs and pelvic region of a specimen of *Hyla faber* (femur: 40.5 mm; tibia: 46.7 mm; tarsus: 29.9 mm). The third specimen (CEPB/NAT 2469; female SVL 630.3 mm) contained the posterior limbs of a specimen of *Rana catesbeiana* (tibia: 37.2 mm; tarsus: 17.6 mm). Our observations include three families of amphibians in the diet of *T. strigatus*. The snakes and their respective stomach contents are deposited in the Herpetological Collection of the Centro de Estudos e Pesquisas Biológicas, at the Catholic University, Goiânia, Goiás, Brazil.

Submitted by **IVAN FRANÇA E SOUZA**, **RAFAEL SILVEIRA RIBEIRO,** and **NELSON JORGE DA SILVA JR.**, Laboratório de Herpetologia, Centro de Estudos e Pesquisas Biológicas, Universidade Católica de Goiás, Ave. Universitária, 1440, Setor Universitário, 74.605-010, Goiânia, Goiás, Brazil (e-mail: souzai@terra.com.br).

THAMNOPHIS SIRTALIS SIRTALIS (Eastern Garter Snake). **PREDATION**. On 26 April 2001 in Lake Creek (T16S, R2W, Sec. 13, SW1/4 of NE1/4, Cache, Illinois USGS 7.5' topographic map) Alexander Co., Illinois, USA, one of us (WJP) observed a *Thamnophis s. sirtalis* being carried in the mouth of a gar, *Lepisosteus* sp. (either *L. platostomus*, shortnose gar, or *L. oculatus*, spotted gar) with a portion of the snake's body floating at the surface of the water. The gar swam with the snake for several minutes under and near the State Route 3 bridge before the snake was hooked using a fishing pole and forcibly taken from the fish. The snake was dead but in good condition and measured 621 mm TL. The attack on the snake was not observed. Gars were abundant in the stream and were seen cruising just below the surface of the water. Four gars caught by hook and line and many others observed that day were all *L. platostomus*.

A spotted gar was reported to have eaten a small turtle, *Sternotherus odoratus*, in Missouri (Redmond 1964. Ecology of the Spotted Gar [*Lepisosteus oculatus* Winchell] in southeastern Missouri. M.A. thesis. Univ. Missouri. viii + 115 pp.). Additionally, *T. sirtalis* has been reported in the diet of largemouth bass, *Micropterus salmoides* (Knapik and Hodgson. 1986. Herpetol. Rev. 17:22). However, this is the first report of *T. sirtalis* or any snake being preyed on by any species of gar. The snake is deposited at the Illinois Natural History Survey (INHS 17214).

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THAMNOPHIS SIRTALIS SIRTALIS (Eastern Garter Snake) and ***PLETHODON ALBAGULA*** (Western Slimy Salamander). **PREDATION**. *Thamnophis sirtalis sirtalis* is a generalized feeder predating mostly on earthworms and amphibians (Uhler et al. 1939. Trans. North Am. Wildl. Conf. 4:605–622). Salamanders (*Ambystoma, Desmognathus, Eurycea, Necturus, Notophthalmus,* and *Plethodon*) are among the most frequently consumed amphibian prey (Ernst and Barbour 1989. Snakes of Eastern North America. George Mason Univ. Press, Fairfax, Virginia. 282 pp.). Herein, we describe, for the first time, predation by *T. s. sirtalis* on *Plethodon albagula* from a mine shaft in Arkansas.

We observed a female *T. s. sirtalis* on 11 August 2002 while investigating the nesting ecology of *P. albagula* in an abandoned mine shaft. The mine shaft (Spillway Mine) is a nesting sanctuary for this salamander species; it is located near Blakely Mountain Dam of Lake Ouachita (Garland County) in the Ouachita National Forest of south-central Arkansas. The shaft extends ca. 190 m horizontally into a moderately sloping, rocky hillside. We collected the active garter snake inside the mine shaft at ca. 2.5 m from the mouth of the shaft.

The snake measured 395 mm SVL and 136 mm tail length. Upon necropsy, the snake contained a mostly-digested *P. albagula* in its stomach. It appeared that the salamander had been ingested tail first. We were unable, however, to determine the age or sex of the prey item because of the degree of digestion. We deposited the snake in the Arkansas State University herpetological museum collection (ASUMZ 27218).

We thank David A. Saugey (Vertebrate Biologist, United States Forest Service) and the Army Corp of Engineers for access to Spillway Mine, and Sigma Xi Grants-in-Aid (to RRK) for research funding.

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cussed in Schuett (1992) and Aldridge and Duvall (2002).

This population of *C. polystictus* lies within an artificial, highly-modified habitat. Such an area may provide an increase in prey availability because of high rodent densities typically associated with agricultural areas. Several of the scats from wild collected individuals examined in the lab contained rodent hair (species not identified). Specimens were most commonly encountered near heavily vegetated earthen canals and berms. The monoculture created by hectares of uninterrupted cornfields contain unsuitable habitat, and thus concentrate populations of *C. polystictus* along breaks in their periphery. The use of agricultural chemicals and pesticides and conversion of earthen canals to concrete canals may negatively affect this population. Searches near concrete canals failed to produce any specimens of *C. polystictus*, presumably because of their lack of rodent burrows and vegetated sides. Although this population of *C. polystictus* appears to be healthy, it should be considered fragile because of its location in an area subject to further modification for agriculture.

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Growth Rates and Post-Release Survival of Captive Neonate Timber Rattlesnakes, *Crotalus horridus*

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The need for conservation and management of rare species is becoming increasingly important as wildlife species and their habitat continue to decline. Translocation of wild captured adults to augment and reintroduce populations has been successfully used for some endangered avian species (see Carrie et al. 1999; Rudolph et al. 1992). In general, success rates for mammals and birds are higher than those for amphibians and reptiles (Dodd and Seigel 1991; Griffith et al. 1989).

The Timber Rattlesnake (*Crotalus horridus*) is listed as a State of Texas threatened species and translocation of captive raised snakes might benefit small populations. Controversy exists on the benefits versus problems associated with translocation of amphibians and reptiles (Burke 1991; Dodd and Seigel 1991; Reinert 1991). A recent evaluation of the impacts of translocation on behavior and survival of mature *C. horridus* suggests that translocation of adult snakes not be recommended as a standard management technique because of immediate aberrant movement behavior patterns and long-term elevated rates of overwinter mortality, predation, and disease (Reinert and Rupert 1999).

Because of the problems associated with translocation of adult *C. horridus*, the ability to successfully raise neonate rattlesnakes and successfully introduce them into forest habitat may be an essential conservation technique if viable populations of this rare species are to be maintained in the wild. If captive-raised neonates can be grown to sufficient size, predation-related and overwinter mortality events suffered by neonates and first-year juveniles might be minimized, increasing the net survival rates of cohorts released to the wild.

We captive raised one neonate *C. horridus* in 1993–1994 and eight in 1994–1995, recording detailed growth data on the eight snakes over an 11-month period. The nine snakes were released with surgically implanted transmitters in eastern Texas and we monitored their movements for six years. We determined their survival rates in the wild to evaluate the possible merit of using captive-raised neonates to augment small, isolated populations.

Materials and Methods.—Locations of released *Crotalus horridus* with transmitters were monitored in the Stephen F. Austin Experimental Forest, southern Nacogdoches County (31°29'N,

94°47'W), in eastern Texas. Bottomland hardwood forest comprises 728 ha of this 1038-ha experimental forest and pine uplands the remaining 310 ha. Approximately 670 ha of the bottomland hardwood forest are in the Angelina River flood plain. Minimal timber harvesting has occurred on this forest and canopy trees in both the bottoms and uplands are 70+ years old.

On 30 August 1994 eight neonate *C. horridus* (6 females and 2 males) were obtained from the brood of a telemetered adult female from the Loco Bayou Hunt Club 8 km west of the experimental forest. The neonates were obtained prior to their first ecdysis as they crawled around the entrance to a nine-banded armadillo (*Dasypus novemcinctus*) burrow. The eight neonate rattlesnakes were individually housed in 27 x 29 x 56 cm herpetological cages with clear Lucite sliding fronts, an electric heating pad under the cage, and a rock to assist shedding. Water in a petri dish was always present. Between 31 August 1994 and 17 July 1995 live mice (*Mus musculus*) were offered weekly to the rattlesnakes in an attempt to maximize their growth. From a management perspective, our objective was to get the neonates to a near-adult size as quickly as possible to enhance their probability of survival when released in the wild. During the first two months mice < 18 g were offered to the neonates; thereafter, a range of mice between 10 and 35 g were offered and taken by the snakes. Mice and rattlesnakes were weighed prior to feeding and the weight of each mouse killed and consumed by each snake was recorded. Snake mass, snout–vent length (SVL), and total length were measured initially and then monthly over the next 10 months (last measurement 17 July 1995).

On 17 July 1995 four *Crotalus horridus* (three females and one male) were selected for subcutaneous implantation of a 10.3 g Holohil® SI-2T radiotelemetry transmitter using the technique of Weatherhead and Anderka (1984) and, following at least a one week recovery period, were released together in bottomland hardwood forest on the Stephen F. Austin Experimental Forest on 4 August 1995. The remaining male and three females received a subcutaneous transmitter on 27 February 1996 and were released together at the same location as the initial four snakes on the experimental forest on 13 March 1996. Earlier, an additional female neonate (which weighed 35 g upon capture on 16 September 1993 near Bingham Lake, Tyler County, Texas, on the Forest Lake Experimental Forest and was captive-raised to a weight of 246.7 g) received a transmitter on 5 March 1994 and was released in the experimental forest on 21 March 1994 at a point 100 m ENE of the location where the other eight neonates were released. During periods when snakes were not in hibernacula they were radiotracked and relocated approximately weekly using a Telonics receiver (TR-2, 150-152 MHz) with a two-element Yagi directional antenna.

Locations of all released snakes were determined weekly until they settled in hibernacula in late November. Weekly relocation commenced again in March when rattlesnakes emerged from hibernacula. Thus, post-release movements of nine captive-raised rattlesnakes were monitored from mid-March to late November over a period between four and six years. Mortality of released rattlesnakes was assumed if bones and a transmitter were found together. Dead snakes with transmitters recovered on or immediately next to a road with obvious injuries were assume to be road mortalities.

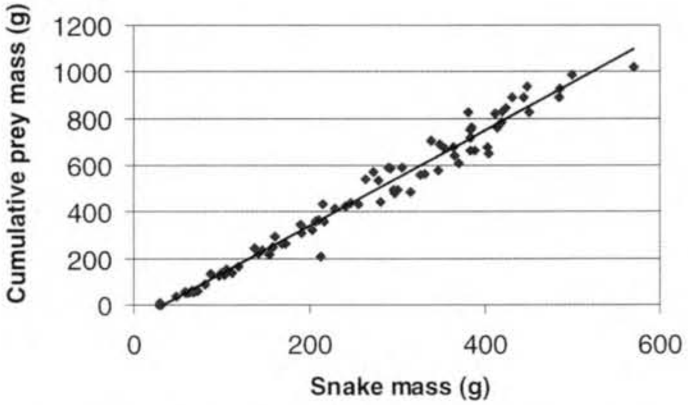

FIG. 1. Cumulative prey mass consumed by eight captive-raised neonate *Crotalus horridus* from eastern Texas versus snake mass as neonates grew (monthly measurements) over a 10-month period. The line within plotted points reflects a regression trend line ($Y = 2.0416X - 66.516$, $R^2 = 0.98$).

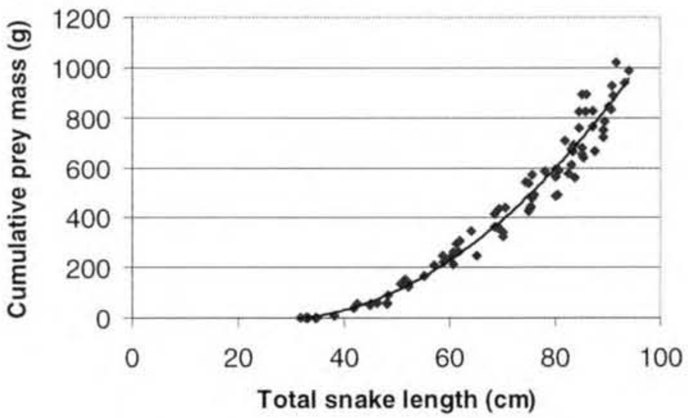

FIG. 2. Cumulative prey mass consumed by eight captive-raised neonate *Crotalus horridus* from eastern Texas versus total snake length as neonates grew (monthly measurements) over a 10-month period. The line within plotted points reflects a second-order polynomial trend line ($Y = 0.0021X^2 - 1.1265X + 142.04$, $R^2 = 0.97$).

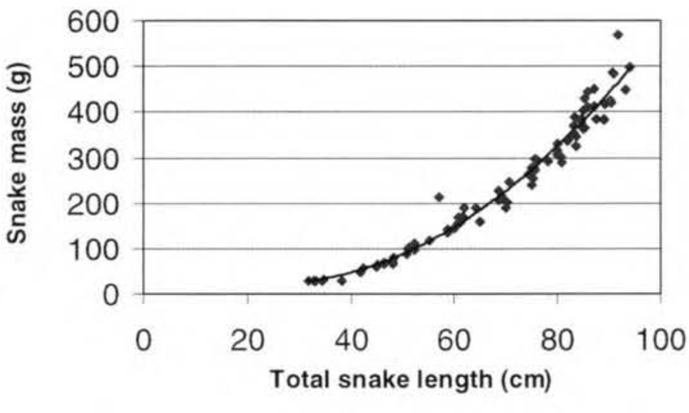

FIG. 3. Mass versus total length of eight captive-raised neonate *Crotalus horridus* from eastern Texas as neonates grew (monthly measurements) over a 10-month period. The line within plotted points reflects a second-order polynomial trend line ($Y = 0.0957X^2 - 4.5229X + 75.063$, $R^2 = 0.97$).

TABLE 1. Post-release survival of ad-lib fed neonate *Crotalus horridus* in eastern Texas. Minimum surviving rattlesnakes were those remaining in the experimental forest study area with functional transmitters. Maximum surviving includes minimum surviving plus those rattlesnakes of unknown status that dispersed from the study area or experienced transmitter failure. M = male, F = female.

Post release	Minimum surviving		Maximum surviving	
survival (y)	No. (M/F)	%	No. (M/F)	%
0	9 (7/2)	100.0	9 (7/2)	100.0
1	8 (6/2)	88.9	8 (6/2)	88.9
2	4 (3/1)	44.4	7 (5/1)	77.7
3	4 (3/1)	44.4	7 (5/1)	77.7
4	3 (2/1)	33.3	7 (5/1)	77.7
5	3 (2/1)	33.3	6 (5/1)	66.6
6	2 (1/1)	22.2	5 (4/1)	55.6

We used the program CALHOME (Kie 1994) to calculate annual minimum convex polygon (Mohr 1947) activity ranges and annual maximum distance between relocation points for nine released rattlesnakes during the first full tracking year after release, the second full tracking year after release, and all tracking years after the first full year of release.

Results and Discussion.—Captive, neonate *Crotalus horridus* initially averaged (mean ± SD) 28.7 ± 0.74 g, SVL 30.9 ± 0.97 cm, and total length 33.2 ± 0.98 cm. During the year of captivity the neonates consumed an average of 873.5 ± 113.5 g of prey mass (mice) per snake and attained an average mass of 461.8 ± 54.8 g, SVL of 81.7 ± 3.1 cm, and total length of 88.3 ± 3.4 cm (Figs. 1, 2). On average, for every 1.0 g of prey mass consumed the snakes increased their body mass by 0.48 g and their total length by 0.063 cm (Fig. 3). Following their first post parturition shed, the captive-raised neonates shed four times prior to release. Ecdysis occurred approximately every time the snakes doubled their body mass.

Eight of the nine captive-raised neonates released in the wild with surgically implanted radio transmitters survived at least one full year after their release (Table 1). A female released March 1996 survived 4 months and a male released August 1995 survived 12 months in the wild, but both were killed in road-related mortality. A female released March 1996 died or lost her transmitter (unknown cause—transmitter found in hibernaculum) two years post-release. The status of three snakes is unknown because of dispersal from our study area or transmitter failure at one, two, and three years post-release, respectively. We strongly suspect that these snakes moved out of our study area because the weekly movement of these three snakes suggested that they were shifting the center of their activity toward the west on private lands. Three of nine captive-raised neonates were known to be alive and had entered the breeding population five years post-release (Table 1). These three snakes (a female released March 1994, a female released August 1995, and a male released March 1996) were observed copulating or participating in precopulatory behavior with wild conspecifics. Although sample size is too small to detect a statistical relationship, neither month of release (March versus August) nor sex appeared to be related to death, dispersal, or survival.

During the first full tracking year after release our captive-raised rattlesnakes averaged (mean ± SD) an annual minimum convex polygon activity range of 12.10 ± 9.61 ha and a maximum distance between relocation points of 0.97 ± 0.69 km. During the second full tracking year after release the activity range was 22.01 ± 29.95 ha and maximum distance between relocation points 0.82 ± 0.06 km suggesting that activity area increased but maximum movement distance decreased slightly. For rattlesnakes that remained alive after the second full tracking year, activity area averaged 7.26 ± 4.96 ha and maximum distance between points 0.51 ± 0.16 km for all subsequent years.

Captive-raised neonate *Crotalus horridus* gained 0.48 ± 0.04 g of body mass for every 1.0 g of prey consumed. Jauch (1993) observed a higher (0.58 g) mass gain per 1.0 g prey in captive-born Puff Adders (*Bitis arietans*) that were offered mice every 2–3 weeks. However, our captive-raised *C. horridus* gained 0.063 ± 0.012 cm in total length for every 1.0 g of prey consumed, whereas Jacobsen (1986), who provided white mice and later white rats every 1–3 weeks, measured only 0.018 cm gain in total length per 1.0 g prey consumed in captive *B. arietans*. Similar to our observations with *C. horridus*, ecdysis occurred in *B. arietans* approximately every time they doubled their body mass (Jauch 1993).

Our captive-raised neonate *C. horridus* attained an average total length of nearly 90 cm prior to release in the wild. Although inexperienced in the wild, the size of these snakes after one year of *ad libitum* food in captivity would likely offset some of the predation-related mortality incurred typically by neonates during their first year. Several years would be required for wild-raised neonates to attain this size, and during these years predation rates would probably be high.

The known survival and incorporation of three (33%) of nine captive-raised neonate *C. horridus* (Table 1) into the breeding population five years post-release indicates at least some potential value of the technique to augment small populations or possibly repopulate areas where extirpation has occurred, especially if neonates were obtained through a captive breeding program. The actual survival of the captive-raised neonates may exceed 33% because the status of three additional snakes was unknown either because of long distance dispersal or transmitter failure. Some of these snakes may have moved off the study site to neighboring properties where we could no longer monitor their movements. The road mortality (two cases in which individuals were killed on blacktop roads adjacent to the experimental forest) and death in hibernaculum (one case) likely reflect what would occur in wild snakes in similar habitat (Rudolph et al. 1998). However, it is likely that unfamiliarity with habitat accounted for some of the mortality and unknown losses of snakes that we observed because the relocated snakes spent more time than typical looking for acceptable habitat, which increased the probability of predation. Charland (1989) reported a 45% overwinter mortality rate of neonate Western Rattlesnakes (*Crotalus viridis*) during their first six to eight months. Timber Rattlesnakes in eastern Texas did not seem to overwinter in communal dens, but instead typically went down a stump hole or an armadillo burrow when temperatures approached freezing. Although winters in eastern Texas are shorter in duration and milder than winters in more northern latitudes, temperatures often reach –8°C and can go as low as –18°C (Chang et al. 1996). Our captive-raised neonates avoided possibly high first-winter mor-

tality and were artificially given a boost to body mass and length well beyond what would occur in wild snakes.

Reinert and Rupert (1999) reported that 6 of 11 (54.3%) wild-captured, mature *Crotalus horridus* experienced mortality over an approximate two-year period. Three of these snakes experienced overwinter mortality, predators killed two, and one died from disease. At least 44.4% and possibly 77.7% of our neonates survived two years post-release (Table 1). The actual survival rate for our captive-raised neonates probably does not differ much from what Reinert and Rupert (1999) observed with mature rattlesnakes.

Translocated adults also exhibited higher activity and larger activity range areas than resident adult *C. horridus* (Reinert and Rupert 1999). Based on these results, they concluded that the translocation of wild-raised mature rattlesnakes to bolster diminished local populations should not be recommended as a standard conservation practice. The maximum activity ranges of our captive-raised neonates was less than 4% of the activity area observed by Reinert and Rupert (1999) for translocated adult snakes, and about 33% of the area observed for resident adults. Although our released rattlesnakes were not mature, their activity range areas did not seem to be excessive.

We do not disagree with the conclusions of Reinert and Rupert (1999) relative to the translocation of mature *Crotalus horridus*, but suggest that translocation of captive-raised neonates may be a feasible conservation technique to bolster diminished populations, particularly if captive breeding is the source of the translocated snakes.

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Liophis atraventer Dixon and Thomas, 1985 (Serpentes: Colubridae): New Localities, Pholidosis Variation, and Notes on Natural History

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The genus *Liophis* comprises about 40 species distributed throughout South and Central America, including the Caribbean (Dixon 1989, 2000). Some species present taxonomic problems or are known by a few specimens, making it difficult to establish phylogenetic relationships among them (Dixon 1987; Dixon and Markezich 1992; Donnelly and Myers 1991).

Dixon and Thomas (1985) described *Liophis atraventer* based on three specimens from Boracéia (Estação Biológica, ca. 900 m elev.), state of São Paulo, Brazil (28°38'S, 45°50'W). Dixon (1987) suggested this species is related to *L. typhlus* (Linnaeus 1758), *L. guentheri* Peracca, 1897, *L. viridis* Gunther, 1862, *L. jaegeri* (Gunther 1858), and *L. maryellenae* Dixon, 1985, which he placed in a group that encompasses the green species of *Liophis*. *Liophis atraventer* was known only by the type series until Passos and Fernandes (2001) reported a fourth specimen (MNRJ 2766) from

FIG. 1. Geographic distribution of *Liophis atraventer*. ⊙ = type locality.

Teresópolis (ca. 870 m elev.), state of Rio de Janeiro, Brazil (22°24'S, 42°57'W). During the reorganization of the herpetological collection of the Instituto Butantan (IB), new specimens of this taxon were found, providing new data about geographic distribution, pholidosis, hemipenis, and some aspects of natural history. A specimen from the Museu de História Natural – Universidade Estadual de Campinas (ZUEC), and another from Museu Nacional – Universidade Federal do Rio de Janeiro (MNRJ), were also examined. The meristic and morphometric data of the examined specimens are reported in Table I. The method of ventral counting follows Dowling (1951) and the terminology for the hemipenis is based on Dowling and Savage (1960) and Myers and Campbell (1981). Criteria to determine the reproductive maturity follow Shine (1980). The measurements for snout–vent length (SVL), tail length (TL), and head length (HL) were taken with a ruler to the nearest millimeter. Individual eggs were measured (length and width) to the nearest 0.1 mm with a dial caliper. Regardless of the low number of specimens, especially males, a Mann-Whitney test was performed with the meristic characters to assign the presence or absence of sexual dimorphism.

The specimens presented herein represent five new localities for *L. atraventer* extending its geographical distribution (Fig. 1). All new records are from the state of São Paulo, southeastern Brazil. Five specimens (IB 28060, 46368, 61618–61620) are from the municipality of Tapiraí (23°57'S, 47°30'W), ca. 880 m elev. Two specimens (IB 54001, ZUEC 1308) are from the municipality of Cunha (23°04'S, 44°57'W), ca. 950 m elev. Another (IB 25295) is from the municipality of São Paulo (23°32'S, 46°38'W), ca. 760 m elev. The two remaining specimens (IB 40455, 65538) are from the municipality of São Roque (23°31'S, 47°08'W), ca. 770 m elev., and Parque Estadual Intervales, municipality of Ribeirão Grande (approximately 24°05'S, 48°21'W), ca. 700 m elev., respectively. These new localities, together with those reported by Dixon and Thomas (1985) and Passos and Fernandes (2001), are at or above 700 m elev.

The Mann-Whitney test did not reveal significant sexual dimorphism in the meristic characters examined (ventrals: $U = 8.5$; $p = 0.47$; $N = 11$; subcaudals: $U = 5.5$; $p = 0.46$; $N = 10$), but a larger series is needed to confirm this result. The following characters showed no variation in the specimens examined and are consistent with data presented by Dixon and Thomas (1985): dorsal scales rows: 19/19/17; supralabials 8, 4th and 5th contacting the orbit; preoculars 1; postoculars 2; temporals 2+1; loreals 1; genials 2 pairs. In the present paper, TL/total length ratios varied from 0.2 to 0.33 (mean = 0.25; s = 0.04; N = 8) for females and 0.2–0.3 (mean = 0.25; s = 0.07; N = 2) for males; reduction to 17 dorsal scales rows occurs through the fusion of scale rows 3+4 over ventrals 72–82 (mean = 77.27; s = 3.32; N = 11); ventral scales 142–149 (mean = 146.0; s = 2.56; N = 8) for females and 140–148 (mean = 144.33; s = 4.04; N = 3) for males; subcaudals 51–57 (mean= 52.75; s = 1.91; N = 8) for females and 52–56 (mean = 54.0; s = 2.83; N = 2) for males; infralabials 9–10, the first pair in

TABLE 1. Meristic and morphometrics (mm) characters of *Liophis atraventer*. Bars correspond to left/right side counting. SVL = snout–vent length; TL = tail length; HL = head length; VE = ventrals; SC = subcaudals; SL = supralabials; IL = infralabials; MT = maxillary teeth; OE = number of oviductal eggs.

Specimen	Sex	SVL	TL	HL	VE	SC	SL	IL	MT	OE
IB65538	F	648	150	27	149	53/54	8/8	9/9	19+2/19+2	5
IB40455	F	690	137	24	149	52/52	8/8	9/9	19+2/19+2	8
IB25295	F	633	145	27	144	52/51	8/8	10/10	19+2/18+2	13
IB54001	M	424	—	20	140	—	8/8	10/10	19+2/20+2	—
IB61618	M	525	115	22	148	51/52	8/8	10/10	18+2/20+2	—
IB46368*	F	445	112	22	148	52/52	8/8	10/10	18+2/18+2	—
IB61619	M	491	147	16	145	56/56	8/8	10/10	18+2/20+2	—
IB28060*	F	361	100	18	144	51/51	8/8	10/10	19+2/21+2	—
IB61620*	F	357	117	—	146	57/57	8/8	10/10	18+2/18+2	—
ZUEC1308*	F	313	79	18	142	52/52	8/8	10/10	19+1/19+2	—
MNRJ2766*	F	519	125	23	146	52/51	8/8	10/10	20+2/20+2	—

*represents immature specimens.

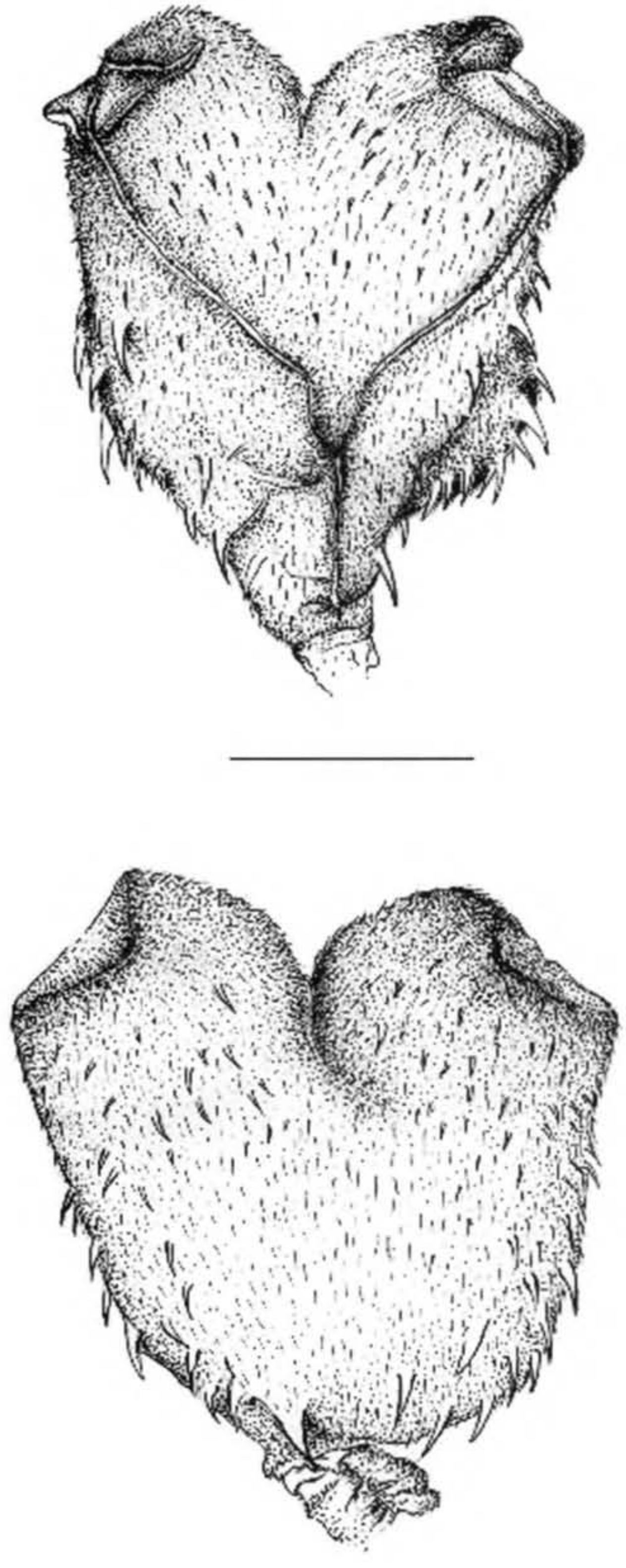

FIG. 2. Sulcate and asulcate side of the hemipenis of *Liophis atraventer* (IB 54001). Scale 5 mm.

contact behind the symphisial, first to fifth contacting the first pair of genials, fifth and sixth contacting the second pair of genials; two pairs of genials; maxillary teeth 20–23 (mean = 21.36; s = 0.93; N = 11) (23–24 according to Dixon and Thomas [1985]), with the last two enlarged and separated from the remainder by a diastema.

Color in preservative: dorsum of the head, body and tail olive brown in specimens fixed during shedding, otherwise they have a bluish green aspect ("sea blue," according to Wilson [1941]); supralabials' lower edges grayish white ("Naples yellow," following Wilson [1941]); infralabials generally grayish white, sometimes with blotches, principally the posterior ones, of the same color as the dorsum; genials and gulars grayish white; anterior ventrals (approximately until 10^{th}) are usually grayish white and the ventrals become darker toward the posterior portion, being completely black in some specimens or having only the lateral edges grayish white; bands may form two ill-defined ventrolaterals lines as pointed out by Dixon and Thomas (1985); subcaudals grayish white, the anterior ones may have black blotches as observed by Dixon and Thomas (1985).

In life, the color of the dorsum is bright green ("emerald green" according to Wilson [1941]) and the venter varies from gray to black (see color photo and comments in Marques et al. 2001:53).

The hemipenis extends through 6–10 subcaudals (inverted organ; N = 3). Everted organ (N = 1) slightly bilobed; lobes smaller than the hemipenial body which has an inflated area in the basal portion; sulcus spermaticus divides approximately one third of the distance between the bottom of the hemipenial body and the point of bifurcation of the lobes; branches have centrifugal orientation and terminate in the median portion of the smooth apical disks located in the distal portion of the lobes; lobes have no calyculation or capitation; spinules covering the entire surface, except the inner surfaces of the lobes which are nude; each basolateral portion of the hemipenial body has large spines (ca. 15) arranged in several rows reaching the basal portion of the lobes [five large spines according to Dixon (1985)]; the asulcate side is mostly covered by spinules; the basolateral portion of the hemipenial body has large spines and the median portion of each lobe contains some medium sized spines; the retractor muscle originates at the level of 24^{th} to 25^{th} subcaudals (N = 3) (Fig. 2).

The habits of *Liophis atraventer* are poorly known. W. R. Heyer collected a specimen in a moist environment and it regurgitated eggs of an *Eleutherodactylus* sp. (Dixon and Thomas 1985). Marques et al. (2001) state that this species is diurnal and flattens the body dorsally or promotes a cloacal discharge as a defensive behavior.

We made a midventral incision in the preserved specimens to determine the presence of prey items in the gut, and vitellogenic follicles or eggs in the oviducts. The only prey item found was a frog of the *Physalaemus cuvieri* species group (IB 61618), swallowed head-first. The species of this group of *Physalaemus* are common in open areas, being found in pools sometimes associated with forest edges (J. P. Pombal Jr., pers. comm.). None of the nine females contained vitellogenic follicles > 5 mm, but three of them had oviductal eggs. One specimen collected in October (IB 25295, 633 mm SVL, 145 mm TL) contained 12 oviductal eggs (mean length = 16.9 mm, s = 2.7, range = 12–22 mm; mean width = 10.6 mm, s = 0.91, range = 9.3–12.4 mm). A second specimen collected in November (IB 40455, 690 mm SVL, 137 mm TL) contained eight oviductal eggs (mean length = 23.5 mm, s = 3.82,

range = 17.0–28.7 mm; mean width = 11.6 mm, s = 0.73, range = 10.5–12.5 mm). The third specimen collected in January is poorly preserved (IB 65538, 648 mm SVL, 150 mm TL) and had five oviductal eggs (mean length = 15.8 mm, s = 5.11, range = 10.0–22.2 mm; mean width = 7.5 mm, s = 0.9, range = 7.7–9.0 mm), and four atresic eggs. These data show that in the rainy season (October–January) *L. atraventer* is reproductively active, but our data are insufficient to suggest a continuous reproductive cycle. Vitt (1983) obtained reproductive data for a few species of *Liophis*, including *L. viridis*, a relative of *L. atraventer* (Dixon 1987). He argues that *L. viridis* has an extended reproductive season and possible multiple clutches. Marques (1996) suggested that continuous reproduction is possibly conservative in the tribe Xenodontini, therefore additional data are needed to ascertain the reproductive cycle of *L. atraventer*.

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Precision and Accuracy of Body-Size Measurements in a Constricting, Large-Bodied Snake (*Elaphe obsoleta*)

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Size measurements are used in a wide variety of snake studies. Obtaining the snout-to-vent length (SVL) of snakes is necessary to study systematics (e.g., Burbrink 2001), sexual size dimorphism (e.g., Madsen 1983; Shine 1989), growth (e.g., Macartney et al. 1990; Forsman 1993), or demography (e.g., Plummer 1985). The body of a conscious snake, however, is elastic and can stretch and contract, yielding variable measurements of SVL. Also, a recent report that Galápagos marine iguanas (*Amblyrhynchus cristatus*) can dramatically decrease in body size when food availability is low (Wikelski and Thom 2000) raises the possibility that reptiles can shrink. Quantifying the precision and accuracy of SVL measurements is important (1) to improve measurement methods for snakes, (2) to partition the observed variance around parameters obtained from SVL measurements (e.g., growth estimates) into variance associated with measurement error and variance associated with individual differences, and (3) to determine whether reported instances of snakes shrinking (Blouin-Demers et al. 2002; Madsen and Shine 2001) can be attributed to measurement error or to previously unsuspected instances of shrinkage. I am unaware, however, of any study that has quantified the error associated with SVL measurements of snakes. My general goal in this paper was to quantify both the precision and accuracy of SVL measurements in black ratsnakes (*Elaphe obsoleta*), a large constricting colubrid.

My first objective was to quantify the precision of SVL measurements of conscious *Elaphe obsoleta* obtained by a method commonly used in field studies and consisting in running a flexible measuring tape along the venter of a snake held horizontally by an assistant (described by Fitch 1987). Measurement error on SVL arises from the behavior of the animal when being measured (struggling) and from limitations intrinsic to the measuring method. Thus, my second objective was to determine what proportion of measurement error was because of the struggling of the snake and what proportion was because of the measurement method itself. Because black ratsnakes are large constricting colubrids, I expected they would be difficult to measure and I predicted that the struggling of the snake should account for a greater proportion of measurement error than the limitations of the measuring method. My third objective was to quantify the accuracy of SVL measurements on conscious *Elaphe obsoleta* obtained by the method described

by Fitch (1987). Lastly, I wanted to determine whether precision and accuracy of SVL measurements varied with the size of the snake being measured. Large snakes, with their strong musculature, might struggle more vigorously and be more difficult to measure. Thus, I predicted that the SVL measures of larger snakes should be less precise and less accurate than those of smaller snakes.

Materials and Methods

In May 2000, 20 wild-caught *Elaphe obsoleta* from the Queen's University Biological Station (40 km N of Kingston, Ontario; 44°34'N, 76°19'W, 200 m elevation) were measured three ways and subsequently returned to the wild. Individuals were selected spanning the size range of *Elaphe obsoleta*, with the caveat that individuals had to be large enough (> 500 mm SVL) to be intubated for anesthesia (see below). First, to determine the precision of SVL measurements, each snake was measured 10 times using the method of Fitch (1987). The snake was held behind the head and behind the cloaca by an assistant. With the snake suspended horizontally, the assistant gently stretched it until the snake tired and extended to full length, at which point a 2-m flexible measuring tape was run along its venter (Fitch 1987). In all cases, the snake was measured twice and the mean of the two measurements was recorded. Using this method (hereafter "Conscious – Tape"), the 20 snakes were measured every day for 10 days, assuming that growth over those 10 days was negligible. Second, to quantify the error associated with the behavior of the snakes when being measured, the snakes were measured again, but first rendered flaccid by isoflurane anesthesia (Blouin-Demers et al. 2000). To avoid anesthetizing the snakes repeatedly, all 10 pairs of measurements were taken during a single dose of anesthesia, but the snakes were coiled on a table between each pair of measurements (hereafter "Anesthetized – Tape"). Third, to quantify the error associated with running the flexible measuring tape along the venter of the snakes, the anesthetized snakes were also measured 10 times by laying them on a table along a 2-m metal ruler. These last 10 pairs of measurements were also taken under anesthesia, but the snakes were loosely coiled on a table between pairs of measurements (hereafter "Anesthetized – Ruler"). Thus, the 30 measurements for each snake (10 measurements by 3 methods) each represent the mean of two measurements. Data collection was blind: the numbers on the measuring device were covered and the measuring device was simply marked, after which an assistant recorded the number.

The measure of precision was the coefficient of variation (CV; Zar 1999). Ideally, the SVL measurement obtained on a conscious snake would be identical to that obtained by measuring the snake when anesthetized (Fitch 1987). In the present study, however, the snakes were measured anesthetized using two different methods. Snakes stretched considerably when anesthetized and suspended in the air (see Results). Consequently, I considered that the "true" SVL of black ratsnakes was the mean of the 10 values obtained by the Anesthetized-Ruler method. Thus, the measure of accuracy for a particular method was the mean of the absolute values of the deviations of the SVL values from the "true" SVL, expressed as a percentage of the "true" SVL.

Repeated measure ANOVA (one within design) or paired t-test were used to analyze the precision and accuracy of each measurement method, and linear regression was used to determine whether precision or accuracy of measurements varied with SVL. The data were screened for violations of the assumptions of normality and homogeneity of variance using box plots and Shapiro-Wilk tests. All analyses were conducted on JMP Version 3.2 (Statistical Analysis Systems 1997) and SPSS Version 6.1 (Statistical Package for the Social Sciences 1995) on a Macintosh desktop computer. Means are reported ± 1 standard error.

Results

The three measurement methods differed in precision as measured by their CVs ($r^2 = 0.85$, repeated measures ANOVA $F_{(2,18)} = 103.42$, $P < 0.001$). Tukey post-hoc tests indicated that the three methods differed from one another. Measuring snakes by laying them along a ruler when they were anesthetized was the most precise method, followed by measuring them with a flexible tape when they were anesthetized, and then by measuring them with a flexible tape when they were conscious (Table 1). Nevertheless, measuring conscious snakes was surprisingly precise, with an average CV of 1.10 ± 0.10% and a maximum value of 2.16%. The calculation of CV involves the deviation of each measurement from the mean. The mean of the absolute values of those deviations gives a direct estimate of measurement error. The mean of the absolute values of the deviations from the mean SVL of the conscious snakes was 8.14 mm, or 0.82% of the mean SVL.

Assuming that measurement error is random and thus has a symmetrical distribution centered on the mean (my data do not suggest otherwise), the mean measurement error around a growth estimate based on two SVL measurements would be twice the measurement error of SVL (2 x 0.82% = 1.64%) half of the time. If errors are random, errors on two SVL measurements should be in opposite direction half of the time (and thus cumulative) and in the same direction the other half of the time (and thus noncumulative). During the active season, the average growth rate for a 1000-mm *Elaphe obsoleta* in Ontario is 0.4 mm/day (Blouin-Demers et al. 2002). Thus, when the errors are cumulative (i.e., 1.64% measurement error) it would take an average of 41 days of activity before growth of a 1000-mm individual becomes detectable using Fitch's (1987) measurement method.

The Anesthetized – Tape method was 44% more precise than

Table 1. Precision (CV), accuracy (absolute values of deviations of SVL), and mean SVL for 20 black ratsnakes measured by three methods. Tape refers to measuring snakes by running a measuring tape along their body while snakes are held horizontally. Ruler refers to measuring snakes by laying them on a table along a metal ruler.

	CV (%)			Deviations (%)			SVL (mm)	
Method	Mean	SE	Max	Mean	SE	Max	Mean	SE
Conscious – Tape	1.10	0.10	2.16	1.39	0.19	2.80	1046.7	62.1
Anesthetized – Tape	0.62	0.04	0.98	3.41	0.34	5.82	1075.1	66.6
Anesthetized – Ruler	0.16	0.02	0.40	—	—	—	1036.3	61.7

the Conscious – Tape method (Table 1), indicating that, on average, 44% of the imprecision when measuring conscious snakes was attributable to their activity (i.e., struggling). A further 42% increase in precision was achieved by the Anesthetized – Ruler method (Table 1). This result did not support my prediction that a greater proportion of measurement error would be attributed to the behavior of the snake when being measured, than to limitations of the measuring method.

The mean SVL of snakes obtained by the three methods differed from one another ($r^2 = 0.64$, repeated measures ANOVA $F_{(2,18)} = 32.65$, $P < 0.001$). Tukey post-hoc tests indicated that SVL values did not differ between Conscious – Tape and Anesthetized – Ruler methods, but the Anesthetized – Tape method yielded SVL values greater than the other two methods (Table 1). Based on the absolute values of the deviations from the "true" SVL, measuring snakes with the tape was less accurate when snakes were anesthetized than when they were conscious (paired $t_{(19)} = 5.77$, $P < 0.001$). These results were due to the anesthetized snakes stretching when they were measured with the tape.

Contrary to my prediction, precision of the Conscious – Tape method increased significantly with increasing SVL ($r^2 = 0.27$, $F_{(1,18)} = 6.57$, $P = 0.019$, Fig. 1). Precision was not significantly related to SVL ($F_{(1,18)} = 0.86$, $P = 0.366$) when snakes were anesthetized and measured with the tape (Fig. 1). Precision decreased significantly with increasing SVL ($r^2 = 0.22$, $F_{(1,18)} = 5.16$, $P = 0.036$) when snakes were anesthetized and measured with the ruler (Fig. 1). This last relationship, however, appears to be driven by one large snake with a high CV (Fig. 1). Excluding this data point from the analysis made the relationship non-significant ($F_{(1,17)} = 3.06$, $P = 0.099$). Contrary to my prediction that SVL measurements on larger snakes should be less accurate than those on smaller snakes, accuracy was not related to SVL for conscious snakes ($F_{(1,18)} = 1.04$, $P = 0.307$). Accuracy was, however, strongly related to SVL for anesthetized snakes ($r^2 = 0.79$, $F_{(1,18)} = 67.23$, $P < 0.001$). Larger snakes stretched proportionally more than smaller snakes when measured anesthetized and their SVL was thus overestimated to a greater extent (Fig. 2).

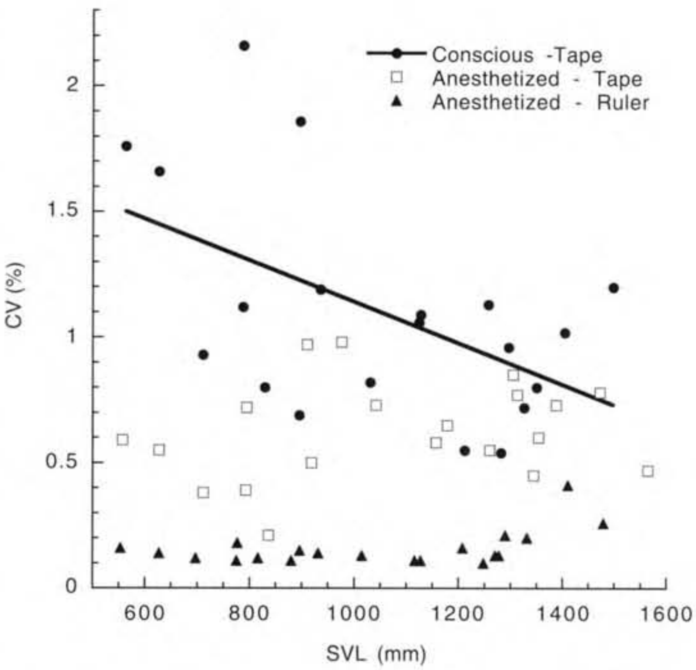

Fig. 1. Precision of SVL measurements (measured by the coefficient of variation expressed as a percentage) as a function of mean SVL for 20 black ratsnakes measured by three methods.

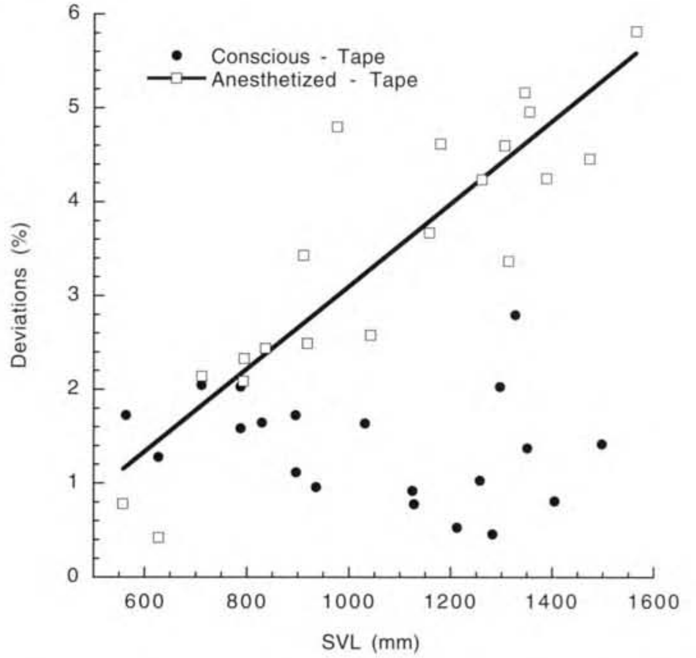

Fig. 2. Accuracy of SVL measurements (measured by the mean deviation of the SVL measurements from the "true" SVL expressed as a percentage) as a function of mean SVL for 20 black ratsnakes measured by two methods.

Discussion

I found that SVL measurements of conscious snakes were both precise and accurate (mean error ≈ 1%) and that the proportions of measurement error attributable to the behavior of the animal and to the measuring method itself were approximately equal. Precision of measurements increased with increasing SVL for conscious snakes. Accuracy of measurements on anesthetized snakes with tape, however, decreased with increasing SVL.

Contrary to my prediction, SVL measurements on a large-bodied constrictor such as *Elaphe obsoleta* were surprisingly precise. After an initial struggle when first grasped, ratsnakes in this study usually calmed down within 1–2 min. This resulted in (1) my ability to make precise measurements, and (2) the behavior of the snakes when measured accounting for approximately the same proportion of measurement error as limitations of the measurement method itself.

One unexpected result was that the precision of measurements increased with increasing SVL for conscious snakes measured with tape. Precision did not vary with SVL for anesthetized snakes measured with tape, suggesting that the behavior of the snakes when being measured causes the difference in precision between large and small snakes. Thus, it appears that larger snakes, which tend to be more placid, are easier to measure than are smaller snakes because larger snakes provide more precise measures. Accuracy did not vary with SVL for conscious snakes. However, measuring anesthetized snakes with tape tended to slightly overestimate their

SVL, and this problem was more severe for larger snakes.

Because SVL measurements in conscious snakes are both precise and accurate, it should be possible to detect instances of shrinkage (Madsen and Shine 2001; Wikelski and Thom 2000) if they do occur in snakes. Based on the small magnitude and low frequency of negative growth estimates in this population (Blouin-Demers et al. 2002), it seems unlikely that shrinkage occurs. Individual cases of apparent shrinkage were thus likely due to measurement error.

In summary, my data suggest that the best way to measure the SVL of snakes is by anesthetizing them and laying them next to a ruler. If this method is not practical, measuring them conscious with a flexible tape (Fitch 1987) is a reasonable alternative.

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Multiple Recaptures of a Hybrid Hawksbill-Loggerhead Turtle in the Ten Thousand Islands, Southwest Florida

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The Miami Laboratory of the National Marine Fisheries Service (NMFS) conducted a study to determine the distribution and abundance of immature sea turtles in the nearshore waters of southwest Florida. Standard mark-recapture techniques were used as described in Eckert et al. (1999), and tissue samples were taken from green, loggerhead, and hawksbill turtles for genetic analysis.

The NMFS turtle survey documented the presence of immature Kemp's ridley (*Lepidochelys kempi*), loggerhead (*Caretta caretta*), and green (*Chelonia mydas*) sea turtles in the coastal waters of southwest Florida, in order of decreasing abundance. One turtle, originally identified as an immature hawksbill (*Eretmochelys imbricata*), was captured on 15 October 1998. Hawksbill turtles are considered a tropical species more commonly found in coral reef habitats (Meylan 1992; Witzell 1983), and it seemed unusual that this turtle was caught in the turbid waters of the Ten Thousand Islands in southwest Florida. The turtle's shape, scale pattern, and color were not readily distinguishable from a "normal" hawksbill. However, nuclear DNA analysis demonstrated that this animal was, in fact, a hawksbill-loggerhead hybrid, a rare phenomenon previously documented (Bowen and Karl 1997; Karl et al. 1995). Researchers from the University of South Florida in Tampa, Florida analyzed tissue samples from the turtle. Maternally inherited mtDNA was used to resolve maternal parent. The control region sequence from the mitochondrial DNA matched *Caretta caretta* haplotype A, indicating that the maternal parent was a loggerhead. Restriction digests of three nuclear DNA loci (CM-12A, CM-28, CM-14A) were performed using restriction enzymes *Rsa I*, *Bst NI*, and *Dra I*, respectively. Together, these three digests indicate the turtle is a post-first generation (F1) hy-

TABLE 1. Capture dates and recorded sizes of an immature hybrid hawksbill turtle recaptured in the Ten Thousand Islands, southwest Florida.

Date (m/d/y)	MSCL[1]	Weight (kg)	Days Free
10/15/98	52.2	20.8	0
07/05/99	54.5	—	263
08/02/99	—	—	296
11/16/99	59.5	25.8	418
09/04/00	64.6	—	711

[1]Medial straight carapace length (notch-to-notch).

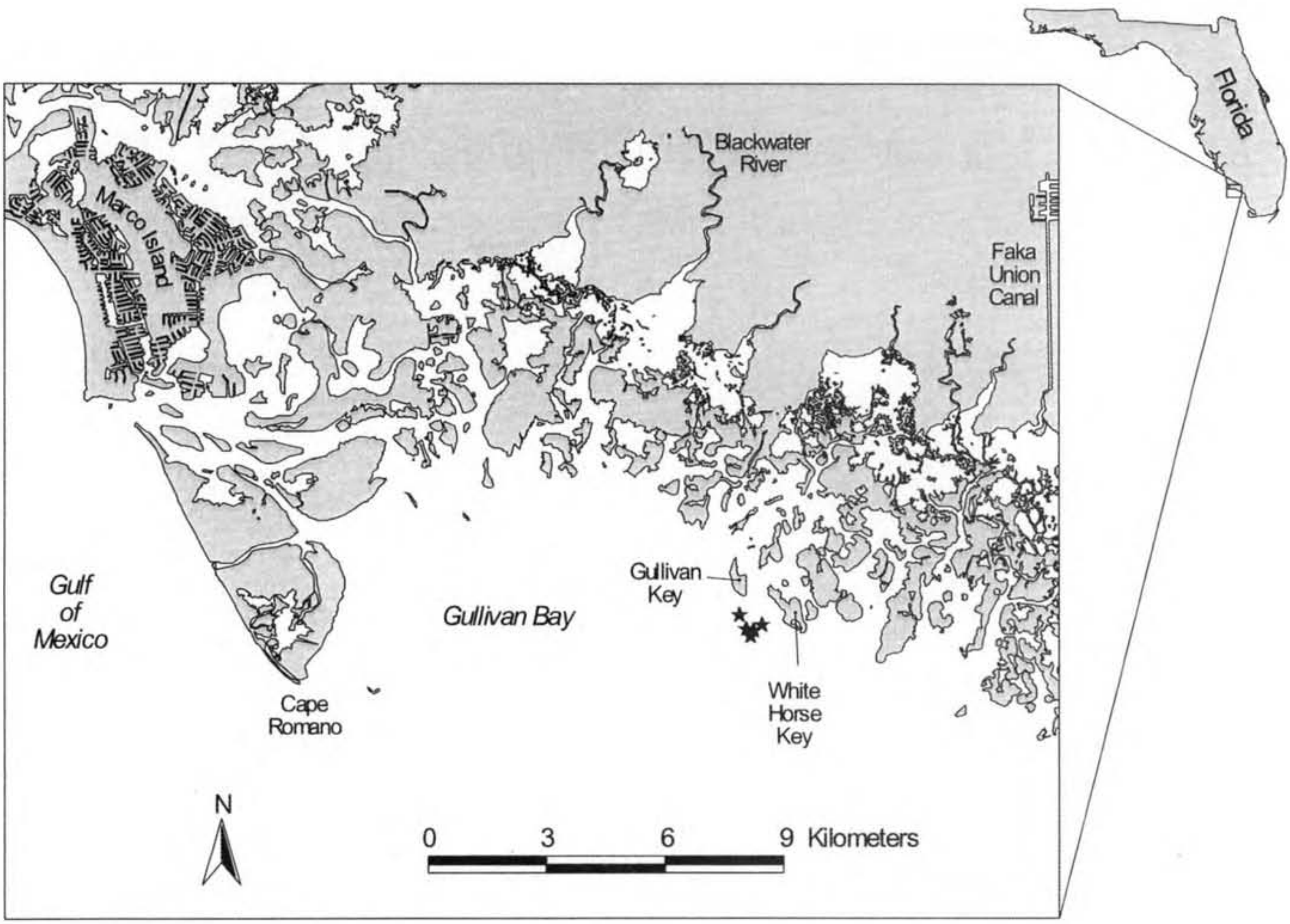


FIG. 1. Ten Thousand Island study area with multiple recapture sites of an immature hybrid hawksbill-loggerhead turtle.

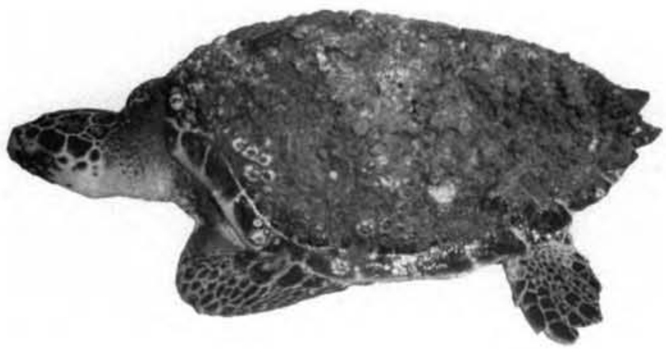
brid between *Caretta caretta* and *Eretmochelys imbricata*. Bowen et al. (1993) provided a molecular phylogeny of sea turtles and concluded that the hawksbill-loggerhead split was nearly 20 million years ago, and the hawksbill-loggerhead hybrid is unique because there are few hybrids between vertebrate species separated by more than five million years.

Intensive surveys in Gullivan Bay have documented only this one putative hawksbill turtle, the majority of turtle sightings being immature Kemp's ridleys. The turtle was recaptured four times over 711 days (Table 1), and all recaptures were within 600 m of the initial capture location. This suggests that the turtle had established a home range within a non-typical hawksbill habitat between Gullivan and White Horse Keys (Fig. 1). The home range of the five recaptures encompasses 14.11 ha, consistent with the home ranges of immature hawksbills on tropical coral reefs (Van Dam and Diez 1998). The small home range suggests that this turtle had located an isolated hard-bottom community with sufficient food to keep it in the vicinity for close to two years. These hard-bottom community organisms typically consist of various sponges, bryozoans, and tunicates.

The warm estuarine environment of coastal southwest Florida promotes the growth of encrusting organisms. This turtle was noted as having "numerous barnacles on carapace, plastron, head and axial regions of flippers" (Fig. 2), indicating that it had resided within these waters for some time prior to first capture. An oyster and additional barnacles were noted on the subsequent captures. On the last capture, an astonishing mass of barnacles, tunicates, and bryozoans was noted on the carapace, in addition to a myriad of attendant crustaceans (Fig. 2). Epibiota communities like these are more commonly found on loggerheads (Dodd 1988) than hawksbills (Witzell 1983). In spite of this growth, the turtle appeared to be robust and healthy. The turtle grew from 52.2 cm to 64.6 cm during 711 days (6.5 cm/year) and gained 5 kg (2.6 kg/year). A substantial head wound above the left eye was noted at the 16 November 1999 capture. The cause of the wound is unknown, but it was healed by the 4 September 2000 capture, illustrating the powerful recuperative capabilities of this individual.

Reports of hawksbill turtles from non-coral reef habitats are uncommon. Hawksbills have been documented from a mangrove habitat in El Salvador (Hasbun et al. 1998) and the turbid northern Gulf of Mexico waters (Rester and Condrey 1996). Interestingly, Carr (1952) reported hawksbills from mangrove-bordered bays, including three turtles that had eaten large quantities of red mangrove fruit, leaves, and bark. Perhaps these turtles were also hawksbill-loggerhead hybrids, as the photo of the specimen from the northern Gulf of Mexico suggests (Rester and Condrey 1996). The apparent residency of a hybrid hawksbill-loggerhead turtle in the Ten Thousand Islands is considered very unusual, primarily because this turtle had the gross appearance of a hawksbill, but it also collected epibionts on the carapace similar to loggerheads

A



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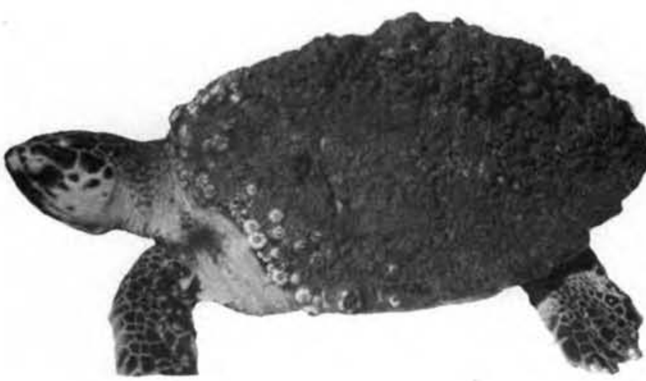

FIG. 2. Immature hybrid hawksbill-loggerhead turtle at first capture (A) and after 711 days (B), illustrating extensive epibiont growth.

and inhabited a habitat more typical of a loggerhead than hawksbill.

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Observations of Mating Behavior and Reproduction in the Scincid *Carlia jarnoldae*

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We observed the mating behavior of *Carlia jarnoldae* during austral summer (January–March 1999) in Townsville, Queensland, Australia (19°19'S, 146°45'E). *Carlia jarnoldae* are relatively small (mean snout–vent length 40 mm), terrestrial, diurnal lizards (Cogger 2000). Adults are sexually dimorphic: males are heavier (2.4 g vs. 1.9 g), but not longer (adult males average 44 mm SVL, 68 mm tail length; females average 43 mm SVL, 64 mm tail length), and males are more colorful than are females (Cogger 2000). Breeding males have an orange-brown dorsum with 4–6 narrow black stripes, a black dorsolateral field scattered with small blue spots, and a reddish-orange lateral stripe. The labial scales and throat of males are pale greenish-blue. Females are brown above with scattered black and white flecks tending to form longitudinal lines, and a bright white lateral stripe bordered above and below by black stripes.

We observed 16 social interactions in which a single adult female was placed into a 1000 L (200 x 100 x 50 cm) oval, semi-natural outdoor enclosure with an adult male. We also made observations of ten individuals in nature. Observations were conducted from behind a freestanding hessian blind. Four copulations were observed in the experimental enclosures (one of these took place under a shelter and could not be observed) and two in the wild.

Courtship.—Males tongue-flicked females during courtship. This behavior occurs in other lizards and suggests an important role of chemical cues in sexual identification and stimulation (Carpenter and Ferguson 1977; Mason 1992; Perrill 1980). Courtship was observed in seven of the social interactions conducted in the enclosures, but resulted only once in copulation.

A courting male would often pursue or approach a female (also while moving with a slow, jerky motion, and tongue flicking), and if the female showed no interest, the male would run to the top of one of the shelters, usually in the sun, and display their lateral coloration by laterally presenting and dorsoventrally compressing their bodies, tilting to the side towards the female. Male throat coloration was displayed by tilting their heads to expose their gular coloration in the direction of the female, before again approaching the female. Copulations not preceded by courtship behavior were initiated shortly after the female was encountered. In cases in which the females did not appear receptive, they would flee from males and hide under shelters or leaves. The male would then search for the female (either simply approaching the female, approaching the female in a slow, jerky motion, or approaching the female while tongue flicking).

Copulation.—Once he located the female, the male initiated copulation. The female often struggled at the onset of these copulations, but became motionless after ~1 min. In the single case that copulation followed courtship, the female allowed the male to approach, initiate a flank bite, and copulate without struggling. When courtship displays did not result in copulation, it was usually because of rejection by the female (i.e., she would flee to a shelter and hide). The copulatory position was similar in all cases, and resembled that described for other skinks (*Carlia* [*Leiolopisma*] *rhomboidalis*, Wilhoft 1963a; *Carlia rostralis*, Whittier 1994; *Eulamprus* [*Sphenomorphus*] *kosciuskoi*, Done and Heatwole 1977; *Eumeces fasciatus*, Fitch 1954; *Eumeces obsoletus*, Evans 1953). To assume a position for copulation, males initiated a flank bite and placed the hind leg nearest the female over the base of her tail, while bringing the base of his tail up and under hers so that their cloacae were opposed (as illustrated in Whittier 1994). The male would thrust his tail and pelvic region as a single hemipenis was inserted into the female and copulation commenced. Pelvic thrusting continued for most of the time the cloacae were in opposition, but ceased before the flank was released. Copulations lasted an average of 3.92 min ($\pm$ 0.18 SE), which is considerably shorter than the 90 min reported for the skink *Eumeces egregius* (Mount 1963), but similar to the 3–5 min reported for the more closely related skink, *Carlia rostralis* (Whittier 1994). The number of thrusts was recorded for only two mating events ($N = 22$ for the one observed in the enclosures and $N = 36$ for the one in the field), and occurred at a rate of 5–6/s. This rate is faster than that observed in *C. rostralis*, which spasmed at a rate of 1 thrust/s, but this increased to 1–4/s in the final 30 s of intromission (Whittier 1994). Mating ceased when the male released his grasp on the female. The male then dragged his cloaca along the substratum with his hemipenis everted. This behavior may function to clean the hemipenis of seminal fluid, or possibly to leave chemical messages for other individuals (Beck 1990). Hemipenes remained everted for up to 2 min after copulation.

Female Receptivity.—Our data suggest that female *C. jarnoldae* are receptive to males after laying eggs, but not while they are gravid. During midsummer three of the four females that were observed copulating in the enclosure had deposited their eggs 1–7 days before mating. These females were exposed to different males prior to laying, but refused courtship advances from these males and did not allow copulation to occur. In all cases of rejection, females were observed to perform a characteristic behavior: females positioned themselves in front of the male, facing away, but with their tails directed towards him. In this position, females waved their tails in a horizontal plane, held posterior to the body, so that their tails waved near his face. If the male moved, the female would often move in front of him and again wave her tail in his face. Usually this caused the male to cease courtship, and resume foraging or basking behaviors. Although this behavior may simply signal that the female is not receptive, it may also provide pheromonal cues (Mason 1992; Shine et al. 2000) because the males often tongue flick the female's cloaca following this display. Regardless of their purpose, these behaviors warrant further study.

Clutch Size.—Females produced one ($N = 4$) or two ($N = 5$) small, white eggs under the shelters provided in the enclosures. *Carlia* spp. typically produce two eggs (Cogger 2000; Zug et al. 1982), although it is possible that in cases where only one egg was found, the second was deposited at a later stage (Zug et al. 1982). Only one egg was hatched in the laboratory, 10 d after being found in the enclosure (we checked under the shelters for eggs approximately every 3 d). The hatchling was 19 mm SVL, with a 29 mm tail, and weighed 0.2 g. In the Townsville region, *Carlia jarnoldae* reproduce annually, with oviposition occurring in the late spring or summer (November to June), coinciding with the wet season (James and Shine 1985; Wilhoft 1963b; Zug et al. 1982; TL and LS, unpubl. observations).

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Defensive Strategies of Texas Horned Lizards (*Phrynosoma cornutum*) Against Red Imported Fire Ants

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The Texas horned lizard (*Phrynosoma cornutum*), a state-listed threatened species, historically occurred throughout most of Texas, but its distribution and abundance has declined dramatically (Henke 2003). Possible reasons for the decline include widespread use of broadcast insecticides, excessive commercial collection, loss of habitat from urbanization and/or agriculture, and the invasion of the red imported fire ant (*Solenopsis invicta*; Donaldson et al. 1994). Potentially, fire ants can negatively impact Texas horned lizards indirectly through competition with harvester ants (*Pogonomrymex* sp.), the main prey item of Texas horned lizards, or directly by their venomous sting (Allen 1993). Similar decline of coastal horned lizards (*Phrynosoma coronatum*) in southern California has been attributed to the invasion of Argentine ants (*Linepithema humile*; Suarez and Case 2002).

Nonaggressive defensive strategies of Texas horned lizards include reliance on cryptic coloration, burrowing into the soil to avoid detection, retreating from predators using a sprint-and-freeze tactic, inflating their body with air, and various defensive stances (Peslak 1985; Pianka and Parker 1975; Reeve 1952; Sherbrooke 1981). Aggressive strategies include hissing and lunging at the predator, biting, jabbing with the occipital horns, or ejecting blood from the conjunctival sac located near the eye (Lambert and Ferguson 1985; Middendorf and Sherbrooke 1992; Sherbrooke and Middendorf 2001). Because Texas horned lizards have not evolved with red imported fire ants, novel defensive strategies may be used to cope to this exotic invertebrate.

We describe two defensive strategies exhibited by Texas horned lizards against red imported fire ants. The two strategies appear to be dependent on the number of ants involved in the attack. Our observations of encounters with Texas horned lizards and fire ants occurred in central and southern Texas (Atascosa, Brooks, Coryell, Frio, Kleberg, and LaSalle counties) from 16 June 2000–20 September 2001. Horned lizards were encountered while observers were conducting reptile and ant surveys. Observers did not disturb horned lizards or ant mounds and maintained ~1.5 m distance from lizards, until lizards buried themselves. At this point, observers would closely inspect the location where lizards were buried. The first strategy, referred to as the consumption strategy (N = 5), occurred when ≤ 12 fire ants were present (Table 1). When adopting this strategy, horned lizards remained very still with their eyes shut, occasionally twitching or jerking their heads as the ants ran across their eyelids. When the ants ran onto or around a lizard's mouth, the lizard would consume them. This continued until the majority of the ants were consumed or retreated from the lizard. The second defensive strategy, referred to as the flee-and-bury strategy (N = 6), occurred when > 20 fire ants were involved in the attack (Table 1). Twenty to > 50 fire ants swarmed onto the body of a horned lizard when the lizard disturbed a fire ant mound. Horned lizards that encountered > 20 fire ants sprinted 2.5–7 m from attack sites and quickly buried themselves, tail first, into the soil. Soils ranged from sandy, sandy-loam, gravelly loam, to clay loam soil, dependent upon location. Horned lizards wagged their tails and shifted their bodies from side to side until they were completely buried below the surface. Fire ants would then appear, within 15 s, on the surface above where the lizard was buried. Horned lizards re-emerged between 5–15 min afterwards.

Both strategies thwarted the attacks of fire ants on Texas horned lizards. We consider the consumption strategy to be a defensive strategy rather than a primary means of obtaining food. Texas horned lizards are considered dietary specialists (Whitford and Bryant 1979), with 69% of their diet consisting of harvester ants (Pianka and Parker 1975). Texas horned lizards appear resistant to the venom of harvester ants (Schmidt et al. 1989). Although Texas horned lizards consume other species of insects (e.g., crickets, grasshoppers, beetles, centipedes, bees, and caterpillars; Milstead and Tinkle 1969; Munger 1984), they do not actively prey on fire ants (S. E. Henke, unpubl. data). Argentine ants were never de-

TABLE 1. Defensive strategies of Texas horned lizards when attacked by red imported fire ants in Texas. Attacking ants were either consumed or returned to the soil surface after the horned lizard buried itself (see outcome column).

Sex	Snout–vent length (mm)	Number of ants in attack	Strategy	Outcome
Female	65	7	Consumption	5 consumed
Male	72	9–10	Consumption	5 consumed
Male	63	6	Consumption	4 consumed
Male	68	6–8	Consumption	4 consumed
Female	75	12	Consumption	9 consumed
Male	62	25–30	Flee and bury	20+ to surface
Female	78	20–25	Flee and bury	15 to surface
Female	69	25–30	Flee and bury	25 to surface
Male	47	20–25	Flee and bury	18 to surface
Female	65	25–30	Flee and bury	20+ to surface
Male	62	50+	Flee and bury	35+ to surface

tected in coastal horned lizard scat (Suarez et al. 2000), indicating that the lack of selection for invasive ant species as prey is not exclusive to Texas horned lizards. The flee-and-bury strategy appears to have a dual purpose. First, it places distance between the lizard and the fire ant mound. Second, the soil may be abrasive causing fire ants to release their grasp as the lizard buries as suggested by the appearance of fire ants on the surface within 15 s of a lizard burying itself.

We acknowledge that our observations of defensive strategies may not be exclusive to red imported fire ants. Native fire ants (*Solenopsis geminata*) also occur in southern Texas. However, because colonies of red imported fire ants are common, achieve high densities, and are more aggressive than are native fire ants (Porter and Savignano 1990; Porter et al. 1991), red imported fire ants may be more likely to elicit a defensive response from Texas horned lizards.

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Some Reproductive Characteristics of a Tropical Arid Lizard Assemblage from Zapotitlán Salinas, Puebla, México

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Descriptive studies have been conducted on squamate reproduction in many different environments (Benabib 1994; Guillette 1981, 1982; Lemos-Espinal et al. 1999; Ramírez-Bautista and Vitt 1997, 1998). These studies have provided data to enable formulating and testing hypotheses on life history evolution. Seminal in this development were the studies of Tinkle (1969) and his colleagues (Tinkle et al. 1970), who showed that lizard species that invest more energy in each reproductive event tend to be early-maturing, short-lived, and highly fecund. In contrast, species that invest less energy in each reproductive event distribute it over more time, and thus, tend to be late-maturing, long-lived, and have fewer clutches. More recently, studies have shown that a portion of life history variation among species is historical (Dunham and Miles 1985; Dunham et al. 1988). That is, related species tend to be more similar in life history characteristics than unrelated ones. For example, SVL at sexual maturity, clutch and egg size, and clutch frequency in *Sceloporus* are more similar within species groups (*scalaris* and *spinosus*) than between them (Valdéz-González and Ramírez-Bautista 2002). Such reproductive characteristics have only been sparsely addressed among lizards from tropical arid habitats. Thus, conclusions regarding patterns of life history characteristics among lizards from such habitats will remain vulnerable to change until considerably more data become available.

To help remedy this deficiency, I present data on selected reproductive characteristics (SVL at sexual maturity, clutch size, and clutch frequency) for a tropical arid lizard assemblage from Zapotitlán Salinas, Puebla, México. Zapotitlán Salinas (18°07'18"N; 97°39'06"W) is located at an elevation of 1420 m; the climate is dry and temperate with most precipitation occurring during the summer months (June–September). Mean annual temperature is 21°C (range 17–24°C) and mean annual precipitation is 450 mm (García 1981). Dominant vegetation consists of thorn

TABLE 1. Size and reproductive data for a lizard assemblage from Zapotitlán Salinas, Puebla, México.

Species	N	Snout–vent length (mm)				Collection	SVL at	Clutch Size				
		Mean	SE	Range		Months	Maturity	N	Mean	SE	Range	
				Min	Max						Min	Max
Anolis quercorum	4	40.0	1.2	38.0	43.0	Jul–Sep	38.0	4	1.0	—	1	1
Cnemidophorus parvisocius	10	57.8	1.4	54.0	62.0	Aug	54.0	3	1.7	0.2	1	2
Cnemidophous sacki	2	108.6	16.1	92.5	124.7	Sep	92.5	2	5.5	1.0	5	6
Sceloporus gadoviae	21	54.8	1.0	49.0	67.0	Apr–Dec	49.0	12	4.0	0.7	2	6
Sceloporus horridus	4	76.0	0.9	62.0	92.0	Aug	62.0	4	9.3	0.8	6	14
Sceloporus jalapae	10	45.8	0.9	43.0	50.0	Aug–Sep	43.0	10	5.4	0.5	4	7
Urosaurus bicarinatus	4	47.8	0.4	42.0	54.0	Jul–Sep	42.0	4	7.6	0.4	3	8

forest, xerophytic brushland, deciduous tropical forest, and columnar cacti (Dávila et al. 1993; Rzedowski 1978).

The local lizard assemblage consists of 11 species (*Anolis quercorum*, *Cnemidophorus parvisocius*, *C. sacki*, *Ctenosaura pectinata*, *Phrynosoma taurus*, *Phyllodactylus bordai*, *Sceloporus gadoviae*, *S. horridus*, *S. jalapae*, *Urosaurus bicarinatus*, and *Xenosaurus rectocollaris*: Mata-Silva 2000). Except for two viviparous species (*P. taurus*: Zamudio and Parra-Olea 2000; *Xenosaurus rectocollaris*: Lemos-Espinal et al. 1996), most species in this assemblage (82%) are oviparous. I present data on 55 females belonging to 7 of the oviparous members of this assemblage (Table 1). All individuals were collected during April–December, with most taken in July–September, the mid-wet season. Lizards were humanely killed, measured snout–vent length (SVL) to the nearest 1.0 mm, fixed with 10% formalin, and subjected to gonadal examination.

During gonadal examination, I counted the number of vitellogenic follicles and/or oviductal eggs: I recorded the length and width of left and right vitellogenic follicles or freshly ovulated eggs to the nearest 0.1 mm; and weighed the eggs to the nearest 0.01 g.

Length and width of the gonads were used to obtain follicular and egg volume (V) using the formula for volume of an ellipsoid (Selby 1965):

$$V = 4/3\ \pi a^2 b$$

where a is half the shortest diameter and b is half the longest diameter. The smallest female (as SVL) with either the largest vitellogenic follicles or oviductal eggs was used to estimate minimum size at maturity. Means are presented ± 1 SE. Statistical analyses were performed with the Macintosh version of Statview 4.5 (Abacus Concepts 1992).

Sample sizes varied from 2 to 21 individuals among the 7 species (Table 1). Only three species (*C. parvisocius*, *S. gadoviae*,

TABLE 2. Clutch characteristics for lizards from Zapotitlán Salinas, Puebla, México. Minimum and maximum SVL and corresponding clutch data are given for each species, except for *A. quercorum*, which clutch size is fixed. Clutch size represents the oviductal eggs, and relative clutch mass (RCM) is based in all females with oviductal eggs for each species.

Species	SVL	Clutch			
		Size	Volume (mm^3)	Mass (g)	RCM
Cnemidophorus parvisocius	54.0	1	529	0.43	0.190
	62.0	2	359	0.78	
Cnemidophorus sacki	92.5	5	189	1.80	0.147
	124.7	6	228	1.74	
Sceloporus gadoviae	49.0	4	170	0.82	0.219
	67.0	4	502	1.75	
Sceloporus horridus	62.0	6	361	3.10	0.335
	92.0	14	615	9.60	
Sceloporus jalapae	43.0	4	120	0.52	0.329
	50.0	7	199	1.05	
Urosaurus bicarinatus	42.0	3	119	0.57	0.238
	54.0	8	265	1.35	
Anolis quercorum	43.0	1	255	0.20	0.097
	38.0	1	253	0.18	
	41.0	1	170	0.15	
	38.0	1	194	0.17	

and *S. jalapae*) had sample sizes ≥ 10; the remaining 4 species had ≤ 4 individuals each. Three species (*A. quercorum*, *S. jalapae*, and *U. bicarinatus*) could be characterized as small (≤ 50 mm SVL), two (*S. gadoviae* and *C. parvisocius*) as medium-sized (> 50 mm and ≤ 60 mm SVL); and two (*C. sacki* and *S. horridus*) as large (> 60 mm SVL).

Size at Sexual Maturity.—The three small species became sexually mature at 38.0 to 43.0 mm SVL; the two medium-sized species were mature at 49.0 mm and 54.0 mm, respectively; and the two large species matured at 62.0 mm and 92.5 mm, respectively (Table 1). Across the 7 species, the estimate of the size at sexual maturity was significantly positively correlated with both estimates of mean and maximum body size (Spearman Rank correlation: size at sexual maturity: $r = 0.929$, $p = 0.0229$; maximum size: $r = 0.964$, $p = 0.0182$).

Clutch Size.—Clutch size among the 7 species varied from 1 to 14 (Table 1). The sceloporine lizards (*Sceloporus* and *Urosaurus*) had higher mean clutch sizes than all non-sceloporine species except for *C. sacki*. Clutch size for *S. gadoviae* reported here is larger than that found for the same species at Río Balsas (mean = 3.6 eggs [1–5]; Lemos-Espinal et al. 1999) and Zapotitlán Salinas (mean = 3.9 eggs [2–5]; Correa-Sánchez et al. 1999). Clutch size for *U. bicarinatus* reported here is similar than that for *U. bicarinatus* at Morelos (mean = 7.7 eggs [3–8]; Ramírez-Bautista et al. 1995), but larger than that found in Chamela (mean = 5.4 eggs [4–8]; Ramírez-Bautista and Vitt 1998) and Michoacán (mean = 5.8 eggs [3–7]; Ramírez-Bautista et al. 1995). The differences of the clutch size among populations of *S. gadoviae* and *U. bicarinatus* reflect either phenotypic response to differing environments or local adaptation (Ramírez-Bautista and Vitt 1998). This analysis assumes that clutch sizes obtained from dissection reflects clutch sizes at oviposition; resorption of eggs may result in differences. Considering the small sample sizes, additional studies will be necessary to determine causes of differences. Some evidence suggests that multiple clutches are deposited within each season. *Anolis quercorum* females (N = 4) had one egg in one oviduct (right or left) and one vitellogenic follicle in the ovary simultaneously, and also had 8 and 16 nonvitellogenic follicles. Similarly, *C. parvisocius* only had one egg in each oviduct and one vitellogenic follicle in each ovary simultaneously, but one female had only one egg in the left oviduct and one vitellogenic follicle in the right ovary. Multiple clutching with extended oviposition for *A. quercorum* and *C. parvisocius* is similar to that reported among other anoline and teiid lizards (Ramírez-Bautista and Vitt 1997; Ramírez-Bautista et al. 2002; Vitt and Breitenbach 1993). Data are too sparse to confidently establish the seasonal pattern of reproduction (reproductive interval and clutch frequency) among sceloporine lizards studied here. However, data agree with the wet season reproduction interval previously reported for *S. gadoviae* (Lemos-Espinal et al. 1999), *S. horridus* (Valdéz-González and Ramírez-Bautista 2002), and *U. bicarinatus* (Ramírez-Bautista et al. 1995; Ramírez-Bautista and Vitt 1998), and wet season reproduction may be a general pattern for most lizard species in this assemblage.

Clutch volume.—Considerable variation in clutch volume and egg mass was found (Table 2). Females of *S. jalapae* had the smallest clutch volume; *A. quercorum*, *U. bicarinatus*, and *C. sacki* had an intermediate clutch volume, and *S. gadoviae*, *C. parvisocius*, and *S. horridus* had the largest clutch volume (Table 2). Clutch mass also varied among species, smallest clutch mass was found in *A. quercorum* and the largest in *S. gadoviae* and *S. horridus* (Table 2). Relative clutch mass (RCM; Vitt and Congdon 1978) among six species varied from 0.097 (anole lizard) to 0.335 (sceloporine lizard; Table 2). As in other studies, RCM reflects the influence of foraging mode on the evolution of morphology within whiptail and *Anolis* lizards (lower RCM) and sceloporine lizards (higher RCM).

Additional data are needed to make conclusions about the apparent variation in clutch size and other reproductive characteristics in this lizard assemblage. Basic data on clutch frequency and reproductive seasonality-should provide more insight into the ecological and phylogenetic basis of this variation.

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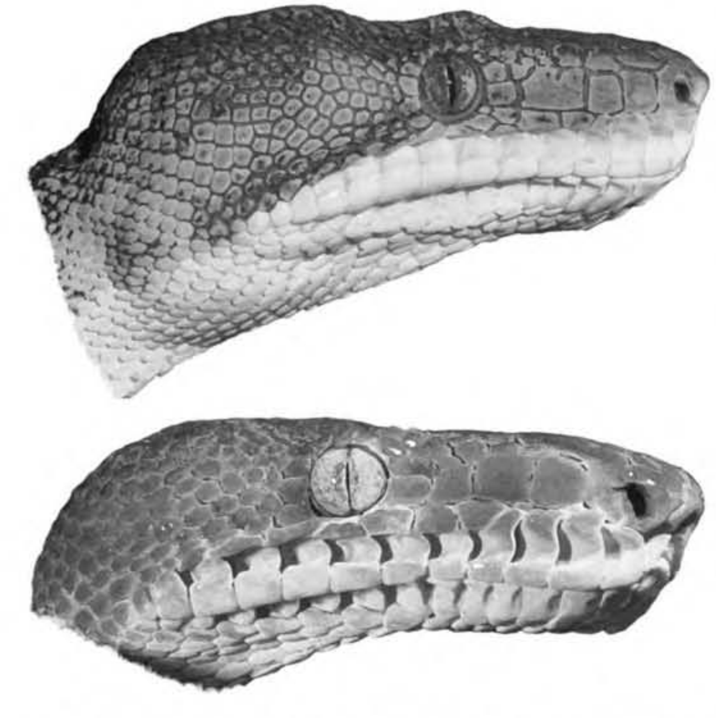

Corallus caninus (Emerald Tree Boa), from Guyana (upper) and Amazon Basin (lower), illustrating variation in head morphology. Photolithographs by Will Brown.

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Chytridiomycosis as a Possible Cause of Population Declines in *Atelopus cruciger* (Anura: Bufonidae)

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Atelopus cruciger is a toad endemic to the lowland rainforest and cloud forest of the Cordillera de la Costa (Lötters 1996), and is the only species of the genus from Venezuela found outside the Andes. As for other *Atelopus* species, *A. cruciger* is diurnal, terrestrial, and breeds along swiftly flowing streams (Lötters 1996; Sexton 1958). Its historical abundance in many localities is evident in museum collections and in the literature (Cocroft et al. 1990; Mebs 1980; Mondolfi 1976; Sexton 1958). With no obvious explanation, the abundance of this species drastically decreased in the mid 1970's and early 1980's (La Marca and Lötters 1997; C. Señaris and J. Manzanilla, pers. comm.), and the last two specimens were collected in 1986 (Fig. 1).

As in many other amphibian species, losses do not seem to be caused by habitat degradation (Laurance et al. 1996; Lips 1999; Pounds and Crump 1994). Recent research has implicated *Batrachochytrium dendrobatidis,* a chytrid fungus, in declines of amphibian populations in Australia, USA, Costa Rica, Panama, Ecuador, Spain, and New Zealand (Berger et al. 1998; Bosch et al. 2001; Bradley et al. 2002; Ron and Merino 2000; Waldman et al. 2001). *Batrachochytrium* is a highly virulent pathogen for many amphibians, and in experimental situations mortality can be 100% (Speare 2001).

To explore the possible chytrid fungus infection of *Atelopus cruciger,* we obtained a complete record of the localities at which *A. cruciger* was collected (Appendix I). Then, we examined histo-

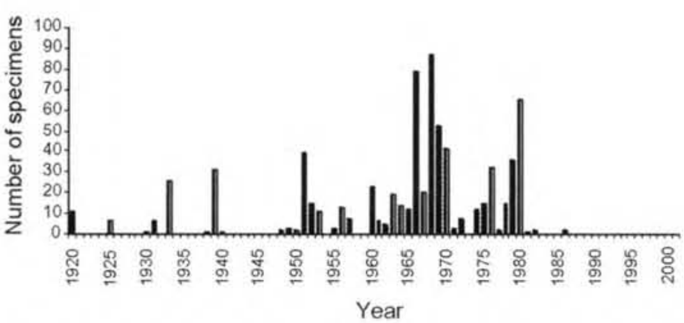

FIG. 1. Number of specimens of *Atelopus cruciger* in 12 herpetological collections (see acknowledgments) from 1920–2001. Note the absence of records after 1986.

logical preparations of specimens collected from 1920–1986 at localities across the historical distribution of the species (Fig. 2; Appendix I).

We removed strips of skin from the ventral surface of Toe IV from 59 specimens preserved in 70% ethanol. Tissue samples were tested for fungal infection following the procedures described in Berger et al. (1999). To remove bias, the histological examination of toad skin was carried out using a blind procedure with the scientist (DM) conducting the examination in the absence of any specimen data.

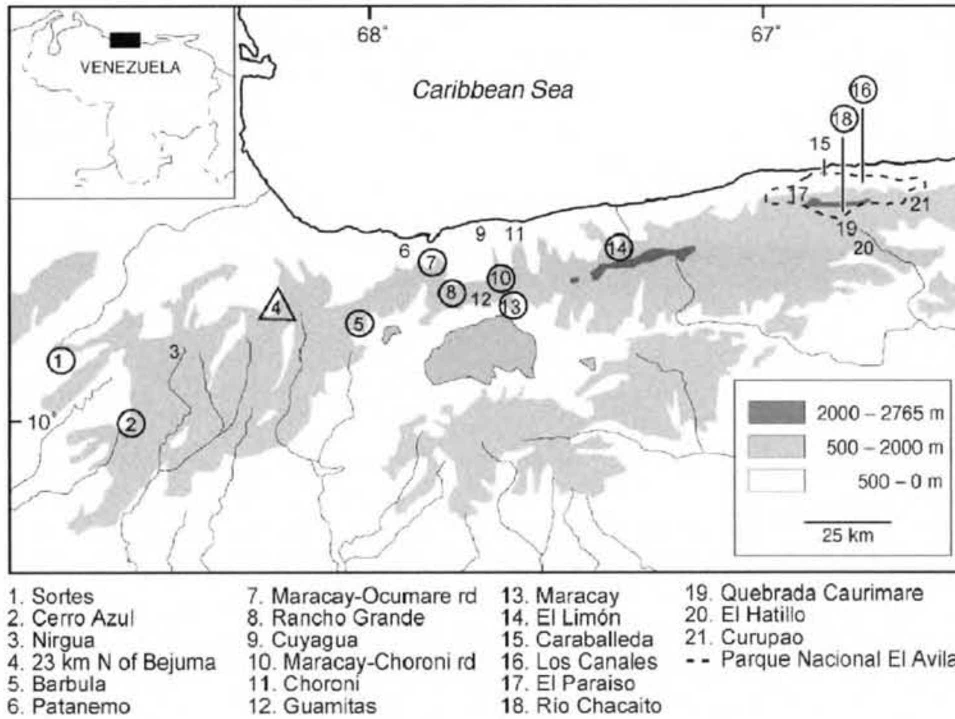

FIG. 2. Distribution of *Atelopus cruciger*. Numbers = non-overlapping collection localities; numbers in circles = collection localities of specimens examined for chytrid infection; number in triangle = locality where the infected specimen was found.

We found infection with *Batrachochytrium* in histologic sections from one specimen (USNM 259135). The superficial epidermis was hyperkeratotic and many zoosporangia of *B. dendrobatidis* were present (Fig. 3). Although most zoosporangia were empty, some contained characteristic developing stages of the fungus (see Berger et al. 1999). The infected specimen was an adult (SVL = 33.4 mm), collected at Palmichal, 23 km N of Bejuma (1465 m; 110°18' N, 68°13' W), Estado Carabobo, in May 1986. This and another specimen (USNM 259136) collected in the same locality in June 1986, constitute the last individuals of *Atelopus cruciger* to have been collected.

This is the first report of chytridiomycosis for Venezuela, and the third from South America. *Batrachochytrium dendrobatidis* has been reported from Ecuador (Ron and Merino 2000) and Uruguay (Mazzoni 2000), the latter record being from commercially raised American bullfrog (*Rana catesbeiana*). In Ecuador, five frog species were found to be infected (*Atelopus bomolochos*, *A.* sp. [aff. *ignescens*], *Gastrotheca pseustes*, *Hyla psarolaima*, and *Telmatobius niger*) with the earliest record in December 1980 (Ron and Merino 2000). Of the infected species in Ecuador, three (*A. bomolochos*, *A.* sp. [aff. *ignescens*], and *T. niger*) have not been recorded in the wild since 1994 (Ron et al. 2000). Ron and Merino (2000) concluded that chytridiomycosis was a factor involved in frog population declines throughout Ecuador. Because infection by *Batrachochytrium* has been shown to be lethal to other amphibians and to be associated with declines in other countries (Berger et al. 1998; Bosch et al. 2001; Bradley et al. 2002; Nichols et al. 2001; Speare 2001; Waldman et al. 2001), its presence in *A. cruciger* supports the hypothesis of the epidemic disease chytridiomycosis as a possible cause of the population declines.

Species that have shown chytrid associated declines often inhabit high elevation and reproduce in streams (Berger et al. 1998; Bradley et al. 2002; Lips 1999; Ron et al. *in press*). Although the infected specimen of *Atelopus cruciger* was collected at an altitude of 1465 m, the species was distributed from 40–1640 m. Local extinctions of *A. cruciger* have occurred throughout its altitudinal distribution (C. Señaris and J. Manzanilla, pers. comm.), suggesting that chytrid fungus could have affected both highland

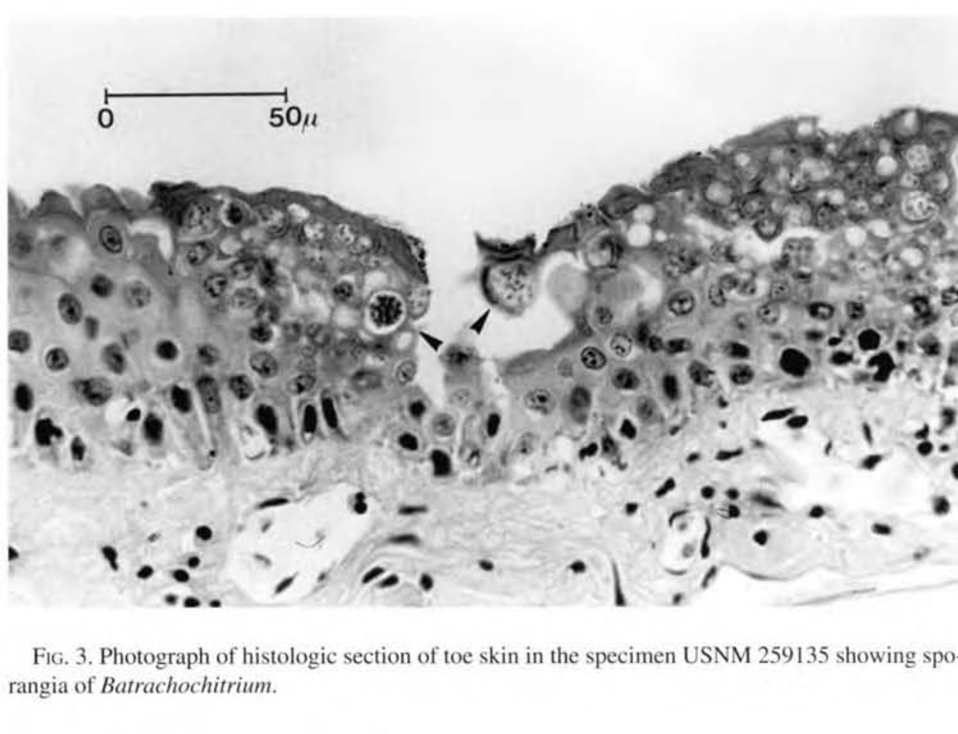

FIG. 3. Photograph of histologic section of toe skin in the specimen USNM 259135 showing sporangia of *Batrachochitrium*.

Appendix I. Collection localities of *Atelopus cruciger* and specimens examined for chytrid infection.

*	Locality	Coordinates	Elevation (m)	Specimens examined	Year of collection
	ESTADO YARACUY				
1	Sortes, Chivacoa	10° 11' N, 68° 41' W	500	MHNLS 788–91	1953
3	Nirgua, Quebrada la Chapa	10° 9' N, 68° 34' W	891	—	—
	ESTADO COJEDES				
2	Cerro Azul	9° 57' N, 68° 38' W	1300	MHNLS 8135–43, 8452–54, 8459–62	1980
	ESTADO CARABOBO				
4	Palmichal, 23 km N Bejuma	10° 18' N, 68° 13' W	1465	USNM 259135–36	1986
5	Bárbula	10° 18' N, 68° 2' W	634	MHNLS 2691–92	1964
6	Patanemo	10° 25' N, 67° 55' W	200–300	—	—
	Parque Nacional San Esteban, Quebrada Las Aguas	—	—	UMMZ 55557 (2 specimens)	1920
	ESTADO ARAGUA				
7	Km 26 Maracay-Ocumare de la Costa rd	10° 21' 46" N, 67° 43' 39" W	610	—	—
7	Km 29 Maracay-Ocumare de la Costa rd	10° 22' 11" N, 67° 44' 07" W	427	KU 185703–08	1979
7	Km 34 Maracay-Ocumare de la Costa rd	10° 23' 19" N, 67° 44' 47" W	140	KU 166678	1978
8	Parque Nacional Henri Pittier (PNHP), Rancho Grande	10° 21' 10" N, 67° 41' 02" W	1100	MHNLS 622	1952
8	PNHP, Estación Biológica de Rancho Grande	10° 20' 58" N, 67° 41' 04" W	1155	KU 132914–15	1974
8	PNHP, Pico Guacamayo	10° 22' N, 67° 40' W	1524	USNM 142370–71	1960
8	PNHP, Pico Periquito	10° 20' N, 67° 40' W	1494	—	—
8	9 km toward coast from Estación Biológica de Rancho Grande	10° 21' 13" N, 67° 43' 26" W	715	—	—
9	ca. 1 km S Cuyagua, along stream	10° 28' 42" N, 67° 42' 02" W	50–80	—	—
10	Maracay-Choroní rd	10° 21' N, 67° 35' W	1640	—	—
10	Maracay-Choroni rd	—	1300	UMMZ 113931	1952
10	Maracay-Choroni rd	—	1100	—	—
11	Choroní	10° 29' 46" N, 67° 36' 30" W	40	—	—
12	PNHP, Quebrada Guamitas	10° 20' 23" N, 67° 39' 10" W	775	—	—
13	Las Peñas, near Maracay, Hacienda de la Trinidad	10° 16' 39" N, 67° 37' 08" W	473	—	—
13	Maracay	10° 15' 23" N, 67° 34' 47" W	480	USNM 097197–98	1925
	ESTADO VARGAS				
14	El Limón	10° 28' N, 67° 17' W	971	MHNLS 4434–35	1967
14	Hacienda El Limón	—	600	MHNLS 4430–31	1965
14	Las llanadas, Hacienda El Limón	—	600	MHNLS 4825–28	1970
14	Cagüita, Hacienda El Limón	10° 31' N, 67° 19' W	465	MHNLS 3662–63	1968
15	Caraballeda	10° 36' N, 66° 50' W	26	—	—
16	Los Canales, Planta Eléctrica de Naiguata	10° 31' N, 66° 45' W	800	USNM 128866–68	1939
	DISTRITO FEDERAL				
17	Parque Nacional El Ávila (PNEA) El Paraíso, Río Tocomé	10° 32' 00" N, 66° 49' 00" W	1400	—	—
	PNEA, Quebrada Quintero	—	1200	—	—
	PNEA	—	**2100	—	—
	PNEA	—	1000	—	—
	ESTADO MIRANDA				
18	Caracas, Rio Chacaíto	10° 31' N, 66° 51' W	ca. 1000	USNM 128879, 128881	1939
18	1 km N of Quebrada Chacaíto	10° 32' N, 66° 51' W	1130–1170	USNM 216506–08	1967
19	Quebrada de Caurimare, Petare	10° 28' 47" N, 66° 49' 50" W	1000	—	—
20	Quebrada de Tusmare, Alto Hatillo	10° 24' 40" N, 66° 50' 10" W	1000	—	—
20	El Hatillo	10° 26' 07" N, 66° 48' 43" W	1200	—	—
20	Urb. Loma Larga, El Hatillo	10° 26' 08" N, 66° 49' 13" W	1200	—	—
	Quebarada Los Corutos	—	ca. 1000	MHNLS 760–63	1952
21	Curupao	10° 30' N, 66° 38' W	1100–1300	—	—

* Numbers correspond to those in Fig. 1.

** Questionable locality: this is the only record above 1640 m; because no more specimens have been found at similar elevations (around 2100 m), we question its validity.

and lowland populations. However, additional studies are needed to provide a more comprehensive spatiotemporal profile. Retrospective studies based on museum specimens and prospective studies sampling wild-caught frogs should be conducted in conjunction with ecological investigations to determine the distribution and impact of *Batrachochytrium* in Venezuela.

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Chytrid Fungus in Northern and Western Cape Frog Populations, South Africa

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Chytrid fungus has been found in areas where frog populations are declining (Berger et al. 1998; Bosch et al. 2001; Lips 1999; Muths et al. 2000). Although there have been no reports of amphibian population declines in South Africa, chytridiomycosis has been detected in *Xenopus laevis* (Speare and Berger 2000). The aim of our study was to further assess the occurrence of chytrid fungus in South African frogs, specifically in the Western Cape and Northern Cape Provinces.

The Cape river frog (*Afrana fuscigula*) was chosen as the primary study species because it is widespread throughout the Cape, with populations at high and low elevation. Other species were tested for the presence of chytrid fungus, such as *Afrana vandijki* and *Strongylopus grayii*, when *A. fuscigula* could not be found or when other species were found at the same site.

Sites were chosen opportunistically, to be representative of the full area of the Western Cape Province (N = 17 sites) and as an initial sample of the Goegap Nature Reserve in the Northern Cape (N = 2). Western Cape sites varied from rivers to pools. Both sites in the Goegap Nature Reserve were natural, small, isolated pools.

Nocturnal searches were conducted with flashlights and adult frogs were captured. The fourth toe tip of the right foot was taken from each animal using nail clippers. Each toe tip was placed in a separate vial containing 70% ethanol. The nail clippers were

TABLE 1. Location of sites, species and numbers of frogs infected at sites in the Northern and Western Cape.

Site	Latitude	Longitude	Altitude (m)	Area	Species	No. infected/ no. tested
Bloukokerboom-water, Goegap	29°38'03.0"	18°00'25.0"	1100	Northern Cape	*Afrana fuscigula*	10 / 10
Kraaifontein, Goegap	29°37'45.0"	18°02'03.0"	1194	Northern Cape	*A. fuscigula*	8 / 9
Algeria, Cederberg	32°22'27.4"	19°03'41.3"	504	Western Cape	*A. fuscigula*	1 / 2
Beaufort West	32°00'31.0"	22°25'05.0"	1630	Western Cape	*A. fuscigula*	0 / 1
Fernkloof	34°23'45.0"	19°16'03.0"	300	Western Cape	*A. fuscigula*	0 / 2
Gamkakloof	33°20'41.0"	22°01'12.4"	1338	Western Cape	*A. vandijki*	0 / 2
Grobbelaars River	33°25'11.2"	22°14'27.0"	525	Western Cape	*A. fuscigula*	2 / 5
Groot Winterhoek	33°03'14.1"	19°04'46.7"	646	Western Cape	*A. fuscigula*	1 / 4
					Strongylopus grayii	0 / 1
Groot Winterhoek	32°59'54.8"	19°03'23.9"	992	Western Cape	*A. fuscigula*	1 / 1
					S. grayii	0 / 2
Jamaka farm pond, Cederberg	32°20'14.9"	19°01'29.0"	378	Western Cape	*A. fuscigula*	1 / 12
					S. grayii	1 / 4
Landroskop	34°02'55.6"	19°00'32.6"	1059	Western Cape	*A. fuscigula*	0 / 2
					Capensibufo rosei	0 / 1
					S. bonaespei	0 / 1
Richmond	31°25'48.0"	24°19'08.0"	1560	Western Cape	*A. fuscigula*	0 / 1
Seweweekspoort	33°22'57.2"	21°24'26.2"	924	Western Cape	*A. fuscigula*	0 / 1
Stellenbosch	33°56'00.0"	18°52'00.0"	120	Western Cape	*A. fuscigula*	1/ 5
					S. grayii	0 / 1
Swartberg	33°22'30.0"	22°06'03.0"	932	Western Cape	*A. fuscigula*	0 / 4
Swellendam	34°00'35.7"	20°27'33.1"	193	Western Cape	*A. fuscigula*	3 / 4
Table Mountain	33°56'52.5"	18°26'04.2"	407	Western Cape	*A. fuscigula*	3 / 4
Table Mountain	33°56'53.7"	18°25'59.9"	393	Western Cape	*A. fuscigula*	3 / 3
Tradouws pass	33°57'54.8"	20°42'16.6"	294	Western Cape	*A. fuscigula*	1 / 2

cleaned in 100% ethanol after each use. Dead frogs were collected, and toe tips similarly tested. In the laboratory, toe tips were embedded in hard wax, sectioned at 6m, stained in haematoxylin and eosin, and examined for the presence of chytrid zoosporangia and empty zoospores (e.g., Briggs and Burgin 2003). The presence of chytrid was confirmed by Rick Speare (James Cook University, Queensland, Australia).

Chytrid fungus was found in 36 of 85 (42%) frogs, in 2 of 5 species tested, at 10 of 17 Western Cape sites and at both Northern Cape sites (Table 1). Frogs infected with chytrid fungus were found at low (Stellenbosch 120 m) and high elevation sites (Groot Winterhoek 992 m), in rivers that flow through town centers (Stellenbosch and Swellendam), and in nature reserves (Cederberg and Groot Winterhoek) with minimum human impact. When detected, chytrid was not found in every frog per site. The number of frogs with chytridiomycosis at a site was not proportional to the number of frogs collected (Table 1).

No mass die-offs were observed in the areas where chytrid was present in the Western Cape. Most of the frogs collected appeared healthy. Two dead *Afrana fuscigula* were found, one in Groot Winterhoek and the other in Stellenbosch. Both of these had chytrid infections while other frogs taken from the same area had no chytrid infection. At the Bloukokerboom-water site in the Northern Cape, 12 dead frogs were seen, one of which was tested for chytridiomycosis along with nine frogs that appeared healthy;-all had chytrid infections (Table 1).

In other examples of chytrid infection the fungus has moved through the population and deaths have occurred in post-metamorphic frogs (Berger et al. 1998; Daszak et al. 1999). At sites in the Western Cape no mass die-offs were seen although chytrid fungus was found in a number of individuals. Apart from two dead frogs, individuals with infection appeared healthy. It is possible that the frogs tested in the Western Cape either completed metamorphosis while carrying chytrid infections, infection occurred later in the life cycle, or die-offs occurred after the site was visited. In contrast, there were many dead frogs found at one of the sites in Goegap Nature Reserve. Although chytrid may have contributed to this mortality, other factors warrant investigation because similar chytrid infections were not related to die-offs in the Western Cape. The Northern Cape area was agricultural land and is now surrounded by copper mines, hence pollutants might be present. Synergistic agents with chytrid or factors affecting immunosuppression could be involved, including toxins as well as other environmental conditions such as temperature, pH, hydration of the skin, and UV B radiation (e.g., Alford and Richards 1999, Rollins-Smith et al. 2002).

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Ecological Aspects of Parasitism in the Tadpole of *Pseudis paradoxa* from Argentina

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Tadpoles act as intermediate hosts for a great number of parasitic helminth species. The metamorphosing tadpole can serve as an efficient link between aquatic and terrestrial ecosystems by transporting larvae of helminths to terrestrial vertebrates. According to Alford (1999), parasites and commensals of tadpoles have not been studied extensively. Until recently, few studies have addressed parasites of different larval stages of amphibians in South America (Hamann and Kehr 1997, 1999; Kehr and Hamann 1995). In North America, to determine the effects of parasitism on performance of amphibians (growth, survival, locomotion), studies have been carried out under experimental conditions. These studies have addressed parasitic infection in different amphibian larval stages, juveniles, and adults (Goater 1994; Goater and Vandenbos 1997; Johnson et al. 1999).

There are very few ecological studies that examine the interaction between parasitism and other environmental factors in anurans. Parasitism may affect an individual's growth and survival. Indeed, ecologists have become increasingly interested in determining the effects of parasitism on their hosts (Minchella and Scott 1991), especially since theoreticians have shown that parasites can regulate host population size (Anderson and May 1979; May and Anderson 1979; Thiemann and Wassersug 2000a, b).

We were interested in examining the interaction of parasitism + environment on a model anuran species, *Pseudis paradoxa*, from the family Pseudidae. This species is endemic to South America and Trinidad. In Argentina the family is represented by three species: *Lysapsus limellus* Cope 1862, *Pseudis minuta* Gunther, 1859 "1858," and *Pseudis paradoxa* (Linnaeus 1758) (Kehr and Basso 1990). The three species are largely sympatric in the northern provinces of Formosa, Chaco, Santa Fé, Corrientes, and Entre Ríos (24°00'S – 33°00'S; and 56°00'W – 62°00'W) (Cei 1980; Gallardo 1987). *Pseudis paradoxa* uses permanent ponds with floating vegetation (Duré and Kehr 2001). The tadpole of *P. paradoxa* is characterized by its large size (maximum length = 230 mm; Kenny 1969) particularly compared to the size of the metamorphosed adult. This gigantism appears to be the result of extended exposure to prolactin in the tadpoles (e.g., during overwintering) (Emerson 1988). Size variability in *P. paradoxa* tadpoles from Argentinean populations has been reported by Dixon et al. (1995).

The main goals of this study were: 1) to record and analyze morphological measurements of tadpoles for different stages; 2) to determine how many helminth taxa infest *P. paradoxa* tadpoles under natural conditions; and 3) to examine the co-occurrence of parasite taxa, and the relationship between co-occurrence and tadpole morphology.

Materials and Methods.—The tadpoles studied were collected in two ponds located ca. 25 km from Corrientes City, Corrientes province, Argentina (27°30'S, 58°45'W). The distance between the ponds was 5 km. Pond 1 is a semi-permanent circular pond, ca. 60 m diameter, with a maximum depth at center of ca. 1.5 m. During the study period, the dominant vegetation was *Cyperus* spp., *Salvinia* sp., *Ludwigia peploides*, *Nymphoides* sp., and *Paspalum* sp. Pond surface vegetative cover was 20–30%. Pond 2 is a permanent circular pond, ca. 110 m diameter, with a maximum depth at center of 2 m. During the study period the dominant vegetation was *Salvinia rotundifolia*, *Pistia stratiotes*, and *Eichornia crassipes*. The pond contained a wide range of aquatic invertebrate organisms including abundant snails belonging to the family Planorbidae.

Eight tadpole samples (four per pond) were taken between 28 February and 20 March 1997. The tadpoles were captured with a 45 cm diameter dip net and maintained alive in the laboratory until they were studied (for up to two days after capture). All tadpoles were anesthetized with ether for study. The developmental stages (Gosner 1960), body length (i.e., distances from the oral disc to the beginning of the cloacal tube), oral disc width, intestine length, maximum body height, maximum tail height, maximum tail muscle height, and maximum body width were recorded for each tadpole.

The intestine, kidney, coelomic cavity, musculature, integument,

brain, and eyes of each tadpole were examined for parasites by dissection. Metacercariae were observed *in vivo* after anesthetizing the tadpoles. Parametric tests were used to establish the relationship between the morphological variables and parasite presence (Kehr 1994; Zar 1996).

We used Principal Component Analysis to 1) examine the relationship between the tadpoles' morphometric variables and the variation explained by the different combinations of them (principal components); and 2) to analyze the association among parasite taxa through a correlation matrix based on the parasite counts. Relationships between two sets of variables were investigated by performing a Canonical Correlation Analysis, one independent set composed of tadpole morphological measurements and other dependent set formed by abundance of parasites by taxa.

Statistical tests were carried out using SYSTAT 7.0 software. In order for all variables to have the same influence on the distance calculation, the variables were standardized, subtracting the variable's sample mean from each value and dividing the difference by the sample standard deviation. The standardized values have a mean of 0 and a variance of 1.

We defined parasite prevalence as the number of hosts infected with one or more parasite taxa divided by the total number of hosts examined and expressed as a percentage. Mean intensity was defined as the average intensity of a parasite taxon in the host infected with that parasite. Bush et al. (1997) detailed more information on these and other aspects of parasite terminology. The relation of variance/mean was used for determining the spatial distribution of parasites inside the host.

Results.—Twenty-seven tadpoles were collected (Pond 1: N = 14; Pond 2: N = 13). The total length of tadpoles ranged from 26.5 to 167.9 mm. Maximum body length recorded (58.3 mm) was for a stage 38 tadpole captured in Pond 2 (Table 1).

The principal components and the percentages of variation accounted for by the morphometric variables are shown in Table 2. All tadpoles collected (N = 27) were included in this analysis. The first component mainly reflects the sum of body length, body height, body width, and tail height. The second component mainly reflects the influence of oral disc width variation and the tail muscle height. The third component mainly reflects a contrast between the total length and tail muscle height.

Ten helminth parasite taxa (larvae and adults) were recorded—nine trematodes and one nematode (Table 1). The prevalence, mean intensity, minimum and maximum parasite numbers, and localization are detailed in Table 3 and 4. In pond 1 (low snail abundance, pers. obs.) the more representative helminth taxa infecting the tadpoles, in decreas-

TABLE 1. Tadpole measurements for each stage (Gosner 1960) captured in each pond type and, number of helminth parasites by taxa. N= number of tadpoles; when more than one tadpole was obtained the measurement for each stage is the mean and in parenthesis is the deviation standard (1s). Parasites species: Trematodes: 1) Diplostomidae gen. sp. 1; 2) Diplostomidae gen. sp. 2; 3) Diplostomidae gen. sp. 3; 4) Digenea gen. sp. 1; 5) Strigeoidea gen. sp.; 6) Digenea gen. sp. 2; 7) Echinostomatidae gen. sp.; 8) *Glypthelmins* sp.; 9) *Catadiscus* sp.; Nematodes: 10) *Gyrinicola* sp.

Pond 1 (N = 14)		Tadpole measurements (mm)						Helminth parasites										
Stages	N	Total length	Body length	Oral disc width	Body height	Tail height	Tail muscle height	1	2	3	4	5	6	7	8	9	10	TOTAL PAR.
28	1	85.50	30.50	4.20	18.80	22.50	8.40	5	-	1	-	-	-	-	-	-	24	30
34	1	123.00	42.20	5.60	29.80	32.20	10.60	-	1	-	-	-	-	-	-	-	73	74
35	3	117.26 (31.28)	47.40 (14.74)	6.70 (2.04)	31.26 (11.20)	35.50 (14.15)	11.26 (3.20)	8	19	-	-	-	-	-	-	-	319	346
40	1	154.40	53.60	6.60	48.70	52.00	17.90	19	-	-	-	-	-	-	-	-	3	22
42	3	157.50 (10.82)	53.76 (6.18)	7.80 (0.50)	38.36 (5.09)	47.66 (2.50)	11.10 (7.75)	12	33	-	-	-	-	-	-	-	662	707
45	5	112.80 (20.56)	34.86 (3.24)	13.08 (1.29)	16.72 (0.99)	21.52 (6.80)	13.46 (2.66)	9	-	-	-	-	-	1	10	-	1	21
TOTAL	14							53	53	1	-	-	-	1	10	-	1082	1200
Pond 2 (N = 13)																		
25	2	66.50 (34.36)	24.55 (7.70)	3.50 (1.69)	15.55 (4.45)	17.40 (4.38)	6.65 (3.60)	7	1	-	-	-	-	-	-	56	73	137
26	1	57.00	20.70	2.70	11.70	10.50	4.20	-	-	-	-	-	-	-	-	-	2	2
29	1	114.60	38.20	5.90	27.30	32.30	10.70	-	-	-	-	-	-	-	-	67	2	69
32	1	129.30	46.40	5.20	30.50	37.40	11.70	4	1	-	-	-	-	-	-	69	222	296
37	3	101.36 (54.55)	48.13 (4.44)	7.10 (0.60)	36.43 (4.71)	37.03 (3.52)	13.06 (1.10)	3	3	-	-	-	2	-	1	227	321	557
38	1	157.00	58.30	8.30	45.30	42.30	14.40	-	-	-	-	-	-	-	-	162	226	388
39	1	111.00	41.00	5.70	30.50	32.30	11.20	-	-	-	-	-	3	-	-	56	232	291
42	1	167.90	57.00	17.80	43.70	41.50	15.70	-	-	-	-	-	-	-	-	94	142	236
45	2	127.95 (2.05)	38.10 (1.97)	14.40 (1.13)	15.15 (1.06)	15.80 (3.53)	11.75 (0.49)	-	-	-	1	1	-	-	12	74	-	88
TOTAL	13							14	5	-	1	1	5	-	13	805	1220	2064

TABLE 2. Results of a principal component analysis of morphometric variables of *Pseudis paradoxa* tadpoles (N = 27): coefficients of standardized measurements (each variable: mean = 0 and $s^2 = 1$), and the percentage of variation explained. Tadpoles analyzed from pond 1 + pond 2 pooled.

Coefficients	PC1	PC2	PC3
Total length	0.726	-0.180	-0.625
Body length	0.959	0.022	0.072
Oral disc width	0.169	-0.923	-0.057
Body height	0.945	0.262	0.082
Body width	0.950	0.131	0.114
Tail height	0.945	0.241	-0.005
Tail muscle height	0.596	-0.561	0.359
Percent of total variance explained	64.567	19.195	7.831
Cumulative	64.567	83.762	91.593

ing order, were: 1) *Gyrinicola* sp. (localized in the intestine), 2) Diplostomidae gen. sp. 2 (localized in the kidneys) and, 3) Diplostomidae gen. sp. 1 (localized in the kidneys). In pond 2 (high snail abundance, pers. obs.) the helminth taxa more numerous, in decreasing order, were: 1) *Gyrinicola* sp. (localized in the intestine), 2) *Catadiscus* sp. (localized in the intestine) and, 3) Diplostomidae gen. sp. 1 (localized in the kidneys).

The *P. paradoxa* tadpoles of the two ponds shared four of the ten parasite taxa recorded. In the kidneys of tadpoles three taxa of trematodes were recorded from both ponds (Diplostomidae sp. 1, 2 and Digenea gen. sp. 2), and one taxon was observed in the intestine of tadpoles in the two ponds (*Glypthelmins* sp.). The nematode, *Gyrinicola* sp. was recorded from the intestine of tadpoles from both ponds.

The principal components and the percentages of variation accounted for by the totality of helminths (pond 1 + pond 2) are shown in Table 5. The first component mainly reflects a contrast among the counts of *Glypthelmins* sp. against the sum of the counts of Diplostomidae gen. sp. 1, Diplostomidae gen. sp. 2 and *Gyrinicola* sp. The second component is mainly a contrast between the sum of the counts of *Catadiscus* sp. and *Gyrinicola* sp. against *Glypthelmins* sp. The third component mainly reflects the contrast between the counts of Digenea gen. sp. 2. against *Catadiscus* sp. The fourth component is mainly the sum of the counts of *Glypthelmins* sp. and *Gyrinicola* sp. The fifth component is mainly the sum of the counts of Diplostomidae gen. sp. 2 and *Catadiscus* sp.

Canonical correlation analysis (CCA) showed a very strong association between the two data sets, one set formed by parasite taxa (dependent variables) and another by tadpoles morphometric variables (independent variables) ($R^2 = 0.977$; RAO F = 2.027, df = 42, 69.1, P = 0.004; Table 6). In Table 6 are summarized the canonical correlations and the Bartlett test of residual correlations. The two first canonical correlations were significant, demonstrating the good associations between the two variables sets.

Discussion.—Our data agree with the observation of Dixon et al. (1995) that populations of *P. paradoxa* tadpoles are highly poly-

TABLE 3. Prevalence, mean intensity, and s^2/mean relation of helminths recorded from *Pseudis paradoxa* tadpoles at two ponds from Corrientes, Argentina, and numbers of tadpoles parasitized.

	Pond 1 (N = 14)				Pond 2 (N = 13)			
	Mean Intensity (min.–max.)	Prevalence %	S^2/Mean	Tadpoles parasitized	Mean Intensity (min.–max.)	Prevalence %	S^2/Mean	Tadpoles parasitized
Trematodes								
Diplostomidae gen. sp. 1	9.00 (1–19)	35.71	10.15	5	14.00 (3–7)	23.07	4.55	3
Diplostomidae gen. sp. 2	9.10 (1–32)	50.00	18.70	7	5.00 (1–3)	23.07	1.96	3
Diplostomidae gen. sp. 3	(1)	7.14	–	1	–	–	–	–
Digenea gen. sp. 1	–	–	–	–	(1)	7.69	–	1
Strigeoidea gen. sp.	–	–	–	–	(1)	7.69	–	1
Digenea gen. sp. 2	–	–	–	–	2.50 (2–3)	15.38	2.42	2
Echinostomatidae gen. sp.	(1)	7.14	–	1	–	–	–	–
Glypthelmins sp.	1.50 (1–3)	28.57	1.69	4	4.50 (1–8)	15.38	7.07	2
Catadiscus sp.	–	–	–	–	73.20 (3–162)	84.61	40.06	11
Nematodes								
Gyrinicola sp.	155.60 (24–323)	64.28	125.35	9	110.40 (2–232)	84.61	103.86	11

Table 4. Summary of helminth taxa, parasite stages, position, transmission and definitive host of parasites in the giant tadpoles of *Pseudis paradoxa* tadpoles from Corrientes, Argentina.

Helminths	Stage in tadpole	Position in tadpole	Transmission	Definitive host
Trematodes				
Diplostomidae gen. sp. 1	Metacerc.	Kidney	Skin and cloaca penetration by cercariae	Bird and mammal
Diplostomidae gen. sp. 2	Metacerc.	Kidney	Skin and cloaca penetration by cercariae	Bird and mammal
Diplostomidae gen. sp. 3	Metacerc.	Kidney	Skin and cloaca penetration by cercariae	Bird and mammal
Digenea gen. sp. 1	Metacerc.	Kidney	?	?
Strigeoidea gen. sp.	Metacerc.	Kidney	Skin and cloaca penetration by cercariae	Reptiles, bird and mammal
Digenea gen. sp. 2	Metacerc.	Kidney	?	?
Echinostomatidae gen. sp.	Metacerc.	Manicotto outside	Oral ingestion by cercariae	Bird
Glypthelmins sp.	Juvenile	Intestine	Skin and cloaca penetration by cercariae	Amphibian
Catadiscus sp.	Juvenile	Intestine	Oral ingestion by metacercariae	Amphibian
Nematodes				
Gyrinicola sp.	Adult	Intestine	Oral ingestion by eggs and larvae	Amphibian

morphic. In our tadpole samples we also recorded great variability in the measurements. About 65% of the variation observed in the tadpoles morphological features were mainly related to body features differences. Approximately 19% of the tadpole variation was produced mainly by the oral disc width. Nevertheless, only about 8% of the variation was attributed to tadpole total length.

Overall, *Gyrinicola* sp. (Nematodes) and *Catadiscus* sp. (Trematodes) showed the highest abundance and a constant frequency and, in both cases, infecting the intestine. Amphibians are the definitive host for these parasites (Baker 1987; Prudhoe and Bray 1982). For both cases, the infection depends directly upon tadpole feeding behavior because the transmission is through oral ingestion of eggs and larvae for the first taxon and metacercariae for the second. A positive correlation with the tadpole body characteristics was observed for both taxa (Table 6), probably because it is related to intestine length.

Gyrinicola sp. had the greatest infestation intensity, prevalence, and formed big nematode schools in the intestine of tadpoles in both ponds. These were the only adult helminth parasites encountered because tadpoles are their definitive host. The oxyurids (*Gyrinicola* sp.) belong to a group of parasites with simple life cycles (SLC) because they require a single host individual for their development (i.e., the eggs are directly infective to the host). Oxyurids are the only nematodes found in both vertebrates and invertebrates (Baker 1987). They commonly parasitize fish, amphibians, and reptiles.

Catadiscus sp. were only recorded in the tadpoles captured in the pond that possessed a great abundance of snails (Planorbidae) because snails are the intermediary host. Their metacercariae encyst on the substrate (e.g., roots, aquatic vegetation) and they are ingested when the tadpoles eat. According to Yamaguti (1973) the life cycle of *Catadiscus* sp. resembles that of trematodes in the genus *Megalodiscus*. The life cycles of *Catadiscus* sp. can be considered autogenic because they complete their cycles within the pond and use definitive hosts which are almost permanently restricted to the pond (e.g., frogs, turtles, snakes). This life cycle is also simple.

Two other taxa well represented in abundance in both of the ponds studied were Diplostomidae gen sp. 1 and Diplostomidae gen sp. 2. These taxa were not as well represented as *Gyrinicola* sp. and *Catadiscus* sp. For Diplostomidae gen sp. 1 and sp. 2 birds and mammals are the definitive host and inside tadpoles they are localized in the kidney (Table 4). In both parasite taxa the infection depends upon either tadpole feeding behavior and cercariae activity. The parasite penetration is through the skin and cloacae of tadpoles. The abundance of Diplostomidae gen sp. 1 and sp. 2 was positively correlated with variables related to the tail of tadpoles (swimming features) (Table 6).

The results suggest that in *P. paradoxa* tadpoles parasite infestation may be either constant or sporadic in occurrence. These results agree with Aho (1990) who suggests that communities of amphibian parasites are generally poor either from the standpoint of number of species or density of individuals that compose them. In our study the influence of pond type and tadpole morphometric features were both important factors regulating the helminth infracommunity. *Catadiscus* sp., one dominant species, was only present in the pond where snails were abundant. Recently, Kehr et al. (2000) demonstrated the relationship between biotic (parasite

TABLE 5. Results of a principal component analysis of helminth parasites: coefficients of parasites numbers standardized (each variable: mean = 0 and $s^2 = 1$), and the percentage of variation explained. Hosts species: tadpoles of *Pseudis paradoxa* (N = 27) from pond 1 + pond 2 pooled. The only taxa considered were those with more than 1 parasite in total.

Coefficients	PC1	PC2	PC3	PC4	PC5
Diplostomidae gen. sp. 1	-0.798	-0.354	-0.012	0.159	0.238
Diplostomidae gen. sp. 2	-0.672	-0.377	0.188	-0.046	-0.594
Digenea gen. sp. 2	0.051	0.396	0.909	-0.038	0.030
Glypthelmins sp.	0.526	-0.484	0.153	0.674	-0.103
Catadiscus sp.	0.039	0.814	-0.269	0.215	-0.383
Gyrinicola sp.	-0.655	0.508	-0.000	0.405	0.217
Percent of total variance explained	29.962	26.315	15.965	11.559	10.239
Cumulative	29.965	56.277	72.242	83.801	94.040

TABLE 6. Results of a canonical correlation analysis between two sets of variables: one set formed by six parasite taxa (dependent variables: Y) and the other set formed by seven tadpole morphometric variables (independent variables: X). Variables of the two sets were standardized (each variable: mean = 0 and $s^2 = 1$). The *Pseudis paradoxa* tadpoles considered (N = 27) were pooled (Pond 1 + Pond 2). The only taxa considered were those with more than 1 parasite in total. Parasite's names: Dipl. 1: Diplostomidae gen. sp. 1; Dipl. 2: Diplostomidae gen. sp. 2; Dig. 2: Digenea gen. sp. 2; Glypt.: *Glypthelmins* sp.; Catad.: *Catadiscus* sp., and Gyrin.: *Gyrinicola* sp.

	Parasite taxa					
Tadpole variables	Dipl. 1	Dipl. 2	Dig. 2	Glypt.	Catad.	Gyrin.
Total length	0.136	0.142	0.020	-0.390	0.004	0.288
Body length	0.078	0.120	-0.006	-0.149	0.337	0.651
Oral disc width	-0.198	-0.123	-0.167	0.487	0.038	-0.245
Body maximum height	0.242	0.170	0.071	-0.368	0.400	0.770
Body maximum width	0.116	0.057	0.043	-0.256	0.439	0.702
Tail maximum height	0.312	0.260	0.044	-0.411	0.212	0.731
Tail maximum muscle height	0.353	0.333	-0.011	0.044	0.225	0.156

Overall association: $R^2 = 0.977$; RAO F = 2.027, df = 42, 69.1; P = 0.004

Canonical correlations	1	2	3	4	5	6
	0.867	0.802	0.752	0.581	0.297	0.074

Bartlett test of residual correlations

Correlations 1 through 6:	$\chi^2 =$ 71.551	df = 42	prob = 0.003 *
Correlations 2 through 6:	$\chi^2 =$ 45.091	df = 30	prob = 0.038 *
Correlations 3 through 6:	$\chi^2 =$ 25.551	df = 20	prob = 0.181
Correlations 4 through 6:	$\chi^2 =$ 9.698	df = 12	prob = 0.642
Correlations 5 through 6:	$\chi^2 =$ 1.861	df = 6	prob = 0.932
Correlations 6 through 6:	$\chi^2 =$ 0.105	df = 2	prob = 0.949

* Significant ($P < 0.05$)

coexistence) and abiotic factors (pond type) on helminth infracommunity structure in populations of the frog *Lysapsus limellus*. The rate at which the host can be infected and the persistence of infection depends strongly on habitat variation, host size, and diet (Kehr et al. 2000).

Johnson et. al. (1999, 2001), under field and experimental conditions, identified a trematode parasite (*Ribeiroia ondatrae*) as the probable cause of malformations in some species of frog from North America. In our study, we did not see malformations or abnormalities in the *P. paradoxa* tadpoles.

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A Second Set of Addenda to the Checklist of West Indian Amphibians and Reptiles

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Since the publication of the most recent checklist of West Indian amphibians and reptiles (Powell et al. 1996) and subsequent addenda (Powell and Henderson 1999), new forms have been described, reevaluated, discovered for the first time in the region, or new populations have become established in areas where the species was not formerly known to occur. We use the format of the 1996 checklist in providing all of the new records that have come to our attention.

CLASS AMPHIBIA, ORDER ANURA

Family Bufonidae

***Bufo marinus*.** *Rana marina* Linnaeus 1758: 211. • WI • Linnaeus, C. 1758. Systema Naturæ per Regna Tria Naturæ, Secundum Classes, Ordines, Genera, Species cum Characteribus, Differentiis, Synonymis, Locis. Tomus I. Editio decima, Reformata. L. Salvii, Holmiae. — Burton and Echternacht (2003) reported the presence of this species on Grand Cayman and Hodge et al. (2003) noted the presence of waifs on Anguilla.

Family Hylidae

***Osteopilus crucialis*.** *Hyla crucialis* Harlan 1826: 64. • JAM • Harlan, R. 1826. Descriptions of several new species of batrachian reptiles, with observations on the larvae of frogs. Amer. J. Sci. Arts 10: 53–65. — Hedges (1996) implicitly reassigned this species from the genus *Calyptahyla* to *Osteopilus*, but see also Anderson (1996). Hass et al. (2001) provided justification based on immunological distance data, but inadvertently used the old name. The new combination was published for the first time in Powell and Henderson (2003b) and Stewart (2003).

Osteopilus marianae. *Hyla marianae* Dunn 1926:129. • JAM • Dunn, E. R. 1926. The frogs of Jamaica. Proc. Boston Soc. Nat. Hist. 38:111–130. — Hedges (1996) implicitly reassigned this species from the genus *Hyla* to *Osteopilus*, but see also Anderson (1996). Hass et al. (2001) provided justification based on immunological distance data, but inadvertently used the old name. Consequently, the new combination is published here for the first time.

Osteopilus pulchrilineatus. *Hyla pulchrilineata* Cope 1869: 163. • HISP • Cope, E. D. 1869. Seventh contribution to the herpetology of tropical America. Proc. Amer. Philos. Soc. 11: 147–169. — Hedges (1996) implicitly reassigned this species from the genus *Hyla* to *Osteopilus*, but see also Anderson (1996). Hass et al. (2001) provided justification based on immunological distance data, but inadvertently used the old name. The new combination was published for the first time in Franz (2003).

Osteopilus vastus. *Hyla vasta* Cope 1871: 219. • HISP • Cope, E. D. 1871. Ninth contribution to the herpetology of tropical America. Proc. Acad. Nat. Sci. Philadelphia 23: 200–224. — Hedges (1996) implicitly reassigned this species from the genus *Hyla* to *Osteopilus*, but see also Anderson (1996). Hass et al. (2001) provided justification based on immunological distance data, but inadvertently used the old name. The new combination was published for the first time in Powell and Henderson (2003b) and Franz (2003).

Osteopilus wilderae. *Hyla wilderae* Dunn 1925:161. • JAM • Dunn, E. R. 1926. A new tree-toad from Jamaica. Occas. Pap. Boston Soc. Nat. Hist. 5:161–162. — Hedges (1996) implicitly reassigned this species from the genus *Hyla* to *Osteopilus*, but see also Anderson (1996). Hass et al. (2001) provided justification based on immunological distance data, but inadvertently used the old name. Consequently, the new combination is published here for the first time.

Scinax rubra. *Hyla rubra* Daudin 1802:19. • LA, PRB • INT • Daudin, F.-M. 1802. Histoire Naturelle des Rainettes, des Grenouilles et des Crapauds. Levrault, Paris. — Previously known from St. Lucia in the Lesser Antilles, Rivero (1998) and Rios-López (1999) reported well-established populations in Puerto Rico. Also, note that the population on St. Maarten/St. Martín listed by Schwartz and Henderson (1991) was the result of misidentified *Osteopilus septentrionalis* (Powell et al. 1992).

Family Leptodactylidae

Eleutherodactylus adelus. *Eleutherodactylus adelus* Díaz, Cádiz, and Hedges 2003: 177. • CUB • Díaz, L. M., A. Cádiz, and S. B. Hedges. 2003. A new grass frog from pine forests of western Cuba, and description of acoustic and pattern variation in *Eleutherodactylus varleyi* (Amphibia: Leptodactylidae). Carib. J. Sci. 39: 176–188.

Eleutherodactylus rivularis. *Eleutherodactylus rivularis* Díaz, Estrada, and Hedges 2001:63. • CUB • Díaz, L. M., A. R. Estrada, and S. B. Hedges. 2001. A new riparial frog of the Genus *Eleutherodactylus* (Anura: Leptodactylidae) from eastern Cuba. Carib. J. Sci. 37:63–71.

Eleutherodactylus simulans. *Eleutherodactylus simulans* Díaz and Fong 2001: 77. • CUB • Díaz, L. M., and A. Fong. 2001. A new mottled frog of the genus *Eleutherodactylus* (Anura: Leptodactylidae) from eastern Cuba. Solenodon 1:76–84.

Family Ranidae

Rana grylio. *Rana grylio* Stejneger 1901:212. • BAH, PRB • INT • Stejneger, L. 1901. A new species of bullfrog from Florida and the Gulf Coast. Proc. U.S. Natl. Mus. 24:211–215. — Previously known from Andros and New Providence islands in the Bahamas, Rios-López and Joglar (1999) reported well-established populations in northern Puerto Rico.

Class Reptilia, Order Testudines

Family Emydidae

Trachemys stejnegeri. *Pseudemys stejnegeri* Schmidt 1928:147. • BAH, HISP, PRB, LA • Schmidt, K. P. 1928. Amphibians and land reptiles of Porto Rico, with a list of those reported from the Virgin Islands. Scientific Survey of Porto Rico and the Virgin Islands. New York Acad. Sci., Sci. Surv. Puerto Rico Virgin Isl. 10:1–160. — Breuil (2002) reported the presence of this species on Guadeloupe.

Family Pelomedusidae

Pelusios castaneus. *Emys castanea* Schweigger 1812:314. • LA • Schweigger, A. F. 1812. Prodromus Monographiæ Cheloniorum. Königsberg. Arch. Naturwiss. Math. 1:271–368, 406–458. — Iverson (1992) noted that populations on Guadeloupe previously assigned to *Pelusios subniger* were actually *P. castaneus*.

Family Testudinidae

Geochelone denticulata. *Testudo denticulata* Linnaeus 1766:352. • LA • Linnaeus, C. 1766. Systema Naturæ per Regna Tria Naturæ, Secundum Classes, Ordines, Genera, Species cum Characteribus, Differentiis, Synonymis, Locis. Tomus I. Editio duodecima, Reformata. L. Salvii, Holmiae. — Breuil (2002) reported the presence of this species on Guadeloupe.

Class Reptilia, Order Squamata

Family Anguidae

Celestus carraui. *Celestus carraui* Incháustegui, Schwartz, and Henderson 1985 and *C. anelpistus* Schwartz, Graham, and Duval 1979 were relegated to subspecific status in the "*C. warreni* complex" by Hallermann and Böhme (2002), but Powell and Henderson (2003a) disagreed, sinking *C. carraui* into the synonymy of *C. warreni* and arguing for the retention of full species status for *C. anelpistus*.

Family Colubridae

Alsophis sanctonum. *Alsophis sanctonum* Barbour 1915:78. • LA • Barbour, T. 1915. Recent notes regarding West Indian reptiles and amphibians. Proc. Biol. Soc. Washington 28:71–78. — Re-elevated to full species status by Breuil (2002).

Elaphe guttata. *Coluber guttatus* Linnaeus 1766: 385. • BAH (?), CAY, PRB, LA • INT • Linnaeus, C. 1766. Systema Naturæ per Regna Tria Naturæ, Secundum Classes, Ordines, Genera, Species cum Characteribus, Differentiis, Synonymis, Locis. Tomus I. Editio duodecima, Reformata. L. Salvii, Holmiae. — Waifs are known from the U. S. Virgin Islands, where the presence of a small breeding population is suspected (Perry et al. 2003), Anguilla (Hodge et al. 2003), Antigua (K. Lindsay 1996, pers. comm.), and St.-Barthélemy (Breuil 2002).

Hypsirhynchus scalaris. *Hypsirhynchus scalaris* Cope 1862:72. • HISP • Cope, E. D. 1862. Synopsis of the species of *Holcosus* and *Ameiva*, with diagnoses of new West Indian and South American Colubridae. Proc. Acad. Nat. Sci. Philadelphia 14:

60–82. — Re-elevated to full species status in Vidal et al. (2000).

Family Gekkonidae

Hemidactylus mabouia. *Gecko mabouia* Moreau de Jonnès 1818:138. • WI • Moreau de Jonnès, A. 1818. Monographie du mabouia des murailles, ou *Gecko Mabouia* des Antilles. Bull. Scient. Soc. Philomath. Paris, ser. 3, 5:138–139. — The presence of a breeding population was reported on Grand Cayman by Echternacht and Burton (2002).

Sphaerodactylus ariasae. *Sphaerodactylus ariasae* Hedges and Thomas 2001:168. • HISP • Hedges, S. B., and R. Thomas. 2001. At the lower size limit in amniote vertebrates: a new diminutive lizard from the West Indies. Carib. J. Sci. 37:168–173.

Sphaerodactylus parvus. *Sphaerodactylus macrolepis parvus* King 1962:16. • LA • King, F. W. 1962. Systematics of Lesser Antillean lizards of the genus *Sphaerodactylus*. Bull. Florida St. Mus. 7:1–52. — Elevated from subspecific status by Powell and Henderson (2001).

Family Iguanidae

Cyclura lewisi. *Cyclura macleayi lewisi* Grant 1941:35. • CAY • Grant, C. 1941. The herpetology of the Cayman Islands. Bull. Inst. Jamaica, Sci. Ser. (2): iv + 56 pp. — Elevated from subspecific status by Burton (2004).

Family Polychrotidae

Anolis altitudinalis. *Anolis isolepis altitudinalis* Garrido 1985:42. • CUB • Garrido, O. H. 1985. Nueva subspecie de *Anolis isolepis* (Lacertilia: Iguanidae) para Cuba. Doñana, Acta Vertebrata 12:41–49. — Elevated from subspecific status by Garrido and Hedges (2001).

Anolis breslini. *Anolis whitemani breslini* Schwartz 1980: 403. • HISP • Schwartz, A. 1980. Variation in Hispaniolan *Anolis whitemani* Williams. J. Herpetol. 14: 399–406. — Elevated from subspecific status by Glor et al. (2003).

Anolis carolinensis. *A[nolius]. carolinensis* Voigt 1832:71. • CAY, LA • Voigt, F. S. 1832. Das Thierreich, Geordnet nach seiner Organisation. Als Grundlage der Naturgeschichte der Thiere und Einleitung in die Vergleichende Anatomie. Vom Baron von Cuvier. Nach der zweiten, vermehrten Ausgabe übersetzt und durch Zusätze erweitert. Zweiter Band, die Reptilien und Fische enthaltend. F. A. Brockhaus, Leipzig. xvi + 539 pp. — The presence of a breeding population on Anguilla was reported by Eaton et al. (2001) and the presence of the species on Grand Cayman by Powell (2002).

Anolis chrysops. *Anolis marmoratus chrysops* Lazell 1964:389. • LA • Lazell, J. D., Jr. 1964. The anoles (Sauria, Iguanidae) of the Guadeloupéen Archipelago. Bull. Mus. Comp. Zool. 131:359–401. — Elevated from subspecies status by Breuil (2002).

Anolis cristatellus. *Anolis cristatellus* Duméril and Bibron 1837:143. • HISP, PRB, LA • Duméril, A. M. C., and G. Bibron. 1837. Erpétologie Générale ou Histoire Naturelle Complète des Reptiles. Volume 4. Libr. Encyclopédique Roret, Paris. — The presence of an established population on Dominica has been reported by R. Thorpe (unpubl. ms.).

Anolis desiradei. *Anolis marmoratus desiradei* Lazell 1964:387. • LA • Lazell, J. D., Jr. 1964. The anoles (Sauria, Iguanidae) of the Guadeloupéen Archipelago. Bull. Mus. Comp. Zool. 131:359–401. — Elevated from subspecies status by Breuil (2002).

Anolis kahouannensis. *Anolis marmoratus kahouannensis* Lazell 1964:382. • LA • Lazell, J. D., Jr. 1964. The anoles (Sauria, Iguanidae) of the Guadeloupéen Archipelago. Bull. Mus. Comp. Zool. 131:359–401. — Elevated from subspecies status by Breuil (2002).

Anolis leachii. *Anolis leachii* Duméril and Bibron 1837:153. • LA • Duméril, A. M. C., and G. Bibron. 1837. Erpétologie Générale ou Histoire Naturelle Complète des Reptiles. Volume 4. Libr. Encyclopédique Roret, Paris. — This form had been treated variously as a species or subspecies for some time until formally re-elevated to species status by Powell and Henderson (2001).

Anolis litoralis. *Anolis centralis litoralis* Garrido 1975:12. • CUB • Garrido, O. H. 1975. Distribución y variación de *Anolis argillaceus* Cope (Lacertilia: Iguanidae) en Cuba. Poeyana (142):1–28. — Elevated from subspecific status by Navarro et al. (2001).

Anolis mimus. *Anolis mimus* Schwartz and Thomas 1975 was allocated to the synonymy of *A. rejectus* Garrido and Schwartz 1972 by Garrido and Hedges (2000).

Anolis oporinus. *Anolis oporinus* Garrido and Hedges 2001:379. • CUB • Garrido, O. H., and S. B. Hedges. 2001. A new anole from the northern slope of the Sierra Maestra in eastern Cuba (Sauria: Iguanidae). J. Herpetol. 35:378–383.

Anolis pogus. *Anolis wattsi pogus* Lazell 1972:35. • LA • Lazell, J. D., Jr. 1972. The anoles (Sauria, Iguanidae) of the Lesser Antilles. Bull. Mus. Comp. Zool. 143:1–115. — This form has been treated variously as a species or subspecies for some time until formally elevated to species status by Powell and Henderson (2001); see also Breuil (2002).

Anolis rejectus. *Anolis vanidicus rejectus* Garrido and Schwartz 1972:517. • CUB • Garrido, O. H., and A. Schwartz. 1972. The Cuban *Anolis spectrum* complex (Sauria: Iguanidae). Proc. Biol. Soc. Washington 85:509–522. — Elevated from subspecific status by Garrido and Hedges (2000).

Anolis sagrei. *Anolis Sagrei* Cocteau *in* Duméril and Bibron 1837:149. • BAH, CAY, CUB, JAM, LA, WC • Duméril, A. M. C., and G. Bibron. 1837. Erpétologie Générale ou Histoire Naturelle Complète des Reptiles. Vol. 4. Libr. Encyclopédique Roret, Paris. — The presence of established populations on Grenada was reported by Greene et al. (2002).

Anolis schwartzi. *Anolis wattsi schwartzi* Lazell 1972:32. • LA • Lazell, J. D., Jr. 1972. The anoles (Sauria, Iguanidae) of the Lesser Antilles. Bull. Mus. Comp. Zool. 143:1–115. — This form has been treated variously as a species or subspecies for some time until formally elevated to species status by Powell and Henderson (2001); see also Breuil (2002).

Anolis terraealtae. *Anolis terrae = altae* Barbour 1915:76. • LA • Barbour, T. 1915. Recent notes regarding West Indian reptiles and amphibians. Proc. Biol. Soc. Washington 28:71–78. — Re-elevated from subspecies status by Breuil (2002).

Anolis terueli. *Anolis terueli* Navarro, Fernández, and Garrido 2001:68. • CUB • Navarro P., N., A. Fernández V., and O. H. Garrido. 2001. Reconsideración taxonómica de *Anolis centralis litoralis* y descripción de una especie nueva del grupo *argillaceus* (Sauria: Iguanidae) para Cuba. Solenodon 1:66–75.

Anolis toldo. *Anolis toldo* Fong and Garrido 2000:666. • CUB • Fong G., A., and O. H. Garrido. 2000. Nueva especie de *Anolis*

(Sauria: Iguanidae) de la región norte de Cuba oriental. Rev. Biol. Trop. 48:665–670.

Family Scincidae

Mabuya macleani. *Mabuya macleani* Mayer and Lazell 2000:871. • PRB • Mayer, G. C., and J. Lazell. 2000. A new species of *Mabuya* (Sauria: Scincidae) from the British Virgin Islands. Proc. Biol. Soc. Washington 113:871–886.

***Mabuya sloanii* complex.** *Mabuya sloanii* Daudin 1802: Figure 4. • JAM, TC, HISP, PRB, LA • Daudin, F.-M. 1802. Histoire Naturelle, Générale et Particulière des Reptiles. Tome IV. F. Dufart, Paris. — Nomenclatural change for West Indian skinks (except *M. lineolata* from Hispaniola), see Mayer and Lazell (2000), who used *Mabuya sloanii* for skinks of the Puerto Rico Bank and stated that: "The Antillean skinks formerly included in the *Mabuya* "*mabouya*" complex not dealt with in this paper (Lesser Antilles, Jamaica, Hispaniola) are best referred to as the *Mabuya sloanii* complex until their systematics can be resolved." Breuil (2002) used *M. mabouya* for most Lesser Antillean skinks, but assigned specimens from St.-Barthélemy to *M. sloanii*. He also noted that populations of both species on St.-Martín had been extirpated.

Family Tropidophiidae

Tropidophis curtus. *Ungualia curta* Garman 1887:279. • BAH • Garman, S. 1887. On West Indian reptiles in the Museum of Comparative Zoölogy, at Cambridge, Mass. Proc. Amer. Phil. Soc. 24:278–286. — Re-elevated to full species status by Hedges (2002).

Tropidophis galacelidus. *Tropidophis pilsbryi galacelidus* Schwartz and Garrido 1975:86. • CUB • Schwartz, A., and O. H. Garrido. 1975. A reconsideration of some Cuban *Tropidophis* (Serpentes, Boidae). Proc. Biol. Soc. Washington 88:77–90. — Elevated to full species status by Hedges and Garrido (2002).

Tropidophis hardyi. *Tropidophis nigriventris hardyi* Schwartz and Garrido 1975:81. • CUB • Schwartz, A., and O. H. Garrido. 1975. A reconsideration of some Cuban *Tropidophis* (Serpentes, Boidae). Proc. Biol. Soc. Washington 88:77–90. — Elevated to full species status by Hedges and Garrido (2002).

Tropidophis hendersoni. *Tropidophis hendersoni* Hedges and Garrido 2002:158. • CUB • Hedges, S. B., and O. H. Garrido. 2002. A new snake of the genus *Tropidophis* (Tropidophiidae) from eastern Cuba. J. Herpetol. 36:157–161.

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Tropidophis schwartzi. *Tropidophis caymanensis schwartzi* Thomas 1963:3. • CAY • Thomas, R. 1963. Cayman Islands *Tropidophis* (Reptilia, Serpentes). Breviora (195):1–8. — Elevated to full species status by Hedges (2002).

Tropidophis stejnegeri. *Tropidophis pardalis stejnegeri* Grant 1940:119. • JAM • Grant, C. 1940. II. The reptiles. *In* W. G. Lynn and C. Grant, The Herpetology of Jamaica, pp. 61–148. Bull. Inst. Jamaica Sci. Ser. (1), Kingston. — Elevated to full species status by Hedges (2002).

Tropidophis stullae. *Tropidophis maculatus stullae* Grant 1940:121. • JAM • Grant, C. 1940. II. The reptiles. *In* W. G. Lynn and C. Grant, The Herpetology of Jamaica, pp. 61–148. Bull. Inst. Jamaica Sci. Ser. (1), Kingston. — Elevated to full species status by Hedges (2002).

Family Typhlopidae

Ramphotyphlops braminus. *Eryx braminus* Daudin 1803: 279. • CAY, LA • Daudin, F.-M. 1803. Histoire Naturelle Générale et Particulière des Reptiles. Vol. 7. F. Dufart, Paris. — Echternacht and Burton (2003) reported the presence of this species on Grand Cayman and Breuil (2002) noted its presence on St.-Martín and St.-Barthélemy.

Typhlops guadeloupensis. *Typhlops guadeloupensis* Richmond 1966:129. • LA • Richmond, N. D. 1966. The blind snakes, *Typhlops*, of Guadeloupe and Dominica with the description of a new species. Herpetologica 22:129–132. — Re-elevated to full species status by Breuil (2002).

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TECHNIQUES

Herpetological Review, 2003, 34(4), 345–348.

A Radio Transmitter Belt for Small Ranid Frogs

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Radio telemetry is a useful technique for gathering information about amphibians when associated caveats are applied (Bartelt and Peterson 2000). A number of designs for transmitter attachment are available for larger anurans including a harness-type attachment (van Nuland and Claus 1981) and various belt designs (Bartelt and Peterson 2000; Rathbun and Murphey 1996; Waye 2001). Attaching radios to small anurans is particularly problematic because of their mass, shape, and delicate skin. Small radios, 0.61 grams or less, are available, although battery life is usually only 2–3 wks (e.g., Holohil Systems Ltd; Carp, Ontario, Canada[1]). The issues remaining are the weight and longevity of the attachment system, ease of application to the animal, and effect on the behavior and health of the animal.

Here I describe an attachment assembly tested in the laboratory on juvenile leopard frogs (*Rana pipiens*) and used on wood frogs (*Rana sylvatica*) in the field.

The goal of the field study was to fit radio assemblies to 8 wood frogs (4 males and 4 females) and to follow them for approximately 2 wks (the life of the battery) during and immediately after the breeding season (May–early June). Male wood frogs generally breed in their second spring when they are between 34 and 40 mm snout–vent length (SVL); females generally breed in their third spring when they are between 45 and 54 mm SVL (Hammerson 1999). Currently available attachment methods were unacceptable for these small ranid frogs.

I used Holohil BD-2A transmitters (0.61 g). The transmitters were configured so that the battery was placed on top of the transmitter rather than in front of it (Fig. 1b). In earlier trials, using the belt system described by Bartelt and Peterson (2000) and the original, linear arrangement of the transmitter, frogs were unable to properly orient themselves in the water. This was because the length of the assembly system made the transmitter ride too far up on the frog's back and because the belt material was too bulky.

I used very fine craft elastic (gossamer floss, B. Toucan, Inc., US $1.64 for 5 yds) and size 14 Japanese glass seed beads in olive

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SOCIETY FOR THE STUDY OF AMPHIBIANS AND REPTILES

www.ssarherps.org

The Society for the Study of Amphibians and Reptiles, the largest international herpetological society, is a not-for-profit organization established to advance research, conservation, and education concerning amphibians and reptiles. Founded in 1958, SSAR is widely recognized today as having the most diverse society-sponsored program of services and publications for herpetologists. Membership is open to anyone with an interest in herpetology—professionals and serious amateurs alike—who wish to join with us to advance the goals of the Society.

All members of the SSAR are entitled to vote by mail ballot for Society officers, which allows overseas members to participate in determining the Society's activities; also, many international members attend the annual meetings and serve on editorial boards and committees.

ANNUAL DUES AND SUBSCRIPTIONS: Annual membership dues for the year 2004 in the Society for the Study of Amphibians and Reptiles are as follows: **REGULAR** membership US$60 (Student $30)—includes *Journal of Herpetology* and *Herpetological Review*; **PLENARY** membership US$80 (Student $45)—includes *JH*, *HR*, and annual subscription to the *Catalogue of American Amphibians and Reptiles*; **INSTITUTIONAL SUBSCRIPTION** $115—includes JH and HR. Additional fee for airmail postage outside USA $35 for one year. Additional membership categories available on the SSAR webpage: http://www.ssarherps.org/pages/membership.html.

All members and institutions receive the Society's primary technical publication, the *Journal of Herpetology*, and its news-journal, *Herpetological Review*; both are published four times per year. Members also receive pre-publication discounts on other Society publications, which are advertised in *Herpetological Review*.

Payment must be made in USA funds, payable to "SSAR," or by International Money Order, or with VISA or MasterCard (account number and expiration date must be provided). Payment should be sent to: Theodora Pinou, SSAR Treasurer, Peabody Museum of Natural History, P.O. Box 208118, New Haven, Connecticut 06520-8118, USA. Fax: (203) 432-5176; e-mail: theodora.pinou@yale.edu

Future Annual Meetings

2004 — University of Oklahoma, Norman, Oklahoma, 26–31 May (with ASIH, HL)
2005 — University of South Florida, Tampa, Florida (with ASIH, HL)

About Our Cover: *Protobothrops jerdonii*

Forested areas of southeastern Asia are home to a diverse group of pitvipers assigned to several genera. Many of these species have traditionally been placed within the genus *Trimeresurus*, but recent molecular phylogenetic studies (Kraus et al. 1996. Copeia 1996:763–773; Parkinson 1999. Copeia 1999:576–586; Tu et al. 2000. Zool. Sci. 17:1147–1157) have confirmed the presence of multiple monophyletic assemblages within *Trimeresurus* (*sensu lato*). Of these, the genus *Protobothrops* (Hoge and Romano-Hoge 1983. Mem. Inst. Butantan 44–45:81–118) comprises a group of seven species of relatively gracile pitvipers that collectively range from India eastward to China, Japan, and Vietnam.

Protobothrops jerdonii occupies areas of southern China, northeastern India, and northern Indochina. The snake on our cover is representative of *P. j. bourreti* (Klemmer, 1963), a relatively rare and narrowly distributed subspecies, occupying northwestern Vietnam (Lao Cao and Lai Chau provinces).

This specimen, photographed in situ by **Nikolai Orlov**, was found in the morning on the branch of a tree in secondary montane rainforest at 1900 m elevation in the Hoang Lien mountain region (Lao Cao Province, northwestern Vietnam). Orlov used a tripod-mounted Nikon F4 camera with a Nikkor f2.8 macro lens, two SB 28 flashes, and Fuji Sensia (100 ASA) film to record the image. To show this snake in landscape with surrounding habitat in focus, a low aperture setting of f11 was used.

Orlov and colleagues have studied this snake in the Mount Fan Si Pan area, where it occurs from 1400 to 2300 m elevation. It is semi-arboreal, active mostly at night on bushes, large boulders, and rocky slopes on the banks of waterfall streams. Basking snakes have been observed in April and May during the day following cold nights where air temperatures dropped to 10°C. Interestingly, snakes have been found at night at air temperatures as low as 11°C, being fully active and even feeding (Orlov et al. 2002. *In* Schuett et al. [eds.], Biology of the Vipers, pp. 345–359. Eagle Mountain Publ., Eagle Mountain, Utah; Orlov et al. 2002. Faun. Abh. Staatl. Mus. Tierk. Dresden 23[10]:177–218). Mating seemingly takes place in April and young are born live.

Orlov is a research scientist affiliated with the Zoological Institute of the Russian Academy of Sciences in St. Petersburg. He has a long-standing interest in the herpeto-fauna of the Palearctic and eastern Asia, and has authored about 140 publications, including six monographs. He has led or participated in more than 50 collecting expeditions to areas throughout the former Soviet Union, as well as Mongolia, Vietnam, Thailand, Laos, Nepal, and India, often in cooperation with herpetologists from Goteborg University, Royal Ontario Museum, Field Museum of Natural History, and Museum of Vertebrate Zoology.

SSAR BUSINESS

Announcing the 2004 Joint Meeting of Ichthyologists and Herpetologists 26–31 May 2004

HERPETOLOGISTS' LEAGUE (HL)
AMERICAN ELASMOBRANCH SOCIETY (AES)
SOCIETY FOR THE STUDY OF AMPHIBIANS AND REPTILES (SSAR)
AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS (ASIH)

Please see the insert included in current issue of *Journal of Herpetology* for information on how to register for the Joint Meeting in Norman, Oklahoma. All material normally included in the Call for Papers will be accessible on the Joint Meeting website (www.dce.ksu.edu/2004jointmeeting). The Joint Meeting website will be linked to ASIH, HL, SSAR, and AES websites. **In contrast to past years, the Call for Papers will only be mailed if requested.** Members who lack access to the internet may request paper copies from William J. Matthews, Department of Zoology, University of Oklahoma, Norman, Oklahoma 73019, USA (e-mail: wmatthews@ou.edu; fax 405-325-6202).

Herpetological Conservation Update

Herpetological Conservation is an SSAR publication series devoted to important topics in the conservation biology of amphibians and reptiles. Volume Three, scheduled for publication in 2005, will focus on **Urban Herpetology**. We are currently seeking contributions. The Editors for the volume are Dr. Robin E. Jung and Dr. Joseph C. Mitchell. For a description of this volume's scope, objectives, topics, and contribution needs, please go to http://www.ku.edu/~ssar/HConservation.html.

Seibert Award Winners for 2003 Announced

The twelfth annual Seibert Awards were presented at the 46th Annual Meeting of the SSAR in Manaus, Brazil, 26 June–1 July

2003. These awards are named in honor of Henri C. Seibert, an early and tireless supporter of SSAR (having served as an officer for over 20 years). In recognition of outstanding student presentations at the annual meeting, a single award was given in each of the following categories: Systematics (3 eligible presentations), Physiology/Morphology (5 eligible presentations), Evolution (3 eligible presentations), Ecology (10 eligible presentations), and Conservation (8 eligible presentations). All five awardees received a check for US $200 and a book from Academic Press.

The Winners.—Systematics: Matthew Brandley, Department of Biology, San Diego State University, "Inferring the Phylogenetic Relationships of Skinks (Squamata: Scincidae) using Partitioned Bayesian Analyses of DNA." Physiology/Morphology: Paula Kahn, Craig Guyer, and Mary Mendonça, Dept. of Biological Sciences, Auburn University, "Biomarkers of Stress and Immunocompetence in Gopher Tortoises: A Preliminary Study." Ecology: Nancy Schoeppner and Rick Relyea, Dept. of Biological Sciences, University of Pittsburgh, "All Cues are not Created Equal: How Predator Diets Affect Prey Behavior." Conservation: Robert Puschendorf, Frederico Bolaños, and Gerardo Chaves, Universidad de Costa Rica, "Long-term, Widespread, Taxonomic and Geographic Prevalence of Chytrid Fungus in Costa Rican Anurans." Evolution: Conrad Hoskin and Craig Moritz, Department of Zoology and Entomology, University of Queensland, "Character Displacement across a Mosaic Contact Zone in the Green-Eyed Tree Frog *Littoria genimaculata* of the Wet Tropics, NE Australia."

Honorable Mention.—Ecology: Josh Auld and Rick Relyea, University of Pittsburgh, "Having the Guts to Compete: Competitor-Induced Plasticity in Tadpole Intestines." Leigh Isaac, University of Victoria, "Characterizing the Thermal Ecology of the European Grass Snake (*Natrix natrix*) in Southeastern England." Patrick Owen, University of Connecticut, "Relative Rates of Evolution in Advertisement and Aggressive Calls in Chorus Frogs, Genus *Pseudacris*." Conservation: Joanne Hoare, Shirley Pledger, Susan Keall, Nicola Nelson, Nicola Mitchell, Charles Daugherty, Victoria University of Wellington, "Declining Body Condition Prompts Concern for the Brothers Island Tuatara, *Sphenodon guntheri*." Taylor Edwards, Cecil Schwalbe, Don Swann, Caren Goldberg, University of Arizona, "Conservation Genetics of the Sonoran Desert Tortoise, *Gopherus agassizii*."

The judges were Adolfo Amezquieta (Universidad de los Andes), Brian Crother (Southeastern Louisiana University), Chuck Crumley (Elsevier Science-Academic Press), David Bickford (University of Texas, Austin), Bobby Espinoza (California State University, Northridge), Cindy Hitchcock (USGS), Bill Magnusson (Instituto Nacional de Pesquisas da Amazônia), Joe Mendelson (Utah State University), Kirsten Nicholson (Washington University), and Marion Preest (The Claremont Colleges).

Graduate Student Reprint and Book Scavenge

Do you have extra or duplicate reprints, books, or other publications taking up valuable shelf space in your office? If so, please consider donating them to the Graduate Student Reprint & Book Scavenge, to be held at the 2004 Joint Annual Meeting in Norman, Oklahoma. This is a great opportunity for younger herpetologists to add to their research libraries. Donors can bring materials directly to the meeting or ship them ahead of time to: *Stephen C. Richter, Oklahoma Biological Survey, 111 East Chesapeake Street, Norman, Oklahoma 73019, USA; e-mail: richter@ou.edu*. Please notify Stephen if you will be bringing items with you to the meeting.

Silent Auction at 2004 Meeting

The SSAR Student Travel Awards Committee announces the Ninth Annual Frameable Art Silent Auction to be held at the 2004 SSAR meeting at the University of Oklahoma, Norman, Oklahoma. Preferred donations include herp-related photos, line drawings, prints, paintings, plates, engravings, or anything frameable, if not already framed. If you are interested in donating an item (tax deductible for U.S. residents), please contact: *Stephen C. Richter, Oklahoma Biological Survey, 111 East Chesapeake Street, Norman, Oklahoma 73019, USA; e-mail: richter@ou.edu*. Please notify Stephen if you will be bringing silent auction items with you to the meeting.

SSAR Student Travel Awards: Call for Applications

Ten awards of US $200 each are available. An applicant for a travel award must be a student and a member of SSAR, must not have previously received a travel award from SSAR, and must be the first author of a paper or poster to be presented. Application package must include: 1) letter signed by his/her major advisor or department chair that states: he/she is not completely funded for travel from another source; 2) an official copy of the poster or paper abstract to be presented; 3) a self-addressed, stamped envelope. If the research is co-authored, the applicant must also include a letter from his/her advisor stating that the work was primarily the product of the applicant. Qualified applicants are pooled and winners are drawn at random. Students from local meeting site and current members of the SSAR Travel Awards Committee are excluded from applying for a travel award. Applications must be postmarked by 15 April 2004. Award checks will be disbursed at the SSAR business meeting. Send application package to: *Dawn S. Wilson, Southwestern Research Station, P.O. Box, 16550, Portal, Arizona 85632, USA*, or for further information e-mail: dwilson@amnh.org.

SSAR Special Membership Recognition

SSAR wishes to acknowledge gratefully the following Supporting and Plenary Members. If you wish to support the Society at either of these levels, please contact Donald Schmitt at the Membership Office (ssar@memsys.com).

Supporting Members: Christopher J. Bell, James Bergan, Alvin R. Breisch, Bryant Buchanan , John P. Feeney, Douglas F. Fraser, Brian Greene, William Holmstrom, Jr., Joseph Hummer, Victor Hutchison, Richard Lardie, Tom Lott, Teresa J. & Eddie Mayfield,

Jack K. McAllister, III, Robert W. McKeever, Paul Moler, William S. Parker, Anders G. Rhodin, Robert M. Rioux, Willem Roosenburg, Hartwell Welsh, Jr., Sharon Wise, Robert A. Young.

Plenary Members: Clifton Acosta, Robert Aldridge, Noel Alt, Steven Anderson, Blain Anderson, Gilda Andrade, James Andrews, John S. Applegarth, Rudolf Arndt, David L. Auth, Ralph Axtell, Donald Ayres, Badger, Jean-Pierre Baron, Sean J. Barry, Rogerio Pereira Bastos, Aaron Bauer, Christopher K. Beachy, Joseph Beatty, Marc-Andre Beaucher, Joseph Bernardo, Matthew Bettelheim, Robert L. Bezy, James P. Bogart, J. Kevin Bowler, Ronald Brandon, Alvin Braswell, Bayard Brattstrom, Jeff Briggler, Henrik Bringsøe, Janine B. Brodeur, Lauren Brown, William S. Brown, Nikolle L. Brown, Chris Brown, Richard C. Bruce, Robert W. Bryson, Jr., Sandra Buckner, Walter Bulmer, Gordon Burghardt, Oswald Burkhard, R. Bruce Bury, Stephen Busack, Janalee Caldwell, Jose L. Camarillo, Jeffrey Camper, Ulisses Caramaschi, Charles Carpenter, Joseph Cebek, Paul Chippindale, Bruce Christman, George Cline, Vincent A. Cobb, Philip Cochran, Charles Cole, William Coles, Scott Coles, Guarino Colli, Joseph Collins, Francis R. Cook, Joseph F. Copp, Michael Corn, David Cundall, Richard Daniel, Robert Davic, Jon Davidson, J. Rogers Davis, Kevin de Queiroz, James Dixon, Michael Dloogatch, C. Kenneth Dodd, Jr., Herndon Dowling, Wayne Drda, William Duellman, Richard Edgren, Carl Ernst, Carlos Estol, Jean-Marie Exbrayat, James D. Fawcett, Gary Ferguson, George Ferguson, Dino Ferri, Bill Flanagan, Oscar Flores Villela, Richard Franz, Thierry Fretey, Patricia Fromm, Darrel Frost, Richard S. Funk, Cory Gardiner, Robert E. Gatten, Jr., David J. Germano, Itzchak Gilboa, Laine A. Giovanetto, Jason Glassy, Stephen Goldberg, Matt Goldsworthy, Steve Gotte, Jan Grathwohl, Edward Greding, Jr., James Grizzell, Neil Gushulak, Ronald Gutberlet, Jr., Carol Hall, Michael Hallman, Geoffrey Hammerson, Robert Hansen, Rick Harmon, Trish Plumb Hartmann, J. Brian Hauge, Thomas M. Hays, Terrell Heaton-Jones, Stephen J. Hecnar, Neil Heinekamp, Philip Heise, Notker Helfenberger, Kurt Henkel, Robert Herrington, D. Grant Hokit, Eugene W. Holmes, Paul Huang, Jun Ikeda, Craig Ivanyi, Robert Jaeger, Alan Jaslow, Bob Johnson, Jerry Johnson, William M. Johnson, David Johnson, Delvin Jones, Robert L. Jones, Frank W. Judd, Tina Jungwirth, J. Eric Juterbock, Ronald Jyring, Larry Kamees, Kiyoshi Kasugai, Maureen Kearney, Edmund Keiser, J. Scott Keogh, Peter Kern, Ken King, James J. Kirk, Erik Kiviat, Michael Klemens, John Kleopfer, Gunther Köhler, Akihiro Koshikawa, Linda Krulikowski, Thomas Laduke, Michael Lannoo, James Lazell, Jr., Holger Lehmann, Brandon Lenenski, Mark Lethaby, Joseph Lewandowski, Lauren Livo, John Lynch, Meredith Mahoney, Clark Mahrdt, Jacob Malcom, Edmond V. Malnate, Allan Markezich, Gilbert Matz, Jeffrey Mayne, Peter Mayne, Chris McAllister, John McBride, Don McCarty, James R. McCranie, Hugh McCrystal, Samuel B. McDowell, William T. McDowell, M. Elizabeth McGhee, Jimmy A. McGuire, Brian McGurty, Jim I. Mead, D. Bruce Means, Philip Medica, Joseph R. Mendelson, III, George L. Meyer, Brian Miller, Edwin Mills, Mark Mills, Russell Mittermeier, Frank Mondrosch, Richard Montanucci, Jose Manuel Mora, John Moriarty, James Mueller, Raul Muniz-Martinez, Sergio Murillo, James Murphy, John C. Murphy, Charles W. Myers, Andreas Noellert, Ronald Nussbaum, R. Andrew Odum, James Organ, Sue Orloff, Mark O'Shea, Christopher Oufiero, Gary C. & Mary J. Packard, William M. Palmer, Ingo Pauler, Thomas K. Pauley, Ray Pawley, Peter Petokas, Ralph Pfingsten, Kok Philippe, Jorge Luis Pinero, Edward Pirog, Michael Plummer, Allan Puskar, Larry R. Raymond, Michael Redmer, Dawn Reis, Randall Reiserer, Christophe Remy, Stephen Ressel, Alan Richmond, Jose Rosado, Philip Rosen, Richard Rosevear, Manny Rubio , Anthony Russell, Paul Russo, Mason Ryan, Richard Sage, Richard Sajdak, Jay Savage, Alan Savitzky, John Scheibe, James Schulte, II, Paul Schulze, Donald Schwab, Tim Schwab, Gregory Setz, David Sever, Owen Sexton, Wade Sherbrooke, C. Robert Shoop, Thomas Simpson, Dan Singer, Jack Sites, Jr., Tim Skelton, Cathie B. Slack, Eric Smith, Hobart M. Smith, James Spotila, Brett Stearns, Dirk Stevenson, Glenn Stewart, James Stewart, Keith Stokes, James N. Stuart, John Sullivan, Samuel Sweet, Tomoko Tanaka-Ueno, Tracy Tarr, Nathan Taylor, Michele Testoni, Andrea Teti, Robert E. Todd, Jr., Michihisa Toriba, Daniel Townsend, Stanley E. Trauth, Eugene Trescott, Jr., Ray Tripp, Tom Tryning, Bern Tryon, Martin A. Tuegel, Clara Turnbull-Murphy, Sheila E. Tuttle, David Ulrich, Robert W. Van Devender, Thomas Vance, Murlin Varner, Jr., Glenn E. Vaters, James L. Vial, Laurie Vitt, Kent Vliet, Richard Vogt, David B. Wake, Warren F. Walker, Jr., Tomas Waller, Harlan D. Walley, Richard Wassersug, R. Mark Waters, Donna J. Wear, Frank Wegscheider, Michael Weil, Scott Weinstein, Wayne Weller, Kentwood Wells, John E. Werler, J. Kirwin Werner, Albert Westerman, Kenneth Williams, Lawrence A. Wilson, Tonnie Woeltjes, Richard D. Worthington, Wolfgang Wüster, Douglas Wynn, Radu Zamfirescu, Peter Zani, David Zeitz, George Zug, Richard Zweifel.

2003 Annual Meeting: Manaus, Brazil

The 46th annual meeting of SSAR took place from June 26 to July 1, 2003 in the Hotel Tropical Conference Center in Manaus, Amazonas, Brazil. As has been the case in recent years, the Society met jointly with the American Society of Ichthyologists and Herpetologists (ASIH), the American Elasmobranch Society (AES), and The Herpetologists' League (HL). Additionally, this year we were joined by the Neotropical Ichthyological Association, Sociedade Brasileira de Ictiologia, Sociedade Brasileira para o Estudo de Elasmobrânquios, and Sociedade Brasileira de Herpetologia. The meeting was hosted by Instituto Nacional de Pesquisas da Amazônia (INPA), Universidade Federal do Amazonas, and Associação de Ictiólogos e Herpetólogos da Amazônia.

More than 1100 herpetologists and ichthyologists (over half of them students) from at least 35 countries attended the meeting. Eleven symposia were held and almost 400 oral and 500 poster presentations were enjoyed over a very busy 6-day period. Many thanks to the local chairs, Richard C. Vogt and Ning Labbish Chao, and the hoards of volunteers for organizing and running the meeting in such a unique and special place.

Social Programs

Walter Hödl, a preeminent tropical amphibian biologist from the University of Vienna, presented this year's SSAR President's Travelogue on the evening of June 26 following an introduction by SSAR President Janalee Caldwell. In a packed room we were treated to a wonderful slide show entitled "From the Amazonian

The site of the annual meeting picnic on the banks of the Rio Negro. Photo by Dawn Wilson.

Floating Meadows to the Surumoni Canopy Crane Project: Frog Research in Amazonia." Dr Hödl's research has focused on behavioral ecology, population and acoustic biology, and reproductive behavior of frogs and salamanders. He has been coming to the Amazon since 1976, so is now well-seasoned, but admitted that his training as an alpine climber and lab biologist did rather little to prepare him for his first visit. We were treated to stories and slides of places he had been, of people who had helped him, and fountains he had bathed in! We also heard a little about Walter's "other life" filming stingless bees and ghost shrimp. Dr Hödl's presentation was wrapped up with a well-received presentation of the toe-tapping "*Phyllomedusa* Blues."

The Joint Plenary Session on the morning of June 27 began with a general welcome and introduction to the meeting from local chairs, Richard C. Vogt and Ning Labbish Chao, and local scientists and dignitaries. The ASIH Presidential Address, given by David Cannatella was entitled "AmphibiaTree: A Community-based Phylogeny of Amphibians." William E. Duellman, The Herpetologists' League's Distinguished Herpetologist, presented "In Search of El Dorado: The Neotropical Herpetofauna," and Ricardo Rosa presented the AES Presidential Address entitled "From the Amazon to Atol das Rocas: A Brief History of Brazilian Elasmobranch Studies." The traditional Group Photograph was then taken outside around the Vitoria Regia swimming pool. This year's photograph gathering outstripped even last year's (in Kansas City) in terms of heat and humidity. A busy schedule of oral and poster sessions was kicked off after lunch.

The Annual Auction, co-sponsored by SSAR and The Herpetologists' League, was held on the evening of June 30. Although the number of items available was down a little compared with recent years, energetic bidding still occurred and the auction was a great success. A canoe filled with beer undoubtedly helped drive up the bidding! An exhibit of live reptiles and amphibians native to the Amazon drew many viewers keen to see some of the local fauna. Thanks to Marcelo Gordo (UFAM) for arranging this.

The mid-meeting picnic was held on the sandy beach of the Rio Negro on the evening of June 29. The picnic featured a typical Brazilian churrasco with more food than we could have eaten in a week! Entertainment included music and dancing by "Boi-Bumbá." The social aspect of the meeting finished with the Joint Meeting Banquet on Tuesday (July 1). Once again we were well-entertained, this time by some of our own members.

Many attendees took advantage of the incredible locality and ventured far from Manaus either before or after the meeting. Full-day and half-day excursions were taken in the Manaus-Rio Negro area for those needing a break from meeting activities. Keen birdwatchers could often be seen lurking around the hotel grounds and trips to the local market were a real treat, especially for the ichthyologists.

Board Meeting and Business Meeting Summaries

Society President Janalee Caldwell called the Annual SSAR Board Meeting to order at 0810 h on June 26, 2003, at the Hotel Tropical in Manaus, Brazil. Nine members of the Board of Directors and/or the Society attended the meeting. Because of the lack of a quorum, issues were discussed but no votes could be taken. Necessary votes will be taken via email by the Board at a later date.

President Caldwell presented summaries of reports made by SSAR Board of Directors members, Committee Chairs, and Coordinators. Former President David Green reported on activities during the last six months of his Presidency. At the 2002 Annual Meeting in Kansas City, Kraig Adler and David Dennis were honored as founders of SSAR and presented with commemorative plaques designed by Jim Murphy. President Green communicated with the Board regarding the consequences of switching to biennial elections. This decision to change to biennial elections necessitates an increase in the number of Directors and a switch to 2- or 4-year terms of office. Relevant changes in the Society's by-laws were published in *Herpetological Review* (Vol. 33[3]: 163) and will be voted on by the general membership.

During President Green's term, a new set of Membership and Subscription rates was approved by the Board of Directors and compiled. Additionally, the role of the Publications Secretary was clarified to include some business oversight and foster

Tables of food were laid out for our enjoyment at the picnic, which was held on the beach of the Rio Negro. The tables were beautifully decorated with orchids and other tropical flowers. Photo by Janalee P. Caldwell.

Barbara and Al Savitzky and John Cadle enjoying a busy poster session. Photo by Dawn Wilson.

communications between the Society editors. Appointments made included Marion Preest as Secretary (replacing John Matter), Dennis Desmond as Webmaster (replacing George Pisani), John Matter as chair of the Conservation Committee (replacing Michael Plummer), Robin Jung as Editor of *Herpetological Conservation* (replacing Steve Corn), and Ron Brooks as chair of the Nominations Committee (replacing Julian Lee). Thanks are given to outgoing officers and editors for their service.

The Board approved the recommendation of a report written by Brian Crother that BioOne be used for on-line publication of the *Journal of Herpetology* and an agreement with BioOne was signed on Dec 31, 2002. President Green stepped down as President as of December 31, 2002.

President Caldwell reported that sites for the Joint Meeting have been finalized for 2004 (Norman, Oklahoma, May 26–31) and 2005 (Tampa, Florida). Plans are underway for meeting in New Orleans in 2006. A letter of invitation was received from Kelly Zamudio to hold the 50th Anniversary Year meeting in 2007 at Cornell University. Preparations for the 2004 meeting are well in hand with a budget approved, logo prepared, etc. A good turnout of SSAR members is expected.

In January, President Caldwell signed a contract with the new SSAR Webmaster, Dennis Desmond. A number of well-received changes and updates to the website have already been made. President Caldwell has recommended the formation of a web content committee.

Appointments made during the first half of 2003 include Dawn Wilson as Chair of the Resolutions Committee and Ruston Hartdegen as Chair of the Committee on Relations with Herpetologists at Zoological Parks.

With assistance from Bob Powell, the Dean E. Metter Memorial Award guidelines were completed and Joe Beatty was appointed as chair of the committee. The Board discussed whether the Award should be administered by the Grants-in-Herpetology Committee. Letters of appreciation were sent to the Bobby Witcher Society and to Dr. Metter's widow and daughter. Additionally, a letter of thanks was sent to Mrs. Robert E. Gordon acknowledging the donation of Dr. Gordon's library and stamp collection to SSAR.

President Caldwell has revised the Nominations Procedures and is compiling recent changes to the SSAR constitution and by-laws. Other documents, including Guidelines for Committee Chairs, will be revised in light of changes from annual to biennial elections. Electronic copies of the updated material will be posted to the SSAR website and transmitted to incoming officers and chairs.

Former Treasurer Robert Aldridge (for Theodora Pinou, Treasurer, *in absentia*) reported on the state of the Society's finances for calendar year 2002. The Society made a profit of \$32,794 during this period: \$18,502 in operating income and \$14,292 in realized investment income. However, as a result of the downturn in the stock market, the Society also has an unrealized loss on its investments of \$75,404. As this is a paper loss only, it will not be realized unless assets are sold before values rebound. All funds have experienced positive year-to-date returns during 2003. The Board discussed briefly a proposal to appoint a Development Officer for the Society to spearhead fundraising efforts. The decline in membership numbers noted in last year's report continues this year, particularly in the foreign individual category. Breck Bartholomew (Publications Secretary, *in absentia*) reported that income from sales of the Society's publications totaled

A Brazilian beach party with "horned lizards." Photo by Adrian A. Garda.

$58,241.

The Board discussed the status of the SSAR publications inventory and how to manage it. The inventory is currently being stored free of charge in St Louis; however, this arrangement will not continue indefinitely. Shipping the material to Salt Lake City (where the Publications Secretary is located) would be expensive and there the Society would need to pay for storage. Several suggestions were made regarding what to do with some material, including providing it free of charge to international scientists, foreign institutions, field stations, and regional herpetological societies and making the material available at nominal charge at the 2004 meeting in Norman.

Journal of Herpetology Editor, Brian K. Sullivan (*in absentia*), submitted a report indicating a number of personnel changes. Steve Busack, Rafael de Sá, Ken Dodd, John Fauth, Mike Harvey, and Paul Verrell resigned as Associate Editors during 2002–2003. They were replaced by Sharon Downes, Don Forester, Howard Whiteman, and Martin Whiting. Mike Harvey resigned from the Board of Editors and was replaced by Steve Busack.

A reduction in the submission rate in 2002 (220 as compared with 284 in 2001 and 262 in 2000) was thought to reflect: 1) the post-acceptance lag to publication; 2) an increased rejection rate; and 3) random fluctuation. The post-acceptance lag time has been reduced significantly as a result of an increase in page numbers. However, the pre-acceptance lag time still exists. The appointment of new Associate Editors and a request for electronic versions of manuscripts should alleviate this problem somewhat. Of the 220 submissions in 2002, 42 were accepted, 126 were rejected, and 52 were being revised by the authors. Compliments have been received regarding the recently implemented use of glossy paper and the inclusion of abstracts and subheadings in Shorter Communications.

Herpetological Review Editor Robert Hansen (*in absentia*), reported a 15% increase in the number of pages in *Herpetological Review* Volume 33 compared with Volume 32. He expects Volume 34 to be approximately the same size as Volume 33. This increase in page numbers has not entailed an increase in costs because the production of *Herpetological Review* is now completely electronic. The size of *Herpetological Review* grew steadily over the past few years (a 31% increase since 1999) and submissions continue to increase. The post-acceptance lag time for Natural History Notes, although down from 9-12 months to 6-9 months, is still higher than desirable. Sharyn Marks and Michael Dorcas stepped down as Associate Editors and were replaced by Michael Grace and Robert Reed. Gordon Schuett has replaced Brian Butterfield as a Section Editor for Natural History Notes.

Robert Powell (*in absentia*), Editor of the *Catalogue of American Amphibians and Reptiles* (*CAAR*), reported on the status of this publication effort. Bob noted that the 2002 contributions to *CAAR* consisted of 20 accounts (Nos. 741–760; one salamander, two frog, two turtle, eight lizard, and seven snake accounts) for a total of 81 printed pages. Color plates were included in 19 accounts. The 2003 subscription is scheduled for June (20 accounts; three salamander, four frog, two turtle, three lizard, and eight snake accounts) and Bob has tentative plans for another 20 accounts for 2004. Production costs continue to increase, primarily because of increases in the price of paper and mailing to members, but also because of costs of shipping accounts to the Publication Secretary. Bob requested a slight increase in the budget for 2004 to allow for typical page costs (including continued use of color plates) and acquisition of software upgrades. Gregory Watkins-Colwell is serving as Index Editor. Bob reported a continual struggle to receive an adequate number of accounts and further noted that the accounts he has received recently have not been geographically balanced.

Kraig Adler (Editor, *in absentia*) reported on the publication activities of *Contributions to Herpetology*. A recent publication in this series was "*Amphibians of Honduras*," by James McCranie and Larry David Wilson (February 2002). Anticipated in August 2003 is "*Islands and the Sea: Herpetological Explorations in the West Indies*," edited by Robert Henderson and Robert Powell. "*Biology of the Reptilia*, Volume 20 (Morphology)," edited by Carl Gans and Abbot Gaunt and "*Field Guide to Amphibians and Reptiles of the West Indies*," by S. Blair Hedges are expected in 2004. Beyond next year, publications will include "*Herpetological Time Travel Through the Zoo and Aquarium World*," by James B. Murphy, "*Tasks and Problems Studying the Life of Reptiles in Zoos*," by Hans-Günter Petzold, and "*Lizards of Southern Africa*," edited by William R. Branch and Aaron Bauer.

Editor of *Facsimile Reprints in Herpetology*, Aaron Bauer (*in absentia*), reported on the reprinting of "*Herpetology of Cuba*," by Thomas Barbour and C.T. Ramsden in April 2003. Expected in 2004 is "*Les Tortues de l'Indochine*," by René Bourret. "*The Herpetological Contributions of Mario Giancinto Peracca*," edited by Franco Andreone and Elena Gavetti (with an English translation of the introduction) and "*The Herpetological Contributions of John Edward Gray*" are anticipated beyond 2004. Gregory Watkins-Colwell has been appointed as Associate Editor. Aaron aims ultimately to produce two facsimile publications per year; however, for the near future he expects one per year.

Herpetological Circulars Editor, John Moriarty (*in absentia*), reported that HC 32, "*Conservation Guide to the Eastern Diamondback Rattlesnake*" will be published in August 2003. No *Herpetological Circular* is planned for 2004; however, manuscripts are being solicited for the future.

Stephen Corn (*in absentia*), former Editor of *Herpetological Conservation* reported that Volume 2 in this series, "*Ecology, Conservation, and Status of Reptiles in Canada*," has been received and is expected to be sent to the printer in Fall, 2003. Robin Jung has taken over the duties of Series Editor and will be involved with the production of Volume 2.

Reports were received from the following committees: Dean Metter Memorial Award Committee, Grants-in-Herpetology Committee, Henri Seibert Awards Committee, Kennedy Student Award Committee, Meeting Management and Planning Committee, Standard English and Scientific Names Committee, and Student Travel Awards Committee.

The Dean Metter Memorial Award Committee (Chair, Joseph Beatty, *in absentia*) has received proposals for this award and a winner will be announced in September, 2003. Deadlines for this award will be different in upcoming years and will be reported in *Herpetological Review*.

Erik Wild (Chair, *in absentia*) reported that six Grants-in-Herpetology Awards in the amount of $500 each have been made. The number of applications increased approximately 30% compared with recent years and included proposals from 12

countries other than the United States.

The Board commended Erik for soliciting proposals actively from individuals outside the U.S. They suggested that, in regard to the International Category, wording to the effect "preference will be given to students with limited access to research funds" be inserted in the call for applications. It was suggested that the posting of a sample proposal on the website might be useful to all applicants, particularly international applicants, and that a statement regarding budget items that will not be funded (e.g., salary) might be appropriate.

President Caldwell approved all requests from Erik Wild regarding changes to the wording of the advertisement in *Herpetological Review* and changes to the title page and supported the idea of electronic submission and review of proposals. The Board clarified that in the International Category the applicant must be a student, but not necessarily a Society member, and that in the Herpetological Education Category the applicant need not be a member or a student.

Marion Preest (Chair, Henri Seibert Awards Committee) reported that four awards were made at the 2002 Kansas City meeting (details published in *Herpetological Review* 33[3]:161–163). This year the (recently very large) Ecology/Evolution Category has been split in two. Although total number of participants was low this year, it is anticipated that numbers will rise next year.

Robert Gatten, Jr. (Chair, *in absentia*) reported that no Kennedy Student Award was made this year due to the lack of a clear emergence of a winner. The Board noted that information regarding the Kennedy Award should be posted to the website, and they discussed a recommendation regarding the eligibility of students for the Kennedy Student Award.

Henry Mushinsky (Chair, ASIH Meeting Management and Planning Committee) reported on the development of plans for the Manaus meeting and on a proposal regarding symposia given to each of the Societies participating in the joint meeting. The proposal recommends limiting the number of symposia sponsored by each Society to two (funded or unfunded) and limiting the length of the symposia to 1 day each.

Henry expects to receive an official invitation to hold the 2007 meeting in Minneapolis (an invitation has already been received from Cornell for the same meeting) and notes that the Societies are now being courted by potential host cities.

Brian Crother (Chair, Standard English and Scientific Names Committee) informed the Board that an update has been submitted to *Herpetological Review* and that David Green and Roy McDiarmid have been added to the committee. A suggestion was made that SSAR might consider sponsoring a field guide of North American amphibians and reptiles. It was thought that this would be a valuable alternative to the field guides currently, or soon to be, available and could be a source of funds for the Society.

Dawn Wilson, Chair of the SSAR Student Travel Awards Committee (*in absentia*) reported that 22 applications were received and ten awards will be presented at the Annual Auction in Manaus.

Coordinators' reports were received from the Elector (Maureen Kearney), Relations with Herpetologists at Zoological Parks Committee (Ruston Hartdegen), and SSAR Representative to the American Institute of Biological Sciences (Al Savitsky). Ruston Hartdegen (*in absentia*) reported on the appointment of five individuals to the committee, the development of a mission statement, and the outlining of general goals and a tentative schedule of events, including submission of an article to *Herpetological Review* detailing the scope and purpose of the SSAR Relations with Herpetologists at Zoological Parks Committee. Al Savitsky (*in absentia*) submitted a thorough report detailing his activities as AIBS representative. He attended the 2003 AIBS council and a meeting of BioOne. One issue discussed at the AIBS meeting of importance to SSAR dealt with the way in which biologists can influence public policy. It was suggested that each Society contribute a "success story" to show how basic research can serve the public interest. Also relevant was information provided about how best to ensure that letters addressed to political representatives reach their target. The BioOne meeting involved discussion of an international program, the role of library consortia, an evaluation of electronic manuscript submissions, and the long-term consequences of electronic publication for scientific Societies.

As per our agreement with BioOne, the *Journal of Herpetology* is now available online. It is too early to assess how many users of this service there are (or will be). The Board discussed making *Journal of Herpetology* available through BioOne to SSAR members who do not have access through their institutions. A charge (to cover costs and provide a small profit) would need to be made for this service. It was not clear how much use there would be of this, since these individuals would need to be members of SSAR and therefore are already receiving paper copies of the journal. It would provide early access to the journal (prior to mailing of the hard copy) and access to some back issues. A suggestion was made that a special membership category be made that only allows access to *Journal of Herpetology* electronically. This category would be less expensive than existing membership categories and could have the effect of increasing membership. The balance between a possible increase in membership and a decrease in sales of *Journal of Herpetology* needs to be considered.

The Board discussed the use of *Allen Track* to convert submissions and review of manuscripts to *Journal of Herpetology* to an entirely electronic process. This would have the effect of reducing the submission to publication lag time. Brian Sullivan is interested in the idea, but does not have the time to invest in setting up this system. A suggestion was made that we provide funds to support someone to assist Brian with the setup. Concern was expressed that conversion to a wholly electronic format makes it more difficult for reviewers to serve as copy-editors (as many currently do with hard copies of manuscripts). This then puts the job of copy editing solely on the associate editor.

There being no further business President Caldwell adjourned the meeting at 1155 h.

A sparsely attended SSAR Annual Business Meeting was held a few days later on June 29 in the Hotel Tropical. It was called to order at 1340 h by President Caldwell who then reviewed some of the issues dealt with in the Board Meeting. The only new business raised related to the upcoming World Congress of Herpetology (WCH) in Canada. Richard Wassersug reported on informal discussions held earlier in the week. Specifically, recommendations included choosing a theme for the Congress, thoroughly organizing the meeting prior to the event, increasing communication with participating societies and society members (possibly through increased website linking), and increasing representation of

individuals from areas other than North America and Europe. Concern was raised at the meeting about the continued dismantling of zoology departments worldwide. It was thought that the WCH could highlight the importance and usefulness of an organismal approach to biological research.

The meeting was adjourned at 1510 h.

— *Respectfully submitted by Marion R. Preest, SSAR Secretary*

NEWSNOTES

Southwestern Research Station Positions and Grants for 2004

VOLUNTEERS.—Approximately 30 volunteer positions are open at the American Museum of Natural History's Southwestern Research Station in Portal, Arizona. The volunteer program is run annually and offers students in biological sciences outstanding opportunities to observe and become involved with scientists doing field research. Food and lodging are provided to volunteers in exchange for twenty-four hours per week of routine chores, with the remaining time available for research activities.

The program is open to both undergraduate and graduate students; the latter may pursue their own research projects. Faculty knowing of promising students should alert them to this opportunity for professional experience toward, development of, and evaluation of their career goals. The program is open to non-students as well, particularly in the spring and fall.

Volunteers are needed between March 4 and October 31, 2004. Appointments are for part of this period, with a minimum appointment of six weeks. Applicants for spring positions (March–May) should submit applications by February 15, summer volunteers (June–August) by April 1, and fall volunteers (September–November) may apply any time.

For applications, write: *Dr. Dawn S. Wilson, Director, Southwestern Research Station, American Museum of Natural History, P.O. Box 16553, Portal, Arizona 85632, USA; phone/fax: 520-558-2396; e-mail:swrs@amnh.org.*

SOUTHWESTERN RESEARCH STATION STUDENT SUPPORT FUND.—The American Museum of Natural History awards several grants each year of approximately US $400–$800 to graduate or postdoctoral students pursuing research at its Southwestern Research Station in the Chiricahua Mountains, Portal, Arizona.

Information and application forms for this program and other Museum grant programs can be obtained by contacting: Office of Grants and Fellowships, American Museum of Natural History, Central Park West at 79th Street, New York, New York 10024-5192, USA; http://research.amnh.org/grants/index.html. Application due date: February 15, 2004. Address questions concerning the Station to: *Dr. Dawn S. Wilson, Director, Southwestern Research Station, American Museum of Natural History, Portal, Arizona 85632, USA; phone/fax: 520-558-2396; e-mail: swrs@amnh.org.*

Amphibian Monitoring Volume Translations

Russian and Spanish translations are now available for the book, "Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians," published by the Smithsonian Institution Press in 1994.

The Russian version was translated by Dr. Sergei M. Lyapkov, edited by Dr. Sergius L. Kuzmin, and printed by KMK Scientific Press Ltd. The Russian translation was printed in June 2003. The cost per copy is $29 US plus shipping. Orders should be sent to Dr. Kirill Mikhailov at kmk2000@online.ru.

The Spanish version was translated by Dr. Esteban O. Lavilla, edited by Olga MacBryde, and printed by Editorial Universitaria de la Patagonia. Although the book was printed in 2001, the Editorial Universitaria de la Patagonia has not been able to distribute it, due in large part to the Argentine economic crisis. Dr. Néstor Basso has successfully acted as an intermediary with the Editorial to resolve the distribution problem. The book is now available from Bibliomania. The cost per copy is US $24.95 plus shipping. Orders should be sent to Bibliomania either at breck@Herplit.com or the Bibliomania web site http://www.herplit.com.

Slowinski Award Recipient for 2003

The Center for North American Herpetology is pleased to announce that the inaugural recipient of the Joseph B. Slowinski Award for Excellence in Snake Systematics is Thomas P. Wilcox, formerly a researcher in the Section of Integrative Biology and Center for Computational Biology and Bioinformatics at the University of Texas, Austin, and currently conducting research in Florida. The award is named for the late Curator of Herpetology at the California Academy of Sciences, who died from the bite of a krait in the jungles of Myanmar on 12 September 2001.

This fitting tribute, brought about through the generous contributions of Joe's friends and colleagues, was created as a trust in perpetuity in 2002, with the commitment to award a $500 prize annually to the biologist who published in the previous calendar year the premier scientific paper on snake systematics, an area of research to which Joe Slowinski was deeply committed.

A distinguished committee, comprised of Frank Burbrink (City University of New York, Staten Island), Brian Crother (committee chair, Southeastern Louisiana University, Hammond), and Robin Lawson (California Academy of Sciences, San Francisco), selected the paper entitled "Phylogenetic Relationships of the Dwarf Boas and a Comparison of Bayesian and Bootstrap Measures of Phylogenetic Support" (published in *Molecular Phylogenetics and Evolution*, volume 25, number 2). The paper was co-authored by Wilcox with Derrick J. Zwickl, Tracy A. Heath, and David M. Hillis (all of the University of Texas at Austin).

MEETINGS

Meetings Calendar

22–23 April 2004—Squamate Evolution and Systematics: A Conference in Honour of Garth Underwood. Linnean Society of London, UK. For information, contact janet@linnean.org.

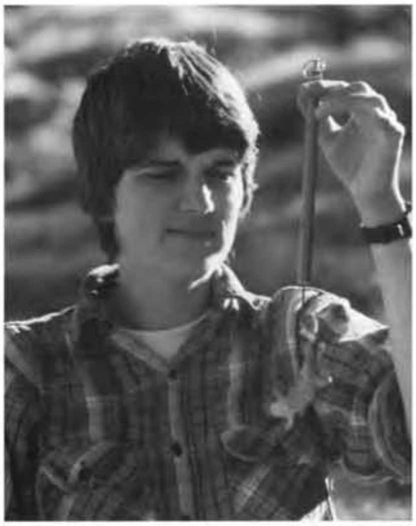
26–31 May 2004—47th Annual Meeting, Society for the Study of Amphibians and Reptiles, together with The Herpetologists' League and the American Society of Ichthyologists and Herpetologists. University of Oklahoma, Norman, USA.

15–20 November 2004—VI Symposium of Zoology, Havana, Cuba. Information: Executive Secretary: DrC. Daysi Rodríguez Batista (zoologia.ies@ama.cu) or www.geocities.com/zoologiacubana/simposio.

OBITUARIES

Herpetological Review, 2003, 34(4), 289.

Cynthia Kagarise Sherman (1950–2002)



Cindy Sherman, who published important papers on amphibian population declines and the role of diseases in them, died of pancreatic cancer in Ithaca, New York, on 16 November 2002, at the age of 52. Cindy was born in Altoona, Pennsylvania, on 6 September 1950. She graduated from Cornell University in 1972 with honors in biology for her research project completed under the mentorship of Jack W. Bradbury. At The University of Michigan, Cindy completed her PhD in 1980, under the supervision of Richard D. Alexander, with a thesis entitled "A Comparison of the Natural History and Mating System of Two Anurans: Yosemite Toads (*Bufo canorus*) and Black Toads (*Bufo exsul*)." It was here that she met and married a fellow student in the same laboratory, Paul W. Sherman, with whom she moved to the University of California at Berkeley.

Cindy returned to Cornell in 1981 as a research associate when her husband took a faculty position in the Department of Neurobiology and Behavior, where earlier she had been a student. When their two children were born, she resigned her position to focus on their welfare but continued her research informally.

In 1993, with Martin L. Morton, Cindy documented the dramatic population declines in the Yosemite toad of the Sierra Nevada of eastern California during 1971–1990. Her last paper, coauthored with D. Earl Green in 2001, has already become a minor classic in showing that chytridiomycosis and other infectious diseases, believed to be responsible for some population declines in frogs, are not a recent phenomenon, but one that goes back at least to the mid-1970s. Cindy also published on her other major research interest—aggressive behavior in dogs. She developed a thriving private consulting practice in the Ithaca area where she conducted a popular series of dog training classes and taught a new sport called "Agility."

—*Kraig Adler.*

CURRENT RESEARCH

The purpose of **Current Research** is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, **Eli Greenbaum** or **Omar Torres-Carvajal**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can be found at: http://www.herplit.com/contents.

Historical Global Ecology of Squamates

The structure of communities is largely affected by the evolutionary history of organisms. Using dietary data of non-snake squamates from the literature, the authors attempted to identify those events in the evolutionary history of large and widespread clades that contributed to the observable disparity in ecological traits among subclades. They examined how this history has affected present-day community structure and proposed three hypotheses to explain the ecological consequences of historically derived traits. The first hypothesis is that a prey shift occurred at the Iguania-Scleroglossa transition, with Iguania retaining the ancestral squamate diet (i.e., mostly ants and other noxious insects). Dietary data on Neotropical and desert lizards support this hypothesis, which suggests that part of the structure with respect to food niches in lizard assemblages is historical. The second hypothesis is that scleroglossans were better competitors than iguanians with respect to prey acquisition because scleroglossans enhanced prey handling and chemosensory-mediated prey discrimination. The third hypothesis is that iguanians and gekkotans shifted to microhabitats or times not used by most autarchoglossans. This hypothesis assumes that autarchoglossans were better competitors for food as a result of the combination of jaw prehension, mesokinesis, vomeronasal chemoreception, and high activity levels. The authors argued that a major determinant of squamate species composition and community structure is historical, without implying that recent species interactions do not contribute to community structure.

VITT, L. J., E. R. PIANKA, W. E. COOPER, JR., AND K. SCHWENK. 2003. History and the global ecology of squamate reptiles. American Naturalist 162:44–60.

Correspondence to: L. J. Vitt, Sam Noble Oklahoma Museum of Natural History and Zoology Department, University of Oklahoma, Norman, Oklahoma 73072, USA; e-mail: vitt@ou.edu.

Bergmann's Rule in Reptiles

Bergmann's rule hypothesizes a negative association between body size and environmental temperature. Although this association has been well studied in endothermic vertebrates, it remains unclear whether Bergmann's rule holds true for ectothermic organisms. The authors gathered data from the literature and museum specimens to investigate intraspecific body size variation relative to latitude/elevation (combined) and environmental temperature in chelonians and squamates. Nonphylogenetic and phylogenetic versions of two meta-analytical procedures (vote-counting and grand mean effect size) were used. The authors found that 83% of the species of chelonians included in the analysis were larger at higher latitudes/elevations and cooler environments. Conversely, 73% of sampled squamate species were larger at lower latitudes/elevations and warmer areas. These results suggest that chelonians follow Bergmann's rule, whereas squamates reverse it. Because the data included in this study were geographically biased (mostly Northern Hemisphere), the authors discussed the possibility that Bergmann's rule and its converse occur predominantly in temperate regions.

ASHTON, K. G., AND C. R. FELDMAN. 2003. Bergmann's rule in nonavian reptiles: turtles follow it, lizards and snakes reverse it. Evolution 57:1151–1163.

Correspondence to: Kyle G. Ashton, Archbold Biological Station, 123 Main Drive, Venus, Florida 33960, USA; e-mail: kashton@archbold-station.org.

Response of Tadpole Epidermis to Thyroid Hormone

Tadpole epidermis is composed of two to three layers of cells. As thyroid hormone (TH) concentration rises during metamorphosis, cells forming the outer layers die, whereas basal cells serve as progenitors for the adult frog epidermis. The authors created transgenic tadpoles of *Xenopus laevis* to determine whether tadpole epidermal cells die autonomously as a result of TH induction, or indirectly by cell-cell interaction. TH-induced death of the epidermis of transgenic tadpoles was inhibited by expression of a dominant negative TH receptor in the epidermal cells. Although these tadpoles metamorphosed normally, a larval epidermis was retained over the developing adult epithelium, indicating that tadpole skin dies autonomously in response to thyroid hormone. This also suggests that epithelial-mesenchyme remodeling and tail resorption are not induced by larval skin in direct response to TH.

SCHREIBER, A. M., AND D. D. BROWN. 2003. Tadpole skin dies autonomously in response to thyroid hormone at metamorphosis. Proceedings of the National Academy of Sciences 100:1769–1774.

Correspondence to: Donald D. Brown, Department of Embryology, Carnegie Institution of Washington, 115 West University Parkway, Baltimore, Maryland 21210, USA; e-mail: brown@ciwemb.edu.

Phylogenetic Significance of the Fossil Snake *Haasiophis terrasanctus*

Different scenarios on the origin and early evolution of snakes have been proposed. Of particular interest has been the discovery of fossil taxa (*Pachyrhachis, Podophis, Haasiophis*) that combine snake-like features with plesiomorphic traits, such as relatively well-developed hind limbs. However, the phylogenetic significance of these fossils remains controversial. Some authors consider these fossils to be basal to all other snakes and suggest that snakes originated from marine mosasauroids. Other authors consider these fossils to be more advanced (macrostomatan) snakes. Rieppel et al. described the anatomy of *H. terrasanctus* in detail and reviewed the current debate on snake relationships and origins, as well as the implications of the presence of hind limbs in these fossil snakes for cladistic analyses. In spite of its well-developed hind limbs, *H. terrasanctus* has the skull of a relatively advanced snake (macrostomatan). Also, *Haasiophis* might be closely related to *Pachyrhachis*. According to the authors, they found further evidence in support of the idea that fossil snakes with well-developed hind limbs are closely related to basal macrostomatans.

RIEPPEL, O., H. ZAHER, E. TCHERNOV, AND M. J. POLCYN. 2003. The anatomy and relationships of *Haasiophis terrasanctus*, a fossil snake with well-developed hind limbs from the mid-Cretaceous of the Middle East. Journal of Paleontology 77:536–558.

Correspondence to: Olivier Rieppel, Department of Geology, The Field Museum, 1400 S. Lake Shore Drive, Chicago, Illinois 60605-2496, USA; e-mail: rieppel@fieldmuseum.org.

Venom Diversity in Advanced Snakes

Among advanced snakes, toxinological research has focused on the venoms of Elapidae, Viperidae, and Atractaspididae. Venoms of species in the various colubrid clades have received little attention. In an attempt to determine how individual toxin families are distributed across the major advanced snakes lineages, the authors used liquid chromatography with mass spectrometry to analyze venoms of 43 species of snakes. Saliva from the reticulated python *Python reticulatus* (Henophidian) was used as negative control. The authors discovered an unexpected diversity of venom proteins in advanced snakes. Terrestrial elapids and pit vipers had a higher diversity of venom components than colubrids (except for *Psammophis* and *Heterodon*), marine elapids, and viperines. Some of the toxins detected in colubrid venoms belong to widespread toxin families shared with front-fanged snakes. The authors also found evidence of the antiquity of various toxin groups and their early appearance in advanced snakes. Additionally, they proposed to abandon the term "Duvernoy's gland," as well as the distinction between opistoglyphous and aglyphous colubrids.

FRY, B. G., W. WÜSTER, S. F. R. RAMJAN, T. JACKSON, P. MARTELLI, AND R. M. KINI. 2003. Analysis of Colubroidea snake venoms by liquid chromatography with mass spectrometry: evolutionary and toxinological

implications. Rapid Communications in Mass Spectrometry 17:2047–2062.

Correspondence to: Bryan G. Fry, Australian Venom Research Unit, Department of Pharmacology, University of Melbourne, Parkville, Vic 3010, Australia; e-mail: bgf@unimelb.edu.au.

Water Depth and Foraging Behavior in Garter Snakes

Based on diet and foraging behavior, North American garter snakes can be divided into aquatic specialists (AS) and terrestrial-aquatic generalists (TAG). As opposed to TAG, AS are capable of crawling, striking, and visually detecting prey items underwater. These foraging behaviors have been hypothesized as adaptations of AS for feeding on widely dispersed aquatic prey. One of the predictions of this hypothesis is that intermediate species (IM) between AS and TAG (in terms of feeding on aquatic prey) shift their behavior in the direction of an aquatic specialist with increasing water depth. The author tested this prediction by comparing the aquatic feeding behavior of *Thamnophis validus* (IM) with that of *T. rufipunctatus* (AS) and *T. proximus* (TAG). A second prediction, which the author also tested using *T. validus*, is that TAG behaviors are less effective than AS behaviors in deep water. Feeding trials were carried out in a circular pool; snakes were fed rosy reds, a variety of *Pimephales promelas*. Kruskal-Wallis, Mann-Whitney U, and Wilcoxon matched-pairs signed-ranks tests were performed. The author found that *T. validus* does in fact change its behavior toward that of AS with increasing water depth. Unfortunately, the second prediction could not be fully supported or rejected. Finally, de Queiroz used a recently published molecular phylogeny of garter snakes to suggest that the facultative behavior observed in *T. validus* might represent an intermediate stage in the evolution of aquatic specialization.

de Queiroz, A. 2003. Testing an adaptive hypothesis through context-dependence: effects of water depth on foraging behaviour in three species of garter snakes. Ethology 109:369–384.

Correspondence to: Alan de Queiroz, 2695 Mineral Drive, Ely, Nevada 89301, USA; e-mail: alandqz@yahoo.com.

Phylogeny of Advanced Snakes

True snakes (Alethinophidia) include three successively less inclusive clades: Macrostomata, Caenophidia, and Colubroidea. As currently defined, the advanced snakes clade (Caenophidia) comprises the sister taxa Colubroidea and *Acrochordus*. Phylogenetic relationships among members of Caenophidia have been subject to continued debate and conflict. Based on phylogenetic analyses of mitochondrial DNA sequence data of 98 species of snakes, the authors attempted to identify higher taxa within advanced snakes and generate robust hypotheses of relationships within and between those taxa. Supertree consensus, maximum parsimony, maximum likelihood, and Bayesian inference methods were used. The results reinforced previously supported clades, such as Viperidae, Xenoderminae, Pareatinae, Psammophiinae, Pseudoxyrophiinae, Homalopsinae, Natricinae, Xenodontinae, and Colubrinae. The position of several other advanced snake taxa was discussed. For example, the authors proposed exclusion of Xenoderminae from Colubroidea because the clade *Acrochordus* + Xenoderminae was recovered as the sister taxon of Colubroidea.

Kelly, C. M. R., N. P. Barker, and M. H. Villet. 2003. Phylogenetics of advanced snakes (Caenophidia) based on four mitochondrial genes. Systematic Biology 52:439–459.

Correspondence to: Christopher M. R. Kelly, Department of Zoology and Entomology, Rhodes University, Grahamstown, South Africa; e-mail: christopher.kelly@zoo.ox.ac.uk.

Patterns of Evolutionary Radiation in Iguanian Lizards

Existence of general properties of evolutionary radiations has been proposed, but none of these properties has been clearly identified yet. The authors used a comparative approach to identify general patterns in the relationship between cladogenesis and morphological disparity among evolutionary radiations in four clades of iguanian lizards. For each of these clades (Caribbean *Anolis*, *Liolaemus*, Australian agamids, and phrynosomatines), the authors examined historical patterns of extant subclades using molecular phylogenies. The extent to which the rate of lineage accumulation departed from a stochastic model of constant rates of diversification per lineages was estimated for each clade with the lineage diversity index. In addition, disparity-through-time plots were calculated to examine the time course of morphological diversification. Elevated levels of early diversification were identified in agamids, anoles, and phrynosomatines. Levels of average subclade morphological disparity were high in *Liolaemus*, low in agamids, and intermediate in the other two clades. The authors found that taxa with steady rates of increase in species richness (e.g., *Liolaemus*) tended to exhibit more overlap in morphological variation among subclades than taxa with high levels of early diversification (e.g., Australian agamids). They suggested that this pattern could be the result of ecological interactions, ecological opportunity, or relaxation of genetic constraints.

Harmon, L. J., J. A. Schulte II, A. Larson, and J. B. Losos. 2003. Tempo and mode of evolutionary radiation in iguanian lizards. Science 301:961–964.

Correspondence to: Luke J. Harmon, Department of Biology, Campus Box 1137, Washington University, St. Louis, MO 63130-4899, USA; e-mail: harmon@biology.wustl.edu.

The Earliest Crown-Group Salamander

A new fossil assemblage containing 200 specimens of salamanders was recently discovered in the Middle Jurassic Jiulongshan Formation of Inner Mongolia, China. Assessment of fossil age was based on biostratigraphic analysis of insect and vertebrate assemblages. The remarkably well-preserved salamanders were described as *Chunerpeton tianyiensis*, a new species of Cryptobranchidae. These specimens represent the earliest known record of crown-group urodeles. The 180 mm holotype retains juvenile features, such as short external gills. Presacral vertebrae with unicapitate ribs, reduction in the number of rib-bearing anterior caudal vertebrae, and absence of lachrymal bones

are some of the derived characters that the new species shares with living cryptobranchoids. Based on the age of the new taxon and distribution of other fossil taxa, the authors hypothesized an Asian origin of cryptobranchoids (Cryptobranchidae and Hynobiidae).

GAO, K., AND N. H. SHUBIN. 2003. Earliest known crown-group salamanders. Nature 422:424–428.

Correspondence to: Neil H. Shubin, Department of Organismal Biology and Anatomy, University of Chicago, 1027 East 57th Street, Chicago, Illinois 60637, USA; e-mail: nshubin@uchicago.edu.

ZOO VIEW

There are three major living herpetological collections in Russia: Moscow Zoo, Leningrad Zoo, and Tula Exotarium.

The Moscow Zoo is supported by the city but is viewed as a national institution. Over the years, it has had partial control over the dispersal of monies to other Russian zoos and acted as a clearinghouse for inventories and conservation efforts. The Zoo was started by a Board of Trustees from a nearby university for research and educational purposes, with public attendance as an added responsibility. The herpetological department has had a rich history which is presented here by curator Sergei Kudryavstev and his assistant Sergei Mamet.

The staff at the Leningrad Zoo (St. Petersburg), known as Leningradskii Zoopark, has published papers on captive management. Yuri Lukin is Chief of the Dept. of Herpetology and Eugeny Kamelin is the Herpetologist. According to *International Zoo Yearbook* (1998:Volume 28), composition of the collection was 76 taxa of reptiles with 252 specimens and 3 taxa of amphibians numbering 8.

In the late 1970s and 1980s, V. A. Igolkina reported on feeding activity in captive animals, incubation of reptile eggs and early ontogenesis of snakes, and captive breeding of snakes such as Lebetine vipers (*Vipera lebetina turanica* and *V. l. obtusa*) in the Leningrad Zoo. Kamelin and Lukin have investigated captive maintenance and breeding of the Central Asia cobra (*Naja oxiana*) and hybridization of *Vipera schweizeri* and *Vipera lebetina obtusa*.

Founded in September of 1987, the Tula Exotarium, located approximately 200 km south of Moscow, has specialized in research on reproductive biology, taxonomy, ecology, and principles of captive management of amphibians and reptiles. Many specimens are maintained in the off-exhibit laboratory. The collection is impressive: Asian arboreal snakes (*Boiga, Rhynchophis, Dinodon, Ahaetula*, some *Elaphe, Philodryas*, and African *Toxicodryas*); terrestrial Asian snakes (*Elaphe* sensu lato; *Spalerosophis, Coluber, Rhabdophis, Oligodon, Lycodon*, and others); kingsnakes (*Lampropeltis*) and other North American colubrids; Euro-Asian rat snakes; Asian vipers (*Trimeresurus, Protobothrops, Ovophis, Tropidolaemus*, and *Azemiops*); European and Caucasian vipers (*Vipera*); pythons and boas (*Morelia, Corallus, Sanzinia, Candoia, Python, Liasis, Leiopython, Antaresia, Boa, Acranthophis, Epicrates, Eunectes, Eryx*, and others); geckos and eublepharids (*Gekko, Rhacodactylus, Uroplatus, Gehyra, Ptychozoon, Eublepharis, Hemitheconyx, Coleonyx, Goniurosaurus*, and others); agamas and skinks (*Pogona, Physignathus, Tiliqua, Corucia, Tribolonotus, Eumeces*, and others); chelonians; and amphibians (*Polypedates, Theloderma, Ichthyophis*). In 2002, the collection included 408 species, subspecies, and forms of reptiles and 30 species of amphibians.

The Exotarium staff members are specialists responsible for specific tasks, rather than generalists as in many zoos. This group is led by Sergei Ryabov, founder of the Exotarium. Many taxa have been bred and results published: Stuart's milk snake and other kingsnakes, rare Southeast Asian ratsnakes, white-lipped python, six species of *Boiga*, rough-scaled sand boa, prairie kingsnake, Jalisco milksnake, and ashy pitviper (*Trimeresurus puniceus*), western hog-nosed snake, two species of geckos (*Paroedura, Goniurosaurus*), bearded dragons, and the green tree python. Other reproductive studies are in press: Trans-Pecos rat snake, Euro-Asian group of ratsnakes, Lotiev's viper, black mangrove snake (*Toxicodryas blandingi*), Central American rat snake (*Elaphe flavirufa*), Chinese bamboo rat snake, green-eyed gecko (*Gehyra marginata*), New Caledonian bumpy gecko (*Rhacodactylus auriculatus*), and scarlet kingsnake. Additional information may be found in Ryabov (2001. The Exotarium—Snake Centre in Russia. Litteratura Serpentium 21:40–46; 2002. The Tula Exotarium. Exso [Kiev, the Ukraine] 1:45–47).

One problem encountered by Russian authors is that their names might be changed during translation and editing into English, such as Kudryavtsev (= Kudrjavtsev in English), and Vassiliev (= Vasiliev or variations in English).

SSAR Webmaster Dennis Desmond prepared the photographs.

—*James B. Murphy, Section Editor*

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History of Moscow Zoo's Herp Department

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When the Moscow Zoo opened in 1864, a few reptiles were housed in various pavilions, mainly at the Aquarium. On occasion, specialized exhibits were created and the number of reptiles increased to as many as 10 species and 50 specimens. However, a formalized Reptile Department was founded in 1926, when an Artificial Mountain Complex was constructed in the so-called New Territory, where the Terrarium was incorporated on the second and third floors. After the official opening in 1927, the reptile collection grew to ca. 70 species and remained at that level for many years. During World War II (which is known as the Great Patriotic

Terrarium-Aquarium building at Moscow Zoo, 1877

War in Russia, 1941–1945) the herpetological collection was nearly disbanded. It is likely that the Terrarium was the only herpetological zoo facility to ever have anti-aircraft artillery placed on the roof during these troubled times.

Many distinguished biologists worked in the Moscow Zoo Terrarium during the period 1930–1950:

Alexey M. Sergeiyev—honorary member of Moscow State University, specializing in the evolution of reptiles. He died at age 31 in Stalin's labor camps.

Roman Khecin-Lourie—geneticist known world-wide and a corresponding member of the Academy of Science of USSR.

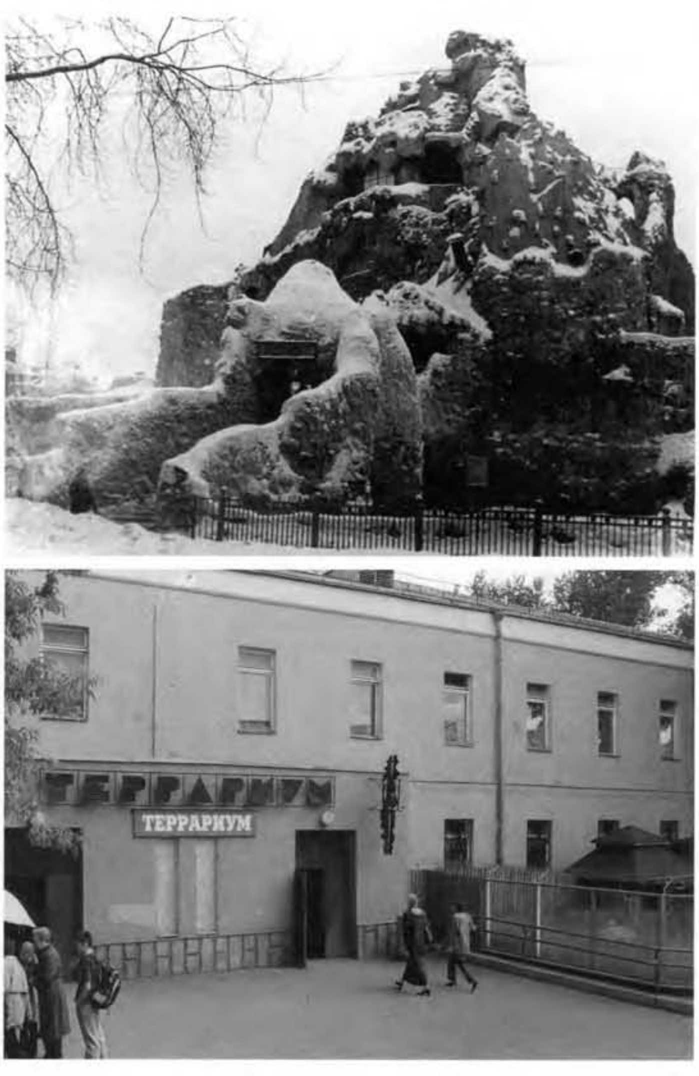
Ilja S. Darevsky—(1962), Head of Laboratory for Ornithology and Herpetology of Zoological Institute of Russian Academy of Science, corresponding member of Russian Academy of Science, professor at University of California, and professor at Armenian Institute of Zoology;

Valentina F. Orlova—from 1962, Curator of Herpetological Department of Zoological Museum of Moscow State University.

The zoo staff was equally distinguished. During the period 1946–1980, the Curator of Reptiles was Zoja N. Kovaleva. At that time, the reptile collection consisted mainly of common species but no scientific research was conducted. Vladimir Y. Frolov occupied the post between 1980–1985 and later became Assistant Director for Zoological and Veterinary matters. His successor was Sergei V. Kudryavtsev, who began working in the Department in 1981. In 1987 Sergei V. Mamet became Assistant Curator of Herpetology. The next year, the leading specialist on reptile disease in Russia, Dmitry B. Vassiliev, joined the Department.

Current Reptile Department staff members (left to right): Ludmila V. Ganina, Oleg V. Shoumakov, Sergei V. Mamet, Sergei V. Kudryavtsev, Andrei O. Bochkarjev, Dmitry B. Vassiliev, Natalja M. Soudina, Vladimir V. Fedin. Two members are missing (Tatyana V. Latysheva and Alexander V. Kouznetcov).

In 1989, the reptile collection was moved to an old, reconstructed two-story building. A rather small exhibit area allows only about 20% of the present collection to be shown. The rest of the facility is used for breeding and research purposes. The 1980s were the most active and fruitful period for herpetology at the Zoo. The collection grew dramatically and in late 1990s consisted of 226 species and 846 specimens, both common and rare. Department staff members were involved in quite a number of scientific research projects, together with colleagues at the Institute for Nature Conservation, Zoological Institute of Russian Academy of Science, zoological organizations of various Soviet Republics, and elsewhere. Researchers focused on ecology and reproductive biology of many rare amphibian and reptile species of USSR. Thus, impressive successes were attained, aimed at study of reproductive biology of nearly all rare species of vipers and ratsnakes (*Elaphe*) of USSR and of many rare Boidae. For the first time, the Central Asian cobra (*Naja oxiana*) was bred in captivity, and captive breeding of the Caspian desert monitor (*Varanus griseus caspius*) occurred at the Zoo. Over 170 scientific and popular articles, as well as several books, were published during that period. Numerous field surveys—Central Asia, Caucasus, Far East, and other regions of USSR—were conducted. In the late 1980s and early 1990s, department staff members participated in numerous herpetological studies, including the Ryukyu Archipelago (Japan), East, West and South Africa, Vietnam, Cambodia, Indonesia (Java, Sumatra, Irian Jaya), and the USA. Also, during those exciting years, many international contacts were established with colleagues from over 30 countries and at institutions such as Instituto Butantan (Brazil), Japan Snake Institute, Razi Institute (Iran), Queen Saovabho Memorial Museum (Thailand), and the National Museum of Kenya.



Top: Moscow Zoo Reptile House, 1972. Bottom: The present-day Reptile House, 2003.

During the last several years, the main research interest has been studying reproductive biology and in developing methods for long-term captive husbandry of rare and problematic species of venomous snakes found throughout the world. Herpetology at the zoo has declined recently as there have been severe financial problems. It is unlikely that funds will be available to construct a new reptile house in the near future. The size of the herpetological collection is decreasing; as a result, research has diminished as well.

Research programs

In situ studies and captive breeding of rare and problematic reptile species of Central Asia.—In the course of this research (1981–1993) the first complete studies on captive breedings of the Central Asian cobra (*Naja oxiana*) and certain species of the family Viperidae were achieved (Kudryavtsev et al. 1991); data on reproduction of the desert monitor (*Varanus griseus caspius*) was obtained (Bozhanskii et al. 1998); and ecology and zoogeography of numerous common reptile species of that region such as Central Asian tortoise *(Agrionemys horsfieldi*) (Makeev et al. 1994) were investigated. Other studies included:

Aspects of captive maintenance and breeding of rare frog and salamander species of the former USSR (Uteshev et al. 1986);

In situ studies and captive breeding of rare vipers of the former USSR, mainly of the genus *Vipera* (*Vipera ammodytes transcaucasiana, V. dinniki, V. kaznakovi, V. latifii, V. lebetina, V. raddei, V. wagneri,* and others) (Kudryavtsev and Mamet 1998b);

Studies on captive maintenance and breeding of rare ratsnakes of the genus *Elaphe* found in the former USSR and adjacent countries–*Elaphe climacophora, E. quatuorlineata, E. mandarina, E. moellendorfii, E. persica,* and others (Mamet 1999);

Studies on captive maintenance and breeding of cobras of the genus *Naja* and related elapids: *Aspidelaps, Boulengerina, Bungarus, Dendroaspis, Haemachatus, Ophiophagus,* and *Oxyuranus* (Vassiliev and Kudryavtsev 1996; Vassiliev 1997; Vassiliev et al. 1999; Kudryavtsev et al. 2001);

Ecology and captive propagation of rare and problematic Boidae species of Southeast Asia and Pacific region: *Apadora papuana, Chondropython viridis, Liasis albertisii, L. amethistinus, L. mackloti, Morelia boeleni, Python curtus breitensteini, P. curtus brongersmai, P. molurus pimbura, P. timorensis,* and others (Kudryavtsev et al. 1995; Vassiliev et al. 1997; Kudryavtsev and Mamet 1998a);

Ecology and captive propagation of rare and problematic Boiginae species of Southeast Asia and Pacific region (Shumakov 2002);

Studies on ecology and captive propagation of rare and problematic pitvipers of Southeast Asia: *Gloydius, Ovophis, Protobothrops, Trimeresurus,* and others (Kudryavtsev et al. 2002);

Studies on ecology and captive propagation of African bush vipers (*Atheris*) and related species (Vassiliev et al. 1999).

Some preliminary results of the research programs described above were published in *Terrestrial Snakes of the Soviet Union* (Kudryavtsev and Mamet 1989) and *Keeping and Breeding in Captivity Snakes of Russia and Adjacent Countries* (Kudryavtsev, Mamet, and Proutkina 1993).

References

Bozhanskyi, A. T., V. M. Makeev, S. V. Kudryavtsev, V. E. Frolov, and Yu. Khomustenko. 1998. *Varanus griseus caspius*: some results of field studies in Turkmenistan and at Moscow Zoo Reptiles Department. Scientific Research in Zoological Parks 10:103–111.

Kudryavtsev, S. V., V. M. Makeev, V. E. Frolov, and Yu. Khomustenko. 1991. Breeding of Central Asian cobra *Naja oxiana* in captivity. Scientific Research in Zoological Parks 1:38–44.

———, and S. V. Mamet. 1989. Terrestrial snakes of the Soviet Union. The Snake 21(1):29–35.

———, and ———. 1993. Keeping and breeding in captivity snakes of Russia and adjacent countries (within the former USSR), part I. The Snake 25(1):39–53.

———, and ———. 1993. Keeping and breeding in captivity snakes of Russia and adjacent countries (within the former USSR), part II. The Snake 25(2):121–130.

———, and ———. 1998a. Short history of the herpetological collection of Moscow Zoo with notes on successful reproduction of several rare species, part I. EAZA News (22):7–9.

———, and ———. 1998b. Notes on successful reproduction of several rare viper species, part II. EAZA News (23):20–21.

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POINTS OF VIEW

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On the Snake Hemipenis, with Notes on *Psomophis* and Techniques of Eversion: A Response to Dowling

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Dowling (2002) recently commented on what he considered to be erroneous descriptions of snake hemipenes and made unsupported assertions concerning the genera *Psomophis* and *Siphlophis*. We here reject his pronouncements on the hemipenial morphology of *Psomophis* and provide additional details; the matter of *Siphlophis* is separately treated by Zaher and Prudente (2003).

Dowling's commentary reveals entrenched opinions that have led us also to review methods of study, particularly the techniques of everting hemipenes of both freshly killed snakes and of museum specimens. There is room for improvement and experimentation, but the procedures are not as difficult as suggested by Dowling.

The reader should keep in mind our distinction that a "fully everted" hemipenis is not necessarily "maximally expanded [or] inflated." A fully everted organ has all surfaces and structures visible, including the terminus or termini of the sulcus spermaticus. A maximally expanded hemipenis is fully everted *and* is inflated to the fullest extent allowed by its original elasticity, which may or may not be regained when working with preserved specimens. As with a balloon, there are imperceptible degrees of inflation, resulting mainly in a changing circumference. This has little taxonomic import unless hemipenial topography is noticeably different at maximal inflation—owing either to differential expansion in fresh tissue or failure to regain sufficient elasticity in a preserved retracted organ. It should be realized that the extent of hemipenial eversion and expansion attained in the female's cloaca is unknown.

Psomophis

Psomophis is a tightly knit genus containing three species of small South American xenodontine colubrids that share a novel type of hemipenis (Myers and Cadle 1994). The two heads of the bicapitate hemipenis bear large papillae that terminate in minute spinules. These spinulate papillae appear to be disposed on calyces on the retracted organ, but the appearance of calyculation may disappear completely when the organ is everted. The everted hemipenes of *Psomophis* also are atypical of capitate or bicapitate organs in that the capitula face almost completely toward the sulcate side (Figs. 1, 2); each capitulum is visible in profile but shows only as a papillate edge or underside of an upturned flap around the nude asulcate side of each lobe.

Dowling (2002:13) disagreed with the last feature mentioned above. He bluntly asserted that his examination of the hemipenis of *Psomophis genimaculatus* that was figured in Myers and Cadle (1994:Fig. 3) "showed the hemipenis to be far from 'fully everted,' and so badly distorted that the drawing showed an apical (rather than a sulcate-side) view of the partly-everted lobes." We here provide photographs (Fig. 1) of the same hemipenis to supplement the original drawing and to demonstrate the fallacy of Dowling's assertions.

The hemipenis in question (Fig. 1) had been *fully* everted and probably maximally inflated by the collector; the branches of the sulcus spermaticus do not disappear into the lobes but are seen (when the sulcus walls are parted with fine teasing needles) to

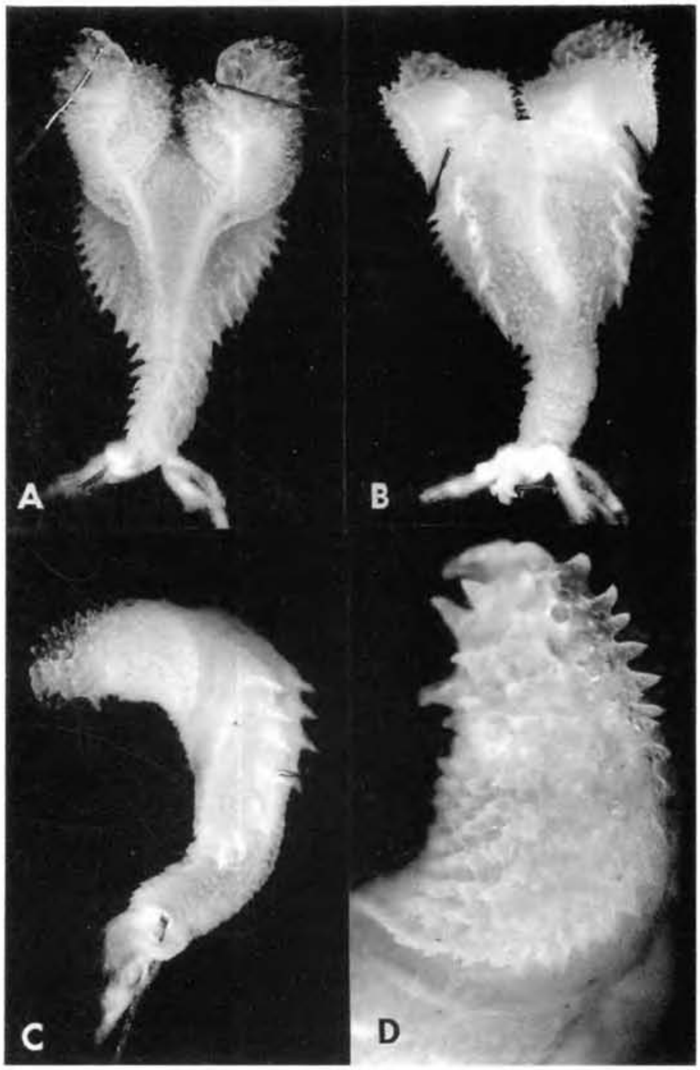

FIG. 1. The fully field-everted hemipenis of *Psomophis genimaculatus* (USNM 331437) thought by Dowling (2002:12) to be incompletely everted and "badly distorted". **A.** Sulcate view of organ restrained by minuten pins in straightened position (x4.7). **B.** Asulcate view of organ in nearly straight position (x4.7). **C.** Side view of unrestrained organ showing strong recurvature, possibly caused by tension of an unrelaxed, unsevered retractor muscle at the time of preservation (x4.7). **D.** Enlarged side view (x11.7) of capitulum showing ornamentation of large, soft papillae, which have minutely spinulate tips. Each capitulum (head) faces the sulcate side of the organ, leaving the nude asulcate side of the lobe framed distally and laterally by a papillate fringe (as figured in Myers and Cadle 1994).

terminate abruptly on the surface of the fully expanded capitula. The hemipenis is "distorted" only in the sense that, as mentioned in the original description, it is strongly recurved (Fig. 1C), although flexible enough to straighten (Fig. 1A). Field-everted hemipenes were available for no other specimen of *Psomophis* (retracted organs were described for each species). For purposes of best showing distribution of micro-ornamentation and shape of the everted hemipenis, both sulcate and asulcate sides of the organ were drawn in straightened views by Edmond V. Malnate, an artist-scientist experienced in hemipenial interpretation. We agree with Dowling that relationships "cannot be determined" from Malnate's "beautiful (but unidentifiable) drawing"—but only because the morphology of the hemipenis itself does not convincingly relate *Psomophis* to any other genus!

Although Dowling cited Zaher (1999) on other matters, he inexplicably failed to notice that Zaher had corroborated the general physiognomy of the *Psomophis* hemipenis in text discussion and with photographs of organs that Zaher had everted from preserved specimens of *P. genimaculatus* and *P. joberti* in the collection of the Instituto Butantan (Zaher 1999:71, 147, Fig. 74). These manual laboratory eversions were difficult owing especially to the extremely narrow base of the *Psomophis* hemipenis; although the photographs show distally complete eversions, the lobes are not expanded to maximum width. We have examined Zaher's preparation of *P. joberti* and provide new photographs in Figures 2–3.

The hemipenial lobes are relatively short and broad in *Psomophis genimaculatus* (Fig. 1). When the edges of the lobes of the field-everted hemipenis of *P. genimaculatus* are raised toward the horizontal plane, the lobes are seen to be nearly as wide (> 90%) as long (length as measured on medial side in sulcate view). Because of the soft drooping lateral edges, capitulum width is better visualized from the published drawing (Myers and Cadle 1994:Fig. 3 [= about x6.3, not "x3.6" in caption]) than in photographs of the same organ (e.g., Fig. 1A).

The lobes of the organ everted from a preserved specimen of *Psomophis genimaculatus* are noticeably narrower in photographic comparisons, appearing to be only about 60% as wide as long (compare Fig. 1A with Fig. 74 [lower right] in Zaher 1999). Differential expansion of fresh lobular tissue evidently accounts for the branches of the sulcus spermaticus appearing relatively shorter in the more fully expanded field-everted organ (see below).

The *Psomophis* organs manually everted from preserved specimens by Zaher show relatively shorter hemipenial lobes in *genimaculatus* than in *joberti*, with corresponding differences also in the lengths of the sulcus branches (see Zaher 1999:Fig. 74). Differences in lobe length in *Psomophis* had been suggested by comparison of retracted organs, the lobes of which varied from about 30% of hemipenis length in *genimaculatus*, to 33% and 40% in *joberti* and *obtusus*, respectively (Myers and Cadle 1994:11–12). The branches of the sulcus spermaticus extend virtually to the tips of the lobes in the retracted condition, but differential tissue expansion causes them to terminate more proximally in the everted condition. And the branches appear relatively shorter in the fully expanded organ of *genimaculatus* (Fig. 1A) than in the incompletely expanded one shown in Zaher (1999:Fig. 74).

Width of everted hemipenes cannot be estimated from the retracted condition, nor can interspecific differences in width be reliably judged by comparing lab-everted and field-everted

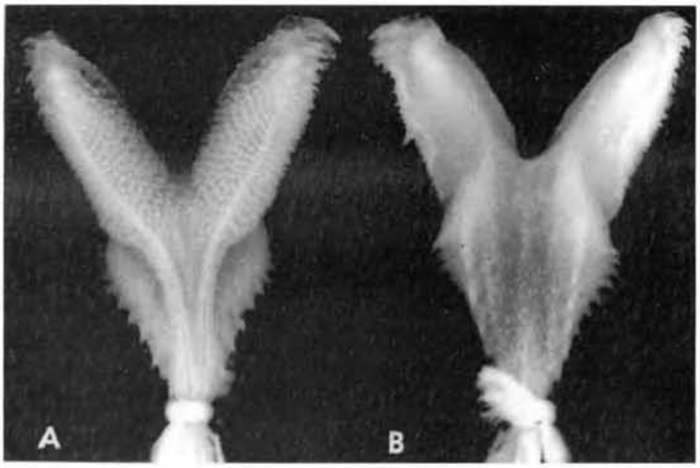

FIG. 2. Hemipenis of *Psomophis joberti* in sulcate and asulcate view, x3.9, prepared by H. Zaher from a preserved specimen (IB 36437). The organ is fully everted but incompletely expanded.

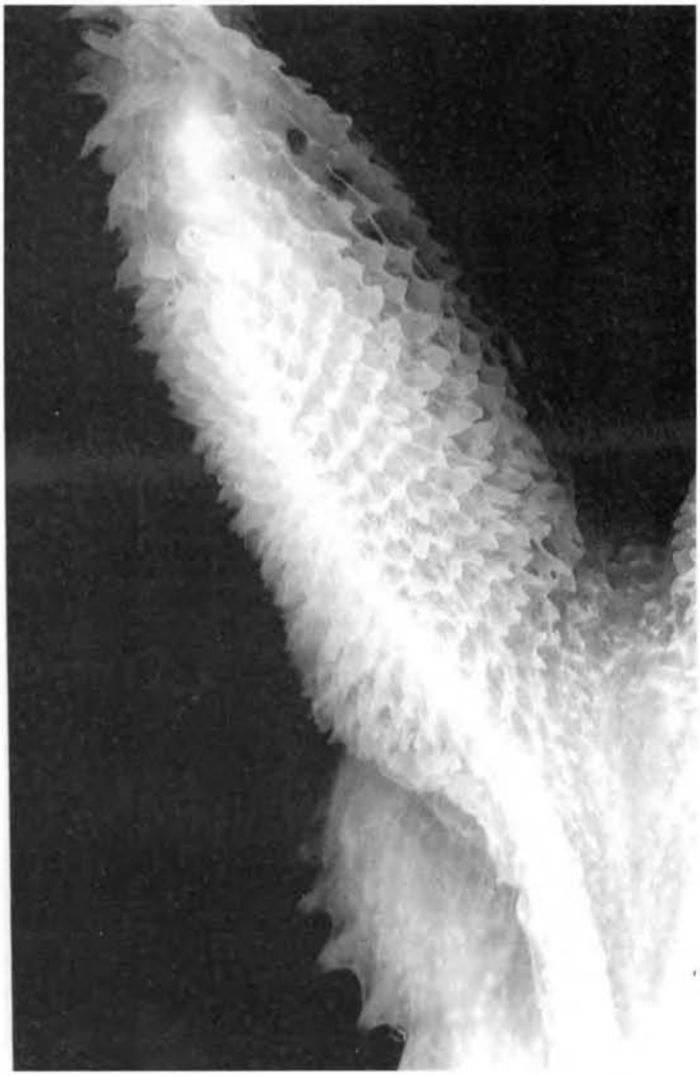

FIG. 3. Enlarged view (x13.7) of capitulum of *Psomophis joberti* (left lobe in Fig. 2A), showing arrangement of spinulate papillae on weak transverse folds. The interconnecting hairline vertical folds probably would disappear in a maximally expanded fresh eversion.

hemipenes. In any case, both the laboratory and field-eversions show clearly that in *Psomophis* the capitula face toward the sulcate side of the hemipenis.

Although Myers and Cadle (1994) and Zaher (1999) were in agreement (*contra* Dowling) over the general appearance of the everted *Psomophis* hemipenis, they differed in their interpretation of calyculation. Myers and Cadle (1994:13) noted that, on first inspection, the retracted organs of each species "appear to be calyculate with exceptionally large papillae, but the papillate surfaces are acalyculate on the everted hemipenis [of *Psomophis genimaculatus*, which] had but weak indications of tissue folds connecting single rows of spinulate papillae." In addition to loss of sharply distinct longitudinal (vertical) folds, it was observed that the transverse folds of tissue could be "flattened by micromanipulation with fine teasing needles," quite unlike normal calyces whose walls retain their rigidity at all times. Although Myers and Cadle noted that these weak folds might be vestigial calyces, they suspected that "they simply represent a method of folding expansible tissue when the *Psomophis* hemipenis is inverted for storage." Consequently the term *pseudocalyces* was coined for these transient structures (we subsequently saw that this term had been used previously by Broadley [1980:493, Pl. IIA] for markedly anastomosing flounces on the elongate, noncapitate hemipenes of two species of the African genus *Prosymna*).

The two organs everted by Zaher from preserved specimens of *Psomophis genimaculatus* and *P. joberti* retained indication of weak but thin and sharply defined longitudinal or vertical folds that connect the transverse rows (Zaher 1999:71); the retention of both vertical and transverse folds in the everted state can be visualized from an enlarged photograph (Fig. 3). Zaher interpreted these faint folds as vestigial calycular walls and noted that they are most evident "proximally near the medial edge of each capitulum." However, comparison with the field-everted hemipenis (Fig. 1) suggests that the thin, hairline vertical folds retained in Zaher's preparations would have become obliterated if further expansion of the lobes had been possible.

Since calyces are probably plesiomorphic among xenodontine and dipsadine snakes, Zaher's belief that the "pseudocalyces" represent vestigial calyces is not an unreasonable interpretation. Furthermore, along with Zaher, we suspect that evolutionary loss of the longitudinal or "vertical" walls of calyces probably explains the evolutionary origin of transverse "flounces" on the capitula of many colubrid snakes, some of which have both calyces and flounces on the same organ (e.g., some *Helicops*, see Zaher 1999:61). The everted hemipenis of *Psomophis*, with a transverse alignment of papillae and virtual absence of interconnecting vertical folds, might be in a stage nearly intermediate between calyculation and flouncing—*if* the pseudocalyces are in fact vestigial calyces, which is an open question.

The large spinulate papillae on the capitula of *Psomophis* hemipenes are doubtless synapomorphic for the genus, but it is uncertain whether they are modified "true papillae" (Zaher, 1999:71) or possibly "spines in which mineralization (an ontogenetic event) has been almost entirely arrested" (Myers and Cadle 1994:13). The first interpretation is probable if the structures rise from vestigial calyces, whereas the latter would be consistent with an origin from a hemipenis that was distally spinose. In at least one colubrid, *Geodipsas laphystia* (Madagascar), the ontogeny of spine mineralization proceeds from proximal to distal for the entire organ, and from tip to base for individual spines (Cadle 1996b:43–44). This would be consistent with Myers and Cadle's suggestion that the spinulate papillae of *Psomophis* might be spines in which mineralization has been arrested. Except for mineralized papillae (spinules) on the calyces (especially basal calyces) of many snakes, spines normally are not found on the heads of capitate hemipenes, although a single indisputable spine extends from among the spinulate papillae on each capitulum of the hemipenis of *Psomophis joberti* (Myers and Cadle 1994:12–13; Zaher 1999:71); one of these spines can be seen extending from midway along the edge of a capitulum in Fig. 2B.

The method of capitation and ornamentation of the *Psomophis* hemipenis is unusual and not clearly homologous with the conditions in other Neotropical snakes (although the sulcate-side orientation of the capitula is at least approached in some other Xenodontinae). Additionally, we know of no other instance in which pseudocalyces or calyces disappear during eversion and full expansion of the hemipenis.

Techniques of Study and Eversion

Edward Drinker Cope called attention to the systematic importance of snake hemipenes in the late 19th century. His data were derived from retracted genitalia, each of which was "laid bare *in situ* and split lengthwise along the exposed (inferior) middle line before it is removed [which is] necessary to avoid cutting it along the sulcus" (Cope 1895:190). Cope's classic 1895 paper included succinct summaries of hemipenial anatomy and variation, as illustrated by 234 elegant interpretive drawings of retracted organs.

With eventual widespread use of hypodermic syringes for preservation, it slowly became commonplace in the following century to evert hemipenes in the field by injecting alcohol (later formalin) into the tail base. Finally, more than 60 years after Cope's (1895) classic survey of diversity revealed in the anatomy of retracted hemipenes, Dowling and Savage (1960) published an influential paper showing a sampling of the extraordinary diversity among everted organs.

Although Dowling and Savage (1960:21) recognized that the majority of characters evident in everted hemipenes can in fact be recovered by dissection of the retracted organ, they stated (p. 22) that "everted preparations are much to be preferred." Indeed, today's workers generally prefer to use everted hemipenes in systematic studies, owing both to increased availability of field-everted organs and to development of techniques for manually everting retracted organs of museum specimens. However, eversion may bring about marked changes in relative positioning of various structures (Dowling and Savage 1960:20; Myers 1974:33); *Psomophis* (see above) provides an example in which there is not a precise correspondence between the apices of the retracted and everted organs. But, in some sense, everted organs seem easier to understand, and everted hemipenes obviously provide the best comprehension of their *potential* for expansion (whether or not maximal inflation is ever attained in the female's cloaca).

It needs to be emphasized in passing that better understanding is gained when retracted and everted hemipenes are compared. Complementary comparisons of retracted and everted hemipenes provide fuller comprehension and in some cases increase the number of taxonomically useful characters (Myers 1974:30–33; Myers

and Cadle 1994:13). Examples: Weak bilobation evident in a retracted hemipenis may disappear completely on eversion; similarly, a clearly non-bilobate hemipenis may reveal in the retracted state the retention of a weakly divided retractor muscle (such conditions can unambiguously establish character polarity within such a genus as *Trimetopon* [Myers, unpubl.]). A narrow gap between spines on the asulcate side of retracted organs expands in some species, but not others, to a diagnostically broad interspinal nude area on the everted organ (Myers and Cadle 1994:ftnote 7). The asulcate side of the capitulum may produce species-diagnostic folding in the retracted state (Myers 1974:31, Fig. 4). These few examples suffice to show that the retracted hemipenis should not be ignored as a potentially important source of taxonomic data.

Regarding the process of everting hemipenes of freshly killed snakes, Dowling and Savage (1960:17) wrote that "Since the hemipenis . . . is relatively easy to ready for study, the belief that it is difficult to locate or prepare is fallacious." Having seemingly changed his mind, Dowling (2002:13) now believes that "the proper preparation of everted hemipenes is a difficult process that requires some experience and skill"! We agree only that experience helps and we hope to provide a few useful tips in the following paragraphs.

Field (Fresh) Eversions.—Early field workers often did not fully evert hemipenes, or, even if they did, contraction of the retractor muscle frequently caused the organs to partially retract. Tying off the base of the everted hemipenis with thread and then opening the underside of the tail base medially (between the hemipenes) and severing the retractor muscle(s) might be all that is needed to provide a quick, simple, and useful field preparation. However, tying off the organ does not seem critical to maintaining eversion in many hemipenes if care has been taken to let the retractor muscle become relaxed so that it is no longer capable of contraction (see below); even then, the retractor muscle may be severed as a precaution. If the everted organ is to be tied off, we now realize that an easily removable overhand knot is preferable, because the thread may obscure or distort such important structures as basal spines or nude pockets (*fide* Cadle and Myers 2003:ftnote 7).

Some published instructions for everting hemipenes seem most applicable to large and moderate-sized snakes being preserved on a laboratory table (e.g., Dowling and Savage 1960; Branch and Wade "1976" [1977]). Dowling and Savage (1960:22) suggested that one should "slit open the ventral surface of the tail, cut the *m. retractor penis magnus* and inject fluid into the blood sinus at the base of the hemipenis so as to cause eversion." Few workers comprehend the last nicety, which is difficult and impractical especially when preserving small snakes in a temporary field camp in poor light, with the distracting drone of diurnal mosquitoes in one's ears. Usually it suffices to inject the tail base and effect eversion prior to slitting the tail and severing the retractor muscle; eversion is accomplished simply by fluid pressure within the tail. If the eversion proves difficult (probably because time was not allowed for the retractor muscle to relax), the tail can be slit medially and the retractor cut before continuing. A scalpel or razor blade may be used, but we prefer the convenience of fine-pointed dissecting scissors. It might be helpful to first start the eversion with external pressure on the tail base, by pushing forward toward the cloaca. With care, it is possible and sometimes desirable to leave one of the two hemipenes uneverted for later study in the retracted condition.

It is very useful and sometimes critically important for the muscles of the freshly-killed snake to become completely relaxed before injecting the tail base. (Not waiting for this accounted for most of our early failures to obtain complete field eversions of complex organs.) In order not to burst a small hemipenis nearing maximum inflation, a jeweler's loupe may be used to monitor the everting apex—in which case it is advisable to protect one's eyes by filling the syringe with water, which also will lessen skin exposure to formalin. In fact, *we suggest the routine use of water for hemipenial eversion*. The initial use of water seems not to affect the subsequent formalin-fixation of delicate hemipenial tissue and may also minimize retraction or shrinkage of the retractor muscle.

In the case of snakes having bilobed hemipenes, including especially those with slender apical structures (as in some *Micrurus* and *Enulius*), it becomes particularly important that the retractor muscles be allowed to become *completely* relaxed after injection of diluted sodium pentobarbital (Nembutal) or other killing agent. Myers (1974:31) recommended waiting the better part of an hour before everting hemipenes of rare snakes, and Branch and Wade ("1976" [1977]:550) extended the wait to 1–2 h, which is even safer if field time permits; placing specimens, especially small ones, in a jar or plastic bag with some water or damp paper towels will prevent desiccation during the wait.

Dowling (2002:13) recommended that the tail first be opened and that the retractor muscle be severed between the end of the hemipenis and its point of division, so that the divided retractor will not form a loop and "impede the complete eversion of the lobes, thus giving them a false appearance." However, separating the two slips of retractor muscle on a bilobed hemipenis normally is essential only when everting a retracted hemipenis from a museum specimen (see below). We find Dowling's suggestion impractical under field conditions because (1) we usually complete the eversion before cutting open the tail, (2) we do not always know in advance if a given snake has a divided hemipenis, and (3) the insertion and division of the retractor muscle is sometimes not evident except under a dissecting microscope. The retractor "loop" seemingly does not impede hemipenial eversion by the snake itself, nor need it do so now *if the retractor is completely relaxed* and severed farther back after eversion. Once the retractor is cut and the organ tied (if necessary) around the base, any subsequent shrinkage of the retractor is too minimal to cause noticeable distortion.

Everted hemipenes may be left on the snake, to be later removed if necessary for detailed study and illustration. The organ will often deflate, in which case remaining air or fluid may be pressed out and the organ re-inflated at any time with colored petroleum jelly (see below); other substances that have been successfully used include paraffin (Ortenburger 1923), liquid latex (Dowling and Savage 1960:22), and agar (Manzani and Abe 1988); everted organs may also be dried (Manzani and Abe 1988), although we question the practicality of this for small delicate structures. If the everted (*or* retracted) hemipenis is to be cut away from the snake, care must be taken to excise the organ at its very base so that proportions are not affected.

What to do with hemipenes only partially protruded at the time of field preservation? These were generally considered as irrecoverable, but that is no longer so. Myers (1974:30) noted that "if

only the base is everted, the tail can be opened and the organ pulled back and studied in the retracted position." For organs partially everted beyond the base, Myers adapted circa 1967 a hot-paraffin technique for rescuing partially everted organs of small dipsadine and xenodontine snakes; Myers (1974:30) speculated that the intense heat of the paraffin softened preserved tissue that would only burst under pressure from other liquids. Branch (1986:287) found Myers' technique to be "rarely successful" for organs that were less than two-thirds everted. However, partial eversions can now be approached using methods that were subsequently developed for everting fully retracted hemipenes of preserved specimens. In fact, as pointed out by Zaher and Prudente (2003), it may be easier to evert a hemipenis that was preserved partially everted than one that is completely retracted (see following).

Laboratory Eversions from Preserved Specimens.—Dowling (2002:13) stated that "with considerable effort, it is possible to evert the hemipenes to some degree from museum material (Pesantes 1994)." In fact, however, eversions of preserved, retracted hemipenes require only a little learning and patience, and some (not all) can not be distinguished from fresh eversions.

It has never been pointed out, but should be acknowledged, that Dowling's own research program sponsored the development of such techniques some 30 years ago. At the time (1968–1973), Frances L. Gibson (née Waite) was working in the capacity of artist-technician for Dowling, who was then a Research Associate at the American Museum of Natural History. She was versed in snake anatomy (e.g., Gibson 1966, 1970) and a talented illustrator, being responsible for the outstanding plates and line drawings in Dowling and Savage (1960). With advice and support from Dowling, Waite Gibson realized that invaginated organs of museum specimens might be everted if the tissues could be softened and returned to an elastic state. A method of softening was partially described by Gibson (1970) and her "improved and completely different technique for everting hemipenes of preserved specimens" was mentioned by Myers (1974:30), who adopted the essentials of it for occasional use starting in the 1970s. Gibson (1970) made reference to a manuscript and in 1974 gave a draft copy to Myers; she unfortunately never published the complete description, but gave permission to quote it (letter from Waite Gibson to Myers, 12 August 1986).

The softening in the Waite Gibson Technique involved, as originally stated, a "soaking in glycerine, and then in a solution of trisodium phosphate and 'Calgonite'" (Gibson 1970). Trisodium phosphate (Na_3PO_4) is a detergent that had been shown useful for softening and rehydrating dried animal tissue (Van Cleave and Ross 1947a, b); Calgonite is the trade name of a water softener containing sodium phosphates and sodium carbonate.

For initial softening, Waite Gibson (MS.) opened the tails and placed *entire* small and medium-sized snakes in undiluted glycerine for up to 6–8 days, followed by two days in a saturated solution of the two detergents. (Myers later found that just removing the hemipenis from the snake directly to a saturated solution of Na_3PO_4 worked about as well.) Waite Gibson described the eversion process as follows:

> The tail is split and the retractor muscle cut as described (Dowling and Savage, 1960, p. 21; and Myers, 1972, pp. 61–63 [= draft of 1974:31]). If the organ is bilobed, the retractor muscle must be cut fairly close to the lobes, anterior to the point where the two fascicles of the muscle coalesce. The preserved muscle, even though softened, is not flexible enough to permit the two lobes to fully evert while still interconnected. Next the hemipenis is freed from its sheath, beginning at the retractor muscle and working forward. The hemipenis is left attached at its base. With blunt forceps, the hemipenis is gently pushed forward as it would normally evert. The forceps should have well-worn teeth as the tissues are easily torn, especially on very spiny specimens. When about a quarter of an inch is everted, it is possible to inject some petroleum jelly into the sinus. This is done with a syringe (a 5 cc syringe with a No. 18 needle for medium sized snakes and a No. 22 needle or a 2 cc disposable syringe for smaller snakes) and petroleum jelly mixed with carmine dye. Sometimes the jelly flows more easily if the filled syringe is allowed to stand a few minutes in warm water. The needle of the syringe is inserted into the sinus of the hemipenis by slipping it forward between the walls of the inverted and everted portions. Care must be taken to keep from puncturing the walls. The jelly thus injected facilitates further eversion, which is continued by alternately pushing the hemipenis forward with forceps and pressing the jelly forward with the fingers, adding more jelly as needed. In bilobed specimens, a dull probe may be used to make certain the lobes are everted to their fullest extent.
>
> When the hemipenis is fully everted, or nearly so, it may be removed from the snake and inflated [with] more petroleum jelly. A better specimen is obtained if the needle can be inserted into the lymph sinus and this inflated also. Since the tissue is so thin, this is sometimes difficult to do without puncturing the outer wall. Preserved specimens can not be expanded to the same degree as fresh specimens so that there is a disparity in diameter between the two. (Waite Gibson, MS.)

Because it was unpublished, Waite Gibson's method was little used by other workers. Her drawings of hemipenes, including an unknown number of organs prepared by this method, are frequently seen in Dowling's publications. If any of his published figures shows a fully everted hemipenis that appears less robust or less bulbous than a new organ being compared, it may be that the drawing represents one of Waite Gibson's early preparations from museum specimens.

Pesantes (1994) subsequently published another method of preparing hemipenes from preserved snakes. He initially removed the organ from the snake and softened it for three days in a 2% solution of potassium hydroxide (KOH). After testing for flexibility, washing, and buffering the remaining hydroxide, the hemipenis could be everted with round-tipped forceps. Pesantes gave little detail of his eversion process beyond mentioning that each lobe of a bilobed organ should be everted separately. After eversion, Pesantes recommended preparing the hemipenis for wet or dry preservation following the methods of Manzani and Abe (1988). His one illustration, a photograph (Pesantes 1994:Fig. 1), showed side-by-side views of two *Bothrops moojeni* hemipenes filled with agar solution; the one prepared from a preserved snake appears virtually identical with one from a freshly killed specimen. Pesantes' demonstration that KOH provides a convenient and effective softening agent was a significant advance. Many of the organs illustrated in Zaher (1999) were prepared using a modification of Pesantes' technique.

We currently use a combination of the Pesantes and Waite Gibson techniques, with modifications of each. KOH probably is a better softening agent than Na_3PO_4 (comparisons would be useful), but

three days immersion in 2% KOH probably is too long for small delicate organs. Zaher (1999:7) increased the solution to 3% but greatly decreased the soaking time. There is concern that buffering with hydrochloric acid as recommended by Pesantes might damage mineralized spines and spinules in small organs (Cadle 1996a:372). It seems sufficient to stop the action of KOH by flooding the softened organ in a large volume of water and several changes of alcohol.

We now use a 2% or 3% KOH solution and follow Zaher (1999:7) in immersing the isolated hemipenis "either for 1–6 hours or overnight," or even longer depending on size and condition of preservation and other factors (e.g., very spiny organs being more difficult than smooth ones). Because of scheduling problems, we have sometimes alternated difficult hemipenes between KOH and diluted glycerine or 65% alcohol over a period of several days (the KOH time for each round being up to several hours). The organ is inspected under a dissecting microscope between soakings, until flexibility seems maximal without totally breaking down the tissues.

When the organ is flexible enough, the base can be rolled back cufflike (e.g., by pushing against opposite sides of the open base with parallel ends of forceps). Because of the narrowness of the base, it usually is necessary to first cut a short slit in the base on the side opposite the sulcus spermaticus (usually located in a thick ridge of tissue on one side); a cut on the sulcate side may spread up the sulcus spermaticus, resulting in the opening of a long split (Zaher and Prudente 2003). Holding the extreme base with forceps, one starts to evert the base by pushing it forward with a second pair of smooth, blunt-tipped forceps. This is usually the most tedious part of the process, and a lack of flexibility may indicate the need for further soaking in KOH. In this way the entire organ can be gradually everted; a rounded-end narrow probe of metal or polished wood may be helpful, particularly in bilobed organs (the round heads of no. 5 or no. 7 insect pins work well in the lobes of small hemipenes). The manually everted organ can now be inflated with petroleum jelly, which may also help in the final everting of small apical structures and narrow lobes.

Yuki (1997) claimed without elaboration that a semi-everted hemipenis "will not produce a general shape similar to that of organs that are completely everted, as the action of the KOH solution is not uniform." This has been neither our usual experience nor that of Zaher and Prudente (2003), although injecting KOH into the lumen of the hemipenis and increasing total immersion time might be needed in some cases. After being sufficiently softened and relaxed, partially everted but undamaged hemipenes should be more easily eversible than fully retracted ones, since the beginning of the process already has been done. If a bilobed organ already has been mostly everted, it can be grasped between the fingers and the retractor muscle pulled back far enough to sever the two slips of muscle anterior to their merging. In the case of single or very weakly bilobate hemipenes, it should be sufficient to snip the retractor shorter so that it disappears into the organ being everted.

In line with Waite Gibson's early observation (see above), we emphasize that lab-everted hemipenes softened either in Na_3PO_4 or KOH may be fully everted without always becoming maximally expanded (inflated), in which case they are of a smaller diameter than field-everted organs. Whether a longer period of softening would have returned more elasticity to the organ usually is not clear. Taxonomic usefulness is not necessarily hindered because all structures are revealed, but taxonomic inference should not be made by comparing widths or circumferences of lab-everted hemipenes with fresh eversions made at the time of preservation. We have not rejected the possibility that lab-everted organs might be overextended longitudinally even while resisting expansion to "normal" diameter, but reliable observation or histological evidence is lacking. At the moment, we consider that lab-everted and freshly everted organs can be compared when assessing relative lobe length (but not width) as a species character (e.g., in the *Geophis brachycephalus* complex; Myers 2003).

Waite Gibson discovered in the late 1960s the practicality of using petroleum jelly for subsequent inflation of field-everted hemipenes and for helping to evert retracted organs of museum specimens. We cannot overemphasize the usefulness of this readily and widely available substance. It can be drawn into a hypodermic syringe (with needle removed) with little prior warming; several syringes can be filled and left on the workbench indefinitely until needed, and used at normal room temperature. For ease of flow, the needle should be sized to the syringe (e.g., a 26- or 20-gauge needle on a 1-cc or 2-cc syringe for small hemipenes, a 16-gauge needle on a 10-cc or 20-cc syringe for larger ones). Branch and Wade ("1976" [1977]:551) thought it advisable to immerse the hemipenis in warm water in order to "prevent blockage of the needle by cooling petroleum jelly," but this is a procedure that had been suggested for paraffin injection (Myers 1974:30) and is not a concern for petroleum jelly. The syringe itself can be placed in hot water for a few minutes if faster flow is desired, but this is not essential and it sometimes seems easier to monitor and avoid bursting small hemipenes that are being slowly inflated. The tip of the needle should *always* be filed blunt before use.

If the hemipenis resists eversion, the petroleum jelly can be squeezed out and the organ put back into KOH. Leakage of jelly from small tears will soon stop when the organ is plunged into water or alcohol, and excess jelly is easily lifted or scraped from the surface of the organ with a teasing needle or fine forceps. One or more large jars of inexpensive petroleum jelly can be pigmented and stored indefinitely.

Petroleum jelly should be colored prior to use in order to enhance surface ornamentation of the hemipenis, thus greatly facilitating study and illustration. Carmine dye was used by Waite Gibson and subsequently by Myers and others. However, if carmine-dyed petroleum jelly is not first vacuum-strained prior to use, solid particles of carmine might plug narrow-gauge hypodermic needles at awkward moments. Zaher found while working at the American Museum that red candle-wax coloring made an effective substitute for carmine dye.

We urge anyone wishing to use these techniques to experiment with some common snakes before working with specimens of rare species, and to remember that small organs tend to be more delicate and easily damaged than large ones. Damaged organs sometimes can be repaired with cyanoacrylate glue before filling with petroleum jelly (Zaher 1999:8). Although occasional organs cannot be everted completely, they may still show useful details of structure and microornamentation and may still be worth illustrating if other material is not available—but the incompleteness or probable incompleteness of the eversion should be noted, as rec-

ognized by Dowling (2002) who attempted to identify some incompletely everted hemipenes illustrated in the literature.

An apical depression or dimpled tip is "almost always an indication of incomplete eversion" of snake and lizard hemipenes (Myers and Donnelly 2001:49). There are a few exceptions to this working generalization, as in some species of the Madagascan genus *Liopholidophis*; the four species comprising the *stumpffi* group are characterized by an "umbelliform" depression at the tips of the lobes, which is correlated with a "broad internal attachment of the [retractor] to the somewhat pleated tissue at the tips of the lobes" (Cadle 1996b:441, Figs. 34–36). Dowling and Duellman ("1974–1978" [1978]:Fig. 112b.5) show the hemipenis of *L. lateralis* as lacking such a depression, but it is an interpretive drawing based on the assumption of incomplete eversion; the actual organ (AMNH 60691), on which the drawing is based, has the branches of the sulcus spermaticus entering an apical depression. This hemipenis, everted by Waite Gibson from a museum specimen, is much narrower and much less robust than a field-everted organ of the same species (cf. Cadle, 1996b:439, Fig. 35).

An apical depression similar to that of the *Liopholidophis stumpffi* group also is present on the non-bilobed hemipenis of *Elaphe longissima*. According to Schultz (1996:23, Fig.27), this depression is part of the normal morphology and not the result of incomplete eversion as previously thought.

Although some of the techniques discussed above (e.g., eversion and use of colored petroleum jelly) are applicable to lizards, we have worked with the hemipenes of relatively few groups of lizards and have little to contribute in a general sense. Böhme (1988) and Ziegler and Böhme (1997) presented extensive reviews of lizard hemipenes, and Savage (1997) commented on parallelism and divergence in some terminology used for hemipenes of male snakes and lizards. The "diverticulum" (Arnold 1984) or "hemiclitoris" (Böhme 1995; Ziegler and Böhme 1996) of female lizards is a hemipenial homologue—a rudimentary hemipenis—also known from a few scattered reports for female snakes (e.g., Hoge et al. 1959; MacLean 1968; Hardy 1975; Ziegler and Böhme 1997:30).

The available literature seems to suggest that in female snakes a recognizable hemipenial homologue or parts thereof (e.g., muscles only) varies from commonly or usually absent to variably present within genera and species, presumably because of the juxtaposition of unknown hormonal and/or developmental events, and complicated by interpretations of intersexuality. The mammalian clitoris (a penile homologue normally always present, with its own function and species-specific morphology) does not seem to be an appropriate analogy in light of such variation, and at this time we personally prefer not to use a special term for female hemipenes. Although much more attention needs to be given to snakes, female hemipenes (sometimes eversible) and their associated musculature are known to be taxonomically widespread among lizards (Arnold 1984; Ziegler and Böhme 1997).

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Hemipenes of *Siphlophis* (Serpentes, Xenodontinae) and Techniques of Hemipenial Preparation in Snakes: A Response to Dowling

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Dowling (2002) recently suggested that the hemipenial pattern of *Siphlophis* described by Zaher and Prudente (1999) as the T-shaped condition is actually an artifact of preparation because of incomplete eversion. Dowling also argued that hemipenial preparations of *Conophis vittatus* and *Hydrops martii* figured by Zaher (1999: Figs. 41 and 52, respectively) show similar eversion deficiencies.

Despite the convincing visual effect produced by his figure 1, a more careful examination of the arguments and examples used by Dowling shows that his criticisms are founded upon two fallacious ideas: 1) that science is a matter of authoritative knowledge instead of a search for answers by empirical observation and test of hypotheses; and 2) that hemipenial morphology shows some special value as a source of information at the detriment of other morphological complexes.

We do agree with Dowling (2002) that hemipenial features are informative at most taxonomic levels within snakes. However, we do not view hemipenial morphology as more reliable than any other morphological complex, as advocated by Dowling who believes that hemipenial structures are less influenced by ecological and behavioral constraints. As shown by Zaher (1999), hemipenial features are surprisingly variable at all taxonomic levels within colubroids. The tribe Pseudoboini (*sensu* Zaher 1999) is an excellent example of a moderately speciose group of colubrid snakes with a highly variable hemipenial morphology (Zaher 1994). Additionally, a number of hemipenial features have been reported to appear homoplastically in several unrelated taxa within the New World xenodontine and dipsadine radiations (Zaher 1999; Zaher and Caramaschi 1994). A nude area associated with the tip of the lobes appeared independently in the Xenodontini (as an apical disk) and *Oxyrhopus* (Zaher and Caramaschi 1994). Unilobation was derived independently several times (e.g., within *Apostolepis*, *Arrhyton*, *Contia*, *Echinanthera*, *Nothopsis*, *Taeniophallus*, and *Xenopholis*). Reduction or loss of calycular walls to form flounces may have arisen independently in *Arrhyton*, *Conophis*, *Farancia*, *Helicops*, *Hydrops*, *Ialtris*, the Xenodontini, and within the Tachymenini. Highly complex transformation series as well as homoplastic occurrences of hemipenial structures at low taxonomic levels do not support the hypothesis of hemipenes being inherently stable morphological complexes (Zaher 1999; Zaher and Prudente 1999).

In order to support our previous observations, we analyzed additional hemipenial material from the Instituto Butantan, totaling seven specimens with previously everted organs (2 *Siphlophis pulcher*, 3 *S. longicaudatus*, and 2 *S. compressus*). Although some of them are only partially everted, all present a clearly T-shaped condition. We completed the preparation of three hemipenes (one from each species) and photographed the most important steps of the procedure. Figure 1 shows these steps on a hemipenis of *S. longicaudatus* (IB uncatalogued). This preparation confirms that the "T-shaped" condition is not an artifact of preparation.

Dowling failed to test accurately our results (Zaher and Prudente 1999) with additional hemipenial preparations of the genus *Siphlophis* (including *Tripanurgos*). His Figure 1 does not represent empirical results based on new preparations, but the author's belief of what might have occurred with our preparations. Dowling attempts to justify his perspective by mentioning his long experience with hemipenial morphology: "I must admit that it took me many years to recognize these problems…." In that sense, his contribution is unscientific and misleading.

Dowling supports his point of view with a montage in which Zaher and Prudente's (1999) original figures of T- and Y-shaped hemipenes are used as background to illustrate the retractor muscle position as a possible cause of the artifactual preparation (Dowling 2002: Fig. 1). It is important to stress that Dowling did not examine the original material used by Zaher and Prudente (1999). As such, his Figure 1 is merely a hypothetical reconstruction of what Dowling believes would be the position of an unsectioned retractor muscle in the hemipenes prepared by Zaher and Prudente (1999). The retractor muscle restricted by ties at the basal end of the T-shaped hemipenis is also another extrapolative deduction (Dowling 2002: Fig. 1B, lower right).

Dowling suggested that failure to section the retractor muscle

caused the hemipenis of *Siphlophis* to retain a T-shaped condition: "if this element of the procedure is neglected (cutting the retractor muscle too far posterior – or not cutting at all) the divided retractor muscle will form a loop in the 'lobular crotch' between the two lobes of the hemipenis" (Dowling 2002:13). However, Dowling figured the Y-shaped hemipenis with an unsectioned retractor muscle (Dowling 2002: Fig. 1). Such inconsistency exposes the speculative ground on which Dowling built his arguments. Indeed, it is not clear from his discussion if the T-shaped condition is an artifact because of an uncut retractor muscle or to a muscle restricted by ties at the base of the organ. According to Dowling (2002:13), "the T-shaped figures shown by Zaher and Prudente also demonstrate the distortions caused by an additional problem.... The short and convoluted hemipenial body and the distortion of the sulcus spermaticus in the T-shaped figures are clear indications that the retractor muscle was included in and restricted by the tied base." However, a quick examination of the original material prepared by Zaher and Prudente (1999) would have saved misleading speculations as it confirms that the muscle has been sectioned and the two remaining tips of each branch are not tied at the base of the T-shaped hemipenis but lodged within their respective lobes. Clear examples of restricted or uncut muscles never result in a T-shaped hemipenis with *fully everted* lobes, as is the case in *Siphlophis*, but rather will result in organs with partially everted lobes. Although Dowling (2002:13) acknowledged this point by arguing that the failure to cut the retractor muscle will "impede the complete eversion of the lobes, thus giving them a false appearance," he failed to observe that the hemipenes figured by Zaher and Prudente (1999) have fully everted lobes.

Myers and Cadle (2003) proposed to distinguish two very different conditions of hemipenial preparation: 1) a "fully everted" hemipenis, and 2) a "maximally expanded" (or inflated) hemipenis. According to Myers (pers. comm.), maximally expanded hemipenes are always fully everted, but fully everted ones may not be maximally expanded. Such distinction is very helpful because it highlights an important variable for a proper interpretation of hemipenial features, as we will discuss in more detail below.

Dowling (2002) suggested that partially everted organs should not be used as source of information. As shown by Zaher (1999), partially everted organs may be of great value for supraspecific comparisons as they may show systematically informative details of structure and micro-ornamentation on the parts of the organ that are adequately everted. Also, incompletely everted field-prepared hemipenes can be easily prepared again, resulting in fully everted, "maximally expanded" organs (see Myers and Cadle 2003; *contra* Dowling 2002). The hemipenial preparation shown in Figure 1 illustrates adequately this point.

Differences in shape and form because of artifactual preparations might be classed in three distinct categories: 1) incomplete eversion of the lobes; 2) incomplete inflation or expansion of the hemipenial body and lobes; 3) "distorted" or strongly recurved hemipenial body and/or lobes due to preservation procedures or unsevered retractor muscles.

Partially everted hemipenes that fall in Category 1 above are easily diagnosed as such by the characteristic depression observable on the tip of their lobes. A fully everted organ is characterized by totally everted lobes, with tips showing no invaginated or depressed tissue (except in *Liopholidophis*; see Cadle 1996; Myers and Cadle 2003). Hemipenes with pointed or rounded tips can be considered, without hesitation, to be fully everted. The terminus of the sulcus spermaticus visible on the rounded surface of the lobe is another indication of a fully everted organ. However, this last feature may not be applicable on hemipenes with large apical disks or nude areas on the tip of the lobes because the sulcus tends to terminate on the edge of these structures.

A fully everted hemipenis might be either only partially or maximally expanded. "Deformations" that fall in Category 2, i.e., fully everted hemipenes that are only partially expanded, in general, have a direct effect on the overall shape of a hemipenis without affecting significantly the microornamentational pattern of the surface. Besides incomplete filling of the organ, destructive steps of the procedure, such as splitting of the organ base for eversion or accidental perforations during injection of petroleum jelly (see below), may also lead to partially expanded organs.

As clearly explained by Myers and Cadle (2003) "a maximally expanded hemipenis has inflated to the fullest extent allowed by its original elasticity... As with a balloon, there are imperceptible degrees of inflation, resulting mainly in a changing circumference." Freshly prepared hemipenes are likely to expand to their greatest elasticity whereas organs dissected out from museum specimens might not expand always to their fullest original extent. The degree of extension of a preserved hemipenis is highly variable and might cause slight differences of proportion when hemipenial preparations from several preserved specimens are compared. However, based on previous results obtained from examination of large series of hemipenial preparations (Myers 1974; Zaher 1999), such differences have little or no impact on systematic data. A common variation in micro ornamentation is illustrated by the differential degree of "erection" of spines. A partially expanded organ typically shows rows of spines (when present) in a "resting" position, more or less parallel to the hemipenial wall, whereas maximally expanded organs will show erected spines with stretched tissues at their base. Dowling seems to recognize only maximally expanded hemipenial preparations as valid for descriptive and comparative studies (although he never made clear such distinction), rejecting any observation made on fully everted organs that would not show a maximally expanded condition.

Dowling also rejects observational data on hemipenial preparations with "distorted" (= strongly recurved) shapes. We here use Dowling's word "distortion" only with caution since the word is inappropriate to describe the hemipenial condition in question. The "distorted" condition suggested by Dowling actually refers to a perfectly everted and inflated organ of *Psomophis genimaculatus* (Myers and Cadle 1994). The so-called "distortion" shown by the *Psomophis* hemipenis clearly corresponds to a strong curvature of the hemipenial body with virtually no consequence to the micro ornamental pattern, a typical case belonging to Category 3. Totally everted, maximally expanded hemipenes may often show a strongly recurved shape, as shown by the hemipenes of *Psomophis genimaculatus* (figured in a straight position by Myers and Cadle 2003), *Taeniophallus occipitalis* (Zaher 1999: Fig 92), *Tomodon dorsatus* (Zaher 1999: Fig 91), or *Antillophis parvifrons* (Zaher 1999: Fig 31). As in the examples of *Psomophis* (Myers and Cadle 2003) and *Antillophis* (Zaher 1999), a "distorted" (= strongly recurved) hemipenis can be straightened to a nearly straight posi-

tion with the aid of pins without changing the micro-ornamentation pattern. Indeed, "distortions" of that nature do not affect at all the micro-ornamentations on the surface of the hemipenes. Dowling wrongly concluded that the *Psomophis* hemipenis figured by Myers and Cadle (1994) was so badly distorted that it would not be useful for drawing systematic conclusions. The exact reasons that lead to hemipenial shape distortions (= strong curvatures) are still unclear. It might be caused by inappropriate preservation procedures (Category 3 defined above) such as unrelaxed and unsevered retractor muscles (Myers and Cadle 2003), or inadequate positioning of the specimen at the time of preservation resulting in excessive curvature of the tail.

Although we recognize the importance of having maximally expanded, minimally "distorted" preparations, we regard "distorted" hemipenes as important material that is interpretable and useful for systematic purposes. This broader approach leads us to view preserved specimens of museum collections as an invaluable source of hemipenial information, although personal experiences have shown that hemipenes from preserved specimens often present problems (Categories 2 and 3).

Hemipenial preparations on freshly-killed specimens.—Hemipenes are easier to prepare from freshly killed specimens than from museum specimens. In the field, the procedure can be straightforward: formalin is injected into the ventral surface of the tail of the freshly killed specimen until the hemipenis is everted by fluid pressure. The needle should puncture at a level that could not inflict damage to the hemipenis. However, such simple technique often results in partially everted organs although it should not be viewed as a problem since partially everted organs (via formalin injection) can be subsequently dissected out and prepared in the lab. Partially everted organs do greatly simplify the process of complete eversion in the lab (see below). A more efficient, but time consuming procedure, involves dissection of the tail and retractor muscles. It has, however, the disadvantage of being impractical to apply on small specimens in the field without a dissecting scope, which restricts the use of this procedure to the lab. The procedure is as follows: 1) slit open the ventral surface of the tail on its midline; 2) cut the retractor muscle just posterior to the tip of the lobe(s) so as to leave the smallest possible piece of muscle attached to the lobe (a careful examination of the tissue color and texture is essential to define the exact location of the tip of the lobes, see below); 3) when the hemipenis is bilobed, gently separate the lobes from each other and remove with caution the sheath of tissue around the hemipenis from the tip to the base; 4) force the hemipenis with thin, rounded tweezers toward the base of the organ, causing its eversion (note that the hemipenis is attached to the specimen; final eversion of the tip of the lobes can be done manually by finger pressure); 5) inject formalin inside the everted hemipenes through the hole at the base of the organ and force it to fully expand (we do not recommend tying off the base with a strand). This procedure permits field or laboratory preservation of hemipenes in a maximally expanded position, which can be later removed from the specimen and filled with petroleum jelly.

An important suggestion to field collectors who are not willing to prepare hemipenes in the field would be to avoid puncturing the area of the tail where the hemipenes are lodged during the process of fixation. Formalin can be injected in the dorsolateral region of the tail or gently injected along the ventral midline of the tail. Simple procedures of fixation, as the ones described above, can greatly augment the chances of subsequent preparation. An illustration of the possibilities provided by good preservation conditions is given by some of the maximally expanded hemipenial preparations obtained from rare specimens that were fixed and stored at the Paris Museum at the end of the 19th Century (Zaher 1999).

In order to clarify some of the more specific steps and provide a guideline for preparation of hemipenes from museum specimens, we furnish a detailed description of our procedure below, based on the steps illustrated in Figure 1.

Hemipenial preparations on museum specimens.—Hemipenes can be prepared from museum specimens that have either totally inverted organs or partially everted ones. The procedure figured herein was performed on a partially everted organ. Partially everted hemipenes are significantly easier to fully evert and prepare than totally inverted ones because the most difficult and delicate step of the process consists of forcing the inverted base of the organ to evert. This is generally done with the help of rounded forceps that serve to secure firmly the basal region of the organ while the rest of the organ is forced manually toward the forceps, thus causing the base to evert. However, the base of the organ is often tighter than the body and lobes, which renders nearly impossible the eversion process without causing irreversible damage to the hemipenis. A solution to this problem consists in cutting longitudinally the basal region of the hemipenial body on its asulcate side (the incision cannot be done on the sulcate side because invariably the cut will spread to the sulcus spermaticus causing it to open and extend toward the lobes). Arrow 1 in Figure 1B shows the approximate length of a cut to be performed at the base of the asulcate side of a totally inverted organ for subsequent eversion. The hemipenis of *Alsophis anomalus* figured by Zaher (1999: Fig. 24) illustrates adequately this procedure.

Any hemipenial preparation from an inverted or everted organ should be done on hemipenes that have been previously removed from the specimen. There should be no attempt to evert or invert a fixed organ before soaking it in a solution of potassium hydroxide (KOH; see next steps below). The tail first has to be opened by an incision on its ventral midline (Fig. 1B). In the case of either an inverted or partially everted organ, the retractor muscle must be severed and removed from the tail as shown in Figure 1B (arrow 2). At this point, the retractor should be severed as far as possible from the hemipenis (Fig. 1B: arrow 2). The long strand of muscle will be helpful in the next steps for pulling back the lobes to an inverted position (see below). With the retractor tightly pressed to the hemipenis, the latter is removed from the specimen via a circular incision around the base of the organ, through the thin mucosa that forms the tissue of the cloacal region (Fig. 1C: arrow 3). This incision should promote the removal of the entire hemipenis along with its retractor muscle (Fig. 1C). After removal, the organ is immersed in a solution of 2% or 3% potassium hydroxide (KOH) for softening the tissues. We recommend injecting KOH with a rounded needle inside the hemipenis to help accelerate the process and to identify possible holes on the hemipenial wall. Softening tissues with KOH is an essential step that provides elasticity to the organ and reduces the friction between the tissue walls during the eversion procedure (Pesantes 1994). Time of immersion in KOH is variable but should not be more than a half a day (except

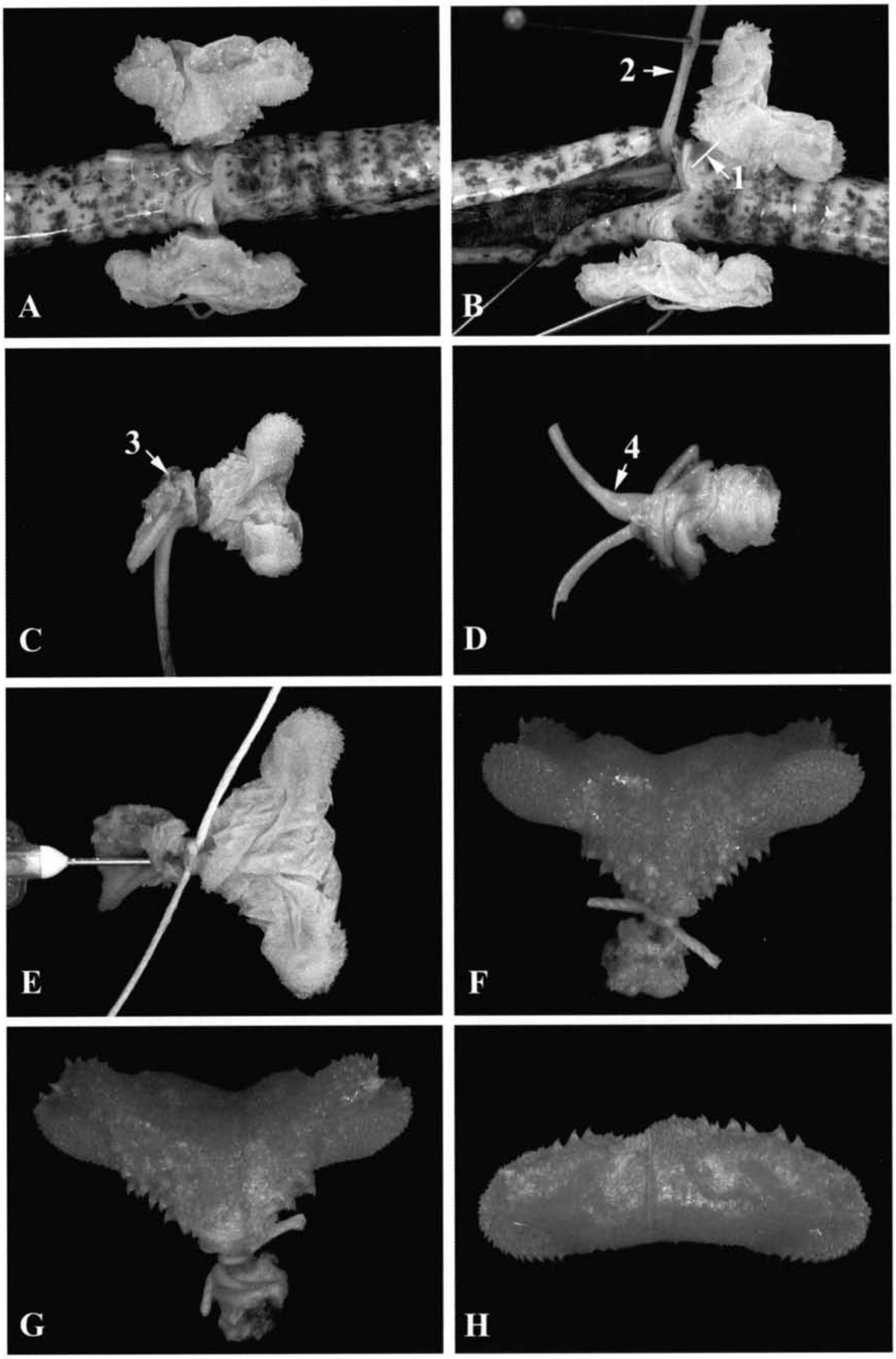

FIG. 1. Steps illustrating the eversion and filling with petroleum jelly of a partially everted hemipenis from a preserved specimen of *Siphlophis longicaudatus* (Instituto Butantan, uncatalogued). A: ventral view of the cloacal region prior to dissection. B: ventral surface of the tail cut and opened to expose retractor muscles. C: right hemipenis dissected out. D: right hemipenis partially re-inverted to expose the lobes. E: right hemipenis totally everted and tied around a needle. F, G, H: sulcate, asulcate and dorsal views (respectively) of the hemipenis, fully expanded and showing a T-shaped condition. See text for details.

for exceptionally large preparations that might stay overnight). Most of the hemipenial material prepared by us did not remain in 3% KOH for more than one hour. The hemipenis is ready for eversion when the tissue becomes rubbery. We recommend not rinsing the hemipenis until eversion is complete because KOH solution reduces friction during the process of eversion. Partially field-everted organs are better candidates for a complete and easy eversion because their basal portion is already on the correct, everted side. Bilobed organs that are half-way everted should be inverted again until the basal crotch appears on the inverted side. This can be done by pulling the organ back by the retractor muscles that were previously left long for this purpose. This procedure allows separating the lobes from each other and removing the thin sheath of tissue from around the hemipenis (Fig. 1D). After the latter procedure is concluded, the hemipenis is ready to be fully everted (Fig. 1E). However, before everting the hemipenis, the retractor muscles should be cut just posterior to the tip of their lobes. The exact location where the retractor muscle inserts on the tip of the lobe is generally marked by a slight constriction (see Fig. 1D: arrow 4). Differential color and texture between lobular and muscular tissues also help to define the precise location of the boundary.

Totally inverted organs are more difficult to evert. As mentioned above, a practical solution for everting totally inverted organs consists of slitting open the asulcate side of the base to force the eversion of the organ through a larger (basal) opening. This should be done using rounded forceps that will serve to grab the tissue proximal to the end of the slit and secure it firmly (avoiding the slit to enlarge) while, with the aid of other forceps or with the fingers, forcing the tissue of the base to roll over and evert toward the tweezers securing the base of the slit. As soon as the base is everted, the rest of the hemipenis can be forced toward it and fully everted. It is important to mention that the tissue of the lobular crotch and lobes is always thinner and much more fragile than the hemipenial body. Special care should be given when forcing these regions to evert (separate eversion of the lobes in bilobed hemipenes is not recommended; both lobes should be grabbed by the rounded forceps and forced together toward the base).

At this step in the procedure, pre-existing or accidental holes can be patched with cyanocrylate glue before filling the organ with agar or petroleum jelly. The area to be glued must be dried before applying the glue (remove alcohol by squeezing the area between your fingers with absorbent paper). It must be kept in mind that this procedure often does not allow perforated lobes to expand at all, and the rest of the organ to expand only to some degree. However, we find the resulting preparation useful since it often permits the assessment of a significant part of the hemipenial structures that might be of systematic value.

The everted organ is preferentially filled by injecting colored petroleum jelly through a syringe (Myers and Cadle 1994). Colored petroleum jelly is preferable because it enhances surface ornamentation (Myers and Cadle 1994). This can be done with Carmine Dye (Myers, pers. comm.) or with concentrated wax dye (candle dye). The syringe should be uniformly filled with petroleum jelly and the needles, with rounded tips, adjusted to the size of the organ to be filled. Petroleum jelly is easy to manipulate because it can be maintained in a liquid state in warm water, although some persons prefer to use it directly at normal room temperature, a procedure also allowed by the petroleum jelly (see Myers and Cadle 2003). We personally prefer to use warm, liquefied jelly because it helps distend the tissues of the hemipenis during injection. Warm and cold water should be kept nearby during the filling procedure and used eventually to liquefy the jelly inside the needle or to stop or diminish possible leaks (the syringe and needle, along with the mounted hemipenis, can be dropped directly into cold or warm water). For proper filling procedure, a totally everted hemipenis has to be tied to a rounded needle with a thread and all the air should be removed from the organ (Fig. 1E). Figures 1F, 1G, and 1H show the sulcate, asulcate, and dorsal views of a fully everted and expanded hemipenis of *S. longicaudatus* using the procedures described above. The result confirms that the T-shaped condition is not an artifact of preparation.

We agree with Dowling (2002) that incompleteness of eversion should always be noted. Zaher (1999) failed to furnish this information because he was focused on showing major hemipenial patterns within a large and diversified lineage of snakes. However, only four hemipenes prepared and figured by Zaher (1999) are not fully everted: *Conophis vittatus* (Fig. 41), *Pseudoboa coronata* (Fig. 72), *Siphlophis pulcher* (Fig. 77), and *Xenopholis undulatus* (Fig. 95). All other figured hemipenes are fully everted as confirmed by re-examination of the original material. The latter species do have a slightly bilobed hemipenis whereas *X. scalaris* shows a clearly unilobed organ.

The differential length of the lobes seen in *Phalotris nasutus* (Zaher 1999: Fig. 63) and several species of *Philodryas* is a natural condition, not the result of partial eversion. The hemipenes of *Helicops leopardinus* (Fig. 47), *H. modestus* (Fig. 48), and *Philodryas aestiva* (Fig. 65), that might be interpreted as partially everted organs, are actually fully everted and expanded. Similarly, and contrary to Dowling's belief, the hemipenis of *Hydrops martii* (Fig. 52) is fully everted and expanded. Unlike the hemipenis of *H. martii* figured by Dowling (2002: Fig. 4B), which shows lobes with distally flattened surfaces, the hemipenis figured by Zaher (1999: Fig. 52) has rounded and expanded lobes. The flounces seen on the asulcate surface also represent a natural condition of the organ (Zaher 1999: 62).

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ARTICLES

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Colubrid Snakebite: A Public Health Problem in Brazil

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Whereas bites by viperid and elapid snakes have long been recognized as an important public health problem in Brazil (Ministério da Saúde. Fundação Nacional da Saúde 1998), bites by other snakes have received much less attention. Nonetheless, reports of symptomatic bites by supposedly non-venomous snakes in Brazil have appeared throughout this century (Martins 1916; Penteado 1918; Vital Brazil and Vellard 1926). Interest in colubrid bites increased after the herpetologists Karl Patterson Schmidt and Robert Mertens were killed by African snakes in the genera *Dispholidus* and *Thelotornis*, respectively (Nahas et al. 1976).

Symptomatic bites by colubrid snakes were reviewed by Minton (1990). Since then, additional species of colubrid snakes have been reported to cause symptomatic bites. These include several life-threatening bites to infants by *Boiga irregularis* (Fritts et al. 1990, 1994), and two serious bites by *Hydrodynastes gigas*, resulting in repeated episodes of collapse and paralysis in one case (Manning et al. 1999) and a "permanently disfigured" arm in another (Stevens 2000).

Apart from *Dispholidus* and *Thelotornis*, *Rhabdophis tigrinus* (Mittleman and Goris 1974; Zotz et al. 1991) has also caused fatal bites, and more recently, a fatal bite by *Philodryas olfersii* was reported (Fowler and Salomão 1994; Salomão and Di-Bernardo 1995). Controversies about the capacity of some colubrids, such as the South American *Tachymenis peruviana*, to kill humans remain. Lema (1978a) reported a case of fatal bite by *T. peruviana*, citing Vellard (1955). However, Vellard (1955) did not mention symptoms in humans, but only discussed the potent effects of *T. peruviana* venom in animal experiments. Serious bite symptoms by this species have been described by Schenone and Reyes (1965). Finally, *Boiga forsteni* is also suspected to have caused fatal bites in Sri Lanka (Fritts and McCoid 1999).

During the 1980s and 1990s certain colubrids thought to possess toxic saliva or venom (see Kochva 1987 for considerations on this matter) were identified (Hill and Mackessy 2000; McKinstry 1978, 1983; Minton 1990; Spawls and Branch 1995), based on the histological observation of their Duvernoy's glands, carried out by Taub (1967), Kochva and Gans (1970), Gabe and Saint-Girons (1971), and the descriptions of clinical manifestations in patients bitten by these snakes. Minton (1990) listed, summarized, and divided these symptoms into two basic categories: systemic poisoning associated with coagulopathy and those that presented local effects.

In Brazil, the number of reports on bites from "non-venomous" snakes has increased considerably and snakebites by "harmless" snakes are now considered a problem of public health. Among all the snakebites registered in the State of São Paulo (Fan and Cardoso 1995) and those caused by crotaline snakes in the city of Uberlândia, State of Minas Gerais (Silveira and Nishioka 1995), approximately 40% did not develop symptoms of envenomation, possibly because the snake was nonvenomous or, if it was venomous, the skin was not deeply punctured or no venom was injected (so called "dry bite") (Albolea 1999; Albolea and Salomão 1998; Ministério da Saúde. Fundação Nacional da Saúde 1998; Santos-Costa et al. 2000).

Examples of snakes which have caused human envenomations with serious clinical manifestations are the opisthoglyphous species *Phalotris lemniscatus* (= *Elapomorphus bilineatus* according to Ferrarezzi [1993]) (Lema 1978b); *Philodryas olfersii* and *P. patagoniensis* (Araújo and Santos 1997; Brito and Carvalho 2000; Campbell and Lamar 1989; Fowler and Salomão 1994; Nickerson and Henderson 1976; Nishioka and Silveira 1994; Salomão and Di-Bernardo 1995; Silva and Buononato 1983/84), *Clelia clelia plumbea* (Pinto et al. 1991) and the aglyphous *Liophis miliaris* (Santos-Costa and Di-Bernardo 1997) and *Helicops modestus* (Albolea and Salomão 1998; Albolea et al. 2000).

This paper is a report on bites caused by snakes other than pitvipers and coral snakes. It includes the frequency of snakebite per year, the identification of the snake species implicated, the profile of victims (age and sex) and clinical manifestations, as an aid in evaluation and prevention of this problem in Brazil.

The Hospital Vital Brazil (HVB), Instituto Butantan, São Paulo, provides free treatment for patients bitten by snakes. Some patients still possessed the snake (live or dead) which caused the snakebite, therefore an immediate identification could be done,

helping doctors make decisions about the use of antivenom. Snakes would then be deposited in the museum collection of the Laboratório de Herpetologia, Instituto Butantan, which contains only snakes responsible for biting humans and subsequent hospitalization of these patients. Data concerning information about the snake, the patient, and the snakebite itself are recorded by the museum and in HVB reports for each patient. A survey of the specimens, museum data, and medical reports allowed us to collect detailed information on the most common snakes involved, patient profiles, and most frequent symptoms. We emphasize that most snakebite victims at HVB come from the state of São Paulo and our conclusions may not apply to other states in Brazil. However, registers from the state of São Paulo are the most complete data sets in Brazil, being used by health authorities as a national reference because a lack of information on this subject from other states.

Hospital Vital Brazil started its activities in 1946. However, routine registration of snake species began only in 1959. Since then, HVB admitted a total of 6048 snakebite victims in which the offending snake accompanied the patient and was available for identification (Table 1). Of these, 4083 were inflicted by elapid and viperid snakes, 42 were inflicted by snakes of the families Anomalepididae, Boidae, and Leptotyphlopidae, and 1923 were caused by snakes in the family Colubridae (Table 2). Among the colubrids, the largest number of snakebites was caused by the genera *Helicops*, *Philodryas*, and *Liophis* (Table 3).

We found that male patients predominated in 11 of the 16 genera investigated. Snakes belonging to five genera—*Tomodon*, *Tropidodryas* ($\chi^2 = 4000$, $P = 0.045$, d.f. = 1), *Liotyphlops*, *Erythrolamprus* ($\chi^2 = 11560$, $P < 0.001$, d.f. = 1), and *Apostolepis* ($\chi^2 = 36000$, $P < 0.001$, d.f. = 1)—bit significantly more female patients.

TABLE 1. Frequency of snakebites registered at Hospital Vital Brazil, Instituto Butantan.

Year	Viperids and Elapids		Others		Total	
	N	%	N	%	N	%
1959	52	64.2	29	35.8	81	1.34
1960	64	68.1	30	31.9	94	1.55
1961	72	69.2	32	30.8	104	1.72
1962	66	61.1	42	38.9	108	1.79
1963	81	68.6	37	31.4	118	1.95
1964	76	70.4	32	29.6	108	1.79
1965	77	72.6	29	27.4	106	1.75
1966	65	60.7	42	39.3	107	1.77
1967	103	64.8	56	35.2	159	2.63
1968	89	60.5	58	39.5	147	2.43
1969	87	66.4	44	33.6	131	2.17
1970	97	74.6	33	25.4	130	2.15
1971	104	68.4	48	31.6	152	2.51
1972	88	59.8	59	40.2	147	2.43
1973	80	64.5	44	35.5	124	2.05
1974	97	68.8	44	31.2	141	2.33
1975	106	65.4	56	34.6	162	2.68
1976	82	62.6	49	37.4	131	2.17
1977	91	62.3	55	37.7	146	2.41
1978	109	61.2	69	38.8	178	2.94
1979	134	64.1	76	35.9	209	3.46
1980	126	65.9	65	34.1	191	3.16
1981	119	65.7	62	34.3	181	2.99
1982	150	69.8	65	30.2	215	3.55
1983	156	70.6	65	29.4	221	3.65
1984	173	72.1	67	27.9	240	3.97
1985	235	71.6	93	28.4	328	5.42
1986	233	70.0	100	30.0	333	5.51
1987	179	71.3	72	28.7	251	4.17
1988	148	68.5	68	31.5	216	3.57
1989	130	74.5	40	23.5	170	2.81
1990	88	66.1	45	33.9	133	2.20
1991	83	72.8	31	27.2	114	1.88
1992	50	59.5	34	40.5	84	1.39
1993	87	73.7	31	26.3	118	1.95
1994	50	66.7	25	33.3	75	1.24
1995	65	67.7	31	32.3	96	1.59
1996	51	61.4	32	38.6	83	1.37
1997	40	64.5	22	35.5	62	1.03
1998	52	68.4	24	31.6	76	1.26
1999	48	62.3	29	37.7	77	1.27
Total	**4083**		**1965**		**6048**	**100.0**

Patients between 0 and 40 years of age were the main victims of colubrid bites, particularly of *Helicops* ($\chi^2 = 23.604$, $P < 0.0001$, d.f. = 1) and *Philodryas* ($\chi^2 = 10.071$, $P < 0.0015$, d.f. = 1). Snakes belonging to the genera *Xenodon*, *Liophis*, *Philodryas*, *Atractus*, *Chironius*, *Waglerophis*, *Helicops*, and *Thamnodynastes* bit more patients between 15 and 40 years old. Children under 14 years old were the main victims of *Liotyphlops*, *Mastigodryas*, *Tropidodryas*, *Oxyrhopus*, *Waglerophis*, and *Helicops* (Table 4). Hands, arms, feet, and legs were the most frequently bitten parts of the body. Snakes of the genera *Atractus*, *Mastigodryas*, *Philodryas*, *Thamnodynastes*, and *Xenodon* bit hands and arms 60.0% of the time, whereas species of the genera *Helicops* ($\chi^2 = 5.22$, $P = 0.0223$, d.f. = 1), *Liotyphlops*, *Tropidodryas*, *Apostolepis*, and *Waglerophis* bit feet and legs more often. The high frequency of *Helicops* bites on feet and legs must be a consequence of the aquatic habits of these snakes, associated with the fact that people do not use protection to walk in the water, especially when fishing. Bites to the trunk were reported for *Erythrolamprus*, *Tomodon*, *Apostolepis*,

and *Tropidodryas*. Most of these bites to the middle of the body occurred when the victim was either in bed or having a bath (Table 5).

The main clinical manifestations exhibited by patients (Table 6) were abrasions (sometimes with bruising) and local pain, followed by local hemorrhage from teeth punctures, swelling, and erythema. Other less significant symptoms included: stinging sensation, local numbness, general discomfort, hyperemia, local paleness, local itching, and sweating. Ecchymoses and gum hemorrhage occurred only in patients bitten by *Philodryas* (Table 7).

Recently (September 2000) a herpetologist from Instituto Butantan was bitten by *Liophis poecilogyrus* on his left fourth digit and thereafter exhibited local effects such as intense pain (particularly throbbing), swelling, local hemorrhage, lack of sensitivity, and local decrease of temperature. These symptoms lasted for three hours (C. A. Falcetti, pers. comm.).

Some of these manifestations are very similar to those exhibited by patients bitten by pitvipers, and this may confuse inexperienced doctors. An example of this is the case of a man, 53 years

TABLE 2. Percentage of snakebites among different families of snakes at Hospital Vital Brazil from 1959 to 1999.

Family	Number of snakebites	(%)
Viperidae	4050	66.96
Colubridae	1923	31.80
Elapidae	33	0.55
Anomalepididae	28	0.46
Boidae	13	0.21
Leptotyphlopidae	01	0.02
Total	6048	100.00

TABLE 3. Percentage of snakebites by genera at Hospital Vital Brazil from 1959 to 1999.

Family	Genus	N	%
Anomalepididae	*Liotyphlops*	28	1.42
Boidae	*Boa*	11	0.56
	Epicrates	1	0.05
	Eunectes	1	0.05
Colubridae	*Helicops*	427	21.73
	Philodryas	397	20.20
	Liophis	258	13.13
	Oxyrhopus	167	8.50
	Thamnodynastes	142	7.23
	Waglerophis	122	6.21
	Chironius	81	4.12
	Xenodon	75	3.82
	Sibynomorphus	74	3.77
	Tomodon	51	2.60
	Atractus	29	1.48
	Mastigodryas	27	1.37
	Apostolepis	14	0.71
	Tropidodryas	13	0.66
	Erythrolamprus	10	0.51
	Tantilla	10	0.51
	Simophis	5	0.25
	Pseudoboa	4	0.20
	Spilotes	4	0.20
	Clelia	3	0.15
	Taeniophalus	3	0.15
	Sordellina	2	0.10
	Gomesophis	2	0.10
	Echinanthera	1	0.05
	Hidrodynastes	1	0.05
	Imantodes	1	0.05
Leptotyphlopidae	*Leptotyphlops*	1	0.05
	Total	1965	100.00

TABLE 4. Percentage of snakebites by genus among patient age groups at Hospital Vital Brazil from 1959 to 1999.

	Age of patients		
Genus	0–14	15–40	Over 40
Helicops	42.4	47.0	10.6
Philodryas	27.3	54.5	18.2
Liophis	31.5	58.0	10.5
Oxyrhopus	50.0	25.0	25.0
Thamnodynastes	36.4	45.5	18.1
Waglerophis	50.0	50.0	0
Chironius	28.6	50.0	21.4
Sibynomorphus	40.0	20.0	40.0
Tomodon	40.0	40.0	20.0
Xenodon	16.7	83.3	0
Atractus	16.7	50.0	33.3
Liotyphlops	66.7	0	33.3
Mastigodryas	60.0	20.0	20.0
Apostolepis	40.0	40.0	20.0
Tropidodryas	60.0	20.0	20.0
Erythrolamprus	33.4	33.3	33.3

TABLE 5. Percentage of snakebites to different parts of the body by genus at Hospital Vital Brazil from 1959 to 1999.

Genus	Trunk	Hand and arm	Foot and leg
Helicops	0	30.8	69.2
Philodryas	0	60.0	40.0
Liophis	0	42.4	57.6
Oxyrhopus	0	50.0	50.0
Thamnodynastes	0	53.3	46.7
Waglerophis	0	40.0	60.0
Chironius	0	42.9	57.1
Sibynomorphus	0	60.0	40.0
Tomodon	20.0	40.0	40.0
Xenodon	0	60.0	40.0
Atractus	0	60.0	40.0
Liotyphlops	0	14.3	85.7
Mastigodryas	0	60.0	40.0
Apostolepis	16.6	16.7	66.7
Tropidodryas	16.7	0	83.3
Erythrolamprus	33.3	33.3	33.4

TABLE 6. Percentage of pathologies presented by patients bitten by mildly venomous snakes admitted to Hospital Vital Brazil from 1959 to 1999.

Pathology	%
Abrasions	30.67
Local pain	28.09
Local hemorrhage	13.40
Swelling	10.05
Erythema	8.25
Discomfort	4.90
Stinging sensation	1.28
Ecchymosis	0.77
Numbness	0.77
Gum hemorrhage	0.52
Hyperemia	0.52
Local paleness	0.26
Local itching	0.26
Sweating	0.26

old (HVB number 73386) bitten by *Helicops*, who was admitted to the hospital and received four vials of bothropic antivenom, because of coagulopathy. Bothropic antivenom was also given to a patient (HVB number 48575), bitten by *Liophis miliaris*, who presented serious symptoms of hemorrhage. On another occasion a 17-year-old boy was admitted with all the symptoms of *Bothrops* envenomation. However, he claimed he had been bitten by a green snake with brown head, which unfortunately he had not managed to catch. When a *Philodryas olfersii* was shown to him, he identified it immediately, which avoided the administration of bothropic antivenom (G. Puorto, pers. comm.).

Colubrids produce the greatest number of bites in relation to their abundance in neotropical regions, compared to other families (Cadle and Greene 1993; Ferrarezzi 1994; McDowell 1987; Vanzolini 1986). In India 80% of reported snake bite cases are caused by "mildly venomous" snakes, particularly a common water snake (*Cerberus rhynchops*) (Saha and Hati 1998). Aquatic snakes of the genus *Helicops* caused most snakebites registered in the state of Rio Grande do Sul, in southern Brazil (Costa 1997). A possible explanation for this is the defensive behavior exhibited by species of *Helicops* (Cei 1993) when compared to species of other genera. Bites to the feet and legs are more frequent because farm workers often do not wear shoes. A similar situation has been found regarding colubrid bites reported by Minton (1996), Costa (1997), and Saha and Hati (1998). Snakebites involving *Helicops* and *Liophis* occurred predominantly near or in the water, where snakes are difficult to see because of cryptic coloration. Snakes of other genera such as *Waglerophis*, *Chironius*, *Apostolepis*, *Tropidodryas*, and *Tomodon* can also have a cryptic color pattern, thus increasing the probability of bites. This is because people typically touch or step on them without realizing their presence. Alternately, brightly patterned species might inflict more bites because of their attractiveness and increased liklihood of being handled. This seems to be the case with species of *Philodryas*, *Apostolepis*, and *Erythrolamprus*, as many patients admitted they were bitten when attempting to capture snakes.

Blind snakes (*Liotyphlops*) have not been reported to bite humans. Data presented here show that children were most frequently involved in these encounters (66.7%), probably because they play on the ground, digging up soil and often have bare feet (part of the body most affected—85.7%). Many parents indicated that the child was playing with the snake. This shows a close correlation between the fossorial habits of this snake, and the situation in which the encounter occurred. However, despite the number of cases (N = 28), the medical reports of these patients described only abrasions and local pain.

Local hemorrhage is one of the most common pathologies produced by snake venom. Proteolytic activity at various levels, high phospholipase A (2) activity, phosphodiesterase and acetylcho-

TABLE 7. Distribution of main clinical manifestations (%), shown by patients admitted to Hospital Vital Brazil, Instituto Butantan, among the different genera of mildly venomous snakes. (SS – stinging sensation; LP – local pain; N – numbness; SL – swelling; EC – ecchymosis; ER – erythema; A - abrasions; GD – general discomfort; GH – gum hemorrhage; HY – hyperemia; HE – local hemorrhage; PL – local paleness; LI – local itching; SW – sweating).

Genus	SS	LP	N	SL	EC	ER	A	GD	GH	HY	HE	PL	LI	SW
Helicops		30.5		10.6		1.2	41.2	5.9			10.6			
Philodryas	2.7	19.3	2.0	14.7	2.0	13.3	20.7	7.3	1.3		16.0	0.7		
Liophis		32.6		4.4		6.5	39.1	6.5			8.7		2.2	
Oxyrhopus	16.7	16.7		16.7		16.6	33.3							
Thamnodynastes		21.4		7.1		7.1	42.9				14.3			7.2
Waglerophis		55.6					22.2				22.2			
Chironius		37.5		6.2			43.8				12.5			
Sibynomorphus		50.0					25.0				25.0			
Tomodon		40.0					60.0				16.7			
Xenodon		41.7		8.3		8.3	25.0							
Atractus		50.0					50.0							
Liotyphlops		57.1		14.3			28.6				22.2			
Mastigodryas		11.1				22.2	44.5							
Apostolepis		28.6		14.3		28.5	14.3			14.3	33.3			
Tropidodryas		55.6					11.1							
Erythrolamprus		33.3				16.7	33.3				16.7			

linesterase activities, have been found in the "venom" (Duvernoy's secretion) of twelve species of colubrid snakes (Hill and Mackessy 2000). Bioassays using mice (18–22 g) have shown that the species *Apostolepis dimidiata*, *Phalotris lemniscatus*, *Elapomorphus quinquilineatus*, *Erythrolamprus aesculapii*, *Thamnodynastes strigilis*, and *Liophis miliaris* have highly hemorrhagic "venoms" (M. G. Salomão, pers. obs.). Such reactions in mice were similar or more intense than those resulting from *Philodryas olfersii*, whose Duvernoy's secretion causes quantitatively more hemorrhaging than the venom of many species of *Bothrops* (Assakura et al. 1992; Salomão 1991). Local hemorrhage is normally a consequence of skin perforation combined with venom effects. *Philodryas* is an exception because bites cause significant systemic coagulopathy such as gum hemorrhage.

Experiments using the saliva of *Helicops* (0.0725 mg dried venom/g mice) killed mice in 10 minutes, with the mice exhibiting spasms and distension of posterior legs. When tested on fish (4–6 g), their usual prey, it caused a decrease of opercular beatings and general immobilization for about 30 minutes, followed by death (Albolea 1999; Albolea et al. 2000). Paralysis was also observed when extract of the Duvernoy's glands of *Sibynomorphus neuwiedi* (Laporta-Ferreira 1985) and of *S. mikani* (Salomão and Laporta-Ferreira 1994) were used on snails and slugs, respectively.

Other symptoms, such as general discomfort (e.g., headache, nausea, dizziness) and sweating may be a consequence of psychological effects of encountering a snake. These results show a relationship between the effects of venom on prey and certain symptoms present in victims of bites from "mildly venomous" species. Moreover, additional laboratory studies should be undertaken to determine if other snake species, presently considered nonvenomous, might have "venoms" of medical significance to humans (Nishioka and Silveira 1994).

Our results have documented the potential danger of certain Brazilian colubrid snakes to humans. Several taxa, in particular *Philodryas olfersii* and at least some species of *Phalotris* and *Apostolepis*, and possibly *Hydrodynastes gigas*, can cause potentially life-threatening illness. The adjective "harmless" should be abandoned when referring to colubrids. We suggest the designation of "mildly venomous" (Minton 1990) to refer to those snakes which are known to produce toxic symptoms and recommend the use of "non-venomous" exclusively for those species which lack Duvernoy's glands. Moreover, we feel people should be advised not to handle snakes unnecessarily, mainly because the effects of the "venom" of many species are completely unknown and even those species, such as boids, which do not inject toxic saliva may cause serious injuries (see Duarte et al. 2000 for details on attacks by boids). Campaigns such as those carried out in Instituto Butantan to teach people about the importance of snakes in the environment, despite their potential danger to humans, should be encouraged and implemented in other states. Training for doctors and nurses for immediate snake identification should be reinstituted; such training would minimize unnecessary administration of antivenom, and consequently, antivenom side effects (see Nishioka and Silveira 1994 for more examples). Studies on natural history should focus on epidemiological aspects of colubrid species to better understand their behavior, consequences of interaction with people, and thereby reducing risks of snakebite to the public. Finally, the idea of preparing a specific antivenom for some colubrid snakes, as suggested by Lema (1978a, b) and Salomão (1991) should be considered on the basis of its cost/benefit ratio, despite the logistic difficulties of venom extraction from colubrid snakes (Salomão et al. 1990).

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Observations on a Population of Mexican Lance-headed Rattlesnakes (*Crotalus polystictus*) from an Agricultural Area in the Mexican State of México

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The Mexican lance-headed rattlesnake (*Crotalus polystictus*) is distributed across the Mexican Plateau and has been documented from the states of Veracruz, Puebla, México, Distrito Federal, Michoacán, Querétaro, Guanajuato, Jalisco, and Zacatecas (Campell and Lamar 1989). Few data exist on the natural history of this species. Armstrong and Murphy (1979) provided habitat descriptions, behavioral observations, and morphometric data on several gravid females and their offspring. Other records of reproduction in *C. polystictus* were reported in Klauber (1972) and Hubbard (1980). Klauber (1972) stated that one specimen of *C. polystictus* contained mammal hair, and in another a small passerine bird and a small mammal. Specimens have been found in mesquite-grassland (Duellman 1965), plains-grassland, on plateaus in breaks in pine-oak forest (Armstrong and Murphy 1979), and in pine-oak forests (Campbell and Lamar 1989). McCranie and Wilson (2001) reported finding a female and six young near a stream in a cornfield in Aguascalientes. The historical range of *C. polystictus* may be declining because of the conversion of this species' native habitat to farmland and habitat destruction (Armstrong and Murphy 1979; Greene and Campbell 1992). The draining of Lago de Chapala also might have caused a decline in the number of *C. polystictus* (Duellman 1961). Greene and Campbell (1992) listed this species as "vulnerable to extinction" because of habitat conversion and its restricted distribution.

The region of central México situated on the Mexican Plateau west of the Sierra Ajusco between Toluca and Atlacomulco is characterized by vast monocultures of corn fields. In mid-August 2001 we spent four days in the environs several kilometers north of Ixtlahuacán, México. This area lies at an average elevation of 2500 m and is relatively flat. Approximately 25 individuals of *C. polystictus* were observed. Most were found along a small stretch of earthen canal (ca. 50 m long) bordering a dirt road between two fallow corn fields. The canal averaged 1.5 m deep and 2 m wide, and was covered by thick vegetation. There was no running water in the bottom of the canal, though standing pools of water up to ca. 30 cm deep in places were present. Rodent burrows were found on the steep canal sides. Several other specimens of *C. polystictus* (including a female with neonates) were found ca. 1 km from the canal on top of a grassy earthen berm next to a cornfield.

All specimens were observed from 1115 h to 1815 h CST. On 10 August 2001 we were in the field from 9000 h until 1500 h. After 10 August all our search times were limited to the late afternoon and early evening (1500–1900 h). Cooler temperatures (< 15°C), cloudiness, and rain in the early evening limited *C. polystictus* activities. An adult male was found active at 1815 h before it started raining, and nocturnal activity, such as that found by Armstrong and Murphy (1979), is probable when environmental conditions are favorable. Specimens were located in a coiled position basking in direct sun in the morning and early afternoon. Often these basking individuals were found coiled on top of bunchgrass (zacatón). Most specimens observed in the late afternoon and early evening were found actively crawling or in a semi-coiled position out of the direct sunlight, when it was present. Upon collection, specimens were restrained in clear plastic tubes for ease of handling and to verify sex and reproductive condition.

Adult *C. polystictus* were alert and difficult to approach. Specimens observed from a distance often laid motionless before being approached to within a few meters, at which time they would rapidly retreat into burrows. Several specimens that were first observed perched on zacatón retreated into the water of the canal and could be heard or were seen swimming away. Klauber (1972) reported that Paul D. R. Ruthling found *C. polystictus* in the tules of Lake Chapala that sought refuge in the water. These behaviors contrast with those found in *C. polystictus* by Armstrong and Murphy (1979), who found these rattlesnakes to "generally not retreat when approached" during the summer.

Reproduction and mating behaviors in *C. polystictus* were observed. A female was found basking with six neonates on top of her at 1115 h on 10 August 2001. The air temperature was 17.4°C. Upon discovery the neonates and female took refuge under a nearby concrete fence post. Though no length measurements were taken, the female weighed 122 g and the combined weight of the neonates was 52 g. The neonates shed a few days later. At 1232 h later that day an adult female (167 g) was found with four neonates coiled next to her, one of which was shedding, on the steep side of the earthen canal in thick vegetation in partial shade. However, gentle palpation of the female revealed she was gravid. She gave birth to two live and two stillborn neonates and four infertile ova on 21 August 2001. No data were recorded on the litter.

Reproductive associations were observed in *C. polystictus* on several occasions. On 10 August 2001 at 1245 h an adult male (306 g) was found stretched out on top of an adult female (108 g) on the side of the earthen canal underneath a small bush. The male was collected but the female escaped into a rodent burrow. She was observed again at 1406 h below the rodent burrow coiled on top of another adult male. She was collected but the male escaped into the burrow. This female had shed after the first observation of her prior to being collected. The fresh shed skin was found near the entrance to the burrow and a small piece was stuck to her. The second male (identified by his unique dark coloration and large size) remained outside the entrance to the rodent burrow and was observed here for several days. On 14 August 2001 at 1750 h this male was found outside the entrance to the burrow alongside another adult male. The shedding of the female and release of pheromones may have stimulated the male courtship behavior, as dis-

cussed in Schuett (1992) and Aldridge and Duvall (2002).

This population of *C. polystictus* lies within an artificial, highly-modified habitat. Such an area may provide an increase in prey availability because of high rodent densities typically associated with agricultural areas. Several of the scats from wild collected individuals examined in the lab contained rodent hair (species not identified). Specimens were most commonly encountered near heavily vegetated earthen canals and berms. The monoculture created by hectares of uninterrupted cornfields contain unsuitable habitat, and thus concentrate populations of *C. polystictus* along breaks in their periphery. The use of agricultural chemicals and pesticides and conversion of earthen canals to concrete canals may negatively affect this population. Searches near concrete canals failed to produce any specimens of *C. polystictus*, presumably because of their lack of rodent burrows and vegetated sides. Although this population of *C. polystictus* appears to be healthy, it should be considered fragile because of its location in an area subject to further modification for agriculture.

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Herpetological Review, 2003, 34(4), 314–317.

Growth Rates and Post-Release Survival of Captive Neonate Timber Rattlesnakes, *Crotalus horridus*

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The need for conservation and management of rare species is becoming increasingly important as wildlife species and their habitat continue to decline. Translocation of wild captured adults to augment and reintroduce populations has been successfully used for some endangered avian species (see Carrie et al. 1999; Rudolph et al. 1992). In general, success rates for mammals and birds are higher than those for amphibians and reptiles (Dodd and Seigel 1991; Griffith et al. 1989).

The Timber Rattlesnake (*Crotalus horridus*) is listed as a State of Texas threatened species and translocation of captive raised snakes might benefit small populations. Controversy exists on the benefits versus problems associated with translocation of amphibians and reptiles (Burke 1991; Dodd and Seigel 1991; Reinert 1991). A recent evaluation of the impacts of translocation on behavior and survival of mature *C. horridus* suggests that translocation of adult snakes not be recommended as a standard management technique because of immediate aberrant movement behavior patterns and long-term elevated rates of overwinter mortality, predation, and disease (Reinert and Rupert 1999).

Because of the problems associated with translocation of adult *C. horridus*, the ability to successfully raise neonate rattlesnakes and successfully introduce them into forest habitat may be an essential conservation technique if viable populations of this rare species are to be maintained in the wild. If captive-raised neonates can be grown to sufficient size, predation-related and overwinter mortality events suffered by neonates and first-year juveniles might be minimized, increasing the net survival rates of cohorts released to the wild.

We captive raised one neonate *C. horridus* in 1993–1994 and eight in 1994–1995, recording detailed growth data on the eight snakes over an 11-month period. The nine snakes were released with surgically implanted transmitters in eastern Texas and we monitored their movements for six years. We determined their survival rates in the wild to evaluate the possible merit of using captive-raised neonates to augment small, isolated populations.

Materials and Methods.—Locations of released *Crotalus horridus* with transmitters were monitored in the Stephen F. Austin Experimental Forest, southern Nacogdoches County (31°29'N,

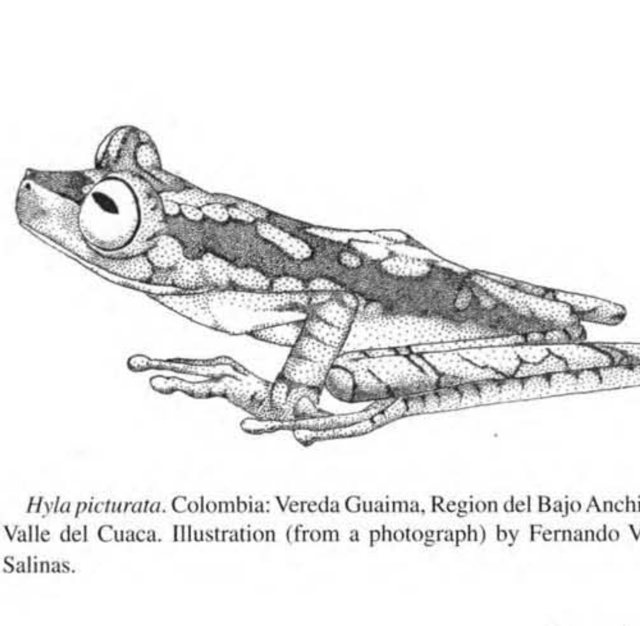
THAMNOPHIS MARCIANUS (Checkered Garter Snake). **SALVAGING PRENEONATES FROM A ROAD-KILL.** The results of salvaging unborn or preneonate young of natricine snakes from road-killed gravid females does not seem to be recorded in the literature. Pope (1952. Snakes Alive and How They Live. The Viking Press, New York. 238 pp.) suggested that the young of a gravid female live-bearing snake, cut open a few days before normal birth, would survive, and that snakes are often killed with enough force to set any well developed young free. Oliver (1955. The Natural History of North American Amphibians and Reptiles. V. Van Nostrand Co., Princeton, New Jersey. 359 pp.) agreed, commenting that if a female carrying young about to hatch, was vigorously clubbed, her swollen body might burst, releasing the young. Accounts of unborn young surviving their mother's death are exemplified by J. T. Burkhart (pers. comm.) who related an account of a *Thamnophis* sp. being run over by a vehicle, expelling numerous young that subsequently crawled away.

This is a report on salvaging preneonate young from a road-killed checkered garter snake, *Thamnophis marcianus*. The specimen was collected from Willow Road in extreme northwestern Enid, Garfield County, Oklahoma, USA at 2059 h (after dark) on 29 September 1995. Abdominal movement was observed in the snake that did not seem to be characteristic reflex action. The snake was hurriedly opened surgically at 2110 h, and 25 preneonate young were removed by 2233 h. Seven young exhibited life signs such as mouth gaping, tongue flickering, and body movements.

The total length of the parent female was 65.5 cm. (SVL 51.2 cm, tail 14.3 cm). Three of the 25 young were accidentally mutilated during hasty surgery, and were not measurable, another remained in its embryonic sac and was not measured. Total lengths of 21 remaining young varied from 15.1 to 20.4 cm, averaging 17.9 cm. Total lengths of the five surviving live young was 17.0 to 20.4 cm, averaging 10.04 cm. Three of these died by 23 December 1995. Two remaining juveniles have survived.

Specimens were deposited in the museum collections of St. Gregory's University, Shawnee, Oklahoma, SGU numbers 510 (adult female), and young 511–528, 534, 560 and 2038.

Submitted by **RICHARD L. LARDIE**, P.O. Box 9002, Vance AFB, Enid, Oklahoma 73705, USA.



Hyla picturata. Colombia: Vereda Guaima, Region del Bajo Anchicaya, Valle del Cuaca. Illustration (from a photograph) by Fernando Vargas Salinas.

GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 34, Number 2 (June 2003). Additional note: The responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extensions unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA OPACUM (Marbled Salamander). USA: VIRGINIA: Scott Co: Rikemo Lodge, ca. 1 km SW of Dungannon. 8 May 1999. Christopher S. Hobson, Steven M. Roble, Anne C. Chazal. Verified by Richard Hoffmann. Virginia Museum of Natural History (VMNH) 10337. One sub-adult was found in a small pit (ca. 0.25 m deep) covered by a piece of plywood at Rikemo Lodge, situated on a slope just above the floodplain of the Clinch River. First record for Scott Co., and first published record for southwestern Virginia (Mitchell and Reay 1999. Atlas of Amphibians and Reptiles in Virginia. Spec. Publ. No. 1, Virginia Department of Game and Inland Fisheries, Richmond, Virginia. 122 pp.; Tobey 1985. Virginia's Amphibians and Reptiles: A Distributional Survey, Virginia Herpetological Survey, Purcellville, Virginia, 113 pp.). The nearest published records within the Ridge and Valley physiographic province are from Knox Co., Tennessee (ca. 160 km SW), and Montgomery Co., Virginia (ca. 180 km NE) (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, Center for Field Biology, Austin Peay State University, Clarksville, Tennessee, 94 pp.; Tobey 1985, *op. cit.*). This record partially fills a hiatus in the known range for this species that includes much of the southern Appalachians.

Submitted by **CHRISTOPHER S. HOBSON** (e-mail: cshobson@dcr.state.va.us) and **STEVEN M. ROBLE** (e-mail: sroble@dcr.state.va.us), Virginia Department of Conservation and Recreation, Division of Natural Heritage, 217 Governor Street, Richmond, Virginia 23219, USA.

AMBYSTOMA TIGRINUM TIGRINUM (Eastern Tiger Salamander). USA: ILLINOIS: Gallatin Co: pond NW side York Lane and 1.3 km E Pounds Hollow Road (37°36'20"N, 88°15'34"W). 7 June 2002. Kurt J. Regester and David W. Butler. Verified by Ronald A. Brandon. SIUC H–07089. Larval specimens collected in Shawnee National Forest wildlife pond. New county record (Philips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, Champaign, Illinois. xii + 282 pp.).

Submitted by **KURT J. REGESTER** and **DAVID W. BUTLER**, Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901, USA.

CRYPTOBRANCHUS ALLEGANIENSIS ALLEGANIENSIS (Eastern Hellbender). USA: TENNESSEE: Cheatham Co.: Sycamore Creek adjacent to Harris Town Road, ca. 4.0 air miles NW of Ashland City (36°19'39"N, 87°05'40"W). 10 July 1996. Brian Canada. Austin Peay State University Museum of Zoology (APSU 5455 B series of 10 color photos). Verified by David H. Snyder. One adult (total length 727 mm) in shallow water (< 10

cm) where small spring-fed waterfall trickles over limestone ledges and enters stream. New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, Center for Field Biology, Austin Peay State University, Clarksville, Tennessee) that fills gap between records from Montgomery and Davidson counties.

Submitted by **BRIAN CANADA**, 431 Van Hook Drive, Ashland City, Tennessee 37015, USA (e-mail: Brian.Canada@state.tn.us), and **A. FLOYD SCOTT**, Department of Biology and Center for Field Biology, Austin Peay State University, Clarksville, Tennessee 37044, USA.

EURYCEA LONGICAUDA (Long-tailed Salamander). USA: MISSOURI: Maries Co: 0.7 km N–3.4 km E jct of US 63 and MO 42 in Vienna (38°11'32"N, 91°54'35"W). 25 April 1971. J. Puricelli. Verified by R. W. Axtell. SIUE 752. New county record.

Submitted by **CAROL A. BRYANT**, 7841 South Panther Creek Road, Mount Olive, Illinois 62069, USA; e-mail: cabryant@ctnet.net.

EURYCEA LUCIFUGA (Cave Salamander). USA: MISSOURI: Reynolds Co: Johnson Shut-Ins State Park campgrounds (37°32'20"N, 90°50'30"W). 4 May 1963. C. Glaeser. Verified by R. W. Axtell. SIUE 969. New county record.

Submitted by **CAROL A. BRYANT**, 7841 South Panther Creek Road, Mount Olive, Illinois 62069, USA; e-mail: cabryant@ctnet.net.

EURYCEA LUCIFUGA (Cave Salamander). USA: INDIANA: Franklin Co: Mounds State Recreation Area, rocky seep, 1.4 km NE of top of "The Mounds." 24 April 2001. Rhys Dale, under permit to John Iverson. Verified by John Iverson. Florida Museum of Natural History, University of Florida (UF 134743). Extends range 9.0 km NNE of previous record (Brookville; Minton 2001. Amphibians and Reptiles of Indiana. Indiana Acad. Sci., Indianapolis, 404 pp.).

Submitted by **STESHA A. PASACHNIK**, Earlham College, Richmond, Indiana, 47374, USA; e-mail: pasacst@earlham.edu.

HEMIDACTYLIUM SCUTATUM (Four-toed Salamander). USA: MICHIGAN: St. Clair Co: Pond in woodlot south of Marysville along Highway 29, 1 km NW of jct with Davis Road (42°53.3'N, 82°29.3'W). 24 April 2002. Richard Lehtinen, Glenn Fox, Keith Pecor, and Greg Schneider. Verified by Ronald A. Nussbaum, University of Michigan Museum of Zoology (UMMZ 229576). Extends range northwards into the "thumb" of Michigan.

Submitted by **RICHARD LEHTINEN**, **GLENN FOX**, **KEITH PECOR**, and **GREG SCHNEIDER**, University of Michigan Museum of Zoology, Ann Arbor, Michigan 48109–1079, USA.

ANURA

BATRACHYLA NIBALDOI (Nibaldo's Wood Frog). CHILE: X REGION DE LOS LAGOS: Quinchao, Isla Alao (42°35'S, 73°16'W, 114 m elev.), ca. 6 km N of Isla Chaulinec. 13 and 18 February 2001. L. Iriarte. Museo Nacional de Historia Natural, Santiago, Chile (MNHN 3422 and 3421). Verified by H. Núñez. Collected on mosses in a Chilean Valdivian rain forest. Species previously known in Chile from Puente Traihuanca (Formas 1997. Herpetologica 53:6–13). Subsequent records extended the range to Laguna San Rafael National Park (Díaz-Páez and Williams 2001. Herpetol. Rev. 32:189) and Las Guaitecas National Reserve (Díaz-Páez and Carreño 2002. Herpetol. Rev. 33:218). This specimen represents the first record from X Administrative Region of Chile; and extends the northern range of the species ca. 360 km NW from Puente Traihuanca.

Submitted by **DANIEL PINCHEIRA-DONOSO**, Sección Zoología, Museo Nacional de Historia Natural, Casilla 787, Santiago, Chile and **HELEN DÍAZ-PÁEZ**, Departamento de Zoología, Facultad de Ciencias Naturales y Oceanográficas, Universidad de Concepción, Casilla 160-C, Concepción, Chile.

BUFO CALIFORNICUS (California Arroyo Toad). MÉXICO: BAJA CALIFORNIA NORTE: Río San Rafael, Cañon San Rafael, 18 air km E Punta Colonet (31.09876°N, 116.2539°W), 200 m elev. 25 May 2002. Los Angeles County Museum of Natural History voucher photographs (LACM–PC 1390). Río de Las Palmas, Cañon el Alamo, 6.5 air km NE El Testerazo (32.33030°N, 116.51396°W), 450 m elev. 23 March 2002. (LACM–PC 1391); and Río los Encinitos, Cañon la Grulla, 1 air km NW Uruapan (31.63665°N, 116.46570°W), 175 m elev. 5 April 2002. (LACM-PC 1392). Observed by Diego Casas, Hector Cevallos, Gustavo Danneman, Brian Freiermuth, Robert Lovich, Clark Mahrdt, Mark Mendelsohn, Jeff Saurwein. All photos verified by Edward L. Ervin. This species ranges west from the Sierra Juárez and Sierra San Pedro Mártir peninsular range to the foothills and coastal plains of northwestern Baja California, and south to San Quintín (Grismer 2002. Amphibians and Reptiles of Baja California including its Pacific Islands and the Islands in the Sea of Cortés. University of California Press, Berkeley and Los Angeles, California). Both adults and larvae of *Bufo californicus* were previously reported by Welsh (1988. Proc. California Acad. Sci. 46:1–72) from the upper Río San Rafael drainage in the western foothills (1330 m elev.) and conifer forest (2210 m elev.) of the Sierra San Pedro Mártir. The Río San Rafael population reported here represents a new coastal record for this drainage, located ca. 65 km downstream from the foothill locality reported by Welsh (1988, *op. cit.*). Several paedomorphs in addition to *Hyla regilla* and *H. cadaverina* tadpoles were observed at the site along a 200 m portion of stream. An adult male (SVL 55 mm; 27g) was observed in the Río de las Palmas in association with introduced adult *Xenopus laevis* and adult *H. regilla*, and *H. cadaverina*. Although Grismer (2002, *op. cit.*) does not include *X. laevis* as occurring in Baja California, Tinsley and McCoid (1996. *In* R.C. Tinsley and H. R. Kobel [eds.], The Biology of *Xenopus*. Symposia of the Zoological Society of London, No. 68, pp. 81–94, Clarendon Press, Oxford) indicate that this species may occur in large populations in the Municipality of Tijuana, Baja California, Mexico. This record of *X. laevis* confirms the species presence in the Rio las Palmas watershed and represents the southernmost record in Baja California. In the Río los Encinitos drainage, an adult male arroyo toad (SVL 54 mm; wt.17 g) was observed with several adult H. regilla. The Río de las Palmas and Río los Encinitos records represent new river drainages for the arroyo toad (see Mahrdt et al. 2002. Herpetol. Rev. 33:123–125) and potential breeding sites of *Bufo californicus*

in Baja California.

Submitted by **CLARK R. MAHRDT**, Herpetology Department, San Diego Natural History Museum, P.O. Box 1390, San Diego, California 92112, USA, **ROBERT E. LOVICH**, AC/S Environmental Security, Box 555008, Marine Corps Base, Camp Pendleton, California 92055-5008, USA, **SALVATORE J. ZIMMITTI**, P&D Environmental, 401 West "A" Street, San Diego, California 92101, USA, and **GUSTAVO D. DANEMANN**, Pronatura Noroeste, Riveroll No. 724, Ensenada, Baja California, CP 22800 México.

BUFO MARINUS (Cane Toad): BRITISH WEST INDIES: Cayman Islands: Grand Cayman: Georgetown; Melody Lane off Crewe Road (under a pile of brush). 18 June 1999. David Arch, Jr. Verified by R. Powell. Photographic documentation (by the senior author): Milwaukee Public Museum (MPM) Herp Photo 710. First record of this genus from the Cayman Islands (Seidel and Franz 1994. *In* M. A. Brunt and J. E. Davies [eds.], The Cayman Islands: Natural History and Biogeography, pp. 407–433. Kluwer Academic Publ., Dordrecht, Netherlands). The previous summer, Mr. Geddes Hislop, a Trinidadian naturalist familiar with the species, had observed another individual on the grounds of the Catholic School on Walkers Road. The specimen reported here was the subject of an article and accompanying photograph in the *Caymanian Compass* newspaper on 23 June 1999. Subsequently, the National Trust for the Cayman Islands and the Cayman Department of Agriculture received many telephone calls from the public that suggest that the species is established from West Bay to Bodden Town. One respondent stated that he had first observed it five years earlier. These reports probably have merit because no other bufonid occurs in the Cayman Islands; the only other relatively large anuran resident in the islands is the distinctive *Osteopilus septentrionalis* (Cuban treefrog). No reports were received from East End or North Side on Grand Cayman. The source of the introduction is unknown. The species has not been reported from Cayman Brac or Little Cayman.

Submitted by **F. J. BURTON**, P.O. Box 10308 APO, Grand Cayman, Cayman Islands, British West Indies (e-mail: fjburton@candw.ky), and **A. C. ECHTERNACHT**, Department of Ecology & Evolutionary Biology, University of Tennessee, Knoxville, Tennessee 37996-1610, USA (e-mail: echterna@utk.edu).

BUFO NEBULIFER (Gulf Coast Toad). *Bufo nebulifer* was formerly part of *B. valliceps*, now restricted to Central and South America (Mulcahy and Mendelson 2000. Mol. Phylog. Evol. 17:173–189). USA: TEXAS: ANDERSON Co: In a small, semi-flooded pasture at the corner of Farm Road 321 and County Road 349 (31°52.205'N, 87°34.799'W). 29 May 2002. Matthew E. Gifford. This specimen will be deposited in the University of Texas at Arlington Collection of Vertebrates. (UTA A–55078) Verified by Ronald L. Gutberlet, Jr. *Bufo nebulifer* is widespread in eastern and central Texas. This species has never been recorded in Smith, Cherokee, Van Zandt, Rains, Upshur, and Rusk counties, however, it has been recorded from adjacent counties. Smith Co. has been extensively surveyed and has an extremely well documented herpetofauna with no evidence of the presence of *B. nebulifer*. The individual we collected in Anderson Co. represents a new county record (Dixon 2000. Amphibians and Reptiles of Texas,Texas A&M University Press, College Station Texas). No other *B. nebulifer* were located nearby, however, several large choruses of East Texas Toads, *B. woodhousii velatus*, were in proximity. *Bufo w. velatus* is relatively rare in the southern Texas counties where *B. nebulifer* is common, whereas dense populations of *B. w. velatus* occur in each of the counties where *B. nebulifer* has not been recorded. Further sampling is required to determine if the absence of *B. nebulifer* in these counties is a result of natural events or inadequate sampling.

Submitted by **MATTHEW E. GIFFORD*** and **BRIAN E. FONTENOT**, Department of Biology, The University of Texas at Tyler, Tyler, Texas 75799, USA. *Current address: Box 1137, Department of Biology, Washington University, St. Louis, Missouri 63130, USA; e-mail: gifford@biology2.wustl.edu.

BUFO PUNCTATUS (Red-spotted Toad). USA: COLORADO: DOLORES Co.: Side canyon off Monument Canyon. July 1979. T. Paul Maslin. UCM 61297, 14 transformlings and 3 larvae. Verified by Richard L. Holland. First record for the county (Hammerson 1999. Amphibians and Reptiles of Colorado. Second Ed. University Press of Colorado, Niwot. 484 pp.).

Submitted by **DAVID CHISZAR** and **HOBART M. SMITH**, University of Colorado Museum, Boulder, Colorado 80309, USA.

CREPIDOPHRYNE EPIOTICA (NCN). COSTA RICA: HEREDIA: Cerro Dantas Wildlife Refuge (10°05'N, 84°03'W), 1800 m elev. 28 September 2002. Andrés Vaughan. Museo de Zoología de la Universidad de Costa Rica (UCR 16855). Verified by Gerardo Chaves. First record for Heredia and for the Cordillera Volcánica Central and bridges the gap between previous Atlantic versant records on Volcán Miravalles to the northwest and the Talamanca Mountains to the southeast (Savage 2002. Amphibians and Reptiles of Costa Rica. Univ. Chicago Press, Chicago. xv + 934 pp.). The juvenile specimen was caught on the ground during the day in secondary growth forest.

Submitted by **ANDRÉS VAUGHAN** (e-mail: andresvaughan@hotmail.com) and **WARREN CALVO** (e-mail: junglemonkey78@hotmail.com), Escuela de Biología, Universidad de Costa Rica, San Pedro de Montes de Oca, San José, Costa Rica.

ELEUTHERODACTYLUS DIMIDIATUS (Black Whiskered Frog). CUBA: MATANZAS: ZAPATA SWAMP: (81°15'57.24"N, 22°19'27.48"W) ca. 5 km from Buenaventura, departing 100 m to the NE from the road to Santo Tomás. May 1997. A. Rodríguez. Instituto de Ecología y Sistemática, Colección Zoológica de la Academia de Ciencias de Cuba (CZACC 14 3776). Verified by L. V. Moreno. CUBA: ISLE OF PINES: Los Indios River, ca. 800 m to the NE of the "Los Indios" Ecological Station (82°59'30.48"N, 21°4.68"W). 11 August 1999. A. Rodríguez and R. Alonso. Male collected as it called from the forest litter. Instituto de Ecología y Sistemática, Colección Zoológica de la Academia de Ciencias de Cuba (CZACC 145600). Verified by L. V. Moreno. First record of this species for these two biogeographic regions from which it was considered absent (Hedges 1999. *In* W. E. Duellman [ed.], Patterns of Distribution of Amphibians, A Global Perspective, pp. 211–254. The Johns Hopkins University Press. Baltimore and London).

Submitted by **ARIEL RODRÍGUEZ** and **ROBERTO ALONSO**, Instituto de Ecología y Sistemática Carr. de Varona, Km 3, Capdevila, Boyeros. AP 8029, CP 10800, Ciudad de la Habana, Cuba; e-mail: zoologia.ies@ama.cu.

ELEUTHERODACTYLUS EILEENAE (Colín). CUBA: MATANZAS: Zapata Swamp: (81°15'57.24"N, 22°19'27.48"W) ca. 5 km from Buenaventura, departing 100 m to the NE from the road to Santo Tomás. May 1997. A. Rodríguez. Male collected as it called from a leaf in the understory of a deciduous forest. Instituto de Ecología y Sistemática, Colección Zoológica de la Academia de Ciencias de Cuba (CZACC 14 3415). Verified by L. V. Moreno. First record of this species in the lowlands of Zapata Swamp where it was previously considered absent (Hedges 1999. *In* W. E. Duellman [ed.], Patterns of Distribution of Amphibians, A Global Perspective, pp. 211–254. The Johns Hopkins University Press. Baltimore and London).

Submitted by **ARIEL RODRÍGUEZ** and **ROBERTO ALONSO**, Instituto de Ecología y Sistemática Carr. de Varona, Km 3, Capdevila, Boyeros. AP 8029, CP 10800. Ciudad de la Habana, Cuba; e-mail: zoologia.ies@ama.cu.

ELEUTHERODACTYLUS TETAJULIA. CUBA: HOLGUÍN: Municipio Frank País: El Desayuno, Sierra de Cristal (75°26'12.84"N, 20°31'54.48"W). 15–19 December 2000. A. Rodríguez and R. Alonso. A series collected on the leaf litter in the rainforest ca. 700 m elev. Instituto de Ecología y Sistemática, Colección Zoológica de la Academia de Ciencias de Cuba (CZACC 14 11403–4 and 14 11407–11). Verified by L. V. Moreno. First record of this species outside the type locality with a range extension of ca. 76 km airline distance W of the previous record on Arroyo Sucio (Anacleto) Arriba, on the western slope of Monte Iberia, Municipio Baracoa, Guantánamo (Estrada and Hedges 1996. Herpetologica 52:435–439).

Submitted by **ARIEL RODRÍGUEZ** and **ROBERTO ALONSO**, Instituto de Ecología y Sistemática Carr. de Varona, Km 3, Capdevila, Boyeros. AP 8029, CP 10800. Ciudad de la Habana, Cuba; e-mail: zoologia.ies@ama.cu.

ELEUTHERODACTYLUS RONALDI. CUBA: HOLGUÍN: Municipio Frank País: Baconal, Sierra de Cristal (75°25'25.32"N, 20°34'35.04"W). 24 December 2000. A. Rodríguez and R. Alonso. A male collected as it called on a leaf of a tree in a rather open situation, ca. 600 m elev. Instituto de Ecología y Sistemática, Colección Zoológica de la Academia de Ciencias de Cuba (CZACC 14 11402). Verified by L. V. Moreno. First record of the species in Sierra de Cristal, range extension of ca. 45 km from the closest previous record in Cupeyal del Norte, Cuchillas del Toa (Garrido and Jaume 1984. Doñana, Acta Vertebrata 11[2]:5–128).

Submitted by **ARIEL RODRÍGUEZ** and **ROBERTO ALONSO**, Instituto de Ecología y Sistemática Carr. de Varona, Km 3, Capdevila, Boyeros. AP 8029, CP 10800. Ciudad de la Habana, Cuba; e-mail: zoologia.ies@ama.cu.

HYLA ARENICOLOR (Canyon Treefrog). USA: NEW MEXICO: Union Co.: Brown's Ranch, Long Canyon (36°44'31"N, 103°44'45"W). 30 May 1958. T. Paul Maslin. UCM 61366, 19 tadpoles, associated with ghost shrimp, *Thamnocephalus*. Tadpoles verified by Richard L. Holland, shrimp by D. Christopher Rogers. First record for the county (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. Albuquerque, Univ. New Mexico Press. 431 pp.).

Submitted by **DAVID CHISZAR, HOBART M. SMITH,** and **LAUREN GOLTEN**, University of Colorado Museum, Boulder, Colorado 80309-0334, USA.

HYLA BOANS. PANAMÁ: COCLÉ: Distrito de La Pintada: Palmarazo, margin of the stream Quebrada La Varona, a tributary of the Río San Juan (8°43'57.0"N, 80°39'11.4"W), 85 m elev. 18 December 2001. C. A. Jaramillo A. and R. Ibáñez D. Verified by A. S. Rand. Museo de Vertebrados de la Universidad de Panamá (MVUP 1767). New record for Coclé and extends the range ca. 112 airline km SW of the nearest locality in the former Canal Zone (Duellman 2001. Hylid Frogs of Middle America. SSAR Contrib. Herpetol. 18:1–1180).

This record was obtained during a project funded by the Autoridad del Canal de Panamá to The Louis Berger Group Inc., The Universidad de Panamá, and Smithsonian Tropical Research Institute Consortium.

Submitted by **ROBERTO IBÁÑEZ D.**, Smithsonian Tropical Research Institute, Apartado 2072, Balboa / Ancón, Panamá, Panamá (e-mail: ibanezr@tivoli.si.edu), **CÉSAR A. JARAMILLO A.**, Círculo Herpetológico de Panamá, Apartado 10762, Estafeta Universitaria, Panamá, Panamá (e-mail: jaramilc@tivoli.si.edu), and **FRANK A. SOLÍS**, Universidad de Panamá, Escuela de Biología, Departamento de Zoología, Panamá, Panamá (e-mail: solisf@tivoli.si.edu).

***HYLA CHRYSOSCELIS / HYLA VERSICOLOR* COMPLEX** (Gray Treefrogs). USA: MISSOURI: Iron Co: 8.1 km N–5.8 km E Johnson Shut-Ins State Park campground on Hwy H (37°36'30"N, 90°46'30"W). 3 May 1963. L. Leitner. Verified by R. W. Axtell. SIUE 816. New county record.

Submitted by **CAROL A. BRYANT**, 7841 South Panther Creek Road, Mount Olive, Illinois 62069, USA; e-mail: cabryant@ctnet.net.

HYLA IBITIPOCA BRAZIL: MINAS GERAIS: Municipality of Araponga: Fazenda Brigadeiro, Parque Estadual da Serra do Brigadeiro (21°42'S, 43°53'W). December 2001. R. N. Feio, P. L. Ferreira, and D. Pantoja. Museu de Zoologia João Moojen de Oliveira, Universidade Federal de Viçosa, Viçosa, Minas Gerais (MZUFV 4419). Verified by U. Caramaschi and M. F. Napoli. First record outside the type locality, Ibitipoca State Park, Municipality of Lima Duarte, Minas Gerais (Caramaschi and Feio 1990. Copeia 1990:542–546), extends northeastern range ca. 200 km airline.

Submitted by **RENATO NEVES FEIO, PAULA LEAO FERREIRA,** and **DAVI LIMA PANTOJA,** Museu de Zoologia João Moojen de Oliveira, Universidade Federal de Viçosa, 36571-000, Viçosa, MG, Brazil; e–mail: rfeio@ufv.br.

LEPTODACTYLUS POECILOCHILUS (Turbo White-lipped Frog). COSTA RICA: HEREDIA: Cantón Sarapiquí: La Selva Biological Station (10°25.847'N, 84°00.201'W), 75 m elev. 26 April 2002. Andrew J. Crawford. Universidad de Costa Rica, Museo de

Zoología (UCR 16417). 20 June 2002. Eduardo Toral. La Guaria annex of La Selva reserve (UCR 16762). Both verified by Gerardo "Cachí" Chaves. First records (with vouchers) for Heredia and westernmost localities for the Atlantic versant of Costa Rica (Savage 2002. Amphibians and Reptiles of Costa Rica. Univ. of Chicago Press, Chicago. 934 pp.). Because La Selva is herpetologically the most thoroughly studied site in the country, we suspect that this species might be a recent arrival rather than a rare or overlooked species. *Leptodactylus poecilochilus* might be expanding its range because of local deforestation as the species is thought to prefer open and disturbed habitats (Savage, *op. cit.*).

Submitted by **ANDREW J. CRAWFORD**, Smithsonian Tropical Research Institute, Apto. 2072, Balboa, Ancón, Panama (e-mail: crawfordaj@naos.si.edu), **EDUARDO TORAL** (e-mail: guashote@yahoo.com), and **FEDERICO BOLANOS**, Escuela de Biología, Universidad de Costa Rica, San Pedro, Costa Rica.

MYERSIELLA MICROPS (NCN). BRAZIL: MINAS GERAIS: Municipality of Caratinga: Estação Biológica de Caratinga, (19°44'S, 41°49'W). November 2000. J. Cassimiro. Museu de Zoologia João Moojen de Oliveira, Universidade Federal de Viçosa, Viçosa, Minas Gerais, (MZUFV 4744–45). Verified by J. P. Pombal, Jr. Published distribution for the species is Atlantic forests in the states of Rio de Janeiro and São Paulo, in southeastern Brazil (Frost 2000. Amphibian Species of the World. An Online Reference. http://research.amnh.org/herpetology/amphibia/). First state record, also represents the most inland and northermost record for the species and extends known distribution ca. 350 km airline.

Submitted by **RENATO NEVES FEIO**, Museu de Zoologia João Moojen de Oliveira, Universidade Federal de Viçosa, 36571–000, Viçosa, MG, Brazil; **JOSE CASSIMIRO**, Departamento de Zoologia, Instituto de Ciencias Biológicas, Universidade Federal de Minas Gerais, 30123–970, Belo Horizonte, MG, Brazil and **CARLOS ALBERTO GONÇALVES DA CRUZ**, Departamento de Vertebrados, Museu Nacional, Quinta da Boa Vista, 20940-040, Rio de Janeiro, RJ, Brazil.

PLETHODONTOHYLA COUDREAUI (Coudreau's Frog). MADAGASCAR: Ambolokopatrika Forest, Campsite 3 (Antsinjorano), Andapa Fivondronana, Antsiranana Faritany (14°32.6'S, 49°25.8'E, ca. 950 m elev.), and Masoala Peninsula, Campsite 3 (Andasin'i Governera), Antalaha Fivondronana, Antsiranana Faritany (15°18'S, 50°01'E, ca. 650 m elev.). Collected 13 December 1997 by F. Andreone, G. Aprea, and J. E. Randrianirina (Museo Regionale di Scienze Naturali di Torino [MRSN] A2066: Fig. 1), and 2 December 1998 by F. Andreone and J. E. Randrianirina (MRSN A2115), respectively. Verified by M. Vences. *Plethodontohyla coudreaui* was described by Angel (1938. Bull. Mus. natn. Hist. nat. Sér. 2 10:260–261) from Betampona, eastern Madagascar (Toamasina Fivondronana, Toamasina Faritany: 17°52'–17°56'S, 49°11'–9°15'E). After its initial discovery (holotype MNHN 1937–19), the species was not found again until recently, when it was reported from campsites 2 and 3 in Marojejy (NE Madagascar) (Raselimanana et al. 2000. Fieldiana:Zoology, n.s. 97:157–174). During a series of surveys in this area the species was found in two additional localities as above, of which Ambolokopatrika is a mid-altitude rainforest between Marojejy and Anjanaharibe-Sud massifs (Andreone et al. 2000. Biodivers. Conserv. 9:1587–1622). The Masoala site is a low altitude rainforest corridor between two larger forest parcels. The specimens were captured using pitfalls. MRSN A2066 and A2115 measure 21.8 and 25.5 mm SVL, respectively, versus 26.1 mm in the holotype.

FIG. 1. *Plethodontohyla coudreaui* from Ambolokopatrika, NE Madagascar (MRSN A2066).

Submitted by **FRANCO ANDREONE,** Museo Regionale di Scienze Naturali di Torino, Via G. Giolitti, 36, I-10123 Torino, Italy; e-mail: f.andreone@libero.it.

PLEURODEMA GUAYAPAE (NCN). ARGENTINA. SAN LUIS: Sierra de las Quijadas National Park (32°20'–32°47'S, 67°10'–66°58'W). February and March 1999. J. C. Baldoni and A. C. Guerreiro. Herpetological Collection of the Universidad Nacional de San Luis, San Luis (UNSL–CH 0250 and 0252). Verified by Ismael di Tada. First province record. Previously reported from southeastern La Rioja; southern Catamarca, southwestern Santiago del Estero, and northwestern Córdoba (Barrio 1964. Physis XXIV[68]:471–489); the present record extends the known distribution 260 km S of Patquía, La Rioja, the type locality.

Submitted by **ANALIA GUERREIRO, JUAN CRUZ BALDONI,** and **ANA M. BRIGADA,** Universidad Nacional de San Luis. Facultad de Química, Bioquímica y Farmacia, Area de Zoología. Chacabuco y Pedernera, San Luis, (C.P. 5700), Argentina (e-mail: analiag@unsl.edu.ar).

PSEUDACRIS CRUCIFER (Spring Peeper). USA: ILLINOIS: MASON CO: 0.5 mi. N of 1370 N on 1900 E. 15 May 2002. J. A. Crawford and M. J. Meyer. Verified by C. A. Phillips. Illinois Natural History Survey (INHS 18098). New county record. One male collected from a roadside ditch.

Submitted by **JOHN A. CRAWFORD**, Division of Biological Sciences, University of Missouri, Columbia, Missouri 65211, USA (e-mail: jac7vc@mizzou.edu), and **MATHYS J. MEYER,** Department of Biological Sciences, Illinois State University, Normal, Illinois 61790, USA (e-mail: altboer@hotmail.com).

PSEUDACRIS NIGRITA NIGRITA (Southern Chorus Frog). USA: VIRGINIA: YORK CO.: powerline right-of-way ca. 0.7 km

SE junction of Virginia Route 105 and Richneck Road (N 37.17791 W 76.50072). 3–5 April 2003. Emily C. Moriarty, Christopher S. Hobson, and Erikka Conrad. Verified by David Cannatella. Texas Memorial Museum (TMM 62399–62401). Adults were heard calling on three consecutive nights along a powerline that straddles Richneck Road, and lies along the southern edge of the Grafton Ponds Natural Area Preserve. Three specimens were collected during the period of 3–5 April. First record for Virginia (Mitchell and Reay 1999. Atlas of Amphibians and Reptiles in Virginia. Spec. Publ. No. 1, Virginia Department of Game and Inland Fisheries, Richmond, Virginia. 122 pp.; Tobey 1985. Virginia's Amphibians and Reptiles: A Distributional Survey, Virginia Herpetological Survey, Purcellville, Virginia, 113 pp.), and northernmost known locality. The North Carolina State Museum of Natural Sciences collection contains specimens from the nearest known *P. nigrita* populations in Beaufort Co., North Carolina (A. Braswell, pers. comm.), which is ca. 200 km S of the Virginia locality. Published range maps show the northern limits of distribution in east-central North Carolina (Conant and Collins. 1998. Reptiles and Amphibians of Eastern/Central North America. Houghton Mifflin Co., Boston, Massachusetts, 616 pp.; Martof et al. 1980. Amphibians and Reptiles of the Carolinas and Virginia. The University of North Carolina Press, Chapel Hill, 264 pp.). Other species calling at this site included *Pseudacris feriarum*, *P. crucifer*, *Hyla chrysoscelis*, *Rana sphenocephala*, and *Bufo fowleri*. Surveys conducted on 12 and 14 April 2003 along County Route 625 in Prince George County, Virginia revealed the presence of two choruses of *P. nigrita nigrita*, along with *P. brimleyi*, *P. crucifer*, *Bufo americanus*, *Acris gryllus*, and *Rana sphenocephala*. The Prince George County site is ca. 55 km W of the York County site.

Submitted by **CHRISTOPHER S. HOBSON,** Virginia Department of Conservation and Recreation, Division of Natural Heritage, 217 Governor Street, Richmond, Virginia 23219, USA (e-mail: cshobson@dcr.state.va.us), and **EMILY C. MORIARTY,** Patterson Laboratory 141, 24th and Speedway, University of Texas, Austin, Texas 78712, USA (e-mail: chorusfrog@mail.utexas.edu).

PTYCHADENA TRINODIS (NCN). MAURITANIA: Guelta Oumm Lebare (Wilaya Assaba), 16°29.472'N, 10°49.822'W. 31 May 2002. Museo Nacional de Ciencias Naturales, MNCN 41783. Verified by Ignacio de la Riva. Adult male was found active during the night near a pond. The area is a gorge with permanent water, belonging to the Sahel Savannah. Other amphibians noted were *Bufo xeros*, *Hoplobatrachus occipitalis*, and *Tomoptera cryptotis*. First record of this genus for Mauritania.

Submitted by **JOSÉ M. PADIAL**, Museo de Historia Natural Noel Kempff Mercado, Área de Zoología, Sección Herpetología, PO Box 2489, Santa Cruz de la Sierra, Bolivia; e-mail: jmpadial@yahoo.com.

SYNAPTURANUS SALSERI (Sapito apuntado de Salser). VENEZUELA: AMAZONAS: Tobogán de La Selva, 34 km S of Puerto Ayacucho (5°23'50"N – 67°37'04"W), 120 m elev. December 2002. Osvaldo Villareal. Museo de Historia Natural La Salle, Caracas, (MHNLS 15910–11). An adult and a juvenile found inside a decaying log. Verified by José Ayarzagüena. This species has been reported from Vaupés in Colombia (Pyburn 1975. Herpetologica 31:439–443; Ruiz Carranza et al. 1996. Rev. Acad. Colomb. Cienc. 20[77]:365–415) and near Neblina Base Camp on Baria River, Amazonas State, in Venezuela (Zweifel 1986. Amer. Mus. Novitates 2863:1–24; McDiarmid and Paolillo 1988. *In* Brewer Carias [ed.], Cerro Neblina. Resultados de la Expedición 1983–1987, pp. 667–670. Fudeci). Second record from Venezuela, and extends known range more than 350 km N from the previous records.

Submitted by **J. CELSA SEÑARIS, CESAR MOLINA**, and **OSVALDO VILLAREAL,** Museo de Historia Natural La Salle, Apartado 1930, Caracas 1010-A, Venezuela; e-mail: celsa35@hotmail.com.

TESTUDINES

APALONE SPINIFERA (Spiny Softshell). USA: MISSOURI: Crawford Co: Keysville, 4.0 km S–0.4 km E Crooked Creek crossing on county road (37°50'20"N, 91°23'05"W. 16 May 1965. M. P. McKelvey. Verified by R. W. Axtell. SIUE 454. New county record.

Submitted by **CAROL A. BRYANT**, 7841 S. Panther Creek Road, Mount Olive, Illinois 62069, USA; e-mail: cabryant@ctnet.net.

APALONE SPINIFERA (Spiny Softshell). USA: ILLINOIS: McLean Co: Bray Creek, a headwater of the Mackinaw River (40°32.35'N, 88°37.34'W). A juvenile was found on 8 August 2002. Mary H. Lee. Verified by John Petzing. Illinois Natural History Survey (INHS 18523). New county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8. Champaign, Illinois. 300 pp.).

Submitted by **MARY H. LEE**, Department of Biological Sciences, Illinois State University, Normal, Illinois 61790-4120, USA; e-mail: mhlee@ilstu.edu.

CLEMMYS (=GLYPTEMYS) MUHLENBERGII (Bog Turtle). USA: NORTH CAROLINA: Burke Co.: Recently dead specimen from natural senescence or predator related causes, 8.2 km airline NNE Morganton in an alder/shrub wetland. 6 October 2002. Eric Chapell and David Campbell. North Carolina Museum of Natural Sciences (NCSM 64264). Verified by Alvin L. Braswell. First county record. Fills a gap in the distribution and extends the range 38.2 km airline NE nearest Piedmont Province record in McDowell Co. (Herman et al. 1993. Herpetol. Rev. 24:154; Project Bog Turtle database) and 30.7 km airline SSE nearest Blue Ridge Mountain Province record in Avery Co. (Palmer and Braswell 1995. Reptiles of North Carolina. Univ. North Carolina Press, Chapel Hill; Project Bog Turtle database).

Submitted by **DENNIS W. HERMAN**, Project Bog Turtle, North Carolina Museum of Natural Sciences, 11 West Jones Street, Raleigh, North Carolina 27601-1029, USA, **DAVID CAMPBELL**, 430 9th Street NW, Hickory, North Carolina 28601, USA, and **ERIC CHAPELL**, Freedom High School, 511 Independence Boulevard, Morganton, North Carolina 28655, USA.

EMYDOIDEA BLANDINGII (Blanding's Turtle). USA: ILLINOIS: Mason Co: 0.5 mi. N of 1370 N on 1900 E. 24 May 2002. M. J. Meyer and J. A. Crawford. Verified by C. A. Phillips. Photographic voucher deposited at the Illinois Natural History

Survey (INHS 2002.04). Updates the last known specimen (INHS 7384) seen in 1954. One adult female was found in a roadside ditch.

Submitted by **JOHN A. CRAWFORD,** Division of Biological Sciences, University of Missouri, Columbia, Missouri 65211, USA (e-mail: jac7vc@mizzou.edu), and **MATHYS J. MEYER,** Department of Biological Sciences, Illinois State University, Normal, Illinois 61790, USA (e-mail: altboer@hotmail.com).

GRAPTEMYS PSEUDOGEOGRAPHICA KOHNII (Mississippi Map Turtle). USA: TEXAS: Bell Co: Fort Hood Military Reservation, arroyo near Belton Lake, 390 m NE of Taylor Valley Rd. (NAD 83 UTM Zone 14: N3450204m E636878m). 4 June 2002. Steven J. Taylor, Christopher A. Phillips, Jen Mui, and Jean K. Krejca. Verified by John E. Petzing. Illinois Natural History Survey (INHS 18234). New county record, extends range one county to southwest (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station. 421 pp.). Shell of dead female with decomposing eggs and bones.

Submitted by **STEVEN J. TAYLOR, CHRISTOPHER A. PHILLIPS**, Illinois Natural History Survey, Champaign, Illinois 61820, USA, and **MICHAEL L. DENIGHT**, U.S. Army Engineer Research and Development Center, Champaign, Illinois 61826, USA.

PSEUDEMYS CONCINNA CONCINNA (Eastern River Cooter). USA: NORTH CAROLINA: Burke Co.: 8.2 km airline NNE Morganton, DOR. 13 October 2002. Eric Chapell and Patrick Heavner. North Carolina Museum of Natural Sciences (NCSM 64047). Verified by Alvin L. Braswell. First county record. First Catawba River system record. Extends the range 71.7 km airline NE nearest Broad River system record in Polk Co. and 111.5 km airline WSW nearest Yadkin River system record in Davie Co. (Palmer and Braswell 1995. Reptiles of North Carolina. Univ. North Carolina Press, Chapel Hill).

Submitted by **DENNIS W. HERMAN**, North Carolina Museum of Natural Sciences, 11 West Jones Street, Raleigh, North Carolina 27601–1029, USA, **DAVID CAMPBELL**, 430 9th Street NW, Hickory, North Carolina 28601, USA, and **ERIC CHAPELL** and **PATRICK HEAVNER**, Freedom High School, 511 Independence Boulevard, Morganton, North Carolina 28655, USA.

PSEUDEMYS CONCINNA CONCINNA (Eastern River Cooter). USA: ALABAMA: Conecuh Co: Murder Creek, 6.4 km SW of Evergreen (31°22.066'N, 87°00.437'W). Adult male basking. 20 October 2002. Matthew J. Aresco. Color Slide UF 135493. Verified by D. R. Jackson. First county record (Mount 1975. The Reptiles and Amphibians of Alabama. Auburn Univ. Agric. Expt. Stat. Auburn, Alabama. 347 pp.).

Submitted by **MATTHEW J. ARESCO, JEFF BIRDSLEY, REBECCA C. FULLER, MARGARET S. GUNZBURGER**, and **JOSEPH TRAVIS**, Department of Biological Science, Florida State University, Tallahassee, Florida 32306-1100, USA; e–mail: aresco@bio.fsu.edu.

TERRAPENE CAROLINA (Eastern Box Turtle). USA: ILLINOIS: Massac Co: CR1775N,16 S 0334738E 4133283N (WGS 84). 28 April 2002. M. J. Ingrasci and C. Mock. Illinois Natural History Survey (2002.22). Verified by C. A. Phillips. This locality constitutes a new county record (Phillips et al. 1999. Illinois Nat. Hist. Surv. Man. 8:1–282).

Submitted by **MATTHEW J. INGRASCI**, Department of Biological Sciences, University of Notre Dame, Notre Dame, Indiana 46556–0369, USA; e-mail: mingrasc@nd.edu.

LACERTILIA

ANOLIS PUNCTATUS. VENEZUELA: ESTADO BOLÍVAR: Gallery forest at Purumai River, SW Auyán-tepui, ca. 200 m from expedition base camp (05°54'33"N, 62°44'41"W), 420 m elev. 6 May 2002. C. Molina. Museo de Historia Natural La Salle, Caracas (MHNLS 15585). Quebrada Ataperé, headwaters of the Cucurital river, slopes of the Auyán–tepui (05°43'17.7"N, 62°34'21.1"W), 970 m elev. 5 November 2002. V. Romero and C. Molina. (MHNLS 16032). All verified by G. Rivas. The presence of this lizard in Venezuela was questionable. Previously it was believed to inhabit Amazona state (Donoso-Barros 1968. Carib. J. Sci. 8[3–4]:105–122), based on Boulenger (1885. Catalogue of the Lizards in the British Museum of Natural History. 2:xiii + 497 pp.) and other authors (Peters and Donoso-Barros 1970. Catalogue of the Neotropical Squamata: Part II. Lizards and Amphisbaenians. U.S. Natl. Bull., 297:64; La Marca 1997. Vertebrados Actuales y Fósiles de Venezuela. Serie Catálogo Zoológico de Venezuela. Vol. 1. Museo de Ciencia y Tecnología de Mérida, Venezuela). However, Avila-Pires (1995. Lizards of Brasilian Amazonia [Reptilia:Squamata], Zool. Verh. Leiden 299:1–706) had already indicated that the Donoso-Barros (1968, *op. cit.*) record for Territorio Amazonas was questionable because Boulenger (*op. cit.*) did not cite any specimen from Venezuela. Given the evidence, MHNLS specimens constitute the first museum vouchers for this species in the country. The single specimen extends the range for the species more than 450 km W of the nearest reported locality, close to the confluence of the Cuyuní and Essequibo rivers, in Guyana and more than 300 km NE of a doubtful record in Serra Parima, Roraima, Brazil (Avila-Pires, *op. cit.*: 97, map 26).

Submitted by **CÉSAR MOLINA**, **CELSA SEÑARIS**, Museo de Historia Natural La Salle, Sección de Herpetología, Apartado Postal 1930, Caracas 1010-A, Venezuela (e-mail: washaema@hotmail.con and celsa35@hotmail.com, respectively), and **ENRIQUE LA MARCA** Laboratorio de Biogeografía, Universidad de Los Andes, Mérida, Venezuela (e-mail: lamarca1@telcel.net.ve).

ANOLIS SAGREI (Brown Anole). USA: ARKANSAS: Pike Co: 3.7 km SW Langley off AR 84, Little Missouri River watershed. 20 October 2002. C. S. Harris. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 27317). Verified by Malcolm L. McCallum. First specimen reported from Arkansas (Trauth et al., Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville, *in press*), a non-gravid adult female (SVL = 46 mm). This common invader is known to use hitchhiking (primarily in nursery plants from Florida), and has been reported in neighboring Texas (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station. 421 pp.) and Louisiana (T. S. Campbell, pers. comm.).

Submitted by **CHRIS T. McALLISTER**, Department of

Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA (e-mail: chris.mcallister@tamut.edu), **STANLEY E. TRAUTH**, Department of Biological Sciences, Arkansas State University, State University, Arkansas 72467, and **CHRIS S. HARRIS**, Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA.

CALOTES VERSICOLOR (NCN). BRITISH INDIAN OCEAN TERRITORY: Diego Garcia. May 2002. Nestor Guzman. Verified by A. Allison. Bernice P. Bishop Museum (BPBM 14777–78). First record of this South Asian native in the Chagos Archipelago (Dutton 1981. Brit. J. Herpetol. 6:133–134; Barnett and Emms 1997. Brit. Herpetol. Soc. Bull. 59:6–12), where it was first observed in March 2001 and where it has presumably arrived as a cargo stowaway.

Submitted by **FRED KRAUS**, Department of Natural Sciences, Bishop Museum, Honolulu, Hawaii 96817, USA.

CYRTODACTYLUS DARMANDVILLEI (NCN). INDONESIA: NUSA TENGGARA: Lombok, Tanjung Ringgit cave (8°30'S, 116°40'E). 12 February 2002. Arthur Anker. Raffles Museum of Biodiversity Research: Zoological Reference Collection (ZRC.2.5402, adult female, SVL 84.0 mm, tail length 121.0 mm). Verified by Kelvin K. P. Lim. New island record and westerly range extension. Otherwise known from Flores, Pulau Kalao, Sumbawa, and Komodo (De Rooij 1915. The Reptiles of the Indo-Australian Archipelago. I – Lacertilia, Chelonia, Emydosauria. E. J. Brill Ltd., Leiden. xiv + 382 pp.; Welch et al. 1990. Lizards of the Orient: a Checklist. Robert E. Krieger Publishing Company, Malabar, Florida. 162 pp.).

Submitted by **TZI MING LEONG**, Department of Biological Sciences, National University of Singapore, Singapore 119260; e-mail: scip0132@nus.edu.sg.

EUMECES LATICEPS (Broad-headed Skink). USA: ILLINOIS: MACOUPIN CO: 3.4 km ENE of Benld and N of Mount Olive Lake (39°06'23"N, 89°45'35"W). 1 August 2001. C. A. Bryant. Verified by R. W. Axtell. SIUE 2829. New county record.

Submitted by **CAROL A. BRYANT**, 7841 South Panther Creek Road, Mount Olive, Illinois 62069, USA; e-mail:cabryant@ctnet.net.

HEMIDACTYLUS GARNOTII (Indo-Pacific Gecko). USA: FLORIDA: DESOTO CO: Arcadia, 1173 SW Highway 17, was Don Olson Tires now Tires Plus (27.2350°N, 81.8526°W). 8 July 2001. Florida Museum of Natural History (UF131763). Collected by Gregg S. Klowden. Verified by Kenneth L. Krysko. New county record. This species has been reported from neighboring counties and many others throughout peninsular Florida (Conant and Collins 1991. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Houghton Mifflin Co., Boston, Massachusetts, 450 pp.; Meshaka 1997, Florida Scientist 60:1–7).

Submitted by **GREGG S. KLOWDEN**, University of Florida, Department of Wildlife Ecology and Conservation, Gainesville, Florida 32611–0430, USA; e-mail: snakeman@ufl.edu.

LIOLAEMUS ALTISSIMUS ARAUCANIENSIS (NCN). CHILE: IX REGION DE LOS LAGOS: Provincia de Malleco, Malalcahuello (38°26'29"S, 71°31'25"W), 30 km E of Curacautín. 22 November 2000. D. Pincheira–Donoso. Herpetological Collection Museo Nacional de Historia Natural de Chile (MNHN 3474). Verified by H. Núñez. *Liolaemus altissimus araucaniensis* has been known from Villarrica Volcano, Cautín Province (Veloso and Navarro 1988. Boll. Mus. Reg. Sci. Nat. Torino 6:481–539). This specimen was found associated with the *Araucaria araucana* forest, and represents the first record from Malleco Province. This report extends the known distribution of the species ca. 115 km N from previously known localities.

Submitted by **DANIEL PINCHEIRA-DONOSO**, Sección Zoología, Museo Nacional de Historia Natural, Casilla 787, Santiago, Chile; e-mail: dpinchei@udec.cl.

LIOLAEMUS JAMESI (James' Jararanco). CHILE: I REGION DE TARAPACÁ: Quebrada Copaquiri (20°55'S, 68°52'W). 24 February 1994. Herman Núñez. Herpetological Collection Museo Nacional de Historia Natural, Santiago, Chile (MNHN–2612–14). Verified by Herman Núñez. *Liolaemus jamesi* has been known from Tarapacá Andean regions (Donoso-Barros 1966. Reptiles de Chile, Eds. Universidad de Chile) and Chungará (Núñez 1992. Smithson. Herpetol. Info. Serv. 91:1–29 ; Veloso et al. 1982. Sínt. Proy. MAB–6–UNEP-UNESCO–1105–77–01. La vegetación y los vertebrados inferiores de los pisos altitudinales entre Arica y el Lago Chungará, vol. I:135–268). All specimens found at 3850 m elev. Extends the known distribution of this species ca. 290 km S from previously known localities.

Submitted by **DANIEL PINCHEIRA-DONOSO** and **CARLOS GARÍN,** Sección Zoología, Museo Nacional de Historia Natural, Casilla 787, Santiago, Chile.

LIOLAEMUS YANALCU (NCN). ARGENTINA: SALTA-JUJUY. National Road N°40, on the boundary between provinces of Salta and Jujuy, at 36 km S of intersection of national roads n°52 and n°40. 18 January 2003. Museo de Ciencias Naturales, Universidad Nacional de Salta, Salta (MCN 939). F. Lobo and S. Lobo. Verified by J. M. Díaz Gómez. This species, recently described (Martínez Oliver and Lobo 2002. Cuad. Herpetol. 16:47–64) was known only from the Nevado del Acay area 50–60 km S of this location.

Submitted by **FERNANDO LOBO** and **SANTIAGO LOBO**, Cátedra de Anatomía Comparada, Fac. de Cs. Naturales, Universidad Nacional de Salta. Avda. Bolivia 5150, 4400-Salta, Argentina; e–mail: flobo@unsa.edu.ar.

NACTUS PELAGICUS (Rock Gecko). USA: COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS: ANATAHAN: 16°21'18"N, 14°54'30.8"E. 27 April 2002. Nathaniel Hawley. Verified by Steve W. Gotte. National Museum of Natural History (USNM 550136, 550137). New island record. Collected in rotten *Neisosperma oppositifolia.*

Submitted by **NATHANIEL HAWLEY,** Commonwealth of the Northern Mariana Islands, Department of Lands and Natural Resources, Division of Fish and Wildlife, PO Box 10007, Lower Base, Saipan, MP 96950, USA; e–mail: boigaman@itecnmi.com.

SCELOPORUS UNDULATUS (Eastern Fence Lizard). USA: FLORIDA: MANATEE CO: 17 km E of Parrish, at Florida Park Service Parcel - Beker A (South Fork), N of State Road 62; T33S;

R21E; Sec. 18. 30 May 2002. C. R. Becker. Verified by Kenneth L. Krysko. Florida Museum of Natural History (UF 135175). New county record and extends the range south and west of known distribution in Florida.

Submitted by **CHRISTOPHER R. BECKER,** Florida Park Service, District 4 Administration, Osprey, Florida 34229, USA; e-mail:chris.becker@dep.state.fl.us.

SCINCELLA LATERALIS (Ground Skink). USA: MISSOURI: MADISON Co: 3.2 km W of Bollinger Co. line on Missouri 72 at the Castor River crossing (37°31'45"N, 90°10'20"W). 1 May 1971. J. Puricelli. Verified by R. W. Axtell. SIUE 2538. New county record.

Submitted by **CAROL A. BRYANT,** 7841 South Panther Creek Road, Mount Olive, Illinois 62069, USA; e-mail: cabryant@ctnet.net.

SERPENTES

BOTHRIOPSIS TAENIATA or ***BOTHROPS TAENIATUS*** (Speckled Forest-pitviper). ECUADOR: PROVINCIA DE ZAMORA-CHINCHIPE: Zamora (ca. 4°05'S, 78°55'W; 900–1200 m elev.). Two specimens; 26 May 1999, Colón Reyes; July 1999, Hector Apolo. Instituto Nacional de Higiene y Medicina Tropical (INHMT 4018 and 4062, respectively). Verified by Luis A. Coloma. This species has a wide distribution in South America E of the Andes (Campbell and Lamar 1989. The Venomous Reptiles of Latin America. Comstock/Cornell University Press, Ithaca, New York. 425 pp.) and has previously been recorded from the Ecuadorian provinces of Napo, Pastaza, and Morona–Santiago (Pérez-Santos and Moreno 1991. Mus. Reg. Sci. Nat. Monogr. 11:1–538). This is the first record for the adjacent province of Zamora-Chinchipe and documents the occurrence of this species in the upper Río Zamora valley, which is separated from Amazonian lowlands by the mountain ranges of the Cordillera de Tzunantza and the Cordillera del Condor. On the Amazonian (Peruvian) versant of the Cordillera del Condor, this species has been collected at the upper Río Comainas (Reynolds and Icochea 1997. RAP Working Papers 7:82–90+204–206). As the generic assignment of this pitviper species is controversial, we offer the two most widely recognized combinations to facilitate information retrieval.

Submitted by **ANTONIO FREIRE L.** and **FERNANDO GARCIA**, Departamento Ofídios, Instituto Nacional de Higiene y Medicina Tropical "Leopoldo Izquiéta Pérez," Casilla 3961, Guayaquil, Ecuador, **WOLFGANG WÜSTER**, School of Biological Sciences, University of Wales Bangor, Bangor, Gwynedd LL57 2UW, United Kingdom, and **ULRICH KUCH**, Sektion Herpetologie, Forschungsinstitut und Naturmuseum Senckenberg, Senckenberganlage 25, 60325 Frankfurt am Main, Germany; e-mail: U.Kuch@em.uni-frankfurt.de.

CARPHOPHIS AMOENUS (Worm Snake). USA: ILLINOIS: MASSAC Co: CR1775N, 16 S 0334738E 4133283N (WGS 84). 28 April 2002. M. J. Ingrasci and C. Mock. Illinois Natural History Survey (2002.25). Verified by C. A. Phillips. This locality constitutes a new county record (Phillips et al. 1999. Illinois Nat. Hist. Surv. Man. 8:1–282).

Submitted by **MATTHEW J. INGRASCI**, Department of Biological Sciences, University of Notre Dame, Notre Dame, Indiana 46556-0369, USA; e-mail: mingrasc@nd.edu.

CEMOPHORA COCCINEA (Scarletsnake). USA. TENNESSEE: RUTHERFORD Co.: Hwy 70S at Cripple Creek Rd. crossing. DOR 5 Aug 1994. B. T. Miller, J. L. Miller. Verified by V. Cobb. Middle Tennessee State University (MTSU 88S). County record.

Submitted by **BRIAN T. MILLER** and **JOYCE L. MILLER**, Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee 37132, USA; e-mail: bmiller@mtsu.edu.

CROTALUS MITCHELLII PYRRHUS (Southwestern Speckled Rattlesnake). USA: ARIZONA: COCONINO Co: Colorado River: Havasu Canyon, river mile (RM) 156.8 L: 1.6 km from the Colorado River, 36.30°N, 122.75°W. June 1999. Nikolle L. Brown. KU–CT 11898. Verified by Eric M. Rundquist. First verified record in the Grand Canyon region. There are also additional records from Havasu Canyon: June 1999, KU–CT 11899–11900; and GRCA 32949 from S of Mooney Falls, 2.2 km from the confluence of the Colorado River (initially misidentified, John Weinschenk, 1969).

Crotalus mitchellii was never mentioned by Miller et al. (1982. Amphibians and Reptiles of the Grand Canyon. Grand Canyon Nat. Hist. Assoc., Grand Canyon, 143 pp.). Lowe et al. (1986. The Venomous Reptiles of Arizona. Arizona Game and Fish Dept, Phoenix, 115 pp.) state "its distribution within the Grand Canyon remains poorly known." Stevens (1993. The Colorado River in Grand Canyon: a Guide, 5th edition, Red Lake Books, Flagstaff, Arizona, 115 pp.) mentions this species is rare in lower end of the canyon. However, there have been no records published of this species inhabiting the Grand Canyon. Based on my experience with visitors in the canyon, *C. mitchellii* has been frequently misidentified as *C. abyssus*, the Grand Canyon rattlesnake.

These are the upstream-most voucher specimens of *Crotalus mitchellii* in the Grand Canyon. As of April 2003, the furthest downstream record of *C. abyssus* in the canyon is from Fern Glen, RM 168 (KU-CT 11901), indicating an overlap of ca. 11.2 river miles (17.92 km) for these two species in the Grand Canyon.

Submitted by **NIKOLLE L. BROWN**, 7779 North Leonard, Clovis, California 93611, USA; e-mail: black-catnik@att.net.

CROTALUS SCUTULATUS (Mojave Rattlesnake). USA: ARIZONA: MOHAVE Co: Hualapai Indian Reservation, Quartermaster Point, 0.8 km from the Colorado River: river mile (RM) 260.5 L: 35°58'N, 113°47'W. Summer 1999. Ralph Jones. KU CT 11885. Verified by Cecil R. Schwalbe. First verified record in the Grand Canyon Region. Miller et al. (1982. Amphibians and Reptiles of the Grand Canyon. Publ. Grand Canyon Natural History Association. 114 pp.) suggested that it was probable that *C. scutulatus* might inhabit the lower end of the canyon, however there were no confirmed records. Grater (1981. Snakes, Lizards, and Turtles of the Lake Mead Region. Publ. Southwest Parks and Monuments Association. 47 pp.) mentioned that *C. scutulatus* did not appear common in the Lake Mead Region. Lowe et al. (1986. The Venomous Reptiles of Arizona. Publ. Arizona Game and Fish Department, Phoenix. 115 pp.) show the northern distribution of *C. scutulatus* extending north close to the Colorado River near Peach Springs Canyon (RM 225.7 L) and reaching the Colorado River at Pierce Ferry (RM 280 L), but not found near the Colorado River in the region in between.

Submitted by **NIKOLLE L. BROWN**, 7779 North Leonard, Clovis, California 93611, USA; e-mail: black-catnik@att.net.

CROTALUS TIGRIS (Tiger Rattlesnake). USA: ARIZONA, MARICOPA CO: Buckeye Hills, Hassayampa SE 1/4 sec. UTM 3683.40N, 338.75E, ca. 1.6 km E Gila River, 2.8 km S Powers Butte. 4 September 1999. R. D. Babb. Verified by C. R. Schwalbe. UAZ 52169. Represents W extension of distribution ca. 32 km in N reaches of U.S. distribution (Lowe et. al. 1986. Venomous Reptiles of Arizona. Arizona Game and Fish Department, Phoenix. 115 pp.). At this latitude *Crotalus trigris* is strongly associated with Arizona Upland communities. The vegetation of the Buckeye Hills is Lower Colorado subdivision, typical of the more xeric habitat that dominates western Arizona lowlands.

Submitted by **RANDALL D. BABB**, Arizona Game and Fish Department, 7200 East University, Mesa, Arizona 85207, USA.

DENDRELAPHIS STRIATUS (Cohn's Bronzeback). WEST MALAYSIA: PAHANG: Pulau Tioman: Kampung Juara (2°47.73'N; 104°12.26'E). 18 July 2002. Perry L. Wood, Danny Morgan, and Jesse L. Grismer. Female, 504 mm SVL, 764 mm TL. Zoological Reference Collection, The National University of Singapore, Singapore (ZRC) 2.5539. Verified by L. Lee Grismer. New island record. Previously known from southern Thailand, west Malaysia, Borneo, and south to Sumatra and Pulau Nias (Manthey and Grossman 1997. Amphibien und Südostasiens. Natur und Tier-Verlag, Münster. 339 pp.). The specimen was collected on a medium-sized coconut palm (ca. 0.5 m diam), ca. 1 m above the ground at 1200 h in the coastal vegetation. This individual was sighted while basking on the side of the tree.

Submitted by **PERRY L. WOOD**, **NURUL'AIN ELIAS**, and **DANNY MORGAN**, Department of Biology, La Sierra University, Riverside, California 92515-8247, USA; e-mail: perrwood@lasierra.edu.

DRYOCALAMUS GRACILIS (Scarce Bridal Snake). SRI LANKA: NORTHERN CENTRAL PROVINCE: Kurunegala District, Ambanpola (07°55'N, 80°13'E). 18 March 2002. Colombo National Museum (CMS2003–2–1). Male hit by a motor vehicle on the road. Verified by K. Manamendra-Arachchi. *Dryocalamus gracilis* is a very rare species, distinguishable from its relative *D. nympha* by the presence of 15 scale rows at midbody (13 in *D. nympha*) and anal plate usually entire (divided in *D. nympha*) (de Silva 1980. Spolia Zeylanica 34:263–266). Mahendra (1984. Ann. Zool. 22:211) considered *D. gracilis* conspecific with *D. nympha*, despite the differences noted above, an opinion not accepted by all subsequent authors (de Silva 1990. Colour Guide to the Snakes of Sri Lanka. R & A Publishing; Das 1996. Biogeography of the Reptiles of South Asia. Krieger Publ., Malabar, Florida). *Dryocalamus gracilis* is reported from Peninsular India (as far north as Orissa) and from False Island, off the Rakhine (Arakan) coast of Myanmar. For Sri Lanka it is known from only two specimens collected from the Jaffna Peninsula, in the extreme north, and recorded as *Odontomus fergusoni* (Haly 1888. Taprobanian III p. 51). The present report represents only the third specimen of *D. gracilis* for Sri Lanka, the first for 114 years, and the southernmost record of the species with a range extension of at least 196 km from Jaffna. We thank YAP Films and Animal Planet for funding and support of the project "O'Shea's Big Adventure Series 3: Venom" in Sri Lanka.

Submitted by **MARK O'SHEA**, School of Applied Sciences, University of Wolverhampton, Wolverhampton, WV1 1SB, England (e-mail: oshea@snakemos.demon.co.uk), and **ANSLEM DE SILVA**, Faculty of Medicine, University of Peradeniya, Peradeniya, Sri Lanka (e-mail: kalds@sltnet.lk).

ELAPHE GUTTATA GUTTATA (Corn Snake). USA: US VIRGIN ISLANDS: St. Thomas: Crown Bay Cargo Port Area (18°20.29'N, 64°56.84'W). 3 October 1999 and two undated specimens from the 1990s. Judy Pierce and Donna Griffin. Both specimens verified by Jose Rosado. The dated specimen, an adult female, 66 cm SVL, 80 cm TL, was found at the industrial park near Victor's Hideout restaurant, ca. 600 m W of the Crown Bay cargo port area. It is preserved in the collection of the US Virgin Islands Division of Fish and Wildlife (address below). The two undated specimens are at the Museum of Comparative Zoology. MCZ 183544 is an adult male, SVL 83 cm, TL 103 cm; MCZ 183545 is a juvenile, SVL 31 cm, TL 37 cm.

Circumstantial evidence suggests these specimens might have arrived in cargo containers originating in Florida, a pattern which is consistent with other reports of introduced reptiles and amphibians in the Caribbean (e.g., Powell 2002. Herpetol. Rev. 33:321). Repeated sightings, as well as the capture of juveniles at the site, suggest a nascent population might be in the process of emerging. This is a first documented record for this part of the Caribbean. Previous published records include Antigua (Powell and Henderson 2003. Herpetol. Rev., *in press*), Anguilla (Hodge et al. 2003. The Reptiles and Amphibians of Anguilla, British West Indies. Anguilla National Trust, The Valley), and St. Barts (Breuil 2002. Patrimones Naturels 54:1–339). In addition, although no specimens are available, corn snakes have also been reported from Curaçao and Bonaire. These too might have arrived from Florida, and juveniles have been reported on Curaçao as well (Gerard van Buurt, unpubl. obs.). If the presence of juveniles indicates local reproduction, this is a source of conservation concern because, similar to the invasive brown treesnake (*Boiga irregularis*; Rodda et al. 1999. Problem Snake Management: the Habu and the Brown Treesnake. Cornell University Press, Ithaca, New York. 534 pp.), *E. g. guttata* has a generalized vertebrate diet. What effect the presence of introduced Indian mongooses in St. Thomas (Horst et al. 2001. *In* Woods and Sergile [eds.], Biogeography of the West Indies: Patterns and Perspectives, pp. 409–424. CRC Press, Boca Raton, Florida) might have on the future and impact of the species remains to be seen.

We thank Kate LeVering and Robert Henderson for critically reading the manuscript. Financial support was provided by The Conservation Agency through a grant from the Falconwood Foundation. This is manuscript T–9–973 of the College of Agricultural Sciences and Natural Resources, Texas Tech University.

Submitted by **GAD PERRY**, Department of Range, Wildlife, & Fisheries Management, Texas Tech University, Box 42125, Lubbock, Texas 79409-2125, USA; e-mail: Gad.Perry@ttu.edu, **JUDY PIERCE** and **DONNA GRIFFIN**, Division of Fish and Wildlife, 6291 Estate Nazareth, 101, St. Thomas, Virgin Islands 00802-1104, USA, **GERARD VAN BUURT**, Department of Agriculture, Animal Husbandry and Fisheries, Klein Kwartier 33, Curaçao, Dutch Antilles, and **JAMES LAZELL**, The Conserva-

tion Agency, 6 Swinburne St., Jamestown, Rhode Island 02835, USA.

ENULIUS FLAVITORQUES (Pacific Long-tailed Snake). HONDURAS: ISLAS DE LA BAHIA: Isla de Utila, north coast on Iron Bound Beach (16° 07'22"N, 86°54'16"W). 30 March 2001. Alexander Gutsche. UF 134752 (photograph by Christian Wild). Verified by James R. McCranie. First record for Isla de Utila (Köhler 1998. Senck. Biol. 77:139–145; McCranie and Köhler 1999. Caribbean J. Sci. 35:14–22). The snake was found buried 35 cm deep in the sand about 30 m from the ocean.

Submitted by **ALEXANDER GUTSCHE**, Humboldt-Universität zu Berlin, Inst. für Biologie, Abt. Sinnesbiologie, Invalidenstr. 43, D-10115 Berlin, Germany; e-mail: alexander-gutsche@web.de.

LAMPROPELTIS TRIANGULUM (Milk Snake). USA: ILLINOIS: MASSAC CO: CR1775N, 16 S 0334738E 4133283N (WGS 84). 28 April 2002. M. J. Ingrasci and C. Mock. Illinois Natural History Survey (2003.1). Verified by C. A. Phillips. This locality constitutes a new county record (Phillips et al. 1999. Illinois Nat. Hist. Surv. Man. 8:1–282).

Submitted by **MATTHEW J. INGRASCI**, Department of Biological Sciences, University of Notre Dame, Notre Dame, Indiana 46556–0369, USA; e–mail: mingrasc@nd.edu.

LAMPROPELTIS TRIANGULUM SYSPILA (Red Milksnake). USA: MISSOURI: REYNOLDS CO: Near Johnson Shut-Ins State Park, 3.2 km N on Hwy MM from junction with Hwy N (37°35'30"N, 90°51'06"W). 4 May 1963. L. Fencel. Verified by R. W. Axtell. SIUE 1703. New county record.

Submitted by **CAROL A. BRYANT**, 7841 South Panther Creek Road, Mount Olive, Illinois 62069, USA; e-mail: cabryant@ctnet.net.

LEPTOPHIS NEBULOSUS. PANAMÁ: PANAMÁ: Distrito de Panamá: Parque Nacional Chagres, on the margins of the forest stream Quebrada Las Pavas, a tributary of the Río Chagres (9°17'10.65"N, 79°27'10.67"W), 130 m elev. 8 March 1997. C. A. Jaramillo A. Verified by J. M. Savage. Museo de Vertebrados de la Universidad de Panamá (MVUP 1798). New record for Panamá and extends the range ca. 420 km (airline) ENE of the nearest locality in Costa Rica (Savage 2002. The Amphibians and Reptiles of Costa Rica, University of Chicago Press, Chicago, Illinois. xv + 934 pp.).

This record was obtained during a project funded by the U.S. Agency for International Development - Panama.

Submitted by **CÉSAR A. JARAMILLO A.,** Círculo Herpetológico de Panamá, Apartado 10762, Estafeta Universitaria, Panamá, Panamá (e–mail: jaramilc@tivoli.si.edu), and **ROBERTO IBÁÑEZ D.**, Smithsonian Tropical Research Institute, Apartado 2072, Balboa / Ancón, Panamá, Panamá (e–mail: ibanezr@tivoli.si.edu).

LIOPHIS MILIARIS MILIARIS: VENEZUELA: ESTADO AMAZONAS: Cerro Yapacana, Caño Cotua (3°47'N, 66°39'W). 4 July 1978. Julio Cerda. Museo de la Estación Biológica de Rancho Grande, Aragua (EBRG 1156). Verified by Ramón Rivero. *Liophis miliaris* was mentioned for the first time in Bolívar state Venezuela by Fuentes et al. 1999. (Publ. Extra Mus. Nac. Hist. Nat. Montevideo, Uruguay 50:63); subsequently, Kornacker et al. (2002. Herpetofauna 24[138]:29–34) assigned the Venezuelan population to the nominal subspecies *L. m. miliaris* without mentioning the report by Fuentes et al. (*op. cit.*). First state record, enlarges known distribution in Venezuela about 600 km SW of Bolívar state and demonstrates a much wider distribution in Venezuelan Amazon Basin.

Submitted by **OSWALDO FUENTES R.,** Colección de Herpetología, Museo de Biología, Universidad Central de Venezuela, Eugenio Gross #7, 11-B Málaga 29010, Spain; e-mail: osfuentes2@hotmail.com.

NERODIA RHOMBIFER RHOMBIFER (Northern Diamond-backed Watersnake). USA: ARKANSAS: LOGAN CO.: 2.5 km NE Delaware off St. Hwy 393, vic. Riverside. 2 June 2002. C. T. McAllister. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 27110). Verified by Stanley E. Trauth. New county record (Trauth et al., Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville, *in press*). Salvaged specimen found dead, washed-up on south shore of Lake Dardanelle, a 1964 Corps of Engineer impoundment of the Arkansas River, Arkansas Valley physiographic province.

Submitted by **CHRIS T. McALLISTER**, Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA (e-mail: chris.mcallister@tamut.edu); and **JENNIFER L. HOLLIS**, Department of Biology, University of Northern Iowa, Cedar Falls, Iowa 50613, USA.

NERODIA SIPEDON SIPEDON (Common Watersnake). USA: NEBRASKA: GARDEN CO: Blue Creek, ca. 3.0 km E and 11.5 km N of Oshkosh. 27 May 2002. 2 specimens. Stesha A. Pasachnik, John Iverson, and Steve Dinkelacker. Florida Museum of Natural History, University of Florida (UF 134731 and UF 134732). One additional specimen, ca. 8.0 km E and 13.2 km N of Oshkosh. 2 June 2000. Steve Dinkelacker and John Iverson. Florida Museum of Natural History, University of Florida (UF 120934). All verified by John Iverson. New county record. Extends range ca. 31.0 km upstream from nearest locality in Keith Co. (Lynch 1985. Trans. Nebraska Acad. Sci. 13:33–37).

Submitted by **STESHA A. PASACHNIK**, Earlham College, Richmond, Indiana 47374, USA; e-mail: pasacst@earlham.edu.

RAMPHOTYPHLOPS BRAMINUS (Brahminy Blindsnake): BRITISH WEST INDIES: Grand Cayman Island: Bodden Town District, Newlands (under a plank half-buried in leaf litter under a Tamarind tree next to a house). 16 June 2002. F. J. Burton. Verified by R. Powell. Bobby Witcher Memorial Collection (BWMC), Avila University, 07035–6. First record of this genus and species from the Cayman Islands (Schwartz and Henderson 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History. Univ. Florida Press, Gainesville). It is likely that the species arrived on Grand Cayman from south Florida in soil accompanying ornamental foliage plants. In addition to the locality cited, Joanne W. Ross provided a photograph of an individual found following heavy rains in a garden in George Town at the west end of the island and the senior author found a specimen on the ground

under a potted plant at Queen Elizabeth II Botanic Park near the center of the island. Newlands is approximately midway between these two localities.

Submitted by **A. C. ECHTERNACHT**, Department of Ecology & Evolutionary Biology, University of Tennessee, Knoxville, Tennessee 37996-1610, USA (e-mail: echterna@utk.edu) and **F. J. BURTON**, P.O. Box 10308 APO, Grand Cayman, Cayman Islands, British West Indies.

SIBYNOMORPHUS MIKANII (Dormideira). BRAZIL: PARÁ: Municipality of São Domingos do Araguaia (05°30'27"S, 48°43'04"W). 10 January 2003. F. França. Coleção Herpetológica da Universidade de Brasília (Distrito Federal) (CHUNB 29405). Verified by G. R. Colli. The specimen was collected in a deforested area of Amazonia forest. First record for Pará state, and extends range ca. 600 km SW of nearest locality, São Raimundo, Maranhão, in border of Amazonia/Cerrado region (Cunha et al. 1980. Bol. Mus. Par. Emílio Goeldi 103:1–15).

Submitted by **FREDERICO G. R. FRANÇA**, Departamento de Ecologia, Universidade de Brasília, 70910–900, Brasília, Brazil; e-mail: fredgrf@terra.com.br.

SIBYNOPHIS MELANOCEPHALUS (Black-headed Collared Snake). WEST MALAYSIA: PAHANG: Pulau Tioman: Kampung Juara (2°47.73'N; 104°12.26'E). 18 July 2002. A female captured and released by Jesse L. Grismer, Jim McGuire, and Chris Rassmusen. La Sierra University Photographic Collection S-53579-88. Verified by Wolfgang Grossmann. New island record. Previously known from southern Thailand, West Malaysia, and Singapore (Manthey and Grossman 1997. Amphibien und Reptilien Südostasiens. Natur und Tier-verlag, Münster. p. 392). This individual was captured on the cement walkway that dissects the village. When approached the individual quickly escaped to the leaf litter alongside of the trail. Upon capture, the snake voluntarily broke off its tail into many pieces.

Submitted by **JESSE L. GRISMER** (e-mail: jessgris@lasierra.edu) and **CHRIS RASSMUSEN**, Department of Biology, La Sierra University, Riverside, California 92515-8247, USA, and **JIMMY A. McGUIRE***, Museum of Natural Science, 119 Foster Hall, Louisiana State University, Baton Rouge, Louisiana 70803, USA. *Present address: Museum of Vertebrate Zoology, University of California, Berkeley, California 94720, USA.

TANTILLA GRACILIS (Flat-headed Snake). USA: MISSOURI: Crawford Co: Keysville, 0.6 km N – 3.1 km W Crooked Creek crossing on Hwy M (37°52'50"N, 91°25'30"W). 15 May 1965. R. Martini. Verified by R. W. Axtell. SIUE 1827. New county record. Reynolds Co: Johnson Shut-Ins State Park campgrounds (37°32'20"N, 90°50'30"W). 4 May 1963. J. Hassard. Verified by R. W. Axtell. SIUE 1826. New county record. Washington Co: Near Washington State Park, 0.6 km N – 0.8 km E junction Missouri 21 and Missouri 104 on Missouri 21 (38°05'12"N, 90°40'W). 16 May 1965. D. Keutzer. Verified by R. W. Axtell. SIUE 1835. New county record.

Submitted by **CAROL A. BRYANT**, 7841 South Panther Creek Road, Mount Olive, Illinois 62069, USA; e-mail: cabryant@ctnet.net.

THAMNOPHIS SIRTALIS SIRTALIS (Eastern Gartersnake). USA: ARKANSAS: Scott Co: 3.7 km SW "Y City" off US 71/270. 5 April 2003. C. T. McAllister and Z. D. Ramsey. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 27631). Verified by Stanley E. Trauth. New county record (Trauth et al., Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville, *in press*). Juvenile specimen found under trash pile near water-filled ditch at abandoned homestead in Ouachita National Forest along with sympatric *Lampropeltis getula holbrooki*, *Virginia valeriae elegans*, and *Diadophis punctatus arnyi*.

Submitted by **CHRIS T. McALLISTER** and **ZACHARY D. RAMSEY**, Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA (e-mail: chris.mcallister@tamut.edu).

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New Herpetofaunal Records for Psara and Neighboring Islands, Aegean Sea, Greece

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Psara and its neighboring islands are a poorly studied cluster of Greek islands in the northeastern part of the Aegean Sea. Few herpetofaunal surveys have been conducted for these islands. Psara lies 150 km east of Athens and about 25 km west of Turkey's eastern coast (Fig. 1), in an area known as the Anatolian-European transition zone (Legakis et al. 1999) because it represents a convergence zone for species representative of Europe and Asia Minor. This report is the first intensive herpetological survey for the Psara archipelago. Previous surveys (e.g., Tsunis and Dimitropoulos 1994) of the surrounding Aegean islands made only passing reference to Psara. One early survey of the herpetofauna from many Aegean islands (Werner 1930) has no mention of Psara. In a checklist of Greek lizards, Chondropoulos (1986) does not list *Cyrtopodion kotschyi*, *Hemidactylus turcicus*, or *Ablepharus kitaibelii* for Psara but has a subspecies of *Ophisops elegans* as present.

The neighboring islands of Chios and Lesvos receive 600–800 mm of rainfall annually (Tsunis and Dimitropoulos 1994) with Psara getting less and often no rainfall during the summer months. The temperatures on Psara range from 5°C during the winter to 40°C in the summer. Psara has an area of ca. 43 km^2 and sustains a small population of about 500 people that is doubled during the summer months. There is a small village (labeled in Fig. 1) and a military base in the southern peninsula. Cultivation is rare and localized to the southern region while the northern part of the island is mostly uninhabited. Few roads exist, with one main road connecting the village, monastery, and a radio tower that lies in the northern area of the island. The terrain consists of garrigue to low maquis vegetation with *Sarcopoterium spinosum* as the domi-

nant species in undisturbed areas and *Genista acanthoclada* as the dominant species in abandoned fields. A floristic analysis (Greuter 1976) indicates that Psara was probably isolated from the neighboring islands and did not share a land connection during the lowered sea level of the last ice age. Psara's flora apparently shares a relationship to the western Aegean islands rather than to those to its east.

The island is fairly mountainous with the highest peak reaching 531 m. Damage from overgrazing, occasional fire, and human activity is widespread on Psara. There are four major uninhabited islets near Psara: Agios Nikolaos, Daskalio, Mastroghiorghi, and Prasonisi. Prasonisi lies about 62 m off the north coast of Psara and Mastroghiorghi is 65 m off the NW coast. These two islets are nesting sites for *Falco eleonorae* (Eleonora's falcon). Agios Nikolaos lies 300 m off the western coast of Psara. A small church is located on Agios Nikoloaos, but visits to the island are rare. Daskalio is uninhabited and is ca. 110 m W of Psara.

Antipsara, located 2 km W of Psara, is uninhabited. There is a small sheepfold by the southeastern shore that is occasionally used as a temporary shelter by the local fishermen throughout the year. There are two islets south of Antipsara: Kato Nisi and Meso Nisi. Antipsara and Kato Nisi have a garrigue to low maquis vegetation similar to that of Psara but Meso Nisi has a strikingly different vegetation, several succulents and leafy plants being ungrazed. Antipsara receives little human disturbance throughout the year.

Of the larger Aegean islands, the closest to Psara is Chios, ca. 18 km eastward. The other islands are farther away: Skyros is over 76 km to the west, Lesvos lies 38 km to the northeast, and finally Samos is 55 km to the southeast of Psara.

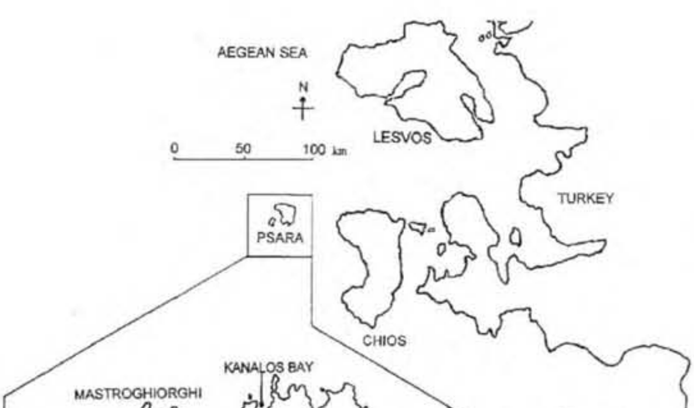

FIG. 1. Composite map showing region in Psara vicinity (modified from a map in a tourist publication), and detail map of Psara redrawn after Greuter (1976).

Our fieldwork was conducted during three seasonal visits from mid-June to July, 2000–2002. The goal was to survey the island's herpetofauna and see what future studies should be conducted. Specimens were captured by hand, pitfall, and glue traps. All collected specimens were deposited at the Long Island University (Brooklyn Campus) Vertebrate Collection (LIUZOO). There are new records of *Ablepharus kitaibelii* and *Bufo viridis* for Psara. A comparison with the herpetofauna of Chios, Lesvos, and Samos is presented.

Anura

Bufo viridis (Green Toad). Limnos, Psara. 19 June 2002. G. Sideris. LIUZOO 19–21. This toad is known to tolerate harsh environments—surviving in xeric conditions (Bringsøe 1985; Clark 1989). No amphibians were seen during the 2000 and 2001 surveys and this was not surprising as the island is so arid. There were no indications of amphibian presence even at seasonal pools during the 2000 and 2001 survey and no published record for Psara. However, the islands had received unusually heavy rain during the winter and spring of 2002 as noted during fieldwork. As an explosive breeder *B. viridis* was able to populate the island with its offspring in spring 2002. Toads were so numerous around the island that some were crushed by pedestrians on a road. Tadpoles were found in almost every standing body of water throughout the island including one brackish pool. Similar observations regarding plentiful *B. viridis* populations—often after a heavy rain—have been made on other Aegean islands (Buttle 1989) although this species is still prone to human interference in water systems. The green toad population on Samos is quite widespread (Ioannides et al. 1994). Other records of *B. viridis* exist for Lesvos and Chios (Axiotis 1998; Ioannides et al. 1994). Tsunis and Dimitropoulos (1994) found *B. viridis* only on Lesvos and not on Chios. A brief visit to Psara in August 2002 failed to yield any specimens in spite of the continued presence of some water pools.

Testudines

Mauremys caspica (Striped-neck Terrapin). Xerokampo, Psara. 12 July 2000. G. Sideris. LIUZOO 016–018. The population is located along a 30 m stretch of a seasonal stream bed which flows to Kanalos Bay in the north, over a bed of conglomerate rock. No other localities on Psara, even those with seasonal pools, sustained individuals of *M. caspica*. These terrapins were found in three temporary pools of stagnant water and in a man-made cistern. These pools and the cistern are often too deep for *M. caspica* to climb out of and should the water dry up, which is very likely during late summer, death occurs due to overheating and dehydration. Three live turtles were found in such a desiccated pool. In the 2000 season, two dead turtles were collected from a dried-out cistern in the vicinity. All of the live turtles found were marked and released. Although this population of *M. caspica* seems marginal, juveniles were found in the 2002 field season. A thorough census of this small population is planned for 2003. Records of this terrapin have been noted for Chios and Lesvos (Tsunis and Dimitropoulos 1994) as well as for Samos (Ioannides et al. 1994).

Lacertilia

Cyrtopodion kotschyi (Kotschy's Gecko). Lazareta Bay (500 m E of the village), Psara. 18 June 2002. A. Duperault and G. Sideris.

Caught by glue trap on a sandy habitat, ca 50 m from beach area. LIUZOO 004. Agios Nikolaos. 28 June 2002. G. Sideris. Found under a piece of wood near the church. LIUZOO 13. *Cyrtopodion kotschyi* was found in most parts of Psara including the Agios Nikoloaos islet. This is the most widespread lizard in the Aegean (Tsunis and Dimitropoulos 1994; Valakos 1989), although there are few records for the larger northeastern islands (Tsunis and Dimitropoulos 1994). Although records exist on both Lesvos and Chios (Ioannides et al. 1994; Tsunis and Dimitropoulos 1994) it should be noted that the Chios record from the Tsunis and Dimitropoulos (1994) survey was found at Karfas beach under rotting wood—quite close to shore. This finding is interesting as we found this gecko to be quite common on Psara which is only 18 km W of Chios. An older survey (Werner 1930) cites this gecko as common in Skyros which lies 70 km WNW of Psara. Success of *C. kotschyi* on small islets has been noted previously, sometimes being the only reptile recorded (Clark 1989). This gecko was usually seen on buildings and stone walls and sometimes hidden in *Sarcopoterium spinosum* shrubs. It was easily found in the village but also in remote areas. During our visits, *C. kotschyi* was not observed at elevations above 300 m, and it was not found on Antipsara. Activity was primarily nocturnal but occasionally it was seen during the day, usually in the shade of stone walls.

Hemidactylus turcicus (Mediterranean Gecko). Psara. 27 June 2002. A. Duperault and G. Sideris. Caught by glue traps in an abandoned sheepfold, ca. 6.2 km N of the village (ca. 300 m elev.). LIUZOO 005–008. Antipsara. 22 June 2002. C. Matyi and A. Duperault. Found under a piece of wood near the sheepfold, ca 15 m from the southeastern coast. LIUZOO 015. This species was observed in all areas of Psara and Antipsara, and was most commonly found at an elevation of 300 m on Psara. We concur with previous observations that this gecko is nocturnal (Clark 1989). During the day we found *H. turcicus* hidden under rocks but one specimen was caught in a pitfall trap near a *S. spinosum* shrub. This gecko is common on Chios, both near human settlements and in fields (Tsunis and Dimitropoulos 1994). However, *H. turcicus* was not found to be as common in the village, and it was usually found in areas that received little human disturbance. Although *C. kotschyi* and *H. turcicus* occurred in the same area, *H. turcicus* was found in greater numbers in places where *C. kotschyi* was absent.

Ophisops elegans (Snake-eyed Lizard). Lazareta Bay, Psara. 19 June 2002. A. Duperault and G. Sideris. Collected at a sandy beach habitat, ca. 500 m from the village. LIUZOO 001–002. In village, Psara. 24 June 2002. G. Sideris. LIUZOO 010. Ftelio, Psara. 26 June 2002. George Sideris. Collected at a sandy habitat. LIUZOO 012. This lizard was found in most parts of Psara. Although *O. elegans* was found to be quite common on Psara by Tsunis and Dimitropoulos (1994), even at high altitudes, we observed a noticeable decrease at higher elevations. During the course of the study, *O. elegans* was found abundantly in lowland fields but also in mid-grade hills though less common. Only one lizard was seen and caught at an elevation of ca. 250 m, and none at higher elevations. There was a complete absence of *O. elegans* on Antipsara and its neighboring islets throughout the study periods.

Ablepharus kitaibelii (Snake-eyed Skink). Lazareta Bay, ca. 500 from the village, Psara. 18 June 2002. Anne Duperault. Collected at a sandy beach habitat. LIUZOO 003–014. Ca. 6.2 km N of the village (ca. 300 m elev.). 27 June 2002. Anne Duperault. Caught by a glue trap in an abandoned sheepfold. LIUZOO 009. Antipsara, ca. 40 m from seashore. 28 June 2002. Anne Duperault. Caught by hand. LIUZOO 011. This skink was ubiquitous throughout Psara and Antipsara. There was no indication that the population was restricted to the lowlands (Arnold and Burton 1978), as it was found at elevations of 300 m and higher. *Ablepharus kitaibelii* was most often found hidden in *S. spinosum* bushes. Adults were often secretive but juveniles were the only specimens observed on Psara that occasionally ventured into open patches only to run from one *S. spinosum* bush to another. In contrast, adults and juveniles on Antipsara were more evident in open spaces.

Discussion.—Chios, being much larger than Psara, supports a variety of habitats and populations of reptiles and amphibians (Chondropoulos 1986, 1989; Dimitropoulos 1990a; Ioannides et al. 1994; Tsunis and Dimitropoulos 1994). However, there is a limited record of *Cyrtopodion kotschyi* while this species is commonly found on Psara. There are no records of *Ablepharus kitaibelii* from Chios.

Unexpectedly, we found no snakes on Psara, despite its proximity to Chios, which supports eight species of snakes (Chondropoulos 1989; Dimitropoulos 1986, 1990a, 1990b; Ioannides et al. 1994; Tsunis and Dimitropoulos 1994). In fact, Chios is commonly referred to as "Snake Island." The absence of snakes on Psara (Tsunis and Dimitropoulos 1994) has created village legends such as one that tells of a priest's curse that lead to the disappearance of all the snakes from the island. Another bit of folklore is from those who believe that the island's soil is toxic to snakes. There is no geographical and/or toxicological explanation to suggest that snake populations could not have existed on the island.

Because of the presence of snakes in all of the surrounding islands, it would be expected that snakes must have existed on the island in the past. However, other small islands, such as Anafi and Astypalea, carry equal reputations of no snake populations and it might be the island's size and not the soil composition that results in their absence (Gruber 1979). However, some eastern Aegean snake species, notably *Eryx jaculus* and *Telescopus fallax*, have adapted to hot, dry conditions—typical of the islands in the Aegean (Gruber 1979). Thera, located in the Kyklades archipelago, is a much larger Aegean island that lacks amphibians and tortoises but has two snake species (Frör and Beutler 1978). This is of interest in terms of dispersal, as most likely the fauna on Thera was extirpated in a volcanic eruption over 3600 years ago (Gruber 1979).

Thus, further study is needed to explain the absence of snakes from Psara and Antipsara. One hypothesis is that the native snakes have been extirpated by humans as the island has been heavily populated for over 4000 years (Mycenaeans were living on the island in 2400 B.C.). Although tedious, a plan of sifting through some thick sedimentary deposits for reptile bones would be a useful test to this hypothesis.

Furthermore, there were village rumors of the existence of a legless lizard, most likely *Pseudopus apodus*. Despite our efforts we were unable to verify its presence but we cannot dismiss its existence on Psara as it is common on Lesvos (Axiotis 1998; Tsunis and Dimitropoulos 1994). We doubt that the village people are able to differentiate between a legless lizard and a snake. Thus,

although *P. apodus* might exist on Psara, it is conceivable that the rumor instead derives from the mistaken observation of a snake, as yet unrecorded by us, as the local people are proud of the island's reputation of being snakeless.

We recorded only *A. kitaibelii* and *H. turcicus* on Antipsara. The apparent absence of *O. elegans* and *C. kotschyi* from Antipsara is enigmatic, as Antipsara and Psara largely consist of the same habitat types, and *O. elegans, C. kotschyi, H. turcicus,* and *A. kitaibelii* have been found in the same habitat on Psara.

In light of the above there are some enigmas relating to ideas of species dispersal between the islands. Although the herpetofauna of the Psara archipelago is similar to that observed on smaller North Aegean islands, such as Aghios Efstratos (Schneider 1994), the new record of *A. kitaibelii* is significant not only in terms of its absence from Chios but also of its success on Psara and Antipsara. One factor contributing to the limited number of species recorded in our surveys is the lack of fresh water on Psara. This observation is consistent with a survey on Agios Efstratios, another small North Aegean island (Schneider 1994). A planned molecular study should elucidate population relationships between Psara and Chios. The survey described here has laid the groundwork for a long-term investigation of the Psara archipelago.

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New Distributional Records for Amphibians and Reptiles from Campeche, México

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During the course of fieldwork, from March 1997 to April 2000, in the Calakmul Biosphere Reserve (17°45' and 19°15'N, 89°15' and 90°10'W) and surrounding areas of Campeche, México, we documented several new records for amphibian and reptile species that either represent significant range extensions on the Yucatán Peninsula or new records for the state of Campeche. Records are from the Municipality of Calakmul, mainly from the archaeological site of Calakmul (AS) (18°06'26"N, 89°48'34"W), unless indicated otherwise. The specimens were collected by the authors and deposited in the Herpetological Collection, Museo de Zoología, El Colegio de la Frontera Sur, Chetumal, Quintana Roo (ECO-CH-H). Oscar Flores-Villela verified all species, except *Ctenosaura alfredschmidti* and *C. defensor*, which were verified by Gunther Köhler. All new distributional records are based on Lee (1996), except the one for *Ctenosaura alfredschmidtii*, which is based on Köhler (2000). Common names follow Liner (1994).

Included herein is one new state record for amphibians and eight for reptiles. Additionally, three amphibians and 24 reptiles represent significant range extensions on the Yucatán Peninsula.

New State Records for Campeche

Anura

Hyla ebraccata (Hourglass Treefrog). 30 km S Xpujil, Ejido Narciso Mendoza, 18°15'35"N, 89°27'07"W (ECO-CH-H 1030); 700 m S Plan de Ayala, 18°03'30"N, 89°17'34"W (ECO-CH-H 1051); and Bella Union de Veracruz, 18°02'00"N, 89°17'23"W (ECO-CH-H 1070). The closest previosly known localities for this species is an isolated population about 200 km northeast in central Quintana Roo and about 100 km to the south in Guatemala.

Lacertilia

Thecadactylus rapicaudus (Turniptail Gecko). 11 km NE AS, 18°11'35"N, 89°44'51"W (ECO-CH-H 0716) and AS (ECO-CH-H 0834). These records close the gap between the known ranges of this species on the northern (Yucatán, Quintana Roo) and southern portions (Guatemala, Belize, and Chiapas) of the Yucatán Peninsula.

Corytophanes hernandezi (Hernandez's Helmeted Basilisk). 11 km NE AS, 18°11'35"N, 89°44'51"W (ECO-CH-H 0612, 0642, 0777) and AS (ECO-CH-H 1440). This species has been previously reported from the base of the Yucatán Peninsula and from isolated records in the state of Quintana Roo. These records extend the range of the species ca. 120 km NW of the closest record in northwestern Belize.

Anolis pentaprion (Lichen Anole). 24 km N Xpujil, 18°43'10"N, 89°23'43"W (ECO-CH-H 0559); AS (ECO-CH-H 0835); and 64 km N Xpujil, 2.5 km E from Highway 269, 19°00'06"N, 89°16'48"W (ECO-CH-H 0964). These records extend the known species range ca. 210 km N of the nearest record in northern Guatemala.

Eumeces sumichrasti (Sumichrast's Skink). AS (ECO-CH-H 1632). This record extends the range of the species ca. 150 km from the nearest record in northwestern Guatemala and closes the gap between the northeastern and southern Yucatán Peninsula populations.

Serpentes

Symphimus mayae (Yucatán White-Lipped Snake). 15 km SE Nueva Vida, Brecha a Ricardo Flores Magon, 18°45'00"N, 89°17'54"W (ECO-CH-H 0591); 10 km N AS, 18°11'35"N, 89°44'51"W (ECO-CH-H 0776). This species was previously known only from the northern section of the Yucatán Peninsula and from an isolated population in northwestern Belize. These records extend the range ca. 150 km NW of the nearest record in Belize and close the gap between northern and southern Peninsula populations.

Tantillita lintoni (Linton's Dwarf Short-tailed Snake). 15 km SE Nueva Vida, Brecha a Ricardo Flores Magon, 18°45'00"N, 89°17'54"W (ECO-CH-H 0820). This record extends the range of the species on the Yucatán Peninsula ca. 200 km N of the closest known locality in northern Guatemala.

Thamnophis marcianus (Checkered Garter Snake). 17 km N Xpujil, 18°39'55"N, 89°24'06"W (ECO-CH-H 0630) and 15 km SE Nueva Vida, Brecha a Ricardo Flores Magon, 18°45'00"N, 89°17'54"W (ECO-CH-H 1334). These records add another apparently isolated population to the known range of the species on the Yucatán Peninsula; the closest known locality being ca. 150 km northeastward in southern Yucatán.

Xenodon rabdocephalus (False Fer-de-Lance). AS (ECO-CH-H 0874) and 30 km S Xpujil, 18°15'35"N, 89°27'07"W (ECO-CH-H 1081). These records extend the range of the species more than 100 km NW of the closest locality in northern Belize.

Range Extensions

Caudata

Bolitoglossa yucatana (Yucatán Mushroom-tongued Salamander). 20 km NE Xpujil, 18°42'33"N, 89°21'50"W (color slide photo voucher [ECO-CH-H A-0001]) and 20 km S Conhuas, 18°22'38"N, 89°53'46"W (ECO-CH-H 1629). These records fill a gap between populations on the northern section of the Yucatán Peninsula and an isolated population ca. 150 km SW of the nearest record in central Campeche. ECO-CH-H A-0001 was found inside a large tank bromeliad (*Achmea bracteata*) located 4 m above ground.

Anura

Hyla loquax (Mahogany Treefrog). Municipality of Hopelchen, 64 km S Dzibalchen, 19°01'51"N, 90°00'53"W (ECO-CH-H 1222) and 23 km SW Xkan-Ha, 19°06'47"N, 89 30'13"W (ECO-CH-H 1234). These records extend the range in Campeche ca. 66 km N of the closest known localities along Mexican Hwy 186.

Gastrophryne elegans (Elegant Narrowmouth Toad). Municipality of Hopelchén: 64 km S Dzibalchén, 19°01'51"N, 90°00'53"W (ECO-CH-H 1216, 1217, 1221, 1224) and 23 km SW Xkan-Ha, 19°06'47"N, 89°30'13"W (ECO-CH-H 1235). These records extend the range ca. 50 km northward from the closest known localities in east-central Campeche.

Testudines

Staurotypus triporcatus (Mexican Giant Musk Turtle). 7 km E Nuevo Becal, El Chorro, 18°35'28"N, 89°15'28"W (ECO-CH-H 1189). This species is known primarily from the southern base of the Yucatán Peninsula. This record expands the known range ca. 106 km E from the closest known locality in central Campeche.

Terrapene carolina yucatana (Yucatán Box Turtle). 8.5 km S Conhuas, 18°27'13"N, 89°53'21W (ECO-CH-H 0792); and AS (CHO-CH-H 1187). This box turtle is known from the northern and western parts of the Yucatán Peninsula. These records represent a range extension of ca. 140 km E from the closest record.

Lacertilia

Ctenosaura alfredschmidti (Schmidt's Spiny-tailed Iguana). AS (ECO-CH-H 0622) and 25 km SSE Conhuas, 18°26'54"N, 89°53'21"W (ECO-CH-H 1293). Previous records for this species were from the type locality at Pablo Garcia village and surroundings (Köhler 1995), ca. 70 km NW of AS.

Ctenosaura defensor (Yucatán Spiny-tailed Iguana). Municipality of Hopelchen, 55 km SW from Dzibalchén, 19°00'51"N, 89°54'35"W (ECO-CH-H 1255). This species is known from northwestern Yucatán as well as from two records in Campeche. This is a range extension for the species ca. 95 km SW and ca. 180 km NE from the two previously known Campeche records.

Iguana iguana (Green Iguana). Municipality of Escárcega, 71 km

SW Escárcega, between El Machetazo and El Naranjo, 18°00'03"N, 90°55'58"W (ECO–CH-H 1642). This is the southeasternmost record for the species in Campeche and extends the range ca. 70 km NE of the closest record in Tabasco.

Sceloporus lundelli (Lundell's Spiny Lizard). AS (ECO-CH-H 0621, 0922, 1146). This species is recognized from the northern and western portions of the Yucatán Peninsula and from an isolated population in central Belize and adjacent northeastern Guatemala. These records represent range extensions of ca. 100 km from the nearest record to the north and close the gap between the northern and isolated southern populations.

Anolis biporcatus (Neotropical Green Anole). 30 km S Xpujil, Ejido Narciso Mendoza, 18°15'35"N, 89°27'07"W (ECO-CH-H 0829). This species has been reported only from the southern end of the Yucatán Peninsula and from an isolated locality in western Campeche. This record extends the range ca. 76 km NW from the closest record in Belize.

Anolis sagrei (Brown Anole). Xpujil, 18°30'30"N, 89°23'51"W (ECO-CH-H 1299). This is the first record of the species from the center of the Yucatán Peninsula and closes the gap between known populations on the eastern and western sections of the Peninsula. Its present distributional pattern is surely the result of human activity, because the species is a human commensal rarely found far from areas of human activity (Lee 1996).

Sphenomorphus cherriei (Brown Forest Skink). 15 km SE Nueva Vida, Brecha a Ricardo Flores Magón, 18°45'00"N, 89°17'54"W (ECO-CH-H 0576, 1324); AS (ECO-CH-H 0843); and10 km NE AS, 18°11'35"N, 89°44'51"W (ECO-CH-H 0880). This species is primarily known from the base of the Yucatán Peninsula and also from an isolated population to the north in Yucatán and adjacent Quintana Roo. These records confirm its presence in the central part of the Peninsula and extend its range ca. 100 km NW from the nearest locality in northern Belize.

Aspidoscelis angusticeps (Yucatan Whiptail). 2 km NW Conhuas, Balam-Ku ruins, 18°33'18"N, 89°56'38"W (ECO-CH-H 1486) and 64 km N Xpujil, 19°00'27"N, 89°17'24"W (ECO-CH-H 0984). This species is known from the northern portion of the Yucatán Peninsula and from two isolated populations in central Belize and adjacent Guatemala. These records extend the range ca. 40 km E and 55 km SE from the nearest known localities in central and northern Campeche, respectively.

Aspidoscelis deppei (Black-bellied Racerunner). 35 km S Xpujil, near Cristobal Colon village, 18°12'44"N, 89°27'04"W (ECO-CH-H 1091, 1096, 1099, 1519, 1520, 1521, 1522). This species has been previously recorded on the Yucatán Peninsula only from extreme southwestern Campeche. These records extend the range southeastward ca. 300 km into the southcentral portion of the state.

Serpentes

Dipsas brevifacies (Snail-eating Thirst Snake). 34 km S Xpujil, Cristobal Colon village, 18°12'44"N, 89°27'04"W (ECO-CH-H 0555, 1083) and AS (ECO-CH-H 0646, 0841, 1160). This species is endemic to the Yucatán Peninsula and known primarily from the northern and eastern portions, although there is one other isolated record close to the city of Belize. These records extend the distribution ca. 50 km SE of the closest locality.

Dryadophis melanolomus (Lizard Eater). 30 km S Xpujil, Ejido Narciso Mendoza, 18°13'49"N, 89°26'20"W (ECO-CH-H 0655) and AS (ECO-CH-H 0767). This species is known to occur on the northern and southeastern sections of the Yucatán Peninsula. These records extend its range ca. 135 km S from the only other records from Campeche.

Imantodes gemmistratus (Central American Tree Snake). 64 km N Xpujil, 2.5 km E from Mexican Highway 269, 19°00'06"N, 89°16'48"W (ECO-CH-H 0960). This species is known to occur in the northern and western parts of the Yucatán Peninsula and from an isolated population in north-central Guatemala. This record extends the range ca. 180 km NE from the closest locality in Campeche and bridges the gap between the northeastern and western Peninsula populations.

Imantodes tenuissimus (Yucatan Blunt-headed Tree Snake). AS (ECOCH-H 0640). This species is endemic to the Yucatán Peninsula and is primarily known from the northern portion, although a record from western Campeche is also documented. This record is the southernmost for the Peninsula and extends the range ca. 200 km S from the closest record in Yucatán.

Lampropeltis triangulum (Milk Snake). 64 km N Xpujil, 2.5 km E from Mexican Highway 269, 19°00'06"N, 89°16'48"W (ECO-CH-H 0959). This record closes the 200 km gap between other populations on the northern and southern portions of the Yucatán Peninsula.

Oxybelis aeneus (Mexican Vine Snake). 24 km N Xpujil, 18°44'10"N, 89°23'40"W (ECO-CH-H 0822); 1 km S Plan de Ayala, 18°03'30"N, 89°17'34"W (ECO-CH-H 1088); and AS (ECO-CH-H 1284, 1439). This species is well documented from the northern, eastern, and southern parts of the Yucatán Peninsula. These records extend the range by ca. 163 km SE from the nearest record in northern Campeche and close the gap within the central section of the Peninsula.

Oxybelis fulgidus (Green Vine Snake). Nuevo Becal, 18°36'29"N, 89°18'01"W (ECO-CH-H 0816) and 1.5 km S Plan de Ayala, 18°03'30"N, 89°17'34"W (ECO-CH-H 1076). This species has been previously recorded from the northern and southeastern portions of the Peninsula. These new records confirm the presence of this species in the central Peninsula, and extend the range ca. 90 km NW from the closest known locality in Belize.

Sibon nebulata (Cloudy Snail Sucker). 30 km S Xpujil, Ejido Narciso Mendoza, 18°15'35"N, 89°27'07"W (ECO-CH-H 0790); 24 km N Xpujil, 18°44'10"N, 89°23'40"W (ECO-CH-H 1007); and AS (ECO-CH-H 1170). These records confirm the presence of this species in central Campeche as proposed by Lee (1996). There is only one previous record for the state, from a locality ca. 230 km W of these records.

Sibon sanniola (Pigmy Snail Sucker). 30 km S Xpujil, Ejido Narciso Mendoza, 18°15'35"N, 89°27'07"W (ECO-CH-H 1098); and AS (ECO-CH-H 1285). This species is endemic to the Yucatán Peninsula and its previously known range included the northern and southeastern sections. These records extend its range ca. 135 km S into the center of the Peninsula.

Urotheca elapoides (False Coral Snake). 10 km NE AS, 18°11'35"N, 89°44'51"W (ECO-CH-0772). This is a well-known

species on the southern end of the Yucatán Peninsula and there is also an isolated population in eastern Yucatán and adjacent Quintana Roo. This record extends the known distribution ca. 130 km SE from the nearest record in western Campeche.

Agkistrodon bilineatus (Cantil). AS (ECO-CH-H 1261) and 2 km NW Conhuas, Balam-Ku ruins, 18°33'18"N, 89°56'38"W (photographic collection, ECO-CH-H R-0037). This species is uncommon, but known from several localities on the northern end of the Yucatán Peninsula and from an isolated population in northern Belize. These records extend the range ca. 170 km SE from the only other state record in northwestern Campeche.

Crotalus durissus (Neotropical Rattlesnake). AS (ECO-CH-H 861, 1147,1441); 24 km N Xpujil, 18°44'10"N, 89°23'40"W (ECO-CH-H 884); 31 km S Xpujil, 18°15'07"N, 89°26'30"W (ECO-CH-H 1549); and 7 km E Nuevo Becal, El Chorro, 18°35'28"N, 89°15'28"W (ECO-CH-H 1419). This species is recorded from most of the Mexican part of the Yucatán Peninsula, except south-central Campeche, and from isolated populations in northern Guatemala and central Belize. These records confirm the presence of the species in southern Campeche, extending the range ca. 60 km S.

Porthidium yucatanicum (Yucatan Hog-nosed Pitviper). Municipality of Hopelchén, Dzibalchén, 19°27'49"N, 89°43'30"N (ECO-CH-H 1204). This species is endemic to the Yucatán Peninsula and previously known only from the northern sections. This is the southernmost record for the Peninsula, the second record for Campeche, and extends the range by more than 80 km S from the closest recognized locality in the northern section of the state.

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BOOK REVIEWS

Herpetological Review, 2003, 34(3), 272–274.

Les Serpents d'Afrique Occidentale et Centrale, 2nd ed., by Jean-Philippe Chippaux. 2001. Editions de l'Institut de Recherche pour le Développement, Collection Faune et Flore Tropicales, Paris (diffusion@bondy.ird.fr). 292 pp., softcover. 25.91 € (approx. US $27.70). ISBN 2-7099-1439-5.

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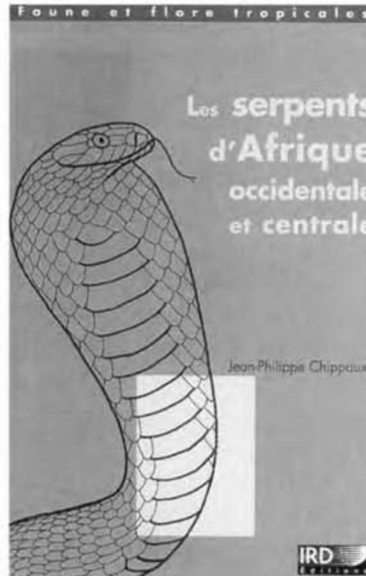

The West African herpetofauna is poorly documented, despite having one of the richest snake faunas in Africa (e.g., Böhme 2000; Lawson 1993). Moreover, in many regions snakebite is of exceptional medical significance (see reviews by Spawls and Branch 1995 and Chippaux 1998). This new volume, therefore, fills a much needed gap.

"Chippaux 2001" is a re-edition, revised and updated, of "Chippaux 1999," the chronological successor of Villiers' (1975) famous *Les Serpents de l'Ouest Africain* (also in French and long out of print). The new volume has an agreeable format and a clear and practical organization. It begins with a general section (pp. 11–33) including a presentation of the classification and the evolution of snakes, an introduction to the main morphological characters useful to their identification (with good scale drawings), and a long chapter on venoms, envenomation and its treatment (the author's speciality). The systematics section (pp. 35–249) includes a detailed account for each of the species occurring in the covered area (from Senegal east to the Central African Republic and from Mauritania south to Congo-Brazzaville). It also includes distribution maps, preceded by identification keys to the families, genera, and species. An impressive bibliographical section of 33 pages terminates the book. The text is accompanied by eight color plates, showing in total 55 photographs (illustrating four clinical envenomation cases and 47 snake species).

Several book reviews of the first edition have appeared, mentioning some important corrections. We concur with Hughes (2000) and Akani (2002) that the "*Dasypeltis fasciata*" shown in photograph 18 is in fact *D. scabra*, and that the "*Thelotornis kirtlandii*" (photograph 30) is *T. capensis*. Hughes (2000) also suggested that the "*Psammophis phillipsii*" in photograph 36 (from near Cotonou airport, Bénin; pers. comm. J.-P. Chippaux) is *P. sibilans*, that "*P. rukwae*" (photograph 38) is probably *P. sudanensis*, and that the viper "*Echis leucogaster*" (photograph 52) is *E. ocellatus*. The numbering of the pictures and their specific identification (except for the *Echis*, which has been corrected) remain unchanged in the second edition. We add that "*Grayia tholloni*" (photograph 15) is a (starving ?) *G. smithii* (the specimen probably originating from Togo; J.-P. Chippaux, pers. comm.). It would have been preferrable for each photograph to be accompanied by the locality of the specimen. It should be noted also that "*Grayia smythii*" should be spelled *G. smithii* (see Pauwels et al. 2000), and "*Elapsoidea güentheri*" should have a double i and lack an umlaut. Other misspelled scientific names include "*Bothrophtalmus*" (p. 54, map; = *Bothrophthalmus*) and "*Lycophidion multimaculata*" (p. 76, right column; = *multimaculatum* as the gender of *Lycophidion* is neutral).

It is a great pity that scolecophidians, although represented by some 30 species in the area covered by the present opus (i.e., 15 % of the 195 local species recognized by Chippaux) are treated in only two pages, without any key to the genera or species. However, a volume wholly dedicated to the African Typhlopidae (Roux-Estève 1974) is available and, moreover, the Leptotyphlopidae and Typhlopidae of Africa have been dealt with in identification keys by Meirte (1992).

An excellent feature of Chippaux's book is that head scalation drawings have been provided for many species, which is very useful for identification. In general, at least one species per genus has so been illustrated, but unfortunately not for the genera *Rhinoleptus* (Leptotyphlopidae), *Ramphotyphlops*, *Rhinotyphlops* (Typhlopidae), *Hemirhagerrhis* (Colubridae), *Poecilopholis*, *Xenocalamus* (Atractaspididae), and *Cerastes* (Viperidae). A few drawings should be corrected, including the lateral view of the head of *Malpolon moilensis* which shows one preocular, whereas the species account (p. 158) notes "la préoculaire inférieure est au moins trois fois plus petite que la supérieure" ["the lower preocular is at least three times smaller than the upper one"]. The scalation drawing for *Dromophis lineatus* (p. 162) shows two preoculars, while the species and genus accounts specify only one. The lateral view of the head of *Atractaspis reticulata* (p. 187) shows fused internasals and prefrontals (perhaps a particularity of the illustrated specimen, but at least a very atypical configuration for the species); the upper view of the head of *Polemon gracilis* (p. 204) indicates a broad supralabial/prefrontal contact although the lateral view shows an absence of contact (same remark as above). For this latter species, Chippaux wrote (and this is also visible in his drawing) "aucune labiale supérieure n'est en contact avec la pariétale" ["none of the supralabials contacts the parietal"], *contra* de Witte and Laurent (1947). Those uncertainties concerning the drawings could be removed if the illustrated specimens could be traced and examined, i.e. if the drawings had been accompanied by the museum collection numbers of the specimens on which they were based (the same comment also applies to the hemipenis and maxillary drawings).

The generic allocation of some species remains debatable, e.g., *Charina* for *Calabaria* (sensu Kluge 1993) has not received common acceptance; African *Geodipsas* have been transferred to the new genus *Buhoma* (Ziegler et al. 1997); and the use of *Haemorrhois* for all African *Coluber* is premature—although *algirus* has been transferred to *Haemorrhois*, *Coluber dorri* remains anomalous among African racers and should remain in *Coluber* sensu lato (Schätti and Utiger 2001). It should be noted as well that the Dispholidini has recently been revised (Broadley and Wallach 2002) with resurrection of *Rhamnophis* for *aethiopissa* and *batesi*. Molecular studies have also shown that the two races of Gaboon adder show sufficient divergence to be treated as separate species (Lenk et al. 1999). Both species therefore occur in the region, and *Bitis rhinoceros* is endemic to the Upper Guinea forest.

Inclusion of the summarized classification of African colubrids (p. 50) by Bogert (1940), while of historical value, does not reflect current understanding of relationships among African snakes and could be easily deleted. Similarly the groupings of atractaspids by features of dentition and hemipenes (p. 177) is of little value and is, moreover, inaccurate as *Aparallactus modestus* lacks back fangs.

The identification keys and generic and specific accounts are very useful, but some mistakes are present. The general key to the Colubridae (pp. 51–53) presents two couplets numbered 31 but no couplet 33, which makes the use of the key between couplets 31 and 45 questionable. The second part of couplet 37: "de 15 à 21 rangées dorsales" ["15 to 21 dorsal scale rows"], is erroneous, because it refers to various genera, of which *Philothamnus* includes species with only 13 dorsal rows. On pages 70–71, it is stated that *Lycophidion*, whose "frontale est plus large ou aussi large que longue" ["frontal is wider than or as wide as long"], can be distinguished from *Chamaelycus* because the latter possesses "une frontale plus large que longue" ["a frontal wider than long"]. There is also a contradiction within the account of *Lycophidion nigromaculatum* (p. 74) regarding the number of preoculars (1 vs. 2). Chippaux (p. 94) indicated that *Hydraethiops laevis* shows a single internasal, while it is in fact either single or divided (Pauwels et al. 2002) as indicated in the original description. The key for the genus *Thrasops* (p. 103) begins with a first couplet leading to a single vs. divided anal plate, but the introduction to the genus incorrectly characterizes all species as having a divided anal. In the presentation of the genus *Hapsidophrys*, Chippaux (p. 119) wrote that both species show a single preocular, while two are visible on the lateral head scale drawing of *H. lineatus*, in agreement with the species account which states "1 préoculaire, parfois 2" ["1 preocular, sometimes 2"]. Chippaux indicates a maximal number of 143 subcaudals for *Dispholidus typus*, which corresponds to that shown by the only known Gabonese specimen, plotted on the map on p. 153. This specimen, however, is probably a *Thrasops* (Hughes 1983). In the introduction to the Elapidae (p. 207), the author states that the loreal scale is always absent in the group, but on p. 220, in the presentation of the cobras of the genus *Pseudohaje*, one finds "loréale généralement absente" ["loreal generally absent"] (as previously noted by Hughes 2000). The generic account for *Paranaja* (p. 227) indicates that the dorsal scale rows are oblique, contrary to the species account where they are said to be straight.

Although the nomenclature of scales has been very well explained and illustrated in the general section, these definitions are not always taken into account in the species accounts. For instance, the drawing of *Scaphiophis albopunctatus* (p. 116) shows two preoculars, no subocular and two postoculars, but the species account states that there is one preocular, two or three suboculars and two or three postoculars. For *Thrasops batesii* too (p. 107), what should be called a subocular following the earlier definitions on p. 16, is called a postocular.

The maps, each dotted and tinted, most often dealing with a single taxon, give a good idea of the general distribution of the species. Point localities are based on literature records (white dots) and personal observations of the author (black dots). It is important to draw the attention of non French-speaking readers to the fact that the map tinting is based on the probability of the presence of the species "en fonction de critères écologiques (climat, végétation, degré d'anthropisation)" ["according to ecological criteria (climate, vegetation, degree of anthropisation)"]. As Hughes (2000) and Akani (2002) have noted, the point localities for most species are drawn mainly from the French literature, and many localities from English language publications have been omitted (even if the articles are listed in the bibliography). In addition to this deficiency we also noted important discrepancies between the text and the distribution maps, notably for *Dipsadoboa underwoodi*, *Gonionotophis grantii*, *Lamprophis virgatus*, *Lycophidion irroratum*, *L. multimaculatum*, *Psammophis phillipsii*, *Telescopus variegatus*, *Atractaspis dahomeyensis*, *Polemon gabonensis*, *P. gracilis*, and *Causus resimus*. The distribution of *Python sebae* (p. 47) is still given as extending to South Africa, although southern and eastern populations have since 1984 been referred to *P. natalensis* (Broadley 1984). Chippaux (p. 238) included in the map for *Atheris broadleyi* dots intended to depict the distribution of *A. squamigera* in the map provided in the original description of the former species, and thus erroneously shows *A. broadleyi* from Gabon and Congo-Brazzaville. *Echis jogeri* Cherlin, 1990 (ignored in Chippaux 1999) is dotted on a map but not discussed in a detailed species account. This was attributed to the "nombre de spécimens trop faible (4 exemplaires au total) pour permettre une plus ample description" ["too low number of specimens (4 in total) to allow for a more complete description"], even if this species is considered as "probablement valide" (p. 244). However, other species known from less than four specimens, including some taxa that are probably invalid, such as *Mehelya riggenbachi* and *Atractaspis coalescens* (each known from a single specimen), are discussed in dedicated accounts. The genus *Eryx*, included in the first edition on the basis of the presence of *E. somalicus* in the Central African Republic, has disappeared without comment from the second edition. The map for *Mehelya capensis* shows a strong overlap of the distribution of the subspecies *capensis* and *savorgnani*, indicating they should be better treated as distinct species, and similar comments could be made for the sympatric subspecies *lineatus* and *brunneus* of *Bothrophthalmus lineatus*. Type localities are indicated in French, but should be given in the language of the original description in order to avoid possible misinterpretations due to translation.

Despite these relatively few errors and problems this book is a remarkable reference work and will serve as a useful starting point for herpetologists in the field and in the laboratory. It is an excellent synthesis that all naturalists interested in the rich African fauna will want to consult. We strongly recommend its acquisition by all natural science libraries.

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Amphibians and Reptiles of Delmarva, by J. F. White, Jr., and A. W. White. 2002. Tidewater Publishers, P.O. Box 456, Centreville, Maryland 21617, USA. xvi + 288 pp. Softcover. US $14.95. ISBN 0-87033-543-X.

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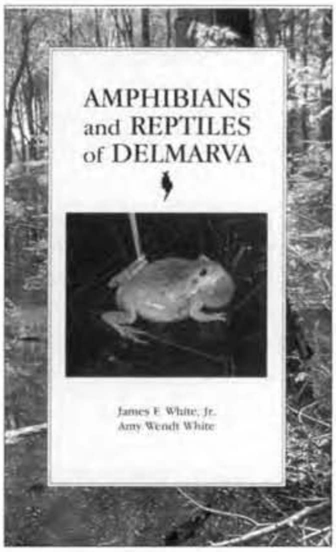

Local and regional field guides are important outlets of public education, working to dispel the myths surrounding reptiles and amphibians by presenting valid information in a readable manner. Because of the directed focus of these efforts, these guides also work to include extensive detail of both habitats and species that occur in these generally small areas. *Amphibians and Reptiles of Delmarva* is no exception, combining detailed species accounts with simple habitat descriptions that will assist nature enthusiasts and experienced herpetologists alike in identifying species and learning about the natural history of this diverse coastal herpetofauna. This book focuses on the herps of the Delmarva Peninsula, which sits on the mid-Atlantic Coast, encompassing all of Delaware and extending south into part of Maryland and Virginia east of the Chesapeake Bay. The Delmarva represents an interesting zoological and botanical transition zone because many species reach either the northernmost or southernmost range of their distributions in this area.

Amphibians and Reptiles of Delmarva is a pocket-sized (18.8 cm x 11.5 cm) book ideal for field identification of specimens. It begins with an introductory explanation of the nomenclature adopted, how to use the field guide, and a brief history of herpetology in the Delmarva region. Although the history section presents only a short summary of the herpetologists who have worked in this region, it is filled with references from the primary literature, most of which are difficult to locate. Next is an explanation of the physiography of the region, which provides an excellent overview of some of the geographical features that make up the Delmarva. Additionally, it provides a short summary of the habitat types in the area, as well as a list of the most common groups of reptiles and amphibians found in each habitat. The third section is aimed towards the casual nature observer or amateur naturalist, and provides detailed information on observing, identifying, and handling amphibians and reptiles. Also presented are the names and addresses of individuals and organizations interested in range extensions, sightings of rare species, or simply in assisting with identifications of observed animals.

The real treasure of this book lies in the species accounts, describing in detail the 73 species recorded from or suspected as occurring on the Delmarva. A brief overview of each species is presented, including a description, a list of morphologically similar species, overall range, range and status (very common to extremely rare) on the Delmarva, habitats where the species can be found, and life history. Distribution maps are also presented, with the entire county shaded to denote species presence. Nestled in the center of the species accounts are color photographs of each species presented in the text as well as some of the previously described habitat types. The photographs are arranged by taxonomic group, allowing easy preliminary identification of observed species using only the photographs, which is helpful for those unfamiliar with identifying species from written descriptions. The final section overviews conservation issues as they relate to the Delmarva, including a table of rare species with their State, Federal, and National Heritage rankings, as well as a description of the significance of each category. Presenting even a brief overview of conservation issues in a field guide aimed at a broad audience is an excellent way of educating herpetology enthusiasts about the effects of humans on the species they are interested in. Finally, an appendix presents a species list with room to write in short field notes for each species.

Although the authors follow the nomenclature of Crother (2000) for both common and scientific names, several of the common names used differ from those used in other regional field guides (e.g., little brown skink for ground skink, *Scincella lateralis*, northern diamond-backed terrapin for northern diamondback terrapin, *Malaclemys terrapin terrapin*), possibly causing some confusion for those unfamiliar with scientific nomenclature. However, the designation of consistent common names must begin somewhere and I applaud the authors for using a previously published nomenclature throughout their work. The distribution maps are quite small (3.4 cm x 1.2 cm) and lack detailed species ranges, as one species record is presented as equivalent to a true county-wide distribution. I feel more detailed distribution maps are useful to those searching for specific species, with each museum specimen locality designated (e.g., Palmer and Braswell 1995) or at least more precise ranges presented (e.g., Bartlett and Bartlett 1998) so that the reader can get a true idea of the distribution of a species with regard to habitat and geographical features, rather than political boundaries. Additionally, a smaller-scale map depicting the entire states of Delaware, Maryland, and Virginia, including the Delmarva's location within this area at the beginning of the book would help those unfamiliar with the region to visualize the relationship between the peninsula and the mainland.

This book is exceptionally thorough and well organized for being focused on such a small geographic region and I recommend this book to anyone interested in coastal herpetofaunas, especially those interested in biogeography. The cost is a bargain considering the wealth of information presented and the beautiful color photographs. It makes an excellent field companion and will serve as a general guide to those unfamiliar with the herpetofauna of the mid-Atlantic region, both on and near the Delmarva.

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Herpetological Collecting and Collections Management, by John Simmons. 2002. Society for the Study of Amphibians and Reptiles, Herpetological Circular Number 31, vi + 153 pp. Available from Breck Bartholomew, SSAR Publications Secretary, P.O. Box 58517, Salt Lake City, Utah 84158-0517, USA (ssar@herplit.com). Softcover. US $16.00. ISBN 0-916984-60-5.

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This book is a revision of John Simmons' 1987 SSAR Herp Circular Number 16, which is now out of print. Since the publication of the first edition of this volume, much has changed in terms of both collecting herpetological material and managing these collections. An indication of this change is the length of the circular. The new edition has increased from 56 pages of text to 108, references have increased from 14 pages to 25 pages, and three appendices have been added to provide additional sources of information.

The publication is divided into four parts covering the following topics: I. A Brief History of Systematic Collections, II. Field Collecting, III. Preservation of Specimens, and IV. Museum Collections. To the extent that the stated goal of the author is to provide "an even better, but equally flexible framework for collection care in line with recognized professional standards and practices," I have to say that he has gone beyond his own expectations.

Part I is an addition to the first edition. It presents a historic overview of collecting as a human endeavor, the development of museum collections, and the evolution of preservation technology and record keeping. Collecting has long been a part of our natural learning process. The documentation of natural diversity and the collection of curiosities have long histories. Preservation techniques predate the development of collections and museums, but the advent of new and more effective preservation methods facilitated the rise of modern natural history museums and transformed systematic collections from 'cabinets of curiosity' for the select few, to a worldwide resource documenting natural diversity. Following Whitehead's (1970) historical periods, Simmons discusses the changing nature of systematic collections as an interaction of our search for knowledge and the development of the technologies to preserve and conserve natural history specimens through time. In his section on the future of systematic collections, the author points to the growing value of systematic collections as new ways of obtaining data from specimens (e.g., DNA extraction from preserved specimens) are discovered and new uses for collections (e.g., biodiversity informatics) are developed. As fieldwork and collecting become more difficult and expensive, the value of present holdings will only increase.

The bulk of the book is devoted to the topics of collecting and preservation, and to a discussion of the framework for a properly managed systematic collection. From the onset, it is clear that these go hand in hand. Given the expense, time, and effort that go into the preparation for and execution of any given field trip, there is a corresponding need for the proper care and curation of the collections realized. If not, all would be wasted.

In Part II, the many field collecting strategies, methodologies, and techniques that the herpetological community has developed are reviewed, providing both an introduction to beginners as well as a benchmark for experienced workers. In this section John also thoroughly covers preparing for a collecting trip, providing a discussion of what needs to be considered and accomplished before departure. Much of the material covered might seem obvious, but I have found checklists much more reliable than my memory. Appendix II serves as a guide to how to prepare and what to pack and can be adjusted to fit the type and duration of any field trip. One of the more important elements of preparation involves obtaining the appropriate permits. It is imperative that any collecting is done legally, with all the proper permits and documentation constituting an integral part of the collection itself. Without these, the legal ramifications can be extensive and severe, affecting not only the individual collector, but also the institution that accessions the collection. One must also be prepared to anticipate problems; it is not unheard of to have all the appropriate documentation and still run into difficulties.

Part III of the book addresses the actual preparation and fixing of specimens and proceeds step by step from the field to the collection shelf. This section has tripled in size from the previous edition and its completeness attests to the importance of proper preparation and documentation procedures to maximizing the value of each specimen collected. The author has provided an excellent resource for collectors, curators, and collection managers. He supplements the discussion with alternatives and associated references. This is where Simmons' experience really shows. For example, he discusses preferred methods for preservation of specimens, laying out alternatives depending on the ultimate use of the specimen. His discussion on fixation and preservation clearly explains the actual fixation process and reviews specific methods for preserving amphibians and reptiles, pointing out things easily forgotten, for example, tying off an everted hemipenis so that it remains fully extended.

The author's coverage of techniques is extensive and more than I can mention in this review. Although I may disagree with a procedure here or there or maybe just do things differently, I found the discussion complete and helpful, with ample references to sources providing detailed information about the recommendations and techniques mentioned. Inherent in the discussion is the need to continue to develop these techniques and to document

current procedures to assist future workers to understand better what has happened to specimens. Such documentation, at a procedural level, gives another layer of added value to specimens.

In Part IV, Museum Collections, dealing with collection management, Simmons puts everything together. It accounts for almost half of the text as a whole. What should happen to the specimen and its associated data once collected, processed, and placed on the shelf? Simmons defines the most important functions of collection management as (1) maintaining the integrity of specimens and their associated data; (2) maintaining specimens and data in optimum usable condition; and (3) making specimens and data available for appropriate use. His discussion outlines professional standards and procedures and defines what museum collections should strive for operationally. He considers the physical conservation of specimens and related data, as well as factors that affect the longevity and usefulness of specimens. Preservation techniques, storage conditions, environmental parameters, and laboratory facilities are thoroughly reviewed as are personnel and their respective roles and responsibilities and both the physical and administrative management of the collection. All in all, it is a concise discussion of how to manage a collection and a museum, providing specific recommendations based, in part, on personal experience.

This publication is an excellent summation of the progress that has been made in the field of conservation of herpetological collections and is a tribute to the author's continued efforts to expand our knowledge. Simmons provides the reader with a detailed guide to herpetological collecting and the management of museum collections. This is a publication that should be on the desks of all museum professionals, worn from use. The museum community owes John a debt of gratitude for providing such a tool to assist us in the execution of our trust. I only hope that enough copies have been printed for all who should read it.

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PUBLICATIONS RECEIVED

The Herpetofauna of Shek Kwu Chau, South China Sea, with Descriptions of Two New Colubrid Snakes, by James Lazell. 2002. Memoirs of the Hong Kong Natural History Society 25. 82 pp.

This memoir documents the herpetofauna of Shek Kwu Chau, a small island in the South China Sea near Hong Kong. Following an introduction to the geological and historical background of the island, accounts are provided for 24 species of amphibians and reptiles, including the new taxa *Ahaetulla prasina medioxima* and *Dendrelaphis hollonrakei*. Most accounts provide detailed systematic and/or natural history notes and some contribute significantly to the knowledge of poorly known forms. The work concludes with general considerations of life histories and biogeography. It is illustrated by numerous graphs, maps, line drawings and photographs. This contribution should be of special interest to herpetologists studying the tropical Asian fauna, island biologists, snake systematists, and ecologists.

Anakondas, by Lutz Dirksen. 2002. Natur und Tier-Verlag GmbH, An der Kleimannbrücke 39/41, D-48157 Münster, Germany (www.ms-verlag.de). 190 pp. Hardcover. 48.00 €(approx. US $52.00). ISBN 3-931587-43-6.

This book, written in German, is a monographic revision of the genus *Eunectes*, based on the doctoral dissertation of the author. It begins with short overviews of the systematic relationships of anacondas, current taxonomy (including synonymies), paleontology, and conservation status, as well as a brief summary of South American geography, geology, climatology, vegetation, and fauna. More than 750 specimens were examined in the course of the work and morphological and color data were subjected to multivariate analysis, while RAPD data were used to generate a phylogeny for the genus. Four living species of anacondas, including a new species, *E. beniensis*, are recognized. For each taxon a diagnosis is provided and color, pattern, morphometry, scalation, skeletal and dental anatomy, sexual dimorphism, hemipenial structure, reproduction, feeding, behavior, captive care, and commercial trade are discussed. The text is complemented by many color photographs, tables, and graphs dealing with all aspects of anacondas, their anatomy, biology, and habitats. Point locality maps and country-by-country discussions of distribution clarify the ranges of each taxon and reveal previously unrecognized patterns. The book concludes with summaries in German, English, French, and Spanish and a bibliography with approximately 250 entries. "Anakondas" summarizes a wealth of information about these giant snakes and will be a valuable addition to the libraries of snake systematists, morphologists, and those interested in the fauna of South America.

Die Äskulapnatter – *Elaphe longissima*, Verbreitung und Lebensweise in Mitteleuropa, by Axel Gomille. 2002. Edition Chimaira, Friedberger Anlage 14, D-60316, Germany (frogbook@aol.com). 158 pp. Hardcover. 27.80 €(approx. US $30.00). ISBN 3-930612-29-1.

This book presents a detailed picture of the distribution and natural history of the Aesculapian snake, *Elaphe longissima*, the largest snake (to 1.8 m or more) of central Europe. The author dispels earlier views that the species, which has been important in mythology and symbolism since ancient times, was translocated by the Romans. Rather, its patchy distribution in several river valleys in central Europe is relictual and reflects the species' need for warm, humid forest conditions. A large section of the book is devoted to a study of the snake in the Neckar-Odenwald region of Germany, one of the isolated northern localities where the snake occurs. Ecological and population data are presented and fine scale correlates of local distribution are discussed. The book also hypothesizes historical processes and ecological constraints that have contributed to current reptile distributions in central Europe and reviews aspects relevant to the conservation of the aesculapian snake in Germany and elsewhere. The volume is illustrated by

five maps, nine graphs, and more than 80 photos and illustrations, mostly in color. All figure and table legends are provided in both German and English and there is a five-page English summary. A bibliography of almost 200 references rounds out the book. In addition to those studying the European herpetofauna, "Die Äskulapnatter" should be of special value to anyone interested in questions of herpetofaunal distribution and their relationships to Pleistocene and Holocene events.

Lizards, A Natural History of Some Uncommon Creatures – Extraordinary Chameleons, Iguanas, Geckos, & More, by David Badger, photography by John Netherton. 2002. Voyageur Press, P.O. Box 338, Stillwater, Minnesota 55082, USA (books@voyageurpress.com). 160 pp. Hardcover. US $29.95 + $4.95 shipping and handling. ISBN 0-89658-520-4.

This is the latest popular book from the same author/publisher combination that has produced the recent titles "Frogs" and "Snakes." The book is aimed at a general audience and endeavors to introduce the basic biology and diversity of lizards through a combination of clear, simple narrative and excellent photography. Most of the information is drawn from secondary works in herpetology, but is accurate and engagingly written. The book is divided into four chapters, shorter treatments of "Lizards and Humans" and "Lizard Conservation" and longer ones on "Physical Characteristics and Behavior" and "Families and Species." The first of these sections points out the role of lizards in human societies around the world and their significance to modern popular culture. Twenty-nine species are featured with two page entries including a color photograph and a general text, highlighting interesting aspects of the species' biology. Many additional species are illustrated in the "Physical Characteristics and Behavior" chapter under such headings as "limbs and locomotion," teeth and venom," "thermoregulation," and "predation." Scientific names are provided in the species profiles, but not in the rest of the book. In addition to a bibliography of more than 120 references, the book is fully indexed. This volume would be appropriate for younger readers or other novice herpetologists. Very good to excellent photography and clear explanations should help engender a real appreciation for lizards.

A Field Guide to Amphibian Larvae and Eggs of Minnesota, Wisconsin, and Iowa, by Jeffrey R. Parmelee, Melinda G. Knutson, and James E. Lyon. 2002. U.S. Geological Survey Information and Technology Report USGS/BRD/ITR-2002-0004 (available from National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161, USA). 38 pp. Softcover.

This slim volume provides species accounts for the eight salamanders and 21 frogs occurring in the three upper Midwest states covered. Each account includes a black and white illustration of the larval form (a female guarding eggs is shown for the direct developing *Plethodon cinereus*), a shaded distribution map with county boundaries shown, and a short text section describing the eggs and larvae as well as comments about distribution and/or adult habitat. Some similar species are combined into single accounts. Circular field keys to eggs, salamander larvae, and tadpoles are a highlight of the guide and are supplemented by simple line drawings that illustrate terms used in the keys. The book also provides short sections on preserving eggs and larvae and raising larvae, and concludes with a short bibliography. It should prove especially valuable to those involved in amphibian monitoring. Because many of the species dealt with are broadly distributed in the Midwest and the eastern United States, the guide will have utility outside of the three states noted in its title.

Exploring Animal Behavior in Laboratory and Field, edited by Bonnie J. Ploger and Ken Yasukawa. 2002. Academic Press, 525 B Street, Suite 1900, San Diego, California 92101-4495, USA. 472 pp. Softcover. US $44.95. ISBN 0-12-558330-3.

This lab/field manual is subtitled "An Hypothesis-Testing Approach to the Development, Causation, Function, and Evolution of Animal Behavior" and is divided into major sections dealing with "Describing Behavior," "Causation," "Development," and "Adaptation and Evolution." The 35 chapters by 50 contributors use a diversity of animals to illustrate principles in the context of experimentation and hypothesis testing. The book is written for the student in an introductory animal behavior class and each chapter includes an introduction to the topic and subject organism(s), materials, experimental procedure, hypotheses and predictions, data recording and analysis (with sample data sheets in some cases), questions for discussion and a literature cited section. Important terms are highlighted in bold and are defined in an extensive glossary at the end of the book. Herpetological exercises are: Chemoreception in Lizards (C.O. Krekorian), Behavioral Thermoregulation in Field Populations of Amphibian Larvae (H.H. Whiteman and N.L. Buschhaus), Aggregation and Kin Recognition in African Clawed Frogs (K.L. Anderson and B.J. Ploger), and Vocal Behavior and Mating Tactics of the Spring Peeper (*Pseudacris crucifer*): A Field Exercise in Animal Behavior (D.C. Forester). Other experiments use birds, insects, fish, and mammals, including humans. Appendices dealing with the treatment of animal subjects, the ethics of human subject use, and an introduction to statistics round out the volume. Instructors of laboratory courses in animal behavior should consider this text for adoption.

The Lizards of Italy and Adjacent Areas, by Claudia Corti and Pietro Lo Cascio. 2002. Edition Chimaira, Friedberger Anlage 14, D-60316 Frankfurt am Main, Germany. 165 pp. Hardcover. US $39.95. ISBN 3-930612-68-2.

This book treats the 27 species of lizards (in five families) occurring in Italy and the neighboring areas of Corsica, Istria, and Malta. It commences with an overview of the region and a discussion of zoogeography, highlighting the relatively high level of endemism among the region's lizards. Each species account provides Latin, English, and Italian names and a relatively detailed description, including information on sexual dimorphism. This is followed by sections on "Distribution, zoogeography and taxonomy" and "Biology and ecology." These sections are typically several pages long and cite original sources extensively. Each ac-

count is illustrated by a shaded distribution map and by several color photos, each captioned with the corresponding locality. Representative habitat photos supplement the text. The volume concludes with a short section on conservation and an extensive bibliography of more than 500 references, although there is no index. The book is the first major treatment of the Italian saurofauna in English, and should appeal to herpetologists interested in the lizards of Europe, and particularly to those interested in lacertids, as these are represented by seven genera and make up more than half of the species covered.

Herpetology in Montana, by Bryce A. Maxell, J. Kirwin Werner, Paul Hendricks, and Dennis L. Flath. 2003. Society for Northwestern Vertebrate Biology, Olympia, Washington (www.snwvb.org). Northwest Fauna Number 5. Peabody. viii + 138 pp. Softcover. US $12.00 + $1.50 postage and handling ($2.50 foreign). ISBN 0-912532-57-2.

This is not a field guide, and there are no photographs of amphibians or reptiles, but this book provides a wealth of information about the 12 amphibians and 17 reptiles of America's fourth largest state. It begins with a thorough review of the history of herpetology in Montana and then reviews the status of information on the fauna based on published papers, voucher specimens (more than 4600), and well documented observations (more than 7000); checklists and keys (to amphibian eggs and larvae, as well as adults of both classes) follow. The bulk of the book is occupied by species accounts. These include the sections: Comments (general comments on species status in Montana), Earliest Literature Record, Earliest Voucher Record, Maximum Elevation Record, Maximum Elevation Voucher Record, Voucher Record Summary (listing all museum specimens by county), and Bibliographic Index (with references sorted by topic). The distribution of each species is plotted on a large point locality map of the state that shows county boundaries as well as rivers and montane regions; voucher and sight records are distinguished by different symbols. Short accounts are provided for seven species or subspecies of possible occurrence and for 12 exotics reported from the state. *Herpetology in Montana* concludes with a bibliography of more than 600 references and brief sections on reporting observations of amphibians and reptiles and preventing the spread of viral and fungal pathogens. Herpetologists with interests in the fauna of the Pacific Northwest, the Rocky Mountains, Great Basin, or Great Plains, as well as those interested in the history of American herpetology, will find this book a welcome addition to their shelves.

Frogs of the Great Lakes Region, by Jim McGrath. 2002. Nature Discovery, 5900 N. Williamston Road, Williamston, Michigan 48895, USA. Compact Disc. US $14.00 + $2.00 postage and handling.

This CD features the calls of 13 species of anurans of the Great Lakes region, presented in chronological order of emergence and breeding. The calls are presented with narrated commentary in an instructional format geared towards those participating in amphibian surveys. An additional 13 tracks, with titles such as "Marsh

Mellow Peepers" and "April Showers Bring May Fowler's" provide more than 45 minutes of uncommented chorusing. A small booklet accompanying the CD features 12 color photos of frogs (*Hyla versicolor* and *H. chrysoscelis* are treated together), and briefly lists identifying physical characteristics and describes the breeding period, breeding call, and breeding habitat. As most of the species have broad distributions in eastern North America, the CD may be of interest to frog enthusiasts across the Midwest and adjacent areas.

Erratum

Two geographic distribution notes authored by M. J. McCoid (2002, 33:321, 322) require corrections for species identifications. In the first instance, the specimen reported as *Ctenosaura pectinata* (TCWC 84723) is actually *C. similis*. In the second case, the specimen reported as *Hemidactylus turcicus* (TCWC 84910) is actually *H. garnottii*. Identifications of both were confirmed by James R. Dixon and R. Kathryn Vaughan.

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fore, the incidence of breakage could be expected to differ at each locality, and to change over time.

In the data set that included recaptures, snakes probably averaged older and therefore had a higher ratio of broken tails, but the trends for the two data sets are similar. In both samples, females had higher frequencies of broken tails than males, and adults had higher frequencies of broken tails than juveniles (Tables 1–4). Tail breaks are not common in first-year snakes, and it seems that immatures seldom rely on autotomy for defense. Of first-year young (less than 350 mm SVL) only 2.42% of 452 had broken tails, but for 886 larger snakes the ratio was 13.7%. As adult size is attained the incidence of tail breaks rises sharply, especially in females. The incidence of breakage was 10.3% in 399 males and 16.7% in 487 females. It is not known how much tail loss affects survivorship.

Acknowledgments.—I thank my daughter, Alice F. Echelle, and Galen L. Pittman for advice concerning statistics.

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TECHNIQUES

Herpetological Review, 2003, 34(3), 213–215.

Using Rims to Hinder Amphibian Escape from Pitfall Traps

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Pitfall traps, either arranged in grids or associated with drift fences, are commonly used to assess amphibian species richness and abundance in various habitats (Corn 1994). However, trap efficiency is believed to differ across species, as some species are more likely to be captured and remain in traps than others (e.g., tree frogs can climb out, large individuals may jump out; Corn 1994). This is particularly important in large-scale studies with distant sites or large numbers of traps that cannot be checked daily (e.g., Bury and Corn 1987; Degraaf and Rudis 1990; deMaynadier and Hunter 1998; Mazerolle 2001; McLeod and Gates 1998; Stockwell and Hunter 1989). To overcome this problem, researchers have made different modifications to traps, such as varying trap size (Vogt and Hine 1982), or adding funnels (Corn 1994; Vogt and Hine 1982), side flaps (Nadorozny and Barr 1997), pivoting top flaps (Christiansen and Vandewalle 2000), or rims (Bury and Corn 1987; Stenhouse 1985). However, very few investigators have experimentally tested the effectiveness of their alterations against amphibian escape (but see Brown 1997; Christiansen and Vandewalle 2000; and Vogt and Hine 1982). In this paper, I present data collected in field conditions to test the effectiveness of pitfalls with and without rims in hindering amphibian escape (i.e., animals being missing from the trap).

All experimental trials were conducted in Rankin Bog (46°48'N, 65°00'W), a peat bog within Kouchibouguac National Park, in southeastern New Brunswick, Canada, during the summers of 1998, 1999, and 2001. Pitfall traps consisted of 11.4-L plastic buckets (24 cm diameter x 30 cm height), each of which was placed in a shallow hole ca. 10 cm in depth. This ensured that the tops of the buckets were well above the bog surface to alleviate the probability of an accidental capture during trials. Each trap was a quarter-filled with water, and a thick mat of *Sphagnum* moss was added in the buckets to provide cover (Mazerolle 2001). Rims were fashioned from bucket lids by cutting out their center portion, leaving a margin of 2 cm. These rims were added to some traps to test whether the presence of rims helps prevent escapes from the pitfall traps.

A predator exclosure was built around the entire array of buckets in 2001 to test whether escape rates were confounded with avian or mammal predation at the site during 1998 and 1999. The exclosure (0.91 m in height and 7.2 m in circumference) consisted of plastic snow fencing with a mesh size of 1 cm^2. The top of the exclosure was covered with nylon window screening fastened with clothespins to hinder avian predation.

I collected individuals of five amphibian species (see Table 1) from breeding ponds in the proximity of Kouchibouguac National Park. Amphibians also were collected during night driving surveys conducted on rainy evenings (Shaffer and Juterbock 1994) between April and September of 1998, 1999, and 2001 in the same area. Individuals were temporarily housed in a cool dark room and used in experimental trials within 36 h of capture. At the beginning of experiments, I measured the snout–vent length (SVL) of each amphibian. Individuals were randomly allocated to buckets fitted with or without rims, with the restriction of a single individual to each bucket. During a given trial period, the number of traps employed varied depending on the number of amphibians at hand (range 5–27 traps); for each species, half the individuals were randomly allocated to traps with rims, with the other half assigned to traps without rims. In those cases with an odd number of amphibians, the last individual was randomly allocated to one of the two trap types. The traps were arranged in a small grid of ca. 5 m^2. Traps were checked four days following the introduction of amphibians to assess whether animals were present or absent. Each individual was used only once, and was released at its original capture location if it was present in the trap at the end of the trial. A total of 256 individuals was tested over 17 four-day periods during 1998, 1999, and 2001.

I used logistic regression (Hosmer and Lemeshow 1989) to assess, for each species placed in pitfall traps, the effect of trap type (i.e., with or without rim) on the probability of being missing from the trap at the end of the trial. I accounted for the presence or absence of a predator exclosure by systematically including the variable in all models. Snout–vent length (SVL) was added to models if it was significant at $\alpha = 0.10$ in univariate logistic regressions (Type III log-likelihood ratio statistic, SAS Institute Inc.

TABLE 1. Mean snout–vent length ± SD and percentage of amphibians missing from pitfall traps, with and without rims, placed inside and outside a predator exclosure. Numbers in parentheses denote the total number of individuals tested in each category. A † identifies trials conducted in 1998 and 1999, whereas * identifies trials conducted in 2001.

Species	SVL ± SD (cm)	Percentage of animals missing					
		No exclosure†		Exclosure*		Totals	
		No rim	Rim	No rim	Rim	No rim	Rim
Bufo americanus	4.07 ± 1.01	0 (7)	0 (7)	0 (2)	0 (3)	0 (9)	0 (10)
Rana clamitans	4.18 ± 0.99	46.7 (30)	22.2 (36)	42.9 (21)	38.5 (26)	45.1 (51)	29.0 (62)
Rana sylvatica	4.24 ± 0.82	82.4 (17)	80.0 (15)	33.3 (9)	50.0 (12)	65.4 (26)	66.7 (27)
Ambystoma laterale	5.06 ± 1.02	83.3 (6)	80.0 (5)	100 (6)	40.0 (5)	91.7 (12)	60.0 (10)
Ambystoma maculatum	5.58 ± 1.64	71.4 (14)	10.5 (19)	11.1 (9)	0 (7)	47.8 (23)	7.7 (26)

1993). In this experiment, the absence of an individual from a trap could be due either to escape or predation. Although predation was improbable in the exclosure, some amphibians may have been predated in traps outside the exclosure. To elucidate the possible effect of predation on my results, I evaluated whether trends were similar within and outside the exclosure by testing the effect of the interaction of trap type and trap location (i.e., inside or outside the exclosure) on the probability of an individual being missing from a trap. All analyses were performed with the GENMOD procedure of SAS version 8.01 (SAS Institute Inc. 1993) at $\alpha = 0.05$.

For three out of the five species tested (*Ambystoma maculatum*, *A. laterale*, and *Rana clamitans*), a lower percentage of animals was found to be missing from traps with rims (relative to those without rims), at the end of the four-day period (Table 1); however, the relationship was significant only for spotted salamanders (*A. maculatum*; Table 2). All American toads (*Bufo americanus*) remained in the pitfall traps, regardless of snout–vent length, trap type, or trap placement (i.e., inside or outside exclosure).

In two of the five species, the probability of being missing from the trap depended on the size of individuals (Table 2). Larger green frogs (*R. clamitans*) had a greater chance of being absent from pitfall traps, whereas the presence of rims on traps slightly decreased the probability of absence (log-likelihood ratio statistic = 3.34, df = 1, $P = 0.068$). Smaller wood frogs (*R. sylvatica*) had a greater chance of being absent from traps, and the presence of rims had no effect on the probability of individuals being absent from traps after the four-day period. Furthermore, wood frogs were more likely to be missing from traps outside the exclosure than within (Table 2).

Spotted salamanders were more likely to be missing from traps without rims, and from traps placed outside of the exclosure. The probability of absence of blue-spotted salamanders (*A. laterale*) from traps was independent of snout–vent length and trap location, but the absence of rims slightly increased the chance of being absent from traps (log-likelihood ratio statistic = 3.28, df = 1, $P = 0.070$).

I did not find any significant interaction between trap type and location across all species. Despite the greater number of absences of wood frogs and spotted salamanders outside the predator exclosure (i.e., possibly due to predation in the traps outside the exclosure), these were independent of trap type. This suggests that if predation occurred in traps outside the exclosure, both trap types were similarly predated. Thus, predation cannot explain differences in the effectiveness of different trap types at retaining amphibians.

Variations in trap effectiveness can arise from different physical or behavioral characteristics across species. For example, American toads are stout-bodied and apparently unable to leap or climb out of pitfalls. In this study, small wood frogs apparently could climb out of traps with rims, whereas green frogs showed a different pattern, with larger individuals remaining less often in traps with rims. Furthermore, some species may selectively remain in pitfall traps with water (e.g., *Rana pipiens*: Shields 1985). By contrast, Brown (1997) observed that escape rates of *Bufo bufo* from pitfall traps (15 h after toad introduction into traps) were independent of trap depth (21, 28, and 40 cm) and the presence of water. Vogt and Hine (1982) observed higher frog and toad capture rates in 7.6-L traps with funnels than in traps without funnels. They also reported the occurrence of adult green frogs escaping from 7.6-L traps without funnels, but not from those with funnels.

With traps checked every four days, the use of rims improved the efficiency of pitfall traps for spotted salamanders, and to a lesser extent, green frogs and blue-spotted salamanders. For American toads and wood frogs, the presence of rims did not affect the efficacy of pitfall traps at retaining captured individuals. Further-

TABLE 2. Effect of trap type on the probability of absence of captured amphibians in pitfall traps. Parameter estimates of multivariate logistic regression models are shown with ± 1 standard error. Dashed line indicates that SVL was not included in final multivariate model. Trap type (2 levels, traps with rims as reference level) and exclosure (2 levels, traps in exclosure as reference level) are categorical variables. Significance of estimates is based on type III log-likelihood ratio statistics at $\alpha = 0.05$. No toads were missing from traps regardless of trap type or location (inside or outside exclosure), thus the models could not be computed for the species (i.e., perfect classification: Hosmer and Lemeshow 1989). The ** designate $P < 0.01$ and *** designate $P < 0.001$.

Species	N	Trap type	SVL	Exclosure
Bufo americanus	19	n/a	n/a	n/a
Rana clamitans	113	0.751 ± 0.415	0.619 ± 0.249**	−0.430 ± 0.419
Rana sylvatica	53	−0.713 ± 0.722	−1.525 ± 0.605**	1.767 ± 0.715**
Ambystoma laterale	22	2.022 ± 1.239	—	0.611 ± 1.120
Ambystoma maculatum	49	3.091 ± 0.944***	—	3.052 ± 1.198**

more, small wood frogs were more likely to leave traps than larger individuals, whereas smaller green frogs remained more often in the traps than larger individuals. Rims can prevent the escape of amphibians from pitfall traps but their efficiency will depend on the species, and in some cases, the size of the individuals. Based on these results, I suggest caution be used when comparing capture rates between species. Nonetheless, adding rims to pitfall traps is an easy way to improve trap effectiveness for certain species of amphibians. I recommend further investigations on the influence of the frequency of visits to traps on escape rates, and the differences in predation of captured amphibians in traps of different design.

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Comparison of Artificial Cover and Line Transects for the Capture of Grassland Snakes

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Determining differences in methods of reptile collection is essential in order to compare data from different studies. *A priori* knowledge of biases in techniques can be helpful for selecting capture methods appropriate to the target species. Because of the diverse natural history of snakes, it is difficult to outline procedures that are effective for each species (Fitch 1987; Gibbons 1988). Thus, multiple sampling techniques should be used in order to sample all species, sexes, and size classes within a given area (Campbell and Christman 1982; Dodd 1991; Karns 1986; Vogt and Hine 1982). Several types of direct sampling techniques have been used for snake surveys. Two of the most common collection methods are line transects and artificial covers (Fitch 1987). Our study set out to determine the effectiveness of these two methods for the capture of snakes in grassland habitats.

Line transect (LT) searches for snakes have been successfully used in a variety of habitats since the 1930's (Burnham et al. 1980). Several snake studies have used LT as the primary means of capture (Carpenter 1952; Gregory and Nelson 1991; Lacki 1994; Sullivan 1981, 2000), while others have used LT in conjunction with other techniques (Freedman and Catling 1978; Scott et al. 1989; Seibert and Hagen 1947). Advantages to using LT include increased detection of arboreal species, repeatability, and minimal expense. One major disadvantage is that the probability of detection abruptly diminishes away from the middle of a transect, an important limitation when sampling a ground dwelling species in a tallgrass situation (Burnham et al. 1980).

Artificial covers (AC) are an accepted method for collection, but few studies have employed them as the primary means of capture. AC have several benefits including low animal mortality, minimal maintenance, and can be constructed from a variety of materials such as wood, (DeGraaf and Yamanski 1992; Jensen 1968; Monti et al. 2000; Rice et al. 1994), metal (Tietje and Vreeland 1997), plastic (Engelstoft and Ovaska 2000) or a combination of materials (Adams et al. 1999; Fitch 1992; Grant et al. 1992; Parmelee and Fitch 1995).

TABLE 1. Snake species surveyed by capture method at the Prairie Ridge State Natural Area in 1999 and 2000. Only three species (*T. sirtalis*, *L. calligaster*, and *C. constrictor*) were captured in large enough numbers for statistical calculations.

	Total Captures				Weight (g)			
	Covers		Transects		Covers	Transects	K-W Test	
	N	% of Total	N	% of Total	Mean ± SE	Mean ± SE	Z	*P*
T. sirtalis	345	60.8	65	11.5	105 ± 4	104 ± 12	0.31	0.79
L. calligaster	38	6.7	80	14.1	196 ± 36	440 ± 24	5.1	< 0.0001
C. constrictor	24	4.2	10	1.8	252 ± 53	461 ± 97	2.0	0.04
Nerodia sipedon	0	0.0	3	0.5	—	—	—	—
Opheodrys aestivus	0	0.0	1	0.2	—	—	—	—
Storeria dekayi	1	0.2	0	0.0	—	—	—	—

We examined the capture rates of AC and LT for snakes at Prairie Ridge State Natural Area (PRSNA) from 1 April to 10 August 1999 and 2000. PRSNA is an 800 ha tallgrass restoration in Jasper County, Illinois, USA. We surveyed a total of 12 different grassland areas at PRSNA. Of these areas, 11 were surveyed in 1999 and 10 in 2000. Straight line transects were random within the sampling areas, and the transect length was dependent on field size. LT were performed 4–5 d/wk in all weather conditions. We abandoned LT on 25 June of each year because search efforts yielded few captures. Artificial covers were 0.6 x 3.0 m sheets of corrugated metal (barn siding or roofing) placed *in situ* four months prior to the start of data collection (January of each year) as recommended by Grant et al. (1992) and left in place for the duration of the study. Artificial covers were arranged in groups of four sheets. Fourteen groups (56 covers) were utilized in 1999 and 18 groups (72 covers) in 2000. Covers were checked every 5–7 days. Each capture was given a scale clip for future identification. In order to decrease handling time, a random sample of snakes from all grassland tracts were weighed to the nearest gram. To maintain sample independence, recaptures were not used in statistical analyses if the individual was captured more than once using the same technique. Individuals were immediately released under the AC or place of capture along the LT. The mean weights of individuals were compared between the two methods using Kruskal-Wallis tests. Because there is no way to standardize effort between the two methods, direct comparisons of capture efficiency were not evaluated.

To determine if capture rates were affected by temperature or precipitation, we used climate data collected by the Illinois State Water Survey (Station: Newton 6 SSE. ID: 116159). Mann-Whitney *U*-tests were used to compare capture rates on days with and without precipitation. We also tested the influence of the

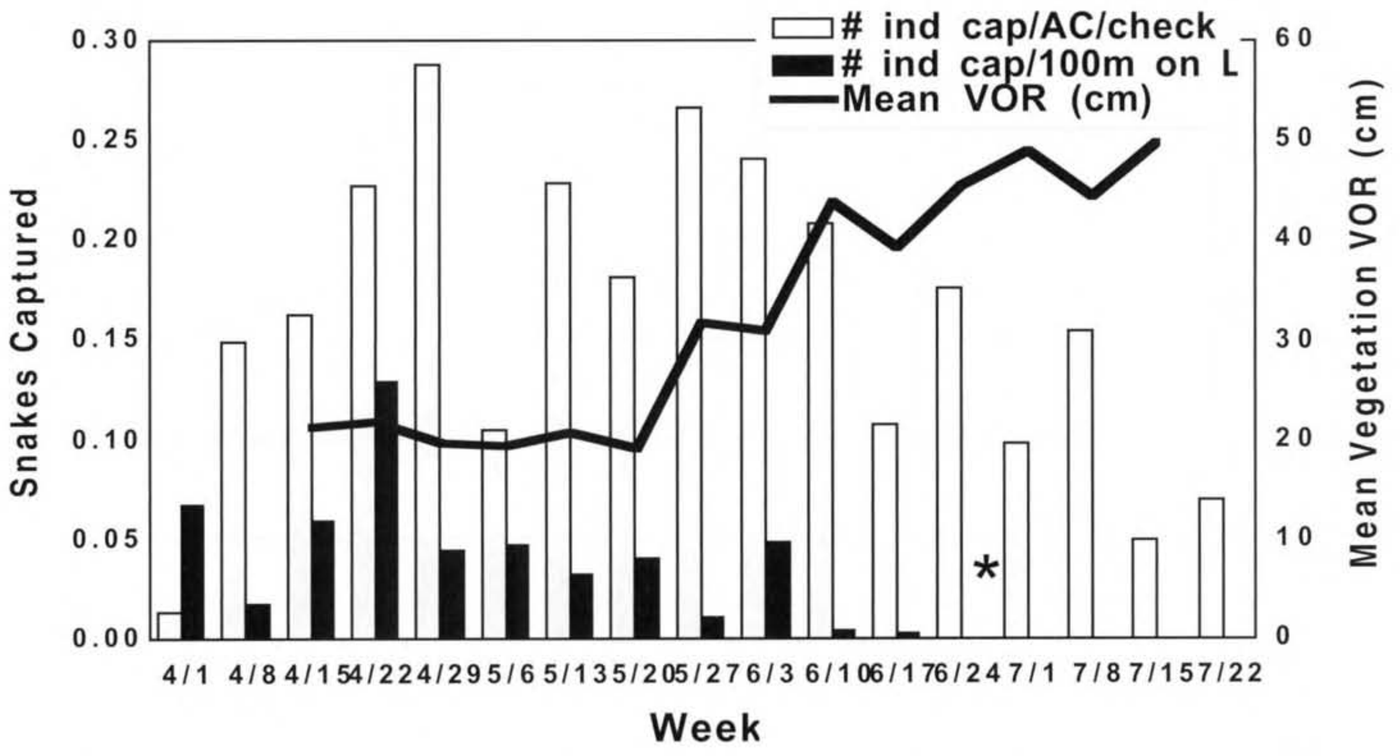

FIG. 1. Capture rates of snakes at Prairie Ridge State Natural Area in Jasper Co. Illinois, USA in 1999 and 2000 using artificial covers (AC) and line transects (LT). * Transects completed by 25 June each year.

amount of precipitation on capture rates using Spearman's rank correlation. In addition, we used Kruskal-Wallis tests to evaluate capture rates in relation to mean daily temperature. For this, we grouped the mean daily temperatures into five-degree intervals (0–30ºC).

A total of 197 random points of vegetation within the sampling areas were measured using a Robel Pole over both years. This method allowed us to record Visual Obstruction Readings (VOR) throughout the sampling period. Visual obstruction is a correlate of height and density of vegetation around a central point (Robel et al. 1970). Points were pooled and a weekly average VOR for PRSNA was calculated (Fig. 1).

A total of 567 captures of six species of snakes (Table 1) were made in 2644 AC checks (Mean = 0.15 individuals captured/AC/check) and 372.4 km searched along LT (Mean = 0.04 individuals were captured/100 m). The majority of captures (71.9%) were from covers, while 28.1% were collected along LT. Eighty-four individuals were recaptured. The common garter (*Thamnophis s. sirtalis*), prairie kingsnake (*Lampropeltis c. calligaster*), and racer (*Coluber constrictor foxii*) account for 97% of the individuals captured. Two species observed on LT were not observed under AC (Table 1).

Thamnophis sirtalis and *C. constrictor* were captured more often using AC (Table 1). The majority of *T. sirtalis* captures (82.3%) were under AC, while 70.6% of *C. constrictor* were found under AC. Conversely, 67.8% of *L. calligaster* were found on LT. Four of five individuals of additional species at PRSNA were collected via LT (Table 1).

An average VOR was calculated by pooling vegetation points from all grassland tracts. This average shows that a decrease in LT capture rates occurred when vegetation VOR increased to approximately 30 cm (Fig. 1). Transects were an efficient method of capture in early spring (15–30 April), but decreased in May when vegetation attained a VOR of 30 to 35 cm. At a VOR > 30 cm the searchers field of view is greatly diminished. However, AC produced a higher capture rate over the sampling period and remained a reliable source of captures until July when a decrease in capture rate occurred, likely in response to the rapid and extreme heating of AC (Fig. 1). We also noted that snakes would not use AC when the temperature under the cover was > 24°C. When covers were removed in November, *T. sirtalis* were utilizing them. Although weekly fluctuations in the capture rate of AC were observed, we did not find that mean daily temperature or precipitation were factors in the fluctuations. Conversely, we found the highest capture rates on LT early in the season when temperatures were 0–5°C. We attribute high capture rates during this period to low vegetation VOR, and to high concentrations of snakes as they left hibernacula, not to cooler temperatures.

We determined that species abundance and diversity was dependant on capture methodology. Certain snake species were captured more often using one particular method. For example, if only LT results are presented, the most abundant species is *L. calligaster*, whereas *T. sirtalis* would dominate if only AC information was given (Table 1). We also determined that species diversity was compromised when results from only one method were presented. Specifically, if only the AC data were given, the species composition at PRSNA would be under-represented by two species. Combining the results from both methods may be a better indicator of species abundance and diversity.

When we compared the weights of snakes between the two trapping methods, *C. constrictor* and *L. calligaster* were found to be significantly larger on LT than under AC (Table 1). This result is similar to Kjoss and Litvaitis (2001), who found smaller individuals (weight and snout–vent length [SVL]) captured under AC than in pitfall traps. In our study, *T. sirtalis* exhibited no size related differences between the two methods, suggesting that all size classes would be represented using either method for this particular species. Our results are different from a similar study of *Thamnophis* spp. by Gregory (1984) in which snakes captured under cover objects had a significantly smaller SVL than snakes found using visual surveys. One explanation as to why smaller individuals were captured under AC might be that larger individuals were easier to detect along transects. However, easier detection is arguable because there was no difference in weight between the two methods for *T. sirtalis*. A more plausible explanation is that age, sex and reproductive conditions can dictate thermal preferences (Lillywhite 1987) that influence the selection of microhabitats. Because snake body size may be correlated with survivorship, mating success, reproductive output (Gregory and Prelypchan 1994), diet (Mushinsky 1987; Rosen 1991) and age (Halliday and Verrell 1988), using a single capture method may exclude pertinent data needed for life history investigations, thereby biasing demographic studies.

Both methods examined here have problematic qualities. As we have shown, the capture rates along line transects in grasslands can vary with the density of vegetation. Additionally, artificial cover may be creating habitat that is not readily available at PRSNA therefore elevating capture rates with AC. Despite this, our findings stress the importance of including multiple collection techniques for studies of species diversity, and life history.

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Marking Medium- to Large-Sized Anurans with Passive Integrated Transponder (PIT) Tags

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A challenge of conducting research on population dynamics of amphibians is the selection of a suitable marking technique (Hecnar and McClosekey 1996; Ott and Scott 1999). Permanently marking individual anurans is especially difficult relative to other vertebrates because of their small size and sensitive skin (Heyer and Donnelly 1994). To date, there is no technique that satisfies all criteria for ideal individual identification set out by Ferner (1979) (Table 1). Recently, passive integrated transponder (PIT) tags have been used to permanently mark anurans (Faber 1997; Jehle and Hodl 1998; for full review of technology see Camper and Dixon 1988), however all reported techniques require anesthesia or a permanent sealant (i.e., VET Seal, super glue, suture).

For most anuran species on which PIT tagging has been applied, long-term field data are lacking (Marsh and Trenham 2000), due in part to the relative novelty (c. 1979) of the technology. Jehle and Hodl (1998) implanted tags into spade-foot toads (*Pelobates fuscus*) over an eight-year period; however individuals were transported 1 km from the study pond to a laboratory, anesthetized with MS-222, and had the PIT tag injected into the subcutaneous lateral lymph sacs with a hypodermic needle. Toads

TABLE 1. Methods for marking anurans relative to criteria set out by Ferner (1979) for ideal individual identification.

	Invasiveness	Practicality	Cost	Permanence	Reference
Toe-clipping	High	High	Low	Medium	Clarke 1972, Ferner 1979, Heyer and Donnelly 1994, Ott and Scott 1999
Tattooing	High	Low	Medium	Low	Brown 1997, Ferner 1979, Nace 1982
Cold Branding	High	Low	High	Low	Brown 1997, Farrell and Johnson 1973
Chemical Branding	High	Low	Medium	Medium	Ferner 1979, Nace et al. 1974
Skin Graphs	High	Low	High	High	Verhoeff-de-Fremery and Vervoordeldark 1982
Elastomers / Wire	High	Medium	Low	Medium	Brown 1997, Ferner 1979, Heyer and Donnelly 1994
Knee-tagging	High	Medium	Low	Medium	Elmberg 1989
PIT Tags – anesthesia	High	Low	High	High	Brown 1997, Camper and Dixon 1988, Faber 1997, Jehle and Hodl 1998, Ott and Scott 1999

were released at the point of original capture some hours later. No methods incorporating PIT tags for anurans have been reported which do not require the animals to be transported away from the study site and anesthetized (Brown 1997; Faber 1997; Jehle and Hodl 1998). In this paper we describe an effective PIT tag technique for anurans (> 40 g or > 75 mm) that can be applied in the field in less than ten minutes.

Pilot Study.—On 4 June 2001, we injected two green frogs (*Rana clamitans*) and two northern leopard frogs (*Rana pipiens*) with PIT tags subcutaneously without the use of anesthetics. Frogs received a light swab (< 0.5 ml) of 70% ethanol directly on the potential injection site (ventral side, posterior to center). This served to dry the skin and to sterilize the site. The skin was pinched with a forefinger and thumb and lifted ~4 mm away from the body cavity wall. Using a 12-gauge hypodermic needle (AVID Marketing, Inc., Norco, California; after Faber 1997), a PIT tag was injected into the flap of extended skin. No VET SEAL (after Faber 1997), or suture was required to dress the wound. Ethanol was reapplied with a sterile swab. Frogs were housed in 30 x 20 x 15 cm glass aquaria with available exposed substrate and open water. One leopard frog suffered light bleeding, most likely due to needle contact with the sub-dermal tissue. Bleeding stopped within 3 minutes. All tags migrated toward the posterior lymph space between the hind legs. The skin adhered immediately and the wound was completely healed in 9 days. Animals were observed continuously for 12 h post injection and no behavioral or physiological stress was apparent. Individuals were observed swimming and basking through the acute 12-hour post injection period. All frogs actively foraged for live grasshoppers provided by researchers 4 h post injection. Prior to the study, the two *R. pipiens* weighed 42 g and 48 g and the two *R. clamitans* weighed 59 g and 81 g; all frogs gained weight and no tags were lost during the two weeks that they were housed in the laboratory.

Field Study.—From June to August 2001 and May to August 2002, we tagged and monitored 550 bullfrogs (*Rana catesbeiana*) from four sites on the Pigeon Lake river system, near Bobcaygeon, Ontario, Canada (44.5N – 78.5W). Bullfrogs were sampled from canoe for 75 nights between 2200 and 0300 h. While one researcher held the frog ventral side up, the other implanted the PIT tag as described above. Manual manipulation of the injected PIT tag into the desired subcutaneous position (posterior lymph space between the hind legs) was required for less than 5% of the frogs. Individual frogs were tagged (and several measurements taken) in less than 10 minutes. No animals were released when bleeding. Individuals were observed for 5 minutes in a bucket post implantation, and then released at the exact point of original capture. Adult males were observed calling less than 30 seconds after release.

From June to August 2001, 65 frogs were recaptured, and from May to August 2002 an additional 150 frogs were recaptured. Ten frogs from known locations were recaptured several times. PIT tags in all recaptured bullfrogs were located in the posterior lymph space where they first migrated post-injection, although researcher handling sometimes caused the tag to move around the ventral subcutaneous space. All wounds had healed and no necrosis at wound sites was observed. Individual identification was easily made with an associated field scanner (AVID Marketing, Inc., Norco, California).

The PIT tag technique described here best satisfies the criteria set out by Ferner (1979) for ideal individual identification. PIT tagging provides a powerful tool to identify medium-to-large sized ranids for indefinite periods of time (AVID microchips have a 25 year warranty, ca. 15 years longer than the longest lived ranid). The practicality of this technique in the field has obvious benefits becasue animals are handled briefly and there is minimal equipment required. Unfortunately, PIT tagging is relatively expensive compared to other methods (each tag costs ca. US $8.00; field scanner ca. US $1000). However, minimal physiological and physical disturbance to the animal, combined with field practicality and longevity of the mark, makes this technique the most suitable and valuable reported to date.

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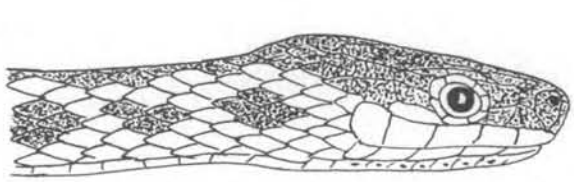

Illustration by Dan Holland.

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From the Frog's Mouth: Buccal Swabs for Collection of DNA from Amphibians

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Toe-clipping of amphibians for identification and DNA collection may have minimal impact on individuals in certain cases (Gelder and Strijbosch 1996) but has also been shown to result in decreased weight gain (Davis and Ovaska 2001), infection (Golay and Durrer 1994; Lemekert 1996), reduced breeding opportunities (Lemekert 1996), and decreased recapture rate indicating increased mortality (Clarke 1972). Genetic data are becoming important not only in determining the phylogeny of amphibian species, but also for examining population history (Bos and Sites 2001), hybridization (Arntzen 2001; Carpenter et al. 2001; Highton 1998), population structure (Newman and Squire 2001; Rowe et al. 2000, Shaffer et al. 2000), and estimating number of breeding adults in populations (Driscoll 1999; Scribner et al. 1997). These studies often involve multiple samples from sensitive species and populations; as amphibian populations around the world are declining (Houlahan et al. 2000), minimizing researcher impact to amphibian populations should be a priority.

Buccal swabs have been used as an easy and non-invasive method of collecting tissue from humans for DNA extraction for many years (Thomson et al. 1992). We successfully used buccal swabs (WB10-0004; Whatman, Clifton, New Jersey, USA) to isolate workable amounts of high molecular weight DNA from barking frogs (*Eleutherodactylus augusti*). We brushed the interior of frog's mouths for approximately 30 seconds per frog and immediately placed swabs in 650 μl of lysis buffer (50 mM Tris pH 8.0, 50 mM EDTA, 50 mM sucrose, 100 mM NaCl, 1% SDS). We stored swabs at room temperature overnight before refrigerating them at 4°C until extraction. We isolated DNA using a phenol-chloroform extraction modified from Sambrook et al. (2001). Extractions began with the addition of 25 μl 10 mg/ml proteinase K followed by 55°C overnight incubation. After incubation, we washed this lysate with 650 μl phenol and then with 650 μl chloroform. We precipitated DNA by adding 0.1 volume 7.5 M sodium acetate and 0.6 volume isopropanol, followed by 0°C overnight incubation and subsequent centrifugation of samples for 30 minutes at 16,000 x g. We assessed the quality of DNA by running 4% of each sample in a 1% agarose gel and quantified using a microplate fluorescence reader (FLx800; Biotek Instruments, Inc., Winooski, Vermont, USA).

From 33 swabs of barking frogs, we isolated an average of 1 μg

high-quality DNA (95% CI 0.7 to 1.5 μg; 31.6 μg maximum) from each swab; we were unsuccessful in isolating DNA from only one swab. We also successfully extracted high molecular weight DNA from buccal swabs of bullfrogs (*Rana catesbeiana*), casque-headed frogs (*Pternohyla fodiens*), and lowland leopard frogs (*Rana yavapaiensis*).

Researchers who wish to minimize disturbance to their study populations and whose research does not require over 1 μg of DNA should consider using buccal swabs as a low-impact alternative to toe-clipping or blood collection. Also, researchers who are storing tissue samples for future studies may wish to note that we extracted high molecular weight DNA from buccal swabs that had been in lysis buffer at room temperature for 2.5 years. Toe-clips preserved in ethanol for 1–4 years also yielded high molecular weight DNA, and other researchers have extracted high molecular weight DNA from tissue preserved in ethanol for up to 10 years (Li et al. 2000). However, one set of barking frog toe-clips preserved in ethanol away from light for 5 years yielded only degraded DNA.

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An Effective Technique for Collecting *Amphisbaena mertensi* with Notes on its Natural History

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Amphisbaenians are secretive reptiles that often are difficult to collect. Because of their fossorial and elusive habits, little is known about the natural history of these reptiles; however, a few aspects of their natural history have been reported. *Amphisbaena alba* has been documented to be a facultative inquiline of the leaf-cutting ant *Atta cephalotes* (Riley et al. 1986). *Amphisbaena mertensi* has been reported to eat termites (Isoptera) and to be in high abundance near isopteran nests associated with fallen tree trunks (Neto and Abe 1993). Beebe (1945) and Duellman (1978) suggested that isopterans were the major prey type of *Amphisbaena darwinii herterozonata* from Argentina. While performing a biodiversity survey of the reptiles and amphibians in southeastern Paraguay, we obtained five individuals of *Amphisbaena mertensi* in a short period of time by using the technique described below. The behaviors, diet, measurements, and habitat conditions of the animals we collected were recorded and are reported herein.

Our findings confirm published reports of *Amphisbaena* natural history. *Amphisbaena mertensi* coexists with termites (Isoptera: Termitidae); data from stomach-content analysis of four individuals collected in southeastern Paraguay are presented below. On 28 November 2000 between 0900–1100 h, we opened 19 termite mounds in Itapúa: Alto Vera: San Pedro Mí (26°31'24"S, 55°48'19"W). The area was an active cattle pasture adjacent to remnant patches of Atlantic Forest. The region is characterized by a subhumid climate, receiving an average of 2030 mm of precipitation annually (www.atlapedia.com). We were assisted by Mr. Roberto Shulz (a local farmer and owner of one of the

FIG. 1. Photo showing the technique used to overturn 19 termite mounds underneath which five specimens of *Amphisbaena mertensi* were collected.

FIG. 2. Termite mound of *Cornitermes cumulans*.

properties we were exploring), who used the backhoe of a tractor to overturn and break open termite mounds on the pasture of his property (Fig. 1). Mr. Shulz uses this technique periodically to clear his pasture of the mounds. The active nests, constructed of hardened termite excretions (the consistency of baked clay), were difficult to penetrate with a shovel but were opened easily with the backhoe of the tractor. After mechanical upheaval and breaking of the termite nests, we used a shovel to dig and search the perimeter of the depressions left by the upturned mounds. In this manner, we excavated and explored 19 nests in 2.0 h. The nests varied in size from ca. 0.5 m to 1 m in diameter (Fig. 2). None of the specimens collected was inside the nests; instead, all specimens were found buried in the softer soil peripheral to the nests. Three of the five individuals were collected from abandoned nests that appeared to be more moist than active nests. All specimens of *Amphisbaena* were found in association with nests of the termite *Cornitermes cumulans* (Termitidae: Nasutitermitinae). Members of the subfamily Nasutitermitinae have an exclusively chemical mode of defense (Borror et al. 1989). The small mandibles of *C. cumulans* appear to pose little physical threat to amphisbaenids; this may explain why these fossorial reptiles, with soft dermal scales, are able to feed on these insects. Armadillo burrows led to some of the nests and one *Leptodactylus elenae* (Anura: Leptodactylidae; MNHNP 8691) was found in the moist space between one nest and the surrounding ground.

TABLE 1. Snout–vent length (SVL) and tail length (TL) measured (in centimeters) for five specimens of *Amphisbaena mertensi* collected in association with the termite *Cornitermes cumulans* in southeastern Paraguay. Prey items ingested by the four specimens were identified to lowest taxonomic level possible.

Specimen number	SVL	TL	Prey items
KU 290720	32.5	3.7	Ctenidae (1)
MNHNP 08740	22.1	3.4	*Cornitermes cumulans* (41)
MNHNP 08741	20.6	2.6	*Cornitermes cumulans* (15)
MNHNP 08742	30.1	4.0	Elateridae (3)

Measurements of snout–vent lengths (SVL) and tail lengths (TL) of four of the collected specimens are presented in Table 1. Average SVL and TL for these individuals was 26.5 cm and 4.3 cm, respectively. One female (MNHNP 8742), was gravid and contained six eggs; average egg volume (volume of prolate spheroid = 4/3P(length/2)(width/2)^2) of the six eggs was 1.6 cm^3. A fifth specimen was found dead in an abandoned nest. This individual had a visible wound to the head, which might have been inflicted by a predator. Because this individual was in an advanced state of decomposition, no measurements or other data were recorded; this specimen was skeletonized and deposited in The University of Kansas herpetological collection (KU 290721).

We dissected and examined the stomach contents of four specimens (MNHNP 8740–2; KU 290720) to investigate further the diets of *Amphisbaena mertensi*. To locate the stomach for dissection, we followed a published description of the soft anatomy of *A. mertensi* (Navega-Gonçalves and de Souza 2001) and made a sagittal incision along the mid-ventral portion of the body of the specimens. We then flushed the stomachs with 70% ethanol and collected their contents. Keys by Constantino (1999) and Emerson (1952) were referenced for identification of the stomach contents to the lowest possible taxonomic level.

The stomach contents of the four specimens consisted mostly of heads of *Cornitermes cumulans* and whole and partial wireworm (Coleoptera: Elateridae) larvae (Table 1). One specimen (KU 290720) had consumed an adult female spider (Araneae: Ctenidae). The remains of the large arachnid took up one-third of the volume of the specimen's stomach. Sand was present in the stomachs of all specimens examined.

Little is known of amphisbaenian natural history and behavior. To our knowledge, this is the first account of *Amphisbaena mertensi* preying on the termite *Cornitermes cumulans*. The method described above for collecting *A. mertensi* associated with termite mounds might be the most effective way of extricating these animals from the nests in a short time.

Acknowledgments.—These observations were made in conjunction with an inventory of the biodiversity of the reptile and amphibian fauna of the Atlantic Forest of southeastern Paraguay conducted by The University of Kansas and supported by the KUNHM Panorama Society and the World Bank. We thank Nancy López-Kolchaka and Marta Motte of the Museo Nacional de Historia Nacional del Paraguay for inviting us to perform our fieldwork in Paraguay. John Simmons was kind to provide assistance

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Two Effective and Inexpensive Methods for Restraining Small Lizards

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Biologists often require accurate measurements of some aspect of an organism's morphology (e.g., scale numbers, limb lengths, head width). Such measurements can be difficult to make in living reptiles. For instance, it may not be practical to restrain a lizard by hand while counting scales. One way to overcome this problem is to anaesthetize the animals. However, administering an accurate dose of anesthetic is crucial, but potentially problematic in small lizards. Furthermore, it may take lizards up to six hours to recover even when low dose rates of anesthetic are administered (Bennett 1991). Consequently, administering anesthetics can pose a significant health risk to small lizards (Bennett 1991). This method is also costly (50 mg/10 ml ketamine = US $45) and requires special licensing or previous experience. Alternatively, researchers sometimes euthanize lizards prior to taking measurements (e.g., Andrews et al. 2000; Melville and Swain 2000; Qualls and Andrews 1999). This technique has obvious disadvantages, such as precluding repeated measurements and, thus, the examination of the long-term effects of experimental manipulations on lizard morphology.

An ideal method would restrain living lizards for long enough to take measurements but would not harm the animals. We describe two such techniques that are suitable for restraining living lizards that span 15–100 mm snout–vent length (SVL). Our first method was developed for hatchling and adult common garden skinks *Lampropholis guichenoti* and *L. delicata*. These species range from 15 to 40 mm SVL (Cogger 2000). Our second method was developed for a series of 13 medium- to large-bodied scincid lizards from northern Queensland, Australia. These species range from 40 to 100 mm SVL. Both techniques are simple and inexpensive, and do not harm the animals.

RESTRAINING LIZARDS BETWEEN 15 AND 40 MM SVL

We placed a lizard inside a 64-ml glass jar located within an insulated box (30 x 20 cm) that was filled with crushed ice to cool the animal for 20–30 min depending on its body size (larger animals typically took longer to cool). We checked the reflexes of animals every 5 min during this time by gently poking their tail with a blunt probe. When the animal did not respond to probing, we considered it to be thermally incapacitated. At this point, we removed condensation on the skin with an absorbent tissue and transferred the lizard to a petri dish. The dish was large enough for the outstretched lizard (including its tail) to fit inside. The dish was partly covered with a rectangular strip of adhesive tape with the sticky side up (Fig. 1). The lizard was restrained by laying it on the tape. For our purposes, it was necessary to position the animal on its ventral surface. We began the positioning by adhering the head and neck of the lizard and, working posteriorly, finished with the tail. To facilitate accurate measurements of limbs

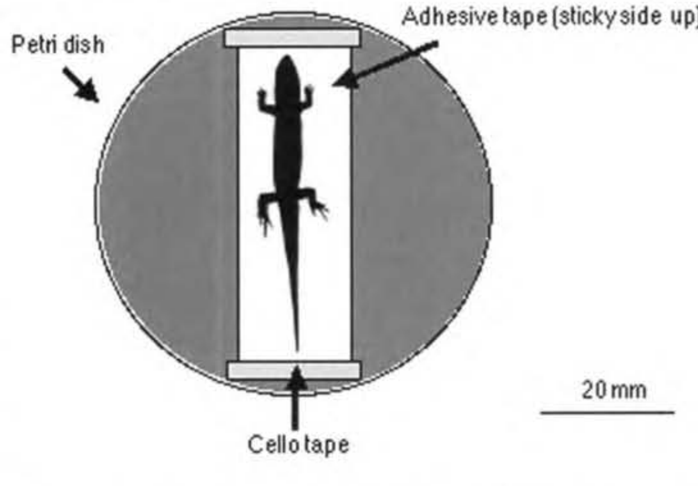

FIG. 1. Schematic of the restraint technique devised for lizards between 15 and 40 mm. The lizard is positioned within the petri dish on its ventral surface.

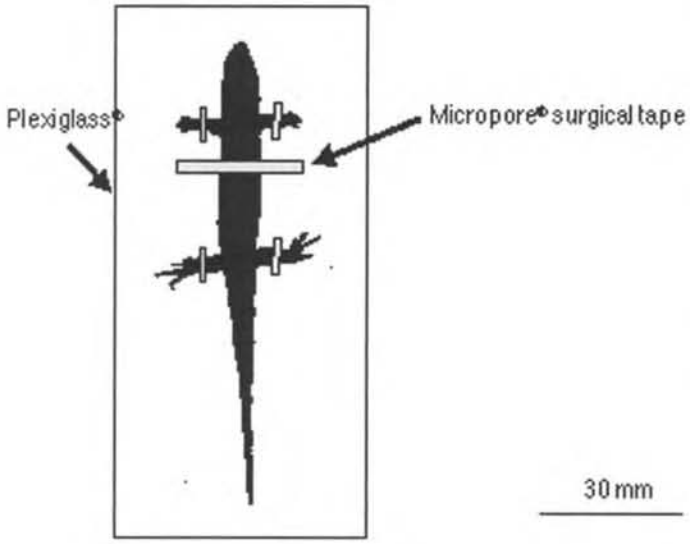

FIG. 2. Schematic of the restraint technique devised for lizards between 40 and 100 mm. The lizard is positioned on the Plexiglas® on its ventral surface.

we pressed the legs of the lizard onto the adhesive so that they were flat and in a natural, bent position (front legs ca. 120° to the body, hind legs ca. 60° to the body; Fig. 1). Fine forceps were used to spread and straighten the toes.

Although the lizards were held fast by the tape, we had no trouble removing them once our measurements had been recorded. Lizards were slowly detached from the tape, beginning with the head, and working back to the tail. Once the body was free, the tail was gently lifted from the tape by moving the body toward the tip of the tail. Lizards were always removed without ill effect and without the aid of solvents or lubricants. However, lizards other than skinks may not peel off the adhesive this easily (e.g., geckos; Bauer and Sadlier 1992). As long as the tape is free of fluids (i.e., condensation and urine), it can be reused to restrain several lizards in succession. When left to recover at room temperature (21°C), lizards typically regained activity 5–10 min after being removed from the crushed ice. This period is usually long enough to take several measurements. In some cases it may be desirable to extend the period of restraint by placing the petri dish on a bed of ice during measurement procedures.

We used this procedure to restrain > 600 *L. guichenoti* and *L. delicata* of various body sizes. Occasionally, lizards became active before completing measurements. In these cases, the lizard was placed into the glass jar and left on the crushed ice for an additional 10 min and the taping procedure was repeated. During our procedures all lizards survived and only a small proportion (< 3%, mostly hatchlings) lost the tip of their tail.

RESTRAINING LIZARDS BETWEEN 40 AND 100 MM SVL

The technique we developed for larger lizards (40–100 mm) can be used to restrain several individuals at the same time. We placed the lizards into a refrigerator set to 10–15°C. Animals were cooled for approximately 30 min, depending on their body size (larger species typically took longer to cool). Individuals were then removed from the refrigerator and placed ventral side down on a plate of Plexiglas® with their limbs outstretched. Lizards were secured to the plate using 12-mm wide strips of Micropore® surgical tape. This tape loses adhesion when wet, thus it is essential that condensation, urine, or feces on the skin of the animal be removed with an absorbent tissue prior to taping the body to the surface. We first taped lizards to the plate using a strip around the midbody and then secured the outstretched limbs (ca. 90° to the body) by placing a strip of tape over the elbow of each appendage (Fig. 2). After taking measurements, the lizards were released from the Plexiglas® plate by wetting the tape. Pulling tape off in the direction in which the scales are pointing provides the minimum amount of resistance, which is important for species that are susceptible to losing scales. Lizards were always removed without ill effect, and without the aid of solvents or lubricants.

We used this procedure to restrain approximately 300 adults of 13 species of scincid lizards. We used Plexiglas® because we radiographed animals and this material facilitates the production of low-power, high-resolution x-rays using mammogram film. However, other rigid materials also would be suitable.

Acknowledgments.—We thank R. Espinoza, A. Krockenberger, M. Halloy, M. Hayward, R. Spencer, S. Stowe, and S. Keogh, and two anonymous reviewers for their advice, technical assistance, and valuable comments on the article. We also thank the Electron Microscope Unit at the Australian National University for providing equipment. The Australian National University Animal Experimentation and Ethics Committee and James Cook Animal Care and Ethics Committee approved the methods reported herein. This research was funded by the Ecological Society of Australia (Student Award to AH), James Cook University (Internal Research Allocation Grant to BG), and the Australian Research Council (Large Grant to SD).

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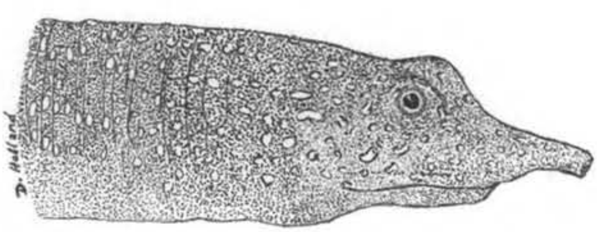

Illustration by Dan Holland.

HERPETOLOGICAL HUSBANDRY

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New Record of Age at Sexual Maturity in Captivity for *Caiman latirostris* (Broad-Snouted Caiman)

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We recently published the first information about age at sexual maturity for the broad-snouted caiman (*Caiman latirostris*), based on data from our captive colony (Verdade and Sarkis 1998). The present report documents a new record for the age at sexual maturity for the species. A female (CL406, Tag USP116) hatched 19 March 1996, in turn produced her first clutch on 31 December 2000. Therefore, her age at sexual maturity was approximately five years (Table 1). Clutch size was 41 eggs, all of them fertile. They were split into four artificial incubators (designed as described by Verdade et al. 1992), incubated at the following temperatures: 28°C, 30°C, 32°C, and 34°C (± 0.5°C), and monitored by StowAway® TidbiT® temperature loggers (–20° to +50°C). Incubation success at each incubation temperature is presented in Table 2.

The parents of female CL406 (sire CL1 and dam CL9) reached sexual maturity by the age of 10 years, being among the group of animals described previously (Verdade and Sarkis 1998). From age 55 days to age 430 days, female CL406 was raised in a greenhouse 16 m^2 (0.8 m^2 per individual) with cement pool ca. 4 m^2 x 60 cm deep (0.2 m^2 per individual). During the spring–summer period (October through March) she was transferred to another nearby greenhouse that offered a significant microhabitat thermal variation in such a way that either the air, the water surface, or the bottom of the pool (70 cm deep) always presented the optimum temperature for crocodilians (ca. 32°C) (as described by Fincatti and Verdade 2002). She was subsequently transferred to another enclosure 64 m^2 (ca. 2.7–10.7 m^2 per individual) with a cement pool approximately 24 m^2 x 60 cm deep (1.0–4.0 m^2 per individual), and maintained at ambient temperature. CL406 belongs to the second generation (F2) of captive bred *Caiman latirostris* in Brazil. Captive propagation of the species has been conducted in order to produce breeders for caiman farms, and thereby reducing the need for capture of individuals from remaining wild populations (Verdade 2001).

Caiman latirostris occupies a large latitudinal range, from the border between Paraíba and Rio Grande do Norte states in northeastern Brazil to southern Rio Grande do Sul at the southernmost point of Brazil (i.e., from ca. 7° to 34°S). Great variation in growth rate and age at sexual maturity can be expected for the species, as has been reported for the American alligator (Ferguson 1985). Thus, animals exposed to warmer temperatures should grow faster and attain sexual maturity earlier than individuals under cooler environmental conditions. How much of this pattern is genetically based and how much reflects phenotypic plasticity is unknown, but our report emphasizes the possible importance of temperature on the growth and reproduction of crocodilians.

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TABLE 1. Age at first reproduction of captive *Caiman latirostris*.

Animal	Sex	Date of birth	Date of first sibling hatching*	Age at first reproduction	SVL† (cm)	Body mass$^{\Delta}$ (kg)
CL406	female	19 March 1996	16 March 2001	5 yrs, 6 d	81.0	19.8
CL9	female	01 April 1986	19 March 1996	9 yrs, 11 mos, 21 d	80.4	24.0
CL1	male	28 February 1986	19 March 1996	10 yrs, 20 d	101.5	51.0

* CL1 and CL9 are parents of CL406.
† Date when first siblings hatched.
$^{\Delta}$ October 1995 (CL1, CL9), August 2000 (CL406).

TABLE 2. Summary of reproduction of female *Caiman latirostris* (CL406). Clutch size 41 eggs.

Incubation temp. °C	No. of eggs	No. of hatchlings	Incubation success (%)	Incubation periods (days)	Deaths (days 0–7)
28	10	5	50.00	98	5
30	10	8	80.00	85	1
32	11	8	72.73	76	—
34	10	8	80.00	74	1

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NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 34, Number 1 (March 2003).

GYMNOPHIONA

ICHTHYOPHIS KOHTAOENSIS (Koh-Tao Caecilian). **DIET.** Oribatid mites are important decomposer animals in soils worldwide. It has been speculated that the predation pressure on these mites is low because of their strongly sclerotized cuticle (Walter and Proctor 1999. Mites. Ecology, Evolution and Behavior, Sydney, University of New South Wales Press, 322 pp.). Oribatid mites presumably live in enemy free space. However, some species have been reported in the diet of terrestrial newts like *Notophthalmus viridescens* (Norten and MacNamara 1978. J. Georgia Entomol. Soc. 11:89–93) and salamanders, e.g. *Batrachoseps attenuatus* (Maiorana 1978. Copeia 1978:664–672). Caecilians are tropical limbless amphibians inhabiting soil ecosystems (Himstedt 1996. Die Blindwühlen, Magdeburg, Westarp Wissenschaften, 160 pp). Little information is available on their dietary habits.

Food habits of *Ichthyophis kohtaoensis* were investigated during a study on the life history and ecology of this species in northeastern Thailand. Both fecal samples (3.2%) and digestive tracts (2.8%) of *Ichthyophis* contained oribatid mites (order Brachypylina). Total length of the mites varied between 0.51 and 0.69 mm (mean = 0.59 mm). The caecilians were collected during three sampling sessions during the rainy seasons from 1999 to 2001 about 15 km NE of the district town Khemmerat, Ubon Province, northeastern Thailand (16°5'N, 105°15').

These observations are the first reports of oribatid mites in the diet of caecilians. The diet of *Ichthyophis* consists mostly of earthworms, termites, and ants (Kupfer, *pers. obs.*). Because oribatid mites were only recorded in low numbers they may serve as an occasional food source.

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CAUDATA

DESMOGNATHUS MONTICOLA (Seal Salamander). **DIET / PREY SIZE.** Seal salamanders and other plethodontids ingest exceptionally large prey items, including lepidopteran larvae and other salamanders (Krzysik 1979. Ecol. Monogr. 49:173–194; Petranka 1998. Salamanders of the United States and Canada, Smithsonian Inst. Press, Washington, DC; Bernardo 2002. Herpetol. Rev. 33:121). However, few papers report sizes of predators and prey. On 11 August 2001, in Shenandoah National Park, Virginia, USA (Research Permit: SHEN-2001-SCI-0005), we captured an adult *D. monticola* (47 mm SVL, 37 mm tail, 2.4 g) of undetermined sex at 38°17'33"N; 78°37'16"W. The capture site consisted of a first order, rocky stream within mixed hardwood forest. The abdomen of the salamander was obviously distended with a large prey item spanning the entire length of the body that was clearly visible through the ventral skin. The salamander gaped during handling thus allowing us to see part of the prey item protruding into the mouth cavity. Using forceps, we removed a lepidopteran larva (Hesperiidae; 35 mm, 0.4 g; Fig. 1) that was swallowed headfirst. Prey body length accounted for 74.5% of the predator's SVL and prey body mass accounted for 16.7% of predator's mass. The preserved lepidopteran larva and color slide of both the larva and salamander were placed in the Virginia Tech entomological collection. We thank Art Evans (Richmond, Virginia) and Eric Day (Virginia Tech) for assistance with caterpillar identification.

FIG. 1. A large lepidopteran larva consumed by a *Desmognathus monticola* in Shenandoah National Park, Virginia.

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DESMOGNATHUS MONTICOLA (Seal Salamander). **AGGRESSION.** Aggressive behavior is widespread among plethodontid salamanders (Jaeger and Forester 1993. Herpetologica 49:163–175). Aggressive encounters for most species have been described primarily from laboratory-based or otherwise staged encounters. Observations of natural occurrences between salamanders are relatively rare. On 15 Oct 2002 I witnessed an aggressive encounter between two large male seal salamanders in a seepage area in Banks County, Georgia. The seepage had been dry most of the summer due to extended drought. However on 15 Oct, the seepage was flowing as 2.6 cm of rain had fallen during the day. Rain continued to fall steadily through the night. Just after dusk (1945 h EDT) I noticed an adult male (SVL 78 mm) that was wandering in the shallow water of the seep while he was approaching a small rocky overhang. Within 2 min I observed him again, and he had bitten, and was continuing to grip, another adult male (SVL 81 mm) that had been previously hidden by the overhang. The victim's head was almost entirely engulfed by the aggressor, the latter's snout reaching past the eyes of the former. I observed the pair again in ca. 30 min, and the aggressor was still holding the victim by the head. At this point the victim was slowly twisting over and over in an apparent attempt to escape. During intervals of rest, the aggressor attempted to pull the victim out of the water onto the bank. After watching them for several minutes, I gently placed both of them into a plastic bag. The handling did not appear to deter the aggressor, who continued his bite-hold of the victim. I checked them again in 5 min, at which time the aggressor had released the victim's head and had seized him by the middle of the tail. The aggressor held the tail for 15 min when the tail broke. I removed the victim for measuring and noticed a series of fresh bite wounds on other areas of the tail and hindquarters. After an additional 45 min, the aggressor still held the broken tail in his mouth. Within another 15 min, the aggressor had swallowed the tail. Male-male aggression is known in *D. monticola* from laboratory-based encounters (Keen and Sharp 1984. Anim. Behav. 32:58–65). However, it is unknown if this attack was male-male interference or an attempt at predation.

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DESMOGNATHUS OCOEE (Ocoee Salamander). **MORTALITY.** Appalachian streams have largely been considered to represent stable environments (Bruce 1985. Copeia 1985:847–854), and have received little attention regarding their potential as unpredictable environments for stream-dwelling salamanders. Camp (2000. Herpetol. Rev. 31:166) reported reproductive failure in a subpopulation of Ocoee salamanders (*Desmognathus ocoee*) occupying a first-order, headwater stream that had completely dried during 1999 due to drought. The site consisted of a pair of small cliffs (ca 1.5 m^2 of wet-cliff area) that prior to the drought, had permanently flowing, thin sheets of water that provided habitat for a robust population of *D. ocoee*. During summer 1994, I observed 11 different gravid females during the course of several nights of observation. During 1995, I observed 9 different females and their egg clutches. Although I did not count them, both adult males and juveniles were abundant on the cliff faces so that on a typical summer night, 30–40 metamorphosed *D. ocoee* were visible on these cliffs. Seal salamanders (*D. monticola*) were also common, but they were greatly outnumbered by *D. ocoee*. By late summer 1999, the stream appeared above ground 88 m from its earlier point of origin. That year was the beginning of a four-year drought, and this headwater stream has dried every summer since with the stream's first appearance occurring farther and farther downstream of the original point of origin. By summer 2002 many nearby second-order streams had also dried. Two tropical systems (Hanna and Isidore) and several weather fronts that passed through the area contributed 32.5 cm of rain between 14 Sept–13 Oct 2002. On 14 Oct, the first pools of above-ground water in the first-order stream were 175 m from the stream's earlier point of origin.

Beginning with the rains of Tropical Storm Hanna, I surveyed these wet cliffs and areas of the streambed for six nights (ca. 30 min/night) during significant rain events. The first survey followed three days of steady rain so that the stream was flowing and the soil was fully saturated. The number of *D. ocoee* observed ranged from 0–3/night with a total of 6–7 different individuals seen. Three were adults, and the others were subadults. No small juveniles were seen. *Desmognathus ocoee* was numerous, and all sizes of metamorphosed individuals were well represented 200+ m downstream. Even though this lower part of the stream had also dried in 2002, it had not dried in previous years, and below-ground water was probably sufficient for individual salamanders to survive in underground retreats. Because intermediate parts of the stream dried first, salamanders at the headwater were probably trapped and unable to migrate downstream. I observed a number of Ocoee salamanders occupying moist crevices in 1999 even though the cliffs were dry. This information suggests that the subpopulation occupying the wet cliffs and adjacent streambed suffered severe mortality due to desiccation.

During the same period of 2002 surveys, I observed 5–9 seal salamanders (*D. monticola*) associated with the wet cliffs each night. Because desiccation tolerance is directly related to body size in desmognathines (Houck and Bellis 1972. J. Herpetol. 6:209–215), the larger body size of *D. monticola* probably accounts for the greater survival rate in this species. I observed no small juveniles, possibly indicating that small *D. monticola* also suffered desiccation-induced mortality.

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DICAMPTODON COPEI (Cope's Giant Salamander). **REPRODUCTION.** We describe herein the discovery of two clutches of *Dicamptodon copei* eggs and their surrounding habitats in headwater streams of the Cascadae Mountains in Skamania County, Washington. The first clutch was discovered on 22 June 1998 at an elevation of ca 450 m and contained 23 eggs attached to the underside of a large basketball-sized cobble. The nest was attended by an adult female (75.6 mm standard length [SL, snout tip to posterior end of vent], Collection of Vertebrates, Department of Biology, University of Texas at Arlington, UTA-A 55076). The stream was located in a regenerating Douglas-fir (*Psuedotsuga menziesii*) plantation 18 years of age. A 2-m length of stream that contained the nest was 0.76 m wide, averaged 4.5 cm deep, had a gradient of 8°, and 93.5% canopy cover. The second clutch of eggs was discovered on 28 June 1998 at an elevation of ca 750 m and

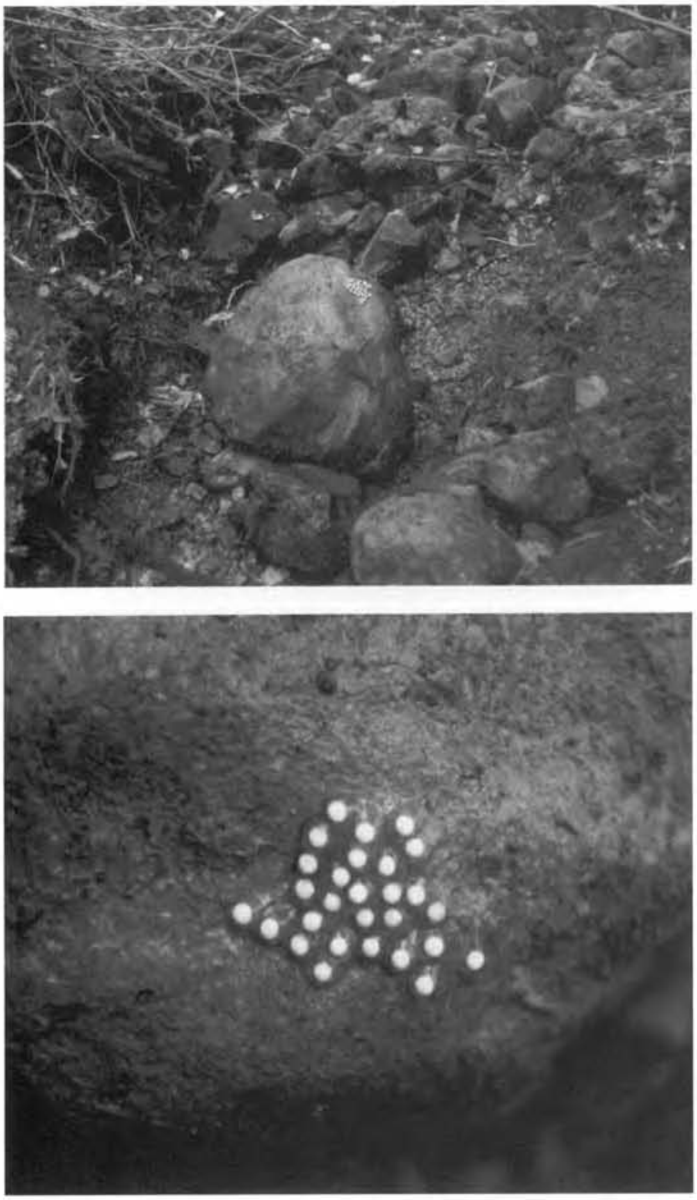

FIG. 1. Boulder on which *Dicamptodon copei* eggs were attached and a close up of the clutch.

contained 28 eggs attached the underside of a small boulder (Fig. 1). An adult female (SL 77.7 mm; UTA-A 55077) was attending the nest. The stream was located in a Douglas-fir (*Psuedotsuga menziesii*) plantation 28 years of age and had a temperature of 8.3°C. The 2-m section of stream that contained the clutch was 1.0 m wide, averaged 3.3 cm deep, had a gradient of 20°, and 92.7% canopy cover. In both cases the clutches were deposited in positions similar to that described for *Dicamptodon tenebrosus* but contained fewer eggs than generally reported for *D. tenebrosus* (Nussbaum 1969. Herpetologica 25:257–262).

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ANURA

ACRIS CREPITANS (Northern Cricket Frog). **COMMUNAL HIBERNACULUM**. Hibernaculum use by *Acris crepitans* in the Arkansas Ozark Plateau is virtually unknown. In the southern parts of its range, this species is active year round and has two breeding seasons (Pope 1919. Copeia 74:93–98; Jameson 1950. Copeia 1950:61; Pyburn 1958. Texas J. Sci. 10:325–342). On 15 Dec 2001 we visited Jane's Creek in the vicinity of Ravenden Springs (Randolph County, Arkansas, USA). Its streambed is comprised of bedrock and gravel. The temperature was 11°C from 1235–1305 h with no wind and it was overcast. We walked three different areas along the shoreline turning rocks. The first area was a gravel embankment immediately adjacent to the stream. It rose steeply about 1.3 m above the waterline and extended about 10 m along the stream course. The second area was a gently sloping gravel area that barely rose above the water level. The third area was structurally similar to area 1 but located about 25 m from the stream, with area 2 between it and the stream. A 10 m stretch was surveyed in areas 1 and 3, while a 180 m transect was searched in area 2. We recovered 5 (33%) *A. crepitans* from the top of the bank in area 1. Seven (47%) were recovered from the bank in area 3, but only 3 (20%) were found in area 2. Eighty percent of the frogs were found hibernating in steep gravel slopes about 1 m above the waterline. All frogs were obviously lethargic. The three frogs found in area 2 were found individually, however, the frogs from the gravel embankments were aggregated. This suggests these frogs not only select steep banks for hibernacula, but also that they communally hibernate. This appears to be the first published report of communal hibernation in *A. crepitans*. Hibernation in groups may stabilize the immediate microclimate where these animals are aggregated, making their survival through the winter more likely. Irwin and Lee (1999. Can. J. Zool. 77:1240–1246) determined cricket frogs have a low tolerance for inundation while hibernating. Captive observations by MLM suggest that if cricket frogs are put in zip-loc bags containing water and then stored on ice or in the refrigerator, there is often significant mortality. If held in a dry bag on ice there is seldom mortality. If the investigator wishes to avoid mortality when cricket frogs are stored on ice, it would be advisable not to add water to the bags containing these frogs. Our field observations suggest that habitat management for *A. crepitans* should include bank management practices that provide hibernacula at least 1 m above the stream. This observation is particularly important considering the continual gravel mining and bank stabilization methods throughout much of the country. If gravel is removed or its height above the water surface is significantly lowered, it could cause significant population declines in this species along gravel streams. Throughout the northern cricket frog's range, if bank stabilization practices change the water content of the bank soils, reduce the availability of cracks and crevices, or drop the bank's height low enough to allow frequent inundation, this species could quickly experience dramatic declines.

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BUFO NELSONI (Amargosa Toad). **PREDATION**. Reports of predation by ranid frogs on adult toads of the genus *Bufo* are extremely rare (Pearl and Hayes 2002. Amer. Midl. Nat. 147:145–152; but see Smith and Green 2002. Herpetol. Rev. 33:125). For the first time, we document predation of adult *Bufo nelsoni* by non-native bullfrogs (*Rana catesbeiana*). To our knowledge, these observations represent the largest toads that have been reported as prey to ranid frogs—at least in North America.

We used radio telemetry to study habitat use of adult *B. nelsoni* in the Oasis Valley, Nye County, Nevada, USA (UTM 0522204 E, 4083053N; Zone 11S, WGS84). On 25 March 2002, we determined that a radio signal was emanating from a bullfrog (ca. 175 mm SVL), suggesting that the frog had consumed the adult *B. nelsoni* which we were tracking. On 27 March 2002, the bullfrog was captured, euthanized, and its stomach dissected to verify the presence of a partially digested gravid female toad (87 mm SVL). The bullfrog was apparently not negatively affected by ingesting the toad as the frog escaped our initial capture attempt and then eluded capture for two additional days. Indeed, it is possible that the toad was consumed as many as 11 days prior to the capture of the bullfrog (the last time the toad was visually located). However, we cannot conclude that there were no negative effects of consuming a toad on the bullfrog as we euthanized the frog before we could rule out negative effects. Bullfrogs with SVL $\geq$ 175 mm are not uncommon in Oasis Valley, especially in areas with permanent water and dense vegetation.

At a nearby site, on 13 May 2002, Kara Vick captured a bullfrog (ca. 185 mm), which had toad legs protruding from its mouth. We pried the frog's mouth open, and removed an adult male *B. nelsoni* (79 mm SVL). The toad was covered in mucus and somewhat disoriented, but was able to crawl away after a few minutes.

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ELEUTHERODACTYLUS ANTILLENSIS (Coquí Churí). **REPRODUCTION**. *Eleutherodactylus antillensis* is a widespread and abundant species in Puerto Rico and adjacent islands on the Puerto Rico Bank, but no published records of eggs and nests exist from within the species' natural range. Here we report on 8 clutches found in nature, 7 on Guana Island, British Virgin Islands (23 Oct 1993, 17 and 20 Oct 1994, 12 Oct 1997, 14 and 23 Oct 1999, 23 Oct 2001; observed by KO and J. Caldbeck) and 1 in Puerto Rico (on 10 Aug 2002, observed by ARE). Like other species of *Eleutherodactylus*, this species has direct development and eggs are laid on land.

On Guana Island, the egg masses were on the ground in a shrub forest: 6 were under a thin (ca. 2 cm deep) layer of leaf litter, and 1 was under a grass mat. The clutch size of 6 newly laid egg masses (located by following courting pairs) ranged from 25 to 42 eggs (mean = 31, SD = 5.8); the remaining clutch (found by raking of leaves) contained 9 eggs. Newly laid eggs were round, opaque white, and were laid in a globular cluster. Individual eggs measured ca. 4–4.5 mm in diameter. The development of one clutch, followed from oviposition to hatching, took 15 days at temperatures of ca. 25–30C° at the natural location. No frog was in attendance at any of these clutches during several day- and night-time inspections.

In Puerto Rico, a clutch of *E. antillensis* with 24 eggs was found near Tetas de Cayey, Barrio Cuyón, Salinas (825 m elev). Individual eggs measured ca. 3.2–4.0 mm in diameter. The eggs were in an advanced stage of development (Stage 7 or later; Townsend and Stewart 1985. Copeia 1985:423–436), based on strong, rapid movements of the embryos. The clutch was under a small wood block (20 x 10 x 5 cm) over reddish soil, clean of vegetation, and near a house in construction. An adult male *E. antillensis* was adjacent to and in physical contact with the egg mass. The clutch and frog were held captive in a small plastic terrarium, with soil taken from the site as substrate, and were maintained at 28–32°C with relative humidity of 75–87%. The male frog sheltered under the same piece of bark where the clutch was placed but did not crouch on top of the eggs, as do males of *E. coqui* when attending eggs. Nine to 11 days after collection, the eggs hatched. The froglets measured 4–5 mm SVL. All froglets had a bicuspid egg tooth on the median margin of the upper lip; no vestigial tail was present at hatching.

Our observations indicate two features of particular interest: oviposition on the ground, rather than in vegetation or arboreal locations, and apparent absence of parental care on Guana Island. In contrast, male parental care of eggs occurs in *E. coqui* and several other Puerto Rican species of *Eleutherodactylus* (Townsend 1996. *In* Powell and Henderson [eds], Contributions to West Indian Herpetology: a Tribute to Albert Schwartz, pp. 229–239. Society for the Study of Amphibians and Reptiles. Ithaca, New York). Our observations also suggest a clutch size that is somewhat larger than reported for *E. antillensis* in captivity (11–32 eggs; Michael 1997. Herpetol. Rev. 28:141–143; Joglar 1998. Los Coquís de Puerto Rico. Su Historia Natural y Conservación. Editorial De La Universidad De Puerto Rico, San Juan, Puerto Rico) and for an introduced population within residential gardens in Panama City (11–28 eggs; mean = 19 eggs; Castillo and Mayorga 1984. Distribucion, habitos ecologicos, reproduccion y embriologia externa de *Eleutherodactylus antillensis* [Anura]. Unpubl. Thesis. Universidad de Panama [Facultad de Ciencias Naturales y Farmacia], Panama City, Panama). Whether the presence of a male frog in the vicinity of the clutch from Puerto Rico represented parental care remains enigmatic.

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ELEUTHERODACTYLUS STEJNEGERIANUS (Stejneger's Dirt Frog). **URBAN HABITAT**. Although certain Caribbean species of *Eleutherodactylus* are notorious for thriving in urban habitats in both their native islands and in cities around the hemisphere (Kaiser 1997. Biodiv. Conserv. 6:1391–1407), within lower Central America no native *Eleutherodactylus* were previously known to occupy urban habitats. We report the widespread occurrence of *E. stejnegerianus* in the city of Escazú (Cantón Escazú, province of San José, Costa Rica), a heavily developed suburb whose human growth replaced coffee plantations and cattle pastures. *Eleutherodactylus stejnegerianus* was previously regarded as a leaf-litter species (Savage 2002. Amphibians and Reptiles of Costa Rica. Univ. Chicago Press, Chicago. 934 pp.), found only in forests. One voucher specimen (University of Costa Rica, Museum of Zoology UCR 16856) was collected 25 June 2002, at 2045 h, under the shrubs in the side yard of the house of Mr. Brian Kubicki (09°54.352'N, 83°08.530'W). Identification of the specimen was verified by Gerardo "Cachí" Chaves of the University of Costa Rica, Museum of Zoology. Two other frogs were heard calling in the yard that same night. Individuals were heard and occasionally captured at three sites within Escazú. Earlier, on 12 June at ca. 1900 h, two frogs were heard calling from a tangle of dead plants in the backyard of a condominium at 09°56.164'N, 84°08.646'W. On 24 June around 2100 h, one *E. stejnegerianus* was captured and at least three more were heard in the well-manicured backyard of a house (09°56.009'N, 83°07.077'W). These three localities were separated by 1.4–3.3 km straight line distance. At the latter two sites, *E. stejnegerianus* was heard calling most nights from the beginning of the rainy season in May though the end of August 2002, and have not been heard in the 1.5 months since then. Specimen collected under MINAE permit number 024-2002-OFAU to A. J. Crawford.

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HYLA ARENICOLOR (Canyon Tree Frog). **TOXIC SKIN SECRETIONS.** Toxic or noxious skin secretions have been well documented in amphibians (Erspamer 1971. Ann. Rev. Pharmacol. 11:327–350; Michl and Kaiser 1963. Toxicon 1:175–228). Among anurans, the most well-known for their toxic skin secretions are dendrobatid frogs and bufonids (Duellman and Trueb 1986. Biology of Amphibians. McGraw-Hill, New York. 670 pp.). However, toxic skin secretions from other anurans are less well documented. *Hyla arenicolor* ranges from southwestern Colorado and southern Utah (USA) southward to Oaxaca, Mexico, and from western Texas to western Arizona (USA) (Stebbins 1985. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin Co., Boston, Massachusetts. 336 pp.). Hammerson (1999. Amphibians and Reptiles in Colorado. University Press of Colorado, Niwot, Colorado. 484 pp.) noted that when handled, *Hyla arenicolor* usually release fluid from the vent and produce a sticky skin secretion. However, no further information or any effects of this skin secretion have been recorded. Herein, we report the effects of skin secretions of *Hyla arenicolor*, contacting the conjunctival mucosa of the eyes.

During a field-collecting trip to central Arizona, one of the authors (RLP) captured and examined several individuals of *Hyla arenicolor* consequently distributing a generous amount of frog skin secretions over his hands and fingers. Shortly afterwards, while attempting to remove dust and perspiration, the substance was accidentally introduced into both eyes by vigorous rubbing. Upon contact with the mucous membranes of the eyes, there was moderate to intense burning of the conjunctiva and marked sensitivity to sunlight. This was followed by copious amounts of mucous discharged from the nasal area that continued throughout the duration of the episode, which lasted ca. 45 minutes and then subsided rather abruptly. Approximately 15 minutes after the initial exposure, the eyes were flushed with liberal amounts of water. However, this did not seem to reduce the symptoms to any degree. Afterwards, only slight reddening of the conjunctiva was apparent, which lasted into the evening, and no discomfort or symptoms were noted the next day.

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HYLA GRATIOSA (Barking Treefrog). **INTESTINAL HERNIA**. Deformities and malformations in anurans occur in a variety of manifestations (Meteyer 2000. Field Guide to Malformations of Frogs and Toads with Radiographic Interpretations. Biol. Sci. Rep., USGS/BRD/BSR-2000-0005, 18 pp.). Most of those described in the literature are visible externally (e.g., ectromelia, brachydactyly, polydactyly, brachygnathia, kyphosis) (Ouellet et al. 1997. J. Wildlife Dis. 33:95–104). Internal malformations are less well

FIG. 1. Intestinal hernia with 3 cm intestine exposed beneath the ventral skin in *Hyla gratiosa*.

known and seldom reported (Reeder et al. 1998. Environ. Health Persp. 106:261–266). Here we describe an unusual condition heretofore unreported for a hylid frog.

On 19 May 2000 we found a calling male *Hyla gratiosa* (49 mm SVL) at USMC Camp Lejeune, Onslow County, North Carolina (USA) that exhibited a ca. 1 cm diameter mass under the skin of the venter. Necropsy revealed that an ca. 3 cm loop of the intestine and the spleen had protruded though a 2.5 x 3 mm hole in the ventral mid-line of the body wall and was entrapped within the ventral lymphatic sac (Fig. 1). The intestine was moderately dilated but not obstructed. The bilateral fat bodies of this frog were severely atrophied. A filarid parasite occurred in the mesentery at the base of the lungs and stomach. Peritonitis was mild to moderate. All other internal organs were normal. This frog was one of several males in a breeding chorus in a large, isolated wetland. Its behavior was normal and it was apparently not hindered by the hernia. We suspect that the intestinal hernia was a deformity secondary to a malformation (hole) in the ventral midline. This hernia may be analogous to umbilical (i.e., yolk sac resorption site of amphibians) hernias in humans and other mammals. An intestinal hernia is an unusual deformity in frogs.

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HYLA PULCHELLA (NCN). **PREDATION.** Anuran tadpoles and froglets are common prey for a variety of invertebrates and vertebrates. On 8 Jun 2002 at 1700 h we collected four *Hyla pulchella* tadpoles at a semipermanent pond in Entre Ríos Provinces (31°31'S, 60°10'W). These *H. pulchella* tadpoles were placed in a semi-natural pond with water and plants from the collecting locality. This pond was ca. 22 x 30 cm, pH was 7, and temperature was 15°C.

Three live tadpoles (TL 27 mm, Gosner stage = 31, 32) were observed being consumed by juvenile snails, *Pomacea canaliculata* (Gastropoda, Ampullariidae) (mean shell diameter 34.5 mm). The snails were positioned 30 cm above the water on detritus, humid soil, and aquatic vegetation, holding a tadpole in the snail's aperture. The snails and tadpole prey were photographed after preservation (Fig. 1). To our knowledge, this is the first report of predation on anuran tadpoles by a snail. However, the diet of *P. canaliculata* is reported to include insects, crustaceans, and fishes (Alonso and Ageitos de Castellanos 1949. Notas del Museo de la Plata. Tomo XIV, N° 115:31–38; Estebenet 1995. The Veliger 38[4]:277–288).

FIG. 1. (a) *Hyla pulchella* tadpole being held by juvenile *Pomacea canaliculata*; (b) after predation. Bar = 15 mm.

We thank Inés Ezcurra de Drago for providing information on the biology of this snail.

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LEPTODACTYLUS CHAQUENSIS (NCN), ***PSEUDIS PARADOXA*** (Paradox Frog), and ***PHRYNOHYAS VENULOSA*** (Veined Treefrog). **PREDATION**. Snakes are often referred to as important predators of frogs, mainly in the tropics (Vitt and Vangilder 1983. Amphibia-Reptilia 4:273–296). Nevertheless, predatory events in nature are rarely observed and published (Martins et al. 1993. Amphibia-Reptilia 14:307–309). Furthermore, among vertebrate predators of frogs, birds are generally reported preying on tadpoles (McAlpine et al. 2001. Herpetol. Rev. 32:183–184; Castanho 2001. Herpetol. Rev. 32:103). Birds that prey on adult frogs are less documented (Brodie and Nussbaum 1987. Herpetol. Rev. 18:8–9; Master 1998. Herpetol. Rev. 29:164–165). Herein I describe predation on different species of frogs by a heron and two snake species observed during fieldwork in southern Pantanal. The observations were made at Base de Estudos do Pantanal/UFMS (19°34'S, 57°00'W), municipality of Corumbá, State of Mato Grosso do Sul, southwestern Brazil.

On two occasions I observed a rufescent tiger heron, *Tigrisoma lineatum* (Ardeidae), preying upon adult frogs at the edge of ponds during the day. On 13 Nov 2000 at 1630 h, a paradox frog, *Pseudis paradoxa*, was observed being preyed upon by the heron, and half an hour later another frog, *Leptodactylus chaquensis*, was also taken. On 13 Jan 2002, another *L. chaquensis* was observed being preyed upon by the heron. In all cases the frogs were partially submerged, and the birds were motionless searching for prey in the water. The Pantanal is rich in ponds that are used as foraging sites by many species of wading birds, thus any Ciconiiformes could represent important predators of adult frogs.

On 21 Nov 1997 at 2140 h, a colubrid snake, *Clelia bicolor*, was observed constricting a juvenile *L. chaquensis* at the edge of a flooded area. On 10 Jan 2002 at 1500 h, a green parrot snake, *Leptophis ahaetulla*, was observed preying upon an adult veined treefrog (female, 77 mm SVL), *Phrynohyas venulosa*. The distress call emitted by the frog called my attention, and I found the snake on a shrub in a flooded gallery forest, about 1.0 m above the water, head-down, and holding the frog with its jaws by the lateral portion of the frog's head. The treefrog remained motionless, secreting the white glue-like skin secretion, which was already spread on the snake's snout. At 1528 h, the snake had finished ingestion of the treefrog, and upon my approach, the snake immediately released the frog, that fled away swimming. The snake disappeared climbing the shrubs and trees. The treefrog was collected to be measured, and seemed to be dying, but one hour later was in good shape, and was released near the same site. Approximately one hour later, the snake returned to exactly the same branch of the

shrub, and seemed to be looking for the lost prey.

The peculiar milky and sticky skin secretion produced by *P. venulosa* is considered to be toxic (Gallardo 1987. Anfíbios Argentinos: Guía para su Identificación. Libreria Agropecuaria S.A., Buenos Aires, Argentina. 98 pp.), and it is suggested that these secretions might have a defensive function against predators (e.g., McDiarmid 1968. Los Angeles County Mus. Contrib. Sci. 134:1–25; Duellman 1970. Monogr. Mus. Nat. Hist., Univ. Kansas [1]:xi + 753 pp.). Furthermore, the rubbery viscosity of the skin secretion was described as preventing snake predation on the veined treefrog by acting as a glue (Leary and Razafindratsita 1998. Amphibia-Reptilia 19:442–446; Manzanilla et al. 1998. Herpetol. Rev. 29:39–40). But the behavior of *L. ahaetulla* described here, returning to the same site, is evidence that this snake could be an important predator of *P. venulosa*, at least in the Pantanal, despite the frog's sticky and alleged toxic secretion. The treefrog's behavior—immobility during ingestion—could also be an important secondary defense, diminishing risks of injury and increasing the survival chance in the case of being regurgitated by the snake.

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LEPTODACTYLUS OCELLATUS (Rã Manteiga). **PREDATION**. On 15 October 2001 at 1035 h we observed natural predation by *Buteo magnirostris* (Roadside Hawk: Falconiformes: Acciptridae) on an adult *L. ocellatus* (Centro de Estudos e Pesquisal Biológicas - CEPB 6738 - femur: 50.8 mm; tibia: 56.6 mm; tarsus: 29.3 mm) on an unvegetated bank of the Uruguai River (27°30'02"S, 51°47'50"W), municipality of Machadinho, in the state of Rio Grande do Sul, Brazil. This observation is the first report of avian predation on *L. ocellatus*.

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PHYLLOMEDUSA SAUVAGII (Painted-belly Leaf Frog) **PHYSICAL COMBAT.** *Phyllomedusa sauvagii* is one of six species that belong to the poorly-defined *tarsius* group and is one of the most distinct species of *Phyllomedusa* (Cannatella 1980. Occ. Pap. Mus. Nat. Hist. Univ. Kansas 87:1–40). On 25 Oct 2001 at 2100 h we observed an interaction between two males (SVL = 84.5 mm and 87.2 mm) in a temporary pond (Serra da Bodoquena, Assentamento Canaã, 20°41'32.3"S; 56°44'34.3"W, Bodoquena Municipality, Mato Grosso do Sul, Brazil). The smaller male was vocalizing from the top of a shrub, and the bigger male moved toward the shrub while emitting a different type of sound. The larger male climbed to the top of the shrub and within 10 sec, the two males engaged in physical combat. The movements of both males were slow as each one tried to grab the head and body of the other by flinging its arms and legs. The two clutched each other so that their bellies remained in contact, but at the same time each one was trying to extricate itself from the other. They were both suspended in the air for 10 min with only their feet clinging to the vertical stem of the shrub, while they were fighting and emitting different sounds. Finally, the larger male managed to throw off the smaller one into the pond. The larger male assumed the place on the top of the shrub where the smaller male had been and began to vocalize within 5 minutes. The two individuals were collected and deposited in the Zoological Collection at the Universidade Federal de Mato Groso do Sul (ZUFMS 0508). Although there are accounts of visual displays in this species (Halloy and Espinoza 1999–2000. Herpetol. Nat. Hist. 7:175–180) and other species of *Phyllomedusa* (*P. distincta*, Castanho, unpubl. data; *P. burmeisteri*, C. F. B. Haddad, pers. comm.), no visual displays were observed in this encounter. There is a report of territorial behavior and physical encounter between two male *P. hypochondrialis* (Matos et al. 2000. Herpetol. Rev. 31:84–86) similar to that reported here with *P. sauvagii*.

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PHYSALAEMUS* CF. *FUSCOMACULATUS (NCN). **PREDATION**. Several groups of birds prey upon post-metamorphic anurans (Duellman and Trueb. 1994. Biology of Amphibians. John Hopkins Univ. Press. 670 pp.). *Physalaemus* cf. *fuscomaculatus* (Leptodactylidae) is found in open vegetation in southeastern Brazil and reproduces during the rainy season (Rossa-Feres and Jim 2001. Rev. Brasil de Zool.18:439–454). On 26 Nov 2001, in the Clube de Caça e Pesca Itororó de Uberlândia municipality, state of Minas Gerais, Brazil, we observed an adult female (bearing eggs) *P.* cf. *fuscomaculatus* (36 mm SVL) being preyed upon by a "Guira Cuckoo" (*Guira guira*; Cuculidae; Aves) (Fig. 1). The frog had the interior right portion of its mouth broken and the tongue exposed. This observation is the first report of predation of *P.* cf. *fuscomaculatus* by a bird and the second of an anuran by *G. guira*.

The specimen of *P.* cf. *fuscomaculatus* (AAG-UFU 2228) is deposited at the Museu de Biodiversidade do Cerrado, in the Universidade Federal de Uberlândia, Minas Gerais state, Brazil. We thank Ariovaldo A. Giaretta and Marcelo Menin for critically reading this mansucript.

FIG. 1. Predation of *Physalaemus* cf. *fuscomaculatus* by *Guira guira*.

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PHYSALAEMUS NATTERERI (NCN). **PREDATION**. On 18 Oct 1995 at 2145 h after a heavy rain (98 mm in five hours) in Nova Itapirema (21°04'S, 49°32'W; 460 m elev), State of São Paulo, Brazil, a water-snake (*Helicops infrataeniatus*) in a temporary pond was observed preying on an adult *Physalaemus nattereri* during vocalization. The snake bit the prey by the head triggering the *P. nattereri* defensive deimatic strategy of inflating the body and exposing the large ocelli on its back (Sazima and Caramaschi 1986. Rev. Biol. [Lisb.]13:91–101). The snake immediately constricted the posterior part of the prey clockwise (Fig. 1). After ca. 15 min the snake uncoiled, keeping the head bitten and then dove to the bottom of the pond, where visual contact was lost. The *P. nattereri* deimatic behavior is considered more defensive than inhibitory when exposed to predators in captivity (Sazima 1973. Ci. e Cult. 25[supl.]:390), and in the event reported here, since *H. infrataeniatus* may be not a visually oriented predator. Probably in this situation, *P. nattereri* relies more on camouflage, "freezing," and in secretions from its inguinal glands (Vizotto 1964. Ci. e Cult. 16:168) as antipredator behaviors. On the other hand, some small visually oriented predators could be the operant selective agents for *P. nattereri* inhibitory behavior.

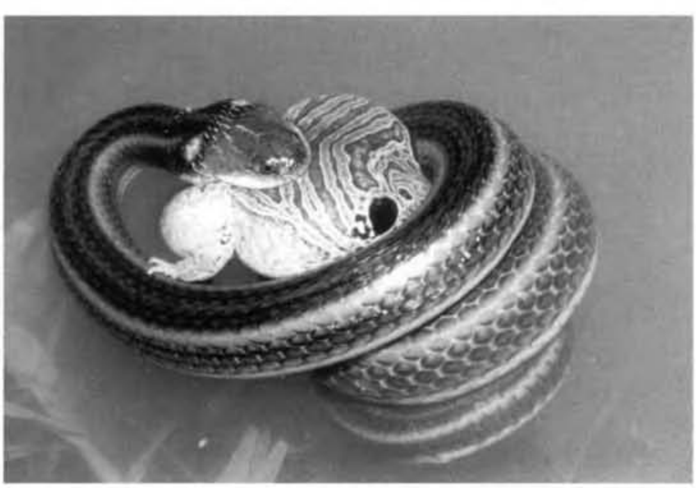

FIG. 1. *Helicops infrataeniatus* preying on *Physalaemus nattereri* (Nova Itapirema, São Paulo, Brazil).

We thank Valdir J. Germano for species confirmation.

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RANA AURORA AURORA (Northern Red-legged Frog). **JUVENILE GROWTH; MALE SIZE AT MATURITY.** Among anurans, high juvenile mortality after metamorphosis often makes recapturing individuals to assess early growth and size at maturity near impossible without extensive marking efforts (Turner 1962. Quart. Rev. Biol. 37:303–314). Licht (1974. Can J. Zool. 52:613–627) minimally estimated survivorship for juvenile *R. a. aurora* from southwestern British Columbia in their first year following metamorphosis at a fairly high 52%, implying that such data might be easier to obtain for this species. Yet, the frequent rapid disappearance of juvenile *R. a. aurora* from their natal ponds (MPH, pers. obs.) and immobility anti-predator tactics (Gregory 1979. Herpetologica 35:175–184) linked to dependence on crypsis have hindered obtaining precise data. Licht (1986. Can. Field-Nat. 100:22–31) did record newly metamorphosed *R. a. aurora* in British Columbia at 28–33 mm SVL and classed frogs > 40 mm SVL as ≥ 1-year old, but this only presumes a lower bound of 7–12 mm 1st-year growth at this latitude. Thus, opportunity to frequently observe a few *R. a. aurora* in a pond in lowland western Washington State allowed us to gather preliminary data on juvenile growth and male size at maturity.

We made observations in an isolated pond (3.3 m^2 surface area; 41 cm max. depth) built in July 2001 as part of a habitat restoration effort within an altered forest matrix NW of Olympia (Thurston County), Washington (47°07'11"N; 122°56'11"W). As water percolated too rapidly through its substrate (glacial till: Hayes and Hayes, Herpetol. Rev. *in press*), a preformed 0.5-cm thick black polyethylene liner had been placed to ensure pond water levels could be maintained. The pond margin was lined with black cobble-sized basaltic rock, and we placed two pieces of wood in the pond. Of the latter, one (0.9 m long x 10 cm diam) was well decayed and sank within a few days; the other (0.5 m long x 10 cm diam), undecayed, remained floating. Mature sword ferns (*Polystichum munitum*) were planted at relatively high density (ca. 1/m^2) over about 90% of the area within 2.5 m of the pond as sword fern is thought to present a cover structure favorable to *R. a. aurora* (Kelsey 2000. *In* O'Connell et al. [eds.], Effectiveness of Riparian Management Zones in Providing Habitat for Wildlife, pp. 8.1–8.38. Final Report: Timber, Fish, and Wildlife Program, Olympia, Washington). The pond was sited within 10 m of a ≥ 80-year-old Douglas-fir (*Pseudotsuga menziesii*) stand and an infrequently traveled, one-lane paved road, and within 3 m of the porch of a two-

story dwelling from which observations could be easily made. During the May–September 2002 interval we discuss, the pond was exposed daily to morning and midday sun, and increasingly shaded thereafter. The pond had been allowed to mature over 10 months during which time it developed a micro- and meso-biota, mostly through accumulation of litterfall and visits from birds. On 4 May 2002, 7 *R. a. aurora* (33–37 mm SVL) near metamorphic climax, each with a unique toe clip mark, were placed in the pond. The source of these individuals was a small stream-associated pond in the Stillman Creek Basin (Lewis County), ca. 64 km SSW of the recipient pond (46°34'05"N; 123°10'58"W).

Of the 7 *R. a. aurora* placed in the pond on 4 May, 5 vanished during the first two months. We recaptured the remaining two frogs (here A and B) on 31 August 2002; on 4 May, these frogs measured 33.0 mm SVL and 2.3 g, and 35.5 mm SVL and 2.9 g. On 31 August (119 days later), both frogs were identified as males based on nuptial pad development and hypertrophied forearms. Male A (now 54.0 mm SVL and 12.8 g) and male B (now 55.5 mm SVL and 12.5 g) had grown at rates of 0.18 mm/dy and 0.17 mm/dy. To further ensure their future identification, we PIT-tagged both frogs before release. Both were recaptured a second time on 22 September 2002; male A was then 58.0 mm SVL and 15.7 g, and male B was 57.5 mm SVL and 15.5 g. Over this next 22-day interval, the growth rate of male A had remained unchanged at 0.18 mm/dy, but that of male B nearly halved to 0.09 mm/dy.

Our observations reveal that juvenile male *R. a. aurora* can exhibit rapid growth during their active season in the Puget Sound lowlands. Male *R. a. aurora* would be able to reach sexual maturity within the year after they develop from eggs with the growth rates we recorded. Based on limited evidence from western Oregon, Nussbaum et al. (1983. Amphibians and Reptiles of the Pacific Northwest. University Press of Idaho. 332 pp.) suggested that males reached sexual maturity around 50 mm SVL in their 2nd year after metamorphosis, and Leonard et al. (1993. Amphibians of Washington and Oregon. Seattle Audubon Society, Seattle, Washington. 168 pp.) indicated that 3 or 4 years were likely required for "froglets" (i.e., recently metamorphosed juveniles) to reach sexual maturity. The 50 mm SVL size at maturity for male *R. a. aurora* that Nussbaum et al. (*op. cit.*) proposed agrees with our findings. However, while more data are clearly required to understand how representative the growth rates we present may be, they indicate that the time required to reach sexual maturity might need reconsideration.

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RANA BOYLII (Foothill Yellow-legged Frog). **OVIPOSITION BEHAVIOR**. *Rana boylii* is a medium-sized (37–71 mm SUL) frog that occurs in rivers and streams of Oregon and California (Stebbins 1985. Western Reptiles and Amphibians. Houghton Mifflin Co., Boston, Massachusetts. 336 pp.). It is a stream breeding frog that usually attaches its eggs to underwater boulder or cobble substrates. There is little known about the reproductive ecology of this species. We describe a previously unreported oviposition behavior of *Rana boylii* in which the female frog prepares the substrate for egg mass attachment.

On 03 May 2002 we observed the oviposition behavior of an amplexing pair of *Rana boylii* at Hurdygurdy Creek in northwestern California, USA. At ca. 1100 h we observed a pair of frogs in axillary amplexus. The pair moved a short distance away from the location where first detected, which we attributed to disturbance caused by our presence. Half an hour later, the pair returned to the original site. The female, with the male still gripping her dorsal side, backed up until her hind feet were resting against a cobble (ca. 35 cm x 12 cm). The female then began scraping the surface of the cobble, loosening particles of algae and sediment that were on the surface of the rock. Scraping continued intermittently for ca. 50 minutes. Three seconds after scraping ceased, the male lowered his hind feet, resting them on the female's thighs. As the female released her eggs on the "cleaned" area of the cobble, the male occasionally rubbed his hind feet down her thighs. It appeared that the male might have been guiding the eggs into the "basket" formed by the hind limbs of the pair and the surface of the cobble. Oviposition and fertilization lasted ca. eight minutes. Following fertilization, the male lifted his hind feet off of the female's thighs. The female crawled away from the egg mass and five seconds later, the male released her.

On 11 May 2002 at ca. 1500 h we observed another amplexing pair of *Rana boylii* where the female was scraping the surface of a cobble (ca. 10 cm x 5 cm) with her hind feet in the same manner as described above. The pair moved away from the location where first detected, which we again attributed to disturbance caused by our presence. Oviposition was not observed, however, at 2100 h we returned to the study area and found a new egg mass attached to the same cobble that the female had been scraping.

Video footage of scraping and oviposition behaviors can be viewed at: http://www.rsl.psw.fs.fed.us/projects/wild/herpwebpage/rabo.html.

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RANA BOYLII (Foothill Yellow-legged Frog) and ***RANA CATESBEIANA*** (Bullfrog). **REPRODUCTIVE BEHAVIOR**. Bullfrogs (*Rana catesbeiana*) were introduced into the western United States in the late 1800s. Populations continue to grow and expand into new areas both as a result of human activities and through "natural" dispersal. Bullfrogs have been identified as predators on, and competitors with, several species of native ranid frogs (Kupferberg 1997. Ecology 78[6]:1736–1751; Twedt 1993. Comparative Ecology of *Rana aurora* and *Rana catesbeiana* Shaw at Freshwater Lagoon, Humboldt County, California, Unpubl. MS Thesis, Humboldt State University, 53 pp.). They have also been

observed to interfere with reproductive activity in *Rana aurora aurora* and *R. a. draytonii* (Storm 1953. Herpetologica 8:109; Twedt 1993, *op. cit.*; M. Jennings and M. Hayes, pers. comm.; G. Fellers, pers. comm.). In addition, bullfrogs might be vectors of disease when introduced outside their range (D. E. Green, pers. comm.). Over the past two years, we have observed two instances of bullfrog interference with reproduction in *Rana boylii* in geographically distant areas of the latter's range. Both of these events involved male *R. boylii* in amplexus with female *R. catesbeiana*. The first event occurred in Rancheria Creek, Mendocino County, California on 22 April 2000. Initially, there were two male *R. boylii* in amplexus with the same subadult *R. catesbeiana*. One of the male *R. boylii* separated when placed in an enamel pan for photographs. The second event occurred in the Middle Fork of the Yuba River, < 100 m upstream of the confluence of Oregon Creek, Yuba County, California on 31 May 2002. Based on surveys over the last six years, *R. boylii* and *R. catesbeiana* are sympatric in this area. Eggs and larvae of *R. boylii* have not been observed in these surveys, but *R. boylii* is known to breed in nearby tributary streams (e.g., lower section of Oregon Creek). In this event, an adult *R. boylii* was first observed in amplexus with a subadult *R. catesbeiana* in the open, in a small pool along the river margin (Fig. 1). The disturbance created by our attempt to photograph the event caused the amplexing pair to take cover under a large boulder. Within a few seconds, the frogs emerged separately from under the boulder. We do not know the extent of these interactions beyond the two observations described here. However, the implications for native ranid frogs and specifically for *Rana boylii* are disturbing and may constitute wasted reproductive effort on part of these native amphibians.

FIG. 1. Male *Rana boylii* and female *R. catesbeiana* in amplexus, Middle Fork Yuba River, Yuba County, California, 31 May 2002.

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RANA OKALOOSAE (Florida Bog Frog): **PREDATION**. The Florida bog frog is one of the least studied frogs in North America, and predation of adults or tadpoles has not been reported. On 28 Aug 2002, a southern water snake (*Nerodia fasciata*) was observed actively foraging in the shallow (ca. 3 cm) headwaters of an unnamed branch of Live Oak Creek on Eglin Air Force Base in Okaloosa County, Florida. Within a 5-min period, the snake ate two *R. okaloosae* tadpoles, an unidentified salamander and attempted to capture a juvenile bog frog.

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RANA SUBAQUAVOCALIS (Ramsey Canyon Leopard Frog). **DIET.** *Rana subaquavocalis* is the most recently described member of the *Rana pipiens* complex in the southwestern USA (Platz 1993. J. Herpetol. 27:154–162). Its range is limited to the Huachuca Mountains in southeastern Arizona, USA. Much natural history of this species remains unstudied. The diet of adult *R. subaquavocalis* has not been studied although is assumed to be similar to that of other members of the *R. pipiens* complex from the western USA (Sredl, *in press*. *In* M.J. Lannoo [ed.]. Status and Conservation of U.S. Amphibians Vol 2: Species Accounts. Univ. California Press, Berkeley.). Adult *R. subaquavocalis* often reach 90–120 mm SVL (Platz 1997. J. Herpetol. 31:552–557), which allows for sizable prey. The diet of other western leopard frogs is known to include a large variety of prey including terrestrial and aquatic invertebrates and vertebrates.

On 27 June 2002 at 1300 h a hummingbird was observed hovering ca. 150 mm above the water of a 13 x 8 m ornamental pond containing *R. subaquavocalis* at Beatty's Guest Ranch in Miller Canyon, Huachuca Mountains, Cochise County, Arizona. The hummingbird was either a rufous or an Allen's hummingbird, the two of which are often indistinguishable in the field (Robbins et al. 1983. Birds of North America: A Guide to Field Identification. Golden Press, New York. 360 pp.). An adult *R. subaquavocalis* successfully captured the hummingbird. The frog had its mouth partially open with none of the bird easily visible inside at 1322 h. We are unsure as to whether the frog was able to ingest and digest the bird completely, however, a bloated frog with its mouth closed was seen in the same location at ca. 1345 h. To our knowledge, this is the first documented observation of *R. subaquavocalis* successfully preying upon avian species and represents the only published data on diet.

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RANA SYLVATICA (Wood Frog). **BREEDING BEHAVIOR DURING DROUGHT**. The breeding behavior of *Rana sylvatica* in southern New England is well described. Typically, large aggregations of males congregate in seasonally flooded ponds during March and early April, where they float on the water's surface, and call when water temperatures are > 10.5°C. Thus, calling activity is greatest during mid-afternoon (Crouch and Paton 2002. J. Herpetol. 36:185–192). Egg deposition generally occurs in shallow water, with most egg masses attached to woody vegetation in communal deposition sites (Crouch and Paton 2000. Wildl. Soc. Bull. 28:895–901; Egan 2001. M.S. Thesis, Univ. Rhode Island). However, the effects of drought on courtship displays and egg deposition of *R. sylvatica* have not been documented. We report here on observations of aberrant breeding behavior during a drought in Rhode Island during 2002, when many breeding ponds were dry until late March.

On 16 March 2002, a group of 4 observers heard a wood frog chorus at 1230 h in a 0.6 ha pond basin (41°26'N, 71°39'W, Washington County, Rhode Island). Upon closer inspection, we found ca. 90 pairs of wood frogs in amplexus in full chorus calling from dry leaf litter in upland habitat, ca. 8 m from the edge of the pond basin. During this time, we observed at least three females depositing egg masses in dry leaf litter. It had rained 1 mm the previous evening, but there was no surface water or moist areas in the pond basin. Frogs were calling from within a closed-canopy forest dominated by red maple (*Acer rubrum*) and green briar (*Smilax rotundifolia*). Two observers revisited the same area on 17 March at 1030 h and found a communal deposition site with 56 egg masses within a 0.3 m radius area, and another 15 egg masses within 1 m of the communal deposition site. All egg masses were deposited on top of dry leaves. During an extensive survey of the entire pond basin on 17 March 2002, we found 8 egg masses deposited on dry ground and 7 dead, desiccated adults throughout the basin. The dead individuals lacked external signs of injury. The pond basin had no canopy cover and all dead animals were detected in open areas exposed to the sun. This pond remained dry until 26 March, with no further evidence of *R. sylvatica* egg deposition until 27 March. It rained 3.1 cm during the afternoon and evening of 26 March, which inundated the pond basin with 0.5 m of water. On 27 March, we found 379 egg masses in 4 communal depositions sites within the flooded pond basin. After 27 March, rains intensified, and many pond basins in the region that previously were dry became inundated and remained flooded until at least late June 2002.

From 17 March to 2 April, we documented 10 instances where *R. sylvatica* deposited egg masses within dry pond basins in Rhode Island and Massachusetts (Table 1). Observations at one pond in Arcadia Management Area, Rhode Island (41°35'N, 71°42'W) on 17 March were particularly unusual. The dry pond basin contained ca. 175 dead adult wood frogs, primarily pairs in amplexus. None of these dead animals exhibited external signs of trauma. In addition, there were at least 20 egg masses deposited on top of dry leaves and moss. A survey of this pond basin on 21 March detected 66 egg masses deposited on dry ground. This pond also had no canopy cover and all dead animals were found in exposed areas in the center of the basin. This pond contained a 2 x 2 m hand-dug pit located toward the center of the pond basin, with very steep sloping sides leading to the bottom of the pit. Water was < 30 cm deep in this pit, with 34 *R. sylvatica* egg masses and 10 dead adults. All other egg masses were on dry land and 165 dead, desiccated animals were found outside the pit.

We also documented frogs probably relocating to alternate breeding ponds in response to the drought when the alternate pond was < 50 m away. We monitored one pond (hereafter South Pond; 41°29'N, 71°37'W, Washington County, Rhode Island) with a drift fence array from 1997 to 2002 (except 1999). A heavily traveled paved road (State Route 138) was located 8 m NNE of South Pond. A second breeding pond (hereafter North Pond) was located 31 m

TABLE 1. Description of ponds in Rhode Island and Massachusetts where aberrant breeding behavior of *Rana sylvatica* was documented during a drought in 2002.

Date	Pond coordinates	Water depth (cm)	No. egg masses	Notes
17 March	41°35'N, 71°43'W	0	44	Pond dry up to 17 Mar, 44 egg masses detected in center of pond basin apparently deposited on dry ground
17 March	41°35'N, 71°42'W	0	20	20 egg masses deposited on dry ground, 175 dead, desiccated adults found in pond basin.
25 March	41°25'N, 71°37'W	0	54	Egg masses deposited on dry ground in deepest part of basin
25 March	41°24'N, 71°37'W	0	117	Egg masses deposited on dry ground in deepest part of basin
27 March	41°56'N, 71°41'W	10	240	100 egg masses deposited on dry ground, 140 egg masses deposited, 7 dead adults in basin
30 March	41°32'N, 71°35'W	15	227	22 egg masses deposited before basin filled on March 27th, remaining 205 were freshly deposited after latest rain
1 April	42°22'N, 72°18'W	0*	**	Adults in chorus and depositing eggs on moist ground, 627 m to nearest other breeding site
3 April	41°24'N, 71°33'W	0	65	Egg masses deposited on dry ground in deepest part of basin.
7 Apr	41°24'N, 71°32'W	0	65	Egg masses deposited on dry ground, 22 m from permanent pond

* Water table 3 cm below surface based on well.

** Present but not counted.

NNE of South Pond on the N side of Route 138. North Pond had a longer hydroperiod, typically drying 1–2 months later than South Pond. In most years, *R. sylvatica* emigrating from South Pond departed towards forested habitats to the ENE (1997: mean emigration direction 59.1°, SE = 11.6°, Rayleigh test of uniformity, $P < 0.01$, $N = 253$; circular statistics calculated with Oriana for Windows), or NW (1998: mean emigration direction 324.5°, SE = 1.9°, Rayleigh test of uniformity, $P < 0.01$, $N = 555$), or randomly when few animals immigrated to South Pond, (2001; Rayleigh test of uniformity, $P = 0.13$; $N = 17$). In 2002, South Pond did not contain surface water until 27 March, whereas North Pond had surface water on 1 March. We documented male *R. sylvatica* calling activity at North Pond from 9 March through at least 28 March. As in past years, adult *R. sylvatica* in 2001 immigrated to South Pond from all directions. Yet in contrast to previous years, adults moved to the NNE corner of pond basin, usually within 1–2 days of entering the array, and emigrated towards North Pond (2002: mean emigration direction = 21.6° SE = 4.5, Rayleigh test of uniformity, $P < 0.01$, $N = 166$). North Pond had at least 220 wood frog egg masses on 21 March 2002, whereas there were no egg masses in the dry pond basin of South Pond on 21 March 2002. It was not until 27 March 2002 that 18 new egg masses were detected in South Pond, when 5 cm of water was present in the deepest part of the pond basin.

We also observed the probable relocation of breeding adults to an alternate breeding pond at a pair of ponds in Arcadia Management Area, 41°35'N, 71°44'W, Washington County, Rhode Island. These two ponds are 15 m apart; one is a small pond (0.02 ha) with a relatively short hydroperiod (typically drying in July), whereas the larger, deeper pond (0.04 ha) has a longer hydroperiod (usually drying in November or permanent in some years). We counted egg masses in both ponds from 1996 to 2001 (large pond: 6-yr mean = 138.7 (SE = 36.2), range 18–245 egg masses annually; small pond: mean = 164.3 (SE = 20.1), range = 65–225; CJR, unpubl. data). In 2002, the small pond was completely dry during March, whereas the large pond had 15 cm of water on 10 March. No egg masses or dead adult *R. sylvatica* were detected in the small pond in 2002, whereas we heard adults chorusing and found 50 egg masses in the large pond on 13 March and 160 egg masses on 17 March. This suggests that adults may have relocated their deposition site from the small pond basin to large basin in 2002, we suspect in response to water availability and chorusing frogs.

The drought conditions experienced in Rhode Island were extreme during March 2002; in over 20 years of fieldwork in Rhode Island, CJR had never seen pond basins at sites used by breeding *R. sylvatica* dry during this time of year. One explanation for the aberrant behavior we documented is that adults still migrated to ponds in early to mid-March, although most ponds had no surface water. At some isolated, dry pond basins (defined here as ponds > 200 m from any other pond basin with water), males initiated choruses despite the fact that no water was present, which attracted females to ponds. Males initiated amplexus with females in these dry situations and we hypothesize that females then had to deposit eggs because males would not dismount from females until eggs were deposited. In pond basins with no canopy closure, *R. sylvatica* apparently initiated courtship behavior in areas where they were exposed to overheating. In situations where alternate breeding sites with standing water were available < 100 m away and supported male chorus activity, *R. sylvatica* apparently relocated to alternate breeding ponds.

In Rhode Island, egg deposition chronology of spotted salamanders (*Ambystoma maculatum*) is similar to *R. sylvatica* (Paton and Crouch 2002. Cons. Biol. 18:194–204). However, no *A. maculatum* egg masses were observed in any dry ponds we surveyed. *A. maculatum* must have either delayed egg deposition until the ponds filled or may have skipped breeding entirely. Erratic breeding patterns in *A. maculatum* have been previously documented, with about 90% of adults breeding annually in a Rhode Island population (Whitford and Vinegar 1966. Copeia 1966:515–519). Because *A. maculatum* is a longed-lived species (up to 38 years; Flageole and Leclair 1992. Can. J. Zool. 70:740–749), and generally exhibit relatively high adult survivorship, they can afford to pass over a reproductive opportunity that has a high potential of failure to conserve that energy for survival to the next breeding season when conditions may be better. In comparison, male *R. sylvatica* often have only one opportunity to breed in their lifetime. Approximately 84% bred once, 14% bred twice, and only 2% bred three times in a Maryland population (Berven 1990. Ecology 71:1599–1608). A wood frog's overall fitness may depend on one breeding event and therefore this species cannot afford to postpone breeding to a time when conditions are more favorable, even if egg masses are deposited on dry land as we observed.

Based on our observations, the aberrant breeding behavior of *R. sylvatica* we documented during Spring 2002 was a widespread phenomenon throughout drought-stricken areas of southern New England. Past research has documented the importance of pond hydroperiod to survival of larval amphibians (e.g., Paton and Crouch 2002, *op. cit.*). The 2002 drought stresses the potential impact that hydroperiod can have on adult survival and reproductive success. In addition, these observations support the importance of maintaining multiple breeding ponds within close proximity with varying hydroperiods to ensure population viability.

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RANA TEMPORARIA (Common Frog) and ***BUFO FOWLERI*** (Fowler's Toad) **TADPOLES. PROTOZOAN INFESTATION**. Sessile ciliate protozoans (Peritrichia) colonize exposed parts of aquatic organisms including amphibian larvae (e.g., *Scyphidia*, *Opercularia* and *Vorticella* in buccal cavities of tadpoles of *Bufo bufo* and *Rana* kl. *esculenta*; Viertel 1979. Salamandra 15:60–62). They are not direct parasites but in high densities may hinder host movement and feeding efficiency. We report two such occurrences with no information on possible effects on the tadpoles or the environmental conditions that may have promoted the infestations. In light of amphibian declines and malformities, these infestations, the species and stages of the hosts and protozoans involved, and the ecological situations in which they occur should be noted so that possible correlations can be detected.

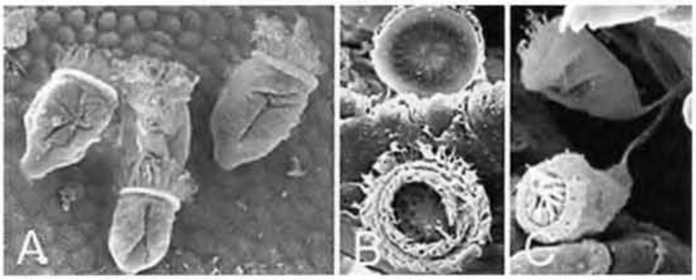

FIG. 1. Peritrichian protozoans attached (A) to the roof of the buccal cavity of *Rana temporaria* tadpoles and (B) at the base of the jaw sheath serrations, and C) between the tooth rows of *Bufo fowleri*.

Rana temporaria tadpoles from the Pyrenean Mountains (Circo de Piedrafita, Aragon, Spain, July 1999) had dense aggregates of peritrichians (Fig. 1A; up to 150–200 specimens on the buccal roof of one tadpole) in the buccal cavities. Tadpoles from ponds C and J out of 11 (Vences et al. 2002. J. Zool. Lond. 257:155–167; single specimens per pond examined with SEM) were infested. These ponds had low tadpole densities (4–11 specimens/m^3) and differed in size (70 vs. 1065 m^2 surface area) and water depth. Tadpoles were in Gosner stages 36–40 (Gosner 1960. Herpetologica 16:183–190). The peritrichians were tentatively identified as *Scyphidia amphibiarum* (Nenninger 1948. Zool. Jahrb. Syst. 77:169–266; described from external skin of tadpoles) based on their short, stout shape, rather distinct peristomal bulge, and many distinct small horizontal furrows on the pellicula.

Eight of 57 tadpoles (Gosner stages 33–36) of *Bufo fowleri* (Bradley Creek, Rutherford County, Tennessee, Spring 2000 and 2001, Gosner stages 25–37; examined with SEM) had ciliates attached along the inner base of the jaw sheaths serrations (Fig. 1B), between tooth rows (Fig. 1C), and on the skin adjacent to the oral disc. Internal examinations were not made, and there were no obvious effects of the infestations on the tadpoles. These peritrichians clearly belonged to a different taxon than those above based on the less distinct peristomal bulge and the long and narrow shape, although a reliable identification was not possible.

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RANA VAILLANTI (Web-footed Frog). **DIET**. Although geographically widespread and locally abundant, few details are known about the diet of *Rana vaillanti*. Arthropods, fishes, frogs, birds, and possibly small mammals comprise the diet (Noble 1918. Bull. Amer. Mus. Nat. Hist. 38:311–347; Ramirez et al. 1998. J. Herpetol. 32:338–344; Savage 2002. The Amphibians and Reptiles of Costa Rica. Univ. Chicago Press. 934 pp.). Although frogs are known to occur in its diet, only conspecifics have been identified as prey.

On 7 Sept 2002 at 1820 h an act of predation was observed 3 km N of Tirimbina Rainforest Reserve in Sarapiqui, Heredia, Costa Rica. A *Rana vaillanti* (mass 93.0 g) was sitting at the edge of a small pond in late second growth and cacao with the hind legs of an *Agalychnis callidryas* (mass 5.0 g) protruding from its mouth. The *R. vaillanti* was captured and the *A. callidryas* removed. Although dead, the *A. callidryas* was virtually unmarked by the capture and subsequent partial ingestion. The prey/predator mass ratio was 0.054. Many *R. vaillanti* were active in and around the pond. Several *A. callidryas* were calling from vegetation at the pond's edge, and amplexing pairs were observed. Presumably the *A. callidryas* was at or very near ground level when captured by the *R. vaillanti*. This is the first record of any frog other than a conspecific in the diet of *R. vaillanti*.

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SCINAX ALTERA (NCN). **PREDATION**. Although tadpoles and metamorphosing anurans often are prey for a variety of invertebrates (Duellman and Trueb 1986. Biology of Amphibians. McGraw-Hill, New York. 670 pp.; Hinshaw and Sullivan 1990. J. Herpetol. 24:196–197), there are few reports of predation on adults (Bastos et al. 1994. Herpetol. Rev. 25:118; Bastos and Haddad 1997. Amph.-Rept. 18:295–298; Hinshaw and Sullivan, *op. cit.*). Most spiders in the genus *Ancylometes* are recognized predators of small vertebrates including frogs, tadpoles, and fishes (Bernarde et al. 1999. Biociências 7[1]:199–203; Brescovit 2000. Insect Syst. Evol. 31[3]:323–360). Herein we report predation on adult *Scinax altera* (SVL = 27.3 mm) by a female *Ancylometes rufus* (23 mm cephalothorax and abdomen length, MNRJ 3489, Museu Nacional, Rio de Janeiro, Brazil) in a swamp at Reserva Biológica de Duas Bocas (20°16'51"S, 40°28'37"W), a biological conservation area located in the Municipality of Cariacica, State of Espírito Santo, Brazil. On 23 Dec 2001 at 0100 h (air temp. 23.5°C, water temp. 29°C) the spider was perched on the leaves of the aquatic plant *Typha dominguensis* about 30 cm above the water surface sup-

FIG. 1. Predation of an adult *Scinax altera* (SVL = 27.3 mm) by a female *Ancylometes rufus* (23 mm cephalothorax + abdomen length).

porting the hylid with pedipalps and first pair of legs (Fig. 1). The chelicerae penetrated the lateral region of the frog.

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TESTUDINES

CHELYDRA SERPENTINA (Common Snapping Turtle). **REPRODUCTION.** On the morning of 7 June 2001, we observed a 2.9 kg female *Chelydra serpentina* digging a nest at the edge of a gravel road in Utica Marsh, an urban wetland next to the Mohawk River and lying partially within the city limits of Utica, New York, USA. The nest site was 53 m from the water on a direct line and within a ca. 30 x 60 m cleared area with a gravel road running along one margin. On closer inspection of the nesting activity, we found several damaged *C. serpentina* eggs from a prior nest in the soil being dug up by the female. As she continued digging, additional eggs surfaced. Palpation of the pelvic region of the laying female indicated that she had a full load of shelled eggs ready for oviposition. We left the animal undisturbed for an hour, and upon return, found the female covering the nest. We found numerous additional broken eggs around the nest site. Palpation indicated that no eggs remained in her body cavity. Twenty-three eggs were recovered from this nest and collected for hatching in the lab. Three undamaged eggs were salvaged from the previous nest of an estimated 15–20 eggs total.

To our knowledge, this represents a rare instance of *C. serpentina* using a previously excavated nest for her own, thus destroying the eggs of the first female. Anecdotal evidence provided by others suggests that this phenomenon has been observed in several species, including snapping turtles, wood turtles, and sea turtles. One published study of nesting in *Malaclemys terrapin* reported that females would occasionally dig up other nests in high density nesting areas, but such incidents represented less than 2% of total nesting events (Burger 1977. Am. Midl. Nat. 97:444–464). We have been unable to find published reports of this type of nest destruction by *C. serpentina*, and such activity was not documented by Congdon et al. (1987. Herpetologica 43:39–54) in their thorough study of nesting ecology of *C. serpentina*.

Although *C. serpentina* nest predation by other species is well established, it remains puzzling as to what mechanism other than chance led to this observed nest destruction by *C. serpentina* in a low-density nesting area containing only six nest sites within this 1800 m^2 nesting area. Difference in soil structure does not appear to be a factor nor does relative openness of each nest site in the area. One could speculate whether olfactory cues may have contributed to selecting the first nest as the site to excavate.

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CHELYDRA SERPENTINA (Common Snapping Turtle). **SITE FIDELITY AND GROWTH.** On 9 July 1996 two *Chelydra serpentina* were individually marked with Trovan™ pit tags (InfoPet™, Burnsville, MN) and released in Salado Creek, Independence Co., Arkansas, USA (T12N, R5W, Sec. 7). On 2 July 2001, we retrieved one of the pit-tagged individuals, a male *C. serpentina* from a fish-baited, 1.2 m double-throated hoop net at the exact same trap site located ca. 1.1 km from the confluence of Salado Creek and the White River, 8.0 km SE of the White River Access, Batesville, Arkansas. In 1996 the turtle's measurements were as follows: mass (MA) = 2.27 kg, curved carapace length (CCL) = 230 mm, pre-anal tail length (PRT) = 95 mm, and post-anal tail length (POT) = 149 mm. Standard carapace length (SCL) was not recorded on the initial capture. In 2001, the measurements were as follows: MA = 2.81 kg, CCL = 243 mm, PRT = 96 mm, POT = 131 mm, and SCL = 237 mm.

Few studies have tracked growth rates in adult *C. serpentina* over extended periods (Brown et al. 1994. J. Herpetol. 28:405–410; Galbraith et al. 1989. Copeia 1989:896–904), although growth is typically considered predictable using growth ring proportional analysis of growth ring–standard carapace length associations (Sergeev 1937. Zool. Zh. 16:723–235) this turtle's age could not be obtained from plastral scutes because only a few ridges were still present.

Galbraith et al. (*op. cit.*) showed that SCL of female *C. serpentina* from Ontario, Canada increased as follows: 24% between the age of 10 and 15 years old, 10% growth between 15 and 20 years, and 4% from their 20th to 25th year. However, in an Iowa study (Christiansen and Burken 1979. Herpetologica 35:261–266) SCL increased 3.7% between the 11th and 16th year. While we cannot document the increase in SCL, the growth in PRT was 2%, while increase in CCL was near 5%, and mass increased 19%. If we assume that growth in PRT is proportional to that of SCL then SCL in 1996 was about 234 mm based on a 2% PRT growth rate. If it is proportional to CCL then the 1996 SCL was closer to 224 mm based on a 5% growth rate. Galbraith et al. (*op. cit.*) suggested that females in northern populations reach reproductive maturity at a larger size and greater age than those from southern populations. Based on this model, our Arkansas specimen is about the same size as expected for a female 15 year-old Ontario *C. serpentina* (236 ± 2.37 mm, N = 19) or a female 11 to 12 year-old Iowa specimen (233.3 ± 2.36 mm). This would suggest that this male specimen was probably no older than 11 years old and likely substantially younger.

A large population of alligator snapping turtles (*Macroclemys temminickii*) is known from Salado Creek (Trauth et al. 1998. Chel. Conserv. Biol. 3:64–70). The reduction in POT can be attributed to an apparent tail loss, possibly through interspecific or intraspecific aggression between Chelydridae in this stream. The tail appeared to have healed and then regrew as it was tapered fairly normally. Tail loss in *M. temminckii* is discussed in McCallum and Trauth (2000. J. Arkansas Acad. Sci. 54:150–152).

Our observation also suggests that *C. serpentina* displays strong site fidelity in their home range over extended periods. This is an important factor for professionals interested in this species' habitat preservation, management and population relocation. If inherently strong site fidelity is characteristic of this species, then major modifications to stream channels, draining of water bodies, and other such anthropogenic disturbances might pose a threat to these animals especially if they begin experiencing population declines in the future. Under such circumstances it would be essential to preserve the physical nature of localized habitats to reduce stress on the studied populations.

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GEOCHELONE RADIATA (Radiated Tortoise). **NOCTURNAL ACTIVITY.** Radiated tortoises (*Geochelone radiata*) are normally active during the day between 0700–1200 h and again between 1400–1700 h (pers. obs.). On the evening of 29 March 2000 at 2054 h two adult tortoises were found actively walking around in the dark on a rocky path near the village of Befeha (Cap Sainte Marie), Madagascar. This was the only incidence of nocturnal activity seen during the 1998–2000 study.

Several North American emydids including *Emydoidea blandingii, Terrapene carolina, Chrysemys picta, Chelydra serpentina,* and the four species of *Clemmys* are known to be active at night when searching for or excavating nests (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Inst. Press, Washington, D.C. 578 pp.). Night-time nesting is also reported for two tortoise species—*Kinixys spekii* (Hailey and Coulson 1997. Brit. Herpetol. Soc. Bull. 58:11–18) and *Testudo hermanni* (Swingland and Stubbs 1985. J. Zool., Lond. 205:595–610).

However, here the microhabitat was inappropriate for nesting because of the presence of large rocks. All nests observed in Madagascar were laid in sandy-soil (N = 24) in the mornings (0700–1000 h). It is more likely that the tortoises were active in response to rain. Adest et al. (1988. Herpetol. Rev. 19:75–76) reports nocturnal activity in Bolson tortoises *(Gopherus flavomarginatus)* because of elevated ambient burrow and/or soil temperatures, and in response to night rains. The 2000 field season had been very dry. In February of 1999, Cap Sainte Marie had 792 mm of rain compared to 1.95 mm in February 2000. At 1930 h on 29 March there had been 0.8 mm of rainfall. Tortoises, on several other occasions, were seen drinking water that accumulated in the crevices of flat rocks *(ranovato)* after rains.

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GLYPTEMYS (= CLEMMYS) MUHLENBERGII (Bog Turtle). **ABNORMAL COLORATION**. On 17 June 2002, a male *Glyptemys muhlenbergii* with white neck patches and white skin around the tympanum was found (by MK) in Sussex County, New Jersey. The turtle was previously found and marked (by JT) on 30 May 2000. Typical coloration of the neck patch and skin around the tympanum in Bog Turtles ranges from yellow to orange or red (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington). Abnormally-colored Bog Turtles with piebald or albino characteristics have been rarely observed (D. Herman, pers. comm.; S. Smith, pers. comm.).

The Bog Turtle noted here was approximately 10 years old when photographed, and appeared healthy. The neck patches and skin around the tympanum were white to the edges, with no other apparent color. Iron staining was present on the white patches, but was easily removed. The eyes were dark brown and the turtle's coloration appeared normal in all other respects.

The turtle was found in a calcareous tussock sedge (*Carex stricta*) and cattail (*Typha latifolia*) meadow and had moved more than 160 m between captures. It has been suggested that diet may influence skin color in this species (D. Herman, M. Klemens, and S. Smith, pers. comm.). However, 42 Bog Turtles have been marked over the past six years within this wetland complex and all had orange or red neck patches.

We thank Dennis Herman, Michael Klemens, Jim Warner, and Scott Smith for graciously sharing their knowledge about Bog Turtles, and Laura Newgard and Lisa Arroyo for field assistance. We also thank the New Jersey Division of Fish and Wildlife for Bog Turtle data and EcolSciences, Inc. for time and financial support.

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GOPHERUS POLYPHEMUS (Gopher Tortoise). **NESTING.** Gopher tortoises are widely reported to nest in burrow aprons, with active burrows being more commonly used than inactive or abandoned burrows (Demuth 2001. Can. J. Zool. 79:1609–1620; Smith 1995. Bull. Florida Mus. Nat. Hist. 3, Pt I[4]:97–126). It is also believed that gopher tortoises lay only one clutch of 3–10 eggs per year (Iverson 1980. Am. Midl. Nat. 103:353–359; Smith 1995, *op cit.*). Here we report two clutches of average size occurring in the same burrow apron.

On 18 June 2002 at Merritt Island National Wildlife Refuge, Brevard County, Florida (USA), active burrow aprons were being excavated in overgrown scrub edge habitat to locate gopher tortoise nests. Two nests were found within the same burrow apron while a resident tortoise was inside the burrow. The first nest contained 4 eggs and was located 5 cm from the burrow opening, 3 cm below the surface. The second clutch contained 5 eggs and was located 22 cm from the opening, 5 cm below the surface.

Both clutches were directly in front of the burrow entrance in line with each other and the entrance. Before beginning excavation of the burrow apron we noted three small depressions located around the periphery of the burrow (~1 m from the entrance) that appeared to be failed attempts at nest excavation by a tortoise. The sex of the resident tortoise was not determined.

As Gopher Tortoises have not previously been reported to produce more than one discrete clutch per year, it is possible that these clutches represent the efforts of two tortoises using the same burrow apron. Alternately, this might represent the first known occurrence of a Gopher Tortoise producing more than one clutch of eggs in a season.

We thank the U.S. Fish and Wildlife Service at Merritt Island NWR and the National Park Service at Canaveral National Seashore for support.

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GOPHERUS POLYPHEMUS (Gopher Tortoise). **MORTALITY.** On 7 June 1999, a Gopher Tortoise hatchling was radio-located that had been killed by a prescribed fire on the DeSoto National Forest, Mississippi, USA. The hatchling was found on the surface ca. 5.5 m from a burrow that it had constructed and inhabited since the previous fall. Prior to the fire, the last location was on 3 June 1999, and the hatchling was found alive and in the burrow. On 5 June 1999, the U.S. Forest Service ignited a prescribed fire. The habitat consisted of a longleaf pine (*Pinus palustris*) overstory and a bluestem (*Andropogon* spp.) dominated understory, and is burned on a 3–4 year rotation.

Gopher Tortoises inhabit upland ecosystems of the southeastern coastal plain that are fire-dependent (Means and Campbell 1981. *In* Wood [ed.], Prescribed Fire and Wildlife in Southern Forests, pp. 89–97. Belle W. Baruch Forest Science Institute of Clemson University, Georgetown, South Carolina). Historically, many of these fires were ignited by lightning strikes (Komerek 1964. Tall Timbers Fire Ecology Conference Proceedings 3:139–183). Currently land managers frequently use prescribed fire to mimic the natural fire regime. Fire-induced mortality of herpetofauna in this ecosystem is thought to be minimal as many species have behavioral adaptations to escape fire. The Gopher Tortoise is a fossorial species that excavates and inhabits a burrow, which provides protection from temperature extremes as well as fire. This is apparently the first recorded mortality of a Gopher Tortoise by prescribed fire. The positive impacts of habitat improvement undoubtedly outweigh rare mortalities.

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GRAPTEMYS GEOGRAPHICA (Northern Map Turtle). **NEST OVERWINTERING.** From 14–21 May 1994, at least 24 hatchling *G. geographica* were recovered crossing West (River) Road, near "E area," Savanna Army Depot, Jo Daviess County, Illinois and released in Crooked Slough. No measurements were taken, but none of the hatchlings had plastral growth annuli, nor did they have external evidence of yolk sacs or unhealed umbilical scars. Adult females were recovered during the same period migrating from Crooked Slough and the Mississippi River proper to the extensive nesting sites in the sand prairies east of West Road. No migrating females were observed prior to 14 May, and no hatchlings were observed after 21 May. The nesting period occurs in the area from May to July and hatchling emergence typically occurs from August through September; however, hatchlings may overwinter in the nest in parts of their range (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington, D.C.). These observations suggest that hatchling Northern Map Turtles from extreme northern Illinois may over winter in the nest, or alternatively at some location near the nest site.

I thank Edward O. Moll and Eastern Illinois University for support while conducting this study, and Stanley E. Trauth for comments on the manuscript.

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KINOSTERNON SONORIENSE (Sonoran Mud Turtle) and ***BUFO PUNCTATUS*** (Red-spotted Toad). **PREDATOR-PREY.** On 3 July 1999, at 0920 h, we observed an adult male *Kinosternon sonoriense* consuming an adult male *Bufo punctatus*. At the time that our approach disturbed the turtle, the contents of the toad's ventral cavity had been consumed; left remaining were the head, vertebral column, portions of the pelvic and pectoral girdles, and the dorsal dermis, including all portions covered with tubercles. The remains of a second *B. punctatus* in similar condition were discovered on 16 July 1999.

Both observations were made in small pools in the Peloncillo Mountains, Hidalgo Co., New Mexico, USA. Rains preceded the discovery of both *B. punctatus* carcasses by 18 h or less (1.2 cm and 0.3 cm, respectively), and toads were heard calling on both days. Three pairs of *B. punctatus* were observed in amplexus on 3 July, the first day we observed anuran breeding in the study area that year.

Based on the remains of the two toads (University of Central Oklahoma Collection of Vertebrates, UCO 0720 and 0723) it appears that *K. sonoriense* readily preys on adult *B. punctatus*, but actively avoid consuming their potentially poisonous tubercles. Consumption of *Bufo* has not been previously reported, though the diet of Arizona populations of *K. sonoriense* has been described from stomach contents (Hulse 1974. J. Herpetol. 8:195–199). Our observations add to the list of dietary items known for this species, and represent the second anuran prey reported. We assume that our observations represent cases of predation; however, it is possible that the toads died of unrelated causes, and were subsequently scavenged by *K. sonoriense*.

We thank the College of Graduate Studies & Research at the University of Central Oklahoma for financial support. This study was conducted under New Mexico Department of Game and Fish

Permit #2905.

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PSEUDEMYS RUBRIVENTRIS (Red-bellied Cooter). **CO-JOINED TWINS**. Axial bifurcation, including bicephalism and bifurcated tails, is a well known malformation in reptiles (Cunningham 1937. Axial Bifurcation in Serpents, Duke Univ. Press, Durham, North Carolina, 117 pp.; Bechtel 1995. Reptile and Amphibian Variants, Krieger Publ. Co., Malabar, Florida, 206 pp.). A hatchling *Pseudemys nelsoni* reported by Bellairs (1981. *In* J. E. Cooper and O. F. Jackson [eds.], Diseases of Reptiles, Vol. 2, pp. 469–485. Academic Press, London) had a partially duplicated carapace and plastron, two heads and anterior limbs, two hearts, respiratory systems, livers, and stomachs, and a single urogenital system, intestine, and cloaca. Here I note an additional instance of co-joined twins in *Pseudemys,* the first reported for *Pseudemys rubriventris*.

On 5 September 2000, Robert Carter found a co-joined twin *Pseudemys rubriventris* adjacent to Bosher's Mill Pond, 0.5 km E Manquin, King William County, Virginia, USA (Fig. 1). He observed normal hatchlings emerging rapidly from the nest and upon inspection found the twins in the bottom of the nest cavity, apparently unable to emerge on their own. The twins had the following measurements: maximum carapace length (CL) = 34.1 mm, maximum plastron length (PL) = 30.9 mm, carapace width = 33.8 mm, and shell height (SH) = 16.6 mm. Two normal siblings measured 34.5 and 34.9 mm CL, 31.7 and 31.8 mm PL, and 17.3 and 17.6 mm SH, respectively. A radiograph revealed two pectoral girdles, each with two pairs of legs and a neck and head, two separate vertebral columns, and one pelvic girdle with a single pair of rear legs. The vertebral columns joined at the sacrum. The nest was adjacent to a parking lot of a power line relay station. The carapace, plastron, head, and limbs were normal in coloration and pattern (Mitchell 1994. The Reptiles of Virginia, Smithsonian Inst. Press, Washington, DC, 352 pp.). In captivity, the left half dominated the right half in strength and direction of movement.

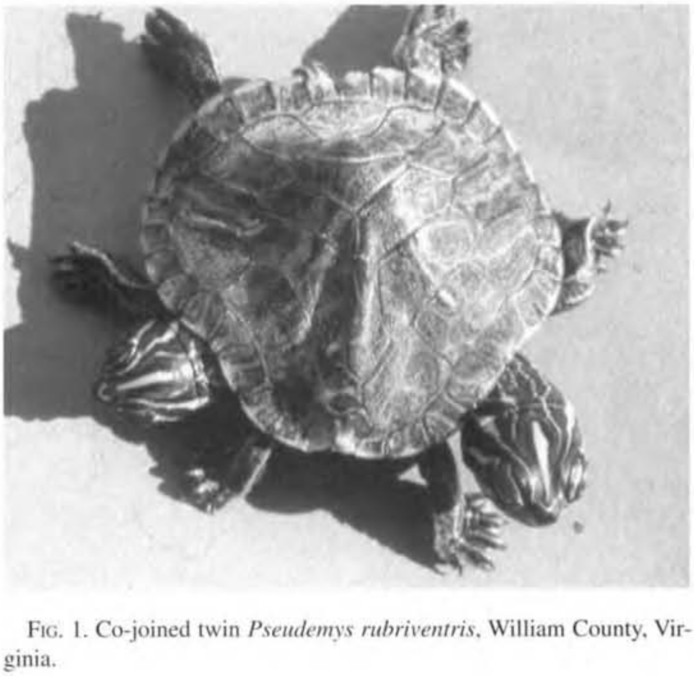

FIG. 1. Co-joined twin *Pseudemys rubriventris*, William County, Virginia.

I thank Robert Carter for allowing me to examine the twins, Deborah Grissom for taking the radiograph, and Elizabeth Pezzullo and Dale Brittle for other forms of assistance.

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TRACHEMYS SCRIPTA ELEGANS (Red-eared slider). **MAXIMUM SIZE**. The maximum straight-line carapace length (CL) reported for *Trachemys scripta elegans* is 28.9 cm (Conant and Collins. 1998. A Field Guide to Reptiles and Amphibians: Eastern and Central North America. Houghton Mifflin Co, Boston. 616 pp.). On 25 September 2001 we found an intact *T. s. elegans* shell with a CL of 29.8 cm (CUSC 2101) on a bluff above Wards Creek (30°25.9'N; 91°07.8'W), ca. 1 km downstream from the bridge at College Dr., Baton Rouge, East Baton Rouge Parish, Louisiana, USA. There is extensive pitting of the plastron bone, and both carapace and plastral annuli are heavily eroded, thus precluding a reliable count. The turtle was probably killed by a raccoon (*Procyon lotor*) several months earlier while nesting. Other straight-line measurements are: plastron length = 25.9 cm; maximum shell depth = 13.2 cm; maximum carapace width = 21.9 cm. This specimen is deposited in the Campbell Museum, Clemson University, Clemson, South Carolina, USA.

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TRACHEMYS SCRIPTA ELEGANS (Red-eared Slider). **DIET.** *Trachemys scripta elegans* is an opportunistic omnivore known to consume a wide variety of plants and animals (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Inst. Press, Washington, D.C. 578 pp.). Herein is the first report of *T. s. elegans* feeding on fruit of the pond apple tree (*Annona glabra*).

On the morning of 14 September 2002 at 0745 h, we observed two *T. s. elegans* feeding on *A. glabra* fruits that had fallen into the C-11 canal in Davie, Broward County, Florida, USA (26°03'56"N, 80°14'29"W). Two days later (16 September 2002), we captured an adult female *T. s. elegans* (carapace length 23.3 cm, plastron length 20.2 cm, mass 2150 g) in a turtle hoop trap baited with canned sardines. The trap was ca. 50 m from the initial observation of *T. s. elegans* feeding on *A. glabra* fruit. The captured turtle was brought back to the lab and maintained in captivity. On 17 September 2002, the turtle defecated and 11 *A. glabra* seeds were observed in its feces.

T. s. elegans is a non-indigenous yet abundant turtle in the freshwater canals of Broward County, Florida (G. Johnston, unpubl. data). However, very little is known about its impact on the native

flora and fauna of this region. Our observations suggest that *T. s. elegans* may play an important role in dispersing seeds of the native *A. glabra*.

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CROCODYLIA

CAIMAN LATIROSTRIS (Broad-snouted Caiman). **BEHAVIOR**. Field studies providing information on parental behavior in *C. latirostris* have focused on nesting and nest protection (Verdade et al. 1992. *In* Proc.11th Work Meet. Croc. Spec. Group. IUCN - Switzerland.). Data addressing parental care and other adult-juvenile behaviors are especially scarce. Captive observations exist, but these have the limitation that the captive environment may interfere with the expression of selected behaviors. Thus, we report here on adult-hatchling interactions that may represent antipredator behavior among wild *C. latirostris* from southeastern Brazil.

Between 18 August and 4 September 1998, we conducted a census and field observations on a small relict group of *C. latirostris* living in Parque Estadual Intervales (Estado de São Paulo), SE Brazil. This group consisted of 2 adults (120–150 cm total length, TL), two subadults (80–100 cm TL) and 16 hatchlings (25–30 cm TL). Observations were made on a small (0.04 ha) lagoon at 315 m elevation (24°23'30"S; 48°29'50"W) created by damming a 1.5-m wide stream flowing from the Serra de Paranapiacaba. Vegetation around the lagoon consisted of herbaceous plants, native bamboo (*Merostachys* sp., Poaceae) and secondary forests (Guix et al. 2002. *In* Mateos et al. [eds.], Censuses of Vertebrates in a Brazilian Atlantic Rainforest Area: The Paranapiacaba Fragment, pp. 141–147. Centre de Recursos de Biodiversitat Animal, Universitat de Barcelona, Barcelona).

On 25 August around 1130 h, we encountered 8 hatchlings on the lagoon margin. Five were in low vegetation just 10–35 cm above the lagoon edge on logs, another 3 were in the water. When one observer approached this hatchling group to within 1 m, the hatchling closest to the observer began to vocalize. The hatchlings immediately began to vocalize, some jumped into the water and some remained on the lagoon margin. Simultaneously, an adult (> 120 cm) slipped off the lagoon margin, and swam toward the center of the lagoon where it began vocalizing. The remaining hatchlings jumped into the water while vocalizing, and then started swimming towards the adult. During this time, the hatchling that had initiated vocalization remained in the water 0.5 m in front of the observer. While most hatchlings fled toward the adult, we caught this hatchling, whereupon it began to vocalize louder. The adult then put its head out of the water at about a 45° angle with its mouth slightly open and vocalized very loudly for 3–5 seconds. After it stopped and put its head down, the hatchling we had in hand also stopped vocalizing.

On 1 September at 2130 h, upon approaching the lagoon margin from a distance of 3 m, we heard an adult *C. latirostris* vocalize. When we reached the lagoon we saw 5 hatchlings on the edge ca. 2 m away. Upon our appearance, one immediately made a plaintive vocalization, after which we saw 15 hatchlings flee in a waterward direction, diving and swimming towards the center of the lagoon. Low vegetation had concealed 10 hatchlings that were only noticed as they fled.

On 2 September at 1000 h, as we got to within 4 m of the lagoon, we heard an adult vocalize, but no hatchlings were seen; none may have been present. On 4 other occasions on different nights, when a hatchling was caught by an observer, it vocalized. Although we did not hear adults vocalize in these cases, they always approached observers, getting as close as 4 m in a slow and silent manner. After approach, adults remained immobile floating at the water surface with their heads out, slightly inclined.

Adults never tried to attack or keep us away from hatchlings; adults approaching observers handling hatchlings seemed more intimidating than agonistic. Hatchlings did not always vocalize when captured, nor did adults always necessarily respond when captured hatchlings vocalized. Of 16 observations in which we handled hatchlings, they were silent in 2 (13%) of them.

Many potential predators of hatchlings are potential prey for adult *C. latirostris*. In part because the relationship between adults and hatchlings was unknown (potentially parental or not), hatchling vocalizations and the approach behavior of adults may have alternate interpretations. These alternatives, which may not be mutually exclusive, include the protection of hatchlings from potential predators (see Steel 1989. Crocodiles. Christopher Helm, London. 198 pp.) through intimidation or agonistic behavior (when a non parental adult or subadult conspecific approaches hatchlings or at nest) and facilitation of the location of prey when hatchlings vocalize in response to the approach of a potential predator.

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LACERTILIA

AMPHISBAENA ALBA (White-bellied Worm Lizard). **REPRODUCTION**. Scattered reports of amphisbaenian eggs found in nature (Goeldi 1897. Zool. Jahrb. [Syst.] 10:640–676; Jared et al. 1997. Herpetol. Rev. 28:44–45) or in the oviducts of gravid females exist (Barros-Filho and Valverde 1996. Sitientibus 14:57–58), but amphisbaenian reproduction remains very poorly known (cf. Gans 1962. Amer. Mus. Novit. 2105:1–31). As far as known, the eggs of *Amphisbaena alba* are laid in ant nests (Riley et al. 1985. Herpetol. Rev. 16:38–43; Azevedo-Ramos and Moutinho 1994. Entomol. News 105:183–184), but egg-laying behavior is undescribed. Here, we provide the first data on oviposition behavior in *A. alba* based on a female collected in southeastern Brazil.

At 0700 h on 5 September 1997, during a faunal rescue for Hy-

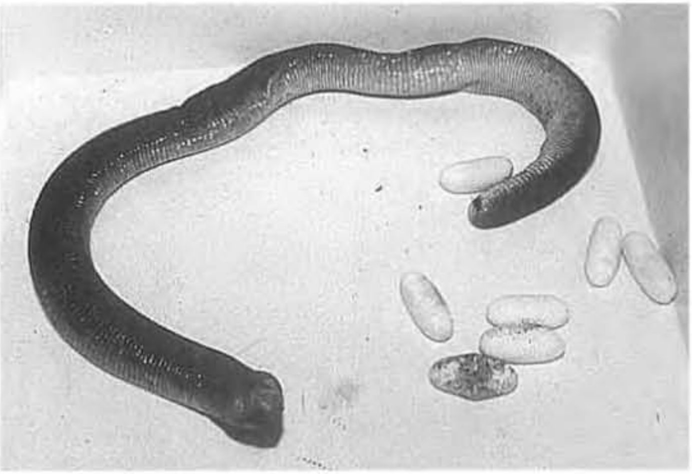

FIG. 1. Adult (ca. 55 cm total length) *Amphisbaena alba* during oviposition with seven of her recently laid eggs. One of the two eggs first deposited is darkened from fungi.

droelectric Usine Miranda in Indianópolis, State of Minas Gerais (18°55'S, 48°02'W), the rescue staff collected a female of *A. alba* (ca. 55 cm total length). The local macrohabitat is "cerrado," a deciduous and semi-deciduous seasonal dry forest association (Rizzini 1979. Tratado de Fitogeografia do Brasil, Vol. 2, Editora da Universidade de São Paulo, São Paulo. 374 pp.). Upon capture, the female was placed in a wooden collection box (1.0 m x 0.5 m). When the box was opened at 1400 h, two eggs had already been laid. One of us (LBN) observed the remaining 6 eggs being laid between 1554 h and 1835 h. During oviposition, the female maintained an extended position (Fig. 1), and strong contractions of the belly were observed; these progressed in an anterior-posterior direction, like a wave, some for each egg deposited. Deposited eggs were white, essentially equal in size (each measured ca. 3.1 cm x 1.5 cm; Fig. 1). During oviposition, the female displayed neither aggressive nor escape behavior. However, the female became aggressive upon being touched after eggs had been laid, raising her head and tail simultaneously with the mouth opened. Despite the obvious collecting stress, we believe that, when collected, the female was close to oviposition, because at least two other females from the same faunal rescue contained well-developed eggs. Incubation of the eggs described herein was unsuccessful because of fungal infestation. The female was released in appropriate habitat upon completion of observations.

We thank CEMIG (Centrais Elétricas de Minas Gerais) for the financial support and permission to collect the *A. alba* for observation, and Augusto S. Abe and Marc P. Hayes for suggestions on the manuscript.

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AMPHISBAENA FENESTRATA (Virgin Islands Amphisbaena). **PREDATION**. Relatively little is known about the biology of many fossorial reptiles and amphibians. For example, almost nothing is known about the predators of any species of *Amphisbaena*. Here we report, for the first time, two cases of predation on *A. fenestrata* observed on Guana Island, British Virgin Islands. In both cases, predation was by the locally abundant colubrid snake *Alsophis portoricensis*.

On 7 October 2001 at 1000 h (air temp. 27.2°C), we captured a male *Alsophis portoricensis* (520 mm SVL, 285 mm TL, mass 52.3 g). It was encountered at an elevation of 160 m near a forest trail on a substrate of dry leaves and small pebbles. The snake was placed in a cloth bag and ca. 30 min later regurgitated a freshly eaten adult *A. fenestrata* (210 mm SVL, 15 mm TL). The specimen was in good condition and was deposited at the Yale Peabody Museum (accession number YPM 12060).

A second predation event was recorded on videotape by Troy Peliwan on 20 October 2001. Around 1800 h, he encountered an *A. portoricensis* attempting to capture and subdue an adult *A. fenestrata*. The snake was first observed on a concrete floor. When disturbed, it moved into the nearby bushes, dragging the *Amphisbaena* with it. Swallowing continued until the snake disappeared, with the prey still in its mouth ca. 10 min later. Both predator and prey were identified from the videotape by GP.

Alsophis portoricensis is known to prey primarily on lizards, though other small vertebrates are also commonly taken (Henderson and Sajdak 1999. *In* Powell and Henderson [eds.], Contributions to West Indian Herpetology: a Tribute to Albert Schwartz, pp. 327–338. Soc. Study Amphib. Rept., Ithaca, New York, 457 pp.). However this is the first record of amphisbaenians in its diet.

We thank L. Lazell and R. Henderson for discussions of these events and the staff of Guana Island for technical assistance. Financial support was provided by The Conservation Agency through a grant from the Falconwood Foundation.

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ANOLIS POLYLEPIS (Golfo Dulce Anole). **DIET.** Several studies have shown that vertebrates are rare in the diet of small Neotropical lizards (e.g., Magnusson and Da Silva 1996. J. Herpetol. 27:380–385). Especially little is known about the importance of lizards in the diet of most *Anolis*, a diverse genus with > 400 species having many relatively small (< 60 mm maximum SVL) forms (Pough et al. 2001. Herpetology. 2nd ed. Prentice Hall. New Jersey. 612 pp.). One such small species is *Anolis polylepis*, which reaches a maximum size of 55 mm SVL. *Anolis polylepis*, commonly encountered either on the ground or in low vegetation at heights < 2 m (Leenders 2001. A Guide to Amphibians and Reptiles of Costa Rica. Zona Tropical. Miami, Florida), is known to prey on insects in leaf litter (Leenders, *op. cit.*). Here, we provide the first report of vertebrate prey.

At 1015 h on 20 October 2001, in Golfito National Wildlife Refuge, Puntarenas Province, SW Costa Rica (8°40'N; 83°10'W), we captured a female (41 mm SVL) *A. polylepis* on a tree trunk,

about 60 cm above ground. Upon capture, the female regurgitated a small (29 mm SVL) partially digested anole. We identified it as another *A. polylepis*, so this is the first report of cannibalism in this species.

Some anoles are known to prey on other anoles; some are cases of cannibalism. The latter has been reported in *A. carolinensis* (Jenssen 1993. Herpetol. Rev. 24:58–59) and *A. sagrei* (Nicholson et al. 2000. Herpetol. Rev. 31:173–174). Eleven species of *Anolis* occur in Golfito, including some common ones such as *A. limifrons*, *A. capito*, *A. aquaticus,* and *A. polylepis*. Saurophagy or cannibalism might have implications for studies of territoriality and social behavior in these and other species of anoles (Nicholson et al., *op. cit.*).

Observations were made during a field trip of the herpetology course at the School of Biology, University of Costa Rica (UCR). We acknowledge UCR for support at Golfito, and thank William Eberhard for his suggestions.

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LACERTA MONTICOLA (Iberian Rock Lizard). **PREDATION.** *Lacerta monticola* is a small (65–78 mm adult SVL) insectivorous lacertid lizard found mostly in rocky, montane areas of the north and central Iberian Peninsula (Pérez-Mellado 1997. *In* Ramos [ed.], Fauna Ibérica, Vol. 10. Reptiles, pp. 207–218. Museo Nacional de Ciencias Naturales, CSIC, Madrid). In the Sierra de Guadarrama (Central Spain), it is the only lizard species recorded between 1750 and 2350 m elevation. *Lacerta monticola* also shares this habitat with the snow vole, *Chionomys nivalis* (Martín and Salvador 1992. Oikos 65:328–333), a poorly known microtine rodent (40–70 g adult mass) discontinuously distributed from SW Europe to Iran that typically inhabits deep cavities and interstices of rocky habitats (Krapp 1982. *In* Niethammer and Krapp [eds.], Handbuch der Säugetiere Europas, Rodentia II, pp. 261–283. Akademische Verlag, Wiesbaden). No data addressing the relationship of these two species exist. Here, we provide the first report of interaction between *L. monticola* and *C. nivalis*.

Our observations were made during lizard surveys in the "Puerto de Navacerrada" (40°46'N, 04°00'W, Guadarrama Mountains; elevation 2000 m) in July–August 2000. At 1200 h on 13 July 2000, we observed an adult snow vole attack an adult *L. monticola* (~70 mm SVL). After having emerged from a crevice, the vole ran rapidly toward a male *L. monticola* that had been basking on a sunny rock nearby. After a chase lasting a few seconds, the vole managed to grasp the lizard by its tail. The lizard immediately autotomized its tail and fled. The vole took the broken tail, ran to a crevice, and, there, ate the entire tail.

On 13 August 2000 at 1100 h, after the period of emergence of hatchling lizards, we observed a second attack by an adult snow vole. The vole had been walking on the rocks close to a crevice when it detected a *L. monticola* hatchling (~30 mm SVL). Upon detection, it easily captured it after a short rush, and immediately started to eat it by the head.

Adult snow voles were considered to be exclusively herbivorous (Krapp, *op. cit.*). Our observations suggest that predation can be at least facultative. The rigor of environmental conditions in alpine habitats may contribute to explaining why snow voles occasionally prey on lizards, but *Chionomys nivalis* needs study to determine the importance of predation in its overall ecology.

We thank "El Ventorrillo" MNCN Field Station for use of their facilities. Project DGESIC PB 98-0505 to PL and JM, and a predoctoral grant 'Beca per a la Formació de Personal Investigador' 1998FI-00668 (CIRIT) and project DGES PB96-0991 to JJL supported this research.

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LEIOCEPHALUS CARINATUS ARMOURI (Northern Curly-tailed Lizard) **OPPORTUNISTIC PREDATION**. Distinctive circumstances can result in opportunistic predation on atypical prey (Woodin and Woodin 1981. Florida Field Nat. 9:64). Here, we document an opportunistic predation event by a great barracuda on a northern curly-tailed lizard, *Leiocephalus carinatus armouri*, in South Florida.

At ca. 0800 h on 22 August 2002, a sunny day with a temperature around 27°C, a ca. 7.5 cm SVL adult lizard was observed sunning 0.3 m above the ground on the smooth, painted seawall above the estuarine canal (the Intracoastal Waterway) near Woolbright Road in Boynton Beach, Florida (26°30'N, 80°03'W). Intimate familiarity with the species, especially the characteristic curl in the tail, revealed the lizard to be a northern curly-tailed lizard, *L. carinatus armouri*, a well-established exotic species in Florida (Weigl et al. 1969. Copeia 1969:841–842). Three anglers, visible from the lizard's position, startled the curly-tail by rapidly approaching its perch from the west. Yet, rather than seek escape by climbing down the seawall to the adjacent ground, the lizard fled down the east side of the seawall and promptly fell 1.5 m down into ca. 0.5 m deep water. After struggling at the water surface no more than 2–3 seconds, the lizard disappeared from the surface in a V-waked noisy splash. A relatively small (ca. 70 cm fork length) great barracuda, *Sphraena barracuda*, could be seen ca. 0.3 m below the surface holding the lizard sideways in its jaws. When the anglers climbed onto the seawall to view the commotion, the barracuda, still with the curly-tail, darted out of view. Observations of the general area continued until about 0805 h, but neither the barracuda nor lizard was seen again.

A breeding population of curly-tailed lizards has existed at the Woolbright Road location since at least 1986, and this species is one of the most common reptiles in the local area (HTS, pers. obs.). Previous observations of northern curly-tailed lizards over many years at this site have shown it to be an agile terrestrial reptile that climbs rough-surfaced hard structures (e.g., cement staircases) with ease and habitually seeks shelter in structural crevices when disturbed. This coupled with unfavorable circumstances of the lizard being startled and the relatively smooth seawall surface presenting a poor surface for purchase likely contributed to this opportunistic predation event.

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LEPIDOPHYMA GAIGEAE (Gaige's Tropical Night Lizard). **REPRODUCTION.** *Lepidophyma gaigeae* occurs in the Mexican states of Hidalgo and Querétaro (Bezy and Camarillo R. 2002. Contr. Sci., Nat. Hist. Mus. Los Angeles Co. 493:1–41). The sparse reproductive data available describe six females collected in Querétaro: five collected in January had ovulated and one collected in December gave birth to one neonate in March (Dixon et al. 1972. Southwest. Nat. 16:225–237). Here we augment the limited information on reproduction in *L. gaigeae*.

Twenty-one males (mean SVL = 54 mm ± 3 SD, range: 47–59 mm) and 24 females (mean SVL = 55 mm ± 3 SD, range: 50–63 mm) were collected at Durango, Hidalgo, México (20°54' N, 99°14' W) March 1999 to February 2000. Lizards were fixed in 10% formalin, preserved in alcohol, and deposited in the herpetology collection of the Escuela Nacional de Estudios Profesionales Iztacala, Universidad Nacional Autónoma de México.

The left gonad was removed (except for yolk filled follicles or oviductal eggs) and embedded in paraffin. Histological sections were cut at 5 µm, mounted on glass slides and stained with Harris' hematoxylin followed by eosin counterstain. Testis slides were examined to determine the stage of the spermatogenic cycle (recrudescence, primary spermatocytes predominate; spermiogenesis, sperm project into lumina of seminiferous tubules). Ovary slides were examined to determine the stage of the ovarian cycle (inactive, no yolk deposition; vitellogenic, yolk granules present). Enlarged ovarian follicles > 5 mm length or oviductal eggs were counted.

Examination of male monthly samples revealed *L. gaigeae* has a prolonged period of spermiogenesis: March (2) one regressed, one recrudescent; May (1) spermiogenesis; June (3) spermiogenesis; July (3) spermiogenesis; August (1) spermiogensis; October (2) spermiogensis; November (4) spermiogensis; December (1) spermiogensis; January (4) three spermiogensis, one recrudescent. The smallest reproductively active male (spermiogenesis) measured 49 mm SVL.

Examination of monthly female samples indicated *L. gaigeae* begins yolk deposition in late summer and ovulates in winter: March (1) oviductal eggs 2; April (5) oviductal eggs 2, 2, 2, 2, 2; June (1) no yolk deposition; August (4) three no yolk deposition, one yolk deposition; September (1) yolk deposition; October (2) yolk deposition; November (3) yolk deposition; January (3) two oviductal eggs 4, 2, one with 3 enlarged (6 mm) follicles; February (4) oviductal eggs 3, 3, 3, 3. Mean litter size was 2.5 ± 0.7 SD, range: 2–4. No significant correlation existed between ln SVL and ln litter size, $P = 0.14$. The smallest reproductively active female (yolk deposition in progress) measured 50 mm SVL. Although we did not collect neonates, we believe parturition occurs in spring. Méndez-de la Cruz et al. (1999. J. Herpetol. 33:336–339) reported similar timing in the ovarian cycle of *Lepidophyma pajapanensis* from Veracruz, México, where ovulation occurs in March and females give birth by late May or early June.

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SAUROMALUS OBESUS (Common Chuckwalla). **ALBINISM.** Albinism in iguanid lizards has been documented for several North American taxa: *Phrynosoma coronatum* (Shaw 1963. Copeia 1963:154), *Sceloporus olivaceus*, and *Sceloporus undulatus* (Hensley 1968. J. Herpetol. 1:92–93). This is the first record of albinism for *Sauromalus obesus*.

On 19 June 2000, two of us (DRT and GTC) observed an adult, albinistic *S. obesus* along the road from Harper Dry Lake through Black Canyon, ca. 200 m northwest of Inscription Canyon and north of Opal Mountain, San Bernardino County, California, USA (35°11'33" N, 117°11'52" W; Fig. 1). The specimen was observed through binoculars at close range (9 m) and its pigmentation was described as "stark white" with a faint pattern that was "off yellow" in color with "white claws." Eye coloration could not be precisely determined, but it appeared dark in an enlarged photograph. Its total length was ca. 60 cm. Other *S. obesus* observed in the area were black to reddish brown in color.

Color slides of this animal were deposited in the Natural History Museum of Los Angeles County (LACM PC 1337–38).

FIG. 1. Albinistic *Sauromalus obesus*, San Bernardino County, California.

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SCINCELLA LATERALIS (Ground Skink). **COMMUNAL NEST; EGG AND HATCHLING SIZES.** Reproductive data on *Scincella lateralis* include single clutches with a mode of 3 (range: 1–7; Fitch and Greene 1965. Univ. Kansas Pub. Mus. Nat. Hist. 15:565–575; Johnson 1953. Tulane Stud. Zool. 1:11–27; Lewis 1951. Amer. Midl. Nat. 45:232–240; Mather 1970. Texas J. Sci. 21:429–438). Communal oviposition is reported for other skinks (Young 1988. Catesbeiana 8:34), but is not known in *S. lateralis*. Here I provide the first report of communal oviposition in this terrestrial skink from a site in Bryan, Texas (USA).

While moving sandy loam soil from beneath a china berry tree (*Melia azderac*) on 22 June 2002 at 705 Inwood Drive (30°37'48"N, 96°20'25"W), I encountered a nest of lizard eggs 14 cm below and 74 cm from the base of the tree. Two hatchling ground skinks, 2 collapsed eggshells, and 29 other eggs were in the nest. The length and width of each egg was measured to the nearest 0.1 mm with Vernier calipers, and the eggs were placed in a plastic container with moist vermiculite. The container was maintained in a shaded environment at ambient temperatures. Upon hatching, each hatchling was measured for snout–vent (SVL) and tail length (TL).

The 29 eggs averaged 7.7 mm (range 5.6–9.2 mm) in width; and 10.7 mm (range 9.3–13.6 mm) in length. The egg hatching sequence (number of eggs hatched on each date in parens) was as follows: 22 June (2); 24 June (3); 25 June (2); 26 June (1); 30 June (1); 2 July (2); 3 July (1); 4 July (2); 11 July (2); 12 July (1); 15 July (1); 20 July (1); 23 July (2); 25 July (3). Five eggs did not hatch and developed fungal growth. These were preserved and later opened. Two contained small amounts of yolk, 2 had unpigmented but well-developed embyros, and 1 was a fully formed pigmented embyro ready to hatch. The latter measured 12 mm SVL, 16 mm TL.

Variation in size of the 24 individuals hatched *in vitro* was 17.0–21.0 mm SVL (mean = 19.4 mm); 22.7–31.0 mm TL (mean = 28.8 mm). The 2 hatchlings found in the nest were within the size range of the *in vitro* hatchlings (19 and 20 mm SVL, 25.5 and 27.1 mm TL, respectively), and contained unhealed umbilical scars, suggesting that they just hatched when the nest was discovered.

Fitch and Greene (*op. cit.*) also found that females have a minimum of 22 days between clutches and produce as many as 4 clutches per year. This communal nest may have contained 15 to 26 clutches of eggs based on when the eggs hatched and known variation in clutch size. Moreover, based on the aforementioned intra-clutch interval of 22 days, some females could have laid more than one clutch in the nest.

The study was carried out under Texas Parks and Wildlife Scientific Collecting Permit number SPR 0290-022. Twenty-four of the hatchlings were deposited in the Texas Cooperative Wildlife Collection (TCWC 84866–89).

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SERPENTES

ARIZONA ELEGANS ARENICOLOR (Texas Glossy Snake). **DEFENSIVE BEHAVIOR.** The Texas glossy snake (*Arizona elegans arenicolor*) is a poorly known, locally abundant snake in sandy habitats of south Texas (Werler and Dixon 2001. Texas Snakes. Univ. of Texas Press, Austin, Texas. 544 pp.). Three male and two female glossy snakes were captured as part of an ongoing mark-recapture study of Western diamondback rattlesnakes (*Crotalus atrox*) on the Chaparral Wildlife Management Area (Texas Parks and Wildlife Department, La Salle and Dimmit Counties, Texas, USA). The snakes were captured in wire mesh funnel traps placed along 21 drift fence arrays at five sites between 23 June and 19 July 2001. Each snake was sexed and marked by scale clipping the ventral scales. Defensive behavior was also noted for four of these snakes.

Males appeared to be aggressive more often than females, but this was not statistically significant (Fisher's exact test $p = 0.25$). Females exhibited no overt defensive behavior as is typical for this species (Werler and Dixon, *op. cit*; Tennant 1985. A Field Guide to Texas Snakes. Gulf Publishing Co., Houston. 292 pp.). Males exhibited active defense. All three male snakes, prior to removal from the trap, formed an elevated S-coil similar to that of *Crotalus* spp. (Klauber 1997. Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind. Vol. 1. 2nd Ed. Univ. California Press, Berkeley, California. 740 pp.) and struck and bit repeatedly.

Additionally, upon release, one male moved swiftly and directly to the nearest shrub, a brasil (*Condalia hookeri*), ca. 1.6 m tall and climbed to the end of a branch ca. 1.3 m above the ground. When an attempt to recapture the snake was made, it moved to the end of a limb on the opposite side of the tree. The spiny nature of the shrub prevented recapture.

Active defense in the form of coiling, striking, and biting have not been reported previously for *A. elegans*. This species typically remains motionless and sometimes forms lateral kinks in its body in the presence of humans (Werler and Dixon, *op. cit*). The apparent difference between males and females may be an artifact of sampling but could potentially be the result of elevated testosterone levels, as the period of my observations is consistent with testicular recrudescence (Aldridge 2001. Amphibia-Reptilia 22:243–249).

The active defensive displays could also be an example of Batesian mimicry, where *A. elegans* is mimicking the defensive displays of *C. atrox* as has been suggested between gopher snakes (*Pituophis catenifer*) and western rattlesnakes (*C. viridis*) (Sweet 1985. J. Herpetol. 19:55–67). Predator density appears to be high in the area. Coyotes (*Canis lupus*) and northern caracaras (*Caracara cheriway*) are extremely abundant, with the latter being a known ophiophage (Palmer 1988. Handbook of North American Birds Vol. 5. Diurnal Raptors Part 2. Yale University Press, New Haven, Connecticut. 448 pp.). Additional predators in the area include bobcat (*Lynx rufus*), common raccoon (*Procyon lotor*), American badger (*Taxidea taxus*), and Harris's hawk (*Parabuteo unicinctus*; D. C. Ruthven, pers. comm.).

Escape into thorny shrubs may also be adaptive in this predator-dense environment. My inability to remove the snake from the brasil attests to this. The aggressive coiling and striking could potentially distract the predator long enough to facilitate escape into nearby woody vegetation. I suggest further investigations concerning geographic variation in antipredator behavior and the influence of predator density on selection of antipredator behavior in this species.

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and Chip Ruthven (Chaparral Wildlife Management Area, Texas Parks and Wildlife Department) for comments that improved the manuscript. The Wildlife Division of Texas Parks and Wildlife Department provided logistical support.

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ATRACTUS RETICULATUS (Cobra-de-terra). **PREDATION**. The majority of Brazilian hawks include snakes in their diet (Sick 1993. Birds in Brazil: A Natural History. Princeton University Press, 703 pp.; Rivas and Owens 2001. Herpetol. Review 32:108); however, we are aware of no records of *A. reticulatus* being preyed upon by hawks. On 8 August 2001, we observed a specimen of *Buteo magnirostris* (Falconiformes: Acciptridae) feeding on an adult female specimen of *A. reticulatus* (CEPB/IFSM 123-01; 240.6 mm SVL), on the south bank of the Uruguai River (27°30'06"S, 51°42'52"W), municipality of Machadinho, in the State of Rio Grande do Sul, Brazil. The hawk was perched on a small rock in a pasture and was eating the head of the snake. After 13 min., the hawk flew away leaving most of the posterior part of the snake.

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BOTHROPS INSULARIS (Golden Lancehead). **DIET**. Accurately determining prey selection and foraging events is essential for a complete understanding of predator foraging ecology and their impact on prey communities (MacGregor and Reinert 2001. Herpetol. Rev. 32:170–172). Some snakes living on small islands have relatively limited sympatric prey items available, and sometimes depend on seasonal bird migrations, e.g. *Macrovipera schweizeri* (Nilson et al. 1999. Amphibia-Reptilia 20:355–375) and *Gloydius shedaoensis* (Sun et al. 2001. Biol. Cons. 97:387–398). On 20 November 2001 (1800 h) at Queimada Grande, a tiny island off the southeastern coast of Brazil (24°28'S; 46°40'W), we discovered an adult *Bothrops insularis* (ca. 60 cm total length) coiled around a freshly-killed adult *Leptotila rufaxilla* (Grey-fronted Dove) on the ground. The head and neck feathers were covered with saliva, evidence that the snake had attempted to swallow the bird. Diameter at the thickest part of the bird's body was ca. 10 cm. However, the prey was apparently too large to be ingested by the snake. Interactions between *B. insularis* and *L. rufaxilla* might be common because this bird is a frequent ground forager and as a result might be highly susceptible to predation. Campos and Mello Filho (1966. A Folha Médica 52:21–44) reported a similar failed feeding attempt on *L. rufaxilla* by *B. insularis*.

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CLELIA PLUMBEA (Mussurana). **NECROPHAGY**. On 23 November 2000, at 2130 h, on a dirt road crossing the coastal plain of Pontal do Ipiranga (19°07'12"S, 39°46'72"W), municipality of Linhares, Espírito Santo state, Brazil, the first author found a female *Clelia plumbea* (61.5 cm SVL; 78.5 cm TTL) with the tail of another snake protruding from its mouth. The *C. plumbea* was immediately collected and placed in a bag, where it promptly regurgitated its meal, a male specimen of the semi-aquatic snake *Liophis miliaris* (49.5 cm SVL; 59 cm TTL). The *L. miliaris* was apparently a road-kill (its body was flattened and appeared to have been run over by a car), which means it was already dead when found by the *C. plumbea*. The *C. plumbea* was subsequently deposited (along with its stomach contents) at the collection of the Museu de Zoologia Mello Leitão (MBLM 729) in Santa Teresa, Espírito Santo, Brazil.

At the time the above event was observed, the entire surrounding pasture area (which is situated on a lower level compared to the road) was flooded, as is typical during the rainy season at this area. We assume that during this period the available habitat area and the food supply for many organisms is reduced, which could favor dietary shifts (such as facultative necrophagy) in some predatory species. Several other snake species have been observed to use the road as their main habitat for foraging during the rainy period in this area (R. L. Teixeira, pers. obs.).

Occasional necrophagy has been previously recorded in a few Brazilian snakes (Sazima and Strussmann 1990. Rev. Brasil. Biol. 50:463–468), as well as in several other species of snakes worldwide (e.g., Bedford 1991. Herpetofauna 21:35–36; Hamel 1996. Herpetol. Rev. 27:43; Mora 1999. Herpetol. Rev. 30:102; Sajdak and Sajdak 1999. Herpetol. Rev. 30:229; Shine 1986. Copeia 1986:424–437). This note adds *C. plumbea* to the list of snake species that can be considered occasional scavengers.

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CLONOPHIS KIRTLANDII (Kirtland's Snake). **AGGREGATING BEHAVIOR** and **SITE FIDELITY**. Little is known about reproductive cycles or social behavior in *Clonophis kirtlandii*. Most information is anecdotal; a published report of communal denning in *C. kirtlandii* exists (Conant 1943. Amer. Midl. Nat. 29:313–341). Fitch (1970. Univ. Kansas Mus. Nat. Hist. Misc. Pub. 52:1–247) did not mention fall copulation in *C. kirtlandii*, but Ernst and Barbour (1989. Snakes of Eastern North America. George Mason University Press, Fairfax, Virginia. 282 pp.) suggested females may produce more than one litter per year. Minton (2001. The

Amphibians and Reptiles of Indiana. Indiana Academy of Sciences, Indianapolis, Indiana. 404 pp.) mentions a 30 July parturition date, which may indicate fall copulation, and refuge/site fidelity.

At 1410 h on 17 September 2001 we encountered four adult *C. kirtlandii* occupying a single crayfish burrow in Will County, Illinois, USA. The sky was overcast with sporadic light rain and an air temperature of 19.6°C. The site is graminoid-dominated restored prairie with a perched water table and numerous crayfish (*Fallicambarus fodiens, Procambarus gracilis*) burrows. The first snake encountered (adult male, 315 mm SVL, 25.5 g) was found at the surface with ca. 1/3 of its anterior down a 22 mm diameter crayfish burrow. Closer inspection revealed a second snake beneath the first, with its anterior half partially concealed within the burrow. This snake, also an adult male (313 mm SVL, 27.5 g) and the other were removed from the burrow for examination. Upon removal of the two snakes, the head of a third immediately appeared at the burrow entrance. This snake vacated the burrow during observation and was another adult male (320 mm SVL, 28.5 g). After capturing this snake, a fourth *C. kirtlandii* appeared at the burrow opening and slowly began to exit when tapped lightly behind the head by one of us. This snake proved to be an adult female (355 mm SVL, 27.05 g). Temperature in the burrow at a depth of 19 cm was 18°C. The four snakes were retained in the laboratory for data collection and photographs. The female shed her skin in the collecting bag en route to the laboratory. While confined in a 2-1/2-gallon aquarium with paper towel substrate, all three males exhibited courtship behavior, e.g., chin rubbing, frequent tongue-flicks along the female's body, and tail wrapping. When inactive, the snakes coiled in a compact mass under the substrate. The courtship behavior continued intermittently until 21 September, when the four snakes were released at the capture site.

At the same locality in April, two adult female *C. kirtlandii* were found under separate (4 m apart) 1.3 x 1 m corrugated tin sheets positioned to survey snakes. Both were identified by unique dorsal patterns and scale-clipped subcaudals. The first female (374 mm TL, 13 g) found 24 April was not recaptured, but the second (250 mm SVL, 9.5 g) found 25 April, was found under the same cover panel on 26, 27, and 30 April. Similar observations occurred previously (D. Mauger, unpubl. data), however four *C. kirtlandii* found under cover panels on successive days from April to June 1996 were not marked; it was therefore unknown whether they represented one or more individuals.

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CROTALUS ATROX (Western Diamondback Rattlesnake). **BEHAVIOR**. Most observations of agonistic behavior between conspecific male snakes have been made during the mating season and have been interpreted as competition "for priority of access to females" (Schuett 1994. Zoo Biol. 15:209–221). Schuett (*op. cit.*) proposes that "there is little evidence that fights in nature occur over space (territories) or food."

Here, we report two observations of male-male fighting from upland Sonoran desert, 22 km E of Carefree, Arizona, USA, in Camp Creek Wash (33°47'N, 11°45'W, 671 m) on the Tonto National Forest. At 0930 h on 15 October 1998 two *C. atrox* (both > 1200 mm SVL) were observed fighting. Fighting continued for ca. 2 min. before the pair, disturbed by the observer's (BLS) presence, disengaged and attempted to retreat into adjacent vegetation. Extensive tracks in the sandy wash suggest a lengthy engagement prior to observation. On 3 November 1998, at 1540 h, two *C. atrox* (both ca. 900 mm SVL) were observed fighting for ca. 1 min. before the pair, disturbed by the observer's (BLS) presence, disengaged and retreated into a *Neotoma albigula* midden. In neither case was a female snake found on the surface, though it is possible a female may have been present in nearby refugia. In addition to our observations, late season male-male fighting has been reported on 6 December in a Texas population (Klauber 1972. Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind. Univ. of California Press, Berkeley. 1533 pp.) and a photograph of fighting that appears in Lowe et al. (1986. The Venomous Reptiles of Arizona. Arizona Game and Fish Department, Phoenix. 115 pp.) was taken on 29 October (Brent Martin, pers. comm.). In upland Sonoran desert of central and southern Arizona, *C. atrox* often overwinter in rocky retreats (or *N. albigula* middens) on hillsides or along dry washes (ATH, radiotelemetric observations). Here, *C. atrox* typically exhibit a flurry of mating and male-male fighting in March–April at or near the den site, usually prior to egress (Roger Repp, pers. comm.). Mating and male-male fighting also occur September–October (Lowe et al., *op cit.*). Although males have been observed with females in November (Roger Repp, pers. comm.), the latest date of confirmed copulation is 15 October (Gordon Schuett, pers. comm.). On warm days in winter, male *C. atrox* occasionally make short movements between refugia (ATH, radiotelemetric obs.). Thus, although it is probable our observations are of males fighting for access to females late in the fall mating period, considered collectively, they raise the possibility that from November through February, males might be competing for primary access to refugia occupied by females that will be receptive upon emergence in spring.

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CROTALUS CATALINENSIS (Santa Catalina Island Rattleless Rattlesnake). **REPRODUCTION**. *Crotalus catalinensis* is endemic to Isla Santa Catalina (25°39'N, 110°49'W), Baja California Sur, Mexico. The biology of this species was summarized by Beaman and Wong (2001. Cat. Am. Amphib. Rept. 733.1–733.4). Information on *C. catalinensis* reproduction is in Grismer (2002. Amphibians and Reptiles of Baja California Including its Pacific Islands and the Islands in the Sea of Cortés, University of California Press, Los Angeles, xiii + 399 pp.). The purpose of this report is to present information on the testicular and ovarian cycle from

a histological examination.

Reproductive data are presented from six *C. catalinensis* collected from 1962–1974. The posterior portion of each snake was opened by a mid-ventral incision to expose the gonads. The left ovary or left testis and vas deferens were removed for histological examination. Gonads were dehydrated in a graded series of ethanol, cleared in toluene and embedded in paraffin. Histological sections were cut at a thickness of 5 µm, mounted on slides and stained with hematoxylin and eosin counterstain. Oviductal eggs from one pregnant female were measured and counted (histological examination of the eggs was not performed).

Three females collected 27 April (San Diego Society of Natural History, SDSNH 48020, SVL 753 mm), 24 June (California Academy of Sciences, CAS14000, SVL 560 mm), and 25 June (SDSNH 53052, SVL 540 mm) did not exhibit yolk deposition (= secondary vitellogenesis *sensu* Aldridge 1979. Herpetologica 35:256–261). One female (SDSNH 44353, SVL = 662 mm) collected 19 April contained four oviductal eggs (12–16 mm length). The presence of non-vitellogenic females during the reproductive season suggests that not all females are reproductively active every year. Frequency of reproduction in rattlesnakes is apparently variable with some populations producing litters each year (Fitch 1985. Misc. Pub. Mus. Nat. Hist., Univ. Kansas 76:1–76; Fitch and Pisani 1993. Univ. Kansas Occas. Pap. Mus. Nat. Hist. 156:1–24). Biennial, triennial, or quadraennial cycles may occur within the same species (Ernst 1992. Venomous Reptiles of North America. Smithsonian Institution Press, Washington, 236 pp.). Yearly percentages of pregnant females appear related to food abundance (Goldberg and Rosen 2000. Texas J. Sci. 52:101–109). While gravid *C. catalinensis* have been observed from mid-July to early August, with one female having five early-developing embryos, neonates have been observed during mid-August with a female collected in early August producing two young (Grismer, *op. cit.*). Cliff (1954. Trans. San Diego Soc. Nat. Hist. 12:67–98) reported that a sexually mature female collected in March had not ovulated, however, it was not stated if the follicles were enlarged.

Two males were examined. The testis from one male, (SDSNH 44353, SVL = 698 mm) collected 19 April was in recrudescence. Sertoli cells, spermatogonia, and primary spermatocytes were present, while the vas deferens contained sperm from the previous spermiogenesis. The second male (University of Kansas, Museum of Natural History, KU 159591, SVL = 750 mm), collected 27 August, was undergoing spermiogenesis. Clusters of metamorphosing spermatids lined the seminiferous tubules. The vasa deferentia contained sperm. These observations suggest the testicular cycle of *C. catalinensis* is similar to that of other North American rattlesnakes (Goldberg 1999. Texas J. Sci. 51:31–36; Goldberg 2000. West. N. Am. Nat. 60:98–100; Goldberg and Rosen, *op. cit.*), which have a summer–autumn period of sperm production (spermiogenesis) followed by a spring-early summer period of regression and renewal (recrudescence) for the next period of spermiogenesis.

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CROTALUS PRICEI (Twin-spotted Rattlesnake). **WINTER ACTIVITY**. We tracked three *Crotalus pricei* (two males and one female) monthly using implanted temperature-sensitive radiotransmitters during September 1997–April 1998 in Arizona's Chiricahua Mountains, USA (elevation range = 2530–2700 m). For reference, mean temperature at 1.5 m above ground (T_{air}) between 20 November 1998 and 20 February 1999 was 5.8°C at the lowest elevation site. At least one snake was visible during each tracking period in all months except February, when we were unable to access the area because heavy snowfall.

In mid- to late October, the two males moved from talus slopes where they had spent the previous months to new talus slopes. Each selected relatively warm locations near the edge of the talus slope where snowmelt was rapid. At one of these sites on 15 December, the substrate (talus) temperature (T_s) was 41.6°C (T_{air} = 15.6°C).

The female snake spent the winter off talus. Like the males, she moved into her winter area in mid-October. She remained in a location densely vegetated with ground cover (mostly *Eriogonum jamesii*) until at least mid-December. From mid-January to mid-March, she was under a surface rock.

The female snake moved at least 11.1 m between 15 December and 13 January. One of the male snakes moved 7.5 m during November, and the other moved at least 1.2 m every month. We never observed conspecifics near radiotelemetered animals in the winter, suggesting that they overwintered singly.

Body temperature (T_b), T_{air}, and T_s were recorded when snakes were located (range = 0922–1538 h). Between November–April, T_b averaged (mean ± SE) 18.5 ± 2.2°C (N = 13, range = 5.0–29.8°C). T_s at *C. pricei* locations was substantially warmer than T_{air} ($T_s - T_{air} = 7.12 \pm 2.21$°C); T_b did not differ significantly from T_s ($T_b - T_s = -1.02 \pm 2.54$°C). Mean T_b of *C. pricei* during December–February (16.1 ± 3.2°C) was slightly higher than T_b reported for *C. atrox* and *C. tigris* during the same months at much lower elevations (689–756 m) in Arizona (Beck 1995. J. Herpetol. 29:211–223).

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CROTALUS TRANSVERSUS (Cross-banded Mountain Rattlesnake). **ENDOPARASITES.** The cross-banded rattlesnake, *Crotalus transversus* is known only from Distrito Federal and Morelos, México (Flores Villela and Gerez 1994. Biodiversidad y Conservación en México: Vertebrados, Vegetacíon y Uso del Suelo, Comision Nacional para el Conocimiento y Uso de la Biodiversidad y Universidad Nacional Autónoma de México, Ciudad

Universitaria, México, D.F., 439 pp). There are, to our knowledge, no reports of endoparasites from this species. The purpose of this note is to report a nematode species from *C. transversus*.

One adult female *C. transversus* was collected July 1998 in the vicinity of Presa Iturbide (19°31'N, 99°30'W), State of México, México. It was maintained in captivity until October 1999 and released. Feces were collected, preserved in 95% ethanol, and later examined with a dissecting microscope. Two female nematodes were found, placed separately on a glass slide and cleared in a drop of concentrated glycerol. Each nematode was found to possess the bivalved buccal cavity characteristic of the genus *Kalicephalus*. Further examination revealed the nematodes to be prodelphic (ovaries parallel and anterior to vulva), to possess a rounded esophagus with the excretory pore at the level of greatest esophageal width, and to have a breviconical tail with a terminal spike. These characteristics are consistent with the description of *Kalicephalus costatus* as provided by Schad (1962. Can. J. Zool. 40:1035–1065). The nematodes were placed in a vial of 70% ethanol and deposited in the United States National Parasite Collection, USNPC, Beltsville, Maryland as USNPC 91754.

Although *K. costatus* is world-wide in distribution and has been reported in a variety of snake species from North and South America (Baker 1987. Mem. Univ. Newfoundland, Occas. Pap. 112:1–325), it is known from only one other rattlesnake, *C. durissus* (Schad, *op. cit.*). *Crotalus transversus* is a new host record and Mexico is a new locality record for *K. costatus*.

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DRYMARCHON CORAIS COUPERI (Eastern Indigo Snake). **COMBAT RITUAL.** The eastern indigo snake (*Drymarchon corais couperi*), a large colubrid native to the southeastern United States, breeds from October through February, with a peak in breeding between mid-November and late December (based on reproductive behavior in captivity) (Speake et al. 1987. *In* Odom et al. [eds.], Proc. Third Southeast Nongame and Endangered Species Symposium, pp. 84–88. Georgia Dept. Nat. Resour. Game and Fish Div., Atlanta, Georgia). Aggressive behavior between male Eastern Indigo Snakes during the breeding season might lead to combat or cannibalism (Moler 1992. *In* Moler [ed.], Rare and Endangered Biota of Florida – Vol. 3: Amphibians and Reptiles, pp. 181–186. Univ. Press of Florida, Gainesville, Florida). Here I describe a combat ritual between two adult male indigo snakes observed under field conditions.

On 20 November 2000 at 1230 h (weather clear, sunny, slight breeze, air temperature 14°C; overnight low on 19 November was 6°C) I discovered a pair of adult Eastern Indigo Snakes together near the entrance to an abandoned, adult-sized Gopher Tortoise (*Gopherus polyphemus*) burrow in Evans County, Georgia, USA. From a distance of 6 m, the snakes were observed continuously for the next 10 min. I then captured both snakes; later the same day they were measured, probed to determine sex, and marked as part of an ongoing mark-recapture study. Both snakes were males (169 cm SVL/2.96 kg; 183 cm/3.41 kg). The larger male was subsequently found on the surface near an adult female indigo snake—at a tortoise burrow 471 m to the north—on 29 January 2001.

The entire time the snakes were observed together, the anterior portions of their bodies were entwined and both snakes were in constant motion; the tails of both snakes extended into the tortoise burrow. During most of my observation, the heads of both snakes were lifted vertically 30–60 cm above the ground, often swaying in tandem; by pressing with their chins/necks, each snake attempted to force the other snake toward the ground ("topping" as described by Gillingham 1987. *In* Seigel et al. [eds.], Snakes: Ecology and Evolutionary Biology, pp. 184–209. Macmillan Publishing, New York). On several occasions both snakes toppled to the ground, only to again soon elevate. Although biting might occur during Eastern Indigo Snake combat under captive conditions (D. Alessandrini, pers. comm.), biting was never observed. Gillingham (*op. cit*) mentions that biting, when exhibited, is of short duration and occurs just prior to the end of a combat encounter. In this instance, I interrupted by capturing the snakes before the conclusion of their combat encounter.

This indigo snake study is being conducted with the permission of the Georgia Department of Natural Resources (Scientific Collecting Permit 29-WMB-00-132).

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GOMESOPHIS BRASILIENSIS (NCN). **REPRODUCTION** and **DIET.** *Gomesophis brasiliensis* is an aquatic, Brazilian endemic snake and is a member of tribe Tachymenini (Amaral 1932. Memórias do Instituto Butantan 52:91–92; Bailey 1967. Herpetologica 23:151–161). Aside from scarce and conflicting statements (see Amaral 1932, *op. cit.*; Amaral 1978. Serpentes do Brasil. Melhoramentos/Univ. São Paulo, Brazil, 246 pp.) no information is available on the biology of this snake. We present herein data on sexual dimorphism, mode of reproduction, reproductive cycle and food habits based upon the dissection of 71 specimens from southeastern and southern Brazil housed in the collection of the Instituto Butantan (IB).

Sexual maturity is attained at similar snout–vent lengths (SVL) in males and females: adult males averaged 355.6 mm (SD = 60.8, range 267–455 mm, N = 27) and females averaged 337.0 mm (SD = 53.7, range 261–475 mm, N = 27). There were no significant differences in SVL and relative head size between sexes (SVL: $U = 289$, $p = 0.270$, N = 54; head size: t-test of residuals: $t = 0.45$, $p = 0.656$, N = 48).

Gomesophis brasiliensis is a live-bearer as already recorded for other members of Tachymenini (Ferrarezzi 1994. *In* Nascimento et al. [eds.], Herpetologia do Brasil 1, pp. 81–91. Fundação Biodiversitas and Ezequiel Dias. Belo Horizonte). Females with vitellogenic follicles appeared from August to February (Fig. 1). Three females with oviductal embryos were collected in December (N = 1) and March (N = 2) (Fig. 1). Eight presumed hatchlings (112–123 mm SVL) were collected in February and March. Thus,

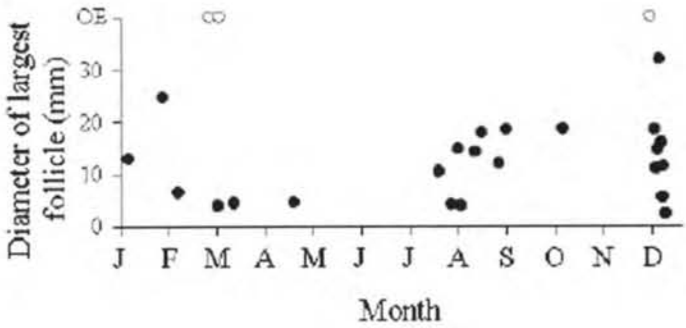

FIG. 1. Seasonal variation in the diameter of the largest ovarian follicle in adult *Gomesophis brasiliensis* females. Open circles represent oviductal embryos.

the reproductive cycle of *G. brasiliensis* is seasonal, with vitellogenesis and gestation occurring throughout the rainy season and recruitment of juveniles at the end of rainy season and onset of the dry season.

Eleven specimens had earthworm chetae in their hindguts. A suggestion was made that *G. brasiliensis* preys on earthworms and insects (Amaral 1932, *op. cit.*), but later Amaral (1978, *op.cit.*) stated that *G. brasiliensis* prey on lizards and small rodents. Our data indicate that *G. brasiliensis* feed primarily if not exclusively on earthworms, and thus the number of goo-eaters (Greene and Cadle 1994. *In* Ricklefs and Schluter [eds.], Species Diversity in Ecological Communities—Historical and Geographical Perspectives, pp. 281–293. Univ. of Chicago Press. Chicago and London) within xenodontine snakes is here increased by one genus. In the Neotropics, species in the genera *Atractus* and *Sordellina*, *Liophis breviceps*, and now *G. brasiliensis* are known to feed largely on earthworms (Greene and Cadle, *op. cit*; Marques 1996. Herpetol. Rev. 27:147; Martins and Oliveira 1999. Herpetol. Nat. Hist. 6:78–150). Most species of Tachymenini feed on frogs and lizards, but *Tomodon ocellatus*, *T. dorsatus*, and *G. brasiliensis* regularly prey on invertebrates (Gallardo 1972. Neotropica 18:57–63; Bizerra 1998. História Natural de *Tomodon dorsatus*. M.S. dissertation. Univ. São Paulo, São Paulo, SP. 102 pp.; present study). A study on phylogenetic relationships within the tribe Tachymenini (Bizerra, *op. cit.*; Franco 1999. Relações filogenéticas entre os gêneros da tribo Tachymenini Bailey, (1967) (Serpentes; Colubridae). Ph.D. thesis. Univ. São Paulo, São Paulo, SP., 252 pp.) indicates that diet based on invertebrates is a derived character in this group.

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LEPTOTYPHLOPS HUMILIS HUMILIS (Southwestern Blind Snake). **BEHAVIOR and POSSIBLE DIET.** Blind snakes are known to feed on the larvae of various ant and termite species, but specific hymenopteran or isopteran species are rarely reported. On 22 June 2000 at 2130 h in the boulder fields surrounding Cataviña, Baja California, México, an adult *L. h. humilis* (273+11 mm) was found immediately adjacent to a series of ant burrows. The snake was captured as it was burrowing its head into the loose sand around a burrow entrance as well as into the entrance itself. The snake was quickly measured and released at the site of capture, with the snake escaping rapidly into the burrow. No ants were seen exiting the burrow, but winged alates were seen at the burrow entrance just after the snake's capture. In the morning of 23 June, several ants were present and identified as *Pogonomyrmex californicus* (Buckley). The burrowing behavior of the snake might have been an attempt by the snake to gain chemosensory information regarding the identity of the inhabitants of the burrow or might have represented the final movements after ingestion of a hymenopteran prey.

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MASTICOPHIS FLAGELLUM TESTACEUS (Western Coachwhip). **CANNIBALISM.** The diets of *Masticophis flagellum* include lizards, small mammals, birds, bird eggs, snakes, insects, and small turtles (Wright and Wright 1957. Handbook of Snakes of the United States and Canada. Cornell Univ. Press, Ithaca. 2 vol., 1105 pp; Werler and Dixon 2000. Texas Snakes. Univ. Texas Press, Austin. 437 pp.). Cannibalism in captivity has been reported several times for this species (for review see Mitchell 1986. SSAR Herpetol. Circ. 15:1–37), but only once before in the field, with the field observation limited to a single line, "Another [*M. flagellum*] was caught while swallowing another small coachwhip" (Guidry 1953. Herpetologica 9:49–56). This note provides a second, more detailed, account of cannibalism in this species.

On 27 August 1999, we found a road-killed *M. flagellum* (TNHC 60252: 860+300 mm; 225.26 g [without prey item]) on FM 2050, 3.6 rd mi S U.S. Hwy 59 (USA: Texas: Webb Co.) at 2108 h. Upon preserving the specimen the following morning, a smaller *M. flagellum* (TNHC 60253: 455+150 mm; 35 g) was found inside the larger snake, anterior of the snake's stomach. The smaller *M. flagellum* did not appear to have any vehicle-induced wounds, but we are unsure whether it was alive or dead when consumed (head-first) by the larger individual.

Submitted by **TRAVIS J. LaDUC**, Section of Integrative Biology, 1 University Station C0930 and Texas Memorial Museum, The University of Texas, Austin, Texas 78712-0253, USA (e-mail: travieso@mail.utexas.edu), and **VERONICA LaDUC**, 7812 Copano Drive, Austin, Texas 78749, USA.

NERODIA SIPEDON PLEURALIS (Midland Water Snake). **REPRODUCTION.** In southeastern Mississippi, *Nerodia sipedon pleuralis* is the most abundant snake associated with the upper Pascagoula River System, which consists of the Leaf and Chickasawhay Rivers and tributaries thereof. Although *N. sipedon* has been extensively studied in the northern and central portions of its distribution, few studies have been conducted on this species from the southern extremity of its distribution, and data are lacking on reproduction from *N. sipedon* in Mississippi. In Alabama, *N. sipedon* bears 12–30 young from July to early September (Mount 1975. The Reptiles and Amphibians of Alabama. Auburn, Alabama. 347 pp.).

As part of a study that required the use of neonatal snakes, gravid females of *N. sipedon* were collected from the Leaf River in Forrest and Jones Counties, Mississippi, USA, during the first week of July (nine individuals each collected in 1999 and 2001). These snakes were maintained in captivity until they gave birth, and were thereafter released at their capture sites. Snakes collected in 1999 and 2001 gave birth from 5 July to 12 July and from 25 July to 10 August, respectively. Data (expressed as means ± 1 SE) collected from these snakes (N = 18) were the following: prepartum mass (g) = 245.2 ± 15.9 (177.6–436.7), postpartum mass (g) = 171.3 ± 12.5 (111.4–319.1), number of offspring = 15.3 ± 0.8 (10–22), and relative clutch mass (RCM) = 30.5 ±.1.5 (19.6–37.3). A correlation analysis indicated a significant positive relationship between prepartum mass (g) of snakes and the number of offspring they produced ($t = 3.231$, $df = 16$, $P = 0.005$; Fig. 1).

Relative to *N. sipedon* in Alabama, snakes from this study produced very small litters early in the birthing season. In fact, the 10 offspring produced by an individual of *N. sipedon* from this study is among the smallest litter size published for this species, with the exception of *N. s. insularum*, which may bear as few as six young (Camin and Ehrlich 1958. Evolution 12:504–511). However, although *N. s. insularum* attains a total length that is comparable to that of *N. s. pleuralis* (56–145 cm versus 61–150 cm [Tennant and Bartlett 2000. Snakes of North America. Eastern and Central Regions. Gulf Publ. Co., Houston, Texas. 588 pp.]), the former taxon may bear far more young (50 versus 30 [King 1986. Copeia 1986:757–772]). Thus, as is typical for most other widespread species of reptiles whose reproductive patterns have been studied in different climates, it appears that individuals of *N. sipedon* from warmer climates produce fewer offspring than do individuals from cooler climates. Further studies on the demography of *N. sipedon* in southeastern Mississippi are needed to determine if the small litter size is offset by an earlier age at maturation or a larger size of individual offspring.

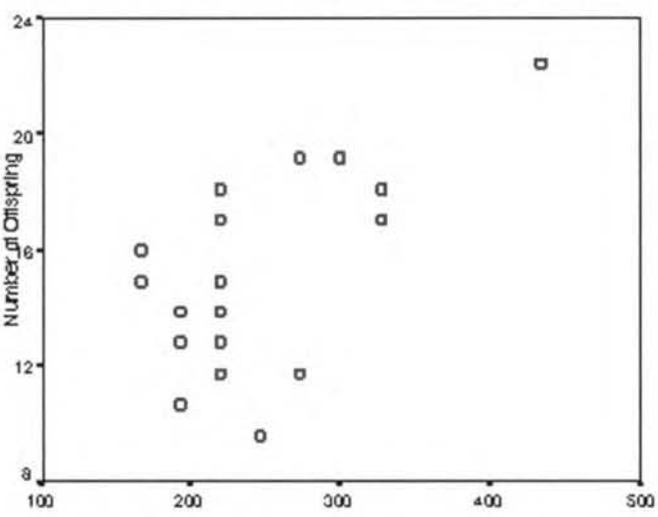

FIG. 1. Scatter plot of the prepartum mass of gravid *Nerodia sipedon* (N = 18) and the number of offspring they produced.

Submitted by **JOHN G. HIMES** and **DAVID C. BECKETT**, Department of Biological Sciences, Box 5018, University of Southern Mississippi, Hattiesburg, Mississippi 39406, USA; e-mail (JGH): John.Himes@usm.edu; (DCB): David.Beckett@usm.edu.

OPHIOPHAGUS HANNAH (King Cobra). **JUVENILE DIET**. Although the diet of *Ophiophagus hannah* is known to constitute snakes and large lizards, especially varanids (David and Vogel 1996. The Snakes of Sumatra. An Annotated Checklist and Key with Natural History Notes. Edition Chimaira, Frankfurt am Main, 260 pp.; Smith, 1943. The Fauna of British India, Ceylon and Burma, Including the Whole of the Indo-Chinese Region. Vol. III. Serpentes. Taylor and Francis, London, xii + 583 pp.), and no specific information is available for the diet of juveniles. A hatchling *O. hannah* from the village of Webbi, near Mayabunder, Middle Andaman Island, Bay of Bengal, India, that was collected on 25 July 2001 as a road kill (USDZ 2.5176; 400.5 mm SVL), contained a recently- ingested juvenile *Lycodon capucinus* (USDZ 2.5177; 255 mm SVL, body width 8.1 mm, and tail length 54 mm). The prey was swallowed head-first.

We thank the Andaman and Nicobar Islands Environmental Team for support of field researches and collection from the Andaman Islands, Alok Saxena and Mr. Ghramduhari of the Andaman and Nicobar Forest Department for permission and facilities, Harry Vasanth Andrews for encouragement, and Kelvin Kok Peng Lim (USDZ) for curatorial assistance.

Submitted by **INDRANEIL DAS*** and **SAMEER GHODKE**, Andaman and Nicobar Islands Environmental Team and Centre for Herpetology, Madras Crocodile Bank Trust, Post Bag 4, Mamallapuram 603 104, India. *Present address: Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, 94300, Kota Samarahan, Sarawak, Malaysia; e-mail: idas@ibec.unimas.my.

PSEUDECHIS PORPHYRIACUS (Red-Bellied Black Snake). **DIET**. The 1935 introduction and subsequent rapid spread of the toxic giant toad (*Bufo marinus*) in Queensland, Australia is well-documented (Sabath et. al. 1981. Copeia 1981:676–680; Easteal et. al. 1985. J. Herpetol. 19:185–188). It has been suggested that apparent density and range declines in anurophagous reptiles (especially varanid lizards and snakes) are directly attributable to attempted predation on *B. marinus* (Covacevich and Archer 1975. Mem. Qld. Mus. 17:305–310), including *P. porphyriacus* in north Queensland (Shine and Covacevich 1983. J. Herpetol. 17:60–69). Such claims are unsubstantiated and recent attempts to quantify this phenomenon have failed to find any direct impact on anurophagous reptiles by *B. marinus* (Catling et. al. 1999. Wildlife Res. 26:161–185). Dead snakes with partially ingested toads

in their mouths have been found throughout the range of *B. marinus* in Queensland (Covacevich and Archer, *op. cit.*) but when viewed in perspective, such finds are comparatively rare.

I have collected data from > 2000 snakes from coastal sub-tropical and tropical Queensland over a nine-year period and have found no evidence of predation on *B. marinus* or of population declines that can be attributed to it. In suitable habitat anurophagous snakes are common, regardless of *B. marinus* densities and it appears that snakes largely ignore *B. marinus* as a prey resource. A well-known exception is the colubrid *Tropidonophis mairii,* which includes metamorph *B. marinus* in its diet but has been recorded to die after ingesting comparatively large specimens (Ingram and Covacevich 1990. Mem. Qld. Mus. 29:396). A similar pattern has been recorded for the toxic native frog *Litoria dahlii* in northern Australia. This frog is ignored as a prey item by all snakes except *T. mairii* (Madsen and Shine 1994. Wildlife Res. 21:21–25). Native Australian fishes rapidly learn to avoid toxic *B. marinus* larvae within one day of their initial encounter (Crossland 2002. J. Fish Biol. 59:319–329), and it would be anticipated that reptiles may exhibit similar behavior.

On 6 June 2001 at 1525 h, a large adult male *P. porphyriacus* (1031 mm SVL, 600 g) was found freshly dead in *rigor mortis* directly below the Kareeya Power Station beside the Tully River, Tully Gorge, northeast Queensland, Australia (17°45.988'S, 145°34.640'E). Assuming the snake to have been killed by power station staff, I made inquiries and learned that it was found active but 'groggy' within the station grounds at noon the previous day. It was carried to the edge of the river and released several meters from where I discovered its body. Palpation of stomach contents revealed two intact sub-adult *B. marinus* (Fig. 1) (61 mm snout–ischium length [SIL], 20.5 g; 54 mm SIL, 12 g). This case is interesting because the snake was able to capture and ingest, to stomach level, two relatively large *B. marinus* and survive > 24 h.

Toxin levels in *B. marinus* are known to increase ontogenetically (Crossland 1998. Herpetologica 54:364–369) and I suggest that occasionally individual snakes that are in the habit of ingesting metamorph *B. marinus* (perhaps because of intraspecific variation in resistance to *B. marinus* toxins), swallow larger specimens

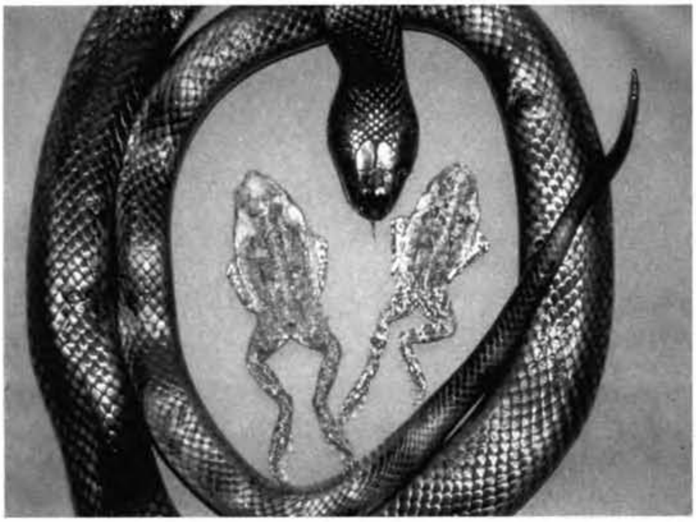

FIG. 1. Adult *Pseudechis porphyriacus* with two sub-adult *Bufo marinus* palpated from its stomach. The snake died 24 h after ingestion of the toads.

with high toxin levels sufficient to kill the snake. I cautiously suggest that, at least in the Tully area, *P. porphyriacus* may be successfully ingesting metamorph *B. marinus*. It is difficult to account for the events described in any other way. Both *P. porphyriacus* and *B. marinus* are common in Tully Gorge and have occurred sympatrically for > 60 yrs (Sabath et. al., *op. cit.*). I urge field biologists active in north Queensland to examine gut contents of *P. porphyriacus* whenever the opportunity arises, to ascertain if *B. marinus* is beginning to become a part of the diets of these snakes. Shine (1991. Copeia 1991:120–131) suggests that the impression that *Tropidonophis* is unusual in eating toads might reflect the abundance of this snake (relative to sympatric anurophagous elapids and pythons) in many of the habitats in which toads also are common, and hence the higher probability of observing predation on *B. marinus* by *Tropidonophis* than by other snake species.

The snake (QMJ76648) and toads (QMJ76649-50) are deposited in the Queensland Museum.

Submitted by **SIMON FEARN**, School of Biological Sciences, James Cook University, Townsville, Queensland, Australia, 4811; e-mail: simonfearn@iprimus.com.au.

RHINOCHEILUS LECONTEI (Long-Nosed Snake). **ALBINISM**. *Rhinocheilus lecontei* has a large geographic range, extending from the southwestern United States through much of northern México. There is a single report of albinism for this species based on a specimen collected in Durango, México (Hendricks 1974. J. Herpetol. 8:185), and no records of albinism for the U.S. portion of the range. On 19 August 2001 at 2130 h, we found a hatchling female *R. l. tessellatus* crossing a paved road in Presidio County, Texas, USA. The specimen has pink irises and a complete lack of black pigment (Fig. 1).

FIG. 1. Hatchling albino female *Rhinocheilus lecontei tessellatus* shown with a normally pigmented male specimen for comparison.

Submitted by **ROBERT L. NORRIS**, Stanford University School of Medicine, Stanford University Medical Center, 701 Welch Road, Suite C, Palo Alto, California 94304, USA (e-mail: bob.norris@stanford.edu), and **MICHAEL BERARDI**, 9526 Amber Dawn, Helotes, Texas 78023, USA (e-mail: txherper@aol.com).

THAMNOPHIS MARCIANUS (Checkered Garter Snake). **SALVAGING PRENEONATES FROM A ROAD-KILL.** The results of salvaging unborn or preneonate young of natricine snakes from road-killed gravid females does not seem to be recorded in the literature. Pope (1952. Snakes Alive and How They Live. The Viking Press, New York. 238 pp.) suggested that the young of a gravid female live-bearing snake, cut open a few days before normal birth, would survive, and that snakes are often killed with enough force to set any well developed young free. Oliver (1955. The Natural History of North American Amphibians and Reptiles. V. Van Nostrand Co., Princeton, New Jersey. 359 pp.) agreed, commenting that if a female carrying young about to hatch, was vigorously clubbed, her swollen body might burst, releasing the young. Accounts of unborn young surviving their mother's death are exemplified by J. T. Burkhart (pers. comm.) who related an account of a *Thamnophis* sp. being run over by a vehicle, expelling numerous young that subsequently crawled away.

This is a report on salvaging preneonate young from a road-killed checkered garter snake, *Thamnophis marcianus*. The specimen was collected from Willow Road in extreme northwestern Enid, Garfield County, Oklahoma, USA at 2059 h (after dark) on 29 September 1995. Abdominal movement was observed in the snake that did not seem to be characteristic reflex action. The snake was hurriedly opened surgically at 2110 h, and 25 preneonate young were removed by 2233 h. Seven young exhibited life signs such as mouth gaping, tongue flickering, and body movements.

The total length of the parent female was 65.5 cm. (SVL 51.2 cm, tail 14.3 cm). Three of the 25 young were accidentally mutilated during hasty surgery, and were not measurable, another remained in its embryonic sac and was not measured. Total lengths of 21 remaining young varied from 15.1 to 20.4 cm, averaging 17.9 cm. Total lengths of the five surviving live young was 17.0 to 20.4 cm, averaging 10.04 cm. Three of these died by 23 December 1995. Two remaining juveniles have survived.

Specimens were deposited in the museum collections of St. Gregory's University, Shawnee, Oklahoma, SGU numbers 510 (adult female), and young 511–528, 534, 560 and 2038.

Submitted by **RICHARD L. LARDIE**, P.O. Box 9002, Vance AFB, Enid, Oklahoma 73705, USA.

Hyla picturata. Colombia: Vereda Guaima, Region del Bajo Anchicaya, Valle del Cuaca. Illustration (from a photograph) by Fernando Vargas Salinas.

GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 34, Number 2 (June 2003). Additional note: The responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extensions unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA OPACUM (Marbled Salamander). USA: VIRGINIA: Scott Co: Rikemo Lodge, ca. 1 km SW of Dungannon. 8 May 1999. Christopher S. Hobson, Steven M. Roble, Anne C. Chazal. Verified by Richard Hoffmann. Virginia Museum of Natural History (VMNH) 10337. One sub-adult was found in a small pit (ca. 0.25 m deep) covered by a piece of plywood at Rikemo Lodge, situated on a slope just above the floodplain of the Clinch River. First record for Scott Co., and first published record for southwestern Virginia (Mitchell and Reay 1999. Atlas of Amphibians and Reptiles in Virginia. Spec. Publ. No. 1, Virginia Department of Game and Inland Fisheries, Richmond, Virginia. 122 pp.; Tobey 1985. Virginia's Amphibians and Reptiles: A Distributional Survey, Virginia Herpetological Survey, Purcellville, Virginia, 113 pp.). The nearest published records within the Ridge and Valley physiographic province are from Knox Co., Tennessee (ca. 160 km SW), and Montgomery Co., Virginia (ca. 180 km NE) (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, Center for Field Biology, Austin Peay State University, Clarksville, Tennessee, 94 pp.; Tobey 1985, *op. cit.*). This record partially fills a hiatus in the known range for this species that includes much of the southern Appalachians.

Submitted by **CHRISTOPHER S. HOBSON** (e-mail: cshobson@dcr.state.va.us) and **STEVEN M. ROBLE** (e-mail: sroble@dcr.state.va.us), Virginia Department of Conservation and Recreation, Division of Natural Heritage, 217 Governor Street, Richmond, Virginia 23219, USA.

AMBYSTOMA TIGRINUM TIGRINUM (Eastern Tiger Salamander). USA: ILLINOIS: Gallatin Co: pond NW side York Lane and 1.3 km E Pounds Hollow Road (37°36'20"N, 88°15'34"W). 7 June 2002. Kurt J. Regester and David W. Butler. Verified by Ronald A. Brandon. SIUC H–07089. Larval specimens collected in Shawnee National Forest wildlife pond. New county record (Philips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, Champaign, Illinois. xii + 282 pp.).

Submitted by **KURT J. REGESTER** and **DAVID W. BUTLER**, Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901, USA.

CRYPTOBRANCHUS ALLEGANIENSIS ALLEGANIENSIS (Eastern Hellbender). USA: TENNESSEE: Cheatham Co.: Sycamore Creek adjacent to Harris Town Road, ca. 4.0 air miles NW of Ashland City (36°19'39"N, 87°05'40"W). 10 July 1996. Brian Canada. Austin Peay State University Museum of Zoology (APSU 5455 B series of 10 color photos). Verified by David H. Snyder. One adult (total length 727 mm) in shallow water (< 10


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Society for the Study of Amphibians and Reptiles

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The Society for the Study of Amphibians and Reptiles, the largest international herpetological society, is a not-for-profit organization established to advance research, conservation, and education concerning amphibians and reptiles. Founded in 1958, SSAR is widely recognized today as having the most diverse society-sponsored program of services and publications for herpetologists. Membership is open to anyone with an interest in herpetology—professionals and serious amateurs alike—who wish to join with us to advance the goals of the Society.

All members of the SSAR are entitled to vote by mail ballot for Society officers, which allows overseas members to participate in determining the Society's activities; also, many international members attend the annual meetings and serve on editorial boards and committees.

ANNUAL DUES AND SUBSCRIPTIONS: Annual membership dues for the year 2003 in the Society for the Study of Amphibians and Reptiles are as follows: **REGULAR** membership US$60 (Student $30)—includes *Journal of Herpetology* and *Herpetological Review*; **PLENARY** membership US$80 (Student $45)—includes *JH*, *HR*, and annual subscription to the *Catalogue of American Amphibians and Reptiles*; **INSTITUTIONAL SUBSCRIPTION** $115—includes JH and HR. Additional fee for airmail postage outside USA $35 for one year. Additional membership categories available on the SSAR webpage: http://www.ssarherps.org/pages/membership.html.

All members and institutions receive the Society's primary technical publication, the *Journal of Herpetology*, and its news-journal, *Herpetological Review*; both are published four times per year. Members also receive pre-publication discounts on other Society publications, which are advertised in *Herpetological Review*.

Payment must be made in USA funds, payable to "SSAR," or by International Money Order, or with VISA or MasterCard (account number and expiration date must be provided). Payment should be sent to: Theodora Pinou, SSAR Treasurer, Peabody Museum of Natural History, P.O. Box 208118, New Haven, Connecticut 06520-8118, USA. Fax: (203) 432-5176; e-mail: theodora.pinou@yale.edu

Future Annual Meetings

2004 — University of Oklahoma, Norman, Oklahoma, 26–31 May (with ASIH, HL)
2005 — University of South Florida, Tampa, Florida (with ASIH, HL)

SSAR BUSINESS

SSAR to Auction Herpetological Library of Sherman A. Minton, Jr., M.D.

Sherman A. Minton, Jr., who died in 1999, was a leading expert on venomous snakes and the herpetology of Pakistan and of his native Indiana, and on each topic he wrote landmark volumes. He was Professor of Microbiology and Immunology at the Indiana University Medical School in Indianapolis for most of his long and productive career. He held many elected positions in several national and international herpetological and toxinological societies, including the presidency of SSAR in 1986. A warm remembrance of Sherman was published in *Herpetological Review* (vol. 30, no. 4, pp. 202–204, 1999), written by his long-time friend and colleague, H. Bernard Bechtel, M.D.

Sherman was a staunch supporter of SSAR and joined the society in the early 1960s when it was called The Ohio Herpetological Society. He and his wife, Madge Rutherford Minton, regularly attended OHS and SSAR meetings and were enthusiastic participants. It seems highly fitting, therefore, that Madge Minton and their three daughters (Brooks, April, and Holly) have donated Sherman's herpetological library to SSAR on the condition that it be auctioned and that the proceeds be used to continue Sherman's interests in society activities. Part of the library was auctioned at the society's joint meeting with The Herpetologists' League in Indianapolis in 2001. The remainder of the library, containing the more important and valuable books, will be auctioned this fall in an on-line auction conducted by SSAR's Publications Secretary, Breck Bartholomew.

If you wish to be notified about this auction, contact Mr. Bartholomew at ssar@herplit.com (phone/fax: 801-453-0489). The on-line auction will begin on or about October 2003. All proceeds will go to SSAR to establish The Sherman A. Minton, Jr., M.D. Endowment, to support student attendance at annual meetings.

NEWSNOTES

Conant and Stebbins Honored by SWAN

The Southwestern Association of Naturalists (SWAN) bestowed to Roger Conant and Robert C. Stebbins its highest honor, the W. Frank Blair Eminent Naturalist Award at the organization's Spring 2003 meeting. This award is named for William Franklin Blair (1912–1984), a long-time faculty member at the University of Texas. The Blair award recognizes excellence in a lifetime of commitment to outstanding study or conservation of the flora or fauna of the Southwest. This was the first time two individuals were selected. Other herpetologists previously honored include Charles C. Carpenter (1986), James R. Dixon (1987), Henry S. Fitch (1991), and Hobart M. Smith (2001). The Southwestern Association of Naturalists was founded in May 1953 to promote the field study of plants and animals (living and fossil) in the southwestern United States, Mexico, and Central America and to aid in the scientific activities of its members. The Association holds an annual meeting and publishes *The Southwestern Naturalist*. Membership is open to all persons interested in natural history. For more information consult the SWAN website at: http://www.biosurvey.ou.edu/swan.

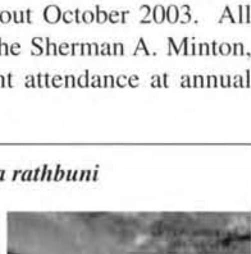
MEETINGS

Meetings Calendar

26–31 May 2004—47th Annual Meeting, Society for the Study of Amphibians and Reptiles, together with The Herpetologists' League and the American Society of Ichthyologists and Herpetologists. University of Oklahoma, Norman.

15–20 November 2004—VI Symposium of Zoology, Havana,

About Our Cover: *Eurycea rathbuni*



Among the least understood amphibians are those species exploiting groundwater or other subterranean environments. Obligate subterranean caudates (or "OSCs") are salamander species whose adults do not occur above ground. Between Europe and the United States, there exist at least 11 OSCs that display some degree of associated morphology that can include reduction or complete loss of pigment, reduction or complete loss of a visual system, hyper development of the lateral line system, limb attenuation and elongation, broadening and flattening of the head, an increased number of teeth compared to above ground relatives, and a shift toward paedomorphosis (Brandon 1971. National Speleological Society Bulletin 33[1]:1–21). Among OSCs, the move toward a paedomorphic condition is important. All but three or four OSC species are aquifer dwellers, and presumably have little or no terrestrial habitat available for occupancy.

The Cretaceous limestone uplifts of the Edwards Plateau of Texas are peppered with springs and caves. Many of the subterranean aquatic systems function as ecological islands because of their isolation, and consequently harbor endemic life forms (Chippindale et al. 2000. Herpetological Monographs 14:1–80). Among the regional endemics is the Texas Blind Salamander, *Eurycea rathbuni*, restricted to a small region of the Balcones Escarpment near San Marcos. More alien than salamander-like, these creatures captured the attention of the scientific community after the first individuals were discovered over 100 years ago. The specimens were belched from the mouth of a well that had been bored 58 m into the earth to tap water from an aquifer below (Stejneger 1896. Proceedings of the United States National Museum XVIII[1088]:619–621). Studying aquifer ecosystems is a daunting task and little is known of the life history of these ghostly amphibians. Texas Blind Salamanders are endangered as a result of groundwater overpumping. Conservation measures include captive propagation as well as efforts to protect their habitat from further water diversions.

Danté Fenolio photographed the cover subject at a U.S. Fish & Wildlife Service captive propagation facility. He used a Minolta 9xi, Minolta 100mm macro lens, Minolta dual flash unit, and Fuji Velvia film to record this image. Fenolio is a graduate student at the University of Oklahoma studying population dynamics and trophic interactions in another subterranean caudate, *Typhlotriton spelaeus*. He uses acrylic elastomer to mark and subsequently identify individuals. Gathering images of much of the Ozark Plateau's subterranean wildlife, Fenolio is collaborating with G. O. Graening of the Subterranean Biodiversity Project to produce a book on the subject.

Editor's note.—Special thanks to Ron Bonett for reviewing a draft of this text.

SSAR Grants-in-Herpetology 2004

Guidelines for Proposals

Proposals are now being accepted for the 2004 SSAR Grants-in Herpetology Program. This program is intended to provide financial support for deserving individuals or organizations involved in herpetological research, education, or conservation. Grant proposals will be considered in the following categories:

CONSERVATION OF AMPHIBIANS AND/OR REPTILES. Proposals should address research (particularly conservation biology) on species endangered or threatened at the state, national, or international level, or address research on potentially threatened habitats or species, or on introduced injurious species. Proposals must be accompanied by a letter of support from another member of the SSAR or a student's major advisor or committee chairperson.

FIELD RESEARCH. Proposals may address needs for field station fees or equipment and materials in field oriented projects, or the field work portions of broader studies. This might include in-situ behavioral studies, ecological, life history, or sexual selection studies. Survey work by individuals or regional societies may be submitted here or in TRAVEL below depending on how the funds are to be used. Proposals must be from individuals only and be accompanied by a letter of support from another member of the SSAR, the president of the sponsoring regional society (if applicable), or a student's major advisor or committee chairperson.

LABORATORY RESEARCH. Proposals may address needs for equipment or materials in laboratory projects or laboratory portions of broader projects. This might include studies in behavior, biochemistry, molecular biology, biomechanics, or physiology. Proposals must be from individuals only and be accompanied by a letter of support from another member of the SSAR or a student's major advisor or committee chairperson.

HERPETOLOGICAL EDUCATION. Proposals may address an educational project or start up support for an educational program in a zoo, museum, park, nature center, regional herpetological society, etc. The project must focus on a herpetological topic. Proposals must be from individuals only and be accompanied by a letter of support from the herpetological curator, the director of the facility, or the regional society president.

TRAVEL. Proposals may address support for travel to field study sites near or far, or to utilize distant collections or facilities. If funding is sought to get from one place to another, proposals should be submitted in the TRAVEL category. Proposals normally submitted in the CONSERVATION or FIELD RESEARCH categories should be submitted here if travel funding is being sought. Proposals must be accompanied by a letter of support from another member of the SSAR or a student's major advisor or committee chairperson, or the regional society president.

INTERNATIONAL. Proposals may address needs in any of the above five categories. Applicants must be from, and currently enrolled in an educational institution in, a country where herpetological research has historically been underfunded, and where alternative sources of financial support are scarce or nonexistent.

BIBLIOGRAPHIC RESEARCH. This special category continues for 2004, thanks to a donation from Itzchak and Carolyn Gilboa. Proposals should address a major need to consult library or other information resources. The project must focus on a herpetological topic. Proposals from individuals only, accompanied by a letter of support from someone knowledgeable about the applicant and about the importance of the project.

In keeping with the Society's goal of encouraging participation by the broadest possible community, preference may be given to individuals who might not have access to other funding sources. All applicants must be students AND members of the SSAR with the exception that those applying for support of regional herpetological society projects or the International category need not be SSAR members. Membership dues must be paid (to SSAR Treasurer) no later than 31 December 2003 for proposals to be considered. Applicants are limited to submission of one proposal in one category per year. In June 1999, the SSAR Board decided that past award recipients are not eligible for additional GIH awards. Applicants must designate to which of the six categories their proposal is submitted (although the committee reserves the right to reassign proposals to categories). If proposals in any of the categories are not forthcoming, or judged not to be of sufficient quality, the funds in those categories may be transferred to other categories. Each proposal must include the following: **(A) TITLE PAGE** giving the title of the project, the name, mailing address, office and home telephone numbers and, if possible, fax number and e-mail address of the applicant. The title page should also include the following numerated items completed in this format in the bottom left corner of the Title Page:

1) Category:
2) Word count:
3) Student status (give school):
4) SSAR membership since:
5) SSAR budget portion:
6) a statement indicating that applicants "will comply with all applicable permit regulations, and adhere to all appropriate animal care guidelines in the course of conducting funded projects.";

(B) BACKGROUND AND OBJECTIVES of the proposed project. **(C) METHODS** of carrying out the project. **(D) COMPLETE PROJECT BUDGET** (regardless of whether the SSAR grant will entirely cover expenses). Include an explicit explanation of how an SSAR award of $500 would be applied toward the objectives of the project (here as well as on Title Page), and provide a listing of all current and pending support for the project. **(E) BRIEF RESUMÉ/CURRICULUM VITAE** of the applicant or project coordinator. **(F) LETTER OF SUPPORT.** The proposal must be typed, double spaced, and must not exceed 1200 words, excluding title page, literature cited, resumé, and budget.

All proposals must be submitted (post-marked or email date) no later than **31 December 2003** to be considered. Electronic submission in any format is strongly encouraged. Failure to meet these guidelines may result in elimination of a proposal from consideration. The awards will be announced on or around 1 April 2004. Successful applicants are encouraged to submit the results of their research for publication in the Journal of Herpetology or Herpetological Review, or to present their findings at the annual meeting of the SSAR. Submit proposals or questions regarding application procedures to: **Erik R. Wild, Chair, SSAR Grants-in-Herpetology, Department of Biology, University of Wisconsin-Stevens Point, Stevens Point, Wisconsin 54481-3897, USA. Tel. (715) 346-4269; Fax (715) 346-3624; email *ewild@uwsp.edu.***

Cuba. Information: Executive Secretary: Dr C. Daysi Rodríguez Batista (zoologia.ies@ama.cu) or www.geocities.com/zoologiacubana/simposio.

CURRENT RESEARCH

The purpose of **Current Research** is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, **Eli Greenbaum** or **Omar Torres-Carvajal**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can now be found at: http://www.herplit.com/contents.

Escape Behavior of *Cnemidophorus murinus*

Little is known about the additive or interactive risks and costs associated with escape behavior; predictions of optimal escape theory suggest an interaction between risk and cost factors. The authors examined escape behavior in *Cnemidophorus murinus*, a teiid lizard that relies on speed to escape predators. Two experiments tested lizard reactions to human "predators" at differing speeds and approaches. Statistical analyses included factorial ANOVA and chi-square tests. Rapid and direct approaches by humans elicited the strongest escape behaviors by lizards. When food was present, flight initiation distance was significantly shorter than trials with no food. These results suggest that one risk factor can affect the response to another, but the risks might not be additive as suggested by previous studies. The data do not fully support predictions of the optimal escape theory.

Cooper, Jr., W. E., V. Pérez-Mellado, T. Baird, T. A. Baird, J. P. Caldwell, and L. J. Vitt. 2003. Effects of risk, cost, and their interaction on optimal escape by nonrefuging Bonaire whiptail lizards, *Cnemidophorus murinus*. Behavioral Ecology 14:288–293.

Correspondence to: William E. Cooper, Jr., Department of Biology, Indiana University-Purdue University at Fort Wayne, Fort Wayne, Indiana 46805, USA; e-mail: cooperw@ipfw.edu.

Evolution of Venom-Injection Morphology in Snakes

Snakes possess a panoply of sophisticated and efficient venom-delivery systems (VDS) that include venom, venom glands and associated muscles, fangs, and maxillary dentition. There are approximately 450 venomous species in the Colubroidea clade, and previous workers have hypothesized that VDS evolved multiple times in this group. To test this hypothesis, Jackson used two previously published snake phylogenies to track several VDS characters; information about VDS characters was obtained from the literature. The most parsimonious interpretation of the results suggests: (1) Duvernoy's gland evolved once at the base of the colubroid tree; (2) viperids, atractaspidids, and elapids independently evolved venom glands (from Duvernoy's gland) and compressor glandulae muscles; (3) the pterygoideus was anteriorly attached in basal colubroids and moved to a posterior attachment in Elapidae and some aparallactines; (4) tubular fangs probably evolved independently several times in Colubridae, whereas grooved fangs might have been acquired and lost several times.

Jackson, K. 2003. The evolution of venom-delivery systems in snakes. Zoological Journal of the Linnean Society 137:337–354.

Correspondence to: Kate Jackson, Department of Herpetology, Museum of Comparative Zoology, Harvard University, 26 Oxford Street, Cambridge, Massachusetts 02138, USA; e-mail: kjackson@oeb.harvard.edu.

Population Trends and Extinction of Amphibians

Population declines are closely associated with extinction risk, but many *r*-selected amphibian species show fluctuating population sizes that are difficult to link to overall declines. Green examined 617 time series of population census data from 89 amphibian species to address the relative degree of variance in population sizes and how variation in demographic characteristics and habitat requirements affect extinction risk. In general, higher levels of population variance were observed in large stream-breeding and pond-breeding species relative to terrestrial direct-developing or small stream-breeding species. The population crash rates were 3.1% and 2.2% for pond-breeding frogs and pond-breeding salamanders, respectively; crash rates were negligible for stream-breeding and terrestrial direct-developing species. High population variance was associated with the smallest populations but not with life-history complexity. Species with high levels of population fluctuation and local extinctions might be susceptible to habitat fragmentation.

Green, D. M. 2003. The ecology of extinction: population fluctuation and decline in amphibians. Biological Conservation 111:331–343.

Correspondence to: David M. Green, Redpath Museum, McGill University, 859 Sherbrooke Street West, Montreal, Quebec, Canada H3A 2K6; e-mail: david.m.green@mcgill.ca.

Effects of Temperature on Locomotor Performance of a Salamander

Studies of locomotor performance in anurans have suggested that amphibians are more likely to possess thermal insensitivity if they live in environments with large temperature fluctuations. The three-lined salamander *(Eurycea guttolineata)* is a model organism to study this phenomenon because females inhabit aquatic habitats (low temperature fluctuations) during the breeding season and terrestrial habitats (high temperature fluctuations) at other times of the year. Marvin measured aquatic and terrestrial locomotor performance of salamanders in a racetrack. In general, salamanders moved faster at higher temperatures; stride length was significantly greater at lower temperatures. These results do not support the hypothesis that terrestrial taxa are more thermally insensitive during locomotion. However, the results demonstrate that metamorphosed amphibians are capable of thermal acclimation

during locomotion.

MARVIN, G. A. Effects of acute temperature and thermal acclimation on aquatic and terrestrial locomotor performance of the three-lined salamander, *Eurycea guttolineata*. Journal of Thermal Biology 28:251–259.

Correspondence to: Glenn A. Marvin, Department of Biology, Gallaudet University, 800 Florida Avenue NE, Washington, DC 20002-3695, USA; e-mail: glenn.marvin@gallaudet.edu.

Species Delimitations in *Liolaemus*

The process of species delimitation is fraught with controversy and numerous methodologies have been proposed in the literature. The authors agree with previous contentions that the strongest support for species delimitations should be based on concordance of independent data sets. To address this issue in the lizard genus *Liolaemus*, the authors examined mtDNA (cyt *b*, ND4, 12S) sequences from 198 samples of the *L. elongatus-kriegi* complex. The authors combined phylogenetic analyses (Bayesian, maximum parsimony, and maximum likelihood) with haplotype networks constructed from nested-clade analyses of complete cyt *b* sequences. All methods recovered three clades that the authors call the *elongatus, kriegi*, and *petrophilus* groups. Species boundaries of numerous samples are discussed; the analyses indicated that numbers of species in the *L. elongatus-kriegi* complex might be doubled. Numerous factors, including sample size and gene flow, might have affected tree topologies. The combined analyses proposed in this paper will allow future researchers to: (1) use large data sets to examine species boundary questions; (2) decrease costs associated with sequencing; and (3) improve statistical rigor.

MORANDO, M., L. J. AVILA, AND J. W. SITES, JR. 2003. Sampling strategies for delimiting species: genes, individuals, and populations in the *Liolaemus elongatus-kriegi* complex (Squamata: Liolaemidae) in Andean-Patagonian South America. Systematic Biology 52:159–185.

Correspondence to: Mariana Morando, Department of Integrative Biology and M. L. Bean Life Science Museum, Brigham Young University, Provo, Utah 84602, USA; e-mail: mariana@email.byu.edu.

Larval Characters and Systematics of Frogs

Despite the steadily increasing number of described species, efforts to resolve anuran phylogenetic relationships are hampered by poor systematic exploration of taxa and their characters. The author examined 156 characters (mostly by personal examination) from 81 ingroup anuran taxa and four salamander outgroup taxa for the purposes of a phylogenetic analysis of major groups of frogs. Analysis of informative characters were conducted with PAUP*, MacClade 4, NONA 2.0, and TreeRot 2.0. Three search strategies (ratchet PAUP, ratchet NONA, and heuristic PAUP) yielded identical strict consensus topologies. *Ascaphus truei* was identified as the sister taxon to all other frogs. The monophyly and relationships of numerous anuran groups are discussed. Homoplasy was common in the data set, but not restricted to specific organ systems. Well-supported clades included Bufonidae, Ceratophryinae, Dendrobatidae, Microhylidae and Scoptanura, Pipoidea, Pipidae, and Phyllomedusinae. This study confirms the importance of larval characters in phylogenetic reconstruction and evolutionary history of frogs.

HAAS, A. 2003. Phylogeny of frogs as inferred from primarily larval characters (Amphibia: Anura). Cladistics 19:23–89.

Correspondence to: Alexander Haas, Institut für Spezielle Zoologie, und Evolutionsbiologie mit Phyletischem, Friedrich-Schiller-Universität, Museum Erbertstr. 1, 07743 Jena, Germany; e-mail: B5HAAL@RZ.UNI-JENA.DE.

Physiological Energy Expenditure of *Bufo marinus*

Specific dynamic action (SDA) is the total amount of energy used for ingestion, digestion, absorption, and assimilation of food. The authors examined SDA in the toad *Bufo marinus* with four meal sizes, four natural diets, and four temperature regimes. Fifty-five *B. marinus* were collected and housed in plastic storage boxes for experiments; some individuals of *B. alvarius, B. boreas, B. terrestris*, and *B. woodhouseii* were tested as well. Gas exchange was measured with closed-system respirometry. Meals of earthworms, superworms, crickets, and juvenile rats weighing 5%, 10%, 15%, or 20% of toad body mass were offered to *B. marinus* at four temperatures (20°, 25°, 30°, or 35°C). Statistical analyses included ANOVA, ANCOVA, correlations, and regressions. Peak and scope of VO_2, and SDA increased with larger meal sizes. Prey types with chitonous exoskeletons required a higher level of SDA for digestion. Each 5°C increase in body temperature (beyond 20°C) decreased the duration of the postprandial metabolic response by two days, but SDA was not significantly changed by temperature. When compared to other taxa, it is clear that the factorial scope of elevated metabolism (peak VO_2) increased with body size.

SECOR, S. M., A. C. FAULKNER. 2002. Effects of meal size, meal type, body temperature, and body size on the specific dynamic action of the marine toad, *Bufo marinus*. Physiological and Biochemical Zoology 75:557–571.

Correspondence to: Stephen M. Secor, Department of Biological Sciences, Box 870344, University of Alabama, Tuscaloosa, Alabama 35487-0344, USA; e-mail: ssecor@biology.as.ua.edu.

Speciation and Biogeography of the Lizard Genus *Proctoporus*

Based on geological evidence of a south-to-north progression of uplift of the Andes mountains, it is likely that colonization and subsequent allopatric speciation of high-elevation taxa also occurred in a south-to-north direction. Doan tested this hypothesis by conducting a phylogenetic analysis on all species of montane *Proctoporus*. Sixty characters of external morphology were collected from 28 species of *Proctoporus* and three outgroup taxa in the genera *Pholidobolus, Opipeuter*, and *Euspondylus*. Most of the characters were polymorphic; the Generalized Frequency Coding method was used to code these characters. Maximum parsimony analyses were executed with PAUP* version 4.0b10. Results support the monophyly of *Proctoporus;* relationships within

the genus are discussed. Based on this analysis, it appears that the genus *Proctoporus* originated in the central Andes. The consensus tree does not support a pattern of south-to-north speciation at finely scaled levels, but the overall branching order of the phylogenies supports the south-to-north hypothesis.

DOAN, T. M. 2003. A south-to-north biogeographic hypothesis for Andean speciation: evidence from the lizard genus *Proctoporus* (Reptilia, Gymnopthalmidae). Journal of Biogeography 30:361–374.

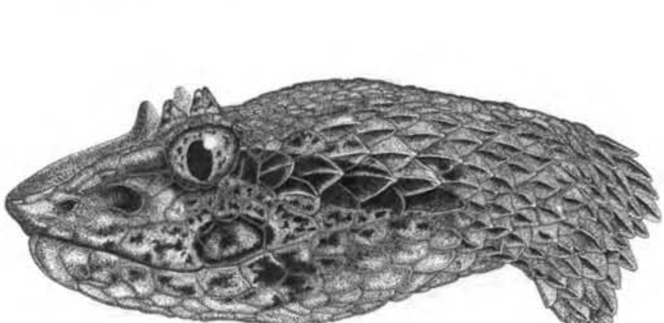
Correspondence to: Tiffany M. Doan, Biology Department, Vassar College, Box 555, 124 Raymond Avenue, Poughkeepsie, New York 12604-0555, USA; e-mail: tiffperu@yahoo.com.

Systematics of Emydine Turtles

Plastral-shell kinesis is considered to be an anti-predator defense; this mechanism is restricted to emydine turtles, which include the genera *Clemmys, Emydoidea, Emys,* and *Terrapene.* To examine the monophyly of the subfamily Emydinae and track the evolution of plastral kinesis, the authors conducted a phylogenetic analysis (cyt *b*, ND4, and adjacent tRNA genes) of all emydine and two deirochelyine taxa. Maximum parsimony (MP) and maximum likelihood (ML) were conducted in PAUP*. A PH test allowed the cyt *b* and ND4 datasets to be combined. A single most parsimonious tree was obtained for both the MP and ML analyses; these trees differed in the placement of a single taxon, *Clemmys marmorata.* Results supported a monophyletic *Terrapene* and paraphyletic *Clemmys.* The authors recommend restricting the name *Clemmys* to a single species (*C. guttata*) and expanding the genus *Emys* to include *E. marmorata, E. orbicularis,* and *E. blandingii.* Moreover, *Calemys* is resurrected for *C. muhlenbergii* and *C. insculpta;* the genus *Actinemys* and *Emydoidea* should be used as subgenera for lineages within *Emys.* Shell kinesis appears to have evolved twice—once in *Terrapene* and once in *Emys.* (See Crother et al. [this issue p. 196] for a discussion of the recommended changes suggested in this summary.)

FELDMAN, C. R., AND J. F. PARHAM. 2002. Molecular phylogenetics of emydine turtles: taxonomic revision and the evolution of shell kinesis. Molecular Phylogenetics and Evolution 22:388–398.

Correspondence to: Chris R. Feldman, Department of Biology, Utah State University, Logan, Utah 84322-5305, USA; e-mail: elgaria@biology.usu.edu.



Bothriechis schlegelii (Schlegel's Pitviper). Costa Rica. Illustration by Julian C. Lee.

ZOO VIEW

Two prominent zoo curators have recently retired from the zoo field: René E. Honegger and R. Howard Hunt. Both have been valued colleagues and friends for over thirty years and their accomplishments and commitment to our profession deserve mention.

René Honegger was the Curator of Herpetology at the Zürich Zoo in Switzerland between 1960 and 1999, and in charge of the Exotarium from 1972. He has been a major player in zoo biology by developing many innovations in terrarium displays, captive husbandry and management, and zoo philosophy. René compiled the first Red Data Book on amphibians and reptiles and has been involved in national and international conservation issues. Honegger has focused on protecting endangered herps in Europe. His career serves to demonstrate that a zoo worker can be an effective conservationist and he has published widely on conservation topics. He retired in October 1999.

SELECTED PUBLICATIONS BY RENÉ E. HONEGGER

Captive Management

HONEGGER, R. E. 1969. Notes on some amphibians and reptiles at Zurich Zoo. Inter. Zoo Yearb. 9:24–28.

———. 1971. Beitrag zur Fortpflanzungsbiologie einiger tropischer Reptilien (Paper on the reproductive biology of several tropical reptiles). Z. Köln. Zoo 13:175–179.

———. 1978. Geschlechtsbestimmung bei Reptilien (Determination of gender in reptiles). Salamandra 14:69–79. [discussion of sexing techniques for reptiles].

———. 1982. Breeding crocodiles in captivity, a retrospect. Proc. 5th Working Meeting Croc. Spec. Group SSC/ IUCN. Florida State Mus., Gainesville, Florida, 12–16 Aug 1980.

———. 1984. Beiträge zur Biologie von *Hydrodynastes gigas* im Terrarium (Serpentes, Colubridae) (Contributions to the biology of *Hydrodynastes gigas* in the terrarium [Serpentes, Colubridae]), pp. 237–244. *In* V. L. Bels and A. P. Van den Sande (eds.), Maintenance and Reproduction of Reptiles in Captivity. Acta Zool. Path. Antverpiensia 78.

———. 1986. Zur Pflege und langjährigen Nachzucht von *Siebenrockiella crassicollis* (Gray, 1831) (Concerning the care and long-term reproduction of *Siebenrockiella crassicollis* [Gray, 1831]). Salamandra 22:1–10. [discussion of reproduction and husbandry. One female lived at Zürich Zoo for nearly 60 years.].

———. 1997. Aussichten-Einsichten; Gedanken zur Gestaltung von Grossterrarien für Grossechsen und Riesenschlangen (Views and insights: Thoughts on the construction of large terraria for large lizards and giant snakes). Z. Köln. Zoo 40(2):71–75. [Vivaria should utilize natural materials, including live plants. Plastic foliage should never be considered as its use sends the wrong message to the zoo visitor.].

———. 1998. Beitrag zu Haltung und Zucht der Skorpionskrustenechse, *Heloderma horridum*, im Zoo Zürich (Contribution concerning upkeep and breeding of the Mexican beaded lizard, *Heloderma horridum*, in the Zürich Zoo). Zool. Gart. (N.F.), Jena 68:287–299.

———, AND A. RÜBEL. 1991. Aufzucht und Erkrankungen der ersten in Europa nachgezogenen Galapagos-Schildkröten (*Geochelone elephantopus*) (Rearing and illnesses of the first Galapagos tortoises bred in Europe [*Geochelone elephantopus*]). *In* 4. Int. Coll. Pathol. Med. Rept. Amph., Dtsche Vet. med. Ges. (German Veterinary Medical Society), Bad Nauheim: 225–243.

———, C. SCHNEIDER, AND E. ZIMMERMANN. 1985. Notizen zur Aufzucht von Schmuckhornfröschen *Ceratophrys ornata* (Bell, 1843) (Notes on

the breeding of the ornate horned frog *Ceratophrys ornata* [Bell, 1843]). Salamandra 21:70–80.

Conservation

HONEGGER, R. E. 1967. Beobachtungen an den Riesenschildkröten (*Testudo gigantea*) der Inseln im Indischen Ozean (Observations of the giant tortoises [*Testudo gigantea*] of the islands of the Indian Ocean). Salamandra 3:101–121. [Many habitat photographs and discussion of pressures on tortoise population.].

———. 1968. Red Data Book Vol. 3: Amphibia/ Reptilia. International Union for Conservation of Nature and Natural Resources, Survival Service Commission, Morges, Switzerland. 1st ed. [2nd edition published in 1970.].

———. 1969. Bedrohte Amphibien und Reptilien (Endangered amphibians and reptiles). Zool. Garten (N.F.) 36 Hediger-Festschrift:173–185. [Discussion of conservation problems, caused by mostly human pressures.].

———. 1972. Breeding and maintaining reptiles in captivity, pp. 1–12. *In* R. D. Martin (ed.), Breeding Endangered Species in Captivity. Academic Press, London.

———. 1972. Amphibians and reptiles appearing in the Red Data Book, vol. III, listed by country or, in the case of island species, under oceanic regions. IUCN Bull. Suppl. 3 (7):1–8.

———. 1979. Some aspects of captive propagation of amphibians and reptiles with the aim of conservation, pp. 121–134. *In* R. A. Hahn (ser. ed.), 2nd International Herpetological Symposium on Captive Propagation and Husbandry. Zoological Consortium, Inc., Thurmont, Maryland.

———. 1980–81. List of amphibians and reptiles either known or thought to have become extinct since 1600. Biol. Conserv. 19:141–158.

———. 1987. CITES Identification Manual III. Dermochelyidae, Chelidae. Genève. [Honegger published nine sections in this series, mostly with Urs Woy: Testudinidae (1980); Trionychidae (1982); Dermochelyidae, Chelidae (1983); Emydidae (1985); Pelomedusidae (1986); Rhynchocephalidae (1987); Cryptobranchidae (1987); Turtle-shell and tortoise- shell-products (1987); all but this one were published in Lausanne].

General

HONEGGER, R. E. 1960. Beobachtungen an einigen Ostamerikanischen Schildkröten im Freiland und in Gefangenschaft (Observations on some eastern American turtles, both living free and in captivity). Z. Vivaristik 6:54–65.

———. 1964. Beobachtungen an der Spaltenschildkröte *Malacochersus tornieri* in Ost-Afrika (Observations on Tornier's tortoises *Malacochersus tornieri* in East Africa). Natur Mus., Frankf. 12:462–470.

———. 1972. Die Reptilien-Bestände auf den Galapagos-Inseln (Populations of reptiles on the Galapagos Islands). Natur und Museum 102:437–454.

———. 1975. The crocodilian situation in European zoos. Inter. Zoo Yearb. 15:277–283.

———. 1979. Marking amphibians and reptiles for future identification. Inter. Zoo Yearb. 19:14–22.

———. 1981. Breeding endangered species of amphibians and reptiles: Some critical remarks and suggestions. Brit. J. Herpetol. 6:113–118. [Discussion of need for cooperation between amateurs and professionals to expand breeding projects. Honegger provided a list of species bred consecutively in zoos during 1978–1979.].

———, AND H. HEUSSER. 1969. Beiträge zum Verhaltensinventar des Bindenwarans (*Varanus salvator*) (Contributions regarding the behavior inventory of the two-banded monitor [*Varanus salvator*]). Zool. Gart. (N.F.), Leipzig 36 Hediger-Festschrift:251–260.

———, AND F. W. ZEIGLER. 1991. The 1989/1990 crocodile surveys in European and American zoos and aquaria. Inter. Zoo Yearb. 30:153–157.

When I entered the zoo field as a keeper at Zoo Atlanta in 1966, John (Steve) Dobbs was the Curator and his assistant was R. Howard Hunt. I only stayed in Atlanta briefly because the opening of the new reptile building was to be delayed; the exhibits had been built with a toxic bonding agent that proved deleterious to reptiles. This unfortunate design flaw caused a protracted legal struggle between the architect and zoo officials. When the building finally opened several years after my departure, Hunt specialized in crocodilians, making use of the several large solariums with living plants available for large reptiles. Some exceedingly large Morelet's crocodiles lived in the enclosure and later bred regularly. When Dobbs was elevated to Zoo Director, Hunt became the Curator.

Hunt has a rapport with crocodilians that I have rarely seen and he taught me a great deal about them. Howard asked me once if crocodiles have acute vision. When I hesitated, he threw some mealworms to a large male estuarine crocodile which was resting in its pool. The animal quickly picked the insects off the surface of the water and swallowed them.

I was responsible for cleaning the many crocodilian pools and was a bit apprehensive to be next to so many large and potentially dangerous reptiles. Thus I was surprised one day to discover Howard lying motionless on his stomach amidst a number of larger specimens. I yelled to see if he was OK and he calmly rose and said that he was fine. When, naturally, I asked what he was doing, he said he just wanted to see what it was like to be a crocodile!

Although retired, Howard continues his long-term study of American alligators in the Okefenokee Swamp. Many years ago, I asked how his study was progressing. Things were generally going well, he said, although donning a bear costume (usually reserved for parties) in order to test nesting female gators' responses to potential predators had, during the blazingly hot summer, nearly caused a major heat stroke.

SELECTED PUBLICATIONS BY R. HOWARD HUNT

BELCHER, A. D., G. RIORDIN, F. GROVES, AND H. HUNT. 1987. Captive propagation of the dwarf caiman *Paleosuchus palpebrosus* at the Rio Grande Zoo, pp. 26–32. *In* R. Gowen (ed.), Captive Propagation and Husbandry of Reptiles and Amphibians. Northern California Herpetological Society.

HONEGGER, R. E., AND H. HUNT. 1990. Breeding crocodiles in zoological gardens outside the species range, with some data on the general situations in European zoos, pp. 200–228. Crocodiles: Proc. 10th Working Meeting of the Crocodile Specialist Group, Gainesville, Florida. IUCN. The World Conservation Union Publ. N.S., Gland, Switzerland.

HUNT, R. H. 1969. Breeding of spectacled caiman *Caiman c. crocodilus* at Atlanta Zoo. Inter. Zoo Yearb. 9:36–37.

———. 1973. Breeding Morelet's crocodile *Crocodylus moreletii* at Atlanta Zoo. Inter. Zoo Yearb. 13:103–105.

———. 1975. Maternal behavior in the Morelet's crocodile, *Crocodylus moreletii*. Copeia 1975:763–764.

———. 1987. Aggressive behavior by adult Morelet's crocodiles, *Crocodylus moreletii* toward young. Herpetologica 33:195–201.

Thomas Van Devender and his brother R. Wayne used to regularly visit with me at the Dallas Zoo when they were youngsters in the mid-1960s. Now, Wayne is a biology professor at Appalachian State University in North Carolina and Tom is a senior research scientist at the Arizona-Sonora Desert Museum in Tucson. For years, Tom has studied the environmental history and evolution of the Desert and has focused on the ecology and conservation of the

desert tortoise. In 2002, he edited a book called "The Sonoran Desert Tortoise: Natural History, Biology, and Conservation" (University of Arizona Press, Tucson) which is an important compendium of present knowledge about this endangered chelonian.

Increasingly, zoo workers are developing partnerships with a number of other zoos, governmental agencies, and conservation organizations. The paper below by Christina Castellano and her associates provides a nice model for these potentially productive interactions.

—*James B. Murphy, Section Editor*

Herpetological Review, 2003, 34(3), 192–193.

National Parks in the Northeast: Preserving America's Herpetological Heritage

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The Wildlife Conservation Society (WCS) and the National Park Service (NPS) have joined together under a cooperative agreement and in partnership to record the reptile and amphibian biodiversity on NPS lands. Launched in 1999, the project aims to inventory reptile and amphibian populations in more than 10 national parks, historic sites, national seashores, and national recreation areas in the northeastern United States.

Reptile and amphibian populations are in precipitous decline throughout the northeast. A combination of habitat loss and fragmentation, exotic plant and animal invaders, pollution, soaring predator levels, incidental take, and over-collection are to blame. For some amphibians and reptiles, America's parklands are their last retreat. In fact, some of the largest surviving woodlands and wetlands are preserved in America's parks. For that reason, NPS initiated the Inventory and Monitoring Program to establish a species database documenting the occurrence of vertebrates and vascular plants on parklands. The program compiles existing information from national databases and institutions, such as museums and universities, and combines it with data generated by targeted field investigations. To accomplish the program's goals, NPS is partnering with institutions and individuals that can provide the required assistance, manpower, and expertise for the mission at hand.

One of the NPS/WCS field crews conducting a snake survey using coverboard arrays at Acadia National Park.

Despite limited information, wildlife biologists recognized that NPS sites in the Northeast represented some of the most significant habitats remaining on the increasingly suburbanized landscape, and likely supported some of the more significant remnants of the region's herpetofauna. The cooperative agreement between WCS and NPS, drafted by Robert Cook (NPS) and John Behler (WCS), has strengthened the database and put the large-scale herpetological inventory in motion.

Parks inventoried since the program's inception include Acadia National Park in Maine, Gateway and Fire Island National Seashores in New York, Morristown, Sagamore Hill and Saratoga, Weir Farm, Saint-Gaudens, and Minute Man National Historic sites in New Jersey, New York, Connecticut, New Hampshire, and Massachusetts, respectively, and the Delaware Water Gap National Recreation Area on the Pennsylvania-New Jersey border. Each of these areas varies greatly in size and scope. Weir Farm in western Connecticut, roughly 24 hectares in size, provides an outdoor experience for a moderately populated residential community. Conversely, Delaware Water Gap National Recreation Area (DEWA) encompasses more than 60 km of the Delaware River and 28,000 hectares of land along its Pennsylvania and New Jersey shores. It is the largest recreational facility in the eastern United States and receives more than 5 million visitors annually.

NPS/WCS field teams have included nearly 30 biologists with a wide range of herpetological expertise. Additionally, student volunteers from Fordham, East Stroudsburg, and Hofstra universities and the University of Maine have participated in various aspects of the project including reptile and amphibian trapping, amphibian calling and egg mass count surveys, time constrained searches, cover board sampling, threatened and special concern species surveys and habitat assessment, and radio telemetry.

The herpetological diversity found at some of the study locations has provided additional opportunities to address more targeted questions. For example, the fens and seeps, cobble beaches, river islands, waterfalls, talus slopes, and shale cliffs that pervade the landscape at DEWA are home to nearly 50 species of reptiles and amphibians, some of which are recognized as *Endangered*, *Threatened*, *Rare*, or of *Special Concern* at the state or federal level. Some of DEWA's significant herpetofauna includes the longtail salamander (*Eurycea longicauda*), spring salamander (*Gyrinophilus porphyriticus*), northern cricket frog (*Acris gryllus*),

Graduate students from East Stroudsburg and Fordham universities recording shell measurements on a painted turtle at Delaware Water Gap National Recreation Area.

bog (*Glyptemys muhlenbergii*), wood (*Glyptemys insculpta*), and northern map (*Graptemys geographica*) turtles, eastern fence lizard (*Sceloporus undulatus*), and timber rattlesnake (*Crotalus horridus*). The information generated by the NPS/WCS teams will be used to plan infrastructure development and for designating wildlife sensitive areas.

NPS has a mandate to manage park resources in a manner that will leave them unimpaired for the enjoyment of future generations of park visitors. It recognizes that the fate of many of our greatest ecological and herpetological communities may rest with the conservation initiatives and wise management of the natural resources under its stewardship. Base-line inventories, with the generation of complete species lists and estimates of relative abundance, as well as the identification of key habitat features, are the necessary first steps in preserving our nation's herpetological resources. They provide the basic tools and grist to create long-term monitoring and resource protection programs to achieve these goals.

The DEWA field crew completing a northern fence lizard survey on the shale cliffs of the Pocono Plateau in eastern Pennsylvania.

LETTERS TO THE EDITOR

Herpetological Review, 2003, 34(3), 193–195.

The Importance of Reporting the Geodetic Datum with Geographic Coordinates

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In natural history notes and other herpetological manuscripts it has become increasingly popular to report the geographic coordinates (e.g., latitude/longitude, UTM) of animal locations and study sites. Unfortunately, the geodetic datum on which these coordinates are based is rarely reported. The lack of datum information with geographic coordinates hinders the integration of location data from individual studies because the coordinate readings of a given geographic location can vary significantly with different datums. If biologists are to use published coordinates to accurately analyze the collection locations of museum specimens, produce range maps, plot population distributions, or examine other spatial patterns, it will be critical to have the datum associated with the reported geographic coordinates.

We argue that geographic coordinates for biological data should be reported with the referenced datum so that published location data can be integrated to provide a more precise geographic view of species distributions and natural history observations.

What is a Datum?

A geodetic datum (here after referred to as datum) is a model of the Earth for geodetic measurements and geo-references of locations (DeMers 2000; McDonnell and Kemp 1995). The datum defines the shape and size of the Earth and the origin and orientation of a coordinate system from which locations on the surface of the Earth can be referenced. There are hundreds of datums currently in use for geo-referencing locations (horizontal datums) and estimating elevation (vertical datums). Horizontal datums assume that the surface of the earth is smooth and can be mathematically approximated as an ellipsoid.

Why is Reporting the Datum Important?

To illustrate the importance of the datum, we have plotted a single geographic coordinate (25°42'14", -124°50'24") referenced from seven different datums (Fig. 1). This graphically demonstrates that identical geographic coordinates are not representative of the same location if they are based on different datums. To explain why these position shifts occur, one must consider how geographic coordinates are calculated. The definitions of latitude and longitude are based on the assumed ellipsoidal surface of the Earth (Featherstone and Vanicek 1999). Different ellipsoids relative to a

specific datum may result in different readings of latitude and longitude for a given geographic location. Therefore, coordinates from different datums are incompatible because coordinate readings are relative to the origin, shape, and size of the respective datum. Failure to transform coordinates to a single datum can cause coordinate shifts and result in measurement errors. For example, the North American datum of 1927 (NAD27) was the primary datum used in early 1:24000 topographic maps published by the United States Geological Survey (USGS). Later, the USGS adopted the NAD83 datum which is based on the geodetic reference system of 1980 (GRS80) ellipsoid. The change from NAD27 to NAD83 resulted in as much as 300-m shifts in identical locations on the ground (Clarke 2001).

Reporting the referenced datum allows researchers to standardize geographic coordinates. In most cases, the National Imagery and Mapping Agency (NIMA) has developed mathematical transformations of geographic coordinates among various datums (NIMA 1991), and many geographic information systems (GIS) have built-in functions for datum transformation. Enhanced software capabilities and other improvements in GIS technologies have increased the feasibility of integrative biological studies and the analysis of fine to broad-scale spatial patterns, but these capabilities require datum information along with the geographic coordinates. Without reporting the datum, the 1–15 m accuracy achieved by many handheld GPS receivers may be degraded to hundreds of meters. This potentially introduces substantial error as biologists attempt to compile spatial data and assess ecological relationships. For example, coordinate shifts may falsely place the reported location of a museum specimen in neighboring populations, communities, or habitats, thus limiting ecological interpretations.

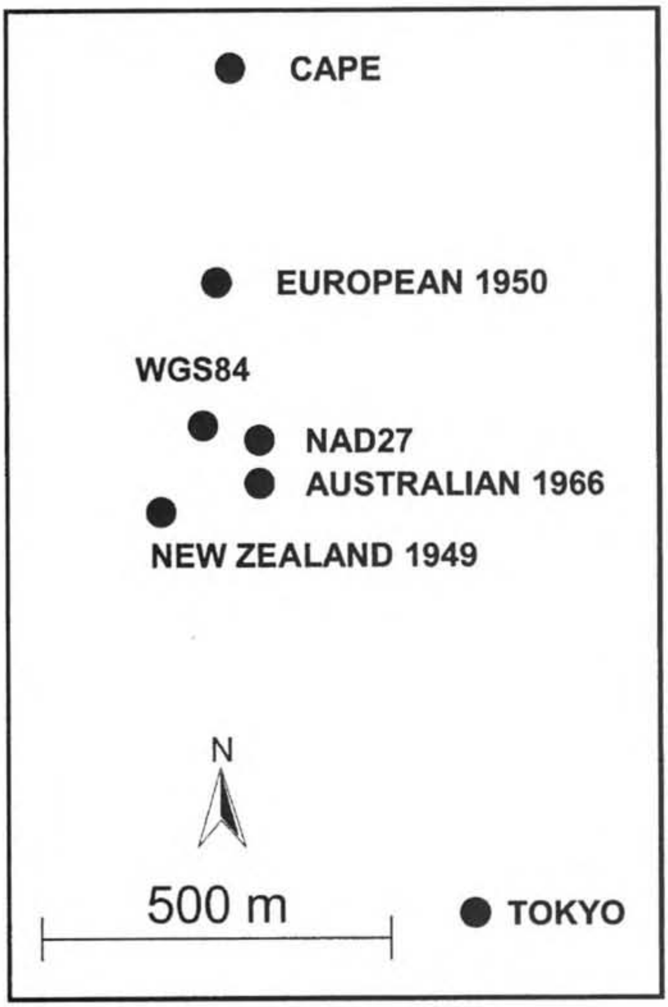

FIG. 1. The locations of a single geographic coordinate (25°42'14", -124°50'24") based on different datums are plotted. The datum on which these identical coordinates are based is listed next to each location.

Which is the Most Appropriate Datum?

As most GPS receivers can be set to the datum of choice, researchers are faced with the problem of choosing an appropriate datum for a desired task. To avoid problems with coordinate conversions, researchers may elect to choose a datum that matches other research materials, such as coordinates obtained from previous studies or chosen reference maps. Another factor to consider when choosing a datum is whether the datum coverage is local or global. A datum is defined by an ellipsoid and a coordinate origin. A local datum has a coordinate origin at a specific point on the Earth's surface (Featherstone and Vanicek 1999). For example, the NAD27 adopts the Clarke 1866 ellipsoid with the coordinate origin at Meades Ranch, Kansas (NIMA 1983). Local datums are commonly used to produce local and regional maps. An advantage of choosing a local datum may be that location errors are minimized near the referenced coordinate origin. However, spatial accuracy decreases as distances from the coordinate origin increase. Consequently, local datums may only be appropriate for specific regions. While choosing a datum may depend upon the availability of a local datum near the chosen study location, biologists may also want to consider the spatial scale of the investigation. Global datums, such as the world geodetic system of 1984 (WGS84), use a coordinate origin from the center of the Earth. Therefore, the spatial distortion from the reference ellipsoid is minimized globally. The WGS84 was developed by NIMA for global mapping production and is commonly used by global positioning systems (NIMA 1997). For these reasons, WGS84 is a frequently referenced global datum and may be appropriate for most biological studies.

Reporting the Datum and Other Spatial Information

When creating collection databases or reporting natural history observations, researchers should also consider the coordinate system being used and the other spatial information that may be required. For example, if a universal transverse mercator (UTM) coordinate system is chosen, then the UTM zone should also be reported with the datum. Similarly, a zone must also be reported when using the state plane coordinate system. The datum information, coordinate system, and zone (if applicable) can usually be obtained from the map or GPS receiver being used for geo-referencing. With the proliferation of spatial data, there is a growing need for biologists to familiarize themselves with these spatial concepts and report all information critical to the standardization of geographic coordinates.

Acknowledgments.—Thanks to Shawn Sartorius, Tania Roth, and Jens Vindum for comments on the manuscript.

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Egyptian Tortoise Conservation: A Response to Perälä

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We would like to make clarifications regarding inaccurate statements made in Perälä (2001) concerning *Testudo kleinmanni* conservation efforts in Egypt, particularly the "introduction" of confiscated Libyan animals into Sinai.

After the confiscation of some 300 animals of Libyan origin from the pet trade by Egyptian authorities in 1997, we were given the task of repatriating these animals to their "natural habitats." Options for doing this west of the Nile are, unfortunately, very limited. Given the reasonable management of Zaranik Protected Area in North Sinai, and working under the assumption that local tortoise populations had been completely extirpated, we decided to explore the possible release of a pilot group of 50 animals to this region. Being aware of potential biogeographical consequences of the introduction of western animals to areas east of the Nile, the animals were transferred into controlled environments, where the risk of release into the wider landscape was minimal. After a detailed health screening (D'Alterio et al. 1999), 40 animals were placed in a double-fenced enclosure, and 10 animals were radio-tagged and placed on a small offshore island.

In the spring of 2000, as a consequence of our efforts to raise tortoise conservation awareness in the local community, a small population of native tortoises was discovered in Zaranik Protected Area (31°05'N, 33°28'E; Baha El Din and Attum 2000), which is not near the Israeli border, as suggested by Perälä (2001). As a consequence we decided to transfer all the Libyan animals to another enclosure between Cairo and Alexandria, and to shift the emphasis in Zaranik to the *in situ* conservation of the local population.

To date we have succeeded in finding a population of over 60 wild animals in Zaranik Protected Area. This population is closely monitored by community guards, who track the animals on a regular basis. In addition, 16 animals have been radio-tagged to facilitate the collection of further ecological and behavioral data, which would aid in the conservation of this population. Moreover, we have been actively seeking the cooperation of the local Bedouin community in tortoise conservation through personal communication and the development of a very successful handicraft program. Other activities include public awareness, maintenance of confiscated animals, health profiling of the species, and lobbying government authorities. We are also in contact with Libyan colleagues and authorities to ban the illegal collection and trade in these animals.

Perälä's comparison of our efforts in Zaranik with a case concerning *Gopherus agassizii* in the USA described by Jacobson et al. (1995) is inappropriate, as the two situations are not similar at all. There was known to be a large native population of *G. agassizii*, into which over 800 *G. agassizii* were relocated. In our situation, no wild populations were known, and "introduced" animals were kept isolated and under control. Perälä's statement that our efforts are a "major and immediate threat" to the survival of the Sinai populations of *Testudo kleinmanni* reflect a real lack of understanding of the scale, scope, and imminence of the threat from habitat destruction and collection for the pet trade these creatures face throughout their range.

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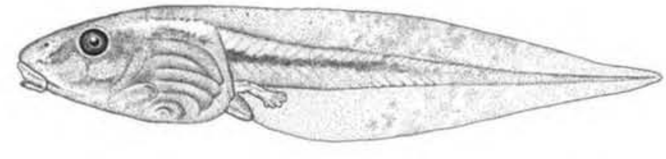

Tadpole of *Phrynohyas venulosa* (Veined Treefrog; USNM 321153). Costa Rica: Guanacaste: Cañas. Illustration by Julian C. Lee.

ARTICLES

Herpetological Review, 2003, 34(3), 196–203.

Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico: Update

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This publication serves as an update for the most recent list of scientific and standard English names of North American amphibians and reptiles north of Mexico (Crother et al. 2000. SSAR Herpetol. Circ. 29). The list below should to be used in conjunction with the previous work (*op. cit.*). This update includes new taxa described since the previous publication and any taxonomic changes that have led to name changes, both English and scientific.

A number of changes herein concern date of publication of the original species description. In the course of other work, one of us (McDiarmid) reviewed the dates of publication for species of amphibians and reptiles. A primary source was *An Index to the Scientific Contents of the Journal and Proceedings of The Academy of Natural Sciences of Philadelphia*, published in 1913, pages vii–xiv, in Commemoration of the Centenary of the Academy, March 21, 1912. Data in the publication were drawn primarily from a file of 'receipt acknowledgments' received by the Academy from libraries to whom the *Journal* and *Proceedings* were sent. While useful in establishing a documented earliest date other than that printed on the volume, these acknowledgments likely were subject to the schedules of the various responding librarians and therefore not always helpful when the year of response was different from the stated date of publication. Another potential source of data are accessions files of the various libraries receiving the publications and initial contact with the library of the American Philosophical Society clarified the date of publication for volume 8 [1856] of the *Proceedings*. We hope that further research along these lines will provide definitive dates for most of these volumes and expect that additional updates will be needed in the future.

The task of compiling the kind of information that goes into these publications is not trivial. We encourage colleagues to please send reprints concerning any taxonomic changes or decisions relevant to this list. Receiving such reprints will help ensure these names lists are as complete as possible.

Anura — FROGS

Compiled by Darrel Frost

Ascaphus Stejneger, 1899—TAILED FROGS
Ritland et al. (2000, Can. J. Zool. 78: 1749–1758), using randomly amplified polymorphic DNA (RAPD), found large genetic distances between isolated coastal and Rocky Mountain populations of *Ascaphus* in British Columbia, as well as genetic differentiation between north and south coastal populations. Subsequently, Nielson et al. (2001, Evolution, 55: 147–160) reported on mtDNA variation among the isolated populations in the Pacific Northwest, concluding that former *Ascaphus truei* is composed of at least two species, and recognized these as *Ascaphus truei* and *Ascaphus montanus*.

A. montanus Mittleman and Myers, 1949—Rocky Mountain Tailed Frog

A. truei Stejneger, 1899—Coastal Tailed Frog

See Metter (1968, Cat. Am. Amph. Rept. 69) for review (as including *Ascaphus montanus*).

Bufo alvarius Girard, 1859—Sonoran Desert Toad

B. americanus Holbrook, 1836—American Toad

B. a. charlesmithi Bragg, 1954—Dwarf American Toad

Masta et al. (2002, Mol. Phylogenet. Evol. 24: 302–314) found that *Bufo americanus charlesmithi* was concordant with a distinctive mtDNA clade in their analysis, suggesting that it might be an independent lineage.

B. boreas Baird and Girard, 1852—Western Toad

See Schuierer (1963, Herpetologica 18: 262–267). Two (sometimes three, see *Bufo nelsoni*) nominal subspecies are generally recognized, although the geographic variation within *Bufo boreas* is poorly studied and may mask a number of cryptic species.

B. b. boreas Baird and Girard, 1852—Boreal Toad

B. b. halophilus Baird and Girard, 1853—California Toad

B. fowleri Hinckley, 1882—Fowler's Toad

Masta et al. (2002, Mol. Phylogenet. Evol. 24: 302–314), on the basis of molecular evidence suggested that *Bufo fowleri* is a distinct species composed of three molecularly distinctive populations, which require additional study as to their taxonomic status.

B. nebulifer Girard, 1843—Gulf Coast Toad

Mendelson (1994, Occas. Pap. Mus. Nat. Hist. Univ. Kansas 166: 1–21; 1997, Herpetologica 53: 14–30) showed that a number of cryptic species were concealed under the name *Bufo valliceps* and subsequently (Mulcahy and Mendelson, 2000, Mol. Phylogenet. Evol. 17: 173) recognized that nominal *Bufo valliceps* was composed of a northern species (*Bufo nebulifer*) in the USA south to central Veracruz, Mexico, and another (*Bufo valliceps*) from central Veracruz, Mexico, to Costa Rica. Although the scientific name of the Gulf Coast Toad has changed, and the likelihood remains that *Bufo valliceps* (sensu stricto) may still hold some surprises, it is unlikely that *Bufo nebulifer* represents more than one lineage.

B. nelsoni Stejneger, 1893—Amargosa Toad
Considered by some to be an allopatric subspecies of *Bufo boreas*. Stebbins (1985, Field Guide W. Rept. Amph., Ed. 2: 70) recognized this allopatric and morphologically distinct population as a distinct species. Altig et al. (1998, Contemp. Herpetol. Inform. Ser. 2: 7) noted its allopatry from *Bufo boreas* as well as fixed differences between larvae. Morphological distinctiveness of the two forms is not controversial.

B. woodhousii Girard, 1854—Woodhouse's Toad
See comments under *Bufo fowleri* in the previous list. The unjustified emendation of the specific epithet to *woodhousei* has been used widely. The status of taxa recognized by Sanders (1987, Evol. Hybrid. Spec. N. Am. Indig. Bufonids: 1–110), has not been evaluated closely by any author, although they have neither enjoyed any recognition. Subspecies in this taxon are controversial, with two (*B. w. australis* and *B. w. woodhousii*) frequently recognized. A third nominal subspecies, *B. w. velatus* Bragg and Sanders, 1951 (East Texas Toad) has been suggested (Sullivan et al., 1996, Copeia 1996: 274–280), to represent part of a zone of hybridization between *Bufo fowleri* and *Bufo woodhousii* and so should not be recognized as a taxon until this issue is resolved. Detailed study of calls and molecules will likely prove fruitful within this widely distributed species. Masta et al. (2002, Mol. Phylogenet. Evol. 24: 302–314) noted that within *Bufo woodhousii* two distinct mtDNA clades exist which are largely concordant with the nominal subspecies *Bufo woodhousii woodhousii* and *Bufo woodhousii australis*, so additional work is warranted to determine the number of species under this name.

B. w. australis Shannon and Lowe, 1955—Southwestern Woodhouse's Toad

B. w. woodhousii Girard, 1854—Rocky Mountain Toad

Gastrophryne olivacea (Hallowell, 1856)—Great Plains Narrow-mouthed Toad

Hyla gratiosa LeConte, 1856—Barking Treefrog

H. wrightorum Taylor, 1939 "1938"—Mountain Treefrog
Until recently (Duellman, 2001, Hylid Frogs Middle Am., Ed. 2: 983–98) considered a synonym of *H. eximia*, in southern Mexico. Nevertheless, the evidence for considering the Mountain Treefrog as indistinguishable from its Mexican relative was always weak and never consistent with call structure. The status of populations of this species from Mexico (south to, but not including, the Mexico City region) is unknown.

Leptodactylus fragilis (Brocchi, 1877)—Mexican White-lipped Frog
No report of geographic variation. See Heyer (2002, Proc. Biol. Soc. Washington 115: 321–322) for summary of nomenclatural confusion regarding the name of this frog, formerly called *Leptodactylus labialis*.

Pseudacris regilla (Baird and Girard, 1852)—Pacific Treefrog
Transferred to *Pseudacris* by Hedges (1986, Syst. Zool. 35: 11) but was disputed by Cocroft (1994, Herpetologica 50: 420–437), although Silva (1997, J. Herpetol. 31: 609–613) provided additional evidence and discussion for placing this species within *Pseudacris*. See Jameson, Mackey, and Richmond (1966, Proc. California Acad. Sci. 33: 551–620) and Duellman (1970, Monogr. Mus. Nat. Hist. Univ. Kansas 1: 484–493). Several nominal subspecies named, though infrequently used in the literature. Whether these represent sibling species or arbitrarily delimited components of geographic variation is unknown. Further investigation is warranted. Highton (2000, Biol. Plethodontid Salamanders: 234) discussed the previously published allozyme evidence (including that of Case, Haneline, and Smith, 1975, Syst. Zool. 24: 281–295) and suggested that what genetic data as exist for *Pseudacris regilla* are not consistent with it being a single species.

P. streckeri A. A. Wright and A. H. Wright, 1933—Strecker's Chorus Frog

P. s. illinoensis Smith, 1951—Illinois Chorus Frog
Considered a distinct species, *Pseudacris illinoensis*, by Collins (1997, SSAR Herpetol. Circ. 25) without discussion.

Rana berlandieri Baird, 1859—Rio Grande Leopard Frog

R. capito LeConte, 1855—Gopher Frog
Rana capito is considered by some to be part of *R. areolata* (but see Case, 1978, Syst. Zool. 27: 299–311, who considered it distinct). Recognized as distinct from *Rana areolata* by Young and Crother (2001, Copeia 2001: 382–388), who also sugggested that the nominal subspecies are arbitrary units.

R. sevosa Goin and Netting, 1940—Dusky Gopher Frog
Reviewed (as *Rana areolata sevosa*) by Altig and Lohoefener (1983, Cat. Am. Amph. Rept. 324: 1–4). Recognized as distinct from *R. capito* and *R. areolata* by Young and Crother (2001, Copeia 2001: 382–388).

R. virgatipes Cope, 1891—Carpenter Frog
Data presented by Pytel (1986, Herpetologica 42: 273) suggest that careful evaluation for cryptic species is warranted.

Caudata — SALAMANDERS

Compiled by Richard Highton, Stephen G. Tilley (Chair), David B. Wake.

Ambystoma cingulatum Cope, 1868—Flatwoods Salamander

Batrachoseps gavilanensis Jockusch, Yanev, and Wake, 2001—Gabilan Mountains Slender Salamander.
See annotation under *B. pacificus*.

B. incognitus Jockusch, Yanev, and Wake, 2001—San Simeon Slender Salamander
See annotation under *B. pacificus*.

B. luciae Jockusch, Yanev, and Wake, 2001—Santa Lucia Mountains Slender Salamander
See annotation under *B. pacificus*.

B. minor Jockusch, Yanev, and Wake, 2001—Lesser Slender Salamander
See annotation under *B. pacificus*.

B. pacificus (Cope, 1865)—Channel Islands Slender Salamander
This formerly polytypic species now includes only populations found on the northern Channel Islands off the coast of southern California (Jockusch et al., 2001, Herpetol. Monogr. 15: 54–99; Jockusch and Wake, 2002, Biol. Jour. Linn. Soc. 76: 361–391). Former members of this taxon have been raised to species rank (*B. major, B. relictus*) or described as new species (*B. diabolicus, B. gavilanensis, B. incognitus, B. kawia, B. luciae, B. minor,* and *B. regius*).

B. robustus Wake, Yanev and Hansen, 2002—Kern Plateau Salamander

B. wrightorum (Bishop, 1937)—Oregon Slender Salamander
Applegarth (1994, Publ. USDI Bureau of Land Management, Eugene, Oregon) made the required emendation from *B. wrighti* to *B. wrightorum*. Petranka (1998, Salamanders of the United States and Canada, Smithsonian Institution Press) employed the original nomenclature.

Desmognathus brimleyorum Stejneger, 1895—Ouachita Dusky Salamander

D. conanti Rossman, 1958—Spotted Dusky Salamander
Elevated to species rank by Titus and Larson (1996, Syst. Biol. 45: 451–472). Treated as a subspecies of *D. fuscus* by Petranka (1998, Salamanders of the United States and Canada, Smithsonian Institution Press). Bonett (Copeia 2002: 344–355) showed that *D. conanti* and *D. fuscus* are

parapatric in Tennessee with only very limited hybridization, and that *D. conanti* consists of two clades of populations that may represent distinct species.

D. folkertsi Camp, Tilley, Austin, and Marshall, 2002—Dwarf Black-bellied Salamander

D. fuscus (Rafinesque, 1820)—Northern Dusky Salamander

Treated as a monotypic species by Titus and Larson (1996, Syst. Biol. 45: 451–472). Treated as a polytypic species consisting of *D. f. conanti*, *D. f. fuscus*, and *D. f. santeetlah* by Petranka (1998, Salamanders of the United States and Canada, Smithsonian Institution Press). Bonett (Copeia 2002: 344–355) showed that *D. conanti* and *D. fuscus* are parapatric in Tennessee with only very limited hybridization, and that *D. fuscus* consists of northern and southern clades of populations. He suggested that these may represent distinct species, although they appear to hybridize over a broad area in Virginia. Frost [2002. Amphibian Species of the World: an online reference. V2.21 (15 July 2002) http//research.amnh.org/herpetology/amphibia/index.html] applied the name *Desmognathus niger* Green to this taxon, noting that the name *Salamandra fusca* Green is a junior primary homonym of *Salamandra fusca* Laurenti (=*Salamandra atra*). However, contrary to the synonymies made by Gray, 1850, Cat. Spec. Amph. Coll. Brit. Mus., Batr. Grad.: 31, Hallowell, 1856, Proc. Acad. Nat. Sci. Philaelphia, 8: 7, and Dunn, 1926, Salamand. Fam. Plethodontidae: 81, Green's [1818, J. Acad. Nat. Sci. Philadelphia, (1)1: 357] descriptions of *Salamandra fusca* and two other taxa that might represent *Desmognathus fuscus* (*S. niger*, and *S. sinciput–albida*) are too vague to be associated unambiguously with any known species of salamander. *Triturus fuscus* was later described by Rafinesque (1820, Ann. Nat., Lexington, 1: 4), whose type description applies to this taxon less ambiguously than any of Green's. Rafinesque should therefore be considered the author of the name *Desmognathus fuscus*, while Green's *Salamandra fusca*, *S. niger*, and *S. sinciput–albida* should be regarded as *nomina dubia*.

D. wrighti King, 1936—Pygmy Salamander

Dicamptodon aterrimus (Cope, 1868)—Idaho Giant Salamander

Eurycea cirrigera (Green, 1830)—Southern Two-lined Salamander

See note for *E. wilderae*.

E. rathbuni (Stejneger, 1896)—Texas Blind Salamander

E. robusta (Longley, 1978)—Blanco Blind Salamander

E. wilderae Dunn, 1920—Blue Ridge Two-lined Salamander

Treated as a species by Jacobs (1987, Herpetologica 43: 423–446), Conant and Collins (1991, Reptiles and Amphibians of Eastern and Central North America, Houghton Mifflin Co.) and Collins (1997, SSAR Herpetol. Circ. 25) on the basis of its level of genetic differentiation from other members of the *E. bislineata* complex. Treated, together with *E. cirrigera*, as a subspecies of *E. bislineata* by Petranka (1998, Salamanders of the United States and Canada, Smithsonian Institution Press), but *E. wilderae* and *E. cirrigera* occur in sympatry (Camp et al., 2000, Copeia 2000: 572–578) and undergo very little gene exchange where they are parapatric (Kozak and Montanucci, 2001, Copeia 2001: 25–34).

Hemidactylium scutatum (Temminck and Schlegel in Von Siebold, 1838)—Four-toed Salamander

Hydromantes platycephalus (Camp, 1916)—Mount Lyell Salamander

Plethodon jordani Blatchley, 1901—Red-cheeked Salamander

The taxon was restricted to populations in the Great Smoky Mountains by Highton and Peabody (2000, pp. 31–94 in Bruce et al., The Biology of Plethodontid Salamanders, Kluwer Academic/Plenum Publishers), who also suggested the standard English name.

Typhlotriton Stejneger, 1892—Grotto Salamanders

T. spelaeus Stejneger, 1892—Grotto Salamander

Squamata — LIZARDS

Compiled by Kevin de Queiroz (Chair), Tod W. Reeder, Jack W. Sites, Jr.

"Ameiva" Meyer, 1795—AMEIVAS (Introduced)

Taxonomy for "*Ameiva*" follows Peters and Donoso-Barros (1970, Bull. United States Natl. Mus. 297: 1–293). Reeder et al. (2002, Am. Mus. Novit. 3365: 1–61) presented evidence that "*Ameiva*," as currently circumscribed, is not monophyletic, though they did not propose a taxonomic change to rectify this situation. We have placed the name "*Ameiva*" in quotation marks to indicate the non-monophyletic status of the taxon.

Anniella Gray, 1852—NORTH AMERICAN LEGLESS LIZARDS

Taxonomy for *Anniella* follows Hunt (1983, Copeia 1983: 79–89), with nomenclatural modifications (ICZN, 1993, Bull. Zool. Nomencl. 50: 186–187).

A. pulchra Gray, 1852—California Legless Lizard

Pearse and Pogson (2000, Evolution 54: 1041–1046) presented evidence that the melanistic form previously designated *Anniella pulchra nigra* is polyphyletic, its Monterey Bay and Morro Bay populations having been derived independently from the silvery form previously designated *A. p. pulchra*. Although Pearse and Pogson did not propose any taxonomic changes, their results indicate that the subspecies *A. p. pulchra* and *A. p. nigra* do not correspond with separated or partially separated lineages, and therefore we do not recognize subspecies within *A. pulchra*. The existence and extent of genetic continuity between melanistic and silvery populations, as well as between northern and southern haplotype clones, deserves further study.

Anolis cristatellus Duméril and Bibron, 1837—Crested Anole (Introduced)

A. c. cristatellus Duméril and Bibron, 1837—Puerto Rican Crested Anole (Introduced)

Anolis cristatellus cristatellus is established in Brevard and Dade Counties, Florida (Wilson and Porras, 1983, Univ. Kansas Mus. Nat. Hist. Spec. Publ. 9: 1–89 and references therein; Seigel et al., 1999, Herpetol. Rev. 30: 173). Subspecific identifications were not reported by Wilson and Porras (*op. cit.*) or Seigel et al. (*op. cit.*) but have been given for the Dade County specimens by Schwartz and Henderson (1988, Contrib. Biol. Geol. Milwaukee Publ. Mus. 74: 1–264; 1991, Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History, University of Florida Press).

Aspidoscelis Fitzinger, 1843—WHIPTAILS

Reeder et al. (2002, Am. Mus. Novit. 3365: 1–61) presented evidence that *Cnemidophorus*, as previously circumscribed, is not monophyletic, and they resurrected *Aspidoscelis* for the clade composed of the species native to North America. Not shown below but necessary to note is that all author names are in parentheses. This change affects the following species names:

C. arizonae becomes *A. arizonae*
C. burti becomes *A. burti* (*C. b. stictogrammus* becomes *A. b. stictogramma*)
C. dixoni becomes *A. dixoni*
C. exsanguis becomes *A. exsanguis*
C. flagellicaudus becomes *A. flagellicauda*
C. gularis becomes *A. gularis* (*C. g. gularis* becomes *A. g. gularis*)
C. gypsi becomes *A. gypsi*
C. hyperythrus becomes *A. hyperythra* (*C. h. beldingi* becomes *A. h. beldingi*)
C. inornatus becomes *A. inornata* (*C. i. heptagrammus* becomes *A. i. heptagramma*, *C. i. juniperus* becomes *A. i. junipera*, *C. i. llanuras* becomes *A. i. llanuras*)
C. laredoensis becomes *A. laredoensis*
C. marmoratus becomes *A. marmorata* (*C. m. marmoratus* becomes *A. m. marmorata*, *C. m. reticuloriens* becomes *A. m. reticuloriens*)
C. neomexicanus becomes *A. neomexicana*
C. neotesselatus becomes *A. neotesselata*

C. pai becomes *A. pai*

C. septemvittatus becomes *A. septemvittata* (*C. s. septemvittatus* becomes *A. s. septemvittata*)

C. sexlineatus becomes *A. sexlineata* (*C. s. sexlineatus* becomes *A. s. sexlineata*, *C. s. stephensae* becomes *A. s. stephensae*)

C. sonorae becomes *A. sonorae*

C. tesselatus becomes *A. tesselata*

C. tigris becomes *A. tigris* (*C. t. mundus* becomes *A. t. munda*[1], *C. t. punctilinealis* becomes *A. t. punctilinealis*, *C. t. septentrionalis* becomes *A. t. septentrionalis*, *C. t. stejnegeri* becomes *A. t. stejnegeri*, *C. t. tigris* becomes *A. t. tigris*)

C. uniparens becomes *A. uniparens*

C. velox becomes *A. velox*

C. xanthonotus becomes *A. xanthonota*

[1]Reeder et al. (*op. cit.*) mistakenly used the name *A. t. undulata* instead of the valid name *A. t. munda* (see Crother et al., 2000, SSAR Herpetol. Circ. 29).

A. laredoensis (McKinney, Kay and Anderson, 1973)—Laredo Striped Whiptail (unisexual)

Abuhteba et al. (2001, Copeia 2001: 262–266) interpreted histoincompatibility between the members of two pattern classes within *Aspidoscelis laredoensis* as evidence for separate hybrid origins of the corresponding clones. The authors noted that two of them are planning to restrict the name *A. laredoensis* to one of the clones and propose a new species name for the other.

A. marmorata Baird and Girard, 1852—Marbled Whiptail

Aspidoscelis marmorata (including *A. marmorata marmorata* and *A. m. reticuloriens* in the United States) was treated as a species by Hendricks and Dixon (1986, Texas J. Sci. 38: 327–402) but as a subspecies of *A. tigris* by Maslin and Secoy (1986, Contrib. Zool. Univ. Colorado Mus. 1: 1–60) and Wright (1993, Pp. 27–81 *in* Biology of Whiptail Lizards [Genus *Cnemidophorus*], J. W. Wright and L. J. Vitt [eds.], Oklahoma Mus. Nat. Hist.). Dessauer and Cole (1991, Copeia 1991: 622–637; see also Dessauer et al., 2000, Bull. Am. Mus. Nat. Hist. 246: 1–148) presented evidence of both differentiation and interbreeding between *marmorata* and *tigris* along a transect near the southern part of the border between Arizona and New Mexico, including a narrow (3 km) hybrid zone in which hybrid indices based on color patterns and allele frequencies changed abruptly in concordant step clines. Although those authors interpreted their data as reflecting incomplete speciation between the two forms (i.e., a single species), the same data can be interpreted alternatively as reflecting largely separate gene pools (i.e., two species). Following the terminology of de Queiroz (1998, pp. 57–75 *in* Endless Forms: Species and Speciation, D. J. Howard and S. H. Berlocher [eds.], Oxford University Press), they are here considered incompletely separated species.

"*Cnemidophorus*" Wagler, 1830—SOUTH AMERICAN WHIPTAILS

Taxonomy for "*Cnemidophorus*" follows Peters and Donoso-Barros (1970, Bull. United States Natl. Mus. 297(Part II): 1–293). Reeder et al. (2002, Am. Mus. Novit. 3365: 1–61) presented evidence that *Cnemidophorus*, even after the removal of *Aspidoscelis*, is not monophyletic, though they did not propose a taxonomic change to rectify this situation. We have placed the name "*Cnemidophorus*" in quotation marks to indicate the non-monophyletic status of the taxon.

Cosymbotus platyurus (Schneider, 1792)—Flat-tailed House Gecko (Introduced)

Cosymbotus platyurus is established in Alachua and Pinellas Counties Florida (Meshaka and Lewis, 1994, Herpetol. Rev. 25: 127; Hauge and Butterfield, 2000, Herpetol. Rev. 31: 52).

Crotaphytus vestigium Smith and Tanner, 1972—Baja California Collared Lizard

McGuire (1996, Bull. Carnegie Mus. Nat. Hist. 32: 1–143) noted that the name *Crotaphytus vestigium* Smith and Tanner is a junior synonym of *C. fasciatus* Mocquard. Nevertheless, he used the junior synonym as the valid name for the taxon because the senior synonym had not been so used during the last 50 years, while the junior synonym had been used repeatedly. McGuire also noted that *C. fasciatus* Mocquard is a junior (primary) homonym of *C. fasciatus* Hallowell (which is itself a junior synonym of *Gambelia wislizenii*) and that Mocquard, apparently aware of the problem, had provided the new replacement name (nomen novum) *C. fasciolatus*. Because the junior primary homonym *C. fasciatus* Mocquard is invalid (ICZN, 1999: Article 57.2), the correct name for this taxon is *C. fasciolatus*; however, for the reasons noted above, McGuire (2000, Bull. Zool. Nomencl. 57: 158–161) has proposed that *C. fasciolatus* be suppressed. Until the International Commission on Zoological Nomenclature rules on this proposal, we have followed the Zoological Code (ICZN, 1999: Article 82.1) by maintaining the name in most common current use.

Eumeces "gilberti" Van Denburgh, 1896—Gilbert's Skink

Richmond and Reeder (2002, Evolution 56: 1498–1513) presented evidence that populations previously referred to *Eumeces gilberti* represent three lineages that separately evolved large body size and the loss of stripes in late ontogenetic stages. Although they considered those three lineages to merit species recognition, they did not propose specific taxonomic changes in that paper. We have placed the name "*gilberti*" in quotation marks to indicate that it refers to a group composed of several species.

E. multivirgatus (Hallowell, 1857)—Many-lined Skink

E. m. epipleurotus Cope, 1880—Variable Skink

Hammerson (1999, Amphibians and Reptiles in Colorado, Univ. Press of Colorado) argued, based on diagnosability and the apparent absence of intergrades, that *Eumeces multivirgatus epipleurotus* (under the name *E. gaigeae*) is a different species than *E. m. multivirgatus*. We have refrained from adopting this proposal until a more rigorous study is conducted.

E. skiltonianus (Baird and Girard, 1852)—Western Skink

Richmond and Reeder (2002, Evolution 56: 1498–1513) presented evidence that the subspecies of *Eumeces skiltonianus*, as currently circumscribed, do not correspond with the boundaries of haplotype clades based on mitochondrial DNA. However, because those authors did not propose a revised subspecies taxonomy, and because resolution of that taxonomy requires more extensive geographic sampling, we have retained the existing subspecies taxonomy (e.g., Tanner, 1988, Cat. Am. Amph. Rept. 447.1).

Hemidactylus turcicus (Linnaeus, 1758)—Mediterranean House Gecko (Introduced)

Hemidactylus turcicus is established at numerous localities in the southern and eastern United States, including the states of Alabama (Mount, 1975, The Reptiles and Amphibians of Alabama, Auburn Univ. Agric. Exper. Stat.), Arizona (Robinson and Romack, 1973, J. Herpetol. 7: 311–312), Arkansas (Paulissen and Buchanan, 1990, Herpetol. Rev. 21: 22), California (Porter, 1988, San Diego Herpetol. Soc. Newsl. 10: 5), Florida (Wilson and Porras, 1983, Univ. Kansas Mus. Nat. Hist. Spec. Publ. 9: 1–89 and references therein), Georgia (Bechtel, 1983, Herpetol. Rev. 14: 27–28), Louisiana (Etheridge, 1952, Copeia 1952: 47–48), Maryland (Norden and Norden, 1989 [1991], Maryland Nat. 33: 57–58), Mississippi (Keiser, 1984, J. Mississippi Acad. Sci. 29: 17–18), Nevada (Saethre and Medica, 1993, Herpetol. Rev. 24: 154–155), New Mexico (Painter et al., 1992, Herpetol. Rev. 23: 62), Oklahoma (Henniger and Black, 1987, Bull. Oklahoma Herpetol. Soc. 12: 20), South Carolina (Eason and McMillan, 2000, Herpetol. Rev. 31: 53), Texas (Conant, 1955, Am. Mus. Novit. 1726: 1–6), and Virginia (Knight, 1993, Dactylus 2: 49–50). Subspecific identifications (*H. t. turcicus*) have been reported in some cases, but not in others.

Holbrookia Girard, 1851—LESSER EARLESS LIZARDS

Taxonomy for *Holbrookia* follows Smith (1946, Handbook of Lizards. Lizards of the United States and Canada, Cornell Univ. Press) with modifications by Axtell (1956, Bull. Chicago Acad. Sci 10: 163–179; description of *H. maculata perspicua* and treatment of *H. lacerata* as a species) and those described in subsequent notes. Separation of *Cophosaurus texanus* (*Holbrookia texana*) from *Holbrookia* follows Axtell (1958, Ph.D.

dissertation, Univ. Texas), Clarke (1965, Emporia St. Res. Stud. 13: 1–66), Cox and Tanner (1977, Great Basin Nat. 37: 35–56) and de Queiroz (1989, Ph.D. dissertation, Univ. California, Berkeley).

H. elegans Bocourt, 1874—Elegant Earless Lizard

H. e. thermophila Barbour, 1921—Sonoran Earless Lizard

Holbrookia elegans was recognized as a species by Lowe (1964, pp. 153–174 in The Vertebrates of Arizona, C. H. Lowe [ed.], Univ. Arizona Press), and corroborating evidence has been provided by Adest (1978, Ph.D. dissertation, Univ. California, Los Angeles) and Wilgenbusch and de Queiroz (2000, Syst. Biol. 49: 592–612); a diagnosis has been provided by Axtell (1998, Interpretive Atlas of Texas Lizards 18: 1–19).

Lacerta bilineata Daudin 1802—Western Green Lizard (Introduced)
Amann et al. (1997, Salamandra 33: 255–268) presented evidence for the specific separation of *Lacerta bilineata* from *L. viridis*, and Green Lizards reported from Shawnee Co., Kansas (Collins, 1993, Univ. Kansas Mus. Nat. Hist. Public Educ. Ser. No. 13; Gubanyi and Gubanyi, 1997, Herpetol. Rev. 28: 96) have subsequently been referred to *L. bilineata* without a subspecific identification (Gubanyi, 2000, Trans. Kansas Acad. Sci. 103: 191–192; Kalyabina-Hauf and Deichsel, 2002, Herpetol. Rev. 33: 225–226).

Leiocephalus carinatus Gray, 1827—Northern Curly-tailed Lizard (Introduced)

L. c. armouri Barbour and Shreeve, 1935—Little Bahama Curly-tailed Lizard (Introduced)

Leiocephalus carinatus armouri is established in Brevard, Dade, and Palm Beach Counties, Florida (Wilson and Porras, 1983, Univ. Kansas, Mus. Nat. Hist. Spec. Publ. 9: 1–81 and references therein; Krysko and King, 2002, Herpetol. Rev. 33: 148).

Mabuya Fitzinger, 1826—MABUYAS

M. multifasciata (Kuhl, 1820)—Many-striped Mabuya (Introduced)
Mabuya multifasciata is established in Dade County, Florida (Meshaka, 1999, Florida Sci. 62: 153–157).

Neoseps Stejneger, 1910—FLORIDA SAND SKINKS
Taxonomy for *Neoseps* follows Telford (1969, Cat. Am. Amph. Rept. 80). Richmond and Reeder (2002, Evolution 56: 1498–1513) presented evidence that *Neoseps* is nested within *Eumeces*, closely related to *E. egregius*, though they did not propose a taxonomic change.

Ophisaurus Daudin, 1803—GLASS LIZARDS
Taxonomy for *Ophisaurus* follows McConkey (1954, Bull. Florida St. Mus. Biol. Sci. 2: 13–23) with modifications by Palmer (1987, Herpetologica, 43: 415–423; description of *O. mimicus*). Macey et al. (1999, Mol. Phylogenet. Evol. 12: 250–272) presented evidence that *Ophisaurus*, if it includes North American, European, African, and Asian species, is not monophyletic. Although they favored placing all species in *Anguis*, this action is both disruptive and makes *Anguis* redundant with Anguinae; we have therefore adopted their alternative proposal of retaining *Ophisaurus* for the North American and Southeast Asian species.

Phrynosoma douglasii (Bell, 1829)—Pygmy Short-horned Lizard

Podarcis muralis (Laurenti, 1768)—Common Wall Lizard (Introduced)
Podarcis muralis is established in Hamilton Co. (Cincinnati), Ohio (Vigle, 1977, Herpetol. Rev. 8: 19; Hedeen, 1988, Herpetol. Rev. 19: 19) and Kenton Co., Kentucky (Ferner and Ferner, 2002, Herpetol. Rev. 33: 226).

P. sicula (Rafinesque, 1810)—Italian Wall Lizard (Introduced)
Podarcis sicula is established in Long Island, New York (Smith and Kohler, 1978, Trans. Kansas Acad. Sci. 80: 1–24 and reference therein) and Topeka, Kansas (Collins, 1993, Univ. Kansas Mus. Nat. Hist. Public Edu. Ser. No. 13). According to Smith and Kohler (*op. cit.*), the New York population is *P. s. sicula*; however, a more recent study by Oliverio et al. (2001, Ital. J. Zool. 68: 121–124) referred both the New York (see also Burke et al., 2002, Copeia 2002: 836–842) and Kansas populations to *P. s. campestris*, though a more thorough characterization of geographic variation within *P. sicula* is needed. A population of *P. s. campestris* was formerly established in Philadelphia, Pennsylvania, but that population is now thought to be extinct (Smith and Kohler, *op. cit.* and references therein).

Sauromalus ater Duméril, 1856—Common Chuckwalla
A proposal to grant the name *Sauromalus obesus* (Baird, 1858) precedence over *S. ater* Duméril 1856 in the interest of maintaining nomenclatural stability (Montanucci et al., 2001, Bull. Zool. Nomen. 58: 37–40) is not followed because both names were in use prior to their treatment as synonyms by Hollingsworth (1998, Herpetol. Monog. 12: 38–191). For further discussion see McDiarmid et al. (2002, Bull. Zool. Nomen. 59: 45–48).

Sceloporus jarrovii Cope, 1875—Yarrow's Spiny Lizard
Wiens et al. (1999, Evolution 53: 1884–1897; see also Wiens and Penkrot, 2002, Syst. Biol. 51: 69–91) presented evidence that several of the previously recognized subspecies of *Sceloporus jarrovii* are not monophyletic and that several clades within this species are more closely related to other species in the *S. torquatus* group than to other populations of *S. jarrovii*. Therefore, they recognized five species for the populations formerly referred to *S. jarrovii*, applying the name *S. jarrovii* to the only one of those five species that occurs in the United States (corresponding with the set of populations formerly referred to *S. j. jarrovii*). No subspecies were recognized.

S. undulatus (Bosc and Daudin *in* Sonnini and Latreille, 1801)—Eastern Fence Lizard
Leaché and Reeder (2002, Syst. Biol. 51: 44–68) presented phylogeographic evidence that *Sceloporus undulatus*, as previously circumscribed, is made up of at least four separately evolving lineages, and they applied the name *S. undulatus* to populations east of roughly the 88th meridian. Their results also suggest that the formerly recognized subspecies *undulatus* (Southern Fence Lizard) and *hyacinthinus* (Northern Fence Lizard) are not natural groups (see also Miles et al., 2002, Herpetologica 58: 277–292), and that the deepest genetic division within *S. undulatus* is not between northern and southern populations but between those east and west of the Appalacian Mountains, though they did not recognize subspecies within *S. undulatus*.

S. consobrinus Baird and Girard, 1853—Prairie Lizard
See note for *Sceloporus undulatus*. Leaché and Reeder (2002, Syst. Biol. 51: 44–68) applied the name *S. consobrinus* to the populations formerly referred to *S. undulatus* from the central United States, most (though not all) of which occur in the plains between the Mississippi River and the Rocky Mountains. Their results also suggest that the formerly recognized subspecies *consobrinus* (Southern Prairie Lizard) and *garmani* (Northern Prairie Lizard) are not natural groups, and they did not recognize subspecies within *S. consobrinus*. Leaché and Reeder (*op. cit.*) noted that the name *S. thayerii* Baird and Girard 1852 (type locality: Indianola, Calhoun Co., TX) may turn out to be the correct name of this species and that populations east of the Mississippi River along the Gulf Coast may represent a separate species.

S. cowlesi Lowe and Norris, 1956—Southwestern Fence Lizard
See note for *Sceloporus undulatus*. Leaché and Reeder (2002, Syst. Biol. 51: 44–68) applied the name *S. cowlesi* to the populations formerly referred to *S. undulatus* from roughly the region of the Chihuahuan Desert. They did not recognize subspecies within *S. cowlesi*.

S. tristichus Cope *in* Yarrow 1875—Plateau Lizard
See note for *Sceloporus undulatus*. Leaché and Reeder (2002, Syst. Biol. 51: 44–68) applied the name *S. tristichus* to the populations formerly referred to *S. undulatus* from roughly the region of the Colorado Plateau. Their results also suggest that the formerly recognized subspecies *tristichus* (Southern Plateau Lizard), *erythrocheilus* (Red-lipped Plateau Lizard), and *elongatus* (Northern Plateau Lizard) are not natural groups, and they did not recognize subspecies within *S. tristichus*.

Scincella lateralis (Say in James, 1823)—Little Brown Skink

Uma notata Baird, 1859 "1858"—Colorado Desert Fringe-toed Lizard

Trépanier and Murphy (2001, Mol. Phylogenet. Evol. 18: 327–334) presented evidence that *Uma notata*, as previously circumscribed, is paraphyletic; the subspecies *U. n. notata* is more closely related to *U. inornata* than to *U. n. rufopunctata* (see also Wilgenbusch and de Queiroz, 2000, Syst. Biol. 49: 592–612). They therefore considered the two previously recognized subspecies to be species.

U. rufopunctata Cope, 1895—Yuman Desert Fringe-toed Lizard
See note for *Uma notata*. Populations formerly assigned to *U. rufopunctata* from the Mohawk Dunes, Yuma Co., Arizona appear to represent a currently undescribed cryptic species (Trépanier and Murphy, 2001, Mol. Phylogenet. Evol. 18: 327–334).

Urosaurus nigricaudus (Cope, 1864)—Baja California Brush Lizard
Aguirre et al. (1999, Herpetologica 55: 369–381) and Grismer (1999, Herpetologica 55: 446–469) presented evidence that *Urosaurus microscutatus* and *U. nigricaudus* constitute a single species, for which the name *U. nigricaudus* has priority and within which no subspecies were recognized. The English name Black-tailed Brush Lizard was applied to *U. nigricaudus* when that species was thought to include only populations from southern Baja California; however, that name is descriptively misleading when applied to the species as currently circumscribed. Although the English name Baja California Brush Lizard has been used for *U. lahtelai* (e.g., Stebbins, 1985, A Field Guide to Western Reptiles and Amphibians, Houghton Mifflin Co.; Grismer, 2002, Amphibians and Reptiles of Baja California, Univ. California Press), that species is restricted to a small area in the vicinity of Cataviña (suggesting the English name Cataviña Brush Lizard); in contrast, *U. nigricaudus* is widely distributed in, and more-or-less restricted to, Baja California.

Uta stansburiana Baird and Girard, 1852—Common Side-blotched Lizard
Upton and Murphy (1997, Mol. Phylogenet. Evol. 8: 104–113) presented evidence for a distant relationship between *Uta* specimens from Durango versus those from Baja California and surrounding islands (as well as one locality in western Sonora), and they considered the Durango population to constitute a different species, to which they applied the name *U. stejnegeri*. Upton and Murphy's study did not include any populations from the United States, where *Uta* is widely distributed (including the type localities of both *stanburiana* and *stejnegeri*), and we have therefore refrained from adopting their taxonomic proposal until more information is obtained on the relationships of the United States populations.

Xantusia bezyi Papenfuss, Macey, and Schulte, 2001—Bezy's Night Lizard

X. gracilis Grismer and Galvan, 1986—Sandstone Night Lizard
Lovich (2001, Herpetologica 57: 470–487), presented evidence that the population formerly designated *Xantusia henshawi gracilis* is evolving separately from other populations of *X. henshawi* and recognized it as a species.

X. henshawi Stejneger, 1893—Granite Night Lizard
Lovich (2001, Herpetologica 57: 470–487) presented evidence that the populations of *Xantusia henshawi* represent at least three separately evolving lineages, though he did not propose recognizing them as species.

X. vigilis Baird, 1859 "1858"—Desert Night Lizard

X. v. arizonae Klauber, 1931—Arizona Night Lizard
Papenfuss et al. (2001, Sci. Pap. Nat. Hist. Mus. Univ. Kansas 23: 1–9) proposed that *X. v. arizonae* represents a different species than other populations of *X. vigilis* based on DNA and allozyme differences. Their study was based on a limited sample of *X. vigilis*, and we have therefore refrained from adopting their proposal until more information becomes available on the relationships of other *X. vigilis* populations.

Squamata — SNAKES

Compiled by Jeff Boundy, Jonathan Campbell, Brian Crother (Chair)

Charina umbratica Klauber, 1943—Southern Rubber Boa
Rodríguez-Robles et al. (2001, Mol. Phylogenet. Evol. 18: 227–237), used mtDNA sequence and considered allozyme data from a previous study (Weisman, 1988, MS Thesis, CSU Polytechnic Pomona) and found *C. b. umbratica* to represent a morphologically distinct, allopatric entity that they elevated to species status.

Chilomeniscus stramineus Cope, 1860—Variable Sandsnake
Grismer et al. (2002, Herpetologica 58:18–31) found *C. cinctus, C. punctatissimus, and C. stramineus* to represent morphotypes of a single species.

Chionactis Cope, 1860—SHOVEL-NOSED SNAKES
Reviewed by Mahrdt et al. (2001, Cat. Am. Amph. Rept. 730).

C. occipitalis (Hallowell, 1854)—Western Shovel-nosed Snake
Reviewed by Mahrdt et al. (2001, Cat. Am. Amph. Rept. 731).

C. o. annulata (Baird, 1859)—Colorado Desert Shovel-nosed Snake
Mahrdt et al. (2001, Cat. Am. Amph. Rept. 730) considered *C. saxatilis* a synonym of *C. o. annulata*.

C. palarostris (Klauber, 1937)—Sonoran Shovel-nosed Snake
Reviewed by Mahrdt et al. (2001, Cat. Am. Amph. Rept. 732).

Contia tenuis (Baird and Girard, 1852)—Sharp-tailed Snake
Hoyer (2001, Northwest. Nat. 82: 116–122) found *C. tenuis* to comprise two morphological species. Molecular data presented by Feldman and Spicer (2002, J. Herpetol. 36: 648–655) support recognition of two species, but the new species remains undescribed.

Crotalus oreganus Holbrook, 1840—Western Rattlesnake
Pook et al. (2000, Mol. Phylogenet. Evol. 15: 269–282), Ashton and de Queiroz (2001, Mol. Phylogenet. Evol. 21: 176–189), and Douglas et al. (2002, pp. 11–50 *in* Biology of the Vipers, G. W. Schuett, M. Höggren, M. E. Douglas, and H. W. Greene [eds.], Eagle Mountain Press) analyzed mtDNA sequence data and concluded that *Crotalus viridis* comprised at least two clades, *C. viridis* and *C. oreganus*, with *C. v. cerberus* being the sister taxon to populations of *C. oreganus*. The former two studies did not formally recognize *cerberus* as a species, although both suggested that it was an evolutionary species based on sequence differences and allopatry. The last study did recognize *cerberus* as well as four other taxa. We take the conservative action supported by the congruence among all three studies, which is the recognition of *viridis* and *oreganus*.

C. o. abyssus Klauber, 1930—Grand Canyon Rattlesnake

C. o. cerberus (Coues, 1875)—Arizona Black Rattlesnake

C. o. concolor Woodbury, 1929—Midget Faded Rattlesnake

C. o. helleri Meek, 1905—Southern Pacific Rattlesnake

C. o. lutosus Klauber, 1930—Great Basin Rattlesnake

C. o. oreganus Holbrook, 1840—Northern Pacific Rattlesnake

C. ruber Cope, 1892—Red Diamond Rattlesnake
The International Commission on Zoological Nomenclature (2000, Bull. Zool. Nomencl. 57: 189–190. Opinion 1960) has ruled that the name *Crotalus ruber* Cope 1892 take precedence over *C. exsul* when used as a specific epithet.

C. scutulatus (Kennicott, 1861)—Mohave Rattlesnake

C. s. scutulatus (Kennicott, 1861)—Northern Mohave Rattlesnake
The spelling of the word "Mojave" has been changed to its proper form, "Mohave." The misspelling was noted by Lowe in the preface to his "Venomous Reptiles of Arizona" (1986). The English name of the nominal subspecies has been changed to reflect the distribution rather than describe rattlesnakes from a small portion of its distribution (D. Hardy and H. Greene, pers. comm.).

C. viridis (Rafinesque, 1818)—Prairie Rattlesnake
See comments under *C. oreganus*.

C. v. nuntius Klauber, 1935—Hopi Rattlesnake

C. v. viridis (Rafinesque, 1818)—Green Prairie Rattlesnake

Drymarchon melanurus (Duméril, Bibron and Duméril, 1854)—Central American Indigo Snake
Wüster et al. (2001, Herpetol. J. 11: 157–165) found two taxa of

Drymarchon coexisting in northern Venezuela, representing South American (*D. corais*) and Central/North American (*D. melanurus*) taxa.

D. m. erebennus (Cope, 1860)—Texas Indigo Snake

Elaphe Fitzinger, 1833—RATSNAKES
Utiger et al. (2002, Russian J. Herpetol. 9: 105–124), using molecular data, divided *Elaphe* into eight genera. New World *Elaphe* are part of a clade outside of Old World species, and *Pantherophis* Fitzinger, 1843, is resurrected for most North American species. The common name would be North American Ratsnakes. Pending further review, we retain the current concept of *Elaphe*.

E. alleghaniensis (Holbrook, 1836)—Eastern Ratsnake
See under *E. obsoleta*.

E. emoryi (Baird and Girard, 1853)—Great Plains Ratsnake
Burbrink (2002, Mol. Phylogenet. Evol. 25: 465–476), using molecular data, found *E. guttata* to comprise three clades, which he elevated to species level. *Elaphe guttata meahllmorum* was inferred not to be an evolutionary entity, and was synonymized with *E. emoryi*.

E. guttata (Linnaeus, 1766)—Red Cornsnake
Burbrink (2002, Mol. Phylogenet. Evol. 25: 465–476), using molecular data, found *E. guttata* to comprise three clades, which he elevated to species level, restricting *E. guttata* to populations east of the Mississippi River.

E. obsoleta (Say, 1823)—Texas Ratsnake
Burbrink divided *E. obsoleta* into three species, with no subspecies, based on the congruence of morphological (2001, Herpetol. Monogr. 15: 1–53) and mtDNA (Burbrink et al. 2000, Evolution 54: 2107–2118) evidence.

E. slowinskii Burbrink, 2002—Slowinski's Cornsnake
Burbrink (2002, Mol. Phylogenet. Evol. 25: 465–476), using molecular data, found *E. guttata* to comprise three clades, which he elevated to species level. The clade comprising populations in western Louisiana and eastern Texas were named *E. slowinskii*.

E. spiloides (Duméril, Bibron and Duméril, 1854)—Gray Ratsnake
See under *E. obsoleta*.

Farancia erytrogramma (Palisot de Beauvois *in* Sonnini and Latreille, 1801)—Rainbow Snake

Gyalopion Cope, 1860—WESTERN HOOK-NOSED SNAKES

G. canum Cope, 1860—Chihuahuan Hook-nosed Snake

Heterodon gloydi Edgren, 1952—Dusty Hog-nosed Snake
Werler and Dixon (2000, Texas Snakes. University of Texas Press, Austin) regarded *H. n. gloydi* to be an allopatric, diagnosable taxon restricted to the low plains-eastern forest ecotone of eastern Texas.

Lampropeltis triangulum (Lacépède, 1789)—Milksnake

L. zonata (Lockington, 1876 ex Blainville, 1835)—California Mountain Kingsnake
Rodríguez-Robles et al. (1999, Mol. Ecol. 8: 1923–1934) examined mtDNA and color pattern. The DNA suggested distinct northern and southern clades that they left unnamed. The color pattern variation was too variable to differentiate the seven subspecies. We follow these data and do not recognize any subspecies at this time.

Leptotyphlops dissectus (Cope, 1896)—New Mexico Threadsnake
See *L. dulcis*.

L. dulcis (Baird and Girard, 1853)—Texas Threadsnake
Dixon and Vaughan (2003. Texas J. Sci. 55: 3–24), using morphological data, elevated *L. d. dissectus* to species status, and diagnosed three subspecies within the nominate race, one of which remains unnamed.

L. d. dulcis (Baird and Girard, 1853)—Plains Threadsnake

L. d. rubellum (Garman, 1883)—South Texas Threadsnake

Masticophis fuliginosus (Cope, 1895)—Baja California Coachwhip
On the basis of a sympatric occurrence with *M. flagellum*, Grismer (1994, Herpetol. Nat. Hist. 2: 51; 2002, Amphibians and Reptiles of Baja California. Univ. California Press, Berkeley) elevated *M. f. fuliginosus* to species status.

Opheodrys aestivus (Linnaeus, 1766)—Rough Greensnake
Reviewed by Walley and Plummer (2000, Cat. Am. Amph. Rept. 718).

Pituophis Holbrook, 1842—BULLSNAKES, GOPHERSNAKES, and PINESNAKES
Rodríguez-Robles et al. (2000, Mol. Phylogenet. Evol. 14: 35–50) used mtDNA data and corroborated the current view of *Pituophis* with three species: *melanoleucus*, *catenifer*, and *ruthveni*. However, the recognition of *ruthveni* rendered *catenifer* paraphyletic. Pending data to corroborate the mtDNA, it is clear that *Pituophis* will undergo taxonomic revision in the near future.

P. catenifer (Blainville, 1835)—Gophersnake
Rodriguez-Robles et al. (2000, Mol. Phylogenet. Evol. 14: 35–50), used mtDNA data and discovered significant internal structuring among *P. catenifer* populations, which may signify the existence of additional species. Rodriguez-Robles et al. did not attempt reclassification. See annotation under *Pituophis*.

P. ruthveni Stull, 1929—Louisiana Pinesnake
Rodriguez-Robles et al. (2000, Mol. Phylogenet. Evol. 14: 35–50), used mtDNA data and argued for the recognition of *P. ruthveni*, despite lack of significant or independent differentiation from some populations of *P. c. sayi*.

Regina Baird and Girard, 1853—CRAYFISH SNAKES
Alfaro and Arnold (2001, Mol. Phylogenet. Evol. 21: 408–423) used DNA sequence data and found the genus to be grossly polyphyletic. This conclusion corroborates the allozyme-based hypothesis of Lawson (1985, Ph.D. dissertation, Louisiana State University). Taxonomic change is necessary for this genus but Alfaro and Arnold recommended against such change pending further investigation of their relationships. Reviewed by Ernst et al. (2002, Cat. Am. Amph. Rept. 756).

R. septemvittata (Say, 1825)—Queen Snake
Reviewed by Ernst (2002, Cat. Am. Amph. Rept. 757).

Sonora semiannulata Baird and Girard, 1853—Groundsnake
Werler and Dixon (2000. Texas Snakes. University of Texas Press, Austin) recognized the subspecies *S. s. taylori* as a diagnosable taxon occupying the Tamaulipan biotic province.

S. s. semiannulata Baird and Girard, 1853—Variable Groundsnake

S. s. taylori (Boulenger, 1894)—Southern Texas Groundsnake

Storeria occipitomaculata (Storer, 1839)—Red-bellied Snake
Reviewed by Ernst (2002, Cat. Am. Amph. Rept. 759).

Tantilla cucullata Minton, 1956—Trans-Pecos Black-headed Snake
Reviewed by Wilson et al. (2000, Cat. Am. Amph. Rept. 719).

T. elegans (Baird and Girard, 1853)—Terrestrial Gartersnake
Bronikowski and Arnold (2001, Copeia 2001: 508–513) used cytochrome b sequence data to identify several clades within *T. elegans* that did not, in some cases, follow phenotypic subspecies boundaries. Hammerson (1999, Amphibians and Reptiles of Colorado. 2nd ed. University of Colorado Press, Boulder) found phenotypes assignable to *T. e. arizonae* and *T. e. vascotanneri* outside of their purported distributions within Colorado, and recommended that the two names be synonymized with *T. e. vagrans*. Hammerson's data supported similar action for Arizona and New Mexico populations as well (J. Boundy, pers. obs.). Three subspecies are tentatively retained.

T. e. elegans (Baird and Girard, 1853)—Mountain Gartersnake

T. e. terrestris Fox, 1951—Coast Gartersnake

T. e. vagrans (Baird and Girard, 1853)—Wandering Gartersnake

T. sirtalis infernalis (Blainville, 1835)—Red-spotted Gartersnake
The International Commission on Zoological Nomenclature (2000, Bull. Zool. Nomencl. 57: 191–192. Opinion 1961) has ruled that the name *Coluber infernalis* be re-associated with Pacific Coast populations referred to as *T. s. concinnus* by Crother et al. (2000, Herpetol. Circular 29:73).

T. s. tetrataenia (Cope, 1875)—San Francisco Gartersnake

Action by the International Commission on Zoological Nomenclature (2000, Bull. Zool. Nomencl. 57: 191–192. Opinion 1961) has retained the name *Eutaenia sirtalis tetrataenia* for San Francisco Peninsula populations of *T. sirtalis*.

CROCODILIA—CROCODILIANS

Crocodylus acutus Cuvier, 1807—American Crocodile

TESTUDINES—TURTLES

Compiled by John Iverson, Peter Meylan (Chair), Michael Seidel

Actinemys Agassiz, 1857—PACIFIC POND TURTLES
Emys and *Emydoidea* are retained despite the recommendation of Feldman and Parham (2002) to lump *Emydoidea* and *Actinemys* under *Emys* because those authors had not seen the argument by Holman and Fritz (2001) for recognizing *Actinemys* as a monotypic genus. We are in agreement with Holman and Fritz that retention of separate genera for *Emys* and *Emydoidea*, and using a third generic name for *Actinemys marmorata*, best serves to reflect the diversity in this monophyletic group. See *Clemmys*.

A. marmorata (Baird and Girard, 1852)—Pacific Pond Turtle

A. m. marmorata (Baird and Girard, 1852)—Northern Pacific Pond Turtle

A. m. pallida (Seeliger, 1945)—Southern Pacific Pond Turtle

Clemmys Ritgen, 1828—SPOTTED TURTLES
Until recently (Holman and Fritz, 2001, Zoolog. Abhand. Staat. Mus. für Tierkunde Dresden 51: 331–354; and Feldman and Parham, 2002, Mol. Phylogenet. Evol. 22: 388–398) the content of the genus *Clemmys* was based on the work of McDowell (1964, Proc. Zool. Soc. Lond. 143: 239–279). This genus was considered to include a set of four North American species (*C. guttata, C. insculpta, C. marmorata*, and *C. muhlenbergii*) and was given the Standard English name, AMERICAN POND TURTLES. Work by Bickham et al (1996, Herpetologica 52: 89–97), Burke et al. (1996, Herpetologica 52: 572–584), Lenk et al. (1999, Mol. Ecol. 8: 1911–1922), Holman and Fritz (op. cit.), Feldman and Parham (op. cit.) and Seidel (2002a, Copeia 2002: 1118–1121) provide ample evidence that *Clemmys* (*sensu lato*) is paraphyletic with respect to the genera *Emys, Emydoidea* and *Terrapene*. *C. marmorata* has been shown to be the sister group of *Emys* and *Emydoidea* with the remaining species being paraphyletic with respect to this group and *Terrapene. C. insculpta* and *C. muhlenbergii* appear to be sister taxa and *C. guttata* appears to be the sister group to all remaining members of the Emydinae. Thus, the taxonomic revision suggested by Holman and Fritz (op. cit.) is advisable and is followed here. In this revision only the type species, *C. guttata*, is retained in the genus *Clemmys*. See notes for *Actinemys* and *Glyptemys*.

C. guttata (Schneider, 1792)—Spotted Turtle

Reviewed by Ernst (1972, Cat. Am. Amph. Rept. 124).

Glyptemys Agassiz, 1857—SCULPTED TURTLES
See note for *Clemmys*.

G. insculpta (LeConte, 1830)—Wood Turtle

G. muhlenbergii (Schoepff, 1801)—Bog Turtle

Kinosternon hirtipes Wagler, 1830—Rough-footed Mud Turtle

Sternotherus carinatus (Gray, 1855 1856)—Razor-backed Musk Turtle

Trachemys Agassiz, 1857—SLIDERS
Content of this genus follows Seidel and Smith (1986, Herpetologica 42: 242–248) and Seidel (2002a, J. Herpetol. 36: 285–292).

T. gaigeae (Hartweg, 1939)—Mexican Plateau Slider

Price and Hillis (1989, First World Congr. Herpetol. Abstract), Seidel et al. (1999, Herpetologica 55: 470–487), and Seidel (2002b, J. Herpetol. 36:285–292) provide evidence for the specific recognition of this form.

T. g. gaigeae (Hartweg, 1939)—Big Bend Slider

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Vocalization and Diet of *Syncope antenori* (Amphibia: Anura: Microhylidae)

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Syncope is a microhylid frog genus composed of two very small species, *Syncope antenori* Walker 1973 and *S. carvalhoi* Nelson 1975, distributed in the Amazonian region of Perú (Morales 1995), Brazil, and Ecuador. Because these frogs are small and are infrequently found, little is known of their life history. Several authors cited some aspect of the reproductive mode of *S. antenori* (Duellman 1978; Krüegel and Richter 1995; Zimmerman and Simberloff 1996), and Duellman (1978) suggested that this species might be mute because of the absence of vocal slits in males. Regarding diet, Duellman (*op. cit.*) reported that 6 of 7 individuals examined fed on ants and mites, without more detail.

We describe the vocalization of *S. antenori* and provide additional diet data. From October to November 1995, we conducted a biological inventory on the west-central side of the Cordillera El Sira, between the Samantoshoari and Saberoshoari Creeks (elevation 210 m, approximately 09°59'S, 74°40'W). The site was located 5 km SE of the Native Community Davis (approx. 09°58'S,

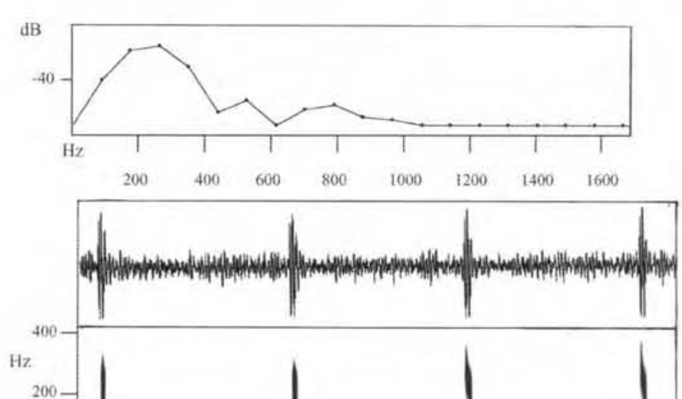

FIG. 1. Vocalization of *Syncope antenori* (Microhylidae), MUSM 17014, from Cordillera El Sira, Pasco, Perú (recorded at 22.5°C). Frequency spectrum (above), oscillogram (middle), sonogram (below) of advertisement call. Hz = Hertz, msec = milliseconds.

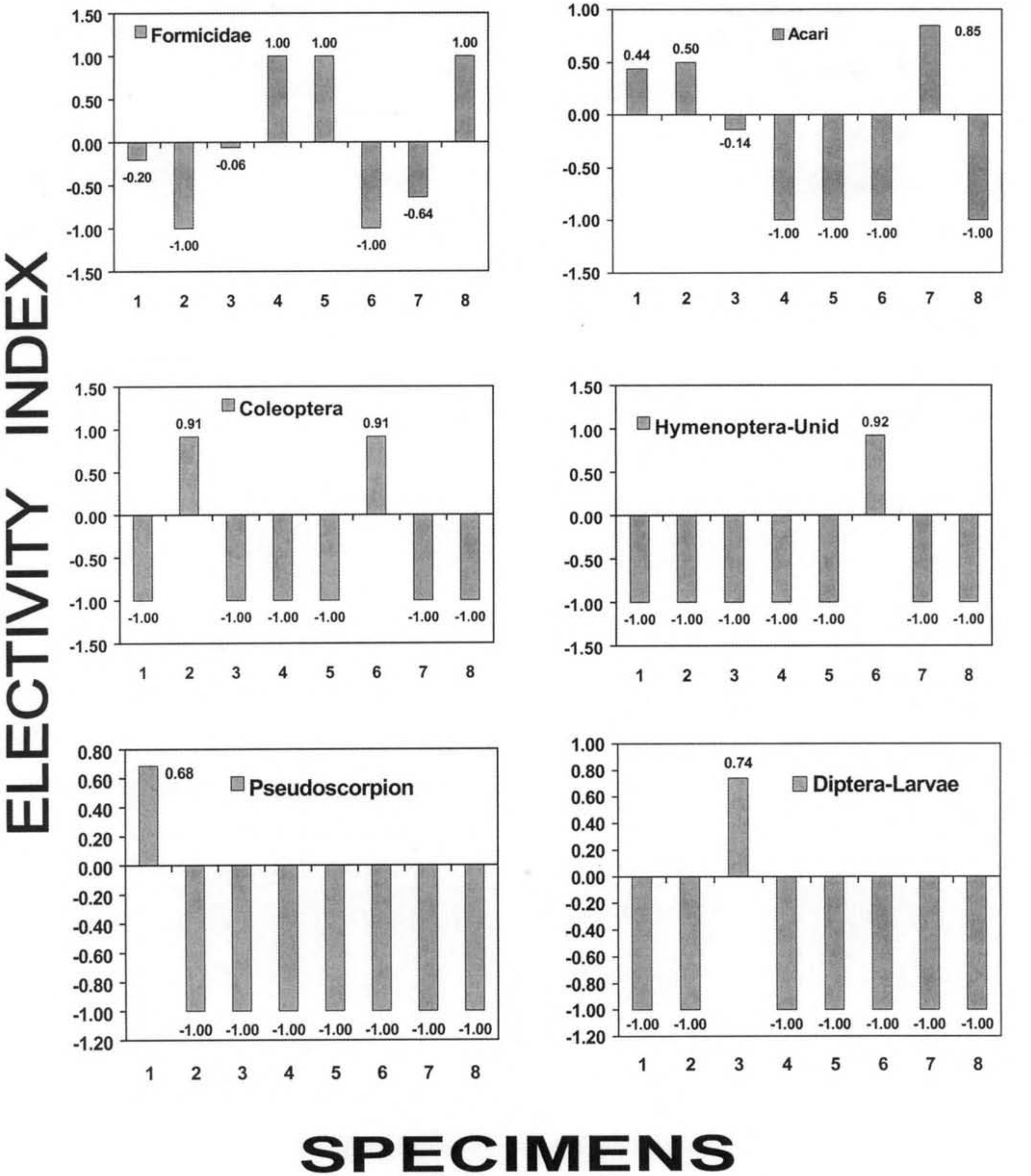

FIG. 2. Stomach contents of *Syncope antenori* (Microhylidae) from Cordillera El Sira, Pasco, Perú.. See Table 1 for explanation of the specimen numbers.

74°43'W) on the Aporucayali River, a tributary of the Pichis River, Oxapampa Department, Pasco, Perú. We recorded calls and made observations of the ecology and behavior of *S. antenori*. Vocalizations were recorded with an AVR General Electric® mini-cassette recorder; air temperature at the time of recording (2000–2300 h) was 22.5°C. Call analysis was done using Canary 1.2.4 (Charif et al. 1995). Specimens were deposited in the Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos (MUSM 17014–17021).

Call analysis.—Snout–vent length (SVL, mean ± SD) of males

TABLE 1. Stomach contents of eight specimens of *Syncope antenori* (Microhylidae) from El Sira, Pasco, Perú.

	*Syncope antenori**									
Prey Item	1	2	3	4	5	6	7	8	Total**	%
Formicidae	6	–	6	5	10	–	1	6	34	69
Acari	3	1	1	–	–	–	2	–	7	14
Hymenoptera - Unid	–	–	–	–	–	1	–	–	1	2
Coleoptera	–	2	–	–	–	2	–	–	4	8
Pseusoscorpiones	1	–	–	–	–	–	–	–	1	2
Diptera - Larvae	–	–	2	–	–	–	–	–	2	4
Total†	10	3	9	5	10	3	3	6	49	

* The numbers 1–8 correspond to MUSM 17014–17021.
** Number of prey individuals in the environment.
† Number of prey individuals eaten by each specimen.

was 12.0 ± 0.3 (N = 6), and female SVL was 13.5 ± 0.5 (N = 2). At El Sira, males of this species called in the leaf litter at night. The low vocalization was almost imperceptible to the human ear, and can be described as a light constant and metallic tapping, "tic, tic, tic." Two males in the field and one captive male were recorded as they called in a plastic bag. There was no significant variation in call characteristics under either natural conditions or in captivity. The advertisement call of *S. antenori* consisted of a series of short notes with a total duration of 10–16 sec. Each note had a duration of 6.3–7.2 msec (mean ± SD: 6.9 ± 0.3, N = 23 calls or notes of two individuals). The call frequency extended from 222 to 634 Hz, with a peak at 375 Hz, and the time interval between calls was from 210 to 234 msec (225 ± 0.4, N = 23 calls or notes of two individuals; Fig. 1). The factor that influences the call frequency in frogs may be the speed of sound within the vocal cavity or vocal sacs (Rand and Dudley 1993). All calling males of *S. antenori* did not have vocal slits and vocal sacs, and their call frequency was relatively low. We observed two specimens singing with their mouths open, most likely expelling air, causing the sound. These frogs may use the oral cavity like a resonator, because this species lacks vocal sacs for this function. This is in contrast to another minute frog, *Phyzelaphryne miriamae* (Leptodactylidae), which had a higher call frequency (2810–4460 Hz), vocal slits and sacs, and called with a closed mouth (Heyer and Gascon 1995).

Diet analysis.—We examined stomach contents of eight specimens. Ants (Subfamilies Mirmicinae and Dolicoderinae) and mites comprised 83% of the diet. Coleoptera, unidentified Hymenoptera, and Pseudoscorpiones formed a much smaller portion of the diet (Table 1). We used the Jacobs (1974) electivity index for the seven most common items eaten, $D = (r-p)/(r+p)-2(rp)$; "r" was the proportion of each item per specimen by the total sum of all items in each specimen. The estimation of the proportion of any item in the environment (p) was calculated by dividing the sum of each item from all the specimens by the total sum of all items found in the specimens. The electivity index value of each item for each specimen ranges from no preference or not eaten (-1) to an exclusive preference or eaten nearly exclusively (+1). The electivity index is "0" when items are eaten in equal proportions. From the diet analysis, it appears that *S. antenori* principally feed on ants, which formed 69% of the total items found in 6 of 8 specimens (Table 1). However, only three specimens had an electivity index indicating exclusive preference (+1) for ants. Another three showed less preference (from -0.64 to -0.06) while two showed no preference for ants (-1), but preferred coleopterans instead (+0.91, Fig. 2). Four of eight specimens ate mites, 14% of the total of items (Table 1), but only three showed a positive electivity index for this prey item (Fig. 2). These results are in contrast to Simon and Toft (1991) who mentioned that the preference for mites was strongly associated with species of small size, and with juvenile frogs rather than adults. We found that half of the *S. antenori* specimens had a diverse diet, including not only ants and/or mites but other taxa (Table 1). These frogs may be choosing prey types independently of prey size (Lima 1998; Lima and Moreira 1993).

Lastly, frog mobility was relatively great, considering the small size of this species. We observed at least two specimens moving slowly within an area of 1.5 m^2 for ca. 20 min. We suggest that *S. antenori* is a relatively widely foraging species (Huey and Pianka 1981) and is opportunistic in terms of prey preference.

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Identification of Marine Turtle Nesting Beaches on the Mediterranean Coast of Sinai, Egypt

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The majority of sandy beaches in the Mediterranean have been surveyed to determine the location of marine turtle nesting areas. Detailed information is available on the status of green (*Chelonia mydas* L.) and loggerhead (*Caretta caretta* L.) turtle populations nesting in northern Cyprus (Broderick and Godley 1996; Glen et al. 1996; Godley et al. 1996), southern Cyprus (Demetropoulos and Hadjichristophorou 1989, 1995), Greece (Margaritoulis 1983; Arianoutsou 1988), Israel (Kuller 1995, 1999), Libya (Laurent et al. 1995, 1997; Venizelos 1996), Syria (Kasparek 1995) and Turkey (Baran and Kasparek 1989; Coley and Smart 1992; Yerli and Demirayak 1996; Gerosa et al. 1998). In addition, a comprehensive synopsis of the status of marine turtles in the Eastern Mediterranean region can be found in Kasparek (2001).

In recent years the coast of Egypt has received less attention than its eastern Mediterranean neighbors such as Israel and Libya, consequently the exact status of nesting populations in this region is unclear. Preliminary surveys of the coastline between the city of Alexandria and the Libyan border (western region; Fig. 1) performed by Kasparek (1993), indicated that negligible marine turtle nesting activity was occurring in this region. We confirmed this in 1998 while conducting a survey of the entire Mediterranean coast of Egypt (Clarke et al. 2000), finding only limited circumstantial evidence (i.e., three sets of emergence tracks and no nests) of nesting activity in the western region. Similarly, no evidence of nesting was found in the Nile Delta (central region; Fig. 1), during the 1998 survey.

Evidence was found however, that a small population of green and loggerhead turtles were nesting on beaches of the Sinai in eastern Egypt, close to the border with Israel. In this paper we document the results of a three-year study to quantify the extent of marine turtle nesting activity occurring along the Sinai coast between the border town of Rhafa to the east, and Port Said to the west (eastern region; Fig. 1).

Methods.—The Mediterranean coast of the Sinai measures 220 km from the Israeli border to the Suez Canal at Port Said; of this section, 200.7 km is sandy beach with potentially suitable habitat for marine turtle nesting. Other than the two inlets to Bardawil lagoon (Fig. 2), the coast in this region is continuous sandy beach with few natural divisions; therefore, for the purposes of this survey it was arbitrarily divided into 19 beaches. The limits of these divisions were determined by the presence of an easily identifiable landmark, or as a length of coastline that could be surveyed in a convenient time period (details are given in Table 1 and Fig. 2). In the lagoon region (i.e., beaches 8–16; Fig. 2) only the north side of the outer sandbar was surveyed, as interviews with local fishermen revealed that marine turtles had never been observed nesting in the inner lagoon.

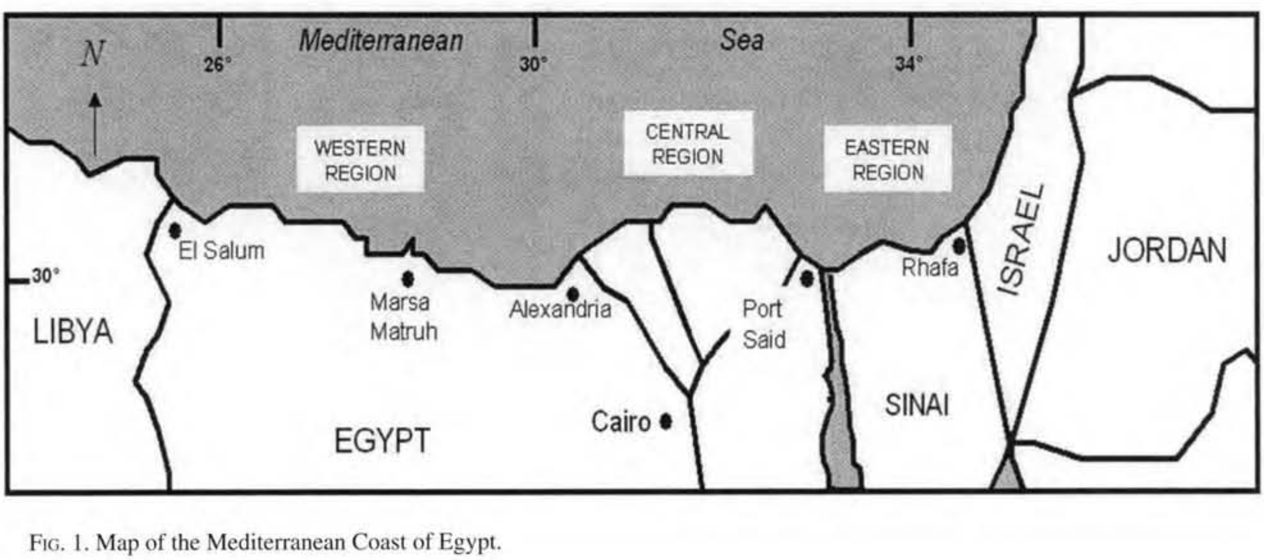

FIG. 1. Map of the Mediterranean Coast of Egypt.

TABLE 1. Locality and character of beaches surveyed in north Sinai.

#	Beach Name	Coordinates Western limit	Coordinates Eastern limit	Length	Comments
1	Rhafa	31°19'16N 34°13'01E	31°16'20N 34°08'37E	9.7 km	Residential/ tourist beach
2	El Sheik Zwayed	31°16'18N 34°08'37E	31°13'11N 34°02'49E	11.0 km	Residential/ tourist beach
3	El Shalak	31°13'11N 34°02'49E	31°11'45N 33°58'29E	9.0 km	Light tourism
4	El Kharruba	31°11'45N 33°58'29E	31°09'27N 33°51'36E	11.5 km	Light tourism
5	El Arish	31°09'27N 33°51'36E	31°08'07N 33°46'27E	9.0 km	Residential/ tourist beach
6	El Masaid	31°08'07N 33°46'27E	31°06'47N 33°36'56E	12.0 km	Residential/ tourist beach
7	Abo Flifel	31°06'47N 33°36'56E	31°07'24N 33°29'17E	11.0 km	Light tourism
8	Zaranik	31°07'48N 33°28'56E	31°11'34N 33°21'34E	12.0 km	Protected area
9	Bardawil – Zaranik to Inlet #2	31°11'34N 33°21'34E	31°12'19N 33°17'00E	8.0 km	Mostly deserted
10	Bardawil- Inlet #2 to Bogaz	31°12'59N 33°15'50E	31°13'40N 33°11'14E	9.0 km	Mostly deserted
11	Bardawil- Bogaz	31°13'40N 33°11'14E	31°13'41N 33°07'05E	10.0 km	Mostly deserted
12	Bardawil- El Kalls	31°13'41N 33°07'05E	31°10'51N 33°00'37E	14.0 km	Mostly deserted
13	Bardawil- El Kalls to Inlet #1	31°10'51N 33°00'37E	31°08'39N 32°55'58E	10.0 km	Mostly deserted
14	Bardawil- El Shagara	31°08'45N 32°55'24E	31°05'06N 32°47'46E	14.5 km	Mostly deserted
15	Bardawil – El Mohamadyat	31°05'06N 32°47'46E	31°03'34N 32°41'05E	11.0 km	Mostly deserted
16	Romana	31°03'35N 32°41'05E	31°04'19N 32°32'47E	14.0 km	Residential/ tourist beach
17	Salina Inlet	31°04'19N 32°33'47E	31°07'22N 32°30'11E	8.0 km	Mostly deserted
18	El Malaha	31°07'22N 32°30'11E	31°07'22N 32°30'11E	14.0 km	Mostly deserted
19	Port Said/Faud	31°13'13N 32°22'40E	31°13'13N 32°22'40E	3.0 km	Mostly deserted
Total				200.7 km	

During the period from late May to mid-September (the main turtle nesting season in the eastern Mediterranean; Baran and Kasparek 1989; Demetropoulos and Hadjichristophorou 1995) all the beaches listed in Table 1 were surveyed during the early morning hours by two-person teams. Access to the beaches was not permitted at night. During the 1998 season, beaches were surveyed by walking from east to west, with one man on the waterline and the other following a parallel track 4–5 m landwards. However, because of the large distances involved subsequent surveys were performed using an all terrain vehicle (ATV), with two persons riding along the beach from east to west. One rider scrutinized the water line while the other surveyed the upper beach.

Early in the season, beaches were re-visited every two weeks until an emergence track was found. Thereafter a beach was visited twice weekly; thus no track recorded was more than four days old. This allowed for a reasonable estimate of the date of egg deposition, and gave a good prediction of the hatch date approximately 40 days later. The exact location of all emergence tracks was noted using a Magellen 2000 Global Positioning System (GPS). Under the climatic conditions encountered during the summer months, emergence tracks were still recognizable for up to three weeks. In addition, the Egyptian Coast Guard was enlisted to find emergence tracks as soldiers patrol every mile of the Sinai coast on a daily basis. Because of these two factors we have high confidence that

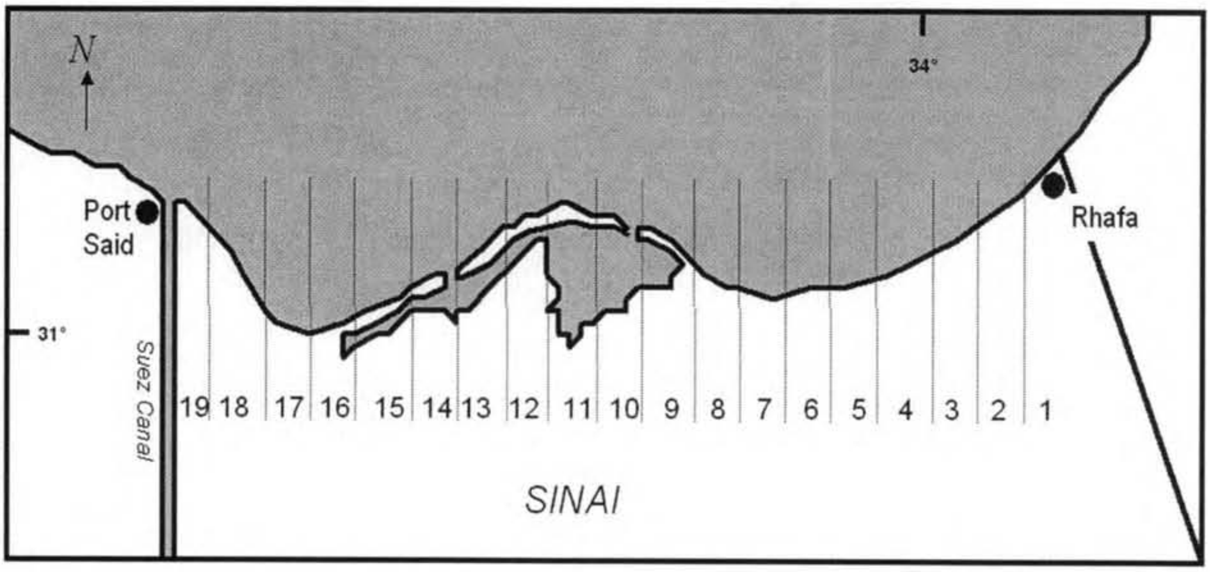

FIG. 2. Mediterranean Coast of Sinai showing the location of survey beaches.

TABLE 2. Nesting data for the coast of north Sinai.

Loggerhead ***(Caretta caretta)***	**1998**	**1999**	**2000**
# of emergence tracks	97	60	79
mean inner track width (cm)	20.21 (N = 93)	16.84 (N = 60)	13.94 (N = 79)
mean outer tack width (cm)	71.25 (N = 93)	69.02 (N = 60)	68.61 (N = 79)
number of nests with eggs	20	32	37
mean clutch size	78 (N = 20)	64.68 (N = 27)	64.26 (N = 37)
% hatching success	—	66.40 (N = 19)	76.21 (N = 19)
# of stranded adults	13	33	28
mean CCL of stranded adults (cm)	60.23 (N = 13)	63.03 (N = 33)	64.50 (N = 28)
Green (*Chelonia mydas*)	**1998**	**1999**	**2000**
# of emergence tracks	8	2	9
mean inner track width (cm)	24.37 (N = 8)	15.50 (N = 2)	14.80 (N = 9)
mean outer track width (cm)	73.38 (N = 8)	76.00 (N = 2)	69.30 (N = 9)
number of nests with eggs	1	0	3
mean clutch size	—	—	101
% hatching success	—	—	53.7 (N = 2)
# of stranded adults	7	8	1
mean CCL of stranded adults (cm)	38.42 (N = 7)	66.88 (N = 8)	68.00 (N = 1)
Leatherback (*Dermochelys coriacea*)	**1998**	**1999**	**2000**
# of stranded adults	2	1	1
mean CCL of stranded adults (cm)	135.00 (N = 2)	—	115.00 (N = 1)

TABLE 3. Summary of the number of green and loggerhead turtle emergences and nests found on each beach between 1998 and 2000.

Beach	1998				1999				2000			
	Loggerhead		Green		Loggerhead		Green		Loggerhead		Green	
	Tracks	Nests with eggs	Tracks	Nests with eggs	Tracks	Nests with eggs	Tracks	Nests with eggs	Tracks	Nests with eggs	Tracks	Nests with eggs
1	4	0	0	0	4	2	0	0	18	7	1	0
2	9	3	0	0	19	11	2	0	15	7	0	0
3	11	0	0	0	23	14	0	0	9	4	3	2
4	3	0	0	0	3	1	0	0	6	3	1	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	5	2	0	0	3	0	0	0	4	3	2	0
7	33	8	7	1	6	3	0	0	12	8	1	0
8	3	0	1	0	1	1	0	0	0	0	0	0
9	0	0	0	0	1	0	0	0	0	0	0	0
10	5	3	0	0	0	0	0	0	0	0	0	0
11	4	1	0	0	0	0	0	0	0	0	0	0
12	3	1	0	0	0	0	0	0	9	4	1	1
13	0	0	0	0	0	0	0	0	5	0	0	0
14	15	1	0	0	0	0	0	0	1	1	0	0
15	1	1	0	0	0	0	0	0	0	0	0	0
16	1	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0

very few emergence tracks were overlooked during the survey.

The species of the emerging turtle was identified from track morphology—green turtles leave a regular pattern of imprints in the sand as they use both front flippers simultaneously to haul themselves across the beach. Conversely, loggerhead tracks are irregular as they use the front flippers in an alternating pattern to move on land (Demetropoulos and Hadjichristophorou 1995). The inside and outside widths of the tracks were recorded; the presence or absence of a body pit noted; and nests checked for egg deposition. Nests were then marked in a cryptic fashion to allow

relocation at a later date.

During the 1999 and 2000 seasons, return visits were made to the nests to check for hatching 40, 42, and 44 days after egg deposition. After hatching, the nests were excavated and an assessment made of the number of eggs laid, and hatching success. The curved carapace length (CCL) and species of dead stranded turtles, or parts of turtles, were also recorded throughout the survey.

Results.—Evidence was found that loggerhead and green turtles nest in the eastern region of the Mediterranean coast of the Sinai (Table 2). Emergence tracks and/or nests were found on 15 of the 19 beaches surveyed during the three-year study. Most of the activity was concentrated on beaches 1–7, situated at the eastern side of the study area (Table 3).

Loggerhead turtles utilized the area most heavily, with 20, 32, and 37 confirmed egg depositions being found in 1998, 1999, and 2000 respectively. Green turtles utilized the area to a lesser degree, with 1, 0, and 3 confirmed egg depositions being found during 1998, 1999, and 2000. No evidence of nesting by leatherback turtles (*Dermochelys coriacea*) was found (Table 2). The majority of stranded turtles were loggerheads (74), however, a small number of green (16) and leatherbacks (4) was also found.

Conclusions.—Loggerhead, green, and leatherback marine turtles are present in the waters off the Mediterranean coast of Egypt; as dead specimens of all three species were found washed ashore during the survey. Conclusive evidence was found that loggerhead and green turtles nest on the Mediterranean coast of the Sinai. No evidence was found to indicate that leatherback turtles nest in this area.

Most nests were located on an 83-km stretch of coastline close to the Israeli border (i.e., between beaches 1 to 7; 31°06'47"N/33°36'56"E to 31°16'20"N/34°08'37"E). Beaches 1, 2, 3, and 7 were the most heavily utilized areas, with 76% of all nests being found on these beaches over the three-year survey. Comparison of the levels of nesting activity in this region with that reported for the Mediterranean coast of Egypt as a whole (Clarke et. al. 2000; Kasparek 1993) indicates that the eastern Sinai is the primary marine turtle nesting region for the entire Mediterranean coast of Egypt.

The number of female loggerhead turtles nesting in this area is apparently small. Given that a single female will lay 1–3 clutches per season (Demetropoulos and Hadjichristophorou 1995), results suggest that only 10–20 individuals are nesting in the region each year. The number of green turtles utilizing this area is even lower, perhaps only one or two individuals per year. These results appear to be consistent with those reported from the adjacent Israeli coast. Kuller (1999) reports that during the 1998 nesting season, 40 loggerhead and 13 green turtle nests were found along a 190-km stretch of the Israeli Mediterranean coastline. However, this does appear to have been an exceptional year, as the annual mean number of nests found over the previous five-year period was only 27.4 loggerhead nests and 2.2 green turtle nests. These means are consistent with those found during our study of the Mediterranean coast of Sinai.

The mean number of eggs found in loggerhead nests on the Sinai coast (78.0 in 1998; 64.68 in 1999; and 64.26 in 2000) was within the range of 60–85 cited for nests from northern and southern Cyprus (Broderick and Godley 1996; Demetropoulos and Hadjichristophorou 1995). Generally, clutch sizes in the Mediterranean appear to be lower than in other parts of the world; e.g., Hirth (1980) reports the average global clutch size for *C. caretta* to lie within the range of 101–126 eggs.

The mean hatching success of loggerhead eggs in the area (i.e., 66.4% in 1999; and 76.21% in 2000) was similar to that of 79.1% reported from southern Cyprus, and 67.7% reported from Zakynthos, Greece (Peters and Verhoeven 1992). Overall, the nesting and survival statistics for loggerhead hatchlings from the Egyptian Sinai coast are comparable to other populations found elsewhere in the eastern Mediterranean. Because of the very small number of green turtle eggs found, no meaningful conclusions on hatching success or mean clutch size can be drawn at this time.

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Lachesis muta rhombeata Wied, 1825 (Serpentes, Viperidae): Defensive Behavior and Snakebite Risk

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Bushmasters (genus *Lachesis*) are remarkable for their large size (≥ 2.0 m total length), venom capacity, and reputation for aggressiveness, which makes them one of the most feared snakes of the New World (Campbell and Lamar 1989; Greene 1997; Hardy and Silva Haad 1998). Their restricted habitat makes the collection of specimens difficult (but see exception in Taylor et al. 1974) and limits studies on the basic aspects of their biology (but see Boyer et al. 1989; Boyer et al. 1995; Chiszar et al. 1989; Melgarejo and Cunha 1991; Ripa 1994, for data on reproduction, captive maintenance and behavior). Another difficulty in collecting specimens for serum production is that many potential collectors fear these snakes. Encounters with bushmasters in their natural habitats are rare, and much popular lore stems from a distorted view of the rural workers who invariably are frightened in these situations. The lack of careful observations leaves unclear the effective risk of snakebites from bushmasters. Indeed, in Brazil, for example, it is said that the low number of accidents caused by this species is probably due to the fact that it is confined to the forests, where human presence is less frequent. In this paper, I present data on the capture of one of the most threatened and lesser known forms of the genus, *Lachesis muta rhombeata* (probably identical to the Amazonian form [Zamudio and Greene 1997]).

Seventy specimens of *Lachesis* were collected from different localities in southeastern Bahia, Brazil, from 1988 to 1998. The specimens are housed in the "Coleção Zoológica Gregório Bondar (CZGB)" of the Centro de Pesquisas do Cacau (CEPEC/CEPLAC), Ilhéus, BA, Brazil, or in captivity at the same institution.

Captures were carried out in a strip of ca. 70 km between the Atlantic coast and 40°20'W and 13°12'S and 16°16'S. Vegetation consists of remnant Atlantic rainforest and cocoa groves (*Theobroma cacao*), pastures, and plantations of rubber and palm oil trees. Some specimens (N = 19; 27.1%) were captured in forest, but the majority (N = 41; 58.6%) were found in cocoa groves. In southeastern Bahia, cocoa is traditionally cultivated under the shade of the forest in a system locally called "cabruca." This fact and the presence of Atlantic forest remnants between the plantations allows the occurrence of a typical forest snake fauna (Argôlo 2001).

The majority of the 70 individuals of *L. m. rhombeata* collected were found coiled on the ground, either exposed or under herbaceous vegetation. From 26 collections for which I have data on activity and behavior, 19 specimens were found between 0700 h and 1530 h, coiled on the ground and apparently asleep. Only 3 of these specimens displayed defensive reactions when approached by the collector. One adult (CZGB 3031) struck the rural worker's machete when he approached the snake without having seen it, inside a cocoa grove. In the same environment, a young specimen (CZGB 1741), after being disturbed, struck the collector. A third specimen (CZGB 7431) coiled in defensive posture and vibrated the tail for a short time before being killed by the collector. These are the only reports of defensive reactions during the captures where circumstances were precisely determined. On the other hand, among several specimens collected under vegetation during cleaning of cocoa groves, one individual was almost stepped on by a rural worker, whereas two others (CZGB 3026, 5599) were stepped on without displaying any reaction. One specimen (CZGB 3316), after being discovered, remained coiled and immobile for five hours while workers removed the vegetation in the vicinity waiting for a collector. None of the five specimens found active (from 1600 to 0600 h) displayed any defensive reactions. One of these (CZGB 3971) was killed at 0100 h inside a house in the field, after having crawled on the body of the sleeping collector. Another specimen, now in captivity at CEPLAC (number B-105), was captured at 2000 h when crossing a road in the vicinity of a forest in Ilhéus. The collector erroneously identified it as the locally common *Boa constrictor* and, relying on illumination only from his car's headlights, attempted to capture it by pulling it by its tail. I collected two specimens (B227, B232) from armadillo caves inside a forest on the Califórnia farm (Ituberá: 13°46'S, 39°12'W). The resident armadillos were not observed, but they likely were *Dasypus novemcinctus*. These caves have one or more inclined entrances ca. 20 cm in diameter each. The ceilings in these caves are dome shaped, smooth, and approximate the size of the armadillo (Emmons, 1999; pers. obs.). As I searched the caves with a flexible stick, the snakes arose immediately through the opening. One of these stopped after flash photography and returned to the interior of the cave. The second specimen, also stimulated to exit the cave, was found shedding its skin. It coiled near the entrance to the cave and I was able to capture it by hook and a tail hold. None of these

specimens showed any defensive reaction during the captures.

Published summaries of human envenomations suggest that snakebites by species of *Lachesis* are infrequent (Hardy and Silva Haad 1998; Jorge et al. 1997). Envenomings attributed specifically to southeastern Bahia are also rare; among 625 venomous snakebites attended at hospitals in Ilhéus and Itabuna in four years, only three could be attributed to *Lachesis* (Argôlo et al. 1998). In a general sense, there is a tendency in Brazil to attribute the low frequency of bites from bushmasters to the fact that this snake is confined to forests, where contact with humans is minimized. However, this species is relatively common in some cocoa groves in southeastern Bahia, yet accidents are still rare.

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Boulengerula fischeri Nussbaum and Hinkel, 1994 is an Objective Junior Synonym and a Homonym of *Boulengerula fischeri* Nussbaum and Hinkel *in* Fischer and Hinkel, 1992 (Amphibia, Gymnophiona)

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The gymnophione species *Boulengerula fischeri* Nussbaum and Hinkel, 1994 was named in honor of the donor (E. Fischer), based on a single individual collected by him in Cyagugu Prefecture, Rwanda. While this species description was in progress, Fischer and Hinkel (1992) published a monograph on Rwanda's flora and fauna. They (p. 105) referred to the new gymnophione species as: "*Boulengerula fischeri* Nussbaum and Hinkel in press." In addition, some diagnostic characters were provided plus a color photograph (p. 115) of the single known specimen (i.e., the later holotype of Nussbaum and Hinkel 1994). Although it was not the authors' intention, the description published in Fischer and Hinkel (1992) is valid under the International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature 1999). Accordingly, *Boulengerula fischeri* Nussbaum and Hinkel, 1994:756 has to be treated as an objective synonym and a homonym of *Boulengerula fischeri* Nussbaum and Hinkel *in* Fischer and Hinkel 1992:105.

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Tail Loss in Garter Snakes

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Tail autotomy is part of the defensive strategy of the common garter snake (*Thamnophis sirtalis*), with the greatest frequency in adult females because their mass facilitates breakage. If garter snakes are held by the tail, they rotate the body with a whirling motion that quickly gains momentum and snaps off the tail (Fitch 1965, 1999). In the present report I explore further the topic of tail breakage in garter snakes, comparing the incidence of breaks in the sexes, and in adults vs. young (Tables 1–4).

Methods and Materials.— The records used in this study were gathered during the course of ecological studies on the Fitch Natural History Reservation (FNHR). Only records obtained during the decade of the 1990's (1828 in all) were used. The ratio of those with tail breaks vs. those with intact tails is noted. Two sets of figures were used and compared. In the larger set every capture was included, with the result that some individuals, those recaptured several times, were overrepresented. In the second sample each individual was tallied only once—at its first capture. However, this data set excluded many records of older snakes that were most likely to have broken tails. On a few occasions I accidentally broke a tail in handling a snake, but the vast majority of breaks are believed to have resulted from the attacks of natural predators such as the coyote (*Canis latrans*), striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), red-tailed hawk (*Buteo jamaicensis*), and great blue heron (*Ardea herodias*). In the tables, males of 400 mm or more SVL were listed as mature, as were females of 500 mm or more.

Results and Discussion.—When a tail breaks, the broken end is very active, performing a series of lateral contractions which may be so rapid that it is seen as a blur, causing it to skip and hop about on the surface of the ground. The lively movements of the detached tail may distract the attention of a predator momentarily, permitting the snake to escape, and the large number of snakes having part of the tail missing suggests the success of the strategy. By sacrificing part of the tail, garter snakes sometimes save their own lives, but it seems that some handicapping may result. Garter snakes with stub tails are noticeably slower in swimming or crawling, and the greater the length of lost tail the more serious the disadvantage. Cooper and Alfieri (1993) described tail autotomy in *T. s. sirtalis* of Seabrook Island, South Carolina and emphasized the greater activity of adults in twisting off the tail; the only small juvenile which they observed did not attempt to autotomize when handled. However, when picked up by the tail, juveniles as well as adults may perform the whirling movements that can result in autotomy. The response tends to be weaker in juveniles than in adults, and is much less effective because of their smaller mass. Unlike lizards, snakes do not regenerate broken tails.

Tail breaks may often result from attempted predation, unsuccessful in all recorded cases, since the snake had survived. Some parts of the tail seem to be more fragile, or else they are more liable to be targeted by predators. In my sample there were no tail breaks from the end of the body to about the seventeenth percentile. The remainder of the tail break lengths were not randomly distributed. In female snakes there was a concentration of breaks at about one-fourth of the distance to the tip, with 17.2% of the sample between the 20th and 29th percentile. Ninety snakes (27.95%) were missing their tail tips, and this was the most frequent type of tail injury. In males, breaks across the tail base would damage the hemipenes. Males average smaller than females but have relatively longer tails. In courtship the male's tail serves a tactile function, helping to bring the vents of male and female together (Fitch 1999), and presumably loss of any of the tail would interfere with male courtship. The increased survival gained by tail autotomy presumably outweighs these handicaps (Fitch 1999). The number of damaged tails in a population obviously depends on the kinds and numbers of snake-predators that are present, as well as the amount, quality, and distribution of escape cover. There-

TABLE 1. Tail breakage compared in adult and juvenile red-sided garter snakes, first captures only.

	Intact Tails	Broken Tails	Totals
Adults	764	122	886
Juveniles	441	11	452
Totals	1205	133	1338

chi-square = 42.95, P = 0.001

TABLE 2. Tail breakage compared in adult male and female red-sided garter snakes, first captures only.

	Intact Tails	Broken Tails	Totals
Males	358	41	399
Females	406	81	487
Totals	764	122	886

chi-square = 7.40, P = 0.005

TABLE 3. Tail breakage compared in adult and juvenile red-sided garter snakes, including all recaptures.

	Intact Tails	Broken Tails	Totals
Adults	982	257	1239
Juveniles	551	38	589
Totals	1533	295	1828

chi-square = 10.63, P = 0.0001

TABLE 4. Tail breakage compared in adult male and female red-sided garter snakes, including all recaptures.

	Intact Tails	Broken Tails	Totals
Males	521	107	628
Females	461	150	611
Totals	982	257	1239

chi-square = 60.24, P = 0.0001

fore, the incidence of breakage could be expected to differ at each locality, and to change over time.

In the data set that included recaptures, snakes probably averaged older and therefore had a higher ratio of broken tails, but the trends for the two data sets are similar. In both samples, females had higher frequencies of broken tails than males, and adults had higher frequencies of broken tails than juveniles (Tables 1–4). Tail breaks are not common in first-year snakes, and it seems that immatures seldom rely on autotomy for defense. Of first-year young (less than 350 mm SVL) only 2.42% of 452 had broken tails, but for 886 larger snakes the ratio was 13.7%. As adult size is attained the incidence of tail breaks rises sharply, especially in females. The incidence of breakage was 10.3% in 399 males and 16.7% in 487 females. It is not known how much tail loss affects survivorship.

Acknowledgments.—I thank my daughter, Alice F. Echelle, and Galen L. Pittman for advice concerning statistics.

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TECHNIQUES

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Using Rims to Hinder Amphibian Escape from Pitfall Traps

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Pitfall traps, either arranged in grids or associated with drift fences, are commonly used to assess amphibian species richness and abundance in various habitats (Corn 1994). However, trap efficiency is believed to differ across species, as some species are more likely to be captured and remain in traps than others (e.g., tree frogs can climb out, large individuals may jump out; Corn 1994). This is particularly important in large-scale studies with distant sites or large numbers of traps that cannot be checked daily (e.g., Bury and Corn 1987; Degraaf and Rudis 1990; deMaynadier and Hunter 1998; Mazerolle 2001; McLeod and Gates 1998; Stockwell and Hunter 1989). To overcome this problem, researchers have made different modifications to traps, such as varying trap size (Vogt and Hine 1982), or adding funnels (Corn 1994; Vogt and Hine 1982), side flaps (Nadorozny and Barr 1997), pivoting top flaps (Christiansen and Vandewalle 2000), or rims (Bury and Corn 1987; Stenhouse 1985). However, very few investigators have experimentally tested the effectiveness of their alterations against amphibian escape (but see Brown 1997; Christiansen and Vandewalle 2000; and Vogt and Hine 1982). In this paper, I present data collected in field conditions to test the effectiveness of pitfalls with and without rims in hindering amphibian escape (i.e., animals being missing from the trap).

All experimental trials were conducted in Rankin Bog (46°48'N, 65°00'W), a peat bog within Kouchibouguac National Park, in southeastern New Brunswick, Canada, during the summers of 1998, 1999, and 2001. Pitfall traps consisted of 11.4-L plastic buckets (24 cm diameter x 30 cm height), each of which was placed in a shallow hole ca. 10 cm in depth. This ensured that the tops of the buckets were well above the bog surface to alleviate the probability of an accidental capture during trials. Each trap was a quarter-filled with water, and a thick mat of *Sphagnum* moss was added in the buckets to provide cover (Mazerolle 2001). Rims were fashioned from bucket lids by cutting out their center portion, leaving a margin of 2 cm. These rims were added to some traps to test whether the presence of rims helps prevent escapes from the pitfall traps.

A predator exclosure was built around the entire array of buckets in 2001 to test whether escape rates were confounded with avian or mammal predation at the site during 1998 and 1999. The exclosure (0.91 m in height and 7.2 m in circumference) consisted of plastic snow fencing with a mesh size of 1 cm^2. The top of the exclosure was covered with nylon window screening fastened with clothespins to hinder avian predation.

I collected individuals of five amphibian species (see Table 1) from breeding ponds in the proximity of Kouchibouguac National Park. Amphibians also were collected during night driving surveys conducted on rainy evenings (Shaffer and Juterbock 1994) between April and September of 1998, 1999, and 2001 in the same area. Individuals were temporarily housed in a cool dark room and used in experimental trials within 36 h of capture. At the beginning of experiments, I measured the snout–vent length (SVL) of each amphibian. Individuals were randomly allocated to buckets fitted with or without rims, with the restriction of a single individual to each bucket. During a given trial period, the number of traps employed varied depending on the number of amphibians at hand (range 5–27 traps); for each species, half the individuals were randomly allocated to traps with rims, with the other half assigned to traps without rims. In those cases with an odd number of amphibians, the last individual was randomly allocated to one of the two trap types. The traps were arranged in a small grid of ca. 5 m^2. Traps were checked four days following the introduction of amphibians to assess whether animals were present or absent. Each individual was used only once, and was released at its original capture location if it was present in the trap at the end of the trial. A total of 256 individuals was tested over 17 four-day periods during 1998, 1999, and 2001.

I used logistic regression (Hosmer and Lemeshow 1989) to assess, for each species placed in pitfall traps, the effect of trap type (i.e., with or without rim) on the probability of being missing from the trap at the end of the trial. I accounted for the presence or absence of a predator exclosure by systematically including the variable in all models. Snout–vent length (SVL) was added to models if it was significant at $\alpha = 0.10$ in univariate logistic regressions (Type III log-likelihood ratio statistic, SAS Institute Inc.

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GEOGRAPHIC DISTRIBUTION

Herpetological Review publishes brief notices of new geographic distribution records in order to make them available to the herpetological community in published form. Geographic distribution records are important to biologists in that they allow for a more precise determination of a species' range, and thereby permit a more significant interpretation of its biology.

These geographic distribution records will be accepted in a **standard format** only, and all authors *must* adhere to that format, as follows: SCIENTIFIC NAME, COMMON NAME (for the United States and Canada as it appears in Crother 2000. *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding*. SSAR Herpetol. Circ. 29:1–82; for Mexico as it appears in Liner 1994, *Scientific and Common Names for the Amphibians and Reptiles of Mexico in English and Spanish*. Herpetol. Circ. 23:1–113), LOCALITY (use metric for distances and give precise locality data), DATE (day-month-year), COLLECTOR, VERIFIED BY (*cannot* be verified by an author—curator at an institutional collection is preferred), PLACE OF DEPOSITION (where applicable, use standardized collection designations as they appear in Leviton et al. 1985, *Standard Symbolic Codes for Institutional Resource Collections in Herpetology and Ichthyology*, Copeia 1985[3]:802–832) and CATALOG NUMBER (required), COMMENTS (brief), CITATIONS (brief), SUBMITTED BY (give name and address in full—spell out state names—no abbreviations).

Some further comments. This geographic distribution section does not publish "observation" records. Records submitted should be based on preserved specimens which have been placed in a university or museum collection (private collection depository records are discouraged; institutional collection records will receive precedence in case of conflict). A good quality color slide or photograph may substitute for a preserved specimen *only* when the live specimen could not be collected for the following reasons: it was a protected species, it was found in a protected area, or the logistics of preservation were prohibitive (such as large turtles or crocodilians). Color slides and photographs *must* be deposited in a university or museum collection along with complete locality data, and the color slide catalog number(s) must be included in the same manner as a preserved record. Before you submit a manuscript to us, check Censky (1988, *Index to Geographic Distribution Records in Herpetological Review: 1967–1986*; available from the SSAR Publications Secretary) to make sure you are not duplicating a previously published record. The responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extensions unless a thorough literature review has been completed.

Please submit any geographic distribution records in the **standard format only** to one of the Section Co-editors: **Alan M. Richmond** (USA & Canadian records only); **Jerry D. Johnson** (Mexico and Central America, including the Caribbean islands); **Hidetoshi Ota** (all Old World records); or **Gustavo J. Scrocchi** (South American records). Short manuscripts are discouraged, and are only acceptable when data cannot be presented adequately in the standard format. **Electronic submission of manuscripts is required** (as Microsoft Word or Rich Text format [rtf] files, as e-mail attachments. Refer to inside front cover for e-mail addresses of section editors.

Recommended citation for new distribution records appearing in this section is: Marques, O. A. V., and G. Puorto. 1996. Geographic Distribution. *Chironius laevicollis*. Herpetol. Rev. 27:212.

CAUDATA

AMBYSTOMA OPACUM (Marbled Salamander). USA: VIRGINIA: Scott Co: Rikemo Lodge, ca. 1 km SW of Dungannon. 8 May 1999. Christopher S. Hobson, Steven M. Roble, Anne C. Chazal. Verified by Richard Hoffmann. Virginia Museum of Natural History (VMNH) 10337. Sub-adult found in a small pit (ca. 0.25 m deep) covered by a piece of plywood at Rikemo Lodge, situated on a slope just above the floodplain of the Clinch River. First record for Scott Co., and first published record for southwestern Virginia (Mitchell and Reay 1999. Atlas of Amphibians and Reptiles in Virginia. Spec. Publ. No. 1, Virginia Department of Game and Inland Fisheries, Richmond, Virginia. 122 pp.; Tobey 1985. Virginia's Amphibians and Reptiles: A Distributional Survey, Virginia Herpetological Survey, Purcellville, Virginia, 113 pp.). The nearest published records within the Ridge and Valley physiographic province are from Knox County, Tennessee (ca. 160 km SW), and Montgomery County, Virginia (ca. 180 km NE) (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, Center for Field Biology, Austin Peay State University, 94 pp.; Tobey 1985, *op. cit.*). This record partially fills a hiatus in the known range for this species that includes much of the southern Appalachians; northeastern Kentucky and Tennessee, western North Carolina, and southwestern Virginia (Conant and Collins 1991. Reptiles and Amphibians of Eastern/Central North America. Houghton Mifflin Co., Boston, Massachusetts, 450 pp.).

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AMBYSTOMA MACRODACTYLUM (Long-Toed Salamander). USA: CALIFORNIA: Tehama Co: Lassen National Forest, Cascade Range, Carter Meadow (40°1324.78"N, 121°24'43.76"W) 1860 m elev. 5 August 2002. Chris R. Feldman and Daniel G. Mulcahy. CAS 225059–60. Verified by Jens Vindum. New county record (Vindum and Koo 2002, Amphibians and Reptiles of the Lassen National Forest: Results of 02-CS011050650-029, the 2002 California Academy of Sciences Survey). The nearest known localities are: 18.5 km S (Coon Hollow, Butte Colorado; MVZ 60909), 12.6 km E (6.4 km SW of Chester, Plumas Co.; MVZ 50204), and 18.3 km N (Bunchgrass Creek, Plumas Co.; CAS 225057). We found the two adult salamanders inside decaying logs in a closed canopy portion of the meadow. In northeastern California, *A. macrodactylum* occurs in mid-elevation meadows, ponds, and lakes. Such habitat is common in the northern Sierra Nevada and southern Cascade Mountains, and *A. macrodactylum* is likely contiguous throughout this region.

We thank Michelle Koo, Jens Vindum, Melanie McFarland, and Ken Roby for supervision during field surveys, which were funded by Challenge Cost-Share Agreement #02-CS-11050650–029, Forest Service Region 5, Lassen National Forest.

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HEMIDACTYLIUM SCUTATUM (Four-toed Salamander). USA: TENNESSEE: Sullivan Co: South Holston Weir Dam, 50 m E of intersection of Holston View Dam Road and TVA Road South (36.5218N, 82.1064W). 7 March 2002. Kevin Hamed and Phil Gentry. Verified by A. Floyd Scott, Austin Peay State University Museum of Zoology, APSU 3344. First record from Sullivan County and second record from upper East Tennessee (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ.

No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.).

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ANURA

BUFO MARINUS (Cane Toad). COSTA RICA: PUNTARENAS: Amistad Biosphere Reserve (8°59'N, 82°49'W), ca. 2200 m elev.: On a small hilltop along the trail leading from the Las Alturas de Cotón field station to Cerro Burú and Cerro Echandí. 14 July 2002. M. A. Schlaepfer and K. A. Pilgrim. KU Photograph Collection (CT 11890–891). Verified by Jay M. Savage. New elevational record for this species, which is generally not found above 1600 m in Costa Rica (Savage 2002. The Amphibians and Reptiles of Costa Rica. University of Chicago Press, Chicago, i–xx + 934 pp.). Campbell (1999. *In* W. E. Duellman [ed.], Patterns of Distribution of Amphibians: A Global Perspective, pp. 111–210. Johns Hopkins Univ. Press) indicated that this species should occur as high as 2000 m elev. in the highlands of Middle America. The specimen reported herein was found in primary lower montane rainforest in an area with no apparent evidence of standing water necessary for breeding. This record may have important implications in the ability of *B. marinus* to expand its range into higher and cooler regions of the world.

Submitted by **MARTIN A. SCHLAEPFER**, Neurobiology and Behavior, Mudd Hall, Cornell University, Ithaca, New York 14853–2702, USA (e-mail: mas50@cornell.edu), and **KERI A. PILGRIM**, Department of Biological Sciences, G–419 Lilly Hall, Purdue University, West Lafayette, Indiana 47907–1392, USA.

BUFO QUADRIPORCATUS (Four-Ridged Toad). BRUNEI: TUTONG DISTRICT: Sungai Ratuan Uluh, slow–flowing stream through peat swamp forest, ca. 200 m behind Pangkalan Kubo at Tasik Merimbun (04°4'52.9"N, 115°1"24.4"E; pH 3.9). 15–18 May 1996. Heok Hui Tan. Raffles Museum of Biodiversity Research: Zoological Reference Collection (ZRC.1.4376, one subadult, SVL 15.3 mm, exhibiting characteristic elongate paratoids; ZRC.1.4377–4378, two larvae, Gosner stages 38 and 40, total lengths 16.4 mm and 16.7 mm, respectively; both larvae exhibiting diagnostic labial tooth row formula of 2(2)/3 (Leong and Chou 1999. Raffles Bull. Zool. 47[1]:81–137). Verified by Kelvin K. P. Lim. New country record, in addition to Sabah, Sarawak, and Kalimantan, confirming its postulated occurrence in Brunei (Inger and Stuebing 1997. A Field Guide to the Frogs of Borneo. Natural History Publications, Kota Kinabalu, Sabah, Malaysia. ix + 205 pp.). This represents the fourth species of the genus *Bufo* recorded from Brunei (Das 1995. Raffles Bull. Zool. 43[1]:157–180).

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BUFO VALLICEPS (Gulf Coast Toad). EL SALVADOR: AHUACHAPÁN: Parque Nacional El Imposible, La Fincona (13°50.8'N, 89°58.8'W), 720 m elev. 17 June 1997. J. Kreutz and M. Vesely. Forschungsinstitut und Naturmuseum Senckenberg (SMF 81319). Verified by J. R. McCranie and J. R. Mendelson. First record for El Salvador (Mendelson 1998. Sci. Pap. Nat. Hist. Mus. Univ. Kansas 8:1–12). The historical specimens of *Bufo "valliceps"* reported by Mertens (1952. Die Amphibien und Reptilien von El Salvador, auf Grund der Reisen von R. Mertens und A. Zilch. Abh. Senckenb. Naturf. Ges. 487. pp. 1–120) have subsequently been identified as *Bufo leutkenii.*

Submitted by **GUNTHER KÖHLER**, Forschungsinstitut und Naturmuseum Senckenberg, Sektion Herpetologie, Senckenberganlage 25, D–60325 Frankfurt a. M., Germany; e-mail: gkoehler@senckenberg.de.

ELEUTHERODACTYLYS AUGUSTI (Barking Frog). USA: NEW MEXICO: DOÑA ANA CO: Organ Mts., Aguirre Springs Campground, campsite #8; ca. 4.5 air mi SE Organ. 5 Sept. 2001. Ian Murray. Verified by Tomas Giermikowski. MSB 62816. New county record and a range extension of ca. 89 miles to the WNW (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque. 431 pp.).

Submitted by **IAN MURRAY**, 501 Sundown Avenue, Alamogordo, New Mexico 88310, USA, and **CHARLES W. PAINTER,** Endangered Species Program, New Mexico Department of Game and Fish, P.O. Box 25112, Santa Fe, New Mexico 87504, USA.

ELEUTHERODACTYLUS PAULODUTRAI (Paulo's Robber Frog). BRAZIL: BAHIA: Municipality of Salvador, Ondina, Campus da Universidade Federal da Bahia (12°58'S, 38°30'W; 8 m elev.). 24 May 2002. M. F. Napoli. Verified by Ulisses Caramaschi. Museu Nacional, Rio de Janeiro (MNRJ 30410–30411). First record outside the type locality (Centro de Pesquisas do Cacau, Ilhéus, southeastern Bahia, 14°47'S, 39°02'W, 52 m elev.), and northernmost for the species. This new record extends the range ca. 210 km northward. Specimens were collected at night as they called in leaf litter or on stems and small branches standing upright 60 cm from the ground.

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ELEUTHERODACTYLUS PLANIROSTRIS (Greenhouse Frog). USA: FLORIDA: WAKULLA CO: Panacea, St. Marks National Wildlife Refuge, ca. 0.3 km E of the intersection of St. Marks NWR roads 325 and 316 (30.026°N, 84.410°W). 23 October 2002. Steve A. Johnson, Jennifer S. Staiger, and William J. Barichivich. Florida Museum of Natural History, University of Florida, Gainesville (UF 134605). Verified by Kenneth Löver Krysko. We captured one adult (23 mm SVL) in a funnel trap associated with a drift-fence array (EYR site) on 23 October 2002 and two more adults on 25 October 2002, one in a funnel trap (NAT site) and the other in a pitfall trap (SPC site, UF 134606) at

drift-fence arrays at St Marks NWR (Special Use permit no. 02011). All three arrays were within 1 km of each other and situated in sandhill uplands. Additionally, on 20 September 2002, SAJ heard several *E. planirostris* choruses in wooded areas along the north side of CR 372 east of US 98 at Ochlockonee Bay. These apparently are the first county records for the species (Conant and Collins 1998. Peterson Field Guide to Reptiles and Amphibians of Eastern and Central North America. Third edition expanded. Houghton Mifflin Co., Boston, Massachusetts. 616 pp.). Greenhouse frogs occur in Tallahassee, Florida (Leon Co.), ca. 50 km N of Panacea, and were first documented there in 1963 (Reichard and Stevenson 1964. Florida Nat. 37:97). One individual was recently collected near Carrabelle, Florida (Franklin Co.), ca. 35 km SE of Panacea (Krysko and Reppas 1999. Herpetol. Rev. 30:106).

In late 1977, herpetologists with the U.S. Fish and Wildlife Service initiated intensive herpetofaunal sampling with drift-fence arrays at 14 sites within St. Marks NWR. They trapped continuously for 20 months and did not catch *E. planirostris* at any of the sites (U.S. Fish and Wildlife Service 1980. St. Marks National Wildlife Refuge: Forestry Management and Non-game Wildlife, unpubl. final report, Gainesville, Florida). Using the USFWS's drift-fence array design and sampling at 12 of their 14 sites, we captured the above *E. planirostris* during our first sampling period. Thus, Greenhouse Frogs appear to have colonized the Panacea area within the last 20 years, and our captures are the first records of the species on St. Marks NWR.

Submitted by **STEVE A. JOHNSON**, **JENNIFER S. STAIGER,** and **WILLIAM J. BARICHIVICH**, U.S. Geological Survey, Florida Integrated Science Centers, Center for Aquatic Resources Studies, 7920 NW 71st St., Gainesville, Florida 32653, USA.

HYLA PENTHETER. MÉXICO: MÉXICO: 9 km W El Salitre on road to Nanchititla (100°18'58"N, 18°52'52"W, 1900 m elev.). 19 April 2002. G. Parra-Olea and M. García-París. Colección Nacional de Anfibios y Reptiles, Instituto de Biología, UNAM (IBH13807). Verified by L. Canseco-Márquez. One adult female found under a small stone by a damp road bank covered by liverworts and ferns, at the edge of a relatively dense pine forest. This is the northernmost record for the species and first record for the state of México. It was previously known only from cloud forest at elevations of 1280–2000 m on the Pacific versant of the Sierra Madre del Sur in Guerrero and Oaxaca (Duellman 2001. Hylid Frogs of Middle America, vol. 2, supplement: 963–964, 1129, SSAR Contrib. Herpetol. 18). The habitat for this record differs considerably from previous reports, as it was found in relatively dry pine forest, although remnants of cloud forest are still present nearby.

Submitted by **G. PARRA-OLEA**, **G. CASAS-ANDREU**, Instituto de Biología, UNAM AP 70–153 México, DF 04510, México; **X. AGUILAR-MIGUEL**, CIRB, Facultad de Ciencias, UAEM, Instituto Literario #100, Toluca, Estado de México, México; and **M. GARCIA-PARIS**, Museo Nacional de Ciencias Naturales, CSIC. José Gutiérez Abascal, 2, 28006 Madrid, Spain.

HYLA VERSICOLOR (Gray Treefrog). CANADA: ONTARIO: ALGOMA DISTRICT. Thessalon Twp., 0.8 km N of Hwys 129 and 17 intersection (NAD 27: UTM Zone 17: N5127200m, E304000m). 7 June 1999. Wayne F. Weller. Royal Ontario Museum (ROM 38443 [segment 23], audio cassette tape). All tape recordings and photographs verified by Ross D. MacCulloch. Intense calling from marsh behind homes in rural setting at 2425 h. This record is the westernmost location among 17 others where calls were recorded (ROM 38443 [segments 6 to 22], audio cassette tape), and 9 other locations where calling was noted within 650 km² of the Thessalon/Basswood Lake area. ALGOMA DISTRICT. Tarentorus Twp., N of Kinsman Park, Sault Ste. Marie (NAD 27: UTM Zone 16: N5163800m, E708600m). 14 June 2001. Wayne F. Weller. Royal Ontario Museum (ROM 39374 [segment 19], audio cassette tape). Moderate calling from wetland behind homes in rural setting at 2210 h (air temperature 25°C) under overcast sky. This record is the westernmost location among four others where calls were recorded (ROM 39374 [segments 4, 5, 20, 21], audio cassette tape), and nine other locations where calling was noted within 450 km² of the Sault Ste. Marie area. ALGOMA DISTRICT. Martel Twp., 2.7 km S of Lane and Martel Twp. boundary (NAD 27: UTM Zone 17: N5211600m, E336800m). 12 June 2001. Wayne F. Weller. Royal Ontario Museum (ROM 39374 [segment 16], audio cassette tape). Intense calling from roadside wetland along Hwy 129 at 2300 h (air temperature 15°C). This record is the northernmost location among six others where calls were recorded (ROM 39374 [segments 1–3, 15, 17, 18], audio cassette tape), where one specimen was photographed (ROM 39373), and 11 other locations where calling was noted within 750 km² of the Aubrey Lake area. The documented western range limit in central Ontario is represented by specimens from the Walford/Massey area in extreme southwestern Sudbury District: Sugar Lake area (National Museum of Canada [NMC] 7456 – August 1963); Cameron Falls area (NMC 33487 – August 1990); Massey (NMC 7397, 7452, 7495 – August and September 1963). The 18 documented records from the Thessalon/Basswood Lake area extend the range 100 km W of the Walford/Massey area. The five documented records from the Sault Ste. Marie area extend the range 160 km to the WNW, and the eight documented records from the Aubrey Lake area extend the range 115 km to the NW. Collectively, these 31 documented records represent the first vouchered records for Algoma District in Ontario, and substantiate observations received from several people over the period of 1974–1997 for Algoma District.

Submitted by **WAYNE F. WELLER**, 250 Chercover Drive, Thunder Bay, Ontario P7G 1A2, Canada.

PROCERATOPHRYS MELANOPOGON. BRAZIL: MINAS GERAIS: Municipality of Araponga: Fazenda Neblina, Parque Estadual da Serra do Brigadeiro (20°40'S, 42°31'W). November 1994. R. N. Feio and J. L. Pontes. Museu de Zoologia João Moojen de Oliveira, Universidade Federal de Viçosa (MZUFV 2201–03). Municipality of Lima Duarte: Parque Estadual do Ibitipoca (21°42'S, 43°53'W). November 1987. R. N. Feio. MZUFV 542. All verified by U. Caramaschi and J. P. Pombal, Jr. Published distribution of this species includes the mountains of Serra do Mar and Mantiqueira in the states of Rio de Janeiro and São Paulo, in southeastern Brazil (Izecksohn et al. 1998. Rev. Univ. Rural, sér. Ciênc. Vida, 20[1–2]:37–54). These localities represent the first record for the state of Minas Gerais, and the most inland (Ibitipoca) and northern (Serra do Brigadeiro) records for the species.

Submitted by **RENATO NEVES FEIO**, Museu de Zoologia

João Moojen de Oliveira, Universidade Federal de Viçosa, 36571–000, Viçosa, MG, Brazil; **CARLOS ALBERTO GONÇALVES DA CRUZ**, Departamento de Vertebrados, Museu Nacional, Quinta da Boa Vista, 20940–040, Rio de Janeiro, RJ, Brazil; and **EUGENIO IZECKSOHN**, Departamento de Biologia Animal, Universidade Federal Rural do Rio de Janeiro, 23851–970, Seropédica, RJ, Brazil.

RANA CATESBEIANA (American Bullfrog). USA: CALIFORNIA: San Francisco Co: John McLaren Park, ca. 20 m SW of intersection of Bacon Street and Oxford Street (37°43'23.94"N, 122°25'6.3"W, 104 m elev.). 25 March 2000. Craig A. Reading. Verified by J. V. Vindum. California Academy of Sciences (CAS) 214825. Single adult male basking on bank of pond. New county record (Banta and Morafka 1966. Wassman J. Biol. 24:223–238). Larvae of *R. catesbeiana* (CAS 218665) were also collected from the same locality indicating that this is a breeding population. Although observations of this species had been recorded in 1966 by Banta and Morafka, this individual and larvae represent the only catalogued museum specimens of *R. catesbeiana* from San Francisco County.

Submitted by **MELANIE M. PAQUIN**, National Marine Fisheries Service, Conservation Biology Division, Seattle, Washington 98112, USA, and **CRAIG A. READING**, Department of Biology, San Francisco State University, San Francisco, California 94132, USA (e–mail: reading@sfsu.edu).

SCINAX AGILIS. BRAZIL: BAHIA: Municipalidade de Prado (17°20'S, 39°13'W, sea level). S. P. Carvalho e Silva, O. L. Peixoto, C. A. G. Cruz, E. Izecksohn. December 1978. Coleção do Departamento de Zoologia, Universidade Federal do Rio de Janeiro (ZUFRJ 210). Found in leaf axils of bromeliads in a restinga formation. Municipalidade de Mucuri (18°05'S, 39°33'W, sea level). M. R. Gomes, S. P. Carvalho e Silva, R. Schasse. May 1988. ZUFRJ 3500/12. Calling from emerging vegetation over a flat swampy area, where tadpoles probably develop. Verified by E. Izecksohn. Previously known only from a few localities in the State of Espirito Santo where the species occurs in littoral scrub formations (restingas). First state record, extends range ca. 250 km N.

Submitted by **OSWALDO LUIZ PEIXOTO**, Departamento de Biologia Animal, Instituto de Biologia, Universidade Federal Rural do Rio de Janeiro, Seropedica, 23851– 970, Rio de Janeiro, Brazil; **MARCIA DOS REIS GOMES** and **SERGIO P. CARVALHO E SILVA**, Departamento de Zoologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Ilha do Fundão, 21941–970, Rio de Janeiro, Brazil.

SCINAX CANASTRENSIS. BRAZIL: MINAS GERAIS: Perdizes Municipality, Estação de Pesquisa e Desenvolvimento de Galheiro (19°12'S, 47°10'W). 2 November 2002. A. A. Giaretta, J. C. de Oliveira Filho, and M. N. C. Kokubum. Verified by A. A. Giaretta. Museu de Biodiversidade do Cerrado da Universidade Federal de Uberlândia, Minas Gerais (AAG-UFU nº 2386). *Scinax canastrensis* is known only from the type locality: Parque Nacional da Serra da Canastra, Minas Gerais, Brazil, (Cardoso and Haddad 1982. Rev. Bras. Biol. 42:499–503). The new record extends the known distribution of the species ca. 120 km NW, outside the limits of the Park.

Submitted by **JÚLIO CÉSAR DE OLIVEIRA FILHO** and **MARCELO N. DE C. KOKUBUM**, Laboratório de Ecologia e Sistemática de Anuros Neotropicais, Instituto de Biologia, Universidade Federal de Uberlândia, 38400-902, Uberlândia, Minas Gerais, Brazil (e–mail: juliofilho2002@yahoo.com.br).

SCINAX WANDAE. VENEZUELA: ESTADO AMAZONAS: Lago Leopoldo (Paraka–Wachoi), Serranía del Sipapo, 300 m elev. 04°57'97"N, 67°29'21"W. 14 May 2000. O. Fuentes. Museo de Biología, Universidad Central de Venezuela, Caracas (MBUCV IV–6617–19). Puerto Ayacucho and La Esmeralda (slides in the collection of Fundación AndígenA, Mérida (FA–0076 and FA–0123, respectively). Verified by G. Rivas. First country record and easternmost for the species, expanding its distribution about 700 km ENE from type locality—Villavicencio, Meta, Colombia (Pyburn and Fouquette 1971. J. Herpetol 5:97–101).

Submitted by **CÉSAR LUIS BARRIO**, Fundación AndígenA. Apartado Postal 210, 5101–A, Mérida, Venezuela (e–mail: cesarlba@yahoo.com) and **OSWALDO FUENTES**, Instituto de Medicina Tropical–Serpentarium, Apartado Postal 47423, Caracas 1041, Venezuela (e–mail: osfuentes@latinmail.com).

TESTUDINES

APALONE SPINIFERA (Spiny Softshell). USA: ILLINOIS: McLean Co: Bray Creek, a headwater of the Mackinaw River (40°32.35'N, 88°37.34'W). A juvenile was found on 8 August 2002. Mary H. Lee. Verified by John Petzing. Illinois Natural History Survey (INHS 18523). New county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8. Champaign, Illinois. 300 pp.).

Submitted by **MARY H. LEE**, Department of Biological Sciences, Illinois State University, Normal, Illinois 61790–4120, USA; e–mail: mhlee@ilstu.edu.

CHELYDRA SERPENTINA (Snapping Turtle). USA: COLORADO: Washington Co., in dry irrigation ditch along State Highway 6, 1.8 mi. NE junction County Road R (UTM: 0636915, 4475854). 13 August 2002. UNC–MNH 4268. Verified by David Chiszar and Hobart M. Smith. First county record (Hammerson 1999. Amphibians and Reptiles of Colorado. Second Ed. Univ. Colorado Press, Niwot. xxvii + 484 pp.).

Submitted by **RON MALECKI, DAVID NEELY,** and **STEPHEN P. MACKESSY**, Department of Biological Sciences, University of Northern Colorado, 501 20th Street, CB 92, Greeley, Colorado 80639–0017, USA (e–mail: stephen.mackessy@unco.edu).

CHELYDRA SERPENTINA (Snapping Turtle). USA: COLORADO: Sedgwick Co., in dry irrigation canal along Highway 59, 2.8 mi. N junction Interstate 76 (UTM: 0709044, 4534169). 15 September 2002. UNC–MNH Photographs #41 & 42. Verified by David Chiszar and Hobart M. Smith. First county record (Hammerson 1999. Amphibians and Reptiles of Colorado. Second Ed. Univ. Colorado Press, Niwot. xxvii + 484 pp.).

Submitted by **RON MALECKI, STEVE ALLEN, MIKE ROCHFORD,** and **STEPHEN P. MACKESSY**, Department of

Biological Sciences, University of Northern Colorado, 501 20th Street, CB 92, Greeley, Colorado 80639–0017, USA (e-mail: stephen.mackessy@unco.edu).

GRAPTEMYS BARBOURI (Barbour's Map Turtle). USA: FLORIDA: Jefferson County: Wacissa River headwaters, parking area at end of southern extension of CR 59; 30°20'23"N, 83°59'28"W. 30 May 2002. Dale R. Jackson and Bob Walker. Verified by Ghislaine Guyot. Florida Museum of Natural History Herpetology Dept. photographic archive (UF 134682). Adult female (292 mm maximum CL, 252 mm PL, 2.8 kg) observed covering nest at 0930 h, released following photography. Clutch of 12 eggs (mean 13.0 g) salvaged to determine fertility. Three of six eggs hatched in 59–60 days at 31°C (first 17 days at 25–29°C), and five of six in 76–78 days at fluctuating 25–29°C. First documented record for county and Aucilla River drainage, ca. 40 km E of recently documented record in Ochlockonee River (Enge et al. 1996. Herpetol. Rev. 27:150–151).

Long considered to be endemic to the Apalachicola River system, this species is now documented from drainages both to the east (Ochlockonee, Aucilla) and west (Choctawhatchee: Wallace 2000. Florida Sci. 63[Suppl. 1]:43; J. Godwin, in litt.). Whether the newly discovered populations are indigenous or the results of human introduction is problematic. The latter is likely for the Aucilla drainage, as the Wacissa River site (from which only one individual is thus far recorded) is a popular recreational area easily accessible to the public. Nonetheless, Pleistocene fossils from the Suwannee River (Jackson 1975. Herpetologica 31:213–219) suggest a historical distribution that extended east of the modern Apalachicola River drainage.

Submitted by **DALE R. JACKSON**, Florida Natural Areas Inventory, 1018 Thomasville Road, Suite 200-C, Tallahassee, Florida 32303, USA.

GRAPTEMYS PSEUDOGEOGRAPHICA (False Map Turtle). USA: IOWA: Allamakee Co: Mississippi River, Upper Mississippi River Wildlife and Fish Refuge. This refuge is adjacent to Crawford Co., Wisconsin. T98N, R6W, Sec. 9; 91°07'W, 43°14'E. 15 November 2002. Robert Hagensick. Northern Illinois University HDW-NIU 1933. Verified by Theresa Wusterbarth. New county record. Although this represents a new county record for Iowa, it could easily be considered as coming from Crawford County, Wisconsin, as this species was collected within 3 km W of the arbitrary border of the Mississippi River as illustrated in the Geological and Natural History Survey Topographic map for Eastman Quadrangle. The species has also been observed at Cold Springs, Crawford County, 2.8 km N of Lynxville, Wisconsin, within the backwaters of the Mississippi River (Christiansen and Bailey 1988. The Lizards and Turtles of Iowa, Iowa Dept. Nat. Resources, 20 pp., revised ed. 1997) and (Casper 1996. Geographic Distributions of the Amphibians and Reptiles of Wisconsin, Milwaukee Public Museum 87 pp.) have shown considerable hybridization between *G. ouachitenisas* and *G. pseudogeographica* in the Mississippi River drainage. Both authors have recognized *G. ouachitenisas* and *G. pseudogeographica* as being subspecies of *G. pseudogeographica*. Crother et al. (2000. SSAR Herpetol. Circ. 29, 82 pp.) consider *G. ouachitensis* and *G. pseudogeographica* as distinct species. All previous localities for Iowa are of a generalized nature only listing the Mississippi River. The Crawford County record fills a gap between Grant County on the south, and Vernon County on the north in Wisconsin.

Submitted by **HARLAN D. WALLEY** and **JULIE M. RAY**, Northern Illinois University, Dekalb, Illinois 60115, USA; e-mail: hdw@niu.edu.

KINOSTERNON CREASERI (Creaser's Mud Turtle). MÉXICO: YUCATÁN: 8 km on road N Celestún. 23 September 2001. Oswaldo Hernández-Gallegos and C. Ballesteros-Barrera. Verified by John B. Iverson. Colección Nacional de Anfibios y Reptiles, Instituto de Biología, UNAM (IBH-RF 19 a–c Color Slides). Westernmost record for the state of Yucatán, extending the geographic range about 100 km (airline) NW of Santa Elena (Lee 1996. The Amphibians and Reptiles of the Yucatán Peninsula. Cornell Univ. Press, Ithaca, New York, 500 pp.; Buskirk 1997. Chelonian Cons. Biol. 2:415–416). The presence of this species in the northwestern portion of the Yucatán Peninsula refutes the speculation that *K. creaseri* may be unable to survive the drier conditions of that area (Iverson 1988. Herpetol. J. 1:285–291). We thank J. B. Iverson for reading an earlier version of the manuscript.

Submitted by **OSWALDO HERNÁNDEZ-GALLEGOS, CLAUDIA BALLESTEROS-BARRERA,** and **FAUSTO R. MÉNDEZ**, Departamento de Zoología, Instituto de Biología, Universidad Nacional Autónoma de México, A. P. 70-153, C. P. 04510, México, D.F., México (e-mail: oswaldo@biologia.unam.mx), and **DAVID E. ALONZO-PARRA,** Ducks Unlimited de México, A.C., Oficina Regional Sureste, Calle 59 #180 – 42 y 44, Fracc. Francisco de Montejo, Mérida, Yucatán, México.

TRACHEMYS SCRIPTA ELEGANS (Red-eared Slider). USA: FLORIDA: Broward Co: Davie, canal along SW 76 Avenue, 0.3 km N Orange Drive (26°04'08"N, 80°14'54"W). 22 September 2002. Gerald R. Johnston and Jennifer C. Johnston. Verified by Kenneth L. Krysko. Florida Museum of Natural History (UF 134596). New county record. Adult male (carapace length 18.1 cm, plastron length 16.3 cm, mass 730 g) captured in turtle hoop trap baited with canned sardines. A total of 138 *T. s. elegans* were captured in Davie, Florida during the summer of 2002.

Submitted by **GERALD R. JOHNSTON** and **JENNIFER C. JOHNSTON**, Department of Natural Sciences, Broward Community College, Davie, Florida 33314, USA; e-mail: johnston713@aol.com.

TRACHEMYS SCRIPTA SCRIPTA (Yellow-bellied Slider). USA: FLORIDA: Broward Co: Davie, canal along SW 76 Avenue, 0.3 km N Orange Drive (26°04'08"N, 80°14'54"W). 22 September 2002. Gerald R. Johnston and Jennifer C. Johnston. Verified by Kenneth L. Krysko. Florida Museum of Natural History (UF134595). New county record. Adult female (carapace length 21.8 cm, plastron length 19.8 cm, mass 1590 g) captured in turtle hoop trap baited with canned sardines. This was the only *T. s. scripta* specimen captured during a turtle survey in Davie, Florida during the summer of 2002.

Submitted by **GERALD R. JOHNSTON** and **JENNIFER C. JOHNSTON**, Department of Natural Sciences, Broward

Community College, Davie, Florida 33314, USA; e-mail: johnston713@aol.com.

LACERTILIA

ANOLIS COMPRESSICAUDUS (Escorpioncillo). MEXICO, VERACRUZ: Municipality of Las Choapas, Colonia Nueva Tabasqueña Ejido (17°31.42'W, 94°01'N), elev. 100 m. 17 December 2000. Collected by Fahd Carmona in a remnant of rainforest in the ranch El Milagro (IBH 13987). Verified by Roberto Luna Reyes. This is the first record for the state of Veracruz. Previous reports were from Oaxaca and Chiapas. This record extend the distribution 77 airline km W from El Ocote Chiapas (Álvarez del Toro 1956. Herpetologica 12:3–17).

Submitted by **FAHD H. CARMONA-TORRES**, **ADRIANA J. GONZÁLEZ-HERNÁNDEZ**,* and **VÍCTOR-HUGO REYNOSO**, Colección Nacional de Anfibios y Reptiles. Instituto de Biología, UNAM, Circuito Exterior, Del. Coyoacán, C.P. 04510, AP. 70–153, México, D.F. (e-mail: cfahd@hotmail.com); *Laboratorio de Vertebrados Terrestres, Facultad de Ciencias, UNAM, Circuito Exterior. Del. Coyoacán. C.P. 04510. México, D.F.

BASILISCUS BASILISCUS. VENEZUELA: YARACUY: Río Carabobo, El Diamante, Sierra de Aroa. 13 April 1995. E. Camargo. Museo de la Estación Biológica de Rancho Grande, Maracay, Venezuela (EBRG 3209). Río El Zamuro, Sierra de Aroa. 8 August 1995. R. Rivero (EBRG 3160). Both verified by César R. Molina. First state records. *Basiliscus basiliscus* is known in Venezuela from the states of Falcón, Mérida, Táchira, Trujillo, Zulia, and now from Yaracuy. Mijares-Urrutia and Arends (1993. Herpetol. Rev. 24:157–158) reported this species from Falcón state, without biogeographical comments. These localities, along with the Yaracuy ones, are the easternmost for the species, showing that *B. basiliscus* is widely distributed through rivers in the area northeast of the Andes and west to the Coastal Range. Barrio and Orellana (2001. Herpetol. Rev. 32:56–57) stated that CVULA 3481 was the first state record for Trujillo state, but this was evidently an error as Maturana (1962. Bull. Mus. Comp. Zool. Harvard, 128:1–33) reported the species from Trujillo without museum numbers. Thus, CVULA 3481 is the only known voucher specimen for that state. Another locality given by Maturana (*op. cit.*) is "Valencia, Esperanza." The location of Valencia, Esperanza is unclear, but it is shown as somewhere between the states of Barinas and Portuguesa, although we are unable to locate such a place on available maps. However, an area called Valencia, Esperanza is found in the bio-region called "región llanera" (Barrio 1998. Acta Biol. Venez. 18 [2]:1–93), which is well outside the known range of the species. Additionally, near Valencia in Carabobo state, there is a Quebrada La Esperanza, but this is also well outside the expected range of this species. Therefore, we believe that the "Valencia, Esperanza" locality is an error.

Submitted by **CÉSAR LUIS BARRIO-AMORÓS**, Fundación AndígenA, Apartado Postal 210, Mérida 5101-A, Venezuela (e-mail: cesarlba@yahoo.com), and **GILSON RIVAS FUENMAYOR**, Museo de Historia Natural La Salle, Apartado Postal 1930, Caracas 1010-A, Venezuela (e-mail: gilsonrivas@mixmail.com).

CHAMAELEO CHAPINI. EQUATORIAL GUINEA: PROVINCIA CENTRO SUR: Monte Alén National Park: Monte Alén (1150 m elev.). Adult male (YPM 12638) found in stomach of a *Thelotornis kirtlandi* (YPM 12649) collected on 5 June 2002 from above locality by Jorge de Leon. Verified by Wolfgang Böhme. First country record; previously known from Zaire (de Witte 1964. Am. Mus. Nov. 2192: 1–3) and Gabon (Knoepffler 1967. Biologica Gabonica 3[3]:245–247).

Submitted by **GREGORY J. WATKINS-COLWELL** (e-mail: gregory.watkins-colwell@yale.edu) and **JORGE DE LEON** (e-mail: ornithology.library@yale.edu), Division of Vertebrate Zoology, Yale Peabody Museum of Natural History, 170 Whitney Avenue, P.O. Box 208118, New Haven, Connecticut 06520, USA.

ELGARIA MULTICARINATA (Southern Alligator Lizard) USA: CALIFORNIA: PLUMAS CO.: Grizzly Creek near Elephant Butte. On 5 June 2002 at 1318 h, an adult specimen (118 mm SVL) was captured ca. 1 m from the right bank of Grizzly Creek (639559 N, 4413845 E; NAD 27, Zone 10; 509 m elev.). This specimen (CAS 224773) represents the first known occurrence of this species in Plumas County (Koo and Vindum 1999. Amphibians and Reptiles of the Plumas National Forest: Historical Collections and California Academy of Sciences 1998 and 1999 Surveys. Unpublished report on file, Department of Herpetology, California Academy of Sciences. San Francisco, California). A second adult male specimen (CAS 224774; 136 mm SVL) was captured on 23 June 2002 at 1434 h along unnamed forest road from Rich Bar (0655255 N, 4429492 E; NAD 27, Zone 10; 800 m elev.) near confluence of Clear Creek and Mill Creek. The nearest record (CAS 209667) is located ca. 31.6 km SE in Butte County, thus extending the known distribution of the species. Specimens verified by Michelle Koo.

Submitted by **KEVIN D. WISEMAN** (e-mail: kwiseman@garciaandassociates.com), **RONALD E. JACKMAN**, and **KARLA R. MARLOW**, Garcia and Associates, 2601 Mission Street, Suite 600, San Francisco, California 94110, USA.

EUMECES MULTIVIRGATUS EPIPLEUROTUS (Variable Skink). USA: COLORADO: LAS ANIMAS CO: 3.87 km NNW Zamora, Santistevan Canyon. 26 July, 1997. Justin P. Hobert. University of Colorado Museum (UCM 58796). Verified by Hobart M. Smith. Specimen was found foraging along a southeast facing rocky outcrop in piñon-juniper woodland. First record for county (Hammerson 1999. Amphibians and Reptiles in Colorado. Univ. Press of Colorado, Niwot. 484 pp.).

Submitted by **JUSTIN P. HOBERT**, Department of Biological Sciences, University of Texas at El Paso, El Paso, Texas 79968, USA.

EUMECES MULTIVIRGATUS (Many-lined Skink). USA: NEW MEXICO: MORA CO: Mora National Fish Hatchery; ca. 3.2 road km. N of Mora on Highway 434. 16 August 2001. Mark L. Watson. KU CT 11835. Verified by James N. Stuart. New county record (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque. xix + 431 pp.). Fills a gap in range records from surrounding counties in New Mexico (Colfax, San Miguel, Santa Fe, Taos).

Submitted by **MARK L. WATSON,** New Mexico Department

of Game and Fish, P.O. Box 25112, Santa Fe, New Mexico 87504, USA.

GAMBELIA COPEI (Baja California Leopard Lizard). MÉXICO: BAJA CALIFORNIA SUR: 3.5 road km NE Ejido San Lucas junction of México Hwy. 1 on road to Punta Chivata (27°04'N, 112°04'W). 25 June 2000. Eric D. Zepenewski, Carrie A. Carreno, and A. Kristopher Lappin. MVZ Photographic Collection 233497. Verified by L. Lee Grismer. The only known record for the gulf coast of Baja California between Santa Rosalia and the vicinity of Loreto (McGuire 1996. Bull. Carnegie Mus. Nat. Hist. 32:i–iv, 1–44).

Submitted by **ERIC D. ZEPENEWSKI, CARRIE A. CARRENO**, and **A. KRISTOPHER LAPPIN,** Northern Arizona University, Flagstaff, Arizona 86011, USA (e-mail: Kristopher.Lappin@nau.edu).

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko) USA: TEXAS: Ellis Co: Downtown Ennis of E. Brown St. 16 September 2001. Casey McCluney. Navarro College Herpetological Collection NC2001.9. 16.1L–3L. Verified by Thomas Vance. Three juveniles of different sizes collected at a residence. New county record; partly fills hiatus of this introduced species in north-central Texas Range (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station. 421 pp.).

Submitted by **CASEY McCLUNEY,** 309 East Brown Street, Ennis, Texas 75119, USA.

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). USA: NEW MEXICO: Otero Co: within Alamogordo city limits, collected from private residence at 501 Sundown Avenue. 12 May 2001. Ian Murray. Verified by Tomas Giermikowski. MSB 62815. Specimen represents a new county record (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque. 431 pp.).

Submitted by **IAN MURRAY**, 501 Sundown Avenue, Alamogordo, New Mexico 88310, USA, and **CHARLES W. PAINTER**, Endangered Species Program, New Mexico Department of Game and Fish, P.O. Box 25112, Santa Fe, New Mexico 87504, USA.

LIOLAEMUS ZULLYI. CHILE: XI REGION DE AYSEN: Reserva Nacional Lago Jeinimeni (46°49'43.5"S, 71°59'35.3"W); three specimens at 850 m elev. in dry steppe, ca. 1 km NE of Lago Jeinimeni. 1–19 February 2002. Museo Nacional de Historia Natural, Santiago, Chile (MNHN–3483). Verified by Herman Núñez. First country record for Chile. Previously known only from type locality in Argentina (Cei and Scolaro 1996. Bollettino del Museo Regionale di Scienze Naturali di Torino. Turín. Italy 14[2]:389–401); extends known range ca. 15 km.

Submitted by **ROBIN D. MOORE** and **SUSAN L. YOUNG**, Durrell Institute of Conservation and Ecology (DICE), University of Kent, Canterbury, Kent, CT2 7NS, UK, and **CARLOS GARIN** and **DANIEL PINCHEIRA-DONOSO,** Museo Nacional de Historia Natural, Casilla 787, Santiago, Chile.

MABUYA FRENATA. BRAZIL: PARÁ: Redenção (08°02'S; 50°02'W). 16 July 1988. Ricardo P. da Rocha. Museu de História Natural Capão da Imbuia (MHNCI 3068). Verified by Sérgio Augusto A. Morato; Conceição do Araguaia (08°15'S; 49°16'W). July 1979. Paulo E. Vanzolini. Museu de Zoologia da Universidade de São Paulo (MZUSP 54442). Verified by Regina Rebouças–Spieker. These represent the first records for the state of Pará and the northernmost records for the species. They extend the distribution more than 150 km N from previous northernmost recorded locality (Cantão State Park, state of Tocantins; Pinto and Araujo 2000. Herpetol. Rev. 31:53).

Submitted by **DAVOR VRCIBRADIC**, Setor de Ecologia, Instituto de Biologia, Universidade do Estado do Rio de Janeiro, Rua São Francisco Xavier, 524, Maracanã, 20550–011, Rio de Janeiro, RJ, Brazil, and **JULIO CESAR DE MOURA-LEITE,** Museu de História Natural Capão da Imbuia, Departamento de Zoológico, Prefeitura Municipal de Curitiba, Rua Prof. Benedito Conceição, 407, 82810–080, Curitiba, Paraná, Brazil.

PHRYNOSOMA HERNANDESI (Greater Short-horned Lizard). USA: COLORADO: Kit Carson Co: County Road U, 0.5 mi E of junction County Road 6 (UTM 0673962, 4350785). 12 September 2002. UNC–MNH Photographs 37–40. Verified by David Chiszar and Hobart M. Smith. First county record (Hammerson 1999. Amphibians and Reptiles of Colorado. Second Ed. Univ. Colorado Press, Niwot. xxvii + 484 pp.).

Submitted by **STEVE ALLEN, MIKE ROCHFORD, RON MALECKI,** and **STEPHEN P. MACKESSY**, Department of Biological Sciences, University of Northern Colorado, 501 20th Street, CB 92, Greeley, Colorado 80639–0017, USA (e-mail: stephen.mackessy@unco.edu).

PODARCIS MURALIS (Common Wall Lizard). USA: OHIO: Cincinnati. *Podarcis muralis* was introduced to urban Cincinnati circa 1950 where it established a population which is still expanding. Deichsel and Gist (2001. Herpetol. Rev. 32:230–232) describe the status as of the year 2000 and conclude from a letter written by the person who released specimens in 1950 the subspecific status as *P. m. muralis*, judging from their origin (Lake Garda, Italy). Ferner (2002. Herpetol. Rev. 33:226) confirms a breeding colony in adjacent Kentucky.

We analyzed blood drawn from the vena caudalis of two adults caught on Eastern Avenue in SE Cincinnati in May 2000 where they were subsequently released. Total DNA was extracted following standard proteinase K and phenol chloroform protocols (Sambrook et al. 1989. Molecular Cloning: A Laboratory Manual. Cold Springs Harbor Laboratory Press, Cold Springs Harbor, New York). A segment of 1039 bp including parts of the cytochrome b gene and the threonin t-RNA gene was amplified by PCR (primers: "sicnt-L" 5'–TTTGGATCCCTGTTAGGCCTCTGTT-3' and "H15906" 5'–GGTTTACAAGACCAGTGCTTT-3') and sequenced (primers "sicnt-L" and "murnum" 5'-AGGCACCTCCATAGTTCACC-3') by MWG-BIOTECH (Ebersberg, Germany) sequencing service. A part of the cyt b gene consisting of 1017 bp was used for analysis. Both sequences were identical. These sequences were compared with homologous regions taken from samples that were analyzed in the course of a comprehensive genetic analysis of the species currently underway

(Schweiger and Mayer, in prep.). The sequences most similar to the sequences of the Cincinnati samples were from individuals collected in a region between the Tyrolian Inn Valley in Austria and the southern border of the Alps near Lake Garda in Italy. This similarity confirms the origin alleged by Deichsel and Gist (*loc. cit.*). However, because a revision of the systematics of *P. muralis* is still in progress, the subspecific status of the Cincinnati specimens remains unresolved as well. Sequences were deposited at GenBank under the accession number AY194855. We thank Daniel Gist for local guidance in Cincinnati.

Submitted by **SILKE SCHWEIGER**, Natural History Museum, Molecular Systematics, Burgring 7, Vienna, Austria A-1014 (e-mail ammo1@gmx.at), and **GUNTRAM DEICHSEL**, Friedr.-Ebert-Str. 62, Biberach an der Riss, Germany D-88400 (e-mail Guntram.Deichsel@bc.boehringer-ingelheim.com).

PTYCHOGLOSSUS NICEFORI: VENEZUELA: MÉRIDA: CBX 13 Island, 240 m elev., Borde Seco Dam (07°44'30"N, 71°32'50"W). 21–22 September 2001. Grupo Ecología Animal 2001. Colección de Vertebrados, Universidad de los Andes, Facultad de Ciencias, Mérida (CVULA IV- 6418–9). Verified by Gilson Rivas. First country record and northernmost for the species, extending the range ca. 400 km NNE from type locality (Loveridge 1929. Proc. Biol. Soc. Washington 42:99) and other Colombian localities given by Harris (1994. Herpetol. Monogr. 8:226–275).

Submitted by **CÉSAR LUIS BARRIO,** Fundación AndígenA, Apartado Postal 210, Mérida 5101–A, Venezuela (e-mail: cesarlba@yahoo.com), **AMELIA DÍAZ DE PASCUAL** (e–mail: adiaz@ciens.ula.ve) and **ANDRÉS CHACÓN** (e–mail aecortiz@yahoo.com), Facultad de Ciencias, Universidad de los Andes, Mérida, Venezuela.

XANTUSIA VIGILIS (Desert Night Lizard). USA: CALIFORNIA: Tulare Co: Sequoia National Forest, Sierra Nevada Mountains, Big Meadows Campground Unit 1, 0.53 km E of FST 29E05 trailhead via FSR 14S11 (N36°43'3.55" W118°49'46.14") 2317 m elev. 21 July 2002. Chris R. Feldman and Daniel G. Mulcahy. CAS 224956. Verified by Jens Vindum. *Xantusia vigilis* is known from the peripheral areas of the Sierra Nevada, restricted to chaparral, desert scrub, and drier mixed pine and oak woodland habitat. East of the Sierran crest, *X. vigilis* occurs in the Mojave–Great Basin transition zone along the lower slopes of the Sierra Nevada and Owens Valley to ~1800 m elev., north to the vicinity of Bishop (Macey and Papenfuss 1991. *In* C. A. Hall Jr. [ed.], Natural History of the White-Inyo Range, Univ. California Press, Berkeley; Scott et al. 1999. Herpetol. Rev. 30:112). On the western slope of the southernmost Sierra Nevada, west of the Kern River drainage, *X. vigilis* is narrowly restricted to grassland, chaparral, oak and grey pine woodland habitat with exfoliating granite to ~600 m elev. in the Greenhorn Mountains, Kern Co. (Bezy 1967. J. Arizona Acad. Sci. 4[3]:163–167). *Xantusia* is widespread in the region from Lake Isabella eastward to Walker Pass, extending south into Kelso Valley, Walker Basin, and Caliente Canyon. Populations of *Xantusia* follow desert scrub and chaparral habitat along the Kern River drainage into southern Tulare Co., at least as far north as Brin Canyon, 3.2 km N of Fairview to ~1100 m elev. (LACM 129881–2), and to the east on the Kern Plateau, in mostly pinyon-juniper habitat along the South Fork Kern River to the Fish Creek drainage, Tulare Co., to ~2250 m elev. (RWH, unpubl.).

While conducting biotic field surveys in Sequoia National Forest, we (CRF, DGM) found a live *X. vigilis* (CAS 224956) under a small granite boulder ~4 m from Big Meadows Creek at 1945 h. Although a massive granite outcrop is nearby, the immediate habitat consists of high elevation coniferous and riparian vegetation such as Lodgepole Pine, Red Fir and willow. This specimen represents a new record for *X. vigilis* in the interior of the Sierra Nevada. The closest museum record is 55 km to the east, near Independence, Inyo Co. (MVZ 228231). However, the highest mountain divide in the contiguous United States separates our specimen and populations east of the Sierran crest. West of the Sierran crest, the nearest population to our specimen occurs in the interior of the Sierra Nevada, restricted to the Kern River drainage, 92 km to the south (LACM 129881–2). Because we found our specimen in a campground, far from any known population of *X. vigilis*, and in habitat not previously recorded for this species, CAS 224956 may represent an introduction. Additional specimens from this locality and intervening areas could demonstrate whether the Big Meadows area contains an established population of *X. vigilis*. Further, a regional genetic survey of *X. vigilis* might have the power to clarify whether our specimen represents a natural or introduced population of *Xantusia*.

We thank Michelle Koo, Jens Vindum, and Phillip Strand for supervision during field surveys, which were funded by Challenge Cost-Share Agreement #00-CC-11051322-034, Forest Service Region 5, Sequoia National Forest.

Submitted by **CHRIS R. FELDMAN** (e-mail: elgaria@biology.usu.edu), **DANIEL G. MULCAHY** (e-mail: dmulcahy@biology.usu.edu), Department Biology, Utah State University, Logan, Utah 84322–5305, USA, and **ROBERT W. HANSEN** (e-mail: rwh13@csufresno.edu), 16333 Deer Path Lane, Clovis, California 93611–9735, USA.

SERPENTES

ADELPHICUS QUADRIVIRGATUS. MEXICO: HIDALGO: Municipality of Orizatlán San Felipe Orizatlan (21°10'15"N, 98°36'23"W) 160 m elev. April 1982. Colección Herpetológica de la Escuela Nacional de Ciencias Biológicas, I.P.N. (CB 11498). Verified by Luis Canseco Marquez. Adult female. First known record for the state and a range extention of 44 km from the nearest previous record in the state of San Luis Potosí.

Submitted by **SERGIO MURILLO**, **TICUL ALVAREZ SOLORZANO**[+] and **NOEMI MATIAS FERRER,** Escuela Nacional de Ciencias Biológicas, IPN. Prol. de Carpió y Plan de Ayala, Col. Santo Tomás. Apdo. Postal 42-186, México D.F., C.P. 11340, México; e–mail (SM): smurilloigu@infosel.net.mx.

APOSTOLEPIS GOIASENSIS. BRAZIL: MATO GROSSO DO SUL: Ribas do Rio Pardo (20°26'S, 53°45'W, 369 m elev.). December 1988. S. S. Abes. Verified by F. L. Franco. Adult male collected from a Cerrado area. Instituto Butantan, São Paulo, Brazil (IB 67852). Second record for the species, previously known only from the type-locality: Rio Verde, Goiás (Prado 1942. Mem. Inst. Butantan 16:7–12). Present record extends known distribution 412 km SW.

Submitted by **SARA S. ABES** and **HEBERT FERRAREZZI**, Laboratório de Herpetologia, Instituto Butantan, Av. Dr. Vital Brazil, 1500, CEP 05503–900, São Paulo, Brazil; e-mail (HF): hferrarezzi@butantan.gov.br.

ARIZONA ELEGANS ELEGANS (Kansas Glossy Snake). USA:COLORADO: WASHINGTON Co., Highway 61, 2.2 mi. N junction County Road 32 (UTM 0673708, 4435583). 7 September 2002. UNC–MNH Photographs 35–36. Verified by David Chiszar and Hobart M. Smith. First county record (Hammerson 1999. Amphibians and Reptiles of Colorado. Second Ed. Univ. Colorado Press, Niwot. xxvii + 484 pp.).

Submitted by **MIKE ROCHFORD, RON MALECKI,** and **STEPHEN P. MACKESSY**, Department of Biological Sciences, University of Northern Colorado, 501 20th Street, CB 92, Greeley, Colorado 80639–0017, USA; e-mail (SPM): stephen.mackessy@unco.edu.

BOTHROPS LEUCURUS (White–tailed Lancehead). BRAZIL: PERNAMBUCO: Serra dos Cavalos; Parque Ecologico João Vasconcelos Sobrinho; Caruaru (08°18'36–08°30'00"S and 36°10'10"W). 22 April 1998. Antônio Ferreira Matos. Instituto de Biologia, Universidade Federal da Bahia (UFBA1214). Verified by Giuseppe Puorto. Serra dos Cavalos (900 m elev. and 350 ha) is an Atlantic forest remnant localized in a semi–arid region of Pernambuco state. *B. leucurus* was known from Bahia, Sergipe, Alagoas, and Ceara states (Porto and Texeira 1995. Herpetol. Rev. 26:156). First state record, extends known distribution ca. 250 km airline NW in the Brazilian Northeast.

Submitted by **MARCO TÚLLIO LIMA DUARTE**, **MARLIETE SOARES**, **ANTONIO DA SILVA SOUTO**, Departamento de Zoologia, Universidade Federal de Pernambuco, Av. Prof. Nelson Chaves, 1235, 50.670–420. Brazil and **REJANE MARIA LIRA-DA-SILVA**, Instituto de Biologia, Universidade Federal da Bahia, Rua Barão de Geremoabo, s/n CEP: 40170–290 Salvador BA, Brazil (e–mail: duartetullio@bol.com.br).

COLUBER CONSTRICTOR FLAVIVENTRIS (Eastern Yellow-bellied Racer). USA:COLORADO: PHILLIPS Co., County Road 61 at junction County Road 14 (UTM: 0746486, 4490198). 26 August 2002. UNC–MNH Photographs 31–32. Verified by David Chiszar and Hobart M. Smith. First county record (Hammerson 1999. Amphibians and Reptiles of Colorado. Second Ed. Univ. Colorado Press, Niwot. xxvii + 484 pp.).

Submitted by **RON MALECKI, MIKE ROCHFORD, DAVID NEELY,** and **STEPHEN P. MACKESSY**, Department of Biological Sciences, University of Northern Colorado, 501 20th Street, CB 92, Greeley, Colorado 80639–0017, USA (e–mail [spm]: stephen.mackessy@unco.edu).

CROTALUS ATROX (Western Diamond-backed Rattlesnake): USA: ARIZONA: MOHAVE Co: Lake Mead National Recreation Area, Pierce Ferry, ca 100 m from water's edge under a picnic platform, Colorado River, river mile (RM) 280 L: 36°07'N, 114°00'W. 27 April 2000. Wayne L. Peterson. KU CT 11877. Verified by Cecil Schwalbe. First verified record for the upper Lake Mead Region and furthest downstream record in the Grand Canyon Region (an extension of 54.3 RM, 87.4 river km; roughly 69 km land distance). Grater (1981. Snakes, Lizards, and Turtles of the Lake Mead Region. Publ. Southwest Parks and Monuments Association. 47 pp.) and Lowe et al. (1986. The Venomous Reptiles of Arizona. Publ. Arizona Game and Fish Department, Phoenix. 115 pp.) suggest that *C. atrox* has been found only in the southern part of the Lake Mead-Lake Mojave Region. MOHAVE Co: Diamond Creek, RM 225.7 L: 35°46'N, 113°22'W. 19 June 2001. Jock Souter. KU CT 11878. Verified by Joseph T. Collins. Third verified record of *C. atrox* in the Grand Canyon Region. The first record of *C. atrox* for this region (KU Color Slide 11725) was from the same drainage (Brown 2000. Herpetol. Rev. 31:54–55).

Submitted by **NIKOLLE L. BROWN**, 7779 North Leonard, Clovis, California 93611, USA; e-mail: black–catnik@att.net.

CROTALUS SCUTULATUS (Mojave Rattlesnake). USA: ARIZONA: MOHAVE Co: Hualapai Indian Reservation, Quartermaster Point, 0.8 km from the Colorado River: river mile (RM) 260.5 L: 35°58'N, 113°47'W. Summer 1999. Ralph Jones. KU CT 11885. Verified by Cecil R. Schwalbe. First verified record in the Grand Canyon Region. Miller et al. (1982. Amphibians and Reptiles of the Grand Canyon. Publ. Grand Canyon Nat. Hist. Assoc. 114 pp.) suggested that *C. scutulatus* might inhabit the lower end of the canyon, however there were no confirmed records. Grater (1981. Snakes, Lizards, and Turtles of the Lake Mead Region Publ. Southwest Parks and Monuments Association. 47 pp.) mentioned that *C. scutulatus* did not appear common in the Lake Mead Region. Lowe et al. (1986. The Venomous Reptiles of Arizona. Publ. Arizona Game and Fish Department, Phoenix. 115 pp.) show the northern distribution of *C. scutulatus* extending north close to the Colorado River near Peach Springs Canyon (RM 225.7 L) and reaching the Colorado River at Pierce Ferry (RM 280 L), but not found near the Colorado River in the intervening region.

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DENDROASPIS POLYLEPIS (Black Mamba). GUINEA: Télimélé (10°54'00"N, 13°01'60"W), 543 m elev. 1996. M. Cellou Baldé. University of Kansas Museum of Natural History (KU CT 11866). Verified by Van Wallach. Adult collected in the hole of a felled tree. First confirmed country record. Although this species has been suggested to occur in Guinea (Droz 1994, *In* Résumé des communications, Premier congrès herpétologique Franco-Suisse. Société Herpétologique de France, Paris. p. 12; David and Ineich 1999. Dumerilia 3:3–499), no specific locality or museum specimen was listed. The nearest records for this species are ca. 420 km NNW in Senegal (Håkansson and Madsen 1983. J. Herpetol. 17:186–89) and ca. 800 km ESE in Burkina Faso (Spawls and Branch 1995. The Dangerous Snakes of Africa. Ralph Curtis Books, Sanibel Island, Florida. 192 pp.).

Submitted by **ELI GREENBAUM,** Division of Herpetology, Natural History Museum and Biodiversity Research Center, The University of Kansas, 1345 Jayhawk Boulevard, Lawrence, Kansas 66045–7561, USA (e–mail: elig@ku.edu), **M. CELLOU BALDÉ,** Institut Pasteur de Guinée, Bp. 146, Kindia, Guinée (e–mail: celloufr@yahoo.fr), and **JOHN L. CARR,** Department of Biology, The University of Louisiana at Monroe, Monroe, Louisiana 71209, USA (e–mail: carr@ulm.edu).

DIADOPHIS PUNCTATUS (Ringneck Snake). USA: CALIFORNIA: Inyo County: Death Valley National Park, Grapevine Canyon: 0.5 mi. E of Scotty's Castle in thick riparian area 5 m from surface water (37°02'00"N, 117°19'20"W), 1027 m elev. 28 March 2002. Kevin Emmerich and Larry O'Hanlon. Museum of Vertebrate Zoology (MVZ 237182 photo voucher). The snake was moving above ground on top of *Salix* sp. and *Vitis* sp. leaf litter. Coloration was light grey with no ring on neck. Because of National Park Service collecting regulations, a 35mm slide was submitted to MVZ. First record for Inyo County. USA: NEVADA: Esmeralda County: 5 mi. E of Lida (37°26'54"N, 117°28'19"W), 1986 m elev. 15 October 2002. Kevin Emmerich and Laura Cunningham. MVZ 238085. The snake was in a pitfall trap under a *Salix lasiolepis*. Coloration was light grey with no ring on neck. First record for Esmeralda County. Specimens verified by Theodore J. Papenfuss. Based on coloration and absence of a neck ring, both specimens are referrable to *D. p. regalis*. These records represent a western extension of the range of that taxon and suggest that additional populations will be found in the desert mountain ranges of western Nevada and extreme eastern California.

Submitted by **KEVIN EMMERICH** and **LAURA CUNNINGHAM**, P.O. Box 70 Beatty, Nevada 89003, USA; e-mail: lacerta@beattynv.com.

DIADOPHIS PUNCTATUS (Ringneck Snake): USA: CALIFORNIA: San Bernardino County: Clark Mountain, Pachalcka Spring (35°31'05"N, 115°37'49"W, elev. 1384 m). 17 April 2000. Collected by Jonathan Richmond and Dustin Wood. Verified by Tod W. Reeder. SDSNH 68893. Female (221 mm SVL) was found under a small rock near the head of the spring. Coloration in life was light olive-gray and lacked the neck ring that typically characterizes this species. It was on the basis of the first specimen from the Providence Mountains that the putative Pacific coast species *amabilis* was lumped into a single wide-ranging species, *D. punctatus* (Croulet 1965. Herpetologica 21:80). MtDNA sequence data collected from this individual show it to be more closely related to *D. p. regalis* from Portal, Arizona than to other *Diadophis* populations in California (C. Feldman, unpubl. data). Coloration, lack of neck ring, and ventral scale counts (231) are also suggestive of *D. p. regalis*. This locality represents ca. 65 km northern extension from the Providence Mountains.

Submitted by **DUSTIN A. WOOD,** Department of Herpetology, San Diego Natural History Museum, P.O. Box 121390, San Diego, California 92112-1390, USA (e-mail: dwood@sdnhm.org) and **JONATHAN Q. RICHMOND**, Department of Ecology and Evolutionary Biology, University of Connecticut, Storrs, Connecticut 06269-3043, USA (e-mail: jonathan.richmond@uconn.edu).

ENULIUS OLIGOSTICHUS (Mexican Long-tailed Snake). MÉXICO: JALISCO: Municipality of Zapopan near Guadalajara (20°47'N, 103°20'W), 1189 m elev. 30 August 2001. Adrián Arceo Contreras. Bosque Tropical, A. C. México (BT, M-003). Verified by Hobart M Smith. New state record and range extension of 213 km SE from near San Blas, Nayarit (Smith et al. 1967. Chicago Acad. Sci., Nat. Hist. Misc. 186:1–4). I thank Departamento de Ecología y Fomento Agropecuario del municipio de Zapopan for financial support and P. Ponce-Villa for aid in the field.

Submitted by **PAULINO PONCE-CAMPOS**, Bosque Tropical, A. C., Apartado Postal 5–515, Guadalajara, Jalisco 45042, México; e–mail: poncecp@hotmail.com.

HETERODON PLATIRHINOS (Eastern Hog-nosed Snake). USA: ILLINOIS: Bureau Co: Highway 29, 0.5 mi E of I–180 (41°15'0"N, 89°26'5"W). 15 September 2002. Tonya D. Bittner. Verified by Christopher A. Phillips. Live adult male found on road. Photographic vouchers deposited in Illinois Natural History Survey Museum, Champaign, Illinois, INHS 2002.15 (dorsal) and 2002.16 (ventral). New county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Natural History Survey Manual 8. 282 pp.).

Submitted by **TONYA D. BITTNER**, PO Box 34, Bradford, Illinois 61421, USA (e-mail: tbittner@theramp.net), and **HARLAN D. WALLEY,** Northern Illinois University, DeKalb, Illinois 60115, USA.

LAMPROPELTIS TRIANGULUM GENTILIS (Central Plains Milksnake). USA: COLORADO: Kit Carson Co., County Road NN 0.5 mi. E jct County Road 46 (UTM 0731682, 4381002). 15 September 2002. DOR. UNC–MNH 4179. Verified by David Chiszar and Hobart M. Smith. First county record (Hammerson 1999, Amphibians and Reptiles of Colorado. Second Ed. Univ. Colorado Press, Niwot. xxvii + 484 pp.).

Submitted by **STEVE ALLEN, MIKE ROCHFORD, RON MALECKI,** and **STEPHEN P. MACKESSY**, Department of Biological Sciences, University of Northern Colorado, 501 20th Street, CB 92, Greeley, Colorado 80639–0017, USA (e–mail [SPM]: stephen.mackessy@unco.edu).

MICRURUS LEMNISCATUS CARVALHOI (Coralsnake). BRAZIL: PARÁ: SANTARÉM (2°26'S, 54°42'W). Sítio Santa Mônica (locality Santa Rosa). Belarmino Carvalho Canto. 13 July 2000. Linha de Pesquisa em Herpetologia da Amazônia (LPHA), Laboratório de Pesquisas Zoológicas (LPZ). Faculdades Integradas do Tapajós (FIT), Santarém, Pará State (LPHA 1362). Verified by Rubens N. Yuki. The species was known from northeastern and central Brazil and from the states of the Paraná and Mato Grosso. The specimen represents the first state record, confirms the natural occurrence of the species in the Amazonian region, and extends the known distribution ca. 720 km W and 764 km N from previous records in Central and Northeastern Brazil (Roze *In* Peters and Orejas-Miranda 1970. U.S. Natl. Mus. Bull. 297:viii + 347; Vanzolini 1986. Smithson. Herpetol. Infor. Serv. 70:1–26; Roze 1982. Mem. Inst. Butantan 46:305–338).

Submitted by **ANDREI GUIMARÃES GUEDES**, Linha de Pesquisa em Herpetologia da Amazônia (LPHA), Laboratório de Pesquisas Zoológicas (LPZ), Faculdades Integradas do Tapajós (FIT), Rua Rosa Vermelha, 335, Santarém, Pará, Brazil, CEP: 68.010-120; e–mail: herpeton6@hotmail.com.

NERODIA SIPEDON SIPEDON (Common Watersnake) USA: COLORADO: Washington Co., basking on culvert of irrigation canal along County Road Q at junction of County Road 59.5 (UTM: 0633480, 4476369). 1 September 2002. UNC–MNH Photographs 33–34. Verified by David Chiszar and Hobart M. Smith. First county record (Hammerson 1999. Amphibians and Reptiles of

Colorado. Second Ed. Univ. Colorado Press, Niwot. xxvii + 484 pp.).

Submitted by **DAVID NEELY**, **MIKE ROCHFORD**, **RON MALECKI**, and **STEPHEN P. MACKESSY**, Department of Biological Sciences, University of Northern Colorado, 501 20th Street, CB 92, Greeley, Colorado 80639–0017, USA (e–mail [SPM]: stephen.mackessy@unco.edu).

PHILODRYAS PSAMMOPHIDEUS (Striped Racer). BRAZIL: DISTRITO FEDERAL: Brasília municipality (15°46'47"S, 47°55'47"W). May 1957. Helmut Sick. Museu Nacional do Rio de Janeiro (MNRJ 7980). Verified by R. Fernandes. Second specimen obtained in 1970 by unknown collector. Coleção Herpetológica da Universidade de Brasília (CHUNB 29405). Verified by G. R. Colli. First record for central Brazil and easternmost record for the species. Extends range ca. 550 km SE of nearest locality, Chapada, Mato Grosso, Brazil (Malnate. 1971. Proc. Acad. Nat. Sci. Philadelphia 123:345–375; Thomas 1976. Unpubl. Ph.D. Diss., Texas A&M University, College Station. 324 pp).

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REGINA SEPTEMVITTATA (Queen Snake). USA: MICHIGAN: OGEMAW Co.: Logan Township: SE corner sec. 3, T22N, R4E, The Woodlands Campground (44°19'35"N,83°55'30"E). 27 August 2002. Kevin Allen. Michigan State University Museum (MSUM 14493). Verified by James Harding. Adult specimen collected 3 m from pond. First county record, possible link between populations in southern Michigan and population found on Bois Blanc Island in the Straits of Mackinaw. Extends known range by ca. 130 km (Harding 1997. Amphibians and Reptiles of the Great Lakes Region. University of Michigan Press, Ann Arbor, Michigan. 378 pp.).

Submitted by **KEVIN ALLEN**, The Woodlands Campground, 318 South Sage Lake Road, Hale, Michigan 48739, USA.

SYMPHIMUS MAYAE (Yucatán White-lipped Snake). MÉXICO: YUCATÁN: Municipality of Tizimín, 4.7 km N, 2.8 km E Calotmul (21°03'57.3"N, 88°08'55.3"W), 10 m elev. 14 July 2002. Colección Herpetológica de la Escuela Nacional de Ciencias Biológicas, I.P.N. (CB 17361). Verified by Edmundo Pérez Ramos. Northernmost record for the state and a range extension of 57 km from the previous record from southwestern Yucatán.

Submitted by **NOEMI MATIAS FERRER** and **SERGIO MURILLO**, Escuela Nacional de Ciencias Biológicas, IPN. Prol. de Carpió y Plan de Ayala, Col. Santo Tomás. Apdo. Postal 42-186, México D.F., C.P. 11340, México (e–mail [SM]: smurilloigu@infosel.net.mx).

SIPHLOPHIS COMPRESSUS (False Coral Snake). VENEZUELA: SUCRE: Península de Paria, 1 km NE Manacal, elev. ca. 800 m. 12 September 2000. H. Kaiser and L. Lee Grismer, La Sierra University (LSUPC–S 3255). Verified by Hussam Zaher. First state record and northernmost for the species in Venezuela, falling into the gap between the Amazonian localities (Roze 1966. La Taxonomia y Zoogeografia de los Ofidios de Venezuela. Ediciones de la Biblioteca, Univ. Central de Venezuela, Caracas, Venezuela. 362 pp.) and Trinidad (Murphy 1997. Amphibians and Reptiles of Trinidad and Tobago. Krieger Publ., Malabar, Florida, 245 pp.). The specimen was found foraging at night at the base of a bush and was photographed and released. The presence of *Siphlophis compressus* in Sucre state was predicted by Rivas and Oliveros (1997 "1998." Mem. Soc. Cienc. Nat. La Salle 147:67–80). In Venezuela, this species shows a typical Amazonian distribution in the states of Amazonas, Bolívar, Monagas (Roze 1966, *op. cit.*), and Delta Amacuro (Rivas and Molina, *in press*. Herpetol. Rev.). This record shows that the species has a more extensive distribution in Venezuela than previously assumed, and it suggests that the southern slopes of the Península de Paria may act as the northern limit for Amazonian amphibian and reptile species. The distribution pattern of *S. compressus* is repeated by other snakes, as expressed by Rivas and La Marca (Herpetol. Rev 32:124). The genus *Tripanurgos* was recently synonymized into *Siphlophis* by Zaher and Prudente (1999. J. Herpetol. 33:698–702).

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TANTILLITA CANULA (Yucatán Dwarf Short-tailed Snake). MÉXICO: YUCATÁN: Municipality of Tizimín, 2.9 km S, 2.2 km W El Cuyo (21°29'00"N, 87°42'3.9"W), 10 m elev. 12 July 2002. Colección Herpetológica de la Escuela Nacional de Ciencias Biológicas, I.P.N. (CB 17360). Verified by Edmundo Pérez Ramos. Northernmost record for the state. This locality is near the coast, and represents a range extension of 118 km from the previous record from southwestern Yucatán.

Submitted by **SERGIO MURILLO** and **NOEMI MATIAS FERRER**, Escuela Nacional de Ciencias Biológicas, IPN. Prol. de Carpió y Plan de Ayala, Col. Santo Tomás. Apdo. Postal 42-186, México D.F., C.P. 11340, México (e–mail [SM]: smurilloigu@infosel.net.mx).

TRIMORPHODON BISCUTATUS LAMBDA (Sonoran Lyresnake). USA: ARIZONA: COCONINO Co: Grand Canyon: Mouth of Royal Arch Creek: ca 100 m from the Colorado River, river mile (RM) 116.5 L: 36°12'N, 112°25'W. 9 April 2000. Nikolle L. Brown. KU CT 11886. Verified by Cecil R. Schwalbe. This record along with MNA Z 7.2797 from Deer Creek (RM 136.2 R; 1975) and KU CT 11887 from Cottonwood Canyon in upper Tuck Up Canyon (RM 164.5 R; Dave Mortenson, 1999) provide additional records for *T. b. lambda* in the Grand Canyon. Miller et al. (1982. Amphibians and Reptiles of the Grand Canyon. Publ. Grand Canyon Natural History Association. 114 pp.) reference two specimens (GRCA 1208 from 75 mile canyon and GRCA 22079 from the top of the Bright Angel Trail, RM 89 L), both being on the south of the river and in the upper reach of the canyon. These additional records extend the distribution of *T. b. lambda* to the

middle and lower reaches of the Grand Canyon on both the North and South rims.

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TYPHLOPS ANGOLENSIS (Angola Blind Snake). EQUATORIAL GUINEA: PROVINCIA CENTRO SUR: Monte Alén National Park: Rio Lobo, Asoc (1°34'3"N, 10°23'3"E). 13 June 2002. A specimen (YPM 12648) collected by Jorge de Leon. Verified by V. Wallach. A first country record for the species (Eisentraut 1973. Bonn. Zool. Monogr. 3:1–428, 5 pls.; Laurent 1964. Bull. Mus. Comp. Zool. 130:387–444; Roux-Estève 1974. Mem. Mus. Natl. Hist. Nat. Série 2, 87A:1–313).

Submitted by **GREGORY J. WATKINS-COLWELL** (e–mail: gregory.watkins-colwell@yale.edu) and **JORGE DE LEON** (e–mail: ornithology.library@yale.edu), Division of Vertebrate Zoology, Yale Peabody Museum of Natural History, 170 Whitney Avenue, P. O. Box 208118, New Haven, Connecticut 06520, USA.

TYPHLOPS MUELLERI (Mueller's Blind Snake). THAILAND: CHUMPHON PROVINCE: Pha To District: Ban Pak Song, ca. 12 km by road E of Ratcha Krut. 2000 (day/month unknown). M. Sumontha. Institut Royal des Sciences naturelles de Belgique (IRSNB 16535). RANONG PROVINCE: Muang District: Ranong (3 km W of the city, direction of Hat Som Pen). May 2000. M. Sumontha. (IRSNB 16536). Both verified by Van Wallach (MCZ). New provincial records (Niyomwan 1999. Species Diversity, Morphology and Habitat Types of Blind Snakes (Family Typhlopidae) in Thailand. MS Thesis, Faculty of Science, Chulalongkorn University, Bangkok). We thank V. Wallach, G. Coulon and G. Lenglet (IRSNB).

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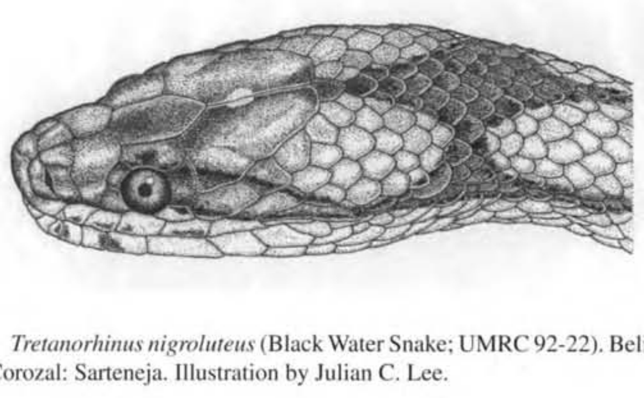

Tretanorhinus nigroluteus (Black Water Snake; UMRC 92-22). Belize: Corozal: Sarteneja. Illustration by Julian C. Lee.

Herpetological Review, 2003, 34(2), 171–173.

New Records of Reptiles from the Orinoco Delta, Delta Amacuro State, Venezuela

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The state of Delta Amacuro is located in eastern Venezuela, and includes the Orinoco River Delta as well as part of the Serranía of Imataca, a total of 40,200 km^2 (PDVSA 1993). This region is framed inside the Venezuelan Guiana (states of Amazonas, Bolívar, Delta Amacuro, eastern Monagas, and southeastern Sucre) which is part of the Guiana Shield (Gorzula and Señaris 1998). Biogeographically, this area is of interest because it is comprised of three big Venezuelan eco-regions: Lowlands, Guiana, and Amazonia. Delta Amacuro possesses very particular geographic and environmental characteristics which are dictated by the area's complex watershed, predominantly the vast quantity of channels and islands formed by the Orinoco River as it drains to the Caribbean Sea and the Atlantic Ocean. In spite of the biogeographical importance of the region, there are only two publications (Gorzula and Arocha-Piñango 1977; Gorzula and Señaris 1998) that mention some of the reptile species found there.

While reviewing specimens collected from the Orinoco River Delta and deposited in the Museo de Historia Natural La Salle, Caracas (MHNLS), Museo de la Estación Biológica de Rancho Grande, Maracay (EBRG) and Museo de Biología, Universidad Central de Venezuela, Caracas (MBUCV) we discovered several species of reptiles whose distribution in Venezuela is poorly known. By reviewing the information on the data cards we were able to extend the distribution of these species in Venezuela. Specimen identifications were verified by Oswaldo Fuentes.

Testudines

Platemys platycephala (Grooved Sideneck). Municipio Antonio Díaz: caño Winikina (09°11'N, 61°06'W) 1 m elev. February 1993. J. Ayarzagüena. MHNLS 15169. First documented museum record for the Orinoco Delta and easternmost record in Venezuela. *P. platycephala* was mentioned by Pritchard and Trebbau (1984) from the Orinoco Delta (no precise locality) based on a personal communication. In Venezuela this species is known from localities in Amazonas, Bolívar, and Monagas states, in the Guiana region (Pritchard and Trebbau 1984).

Amphisbaenia

Amphisbaena alba (Giant Amphisbaena). Municipio Tucupita: Tucupita (09°03'N, 62°02'W), 15 m elev. 08 September 1951. MBUCV 1324–25. First state record (Donoso-Barros 1968; Avila-Pires 1995; Gorzula and Señaris 1998).

Amphisbaena fuliginosa (Mottled Amphisbaena). Municipio Antonio Díaz: Río Ibaruma, 38 km SE of Curiapo (08°10'N, 60°47'W), 15 m elev. 26 February 1995. V. Martínez. MHNLS

13071. Although this species is widely distributed in South America (Peters and Donoso-Barros 1970) this is the first report from Delta Amacuro.

Lacertilia

Gonatodes albogularis (Yellow-headed Gecko). Municipio Pedernales: Pedernales, 0 m elev. 10 December 2002. Oscar Lasso-Alcalá. MHNLS 16104–16106. The specimens, one male and two females, constitute the first state records, the first record from the Venezuelan Guayana, as well as the easternmost locality for the species (Rivero-Blanco 1979). In Venezuela it is known from the western part of the country and the island of Los Monjes in the Gulf of Venezuela (Esqueda et al. 2001; La Marca and García 1987; Rivero-Blanco 1979) and is widely distributed outside of Venezuela. This record extends the known distribution for the species 900 km NE of the nearest known locality (Esqueda et al. 2001). Pedernales is located just 36 km SW from Trinidad, but the presence of this species there is doubtful and requires verification (Hans E. A. Boos, pers. comm.; see also Murphy 1997). The presence of this species in the Orinoco Delta is perhaps a recent introduction, the byproduct of an active maritime commerce.

Hemidactylus palaichthus (Spiny Gecko). Municipio Antonio Díaz: Burojoida island (09°08'N, 60°39'W), 1 m elev. April 1969. J. Bilbao and A. Alvarado. MHNLS 4636 juvenile, 4638 adult male. First state record (Kluge 1969).

Leposoma percarinatum. Municipio Tucupita: Punta Pescador, Boca del Caño Macareo (09°42'N, 61°46'W), 2 m elev. Date not given. G. Solé and E. León. EBRG 3542, adult female. Collected in a flooded forest. Los Castillos de Guayana (08°31'N, 62°22'W). 50 m elev. 01 January 1965. MBUCV 1576. First records for this unisexual species in Delta Amacuro (Donoso-Barros 1968; Uzzell and Barry 1971; Avila-Pires 1995; Gorzula and Señaris 1998).

Tropidurus umbra umbra (Blue-lipped Tree Lizard). Municipio Antonio Díaz: Río Ibaruma, 38 km SE of Curiapo (08°10'N, 60°47'W), 15 m elev. 26 February 1995. V. Martinez. MHNLS 13090. First state record (Donoso-Barros 1968; Etheridge 1970; Avila-Pires 1995; Gorzula and Señaris 1998).

Uranoscodon superciliosus (Diving Lizard). Municipio Antonio Díaz: Río Ibaruma, 38 km SE of Curiapo (08°10'N, 60°47'W), 15 m elev. 3 March 1995. J. C. Señaris. MHNLS 13096. First state record (Donoso-Barros 1968; Avila-Pires 1995; Gorzula and Señaris 1998).

Serpentes

Typhlops brongersmianus (Worm Snake). Municipio Pedernales: Caño Pedernales, 10 m elev. 7 September 1997. J. Ayarzagüena and J. C. Señaris. MHNLS 13799, adult female. First state record (Dixon and Hendricks 1979). Fig. 129 in Gorzula and Señaris (1998) corresponds to specimen MHNLS 13799, which appears as *T. reticulatus*.

Bothrops atrox (Central America Lancehead). Municipio Antonio Díaz: Río Ibaruma, 38 km SE of Curiapo (08°10'N, 60°47'W), 15 m elev. 23 February 1995. J. C. Señaris. MHNLS 13054, adult female. First state record and northernmost for the species (Campbell and Lamar 1989). Collected in a flooded forest.

Chironius carinatus spixi (Machete). Municipio Antonio Díaz: mouth of the Río Acoima, 5 km S of El Toro (08°29'N, 61°29'W), 5 m elev. 24 November 1993. Collector unknown. MHNLS 12774, adult female. First state record and easternmost for the subspecies (Dixon et al. 1993).

Erythrolamprus aesculapii (False Coral Snake). Municipio Antonio Díaz: Río Ibaruma, 38 km SE of Curiapo (08°10'N, 60°47'W), 15 m elev. 2 March 1995. G. Rivas. MHNLS 13088, adult female. First state record. *E. aesculapii* is distributed in Venezuela through the Venezuelan Guiana, a distribution pattern shown by other Guianan-Amazonian Venezuelan species of reptiles (Rivas and La Marca 2001).

Liophis breviceps. Municipio Antonio Díaz: Río Ibaruma, 38 km SE of Curiapo (08°10'N, 60°47'W), 15 m elev. 3 March 1995. R. Figuera. MHNLS 13087, subadult female. Collected in a small well of water. First state record and northernmost for the species in South America (Dixon 1983a).

Liophis reginae reginae. Municipio Pedernales: Caño Pedernales, village of Guacajara, 1 m elev. 15 September 1996. J. C. Señaris. MHNLS 13531, adult male. First country record and westernmost for the subspecies. According to Dixon (1983b) *L. r. zweifeli* intergrades with *L. r. reginae* in Guyana. MHNLS 13531 corresponds to the description of *L. r. reginae*. In Venezuela two other subspecies, *L. r. zweifeli* and *L. r. semilineata* have been reported, the latter mentioned erroneously for Venezuela without voucher specimens (Kornacker 1999).

Siphlophis compressus (False Coral Snake). Municipio Antonio Díaz: Caño Winikina (09°11'N, 61°06'W) 1 m elev. 6 February 1995. V. Ponte and W. Wilbert. MHNLS 13139, adult male. First state record and northernmost in Venezuela (Roze 1966). Stomach contents of this specimen included tails from two geckos (*Gonatodes* sp.). This species feeds exclusively on small lizards (Martins and Oliveira 1998).

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The Introduced Brown Anole (*Anolis sagrei*) Occurs in Every County in Peninsular Florida

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The brown anole (*Anolis sagrei* Dumeril and Bibron 1837), a native of Cuba, the Bahamas, and their satellite islands (Williams 1969), was introduced to at least six different locations in south Florida (USA) in the 1940s (Lee 1985). Since then, this species has rapidly spread northward along the peninsula (Godley et al. 1981) and isolated populations have become established in the Florida Panhandle (Means 1990), Georgia (Campbell 1996; Campbell and Hammontree 1995; Echternacht et al. 1995), Louisiana (Platt and Fontenot 1994), Texas (Dixon 1987), Hawaii (Goldberg and Bursey 2000), Taiwan (Norval et al. 2002), and Grenada, West Indies (Greene et al. 2002). Along with expanding its range by simple diffusion, this species also spreads via jump-dispersal by riding on potted ornamental plants and vehicles (Campbell 1996). Its geographic expansion is best described as stratified diffusion (Shigesada and Kawasaki 1997), roughly analogous to an advancing forest fire that continually releases burning embers, igniting distant spot-fires which eventually coalesce with each other and with the main fire.

Here I document nine new county records for *A. sagrei* in peninsular and northeast Florida (Godley et al. 1981; Campbell 1996; Campbell and Hammontree 1995). This verifies its presence in all 45 peninsular Florida counties southeast of the Suwannee River, and increases to 52 the total number of Florida counties in which this species is established (as of October 2002). Specimens were deposited in the Florida Museum of Natural History Collection (UF) in Gainesville, Florida, and identifications were verified by Kenneth L. Krysko.

Bradford County: KOA Campground on US 301 ca. 1.6 km S of its intersection with SR 100 in Starke. 3 September 2002. Todd S. Campbell. UF 134179–84. Two males and four females collected from a well-established, dense population inhabiting native trees, exotic plants, and landscaping structures throughout the campground.

Desoto County: Morgan Park, ca. 2 km E of Arcadia and ca. 0.5 km N of SR 70 on the east shore of the Peace River. 18 August 2002. Todd S. Campbell. UF 134141–45. One male and four females collected from a well-established, dense population inhabiting a strip of bottomland hardwood hammock habitat between the park entrance road and the Peace River.

Dixie County: Public boat ramp at the end of 8th Avenue in Horseshoe Beach. 1 September 2002. Todd S. Campbell, Kenneth L. Krysko, and Coleman Sheehy, III. UF 134185–86. One male and female collected from large rip-rap boulders used to stabilize the boat ramp. Abundant on trees and fence posts throughout Horseshoe Beach.

Hendry County: Riddle Field, a public park on US 27 in Clewiston. 16 August 2002. Todd S. Campbell. UF 34116–18. Two males and one female collected from a well-established, dense population inhabiting native and exotic vegetation and landscaping timbers throughout the park. Sunset/Ford Park on SR 80 at Martin Luther King Drive (SR 731) in La Belle. 22 August 2002. Todd S. Campbell. UF 134114–15. One male and one female collected from a well-established, dense population inhabiting native oaks, pines, and shrubs throughout the park. This species was observed in La Belle in 1991 (A. C. Echternacht, pers. comm.).

Hernando County: Holiday Inn on Cortez Boulevard (SR 50 / US 98) on the west side of its intersection with I–75 ca. 15 km east of Brooksville. 3 September 2002. Todd S. Campbell. UF 134189. One female collected from a well-established, dense population inhabiting exotic and native vegetation throughout a large complex of hotels and restaurants.

Lake County: Ocala National Forest: Alexander Springs State Park. 1 October 1980. C. R. Smith. UF 50726. Original museum data indicates this specimen was collected in Marion County, but Alexander Springs State Park lies over 5 km east of the Marion-Lake County line, entirely within Lake County. This species is now abundant at this facility.

Okeechobee County: Vacant lot east of Freshman Campus on SW

6th Street and SW 2nd Avenue in Okeechobee. 16 August 2002. Todd S. Campbell. UF 134128–30. One male and two females collected from a large, dense population inhabiting native and exotic vegetation in a residential area. Fort Drum Diner at the intersection of US 441 and NE 326 Trail in Fort Drum. 22 August 2002. Todd S. Campbell. UF 134125–27. Two males and one female collected from a large, dense population inhabiting building materials and disturbed, native vegetation around the diner.

Suwannee County: Capital City Bank on US 129 at the intersection of NW Suwannee and NW Jenkins ca. 0.6 km N of US 27 in Branford. 3 September 2002. Todd S. Campbell. UF 134195–99. Three small males and two small females collected from a large, dense population inhabiting newly planted ornamental vegetation around the bank building, in native vegetation in adjacent residences, and in exotic and native vegetation at a small plant nursery across the street.

Union County: Residence at SW quadrant of the intersection of SW 5th Avenue and SW 5th Street in Lake Butler. 3 September 2002. Todd S. Campbell. UF 134200. One female collected from a newly planted, native ornamental shrub near a residence. This likely represents a recent establishment, as only one other female and two hatchlings were observed during two hours of visual surveys throughout Lake Butler.

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BOOK REVIEWS

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The Amphibians of Honduras, by James R. McCranie and Larry David Wilson. 2002. Society for the Study of Amphibians and Reptiles. x + 625 pp. Hardcover. US $60.00. ISBN 0-816984-57-5.

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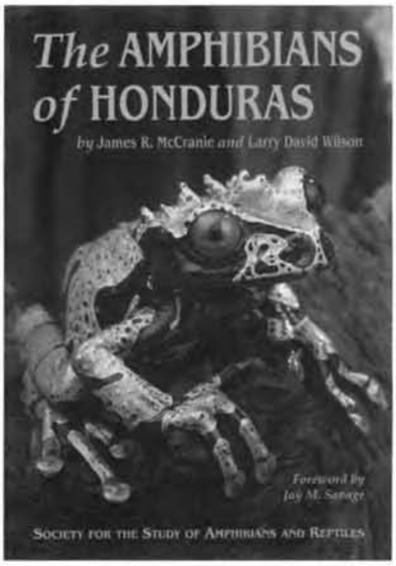

Honduras is the second largest of the Central American countries. Due to its position in nuclear Central America, with coastlines on the Pacific and Caribbean oceans and a complex interior topography, the Honduran herpetofauna is very rich, consisitng of 333 species: 116 amphibians and 217 reptiles (Wilson and McCranie 2002). Studies of Honduran amphibians date back to the late nineteenth century (Werner 1896), but in general this fauna has received far less attention than that of other Latin American countries. Larry David Wilson began his studies in Honduras in 1967. He and Randy McCranie have been working together since 1976 on the enterprise of documenting and improving our knowledge of Honduran herpetology. This volume is the culmination of almost three decades of their efforts, and an important contribution to Neotropical herpetology.

The Amphibians of Honduras is an exceptional piece of work, with very high quality text and illustrations. As Jay Savage points out in his foreword, this is the first book that is a complete treatment of the amphibians of any Mesoamerican country. The depth and breadth of coverage sets a very high standard for those of us interested in doing similar projects. This book is the result of scholarly work both from the field and the laboratory. Their effort includes 1500 field days (the authors actually collected 94% of the species) and the examination of 9550 adult specimens, 447 tadpole lots, and 43 egg clutches. The authors not only have documented the presence and distribution of various taxa but have also contributed substantially to the systematics of the Honduran fauna, including the description of a new frog genus (*Atelophryniscus*), and descriptions of new species in 42% of the amphibian genera previously known from Honduras (a total of 40 new species). This number is even more striking if we consider that the authors have described 50% of the salamander fauna, and 46% of the species of the genus *Eleutherodactylus* from this country.

In the introduction, the authors are explicit about the main

purpose of the book, which is to present the current status of our knowledge of the systematics and distribution of Honduran amphibian species. The volume succeeds in achieving this goal and will be a benchmark for all future herpetological studies in this country. The Material and Methods section outlines the plan of the book, and provides precise descriptions of the methodology used in each section, including the abbreviations and definitions of the morphological measurements used in the identification keys and species accounts.

The authors devote an entire chapter to describing the landscapes and environment in Honduras, thereby introducing the reader to the country. This chapter includes a general description of physiography, climate, and forest formations based on the authors' own work and observations. This section also includes habitat photos and maps illustrating the most prominent physiographic regions and forest formations. Following this introduction is a short chapter on the history of the study of amphibians in Honduras, complete with a chronological reference database for all published studies. This chapter also includes the three main published lists of Honduran amphibians with current names for all taxa.

The section on species diversity begins with clear and user-friendly identification keys to all orders, genera, and species, including those that have not been recorded from Honduras but are expected to occur in the country. When related species are very similar morphologically (salamanders for example) the authors have done a detailed morphometric analysis and use ratios of character combinations to aid in the identification of cryptic taxa. The authors also developed an extremely useful identification key to anuran tadpoles. The keys are accompanied by excellent illustrations, most of them previously published, but beautifully reproduced. Because the keys and illustrations are of excellent quality and because they are also presented in Spanish as well as English, this section of the book will be especially valuable to a wide audience, including Latin American students and researchers.

The bulk of the book contains the systematic accounts (410 pages) for each of 116 amphibian species. The authors provide a short introduction to each order, followed by a brief generic diagnosis that includes the reference to the original description, range, content, and etymology. Species accounts contain the reference to the original description and a chronological synonymy. Geographic and elevational ranges are described for each species. For the non-endemic Honduran taxa, their range in other countries is included as well. The authors point out the main diagnostic morphological characters. A very useful feature is that in some instances diagnosis is accompanied by a table of comparative measurements and proportions of selected characters for the species that is being described and other species with which it might be confused. The description of adult characters lists the material examined and provides a detailed description of each species, including color in life and in alcohol. Tadpole descriptions include a list of the material examined, characteristics of tadpole developmental stages, and a precise description including color in formalin. All accounts include also a list of published illustrations, and remarks, which are mostly comments on the latest taxonomic changes or phylogenetic relationships. For each species a section on ecological distribution and natural history contains basic ecological information mostly based on the authors' own observations. Maps are presented for most species, and excellent color photographs in life are provided for 110 of the 116 species. The quality of the identification keys and species accounts show the extent to which the authors are acquainted with every species from their own field experience, and this greatly enhances the utility of this volume. Following the species accounts, the authors provide a series of names of doubtful or probable occurrence in Honduras, with a short history of the species and the places where it might be found.

The chapter on reproductive modes and guild structure provides data for each species in tabular format. The authors recognize nine reproductive modes for anurans (all Honduran salamanders are direct developers, and the two species of caecilians are viviparous without an aquatic larval stage), eleven adult guilds, and thirteen tadpole guilds. The table for adult guild structures is a modified version of the classification of Heyer et al. (1990), and the table for tadpole guilds is a modified version of McDiarmid and Altig's (1999) classification. The inclusion of population biology and ecological data for these taxa is another example of the breadth of this book.

The authors include a chapter focusing on analyses of amphibian distributional patterns within ecological formations and by elevation, within physiographic regions, and within ecophysiographic areas. The results are presented in three tables that list all amphibians in Honduras and their status in each of the factors analyzed. The authors recognize eight ecological formations (excluding the montane rainforest), and assign each species to one of three categories: widespread, restricted, or peripheral. The results indicate that the three formations with the highest number of species are mesic forests. Honduras is subdivided into ten physiographic regions, and the analysis indicates that the highest number of species (46.3%) is found in the northern cordillera, which is the largest and most topographically and vegetationally complex region. In an ecophysiographic analysis, an update from the one presented by Wilson et al. (2001), the authors now recognize 38 areas. The results from this analysis are also presented in a table and on a map with the distribution of all 38 ecophysiographic areas. Finally, the authors allocate each species to one of the ten broad patterns of previously defined geographical distribution; this analysis indicates that 56.9% of species are either endemic to Honduras or restricted to Nuclear Middle America.

The last section of the book addresses environmental impact and the future of the Honduran amphibian fauna. A natural result of working in the field in Honduras for over 30 years is that McCranie and Wilson have personally witnessed the loss of amphibian diversity and have experienced first hand the accelerated habitat destruction as a result of the increase in human population. The authors effectively convey their frustration and anger at the environmental, social, and political situation in Honduras and do not hesitate in predicting a grim future for amphibian fauna if the current trends are not reversed. Honduras is one of the poorest countries in the Western Hemisphere and it is also one of the most rapidly growing countries in Central America. Not surprisingly, habitat alteration and destruction are identified as the major threat to the integrity of the herpetofauna of Honduras, but pollution and pest and predator control also play an important role. The authors suggest that the problem is so severe that we will all be witnesses to the depletion of the Honduras fauna and that diversity will be reduced to a few tolerant species. Other causes of amphibian

decline worldwide such as pathogen infections have also been detected in Honduras and climatic changes are also likely taking place. To evaluate the environmental vulnerability of each species, the authors consider three categories: geographic range (widespread to highly restricted), ecological distribution (according to the number of ecological formations where the species occurs), and specialization in reproductive modes (from general to highly specialized). The authors rate every species according to those three axes to create a composite environmental vulnerability score. Their results suggest that ca. 30% of the species have a poor chance of survival, 49% have a moderate chance, and almost 21% have a good chance of survival. The taxa with poor chances of survival are primarily Honduran endemics. McCranie and Wilson take this analysis one step further and evaluate the effectiveness of the existing system of Honduran biotic reserves. They conclude that 17% of the amphibian fauna are not protected by the existing system of biotic reserves. Furthermore, many of the existing reserves are not treated as such, and land clearing, lumbering, and ranching are widespread within the reserves. Despite the seemingly hopeless situation, the authors discuss a proposed system of biotic reserves that would protect most of the Honduran amphibian species (Wilson et al. 2001), thus clearly setting a framework for conservation action in this country. The final section of the book contains an abstract in Spanish, a glossary, and a useful gazetteer of all known Honduran collecting localities.

This book will be a necessary addition to the library of all herpetologists interested in Neotropical amphibians. It will also be a valuable tool to those with conservation management responsibilities in Honduras. Although it might be true, as some have claimed, that certain environmental problems in Latin America (such as those caused by overpopulation) are insoluble, and that conservation plans proposed by biologists are destined to fail, I believe that education will make a difference in the course of environmental actions in the next generations. McCranie and Wilson have done the only thing that can truly have an impact on the way Hondureños see their country and natural resources, especially young students who have access to this wonderful book (let's not forget the affordable price) and, who one day might be in the right place at the right time to make a difference for conservation of their fauna.

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The Hylid Frogs of Middle America, by William E. Duellman. 2001. Society for the Study of Amphibians and Reptiles. 2 volumes. 1158 pp., 92 pls., hardcover. US $125.00. ISBN 0-916984-56-7.

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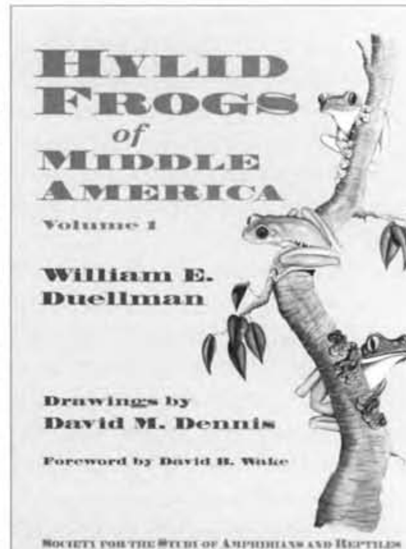

In 1970, William E. Duellman published a two-volume work on the hylid frogs of Middle America that became an instant classic and, eventually, a treasured item on book dealers' lists. As with any such book, however, Duellman's incomparable work grew increasingly out of date. As the twentieth century drew to a close, it became time for an update. The opportunity came in the form of a suggestion to Duellman from Kraig Adler to reprint the 1970 edition of the Middle American hylid book. Duellman bit at the hook proffered by Kraig, with the caveat, however, that Duellman would update the 1970 work.

Duellman's book consists of two fundamental parts. The first part is a reprint of the 1970 work, most of which comprises volume one. The second part is the supplement (including the new plates), which takes up most of volume two. Volume two also contains the appendices, literature cited section, and plates from the original work.

Inasmuch as the 1970 work is unchanged, there is no need to review this portion of the present work. The text of the supplement is 409 pages long. The new plates comprise twelve color paintings and eight black-and-white illustrations.

The introduction to the supplement provides the rationale for the update. The principal impetus was the increase (42.6%) of recognized taxa from 115 to 164 since 1970. Of the 49 species added, 39 were described as new from type localities in Mexico (19 species), Guatemala (8 species), Honduras (10 species), Costa Rica (1 species), and Panama (1 species). The remaining ten species are recognized as a result of taxonomic changes accruing since 1970. It is worthy to note that all of the 49 taxa are from highland habitats, indicating that prior to 1970, these areas have not been sufficiently well studied. It is interesting to consider that the 39 new taxa were described by a relatively few herpetologists, including, most notably, Jonathan A. Campbell, William E. Duellman, Larry David Wilson, James R. McCranie, and Joseph R. Mendelson.

The second section summarizes Middle American geohistory. Given the tremendous impact research into plate tectonics during the past three decades has had on our understanding of the geological changes that have occurred in Middle America, any attempt to understand the evolutionary history of hylid frogs has to be founded on these geological advances. Duellman's discussion is based in large part on a similar one in Campbell's (1999) influential paper. This section culminates in a discussion of the modern Middle American landscape, in which 23 ecogeographic regions are presented.

While acknowledging that the higher-level classification of the neobatrachian frogs is unresolved, in the section on the evolution of the hylid frogs, Duellman uses a suite of 24 characters to create a trio of equally parsimonious trees that support recognition of a clade of three neobatrachian families, Allophrynidae, Centrolenidae, and Hylidae (with the last reducing the Pseudidae to a subfamily). Which of the families Allophrynidae or Centrolenidae comprises the sister taxon of the Hylidae is unresolved, due to the lack of pertinent data on three characters for the Allophrynidae. Nonetheless, with the inclusion of the pseudid frogs, the Hylidae appears to be a monophyletic taxon. Duellman recognizes five subfamilies (Pelodryadinae, Phyllomedusinae, Hemiphractinae, Pseudinae, and Hylinae) within the Hylidae for which taxa he provides a classification. The Phyllomedusinae (genera *Agalychnis* and *Phyllomedusa*), Hemiphractinae (genera *Gastrotheca* and *Hemiphractus*), and Hylinae (genera *Anotheca, Duellmanohyla, Hyla, Phrynohyas, Plectrohyla, Ptychohyla, Scinax,* and *Smilisca*) have members occurring in Middle America. Duellman indicates that *Hyla*, with 318 species, is both paraphyletic and polyphyletic; thus, it stands as a major impediment to clarifying our understanding of the evolution of hyline anurans. Nevertheless, Duellman devotes the next 11 or so pages to a discussion of the evolutionary history of hylid frogs, with most emphasis placed on those of Mesoamerica. This discussion is based on his own work (Duellman, 1979) and that of Jay Savage (1966, 1983). The conclusion of greatest interest and import to Duellman's discussion is that evidence was presented in the earlier works for recognition of an autochthonous Middle American herpetofauna arising from a series of vicariance and dispersal events. Savage's views have recently been updated in his monumental book on the herpetofauna of Costa Rica (Savage, 2002). Duellman divides his story into six chapters, as follows: (1) the movement of hyline and phyllomedusine stocks into Middle America from South America; (2) differentiation of North American and Middle American basal lineages; (3) dispersal of several montane lineages in the Mexican, Nuclear Central American, and Isthmian highlands, most containing stream-breeders; (4) vicariance of the generalized North American lineages caused by increasing aridity in southwestern North America; (5) differentiation of the Middle American basal lineage into lower Central American and Mexican-Nuclear Central American lineages early in the Cenozoic; (6) past the closure of the Panamanian Portal in the mid-Pliocene, dispersal of hylid frogs to a considerable extent northward and a more limited extent southward, related to the comparatively larger number of hylid species in northwestern South America than in lower Central America. In his discussion of the events of the fifth chapter, Duellman states (p. 781) that, "As the Isthmian Highlands rose in the Miocene and Pliocene, a vicariance of the Lower Central American lowland lineage gave rise to an Isthmian highland lineage in the uplifted region of lower Central America. This lineage differentiated into *Ptychohyla* and the *Hyla pictipes* and *H. pseudopuma* groups." The idea of a Lower Central American origin of the Mexican and Central American highland genus *Ptychohyla* seems curious, until one realizes that a single species (*Hyla legleri* auctorum) placed in this putative genus by Campbell and Smith (1992) and Duellman (in the book under review) occurs in Costa Rica and extreme western Panama. Although Savage (2002) recognizes the Campbell and Smith (1992) genus *Duellmanohyla*, he stated, "The transfer of *Hyla legleri* to *Ptychohyla* seems to be on less secure ground, and here it is retained in *Hyla*." The unlikelihood of Duellman's postulate of a lower Central American origin for *Ptychohyla* is further strengthened by his statement (on p. 783) that, "Three lineages of stream-breeding hylines (*Duellmanohyla, Ptychohyla,* and *Plectrohyla*) had independent histories in Nuclear Central America," and yet further by the statement, "An early southward dispersal of the basal lineage of *Ptychohyla* resulted in the isolation of a population (*P. legleri*) in the Isthmian Highlands and *P. salvadorensis* in Nuclear Central America…." Another distinction between the book under review and Savage's (2002) work is in the composition of the Hyla *pictipes* group of Lower Central America. Duellman places 11 species in this group, including *Hyla insolita* of Honduras and *Hyla throrectes* found in the Mexican Highlands. His *pictipes* group represents a combination of the former *Hyla lancasteri, pictipes, rivularis*, and *zeteki* groups. Savage (2002), on the other hand, recognizes three of the four groups Duellman placed in his *pictipes* group, viz., *lancasteri, pictipes* (plus *rivularis* group), and *zeteki* groups. Even at the group level within the troublesome *Hyla*, there are major differences in systematic opinion from one worker to the next, which means that explanations of hyline evolution are similarly rickety.

The fourth section deals with distribution and diversity of Mesoamerican hylids. Duellman discusses the patterns of distribution within 23 ecogeographic regions, as well as elevational distribution, and hylid frog communities. Duellman notes an interesting correlation between geographic distributional patterns and reproductive mode, with 90 of 124 species of highland frogs being stream-breeders and 31 of 35 species of lowland frogs being pond breeders. Expectedly, ponds are more common in lowland than in highland areas. The figure just cited for species of lowland frogs (35) does not agree with the number given in the first sentence of the following topic, which is 52 (and that number is also incorrect, according to the data in Appendix 4, in which 53 species are indicated to occur in the lowlands). Of these 53 species, most belong to the Middle American element, a somewhat smaller number to the South American element, and a small number to the North American element. Duellman concludes that in the lowlands there is a general increase in species richness from higher to lower latitudes. Of the 124 species in the highlands, the large majority is in the Middle American element, with comparatively very small numbers in both the North American and South American elements. Of the 111 Middle American element species, all but two are endemic to Middle America. In the Mexican highlands and Mexican Plateau, as evidenced by one of the diagrammatic representations found in this topic area, the largest number of species and the greatest degree of endemism are found in the Sierra

Madre Oriental, followed by the figures for the Sierra Madre del Sur. Within Middle America, the greatest species richness and degree of endemism are found in the Nuclear Central American Highlands, followed by the Isthmian Highlands. These two areas are highly distinct from one another (they share only a single species) and from the areas both to the north and to the south, further emphasizing Middle America as a center of hylid evolution and endemism. With respect to elevational distribution, Duellman concludes (p. 797) "...the number of species increases from the lowlands to elevations between 500 and 2000 meters and then declines rapidly at higher elevations...." He further notes that, "Elevational distribution seems to be most closely correlated with suitable sites for tadpole development," with most ponds, and therefore, most pond-breeding species being found in the lowlands, and small, clear-water streams, and, consequently, stream-breeding species occurring in the highlands. The final portion of this section deals with hylid frog communities, with Duellman pointing out that local anuran communities are well documented at only a few localities in Mesoamerica. Duellman assembled data on hylid communities at 36 sites in Middle America concerning habitat type and reproductive mode. Species richness is expectedly lower in the drier sites, i.e., 4–7 species in dry forest and 4 and 6 in two coniferous forest sites, and higher in more humid sites, i.e., 5–12 in tropical rainforest and 5–11 in cloud forest.

The fifth section is concerned with biogeographic comparisons with other taxonomic groups, including amphibians in general, the genus *Eleutherodactylus*, and bolitoglossine salamanders. After noting (p. 803), "Generalized comparisons with other taxonomic groups of Middle American biota for the most part are comparable with the proposed evolutionary history of Middle American hylid frogs," Duellman discusses biogeographic patterns among amphibians and confirms that Middle America has been an important center of evolution and radiation for these creatures and that various amphibian groups other than hylid frogs have been affected in similar ways by the major geophysical events discussed above. The huge genus *Eleutherodactylus*, the most speciose of vertebrate genera, has been divided into five subgenera, three of which have representatives in Middle America. Duellman notes that the scenario accounting for the presence of these three subgenera is hampered by the counterintuitive sister-group relationship proposed by Haas and Hedges (1991) and Hedges (1996) between the Mesoamerican subgenus *Syrrhophus* and the West Indian subgenus *Euhyas*. The other elements of the scenario involve a Late Cretaceous-Eocene dispersal from South America of the lineage that gave rise to the members of the subgenus *Craugastor*, followed by a post mid-Pliocene dispersal from South America of lineages of the subgenus *Eleutherodactylus*. Duellman notes that diversity of *Eleutherodactylus* is greatest in the highlands of Middle America; within this region, the greatest species richness and degree of endemism occur in the Nuclear Central American Highlands and the Isthmian Highlands. The Middle American bolitoglossine salamanders represent a clade derived from northern stocks, unlike the history of *Eleutherodactylus*. All but two of the bolitoglossine genera (*Bolitoglossa* and *Oedipina*) are endemic to Middle America, with the two exceptions occurring to some extent in South America (*Bolitoglossa* contains 20 endemic South America species). Duellman indicates that the three major Middle American highland areas are the centers of radiation for this group of salamanders. The greatest numbers of species and degree of endemism occur in the Sierra Madre Oriental, Sierra Madre del Sur, Nuclear Central American Highlands, and the Isthmian Highlands. These four areas are remarkably distinct from one another in species composition, sharing no more than one species between pairs of areas.

The sixth section on conservation is a small one, covering two major topics, protected areas and declining amphibian populations. Anyone who has worked in Middle America for a lengthy span of time has witnessed a hugely disconcerting loss of habitat, primarily due to deforestation to make way for croplands and pasturelands for the support of uncontrolled human population growth. Duellman notes the seemingly large number of protected areas in Mexico (117) and Central America (about 140). Although such a large number of protected areas looks good on paper, these areas are oftentimes subjected to varying degrees of human disturbance, in turn due to pressure exerted by burgeoning human populations. Furthermore, the biota found in these areas is often poorly known. These concerns are receiving increasing attention by herpetologists and conservationists (references in Duellman's book and Wilson et al. 2001). Duellman also briefly discusses the problem of declining amphibian populations, formal notice of which took place at the First World Congress of Herpetology in 1989. Duellman reviews the various postulated causes of this decline, paying greatest attention to the influence of chytrid fungal infections, which degrade keratinous tissue. He postulates that these infections could eventually affect about 85 percent of the Middle American hylid species and possibly eliminate about 65 percent of the Middle American hylid faunal element, "... including essentially all of the montane radiations ..." (p. 817). Such disappearances should be expected to reverberate through highland food webs, being especially devastating to batrachophagous predators.

Future research is discussed in the seventh section. Duellman indicates that not all Middle American hylid species have been discovered. For example, work in southern Mexico is adding to our knowledge of the hylid fauna there (e.g., Canseco-Márquez et al. 2002). Some species may be composites and require future segregation. Tadpoles remain to be described for several species. Some morphological characters have been poorly studied and molecular data are nearly completely unavailable for Middle American hylids. Its unavailability in hylid frogs strikes an especially poignant note in light of the population declines documented in the previous sections, inasmuch as molecular data are most easily gathered from living examples. We may simply be too late for some of this kind of work, as Duellman indicates. In addition, other aspects of the biology of hylid frogs are noted to be poorly understood, especially ecophysiology and ethology. Duellman expresses his hope that his dreams for the use of available biological stations to conduct future work on the biology of hylid frogs will not be dashed by continued anthropogenic destruction and declining amphibian populations.

The eighth section contains the tables and dichotomous keys intended for identification of Middle American hylids. A four-page table provides an update of the diagnostic features of Middle American hylid tadpoles described since 1970. This table complements a similar one in the 1970 work. The dichotomous keys to adults are new and complete, organized into sections dealing with species from northwest of the Isthmus of Tehuantepec, from

the Isthmus of Tehuantepec through Nicaragua, and from Costa Rica and Panama.

As expected, the largest portion of the supplement is the ninth section, which presents the generic and species accounts. Some species groups are also considered. Treatments of the hylid genera range from no new information (*Hyla*) to extensive summarizations (*Agalychnis, Duellmanohyla, Plectrohyla, Ptychohyla*, and *Smilisca*), including cladistic analyses generating cladograms. None of the cladograms presented for these five genera are fully resolved, pointing to the need for analyses using additional characters suites not traditionally considered. Duellman also discusses several species groups within *Hyla*, including the *albomarginata, bistincta, boans, bogotensis, bromeliacia, eximia, godmani, leucophyllata, microcephala, miliaria, miotympanum, mixomaculata, parviceps, pictipes, pseudopuma, sumichrasti*, and *taeniopus* groups. Cladograms are presented for several of these groups, with only the ones for the *bistincta* and *miotympanum* groups being full resolved. Of considerable interest is the relationship between the *Hyla bistincta* group and the genus *Plectrohyla*. Duellman postulates that these two groups comprise a clade defined by four synapomorphies (his Fig. 432). These two groups are allopatric, distributed to the west and east of the Isthmus of Tehuantepec, respectively. His new analysis supports the contention of Duellman and Campbell (1992) that the *Hyla bistincta* group is the closest relative of *Plectrohyla*, which renders the genus *Hyla* paraphyletic. In the case of species-level taxa, accounts are most complete, of course, for species described since 1970. The first such full-fledged account is that for *Hyla graceae*. It is exemplary of other such accounts and contains sections on synonymy, diagnosis, description of adult, description of tadpole, mating call, natural history, remarks, etymology, and distribution, the same categories used in species accounts in Duellman's 1970 work. Several updated distribution maps pepper this section, as well as illustrations of tadpoles and their mouthparts, ventral hand (or thumb) and foot surfaces, and audiospectrograms. A number of tables are distributed among the accounts, including the character matrices that support the cladograms. In general, these accounts represent a masterful synthesis of a huge amount of information that has accumulated in the last three decades.

The Literature Cited section for the supplement contains 450 references, with an up-to-the-minute coverage indicated by several inclusions with 2001 publication dates. This section, along with the citations to this literature in the text, will allow any interested person to follow the history of the changes that have occurred in our knowledge of Middle American hylids from 1970 to 2001.

Four appendices are attached to the end of the text of the book. Appendix 3 is a compilation of data on distribution of hylid frogs, *Eleutherodactylus*, and bolitoglossine salamanders among the 23 ecogeographic regions of Middle America and occupies 15 pages. Appendix 4 is a listing of data on elevational distribution, habitat type, oviposition site, and tadpole site for all Middle American hylids. Appendix 5 is an extremely valuable 27-page listing of locality records and the museum of location of the voucher specimens, which supplements Appendix 1 from the 1970 work. This information will allow any interested workers to locate specimens for their own research. Appendix 6 provides locality data and specimen numbers for the illustrations on the new plates.

The index covers the text of both the original 1970 work and the supplement. It also references the plates in both treatments, all of which follow this section.

The plates comprise the last section of this two-volume work. The 72 plates from the original work are placed here and are followed by twelve color plates and eight black-and-white plates. The new plates are also the work of the superb herpetological artist David M. Dennis. The twelve color plates contain 50 paintings of adults of 42 species and the black-and-white plates comprise 26 paintings of adults of five species, hands and feet of one species, tadpoles of twelve species, and tadpole mouthparts of seven species. These illustrations will be a major attractant to potential purchasers of this book.

The major question I believe that will occur to those who have depended in the past on the 1970 work is whether it might have been preferable for Duellman to have crafted a full-scale revision of his classic work, instead of producing an update and publishing it as a supplement to the original work. This might especially occur to those people who have a copy of the original work for which they paid $25 dollars for a new copy. Sixty-five percent of the pages and 78 percent of the plates in the book under review were in the original. In essence, people who have both works paid $100 for 35 percent of the pages and 22 percent of the plates in the new book. Incidentally, this is not the first time Duellman has produced an update of this type, although in that work (Duellman 1993) he was updating the work of another person (Frost 1985) and Duellman's supplement was not attached to a reprinting of Frost's work. I think the answer to this question is that it definitely will hurt the pocketbooks of those who have the original work, but given the design of the new book, there is no alternative to its purchase, if the purchaser is interested in the hylid frogs of Middle America.

The book will have more obvious appeal to those who do not have a copy of the original or did not care to shell out $300 for a used copy from a book dealer. From the perspective of these people, the new book is a bargain at $125, especially as it is updated to the year 2001. Younger people similarly interested in Middle American hylids also will have to have this book. In sum total, Kraig Adler and William Duellman have cleverly crafted a book that will have to be on the wish list of any herpetologist, young or old, working in Middle America, not to mention the Caribbean and South America.

The reading I did of this book for this review illustrates that the supplement is practically free of errors. I noted only one minor concern. On page 817, Duellman writes, "Many conservationists decry collecting and uniformed bureaucrats often make obtaining collecting permits a costly and time-consuming process, while habitat destruction continues unabated." He meant to write "uninformed bureaucrats," although I am not entirely sure the phrase doesn't work the way it was printed.

The 1970 work was branded "... the Hope diamond of technical herpetological literature" in the review by Hobart M. Smith (1971: 379). It is clear that Duellman, with this supplement, has excavated another diamond, perhaps not of the size and brilliance of the Hope diamond, but still a jewel of distinction. This work is characterized by the high quality Bill Duellman brings to his herpetological work, with the result that the supplement is a rich storehouse of valuable insights into the nature of the Middle American hylid fauna that will be giving up its stores for decades to come. Bill Duellman's

career to date has been a fascinating one to follow, from the days when he counted snake scales to the present day when he is a reigning world authority on the systematics of hylid frogs and amphibians in general.

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Erratum

In the paper by Dowling and Pinou (2003, 34:20–23), Table 1 was inadvertently omitted. A corrected version of the paper is available as a downloadable PDF file from:

<http://pantheon.yale.edu/~tp36/correctedarticle.pdf>

Herpetological Review, 2003, 34(2), 180–181.

The New Encyclopedia of Reptiles and Amphibians, edited by Tim Halliday and Kraig Adler. 2002. Oxford University Press, Oxford, UK. ISBN 0-19-852507-9. £30. 240 pp. Hardcover. North American edition: Firefly Books, Ltd. 3680 Victoria Park Avenue, Toronto, Ontario M2H 3K1, Canada (www.fireflybooks.com). US$40.00. ISBN 1-55297-613-0.

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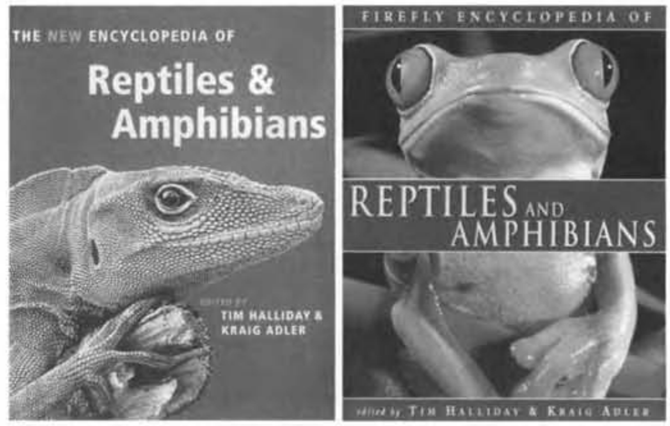

The *New Encyclopedia* is a revision of the popular 1986 original published in the Facts on File Animal Series in North America. The new edition is 100 pages longer than the original and, in line with technology now available, is more profusely and elegantly illustrated with spectacular color photographs. Textual material was prepared by 37 pre-eminent herpetologists, primarily from the UK and USA, 19 of whom contributed to the first edition. The authorship of each section is indicated by the contributor's initials at the end of each covered topic. The first edition was translated into 18 languages and new editions in these languages will be issued over the next several years.

Strictly speaking this is not an encyclopedia as the organization is not by an alphabetical treatment of topics. Rather, the book, as well as its predecessor, is organized along evolutionary lines with each group of amphibians and reptiles covered in order from presumed primitive to advanced taxa.

Major articles introduce amphibians (pp. 10–36) and reptiles (pp. 98–117), present sections on classification and taxonomy, evolutionary history, and a spectrum of information on physiology, ecology, and biology. These articles are followed by main entries on the major groups of living amphibians (the usual three) and reptiles (6), including amphisbaenians as a separate group. These are each introduced by a boxed "Factfile" summarizing composition, distribution, habitats, size, coloration, longevity, and conservation status. The Factfile also contains scale drawings of size ranges found in the group compared to a 1.8 m human being.

The main text gives general coverage on the form and biology of its members with emphasis on unusual or unique features. This is followed by a section on each recognized family within multi-family groups (except in the case of caecilians, worm-lizards and

crocodilians) dealing with important taxa and interesting facets of their biology. At the conclusion of the entries for salamanders and newts, frogs and toads, turtles and tortoises, lizards, and snakes summaries on the families within each group are presented in tabular form. Each table includes brief sections on composition (numbers of genera and species), distribution, example taxa, size, color, and conservation status. Additional sections on breeding (i.e., reproduction) for amphibian families, diet and eggs for turtle families, and scales for lizard and snake families, are also featured. A small colored distribution map is provided for each family. While a bit of this material is redundant to what is included in the main text on each major group, it makes for ready reference and comparison among families.

The new edition has expanded its coverage of interesting aspects of the life of amphibians and reptiles that have broader implications to biology as a whole. This is done in a series of double-page Special Features scattered throughout the text. Revised sections from the original, now Special Features, are: A Key Amphibian Event; Kaleidoscopic Adaptation; Conscientious Parents; Courtship and Mating in Salamanders and Newts; Repellent Defenders; Leaps and Bounds; Decoding the Frog Chorus; The Age of Reptiles; Temperature Control in Reptiles; Venomous Snakes. New Special Features are: Classification and Taxonomy; Amphibian Population Decline; Amphibian Conservation; Swimming, Eating and Growing Machines; From Tadpole to Frogs; Reptiles at Risk; Play in Reptiles; Pre-ejaculators, Sneakers, and She-males; Temperature and Sex; The Asian Turtle Crisis; Natural Desert Dwellers; The Threat from Snakebites; Pollution and Hormone Mimics; and Unisexuality: the Redundant Male. Two "Photo Stories" on Leatherbacks: Birth on the Beach and Harvesting Snake Venom, are other new features.

The book is enhanced on nearly every page by color photographs of amphibians and reptiles in nature. Many are from the first edition but a substantial number are brand-new. The impact of these is extremely effective because of the large format (29 x 23 cm). Fifteen splendid artwork panels, mostly by David Dennis, grace this book. Many are from the first edition but improved by advances in printing technology and paper quality over the original reproductions. Some individual portraits of species have been dropped and several additional taxa have been added, especially to enhance the charm of the preliminary material on pp. 4–7. The illustrations of fossil forms is reduced and mostly replaced by new ones. Frankly, I liked the ones from the first edition better. Numerous line drawings provide additional information.

This is truly a wonderful introduction to the world of amphibians and reptiles and lives up to its dust jacket superlatives of spectacular photography, authoritative, and up-to-date. It is a fine resource for anyone interested in herpetology in the broadest sense. It will also be useful as a supplement to courses in herpetology given at the upper division or graduate level but lacks the necessary technical consideration of systematic characteristics to be used as a stand-alone text.

I come from the generation of herpetologists who, fascinated by amphibians and reptiles while growing up, cut their herpetological teeth on books by Raymond L. Ditmars (I bought my first one when I was 12) and Mary C. Dickerson's *The Frog Book*. No one then could imagine the quality and quantity of resources available to an aspiring member of our discipline today. The Halliday and Adler work, the comparable encyclopedia of Cogger and Zweifel (1998) and the textbooks by Pough et al. (2001) and Zug et al. (2001), all are now available to stimulate and educate the beginning and more advanced student in the quest to understand our favorite creatures. I strongly recommend that the *New Encyclopedia* join the other three on the shelves or desks of anyone seriously interested in amphibians and reptiles. It is a fine reference source and its visual images are aesthetic delights that will be returned to many times.

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Herpetological Review, 2003, 34(2), 181–182.

Life-Histories of the Frogs of the Okefinokee Swamp, North American Salientia (Anura) No. 2. 2002. Cornell University Press, Ithaca, New York. xxi + 509 pp. Hardcover. ISBN 0801440467. US $49.95.

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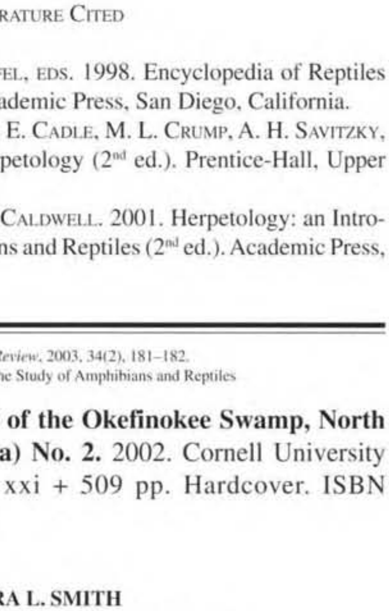

I was pleased to hear that Cornell University Press intended to reprint Wright's *Life-Histories of the Frogs of the Okefinokee Swamp*. I am fortunate to have an original copy of the book and it is truly one of the most useful references on my shelf. As such, it is appropriate that this still-valuable reference be made readily available to researchers and students alike. The Okefenokee Swamp is one of the most significant wetlands in the world and Wright's book is unparalleled in terms of its detailed information on the life-histories of frogs of the region. The hardcover edition is affordable and with just a few minor alterations in layout the book is essentially identical to the original. The new edition is enhanced by a Foreword and Afterword written by J. Whitfield Gibbons, outlining the justification for reprinting the book after nearly 80 years and summarizing the current state of our knowledge of the swamp and its amphibians.

In the Foreword, Gibbons outlines the history of the Cornell expeditions, associated publications and the subsequent scientific careers of those involved in the early expeditions, including Sherman Bishop, Alvin Cahn, and Francis Harper. He also provides an overview of the geologic and land use history of the swamp, pointing out that the swamp is not pristine, having been logged and subject to drainage alterations prior to President Franklin D. Roosevelt's designation of the swamp as a National Wildlife Refuge in 1937. Even after this designation, in the 1960s an impoundment structure (the Suwannee River Sill) was built to retain water within the swamp in an attempt to prevent the spread of wild fires to surrounding private timberlands. In 1974, more than 350,000 ac of the Refuge were designated as a National Wilderness Area, which limits invasive activities such as the use of high powered motor craft in the Refuge.

The body of the book includes the original preface, introduction, acknowledgments, a review of previous and subsequent expeditions to the region, a description of the plant communities of the swamp, followed by a general discussion of the Okefinokee Salientia. The "general" discussion includes everything from the geographic range and habits of 22 species of anurans, to the specifics of larval development, a breadth that is rarely attempted in recent works. This section includes details on morphology of various species at different developmental stages, dichotomous keys to anuran eggs and larvae, as well as lists of subjects for which only incomplete information was available at the time. The accounts of species follow; these include common names, range (including local Okefenokee records), and extensive life history information. For each species, Wright provides a chronologic review of the literature on topics such as egg laying and vocalizations, followed by meticulous firsthand descriptions of these behaviors by Cornell expedition members. I find that the descriptions and photographs of eggs and larvae are particularly useful, since this level of detail is not provided in regional field guides. The quality of the illustrations and black-and-white photographs is quite good. The plates include lateral aspects of adults, examples of normal and abnormal amplexus, egg masses, larvae in different developmental stages, and illustrations of tadpole mouthparts for 25 species.

The Afterword includes an update of the nomenclature of southeastern anurans, which is little changed from Wright's accounts. Gibbons also reviews the subsequent herpetological research in the swamp, pointing out that there has been only limited research since the Cornell Expeditions. He suggests that the swamp be used as a reference site to represent "normal" conditions for anuran populations in the southeast. Having worked in the Refuge recently (2000–2001) as a biologist for the U.S. Geological Survey (USGS), I fear that this assessment of the state of the swamp may be overly optimistic. Although there are a few small stands of large cypress in the swamp interior today, impenetrable shrub thickets of invasive species which thrive in disturbed conditions—titi (*Cyrilla racemiflora*), hurrahbush (*Lyonia lucida*), and fetterbush (*Leucothoe racemosa*)—cover nearly 30% of the swamp (Loftin 1998). We found that the primarily aquatic ranids such as the pig frog (aka southern bullfrog; *Rana grylio*), bronze frog (*Rana clamitans*), and carpenter frog (*Rana virgatipes*) were still broadly distributed within the swamp (Smith 2001). However, the impact of the vegetation changes in the swamp on amphibian populations is entirely unknown. Furthermore, populations of pond-breeding amphibians such as the Florida gopher frog (*Rana capito*), striped newt (*Notophthalmus perstriatus*), and flatwoods salamander (*Ambystoma cingulatum*) may not be secure within the Refuge. Only 5% of the Refuge is upland forest (Loftin 1998) and most of the land surrounding the Refuge is intensively managed for timber. Although the pinelands in the Refuge are managed with prescribed fire (for red-cockaded woodpeckers), few areas even begin to resemble those depicted in the 1921 photograph of Siren's Run on Billy's Island (Plate XXI, No. 1). Surveys by Jensen (1995) and the USGS (Smith 2001) failed to confirm the presence of flatwoods salamanders on the Refuge and only one striped newt breeding pond has been identified in recent years (Dodd and LaClaire 1995). The pond is transected by two service roads; a sad reminder that no part of the Refuge can be considered pristine.

Finally, I had to look long and hard to find errors in the reprinted version of the book and those that I did find were very minor typographical mistakes. For example, in Plate XXIV, image 2 the word "make" appears instead of "male" and on page 479, paragraph 2 of the afterword, it should read E.D., rather than A.D. Cope. The reproductions of the original black-and-white photographs were excellent and in some cases even better than the original. The only other notable differences between the original and reprinted version is that the photo of Leonhard Stejneger that accompanied the dedication was not included, and the photographic plates were grouped in the new version rather than spread throughout the volume. In short, I found the re-issued volume to be of excellent quality.

In addition to the very detailed species accounts, Wright included a list of life history subjects for which only incomplete data were available at the time. Many of these intriguing questions remain unanswered. For example, it can be argued that we still do not fully understand the relationship in range and habitat partitioning between *Rana grylio* and *R. catesbeiana*. And we still lack knowledge about the habits of young gopher frogs (*Rana capito*). The re-issue of this valuable book might well stimulate research interest in the amphibians of the swamp.

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BOOK REVIEWS

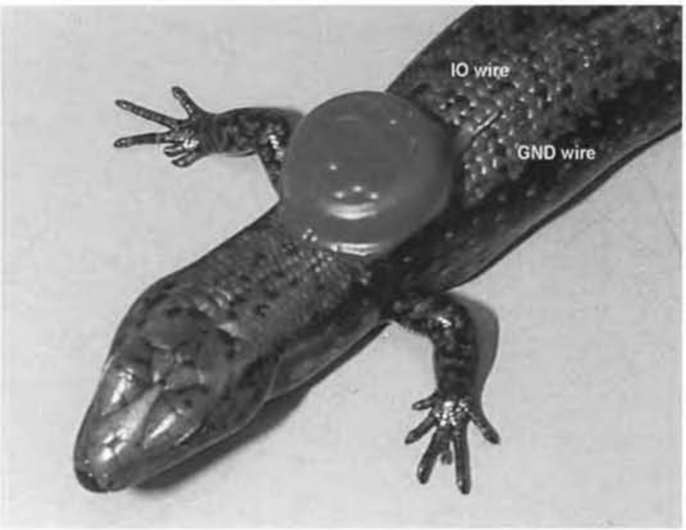

FIG. 4. A female *Eulamprus tympanum* fitted with a modified Thermochron iButton.

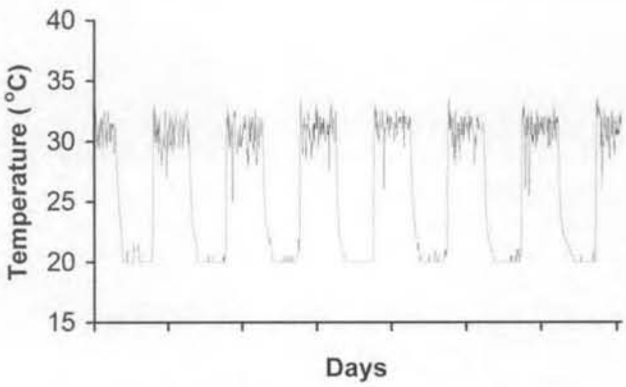

FIG. 5. Thermal profile of a captive female *Eulamprus tympanum* over one-week at a 5-minute sample rate.

clip can then be attached to the exposed IO wire on the unit. Another wire should be coiled around the outer contact of the reader with the opposite end attached to the exposed GND wire on the unit also with a small alligator clip (Fig. 3). After testing the soldered unit, it should be sealed to ensure it is watertight with Plastidip™ (Minnesota, USA) (www.PLASTIDIP.com) with the exposed ends of the IO and GND wires emerging from the Plastidip™ (Fig. 2).

We tested the modified unit on six gravid female *Eulamprus tympanum* over several weeks in laboratory enclosures. Lizards were housed individually in 620 x 400 mm enclosures with 20–30 mm depth of soil, flat rocks and leaf litter for shelter. Lizards were provided with heat from 100 W incandescent bulbs at one end of their enclosure to allow them to thermoregulate. Enclosures provided a thermal gradient of 20 to 40 ± 1°C during daylight hours and 20 ± 1° C during the night. The modified units where attached to the backs of lizards with Super Glue™ (cyanoacrylic glue) behind the head, between the shoulder blades (Fig. 4) and gave continuous measurements of temperature at 5-minute. intervals (Fig. 5). Measurements can be downloaded and units can be re-launched while the unit remains attached to the animal. The unit will detach from reptiles upon shedding or acetone can be applied to the site of attachment to remove the unit prior to shedding.

Acknowledgments.—I thank Patrick Evans from iButton support, Joerg Suckau and Basil Panayotakos from the School of Biological Sciences workshop for technical advice. Lizards were collected under scientific licence from the New South Wales National Parks and Wildlife Service (B2082) and research was approved by the University of Sydney Animal Care and Ethics Committee (L04/10-98/1/2855). The project was supported in part by an ARC Large Grant to M. B. Thompson and by an Ethel Mary Read Research Grant from the Zoological Society of New South Wales to K. A. Robert.

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NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 34, Number 1 (March 2003).

CAUDATA

AMBYSTOMA TIGRINUM (Tiger Salamander). **PREDATION**. Although a wide variety of birds have been documented or implicated as predators of *Ambystoma tigrinum* (Lannoo and Phillips, *in press*. *In* M. J. Lannoo [ed.], Status and Conservation of U.S. Amphibians. Univ. California Press, Berkeley), most of the species target aquatic larval forms. On 19 June 2001 in Taylor County, Georgia, USA, I encountered a cache of numerous animals impaled on a barbed-wire fence by loggerhead shrikes (*Lanius ludovicianus*). Herpetofauna found among the cache included several adult *Hyla squirella* and *H. cinerea*, and one post-metamorphic *A. tigrinum*. Although amphibians have been reported in the diet of loggerhead shrikes (Yosef and Grubb 1993. Condor 95:127–131), I believe this is the first reported observation of loggerhead shrikes predating a salamander.

The barbed wire fence surrounded an agricultural field that contained an isolated wetland used for breeding by a variety of amphibians, including *A. tigrinum*. At the time of the observation, the field's vegetation was low, which may have helped the shrikes see small amphibians dispersing from the wetland.

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ANEIDES VAGRANS (Wandering Salamander). **REPRODUCTION.** *Aneides vagrans*, a sibling species with *A. ferreus*, is a terrestrial forest-dwelling plethodontid salamander found on Vancouver Island (and smaller adjacent islands), British Columbia, and in northwestern California (Jackman 1998. Can. J. Zool. 76:1570–1580). There are few published descriptions of the eggs, clutch sizes, or nest sites of either species. Herein I report five *A. vagrans* egg clusters from Vancouver Island with descriptions of nest cavities, adult attendance, and hatching size.

In 1988 I found three clusters of *A. vagrans* eggs 200 m southwest of Hwy 19, 0.5 km S of Rosewall Creek, north of McNaughton Creek (49°27' N, 124°46' W). The site had been selectively logged within the last 100 years, but contained at least a few very old trees (estimated at > 200 years). Egg clusters were suspended from the roof of small cavities under the bark of Douglas-fir (*Pseudotsuga menziesii*) logs 1.0–1.5 m in diameter in a mid-to-late state of decay with partly rotted interiors and bark that could be removed easily by hand. Eggs were attached individually by gelatinous strands to a single point on the roof of the cavity and the strands from all the eggs were twisted around each other so that the eggs hung in a grape-like cluster typical of *Aneides* (Miller 1944. Copeia 1944:224–230; Storm 1947. Herpetologica 4:60–62; Canterbury and Pauley 1994. J. Herpetol. 28:431–434; Stebbins and Cohen 1995. A Natural History of Amphibians, Princeton University Press). The sex of attending adults was determined by post-mortem examination of the gonads.

The first clutch was found on 23 June 1988, and consisted of nine eggs in a cavity 140 mm wide, 70 mm high, and 35 mm deep. The nearly spherical, smooth, cream-colored eggs each measured 5.6 mm across the horizontal diameter. An adult female *A. vagrans* (SVL: 69.6 mm; BM: 5.6 g) was in the cavity with the eggs. The eggs were brought back to the laboratory and embryos could be seen developing within them, but by 8 July 1988, the eggs were infected by fungi (as evidenced by hyphae), and presumed dead.

The second clutch was found on 29 June 1988 and consisted of 14 eggs, The eggs were similar in size (5.5 mm across the horizontal diameter), shape and appearance to the first clutch. Also, the cavity was similar in size and shape to the cavity described above. Two adult salamanders of undetermined sex (SVL: 63.0 mm, 55.7 mm; BM: 4.9 g, 3.5 g) were found under bark within 20 cm of the eggs on opposite sides of the nesting cavity.

The third clutch was found on 23Aug 1988, and consisted of 3 eggs. An adult female *A. vagrans* (SVL: 62.3 mm; BM: 3.0 g) was in the cavity (width, 120 mm; height, 31 mm; depth, 24 mm) with the eggs. The eggs measured 6.2 mm across the horizontal diameter and 7.4 mm across the vertical diameter. The salamander and eggs were brought back to the laboratory, but after two days, one of the eggs had disappeared, apparently having been eaten by the salamander. I removed the adult and kept the two remaining eggs moist, but not wet. By the end of September, the eggs were dark brown and wrinkled on the surface, but there was no evidence of fungal hyphae. Between 2 and 10 October 1988 both eggs hatched. I fed the hatchlings (SVL: 15.7 mm, 15.3 mm; total length: 24.3 mm, 23.4 mm; BM: 0.093 g, 0.089 g) wingless *Drosophila* for several months, but the salamanders were dead, for no obvious reason, by 16 Feb 1989.

On 7 Sept. 1998, two clusters were found by R. Hyatt on Thetis Island, British Columbia (49°00'N, 123°40'W) and brought to me the following day. These clusters were in a 0.7 m diameter Douglas-fir log that had been felled about 18 months earlier and was mostly solid. The clusters were 12 cm apart within a hollow section of the log, 10–40 cm from one end of the log, and ca. 25 cm below the surface. Hatchlings were emerging from the egg capsules. One cluster had 15 unhatched eggs and 13 empty egg capsules, and the other cluster had 1 unhatched egg and 11 empty egg capsules. Thus, the clutch sizes were 28 and 12. The mean body mass of 23 hatchlings, measured ten days after hatching was 0.09823 g, SD = 0.0096, range 0.0763–0.1135 g. SVL and total length were measured with vernier calipers, but because the animals were difficult to restrain, only approximate measurements of the total length are reported here. Mean SVL was 14.3 mm, SD = 0.27, range 14.5–13.0 mm, and total length was about 25 mm. Hatchling coloration and total length were similar to that reported by Storm (1947, *op. cit.*) for seven *A. ferreus* hatchlings in Oregon.

Some of this work was done in partial fulfillment for the requirements of an M.Sc. degree at the University of Victoria, Victoria, British Columbia, Canada. The egg clusters from Thetis Island were found by Richard Hyatt, collected by Jeannine Caldbeck, and the number of eggs in each clutch was counted by Kristiina Ovaska and me. Kristiina Ovaska and Patrick Gregory offered helpful comments on an earlier manuscript.

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NOTOPHTHALMUS VIRIDESCENS LOUISIANENSIS (Central Newt). **BRANCHIATE ADULT.** The life cycle of *Notophthalmus viridescens* has been described previously by many authors, but only a few branchiate adults (those possessing retained gills) have been reported. We collected 17 *N. viridescens louisianensis* from a small partly wooded, man-made pond on 26 Jan 2002. This pond was located ca. 0.4 km E of Taylor Road within T20N R3W Sec 4, Randolph County, Arkansas. Upon examination we discovered one branchiate adult that appeared in every other respect to be an adult aquatic form. The individual possessed external gills, gill slits, and free opercular folds. This observation appears to be the first recorded instance of this morphology from Arkansas. The locality where this individual was collected has been subjected to a multi-year drought that undoubtedly spanned the lives of the branchiate individual, its parents, and possibly the grandparents. The pond is permanent and fishless. These combined attributes may have induced the expression of branchiate phenotypes within this Ozark population, since this

morphotype had not been discovered during previous visits to the site. It will be interesting to monitor the occurrence of branchiate individuals in this population to investigate the ecological triggers causing expression of this trait.

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PLETHODON IDAHOENSIS (Coeur d'Alene Salamander). **COLORATION.** We are reporting an unusual melanistic adult (4.1 cm SVL) found 24 miles NNE of Libby, Lincoln County, Montana, USA, T34N R29W Sec 11, on 9 May 1988. Normal coloration for *Plethodon idahoensis* includes a pale gular patch and yellow dorsal stripe extending from the head through the tail. Sides, venter, and limbs are typically black with gray or white flecking (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Inst. Press, Washington, D.C. 586 pp.). This individual lacked a gular patch and from head to mid-body, the dorsum was largely black with white flecks. Several yellow patches occurred on the dorsal thorax. The salamander was photographed and released.

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ANURA

AGALYCHNIS CRASPEDOPUS (Amazon Leaf Frog). **REPRODUCTION.** Few observations of the reproductive biology of *Agalychnis craspedopus* have been reported. One study reported that eggs were observed to have been deposited above water-filled cavities in hollow logs that were ca. 1.0 m and 1.8 m above the ground. Eggs have also been found in muddy pools on bare ground in undisturbed primary forest of Amazonian Peru. (Hoogmoed and Cadle 1991. Zoologische Mededelingen 65:129–142). However, these frogs have not been reported to use water cavities in standing plank tree buttresses. Herein we report two such instances from the Departamento de Madre de Dios, Peru (specific locality available from ERW). This also represents the easternmost record for the genus *Agalychnis*.

On 29 December 2000 between 1630 and 1830 h, large, dark blue, almost black, tadpoles were observed swimming in a pool in a plank buttress of a "Mashinga" tree (Moraceae: *Ficus* sp.; 7.147 m DBH) in seasonally inundated forest (Tree #1). The pool was ca. 0.5 m deep with a water temperature of 27°C (Pool 1A). A sample of seven tadpoles was removed for identification and released several days later back into the pool. A second smaller (0.1 m deep) pool (Pool 1B) with similar appearing tadpoles was also discovered in the same buttress; it was not clear if the two pools were connected. Six clutches of eggs at varying stages of development were observed at Tree #1. One clutch was on the buttress itself overhanging Pool 1B; the others were overhanging Pool 1A. Four of the clutches at Pool 1A were stuck to the side of the buttress about 20 mm above the water surface. These clutches were at different stages of development and had approximately 14–20 eggs each. The other clutch was on a leaf of a vine growing on the branches of Tree #1, hanging 2.5 m above and directly over Pool 1A. At 1500 h on 31 December 2000, an adult male *Agalychnis craspedopus* (SVL 61.5 mm; 12.0 g) was observed on the tree buttress 0.5 m above Pool 1A, into which it jumped. This specimen was captured, photographed, preserved, and deposited in the Museo de Historia Natural of the Universidad Nacional Mayor de San Marcos, Lima, Peru (MHNSM 18537). The site was visited again on 1 January, 2002, at which time the clutch on the leaf above Pool 1A was gone and the four nests on the buttress around Pool 1A looked as if some had hatched, and the more developmentally advanced eggs had a yellow-green slimy growth. The clutch over Pool 1B was still present. Grunt calls, presumed to be those of *A. craspedopus*, were recorded later that evening (2100–2200 h: ERWA 1 365–421). On 4 January 2002, water in the pools had dropped and only the clutch above Pool 1B remained; a few

FIG. 1. The locations of five *Agalychnis craspedopus* clutches around a blank buttress pool of Tree 2.

grunt calls were heard. Between 2218 and 2313 h on 5 January, 2002, a second adult male of *A. craspedopus* (SVL 54.8 mm, 9.81 g) was calling 3–4 m above ground on a tree branch approximately 5 m south of Tree #1; at least three other males were heard. During 2100–2330 h on 6 January 2002, we returned to release the specimen and heard 3 or 4 *A. craspedopus* calling from high-up in the canopy. A snake (Colubridae, *Leptodeira*) was crawling down the vine and leaf where originally an egg clutch had been 2.5 m above Pool 1A.

Grunt calls presumed to be *A. craspedopus* were heard at another site in terra firma forest on 8 January 2001. This site was visited after 1400 h on 9 January 2001, and a another large "Mashinga" tree (Moraceae: *Ficus* sp.) (Tree 2) was found that contained a 23.5 cm deep pool, 0.5 m above the ground in the plank buttress. Tadpoles were present in the pool and five egg clutches were on the buttress and vegetation around the pool. The number of eggs and distance from the pool for each of these clutches are: 2 eggs, 1.26 m; 15 eggs, 1.94 m; 14 eggs, 1.63 m; 16 eggs, 0.33 m; and 7 eggs, 0.59 m. Grunt calls were heard on a return visit that evening.

These observations are the first to describe *A. craspedopus* using pools in tree buttresses for reproduction. Furthermore, the observations add significantly to the little that is known about the reproduction of this species.

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BUFO FOWLERI (Fowler's Toad) and ***MALACLEMYS TERRAPIN TERRAPIN*** (Northern Diamondback Terrapin). **REFUGIA and NESTING.** In the context of a nesting and hatchling study of the diamondback terrapin during summer 2000 and 2001 in Bayville, New York, we recorded multiple observations of the use of terrapin nest excavations by the Fowler's toad. Our study site is a 1-ha flat, sandy plot adjacent to an estuarine marsh of Oyster Bay, on the north shore of Long Island.

In our study site, female terrapins frequently begin an excavation and abandon it before it is complete, moving several meters to another location. Such excavations, typically 5–10 cm deep, which we have termed "test holes," are common in our study site.

Once the female completes an acceptable nest, it is cylindrical, about 11–20 cm deep, and the egg chamber usually measures 4–10 cm diam (Montevecchi and Burger 1975. Amer. Midl. Nat. 94:166–178). In our study site, when the hatchlings emerge from the nest they often leave a conspicuous oval-shaped emergence hole, which is ca. 3–5 cm across at the surface and extends ca. 4–12 cm deep (Bossert and Draud, unpubl. data). Approximately 25% of the terrapin nests were predated by raccoons in our study site. This predatory action left a hole that was slightly larger in diameter than, and as deep as, the original egg chamber.

During September 2000 we examined 58 emergence holes and found Fowler's toads residing in 3 (5.2%). During June 2001 we examined 28 test holes and found 2 Fowler's toads (7.1%). In addition, we examined 20 raccoon-predated terrapin nests, and found 1 toad (5%). During September 2001, we examined 63 emergence holes and recorded 5 more resident toads (7.9%). Thus, over the two-season period, 6.5% of the 169 terrapin excavations examined had toads residing in them. Over the same two-season period, seven other toad observations were recorded in the study site (e.g., under various objects or hopping along the ground).

The Fowler's toads found residing in terrapin excavations ranged from 42–63 mm SVL. It is unknown if all 11 occasions were different toads, but from the locations, times, and sizes we believe that they were. In each case, a solitary toad was buried in the soft sandy soil at the bottom of the nest, head facing up. Our data do not allow us to comment specifically on the length of time the toads spent within the terrapin excavations, but in 2001, 2 of the 8 observed toads remained in the same excavation for at least 3 days. Since nest density is high in our study site (mean density = 2.22 nests /100 m^2), it is entirely possible that they would use several different excavations within their home range, which has been conservatively reported to range between 100 and 1000 m^2 (Clarke 1974. Amer. Midl. Nat. 92:257–274).

Bufo use various naturally occurring depressions for water conservation, crypsis, and thermoregulation, and Fowler's toads have been reported to use small mammal burrows (Clarke 1974, *op.cit.*), but to our knowledge this is the first published report of their use of turtle excavations. Fowler's toads are thought to dig into loose sand to hibernate and typically are not active at the surface after late September in our study area. Given our discovery of toads buried in terrapin excavations in late September (latest observation was 25 Sept 2001) we believe it is likely that in addition to using the excavations as refugia, they may also use them for hibernacula. Fowler's toads have also been observed in empty terrapin nests in Wellfleet, Massachusetts (Don Lewis, pers. comm.). It is unknown how widespread the use of empty turtle nests by Fowler's toads might be, but we speculate that wherever large populations of toads coincide with active turtle nesting areas, it is likely to be a common occurrence.

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BUFO TERRESTRIS (Southern Toad). **PREDATION**. On 2 June 2002 I observed three different incidences of adult *Bufo terrestris* being depredated by giant water bugs (*Lethocerus* sp.: Belostomatidae) in a small temporary pond in Gainesville, Florida, USA. The insects seized the toads just posterior to the hind limbs. Two of the toads were male and were captured while calling at the waters surface. The third victim was a female. Although incapacitated, the female was in amplexus with a male that was apparently unaware of the insect attached just below him. All of the toads appeared to be breathing but were paralyzed and unresponsive. Giant water bugs are known predators of anuran larvae (Duellman and Trueb 1986. Biology of Amphibians, John Hopkins Univ. Press, Baltimore, 246 pp.; Peterson and Blaustein 1992. Copeia 1992:577–584; Relyea 2001. Ecology 82:541–554); however, predation on adult anurans is reported from only one other published account involving *Rana cascadae* (Nauman and Dettlaff 1999. Herpetol. Rev. 30:93). The observations reported in this note suggest that predation on adult anurans by giant water bugs may be common, thus making these insects significant predators on both

larval and adult anurans. Furthermore, many anurans are likely to only encounter giant water bugs at breeding sites where they may both reach high densities. The combined effects of predation on breeding adult anurans and their offspring by giant water bugs may have a significant impact on anuran populations.

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HYLA ANDINA (NCN). **DIET**. Diet records for *H. andina* include insects (principally Diptera) and other small arthropods (Basso 1990. Monog. Assoc. Herpetol. Argentina 1:1–71). On 14 March 1998, we collected seven small adult *Hyla andina* under rocks along the Río Toro, 0.1 km E of the Ing. Maury Gendarmaria check point, Ruta Nacional 51, Departamento Rosario de Lerma, Provincia Salta, Argentina (24°41'15.0"S; 65°46'01.7"W; 2469 m elev.). The frogs were kept overnight in a ventilated, plastic 2-L container with 2 cm of water and maintained at 15–20°C. The following afternoon we found, at the bottom of the container, feces containing the remains (partial carapace, one chela, and one leg) of the small decapod, *Aegla* (probably *A. jujuyana*; Lopretto and Tell [eds.] 1995. Ecosistemas de Aguas Continentales, Tomo III, Ediciones Sur, La Plata, Argentina; Morrone 1996. Biogeographica 72:113–119). We thank M. Halloy for assistance in the field and M. Archangelsky for access to literature and for help in identification of the crabs.

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HYLA BIOBEBA (NCN). **PREDATION.** Various species of mammals are predators of anurans (Duellman and Trueb 1986. Biology of Amphibians. Mc Graw-Hill, New York. 670 pp.). The consumption of frogs appears to be relatively widespread in marmosets (Digby and Barreto 1998. Neotropical Primates 6[4]:124–126; Passamani and Rylands 2000. Primates 41[1]:27–38). Herein, we report the first case of predation by the marmoset *Callithrix penicillata* on a neotropical treefrog, *Hyla biobeba*.

In July 2001 a subadult male *C. penicillata* was observed preying on an individual *H. biobeba* in a formation of cerrado, at Instituto do Trópico Subúmido – Campus II of the Universidade Católica de Goiás, Goiânia, state of Goiás, Brazil. The marmoset was observed at a height of ca. 2 m. While holding the treefrog by its trunk, the marmoset pulled off its head with strong bites. After eating the head, the marmoset subsequently ate the forelimbs and the abdomen, with nothing remaining of the treefrog.

While the marmoset was feeding, another juvenile *C. penicillata* approached, crying for food sharing, but the attempt failed. On two other occasions, *C. penicillata* was seen preying upon treefrogs at the same locality, although these frogs were not identified.

We thank the staff of Instituto do Trópico Subúmido – Universidade Católica de Goiás for allowing us access to the field station, R. P. Bastos for comments on the manuscript, R. F. Juliano for help on the English version, and CAPES for financial support.

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HYLA CINEREA (Green Tree Frog). **REPRODUCTION**. In south Louisiana, *Hyla cinerea* breeds from May to September and is considered a prolonged breeder (Wells 1977. Anim. Behav. 27:666–693). Although males may physically compete for calling sites (Fellers 1975. Chesapeake Sci. 16:218–219), to our knowledge, attempts by males to dislodge other males in amplexus have not been reported.

On 6 June 2002 we observed a number of males (at least 3) calling loudly in a small area (ca. 660 cm circumference). We then noticed a pair in amplexus near the calling males. One of the calling males jumped and landed within a few centimeters of the pair and attempted to dislodge the male from the female with its forelegs. The female then jumped to a location more central to the calling males while remaining in amplexus. Shortly thereafter the three males began calling vigorously, converged in the same area near the pair, and began grappling with each other. As a result, the interfering male was pushed into the water. The interfering male then crawled out of the water calling loudly and moved directly towards the pair in amplexus. When the interfering male was within a few centimeters of the pair, it jumped at the pair. The female then jumped, while still in amplexus with the original male, to a location on the opposite side of a tree that was above the calling males. Within a few minutes the remaining males ceased calling and their activity decreased.

These observations occurred in a swamp where the predominant vegetation is willow (*Salix* sp.) near the Lafayette Regional Airport, Lafayette Parish, Lafayette, Louisiana, USA (30°11'88"N, 91°59'09"W). Weather conditions at the Lafayette Regional Airport at 2253 h were 26°C, 78% humidity, 1012.0 hPa pressure, 16.1 k visibility, 7.4 km/h wind speed, clear sky, and 0 precipitation.

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HYLA MIOTYMPANUM (Small-eared Treefrog). **PREDATION**. *Hyla miotympanum* occurs in highland cloud forests from Nuevo León to Oaxaca and central Chiapas in eastern México (Frost 2002. Amphibian Species of the World: An Online Reference V2.21). Although widely distributed and relatively abundant, there is little published information about the natural history of *H. miotympanum*. Herein is the first report of an adult *H. miotympanum* being preyed upon by a water bug (*Abedus* sp.:

Belostomatidae).

At 2230 h on 24 May 2002, a male *Abedus* carrying eggs on its back was found sucking the body fluids from a young adult *H. miotympanum* underwater in a permanent stream. These observations were made near Coatepec, Veracruz, México (19°27'29"N, 96°59'04"W, 1180 m elev.) in a remnant cloud forest surrounded by shade coffee, where these frogs are abundant. This observation suggests that aquatic insects are a source of mortality even during the terrestrial life cycle of these frogs. The frog and the water bug were photographed at the stream. I thank José Antonio Gómez for identifying the belostomatid.

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OSTEOPILUS SEPTENTRIONALIS (Cuban Treefrog). **DIET**. *Osteopilus septentrionalis* is a large hylid introduced to Florida (USA) and is common around buildings and in disturbed areas in southern parts of the state. It feeds on a variety of prey, including several vertebrate species (Meshaka 2001. The Cuban Treefrog in Florida. University Press of Florida, Gainesville. 192 pp.). This note documents *O. septentrionalis* predation on *Storeria victa* (Florida brownsnake), a previously unreported prey item.

O. septentrionalis has been observed on many occasions in the outdoor shower near a house within the boundaries of Big Cypress National Preserve, Ochopee, Collier County Florida, USA. On 6 February 2002 at approximately 2000 h, a large (> 60 mm) *O. septentrionalis* was discovered clinging to a bathroom door with the head and a short portion of the body of a *Storeria victa* protruding from the mouth of the frog (Fig. 1). After taking a photograph, we captured the frog and removed the snake from its mouth for positive identification. The snake had suffered several lacerations, but was able to move away without difficulty upon release.

This is the first account of *O. septentrionalis* in Florida feeding on a native squamate. Meshaka (2001) reported three squamate species in the diet of *O. septentrionalis* in Everglades National Park, but these were all species of introduced lizards. As *O. septentrionalis* continues to expand its range in Florida and increasingly invades natural areas, it may incorporate other native vertebrate species into its diet.

FIG. 1. *Osteopilus septentrionalis* with *Storeria victa* protruding from its mouth.

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PHYSALAEMUS CUVIERI (Barker Frog). **PREDATION.** Aquatic invertebrates, especially belostomatids, are often cited as tadpole predators (Eterovick and Sazima 2000. Amphibia-Reptilia 21:439–461). However data on adult frog predation by belostomatids are scarce (see Bastos et al. 1994. Herpetol. Rev. 25:118; Haddad and Bastos 1997. Amphibia-Reptilia 18:295–298). *Physalaemus cuvieri* is a small leptodactylid frog that occurs in northeastern, central, and southern Brazil, and in adjacent Argentina and Paraguay (Frost 1985. Amphibian species of the world. Allen Press, Lawrence, Kansas, 732 pp.). It is common in open, wet areas, including preserved and anthropic habitats, and is the most abundant leptodactiylid at the Itirapina Ecological Station (IES; 22°13'24"S 47°54'03"W; ca. 750 m elev.), São Paulo State, southeastern Brazil. The reserve includes different, well-preserved Cerrados (savanna-like vegetation).

On 8 Dec 2001 at ca. 2200 h we found an adult male *P. cuvieri* (29.9 mm SVL) being preyed upon by a belostomatid, *Belostoma* aff. *ellongatum* (35.3 mm body length, 13.4 mm body width) on the surface of a temporary pond. The belostomatid was holding the frog by the head with its raptorial forelimbs. We captured and preserved both animals. The frog had a large cut (4.7 mm long) on the right side of the gular region, probably caused by the belostomatid proboscis (Haddad and Bastos 1997. *op. cit.*). *Physalaemus cuvieri* calls and lays its eggs on the water of temporary ponds that usually have high densities of belostomatids and may thus be vulnerable and probably often preyed upon by these aquatic invertebrate predators. Voucher specimens of *P. cuvieri* and the belostomatid are deposited in the Museu de História Natural, Universidade Estadual de Campinas (ZUEC 12046).

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RANA CAPITO. (Gopher Frog). **DROUGHT SHELTER**. During extreme drought, much of the former stream bottom of a small tributary of the Ochlockonee River, Leon County, Florida, USA, was exposed and dried to non-vegetated banks, partially covered with broken-off limbs from overhanging willow trees (*Salix* sp.). The limbs had been submerged, and the bark, phloem, and inte-

rior portion had decomposed leaving brittle tubes of dense secondary xylem. In traversing these banks during mid-afternoon on 26 May 2000, several of these brittle limbs were broken, and on three instances *R. capito* (N = 4) were dislodged from the hollow interiors of these limbs. None of the limbs were more than 5 cm in diameter at the breaking point, and none of the breaking points were in direct contact with the ground. The concentration of these limbs suggests that they could provide significant shelter for a small population of *R. capito* at this site.

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RANA CASCADAE (Cascade Frog). **CANNIBALISM.** Although cannibalism has been reported for several species of ranid frogs in western North America (Pilliod 1999. Herpetol. Rev. 30:93; Licht 1986. Can. Field Nat. 100:22–31), cannibalism in *Rana cascadae* has not been documented. We report observations made on 12 July 2001 of intraspecific predation by post-metamorphic *R.cascadae* in the Cascade Mountains of Oregon, USA. We observed the behavior of five adult (50–65 mm SVL) and two subadult (35–40 mm SVL) *R. cascadae* around East Snow Lake (43°02'04"N, 123°29'9"E), which had dried down to a 3 m x 5 m pool < 0.5 m deep. We estimated ca. 7500 *R. cascadae* larvae and metamorphs (mean SVL 20 mm, N = 10), and ca. 5000 smaller Pacific treefrog (*Hyla regilla*) larvae (mean SVL 10 mm, N = 10) were present in and immediately around the pool.

At ca. 1400 h, we observed a *R. cascadae* subadult (ca. 35 mm SVL) at the water's edge capture and consume a *R. cascadae* larva (ca. 20 mm SVL) that had come to the surface. The subadult lunged forward and engulfed the body of the larva in a single motion, and ingested the tail with a second jaw movement. The entire episode lasted 1–2 seconds. Approximately two minutes later, we observed an adult *R. cascadae* (59 mm SVL) capture and consume a metamorphic *R. cascadae* (ca. 18 mm SVL). The adult *R. cascadae* hopped ca. 20 cm down the bank toward the metamorph as it emerged from the water. The metamorph remained motionless for ca. 10 sec, and upon movement, was captured and swallowed in a single motion. We subsequently examined four adult male *R. cascadae* (50–63 mm SVL) from around the pond. Palpation of their stomachs suggested each frog contained 1–3 large food items consistent in size, shape, and texture with anuran larvae or metamorph prey.

As adult anurans are not believed to distinguish conspecifics from other prey (Duellman and Trueb 1986. Biology of Amphibians, John Hopkins University Press, Baltimore, 246 pp.), this observation of cannibalism likely represents a response to an abundant food source. Conspecifics represent a potential source of nutrition for adult anurans recovering from the physical demands of breeding and preparing for extended winter inactivity (Lannoo et al. 1989. Can. J. Zool. 67:1911–1914; Crump 1990. Copeia 1990:560–564).

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TESTUDINES

APALONE FEROX (Florida Softshell Turtle). **MOVEMENT BEHAVIOR.** Very little is known about the terrestrial movement behavior of *Apalone ferox* (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 578 pp.). In fact, detailed information on the terrestrial movements of aquatic turtles in general is sparse (Gibbons 1970. Amer. Midl. Nat. 83:404–414). Here we report terrestrial movement behavior of an individual *A. ferox*.

On 24 July 2001 at 1500 h one of us (JEC) found an *A. ferox* on a 10 m wide road consisting of a sand substrate at the Archbold Biological Station, Highlands County, Florida, USA. Ambient temperature was 33°C in shade and relative humidity was 64%. The individual was brought into the laboratory and measured and weighed (293 mm CL, 2.3 kg) and was most likely a male because the vent was near the tip of the tail (Ernst et al., *op. cit.*). Tracks of the individual showed that it had moved 264 m north in a straight line along the sand road. We traced the tracks to where the turtle had entered the sand road from an area of old cattle pasture on the east side of the road. On 25 July 2001 at 1500 h we released the *A. ferox* at the capture site. Later that evening we returned and found that it had continued its northward travel, in a straight line, for 68 m, then turned east and traveled 8 m. At that point the turtle entered a gate in a fence and the tracks were lost in the grass. A pond was located ca. 80 m to the east of the last tracks.

This observation is important for three reasons. One, the terrestrial movement behavior occurred in very hot conditions, surprising given the rate of water loss (14.4 g/h) for a congeneric of approximately the same size at 35°C in the lab (Robertson and Smith 1982. Physiol. Zool. 55:124–129). However, the high relative humidity (64%) may have lessened desiccation. Second, 16.5 cm of rain fell 20-23 July at this locality, with no rain falling on 24 July, suggesting that terrestrial movement of *A. ferox* occurs after heavy rains. Third, the *A. ferox* appears to have moved in a relatively straight line, along the dirt road, toward a pond.

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CARETTA CARETTA (Loggerhead Sea Turtle). **NEST ARCHITECTURE.** No studies have compared nest architecture among populations of sea turtles. We compared nest architecture in loggerhead sea turtles at natural beaches in Florida, USA and Brazil to determine how similarities and differences in female morphology and reproductive output in these two populations are reflected in the structure of the nest. There is no significant difference between loggerheads nesting in Florida and Brazil for straight carapace length (distance from middle of nuchal to pygal

notch), mean hind flipper length (distance from proximal end of tibia to the distal tip of the longest digit, averaged for the two flippers), and clutch volume, but Brazilian loggerheads have a larger straight carapace width (widest point across carapace) and lay larger clutches of smaller sized eggs in deeper nests (Tiwari and Bjorndal 2000. Herpetologica 56:343–356).

Data were collected from 33 nests in Melbourne Beach, Florida, USA, in 1993, and from 14 nests from Busca Vida Beach in Bahia, Brazil, in 1995. We measured loggerheads, after they completed nesting, for straight carapace length, straight carapace width, and mean hind flipper length. Eggs were removed from each nest and counted; yolkless eggs were excluded from the counts. The clutch was reburied in a nest chamber dug nearby.

To create a nest cast, an expanding polyurethane foam was sprayed into the empty nest cavity, left to cure, and excavated a few hours later (Carthy 1996. The Role of the Eggshell and Nest Chamber in Loggerhead Turtle [*Caretta caretta*] Egg Incubation. Ph.D. dissertation. Univ. Florida, Gainesville. 123 pp.). From the excavated nest cast, main chamber length (CL) and width (CW), and nest neck length (NL) and width (NW) were recorded (Fig. 1). Nest volume (NV) was determined by quantifying the amount of water displaced when the cast was immersed. This comparison of nest architecture is limited to the nest chamber excavated by the hind flippers.

Cast measurements were compared between sites using t-tests. Equality of variances was analyzed using Levene's test. To determine if body size measurements and clutch size were correlated with chamber length, chamber width, and nest volume, least square regression analyses were used. Alpha level was set at 0.05. Analyses were conducted with SPSS 10.0 software.

Variances for all variables were homogeneous between the two beaches. Mean values of chamber length and width, nest neck length and width, and nest volume did not differ between Florida and Brazil ($P > 0.05$). The mean value (SD) [range] and sample size for each of the preceding variables were: Florida: CL = 25.1 cm (3.0) [17.8–30.8], N= 33; CW = 23.8 cm (4.2) [13.6–30.7], N = 33; NL = 20.3 cm (1.9) [17.6–24.6], N = 33; NW = 15.8 cm (2.6) [11.2–20.4], N = 33; NV = 11030.0 ml (1825.3) [8360–14260], N =21; Brazil: CL = 25.8 cm (2.5) [22.2–29.2], N = 12; CW = 25.2 cm (2.5) [20.4–29.2], N = 12; NL = 19.3 cm (1.7) [17.2–22.6], N = 14; NW = 16.1 cm (1.9) [11.7–18.8], N = 14; NV = 11757.1 ml (2574.3) [7755–15835.7], N= 11. Straight carapace length and mean hind flipper length were not correlated with any nest measurements in Brazil or Florida ($P > 0.05$). Clutch size was not correlated with any cast measurement ($P > 0.05$) except with chamber width in Florida ($r^2 = 0.22$, $P = 0.04$, $N = 20$). Straight carapace width was also correlated with chamber width in Florida ($r^2 = 0.22$, $P = 0.03$, $N = 21$), but not in Brazil ($P > 0.05$). Significant correlations of chamber width with clutch size and straight carapace width in Florida but not Brazil may be due to differences in nesting media between the two beaches or in sample sizes. Sand characteristics were not compared between the two sites.

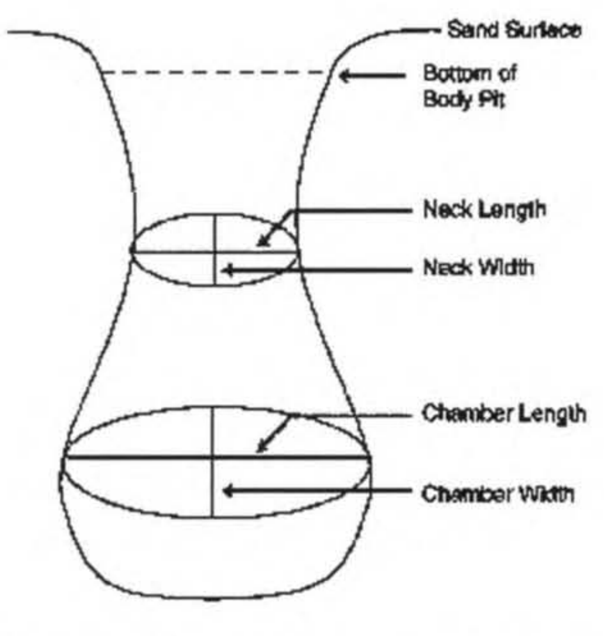

FIG. 1. Neck and chamber measurements taken from loggerhead seaturtle nest casts in Florida and Brazil. Nest volume was measured from the bottom of the body pit.

Understanding nest architecture is essential for conservation programs that relocate nests, to ensure that an appropriate incubation environment is reconstructed for the eggs. Future studies addressing the relationship between nest architecture and the incubation environment could provide important insights into embryonic development (Billes and Fretey 2001. Marine Turtle Newsletter 92:7–9).

We thank N. Marcovaldi and Projeto Tamar (Brazil) and L. Ehrhart and his crew (Florida) for their help and support. Our thanks to A. Bolten who helped develop this project. We are grateful to all of the volunteers in Brazil and Florida who helped with nest casting. S. Balcomb and G. Pryor provided comments on early drafts. Funding for this project came from the Lerner-Gray Fund of the American Museum of Natural History, the University of Florida Grinter Fellowship, and the U.S. Fish and Wildlife Service. The project was approved by the Institutional Animal Care and Use Committee, University of Florida; the Florida Department of Environmental Protection; and Projeto Tamar, Brazil.

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CHELONIA MYDAS AGASSIZII (East Pacific Green Seaturtle). **DIET**. The feeding habits of *Chelonia mydas agassizii* have been documented for much of its range (Felger and Moser 1987. Environ. Southwest, Fall 1987:18–21; Casas-Andreu and Gomez-Aguirre 1980. Bolm. Inst. Oceanogr., S. Paulo, 29:87; Seminoff et al. 2002. J. Herpetol. 36:447–453). Although immature and adult *C. mydas agassizii* are known to be primarily herbivorous, feeding on seagrasses and/or marine algae, this turtle occasionally consumes invertebrates (Casas-Andreu and Gomez-Aguirre, *op cit.*; Felger and Moser, *op cit.*; Seminoff et al. 2000. Herpetol.

Rev. 31:103). Here we report on the consumption of pelagic red crabs (*Pleuroncodes planipes*) by a *C. m. agassizii* along the Pacific Coast of the Baja California peninsula, Mexico.

Between October 2000 and March 2002, we examined digestive tract contents of 23 turtles that were incidentally drowned in fishing nets near Bahía Magdalena, Baja California Sur, México (24°15'–25°20'N and 111°20'–112°15'W). On 12 February 2002, we recovered a stomach from an immature *C. mydas agassizii* (straight carapace length = 54.4 cm) containing more than 82% by volume of red crabs (*Pleuroncodes planipes*). *P. planipes* has been shown to be a primary food of Loggerhead Seaturtles (*Caretta caretta*) in the Pacific Ocean (Ramirez-Cruz et al. 1991. Archelon 1[2]:1–4), but to our knowledge this is the first report of red crab consumption by a *C. m. agassizii*, and the first documentation of a Green Seaturtle feeding predominantly on crustaceans. The highest densities of *P. planipes* in the eastern Pacific Ocean occur off Bahía Magdalena; the crabs migrate inshore during cold season (winter–spring) upwelling conditions (Aurioles-Gamboa 1992. Crustaceana 62:71–84). This finding is consistent with reports by Bjorndal (1997. *In* Lutz and Musick [eds.], The Biology of Sea Turtles, pp. 199–232. CRC Press, Boca Raton, Florida) that East Pacific Green Seaturtles may have a more carnivorous diet than *Chelonia* of other regions.

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PSEUDEMYS PENINSULARIS (Peninsula Cooter). **ESTUARINE OBSERVATION and INTERACTION WITH GIANT LAND CRABS**. At 0710 h, 11 June 2002, a *Pseudemys peninsularis* was found in a Giant Land Crab (*Cardisoma guanhumi*) colony on an isolated isthmus of sandy spoil in a large bulkheaded estuarine canal (Intracoastal Waterway) near Woolbright Road in Boynton Beach, Florida. The spoil site was adjacent to the concrete seawall of the canal and rose < 0.5 m above the mean high tide level. The turtle was found on its back, partially covered by a fallen palm frond, and was surrounded by 20–25 easily visible crabs within 10 m, and three were within 15 cm at the initial sighting. The turtle was deeply retracted into its shell, and its right rear foot exhibited soft tissue damage apparently inflicted by crabs. It was released at ca. 0713 h into 0.25 m deep water adjacent to the island, where it remained submerged and deeply retracted into its shell when observations ended at 0720 h.

The crab colony is an isolated, triangular 255 m^2 area containing 494 burrows > 5 cm diameter, for an average density of 1.94 burrows/m^2. The crab colony has existed at this site since at least 1993 (HS, pers. obs.). The dominant vegetative cover is Sea Oxeye (*Borrichia frutescens*). The cooter was an immature female based on toenail length and tail morphology with a carapace length of 14 cm (Jackson 1988. Bull. Florida State Mus. Biol. Sci. 33[3]:113–158; D.R. Jackson, pers. comm.). Rain had fallen for at least 0.5 h ending 10–15 min prior to finding the turtle. The air temperature was estimated to be 26–29°C.

The turtle's presence in this habitat was unusual, as this species is not normally found in coastal salt waters. The salinity of the water in this canal is 26.9–30.8 parts per thousand (G.H. Powell, Palm Beach County Dept. Environ. Resources Mgmt.). In 9 years of observation, no other freshwater turtles have been observed at, or near, this site. Its presence on the spoil pile was likely not related to nesting since the turtle was below minimum size for reproduction (Jackson, *op. cit.*; D. R. Jackson, pers. comm.). We speculate that the turtle was either washed or released into the estuary, attempted to seek refuge from the salinity or bask on the area with the crab colony, and was unable to escape when attacked by the crabs.

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CROCODYLIA

CAIMAN CROCODILUS YACARE (Pantanal Caiman). **FOOD-RELATED MOVEMENT**. Crocodilians move for many reasons (Lang 1987. *In* Webb, Manolis and Whitehead [eds.], Wildlife Management: Crocodiles and Alligators, pp. 273–294. Surrey Beatty & Sons, Chipping Norton, New South Wales). *Caiman crocodilus yacare* occur in high densities in seasonally flooded habitats in the Brazilian Pantanal (Coutinho and Campos 1996. J. Trop. Ecol. 12:741–747), and food shortages during the dry season have the potential to influence movement. As Santos et al. (1996. Herpetol. J. 6:111–117) mentioned large number adults and tadpoles of *Pseudis paradoxa* (or soaps) in diet of caimans in the brackish ponds, here I report changes in caiman density potentially linked to changes in soap density in a lake in the Brazilian Pantanal.

Observations were made on the Nhumirim Ranch (18°59'S, 56°40'W), Mato Grosso do Sul, Brazil over the period 1989–1999. During night surveys, caiman were counted and soap densities were estimated. One alkaline lake (pH of 9.0–9.9) generally had relatively few (10–34) caiman during each of 20 times it was surveyed. Only two surveys recorded high densities of caiman (> 500), but each coincided with high densities of *P. paradoxa*. In each case, I estimated soap densities on the edge of the lake to be > 100 adults and large tadpoles/m^2. On 10 April 1999, we marked 20 caiman of the several hundred present in the lake during the soap eruption. After 150 days, one marked female was recaptured in a river area 5 km away and the total number of caiman we detected in the lake was reduced to 20. These observations suggest that caiman move in response to changes in prey density.

I thank Sandra Santos and Max Pinheiro for help with surveys in 1989 and Henrique de Jesus, José Augusto Silva and Vandir Silva for assistance with capture of caiman.

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PALEOSUCHUS TRIGONATUS (Dwarf Caiman). **NEONATE TIME BUDGET**. Natural history of forest-dwelling animals is often poorly understood because of the difficulties in observing them. Further, studying neonates can be especially difficult as their small size and cryptic nature limits field observation (Morafka et al. 2000. Herpetol. Monogr. 14:353–370). Dwarf caiman, *Paleosuchus trigonatus*, are no exception to this pattern. Few studies have dealt with their natural history (Magnusson et al. 1991. J. Herpetol. 25:41–48; Rivas et al. 2001. Herpetol. Rev. 32:251), and none have addressed neonate behavior. Here, we present preliminary observations on the behavior of neonate *P. trigonatus* in a creek in the Tiputini River (Amazonian Ecuador) during March 2000.

On 30 September 1999, we discovered a *P. trigonatus* nest in a low stature, seasonally-flooded varzea forest 4.5 m from the base of a tree from a small creek. Based on finding eggshells characteristic of recent hatching, at least 12 neonate dwarf caiman are thought to have emerged from this nest on 27 November 1999 (Rivas et al., *op. cit.*). Five neonate dwarf caiman (mean total length = 30.6 cm, range: 29.9–32.8; mean mass = 103 g, range: 85–120 g) found 19 March 2000 in a small stream (mean width = 1.6 m, mean depth = 0.2 m) < 50 m away are believed to have originated from this nest. To study the time budget and behavior of these neonates, we conducted night observations from 1900 to 0600 the next day. During night observation periods, we recorded the behavior of as many neonates as we could find. We found 4, 2, and 1 neonate dwarf caiman, respectively, on 22, 29, and 30 March 2000. As we did not handle the animals prior to observations, we were unable to determine whether we saw the same animals on different nights; we pooled all data across nights for analysis. We recorded data every 10 min on each animal (using their eyeshine) by turning on a dim flashlight for a brief (5–10 sec) interval. The neonate's head position relative to the water surface (as low [eyes barely showing], intermediate [upper but not lower jaw above waterline] or high [lower jaw at least partly out of water]) and its distance from shore/water edge (cm) was recorded at each interval. We also estimated height over the water (in m) of the lowest plant that directly overhung each caiman, potentially concealing it from possible predators. If an animal was present early in the night and disappeared from one observation interval to the next, we assumed that it was hiding or under the water. We were monitoring a long (ca. 30 m) stretch of creek and neonates were unlikely to have moved out of the area.

We made 410 observations of neonate *P. trigonatus*. Neonates spent most of their time (91%; N = 266) within 0.5 m of shore; relatively little time was spent mid-stream far from the bank. Neonate *P. trigonatus* were also found beneath relatively low overhanging vegetation (i.e., within 1 m of the water surface) 62% (N = 190) of the time, which may indicate selection for relatively sheltered areas. Neonate dwarf caiman were immobile in 51% (N = 206), out of sight (probably immobile as well) in 27% (N = 112), and active in only 22% (N = 91) of the observations. Neonates changed locations between observations more often before 2300 and were more frequently concealed after 0200. Most of the time (83%; N = 246), neonate *P. trigonatus* held their heads high. Holding the head elevated has been associated with territorial behavior in caiman (Verdade 1999. Herpetol. Rev. 30:38–39). Lack of aggregation among neonates, a feature of clutch pods among many crocodilians; lack of distress calls during our periods of observation; and absence of adult dwarf caiman reported previously for this creek (Rivas et al., *op. cit.*) collectively suggests that the neonates we observed may already be on their own, implying that parental protection in this species, if it exists, is short-lived.

During the two months that we spent surveying caimans in the area, we did not detect any other dwarf caiman of a size similar to these neonates in the Tiputini River. However, we regularly saw juvenile (< 20 cm SVL) spectacled caiman (*Caiman crocodilus*) and larger dwarf caiman (≥ 40 cm SVL) using the main river. Neonate dwarf caiman may rear in small forest streams with dense forest vegetation because they gain greater protection from predators in such habitat. If true, deforestation of small forest streams, like this one, may seriously impact the survival of neonate dwarf caiman.

Data for this contribution were collected during a course of tropical ecology by Boston University and Universidad San Francisco de Quito at Tiputini Biodiversity Station. We thank Mayer Rodriguez, Hendry Narváez, Franklin Narváez, Jaime Guerra, and Bradley Kline for their help in the field work and Kelly Swing for comments on early versions of the manuscript.

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LACERTILIA

ANOLIS PORCATUS (Cuban Green Anole). **NECTIVORY**. *Anolis porcatus* is a moderate-sized Cuban anole that has become established in Miami-Dade County, Florida (Meshaka et al. 1997. Herpetol. Rev. 28:101–102). In its native habitat, *A. porcatus* is known to eat insects, particularly odonates (Schwartz and Henderson. 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distribution, and Natural History. Univ. Press of Florida. 720 pp.). Further, Meshaka et al. (*op. cit.*) reported a varied invertebrate diet and occasional consumption of smaller lizards and fruit for introduced *A. porcatus* in Florida, but nectivory is undocumented. Nectivory has been recorded in three other anoles, *A. consperus*, *A. stratulus*, and notably *A. carolinensis* (which is closely related to *A. porcatus*). The latter reportedly consumes the nectar of two native palms, *Serenoa repens* and *Sabal palmetto*, in central Florida (Campbell and Bleazy 2000. Herpetol. Rev. 31:239). Herein, I document the first report of nectivory in *A. porcatus* introduced to Florida.

At 1135–1141 h on 9 May 2002, I observed an adult male *A. porcatus* lapping nectar from and consuming the blossoms of an ornamental areca palm (*Chyrsalipedocarpus lutescens*) in a yard near SW 162nd Street and Old Cutler Road in Miami, Florida. The lizard moved from a basking site on the stem of a leaf directly onto a flowering inflorescence, and immediately began to extract nectar from each of the small flowers with its tongue. The anole visited at least 14 flowers, while moving along the inflorescence,

carefully lapping the nectar from each flower. At least once, the lizard ate a flower that became dislodged from the inflorescence. The portion of the diet of *A. porcatus* comprised of *C. lutescens* flowers is unknown, but these introduced lizards are at least opportunistic feeders on the flowers of some non-native ornamental palms.

I thank Robert Powell for suggestions on a draft of this note. The lizard (UF 132470) was deposited in the Florida Museum of Natural History herpetological collection.

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CNEMIDOPHORUS HYPERYTHRUS (Orange-throated Whiptail). **ENDOPARASITES**. Two reports of endoparasites from *Cnemidophorus hyperythrus* exist: Bostic (1965. Southwest. Nat. 10:313) reported that of 104 individuals, 5 (prevalence 5%) harbored the cestode *Oochoristica bivitellobata*, 17 (prevalence 16%) harbored unidentified oxyurid nematodes, and one (prevalence 1%) harbored a nematode of the genus *Pharyngodon*; Telford (1965. Japan J. Exp. Med. 35:111–114) described the nematode *Thubunaea iguanae* from specimens taken from *C. hyperythrus* and 12 other lizard species (prevalences not reported). Here, we report a second nematode species, *Pharyngodon warneri*, from *C. hyperythrus*.

Thirty-one *C. hyperythrus* (mean SVL = 59 mm, ± 4 SD, range: 49–68 mm) from the herpetology collection of the Natural History Museum of Los Angeles County, Los Angeles (LACM 99852–99855, 99859–99860, 99862–99878, 99880, 150800–150806), collected in Riverside County, California were examined for helminths. The body cavity was opened by longitudinal incision from throat to vent and the digestive tract removed. The esophagus, stomach, small and large intestines were opened and separately examined for helminths under a dissecting microscope. The body cavity was also searched for helminths. Nematodes were cleared in a drop of undiluted glycerol on a glass slide and cestodes were regressively stained in hematoxylin and mounted in Canada balsam before identification using a compound microscope. One species of Cestoda, *Oochoristica bivitellobata* and one species of Nematoda, *Pharyngodon warneri* were found. Selected specimens were deposited in the United States National Parasite Collection, Beltsville, Maryland: *Oochoristica bivitellobata* (USNPC 92221); *Pharyngodon warneri* (USNPC 92222). Prevalence, mean intensity (mean number of helminths per infected lizard) and range for *O. bivitellobata* was 6%, 3.0 ± 2.1 SD, 1–4; for *P. warneri*, 19%, 6.0 ± 5.4 SD, 1–14. Hosts of *O. bivitellobata* and *P. warneri* were summarized in Goldberg et al. (1997. Great Basin Nat. 57:273–277). *Urosaurus ornatus* should be added to the host list of *P. warneri* (Walker and Matthias. 1973. Proc. Helminth. Soc. Washington 40:168–169). *Cnemidophorus hyperythrus* represents a new host record for *P. warneri*.

We thank D. A. Kizirian (Natural History Museum of Los Angeles County) for permission to examine specimens.

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COLEODACTYLUS MERIDIONALIS (NCN). **DIET**. *Coleodactylus meridionalis* is a litter-dwelling gekkonid lizard distributed in the Caatinga and Atlantic Rainforest of northeastern Brazil (Vanzolini et al. 1980. Répteis das Caatingas, Academia Bras. Ciências, São Paulo. 161 pp.). Information about its ecology is scarce with virtually no data on the species' feeding habits. A few data on the species come from the Caatinga region and from forest habitats in the Atlantic Rainforest (Vanzolini et al., *op. cit.*; Freire 1999. Bol. Mus. Nac., Rio de Janeiro 399:1–14) but no ecological information exists about the species from "restinga" habitats (coastal herbaceous and shrubby sand dunes), distinctive habitats within the Brazilian Atlantic rainforest ecoregion. Here, we report information on the diet of *C. meridionalis* based on stomach content analysis of six individuals from two restinga areas in the State of Bahia, northeastern Brazil.

Observations were made on 2 *C. meridionalis* (a 21.8 mm SVL male and a 21.1 mm SVL female) from Dunas de Abaeté in the Municipality of Salvador (12°57'03"S, 38°22'30"W) and 4 others (three males, 18.0, 19.5 and 20.6 mm SVL and 1 female, 21.2 mm SVL) from Baixio in the Municipality of Esplanada (12°06'01"S, 37°41'4"W). Lizards were dissected, and food items identified and counted. One lizard, a female from Baixio, had an empty stomach. Thirteen prey items were found in the five other lizards. Number of prey items per stomachs varied from 1 to 6, but most had < 3. *Coleodactylus meridionalis* ate eight prey groups (Araneae, Diptera, Hymenoptera, Isopoda, Isoptera, Lepidoptera larvae, Orthoptera and Pseudoscorpionida). Except for Isoptera and Pseudoscorpionida (where three and two individuals were eaten, respectively), we found one individual from each prey group. Based on volume, Orthoptera (45%), Isopoda (32%), and Araneae (15%) were the dominant groups. All prey groups had the same percentage occurrence per individual (16%). Data on the congeneric *C. amazonicus* from the Brazilian Amazon indicate a diet composed mostly of Collembola and Acarina (Ramos 1981. Acta Amazonica 11:511–526), prey not found in the *C. meridionalis* we examined.

Voucher specimens of *C. meridionalis* were deposited in the collection of the Instituto de Biologia da Universidade Federal da Bahia (IBUFBA; LAG480–483, LAG554 and LAG558). We thank the Conselho Nacional do Desenvolvimento Científico e Tecnológico (CNPq, processes 300819-4 and 461970/00-7), Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ) for funding, and Marc Hayes, Davor Vrcibradic, and two anonymous reviewers for suggestions.

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ELGARIA PANAMINTINA (Panamint Alligator Lizard). **REPRODUCTION**. The biology of *Elgaria panamintina* is summarized in Banta et al. (1996. Cat. Am. Amphib. Rept. 629:1–4). Information on clutch sizes or the timing of the events in the testicular cycle are unknown. Here we report the first clutch size and time of sperm formation (spermiogenesis) for this species.

Specimens were examined from the California Academy of Sciences (CAS), San Francisco, Natural History Museum of Los Angeles County (LACM), Los Angeles, Museum of Vertebrate Zoology (MVZ), University of California, Berkeley and Department of Biology, San Diego State University (SDSU), San Diego. All specimens were collected in Inyo County, California in the interval 1959–1985. Six males (mean SVL = 99 mm ± 9 SD, range: 90–114 mm) and two females (SVL = 105 mm ± 6 SD, range: 100–109 mm) were examined. In males, the left testis was removed and embedded in paraffin. Histological sections were cut at 5 mm, mounted on glass slides and stained with Harris' hematoxylin followed by eosin counterstain.

One male collected in May (CAS 89230, 93 mm SVL) was undergoing sperm formation (spermiogenesis). Lumina of the seminiferous tubules were lined by sperm. Two males collected in June (MVZ 77063, 97 mm SVL; CAS 89675, 92 mm SVL) had regressed testes containing spermatogonia. One male collected in June (MVZ 75918, 114 mm SVL) had a testis in early recrudescence (i.e., renewal of germinal epithelium for next period of spermiogenesis); spermatogonia and primary spermatocytes were present. One male collected in July (MVZ 227764, 90 mm SVL) had a regressed testis, a second male (MVZ 227765, 106 mm SVL) had a testis in recrudescence. The presence of a male collected in May undergoing spermiogenesis suggests that *E. panamintina* breeds during spring. This agrees with two other North American anguid lizards that also produce sperm at this time: *Elgaria multicarinata* (Goldberg 1972. Herpetologica 28:267–273) and *E. coerulea* (Vitt 1973. Herpetologica 29:176–183). A report of captive breeding in May exists for *E. panamintina* (Banta and Leviton 1961. Herpetologica 17:204–206). Behler and King (1979. The Audubon Society Field Guide to North American Reptiles and Amphibians. Alfred A. Knopf, New York. 743 pp.) reported spring mating for this species.

Histological examination revealed the ovarian follicles from the female collected in May (CAS 88135, 109 mm SVL) described in Banta (1963. Occas. Pap. California Acad. Sci. 36:1–12) as "developing eggs" had not started yolk deposition. One female collected in September (MVZ 150329, 100 mm SVL) contained 4 oviductal eggs and is the first clutch size reported for *E. panamintina.*

We thank J. Vindum (California Academy of Sciences), D. Wake (Museum of Vertebrate Zoology), and T. Reeder (San Diego State University) for permission to examine specimens.

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EUMECES SEPTENTRIONALIS SEPTENTRIONALIS (Northern Prairie Skink). **NESTING BEHAVIOR**. Somma and Fawcett (1989. Zool. J. Linn. Soc. 95:245–256) reported nesting and brooding activity for *Eumeces septentrionalis* in the laboratory, but field observations of *E. septentrionalis* nesting behavior are restricted to the accounts of Breckenridge (1943. Amer. Midl. Nat. 29:591–606), Nelson (1963. Unpubl. Ph.D. dissertation, University of Minnesota, Minneapolis), and Somma (1990. Bull. Chicago Herpetol. Soc. 25:77–80). Here, I augment the limited field data on nesting in *E. septentrionalis* with observations on 3 nests from southern Iowa.

On 22 June 2000 at ca. 0800 h, I observed 3 different *E. septentrionalis* nests each with an associated female and each under a different cover object in an open, grassy field on the south edge of Bridgewater (town; 41°14'N, 94°40'W), Adair County. One nest was under a piece of cement, one was under a flat rock, and one was under a piece of tin. I had placed all cover objects at each location in previous years. Soil in the area was silt loam or silty clay loam. Each female skink was in a short, horizontal burrow (6–10 cm long, 3–6 cm diam opening) with eggs that were poorly visible because they were far back in each burrow. Nest locations were flagged and the cover objects replaced. I returned to the area at ca. 1000 h the same day to observe each nest once again. Close examination revealed that each female had placed her eggs (clutch sizes = 4, 9, 11) into a shallow depression (ca. 2 cm deep) located outside and adjacent to each burrow opening. Each clutch was in the open depression and clearly visible when the cover object was removed during the 1000 h visit. Nests were located in sparsely vegetated areas, which provided better insolation than in adjacent areas. Through apparent repositioning of the eggs to the outside of each burrow and directly under a cover object, the females may have been making the environment of each clutch thermally more favorable for development. Two of three nests I observed hatched by 18 July (< 30 days), over 10 days faster than those reported by Breckenridge (1943. Amer. Midl. Nat. 29:591–606). Based on brooding observations of *E. septentrionalis* in the lab, Somma and Fawcett (1989. Zool. J. Linn. Soc. 95:245–256) reported an incubation interval of < 23 days.

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GAMBELIA SILA (Blunt-nosed Leopard Lizard). **PREDATION**. *Gambelia sila* is a fairly large member of the depauperate lizard fauna of California's San Joaquin Valley (Montanucci 1968. Herpetol. 24:316–320). This lizard, state and federally listed as endangered, remains over only about 15% of its historical range (Germano and Williams 1992. Trans. West. Sec. Wildl. Soc. 28:38–47). Understanding population dynamics, including potential predators, is essential to its recovery. Several predators of *G. sila* are known. These include two snakes, the San Joaquin coachwhip (*Masticophis flagellum ruddocki*) and gopher snake (*Pituophis catenifer*), and five birds, the prairie falcon (*Falco mexicanus*),

American kestrel (*Falco sparverius*), loggerhead shrike (*Lanius ludovicianus*), burrowing owl (*Athene cunicularia*), and roadrunner (*Geococcyx californianus*) (Montanucci 1965. Herpetol. 21:270–283; Tollestrup 1979. Ph.D. dissertation, University of California, Berkeley, 146 pp.; Germano and Carter 1995. Herpetol. Rev. 26:100). Here, we add two new species to the predator set on *G. sila*.

On 5 June 2002 at 0740 h, during a radio-telemetry study on the Lokern area of Kern County (California; 119°37'N, 35°22'W), we located the signal of a radio-collared *G. sila* coming from a northern Pacific rattlesnake (*Crotalus viridis oreganus*) that was curled up under a dead saltbush (*Atriplex* sp.). For the previous 5 days, we had located the signal in a burrow next to a wash ca. 3 m from where the rattlesnake was found. The area had burned in 1997, which killed native saltbush plants, and is one of 4 treatment replicates in a grazing study. Because of grazing and below-average rainfall in the previous winter, the land was largely devoid of herbaceous plants. We had tracked the *G. sila*, a small (100 mm SVL, 28.6 g) female, for 18 days. The rattlesnake, a small adult female (470 mm SVL and 74.6 g including the mass of the partially digested lizard and radio-telemetry package [2.2 g]), was euthanized by freezing. When the snake was opened, only the hind legs and tail of the lizard were recognizable (Fig. 1), which we think indicates that the lizard had been eaten several days prior to our finding it inside the rattlesnake.

On 23 May 2002, we captured an adult male *G. sila* (116 mm SVL, 53.6 g) in another part of the Lokern area. This area had not burned, was covered sparsely by living saltbushes, and was at the base of hilly terrain. We had taken 12 GPS locations until 18 June 2002, when the transmitter signal was determined to be coming from a distant location. We drove towards the signal (3.2 km straight-line distance) until we reached the base of a high-voltage powerline tower. The signal appeared to be coming from the nest of a pair of red-tailed hawks (*Buteo jamaicensis*), located ca. 30 m above the ground. We lost the signal 2 days later and were not able to recover the transmitter; we presume that one of the red-tailed hawks was responsible for the predation event. Although the northern Pacific rattlesnake and red-tailed hawk have been suspected as predators of *G. sila* (Tollestrup, *op. cit.*), these represent the first reports documenting, or suggesting, respectively, their preying on this lizard.

FIG. 1. Radiograph of the remains of a blunt-nosed leopard lizard (*Gambelia sila*) and its radio transmitter inside a northern Pacific rattlesnake (*Crotalus viridis oreganus*).

This work was carried out under U.S. Fish and Wildlife Service permit TE826513-1 and California Department of Fish and Game scientific collecting permit 801092-4 and accompanying memorandum of understanding. The rattlesnake (CAS 224701) was deposited with the California Academy of Sciences.

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HOMONOTA UNDERWOODI (Underwood's Gecko). **BODY TEMPERATURE.** *Homonota underwoodi* is an insectivorous oviparous gecko that inhabits the dry hot landscape of the Monte Phytogeographic Province (Cabrera and Willink 1980. Biogeografía de América Latina. O.E.A. Washington D.C. 109 pp.) in Provincia de San Juan, Argentina. Like most Argentine gekkonids, few data address its biology. Werner *et al.* (1996. Cuad. Herp. 10:62–67), who made observations on body temperatures on a small number of lizards (N = 7), provided the only published data on this species' biology. Here, I augment the few data on field body temperatures as part of a larger study on this species' ecology.

Field work was carried out in a dry streambed with a mosaic of flagstones and patches of sand in La Laja, Departamento Albardon, Provincia de San Juan, Argentina (31°19'S; 68°41'W). Data were collected every 10 days from August 2000 to August 2001 by revisiting bushes and low flagstones across the study site at random. Each individual was captured by hand. The cloacal temperature (TC), temperature of the substrate (TS) and temperature of the air (TA) were measured with a rapid reading Miller-Weber thermometer to the nearest 0.1°C. For each capture, we took TS on the substrate at the exact point of observation, and TA 1 cm above the substrate. For both TS and TA, we distinguished whether the temperature was taken in the sun, shade or partial shade (on shrubby margins).

Of 56 captured animals, 96% were on low flagstones and 4% were in burrows among shrubs in an area heavily altered by human activities and erosion. Mean body temperature was 26.3°C (s = 5.6°C, N = 56). An ANOVA addressing gender differences in TC was not significant ($F_{2,50}$ = 1.61, P = 0.20). An ANCOVA (TS as the covariate) revealed no interseasonal differences in TC ($F_{2,50}$ = 2.30, P = 0.10). Cloacal temperature and TA were not correlated (r = 0.07, N = 56, P = 0.65), but the strong correlation between TC and TS was significant (r = 0.90, N = 56, P < 0.01). Evidence suggests that thermoregulation is enabled through conduction with the substrate and seems independent of air temperature. In contrast, Werner et al. (*op. cit.*), working with *H. underwoodi* on the Telteca Reservation NE of Mendoza (Argentina), obtained a significant correlation between TC and TA. These differences may be a function of the small number of lizards Werner (*op. cit.*) had. Body temperatures and the contrasts between TC and TS were similar in both studies. Lizards in the Telteca study thermoregulated under dry (livestock) dung patties during the day in a manner similar to what we observed in this population where low flagstones were consistently used.

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LEIOSAURUS CATAMARCENSIS (NCN). **CLUTCH SIZE.** *Leiosaurus catamarcensis* is one of three species of a genus endemic to Argentina. It occurs across the arid west, from Catamarca to south of Mendoza, reaching altitudes over 1800 m in the pre-Cordillera de San Juan (Cei 1986. Mon. IV Mus. Reg. Sci. Nat. Torino, 527 pp.). Its conservation status is ambiguous, and has been defined as a species for which "insufficient knowledge" exists (Lavilla et al. 2000. Categorización de los Anfibios y Reptiles de la República Argentina. Asoc. Herp. Arg. 97 pp.). No reproductive information exists for any *Leiosaurus* (Cei, *op. cit.*). Here, we present data on clutch size for a wild-caught *L. catamarcensis* that deposited eggs in captivity.

On 13 February 2002, we collected a gravid female (103 mm SVL) *L. catamarcensis* at Los Blanquitos, 3 km W Jachal (city), Departmento Jachal, Provincia de San Juan, Argentina (30°30'S; 68°15'W). This site is in the Monte Phytogeographic Province, where a shrubby vegetation and sandy terrain is characteristic (Cabrera and Willink 1980. Biogeografía de América Latina. O.E.A. Washington D.C., 109 pp.). This female was maintained in a 45 cm x 60 cm box with a sand substrate and fed crickets. On 5 March 2002, the female laid 10 eggs in the box. Length and width of each egg was measured with Vernier calipers to the nearest 0.01 mm. Volume of each egg was calculated based on Dunham (1983. *In* Huey et al. [eds.], Lizard Ecology: Studies of a Model Organism, pp. 261–280, Harvard University Press, Cambridge, Massachusetts). Eggs averaged 1.84 cm (s = 0.11) in length; 1.23 cm (s = 0.09) in width; and 1.44 cm^3 (s = 0.24) in volume.

Eggs were deposited in the Herpetological Collection, Instituto y Museo de Ciencias Naturales, Universidad Nacional de San Juan, Argentina.

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LIOLAEMUS LINEOMACULATUS (NCN) **PREDATION.** *Liolaemus lineomaculatus* is a small lizard inhabiting the Patagonian steppe that is associated with open bunchgrass (*Stipa* sp., *Festuca* sp.) habitats (Cei 1986. Museo Regionale di Scienze Naturali, Monografie IV, Torino, Italy. 528 pp.). Cei (*op. cit.*) found a population probably referable to this species in Primeros Pinos (38°52'S, 70°34'W), Neuquén Province, ca. 290 km N of our site. Recently, new specimens were found in northern Río Negro and Chubut Provinces (Ibargüengoytía et al. 2001. Herpetol. Rev. 32:120). The specimen reported in this note represents the first record of predation on *L. lineomaculatus* by an Aplomado falcon (*Falco femoralis*) and the second record for Neuquén Province, implying that its distribution may be continuous along the Patagonian Andes from at least central Neuquén Province to the north to Santa Cruz Province to the south.

On 20 November 2001, we found an apparently road-killed Aplomado falcon with remains of a specimen of *Liolaemus lineomaculatus* in its stomach. The lizard was too digested to sex, but we estimated its size to be at least 44 mm SVL. The falcon was found on Route 237 (41°02'S, 71°09'W) in southern Neuquén Province, 22 km NE from the city of Bariloche, Río Negro Province, in Parque Nacional Nahuel Huapi, northwestern Argentine Patagonia. The Aplomado falcon is an open country predator which ranges from southern Texas and New Mexico to Tierra del Fuego (Ferguson-Lees and Christie 2001. Raptors of the World. Christopher Helm, London. 992 pp.). Its diet consists primarily of birds and insects (Hector 1985. Condor 87:336–342; Jiménez 1993. J. Raptor Res. 27:161–163; Bó 1999. Ornitol. Neotrop. 10:95–99). Although it has been recorded to occasionally prey on another species of *Liolaemus* in central Chile (*L. nitidus*: Jiménez, *op. cit.*), this record is the first for *L. lineomaculatus*.

We thank Nora Ibargüengoytía for identifying the *Liolaemus* specimen, and J. Brian Hauge and Marc P. Hayes for their valuable comments. The Delegación Técnica Regional Patagonia (Administración de Parques Nacionales) provided the authors the permit to collect the falcon specimen in Parque Nacional Nahuel Huapi.

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SCELOPORUS MAGISTER UNIFORMIS (Yellow-backed Spiny Lizard). **PREY**. *Sceloporus magister* has been occasionally documented eating vertebrate prey, but only lizards (Stebbins 1985. Field guide to western reptiles and amphibians, 3rd ed. Houghton Mifflin Co., Boston, Massachusetts. 336 pp.). Vitt and Ohmart (Herpetologica 30:410–417) found a juvenile *Cnemidophorus tigris* in one stomach of this subspecies. Here we report the first mammal prey of *S. magister.*

At 1030 on 10 August 2002 at Cottonwood Spring, Riverside County, California (33°45'N; 115°32'W; elevation 900 m), we observed a large female *S. m. uniformis* with a small bat in its mouth. Based on its small size and light dorsal color, the bat was likely a western pipistrelle (*Pipistrellus hesperus*). The lizard was on the ground of the patio of the visitor center, where it is regularly seen. Bats roost frequently under nearby eaves. During the roughly 5 minutes that we observed this encounter, the lizard shook the bat vigorously several times, chewed on it, and dragged it. It disappeared from view while we were momentarily distracted by visitors. A subsequent search of the area failed to reveal either lizard or bat. As we did not observe the final outcome of this potential predation event, whether the lizard was able to swallow the bat is uncertain.

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SERPENTES

ANILIUS SCYTALE (Red Pipesnake). **PREDATION**. *Anilius scytale* is a black-and-red colored, 70–90 cm long, semiaquatic, burrowing snake, native to equatorial South America east of the Andes (Greene 1997. Snakes: the Evolution of Mystery in Nature. University of California Press, Los Angeles, 351 pp.). We are unaware of any reports of predation on *A. scytale*. We report here an instance of predation on *Anilius scytale* by the roadside hawk, *Rupornis magnirostris* (Aves: Accipitridae). On 8 March 2002 at 1012 h we observed the hawk attacking a snake on an unpaved road besides a small creek (02°43'55"S, 44°17'31"W, 31 m elev.) in an area of Amazon Forest in São Luís, Maranhão, northeastern Brazil. With our approach, the hawk flew away carrying just the posterior part of the snake. Examination of the anterior portion of the snake revealed head wounds consistent with pecking.

The specimen of *A. scytale* cited here is deposited in the Museu de História Natural da Universidade Estadual de Campinas (ZUEC 02683). R. J. Sawaya gave us encouragement to submit this report; CAPES provided a grant to JPM.

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BOA CONSTRICTOR (Boa Constrictor). **DIET.** Boa constrictors are large-bodied snakes known to prey on a variety of lizards, birds, and mammals (Greene 1983. *In* Janzen [ed.], Costa Rican Natural History, pp. 380–383. University of Chicago Press, Chicago, Illinois). Previous accounts of avian diet items in *B. constrictor* were recently summarized in Boback et al. (2000. Herpetol. Rev. 31:244–245). Here we report an additional avian prey item. At 0735 h on 19 May 2002, an adult male *B. constrictor* (SVL 132 cm, 1.1 kg, with prey) was discovered constricting an adult female great-tailed grackle (*Quiscalus mexicanus*, Icteridae) near a resort in Placencia, Belize (Fig. 1). This snake was collected ca. 3 m above ground hanging in a dead tree and was surrounded by a flock of agitated great-tailed grackles. Ingestion of the bird, from first movement of mouth parts to storage in stomach, took 17 minutes.

FIG. 1. Male Boa constrictor in the process of swallowing an adult female great-tailed grackle near Placencia (Stann Creek District), Belize.

We thank R. N. Reed for reviewing this manuscript as well as Kitty's Place Resort for allowing us to process and store boas while in Placencia.

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BOA CONSTRICTOR (Boa Constrictor). **DIET**. Recently, Bakkegard and Timm (2001. Herpetol. Rev. 32:261–262) reviewed the rodent prey reported for *Boa constrictor* and added a first record of predation on the Big-eared Climbing Rat (*Ototylomys phyllotis*; Muridae; Rodentia), from Parque Nacional Palo Verde, Guanacaste Provice, Costa Rica. In this note, we report an additional specimen of *O. phyllotis* regurgitated by a female *B. constrictor* (SVL 986 mm, TL 1013 mm), captured on 3 January 2002 in Sector San Benito of Parque Nacional El Imposible, Depto. Ahuachapán, El Salvador, 530 m elev. (13º49'N, 89º56'W). *O. phyllotis* is a common inhabitant of dry, deciduous lowland forests and dense second growth (Reid 1997. A Field Guide to the Mammals of Central America and Southeast Mexico. Oxford University Press, New York. 334 pp), habitat types that are prevalent in the Dry Tropical Forest life zone which includes both the Costa Rican and Salvadoran localities. Because these localities are situated respectively near the southern and northern limits of this particular life zone, our findings may indicate that *O. phyllotis* constitutes a regular component of *Boa constrictor* diet in this ecological assembly.

An additional female *Boa constrictor* (SVL 1145 mm, TL 1280 mm) collected on 18 February 2002, in Sector La Fincona of Parque Nacional El Imposible, Depto. Ahuachapán, El Salvador, 780 m elev. (13º50'N, 89º58'W) was found to contain a recently eaten Deppe's Squirrel (*Sciurus deppei*; Sciuridae: Rodentia) in its stomach. The snake was discovered as it crossed a dry creek bed in a forested environment, hindered in its movements by the size of the prey animal in its stomach (head-body length 210 mm, tail length 200 mm). *S. deppei* is known to be largely arboreal, but sometimes descends to the ground to feed or cross clearings (Reid 1997, *op. cit.*). Even though *B. constrictor* is semi-arboreal, it seems unlikely that the snake managed to overpower and ingest a prey animal of this size on an arboreal perch. This is the first record of a *B. constrictor* feeding on any Neotropical squirrel.

Both specimens of *B. constrictor* (YPM R12438 and YPM R12327) and the *S. deppei* (YPM 1561) are deposited in the collection of the Yale Peabody Museum of Natural History. The specimens were collected under permits from the Ministerio de Medio Ambiente y Recursos Naturales, San Salvador, El Salvador (MARN-DGPN-AIMA-8-01 and MARN-DGPN-AIMA-01-2002), and transported under CITES permit 02399. We thank James G. Owen for identifying the remains of *O. phyllotis* and confirming

the identity of *S. deppei.*

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BOIGA CYANEA (Green Cat Snake) **MALE RIVALRY**. A group of adult (2.1) *Boiga cyanea* are maintained together in a display cage at West Midland Safari Park, England. A pair of the trio had produced fertile eggs resulting in viable hatchlings prior to their arrival at WMSP (Matthewson 1997. Herptile 22:113–118). On 26 August 1998, at 1830 h, the two males were observed locked in combat on the floor of the cage whilst the female was coiled on a branch above. The male rivalry consisted of both males entwining their elongate tails together in a tight and complex knot whilst their mid and anterior body sections and heads were used to compress the other to the floor in a slow twisting motion. This behavior was observed for ca. 10 min. before the males separated. The following morning the male that had previously mated the female was coiled with her on the branch whilst the second male was located under the cage floor furnishings.

Male rivalry is commonly reported for viperids, elapids, and boids, and colubrids of the genera *Elaphe*, *Lampropeltis*, and *Pituophis* (Gillingham 1987. *In* Seigel et al. [eds.], Snakes: Ecology and Evolutionary Biology, pp. 192–197. Macmillan, New York; Ford and Burghardt 1993. *In* Seigel and Collins [eds.], Snakes: Ecology and Behavior, pp. 137–139. McGraw-Hill, New York). Shine (1978. Oecologia 33:269–277) lists male rivalry in nine non-venomous colubrid species but nocturnally arboreal, rear-fanged taxa are not represented. This appears to be a first record of male agonistic behavior, in the presence of a female, for the Asian genus *Boiga*.

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BOTHROPS ALTERNATUS (Urutu). **PREDATION**. *Bothrops alternatus* is a large terrestrial pitviper that occurs from central Brazil to central Argentina (Campbell and Lamar 1989. The Venomous Reptiles of Latin America, Comstock, Ithaca, New York. 425 pp.). We are unaware of any reports of predators on *B. alternatus*. We present two instances of predation and a predation attempt on *B. alternatus* by the burrowing owl, *Athene cunicularia* (Aves: Strigidae). All observations were made in Itirapina Ecological Station (IES; 22°15'S; 47°49'W, 750–780 m elev.), municipalities of Brotas and Itirapina, São Paulo State, southeastern Brazil. The *B. alternatus* and three other pitvipers (*Bothrops itapetiningae*, *B. moojeni*, and *Crotalus durissus*) are common in IES.

The first predation event occurred on 13 April 2001 at 2143 h on an unpaved road crossing an area of pristine "campo sujo" (shrubby grassland). During night driving to search for snakes we spotted a burrowing owl on the ground; when approached by the car, the owl flew away carrying a snake within its claws. After about 15 min. of unsuccessful trials, we succeeded in approaching the owl (ca. 7 m). It was on the ground, tearing small pieces (apparently only muscles and/or internal organs) off the anterior part of the snake and eating them. The snake was still showing motor reflexes, indicating that it had been attacked just before we first spotted the owl. We then drove the owl away from its prey, a young male *B. alternatus* (estimated SVL ca. 330 mm, tail 45 mm, ventrals remaining 133, estimated mass ca. 25 g). The snake's head and ca. 50–60 mm of the anterior part of the body were missing. Small portions of loose skin at the anterior end of the snake showed that the owl cut the skin middorsally and midventrally. The muscles under one of these portions of loose skin were missing (perhaps removed by the owl). There were no remains of the snake's head or neck at the site where the owl was feeding.

The second predation occurred on 26 August 2002 at 2050 h (air temperature 16°C; substrate temperature 20°C) on an unpaved road with pristine "campo limpo" (grassland) at one side and disturbed grasslands at the other. During night driving, FS spotted a burrowing owl on the ground with a snake under its claws; when we approached, the owl flew away leaving the snake on the ground. The snake (a young male *B. alternatus*; SVL 253 mm, tail 81 mm, 72.5 g) was still alive, trying to move away. The top of its head was deeply perforated (from the quadrate region to the eyes) and its left side was connected to the remains of the right side only by the anterior fourth of the head (Fig. 1). There were no additional marks on the body.

The predation attempt occurred on 2 November 2002 at 1910 h on an unpaved road crossing an area of transition beween "campo sujo" and "campo cerrado" (shrubby grassland with trees). During night driving, RJS spotted a young female *B. alternatus* (SVL 637 mm, tail 58 mm) with its body streched on the road. A burrowing owl was standing on the ground, ca. 1.5 m from the snake, staring at it. After a few minutes, the owl made two short flights (ca. 2 m each) keeping its distance from the snake, walked to a spot ca. 2.5

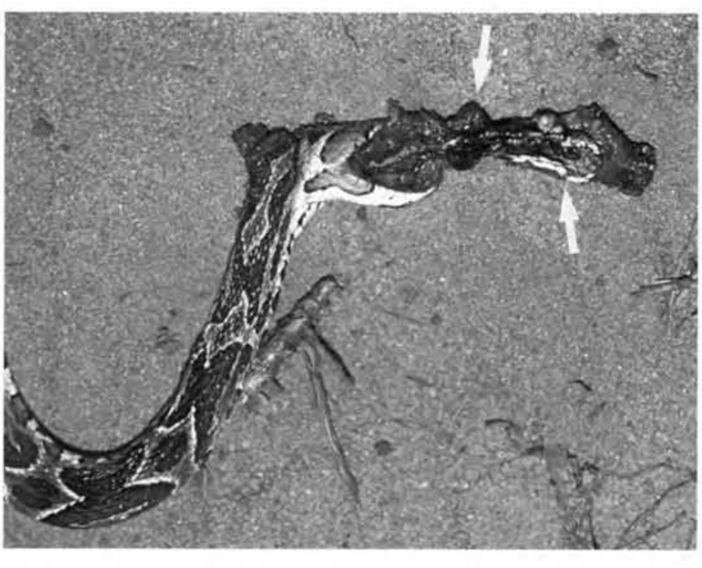

FIG. 1. Detail of the anterior part of a young male *B. alternatus* showing the wound made by a burrowing owl in Itirapina Ecological Station, southeastern Brazil. Note the lower jaw (lower white arrow) connected to the remaining body by the snout (upper arrow) region.

m from the snake, and from this spot flew towards the snake, pecked its head and landed ca. 1 m from it. Immediately after being attacked by the owl, the snake coiled its body. The owl then flew to a spot ca. 2.5 m from the snake, stayed there for 5 min., staring at the snake, and flew away (perhaps disturbed by the observer positioned ca. 10 m from the snake). When the observer approached the snake, it was hiding its head within its body coils; when approached further (about 1 m), it struck twice and hid its head again. At close examination, the snake showed a fresh small wound on the posterior part of the dorsolateral region of the head. It was then marked with a pit tag and released.

In disturbed areas in the region of São Carlos (ca. 20 km from IES), the burrowing owl feeds on insects and small vertebrates, although snake remains are very rare in pellets (four snakes out of 685 vertebrate prey; J. C. Motta-Junior, unpubl. data). However, if these owls do not eat the snake skin (as indicated by our first observation), snakes may be more frequently eaten than the examination of pellets suggest. Valdujo and Nogueira (2000. Herpetol. Rev. 31:45) reported on another species of *Bothrops* (*B. neuwiedi pauloensis*) as prey of a burrowing owl at Mineiros, Goiás, central Brazil.

Both snakes of the predation events are deposited in the Museu de História Natural, Universidade Estadual de Campinas (ZUEC 02471 and 02777, respectively). D. Zanchetta and the staff of Instituto Florestal facilitated our fieldwork at IES and J. C. Motta-Junior provided unpublished data and discussed with us the feeding habits of the burrowing owl. This is publication number 3 of the project Ecology of the Cerrados of Itirapina, funded by FAPESP.

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BOTHROPS INSULARIS (Golden Lancehead). **DIET**. Accurately determining prey selection and foraging events is essential for a complete understanding of predator foraging ecology and their impact on prey communities (MacGregor and Reinert 2001. Herpetol. Rev. 32:170–172). Snakes living on small islands may have a relatively limited range of prey items available, and sometimes depend on seasonal bird migration (e.g., *Macrovipera schweizeri* [Nilson et al. 1999. Amphibia-Reptilia 20:355–375]; and *Gloydius shedaoensis* [Sun et al. 2001. Biol. Conserv. 97:387–398]).

On 20 November 2001 (1800 h) at Queimada Grande, a tiny island off the southeastern coast of Brazil (24°28'S, 46°40'W), we discovered an adult *Bothrops insularis* (ca. 60 cm total length) coiled on a freshly-killed adult Grey-fronted Dove (*Leptotila rufaxilla*) on the ground. The head and neck feathers were covered with saliva indicating that the snake had attempted to swallow the bird. Diameter at the thickest part of the bird's body was ca. 10 cm, presumably too large to be ingested by the snake. Interactions between *Bothrops insularis* and *Leptotila rufaxilla* may be common, because this bird is a frequent ground forager. A similar instance of "ingestion failure" was reported by Campos and Mello Filho (1966. A Folha Médica 52[5]:21–44).

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CAUSUS MACULATUS (West African Night Adder). **MALE RIVALRY**. A pair of snakes was observed in 'combat' on the grounds of a village house (expedition HQ) in the village of Bonjongo on the slopes of Mt. Etinde, in southwestern Cameroon, in February 1989. The pair was observed moving rapidly and attempting to press one another to the ground using their raised head and anterior body. There was also a considerable amount of tail-lashing. Both the snakes were presumed to be males, combating for a nearby but unseen female, since Gillingham (1987. *In* Seigel et al. [eds.], Snakes: Ecology and Evolutionary Biology, pp. 184–209. Macmillan, New York) reports than intersexual combat behavior is rare and only observed under captive conditions.

The snakes were disturbed by the presence of the observers and they parted company to escape but one of the pair, a male, was captured and photographed. Pitman (1974. A Guide to the Snakes of Uganda, revised edition. Wheldon & Wesley, England. 290 pp.) includes Loveridge's report of fighting, biting, and neck flattening in wild male *Causus lichtensteini* and Broadley (1983. FitzSimon's Snakes of Southern Africa. Delta Books, Johannesburg. 376 pp.) reports combat in captive male *C. defilippii* and similar behavior is reported by Spawls and Branch (1995. The Dangerous Snakes of Africa. Blandford, London 192 pp.) for the same species but there seem to be no previous records of male rivalry in *C. maculatus*.

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CEMOPHORA COCCINEA (Scarlet Snake). **SEASONAL ACTIVITY.** In their review of the seasonal activity of *Cemophora coccinea* in Florida, USA, Enge and Sullivan (1999. Herpetol. Rev. 31:82–84) found relatively little evidence of activity during the cooler months and no records of captures during January. On 6 January 1997, I found a DOR *C. coccinea* (475 mm SVL; Milwaukee Public Museum MPM 33145) on State Highway 710 west of County Road 711, ca. 16 km W of Jupiter, Palm Beach County, Florida, USA. The weather was relatively warm; Florida cricket frogs (*Acris gryllus dorsalis*) were calling and juvenile alligators (*Alligator mississippiensis*) were active in the near vicinity. This observation is consistent with Enge and Sullivan's (*op. cit.*) speculation that *C. coccinea* may display normal low-level winter activity during warm weather.

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CONOPSIS BISERIALIS (Two-lined Mexican Earth Snake). **LITTER SIZE.** On 24 March 2001, one gravid female *Conopsis biserialis* was found in a site 900 m N of Tancítaro, Michoacán, México (19°19'78.3"N, 102°22'80.2"W), 2075 m elev. The female was transported to the laboratory, housed in a container, and fed mealworm (*Tenebrio molitor*) larvae. On 16 June 2001, the female (25.7 cm SVL, 4.0 cm tail length TL) gave birth to four live neonates. Each neonate was measured and weighed. Female mass before and after parturition was 23.9 g and 16.3 g. Neonate measurements were (mean ± SD, range): 9.30 ± 0.73 cm, 8.20–10.10 cm SVL; 1.60 ± 0.30 cm, 1.20–2.0 cm TL; 1.3 ± 2.10 g, 1.3–1.3 g .

We thank Elsa Estrada-Virgen and Gabriela Esquivel-Flores for assistance in field work and the Coordinación de Investigación Científica, UMSNH project 5.5 for financial assistance.

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ECHINANTHERA CEPHALOSTRIATA (NCN). **DIET.** Predation on anuran eggs by Neotropical snakes is apparently widespread, although unreported for the colubrid *Echinanthera cephalostriata*. In November 1991 we received an adult male *E. cephalostriata* (540 mm total length) from Marmeleiro, Almirante Tamandaré Municipality, Paraná State, Brazil, now housed in the Museu de História Natural Capão da Imbuia herpetological collection (MHNCI 4690). We examined stomach contents and found 32 intact frog eggs, appearing to have just been ingested and at an early developmental stage. The eggs were identified as belonging to the leptodactylid genus *Eleutherodactylus* (probably *E. guentheri*, the only species of this genus known for this locality, and like other species in the genus it lays terrestrial eggs which undergo direct development).

Snake identification was verified by Marcos Di-Bernardo, and the *Eleutherodactylus* eggs by Magno Vicente Segalla.

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ELAPHE OBSOLETA SPILOIDES (Gray Ratsnake). **FEEDING.** Food of *Elaphe obsoleta*, includes largely birds, bird eggs, and mammals, with the latter predominating in studies from Kansas (Fitch 1963. Copeia 1963:649–658) and Maryland (Stickel et al. 1980. Am. Midl. Nat. 103:1–14). The southern subspecies may be highly arboreal in its pursuit of these prey (Jackson 1974. Auk 91:342–347).

Large snake species like those in the genus *Elaphe* may take only a few large meals during a year (Mushinsky 1987. *In* Seigel et al. [eds.], Snakes. Ecology and Evolutionary Biology, pp. 302–334. Macmillan Publ., New York, New York) making field observations of these rare events less likely. One of us (DL) observed a feeding event between a large adult *E. o. spiloides* and an adult gray squirrel (*Sciurus carolinensis*) in mid-May 2001 at ca. 1600 h at Melton Bottom, ca. 15 km ESE West Point, Clay County, Mississippi, USA. The snake, estimated at > 2 m total length, and squirrel fell to the ground simultaneously but not entwined, from a height of ca. 10 m in an oak tree. DL retrieved a camera and took 14 photographs as the snake constricted and consumed the squirrel.

The squirrel was still living but appeared stunned after falling. It may have already been attacked and constricted in the tree. Constriction (Fig. 1) appeared typical for snakes of the genus *Elaphe* as illustrated and described by Willard (1977. Copeia 1977:379–382). Following the terminology of Greene and Burghardt (1978. Science 200:74–77), the constriction shown in Fig. 1 involved a winding application movement, snake's belly away from its head, posterior coil composition, and long axis of coil horizontal to substrate. Complete headfirst consumption of the squirrel took ca. one hour during which time the snake was no longer coiled around the squirrel.

FIG. 1. Feeding constriction of a gray squirrel by an adult gray ratsnake (*Elaphe obsoleta spiloides*) in Mississippi. The snake's head, with one eye and extended tongue, is visible just to the right of the squirrel's head.

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LAMPROPELTIS CALLIGASTER CALLIGASTER (Prairie Kingsnake). **PIGMENTATION**. In early October 1988, a leucistic juvenile male *Lampropeltis c. calligaster* was discovered DOR by Patricia Pisani within the city limits of Lawrence (Douglas County) Kansas, USA. It was preserved by GRP, and is in the KUMNH collection (KU 291545). There exists the possibility that the animal was albino, though condition of the specimen precluded precise determination. Albinism in *L. c. calligaster* was summarized by Dyrkacz (1981. SSAR Herpetol. Circ. No. 11:1–32). Overall pigmentation is white, with faintly discernible pattern typical of the species.

Sincere thanks are expressed to Patricia Pisani for collecting the snake.

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LAMPROPELTIS TRIANGULUM (Milk Snake). **HABITAT.** Habitat associations of the milk snake in the western United States are poorly understood. In the eastern Great Basin and in the northern Colorado Plateau, accounts typically state that *Lampropeltis triangulum* is found in forests, grasslands, and riparian zones, especially in relatively mesic montane valleys and foothills (e.g., Cox and Tanner 1995. Snakes of Utah. Brigham Young University, Provo, Utah. 92 pp.; Hammerson 1999. Amphibians and Reptiles in Colorado. University Press of Colorado, Niwot, Colorado. 484 pp.; Williams 1988. Systematics and Natural History of the American Milk Snake. Milwaukee Public Museum, Milwaukee, Wisconsin. 176 pp.). Recent observations, and a re-evaluation of previously reported collection localities, indicate that *L. triangulum* inhabits a broader spectrum of habitats. One of us (KWS) observed a *L. triangulum* in arid, big sagebrush (*Artemisia tridentata*) dominated shrubland along the foothills of the Stansbury Mountains, Tooele Co., Utah, USA, in the eastern Great Basin. Surface water was not present within several miles. The presence of *L. triangulum* in arid sagebrush shrubland in the eastern Great Basin is further supported by additional specimens from nearby localities (BYU 334, USNM 335572), from literature reports from another site in the Stansbury Mountain foothills (Brown and Parker 1982. *In* Scott [ed.], Herpetological Communities, pp. 59–81. U.S. Fish and Wildlife Service, Wildlife Research Report No. 13), and from a specimen from similar habitat south of the Stansbury Mountains (BYU 8922).

Two of us (DGM and BLW) also encountered two specimens of *L. triangulum* in arid, sparsely vegetated, greasewood (*Sarcobatus*), sage (*Artemisia*), and shadscale (*Atriplex*) shrubland habitats in the northern Colorado Plateau, Carbon Co., Utah, USA. Surface water was not present near either location. Both observations of *L. triangulum* from the Colorado Plateau were from broad, desert flats of the upper Price River drainage. Shaded range maps provided by Cox and Tanner (*op. cit.*) erroneously indicate that *L. triangulum* occurs only in montane regions of the Wasatch Plateau and the Book Cliffs in this region. The presence of *L. triangulum* in arid shrubland habitats in the northern Colorado Plateau is supported by several museum specimens (BYU 2933, BYU 30531, LACM 102472–3, UTEP 9593). Records of *L. triangulum* on the Colorado Plateau south of the Colorado River are also from arid habitats far from sources of permanent water (Fowlie 1965. The Snakes of Arizona. Azul Quinta Press, Fallbrook, California. 164 pp.; Holycross and Simonson 1998. Herpetol. Rev. 29:113–114; Erika Nowak, pers. comm.). However, all of these southern specimens are from grassland habitats. None of the *L. triangulum* we observed was found in an area with a substantial grassy component. These observations indicate that *L. triangulum* in the western United States occupies a wider variety of habitats than is typically recorded, and might be more widely distributed than is currently known.

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LAMPROPELTIS ZONATA (California Mountain Kingsnake). **DIET**. *Lampropeltis zonata* is an inhabitant of mesic, well lit, rocky canyons and moist woodlands. Its diet (reviewed in Zweifel 1974. Cat. Am. Amphib. Rept. 174.1–174.4; McGurty 1988. Proc. Conf. California Herpetol. 73–78; Cranston 1994. Vivarium 6[3]38–43,47) consists of squamates and their eggs, mammals, and birds. Documentation of *L. zonata* predation on lizards includes skinks (*Eumeces*) and spiny lizards (*Sceloporus*). Here we report the first evidence for predation on an alligator lizard (*Elgaria*). This report is also significant because of the relatively large size of the food item.

While conducting biotic field surveys in Sequoia National Forest (USA: California: Kern Co.) we collected a subadult, male *L. zonata* (295 mm SVL, 11.5 g) at Alder Creek, Greenhorn Mountains (35°43'6.5"N, 118°35'48.2"W). The snake was found on 18 June (~1500 h), under a rock 5 m from the creek. The body of the *L. zonata* was visibly distended. Regurgitation of the food item was induced by palpation. The food item was revealed to be a southern alligator lizard (*Elgaria multicarinata*; 79 mm estimated SVL, 7.1 g) that was swallowed head first. The mass of the partially digested *E. multicarinata* was 61.7% of the mass of the *L. zonata*. The *L. zonata* and *E. multicarinata* were deposited in the California Academy of Sciences (CAS 223955).

We thank Michelle Koo, Jens Vindum, and Phillip Strand for their supervision during this field work which was funded by Challenge Cost-Share Agreement #00-CC-11051322-034, Forest Service Region 5, Sequoia National Forest.

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MASTICOPHIS FLAGELLUM CINGULUM (Sonoran Coachwhip). **DEFENSIVE BEHAVIOR.** *Masticophis flagellum* exhibits a suite of defensive behaviors when threatened or handled, including mouth gaping, hiding the head under the body, hissing, holding the trunk limp, and vibrating the tail (reviewed by

Carpenter and Ferguson 1977. *In* Gans and Tinkle [eds.], Biology of the Reptilia, Vol. 7, Ecology and Behavior, pp. 335–554. Academic Press, New York, New York). Recent observations document death feigning by coachwhips in Oklahoma (Tucker 1989. Herpetol. Rev. 20:72) and Arizona (Repp 2001. Sonoran Herpetol. 14:130–131). Here I document a defensive behavior previously unreported for this species.

On 21 July 2001 at ca. 1030 h, I captured a juvenile *M. f. cingulum* (ca. 30 cm SVL) from under debris near Tucson, Arizona, USA (32°08'N, 110°41'W). It had rained < 0.1 cm earlier in the day and was unseasonably cool (30°C at 1 m above ground). The snake was somewhat active in hand but made no attempt to bite; therefore, I held the snake loosely without restraining it behind the head. The snake did not defecate. While positioning the snake for photography, it assumed a "snout down-neck up" posture. The snout was positioned greater than 45° to the ground, pushed into the substrate, and the snake's neck was raised and arched. The snake periodically made tentative attempts to crawl away but was easily recaptured and repeatedly assumed the position described. The snake continued this behavior for 12–15 min. while being photographed.

This behavior has been reported for several snakes including elapids, viperids, and colubrids (e.g., *Pituophis catenifer* and *Elaphe* spp.) (see Carpenter and Ferguson 1977, *op. cit.*), although its function is unclear.

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MICRURUS ALTIROSTRIS (Southern Coral Snake). **DIET**. The diet of South American coral snakes includes amphisbaenians, lizards, snakes, caecilians, fishes and invertebrates (Procter 1923. Proc. Zool. Soc. 192:1061–1067; Dixon and Soini 1977. The Reptiles of the Upper Amazon Basin, Iquitos Region, Peru II: Crocodilians, Turtles and Snakes. Milwaukee Publ. Mus. 91 pp.; Vanzolini 1986. Levantamento Herpetológico na área do Estado de Rondônia sob a Influência da Rodovia BR 364, Relatório de Pesquisa 1, Brasília: CNPq, Assessoria Editorial 50 pp.; Cunha and Nascimento 1993. Bol. Mus. Par. Emílio Goeldi 9:1–191; Jorge da Silva 1993. Herpetol. Nat. Hist. 1:37–86; Marques and Sazima 1997. Herpetol. Nat. Hist. 5:88–91). *Micrurus altirostris* feeds on amphisbaenians of the genus *Amphisbaena* and snakes of the genera *Atractus*, *Liophis,* and *Sibynomorphus* (Jorge da Silva 1995. Molecular Systematics and Evolution of Venoms in the South American "Triad" Coral Snakes (*Micrurus,* Elapidae). Ph.D. dissertation. Brigham Young Univ. Provo. 226 pp.). However the data available are not sufficient to determine the species of amphisbenids involved, owing to the degree of preservation of the specimens found in stomach contents (Jorge da Silva and Aird 2001. Comp. Biochem. Physiol. Part C 128:425–456).

On 14 January 2000, we collected on the eastern bank of Uruguai River (27°22'42"S, 51°28'58"W) a specimen of *M. altirostris,* near Itá, Santa Catarina, Brazil (Centro de Estudos e Pesquisas Biológicas, Goiânia, Goiás - CEPB/RSR 016, SVL 529 mm) that contained a specimen of *Amphisbaena prunicolor* (169.7 mm TL). The head of the *A. prunicolor* was completely digested. This is the first record of *M. altirostris* feeding on amphisbenids identified to the specific level and it might help to better our knowledge of the biology of this species of Southern Brazil.

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NERODIA ERYTHROGASTER FLAVIGASTER (Yellow-bellied Water Snake). **MATING AGGREGATION.** I observed a mating aggregation of water snakes (*Nerodia erythrogaster flavigaster*) below a bridge in a small seasonal stream in my suburban neighborhood in West Point, Clay County, Mississippi, USA (33°35'14"N, 88°37'46"W). Observations were made between 1015 and 1100 h on 28 April 2001, air temperature ca. 21°C; water depth ca. 0.5 m, clear and flowing; location in direct sunlight; stream < 5 m wide. I was on a bridge ca. 6–7 m above and 3–4 m horizontally away from a group of 3–4 large cement blocks, each ca. 1–1.5 m^2 and 0.5 m thick. I have walked across this bridge on foot hundreds of times per year for the last 15–20 yr and previously have seen only one snake at this location.

Initially, I observed one adult snake emerging from beneath one of the blocks onto the sloping surface of another block as if to bask. In a few moments, a smaller individual emerged and began gliding over the back of the first individual, crawling first toward its head, then toward its tail. Another large individual emerged into the water on the other side of this same block, followed quickly by another smaller individual. This second larger individual remained rather motionless and seemingly passive in the water while the second individual maneuvered alongside. In fairly rapid succession, three smaller individuals emerged from under the block and moved alongside the first individual, such that the five snakes were aligned in an undulating fashion. The tails of some of them were intertwined and I could see the plain yellow bellies of some of the snakes as their tails and lower bodies twisted together. Heads

FIG. 1. Mating aggregation of five or six yellow-bellied water snakes (*Nerodia erythrogaster flavigaster*) in West Point, Mississippi, USA. Intertwined tails of five individuals are visible to the left and heads of four individuals scattered upper center and upper right.

of all five snakes were also visible and exhibited no obvious interactions such as pushing or biting. At this point, I left to get a camera and was gone for ca. 20 min.

When I returned, I observed an aggregation of snakes on the flattest part of a different block in the center of the stream (Fig. 1) and took a series of six photographs. Some photos show five heads and the rear parts and tails of five bodies aligned in plain view on top of the cement block. The snakes separated as I took the last photo and there was no evidence that there had been successful intromission as would have been evidenced by two of the snakes staying connected. Because the two larger individuals (est. length 1 m) appeared passive and sedentary and had larger heads, I assumed that they were females and that the five smaller individuals (est. length 0.6–0.75 m) were all males.

Mating in *N. erythrogaster* has been noted from April to June in different parts of its range (Diener 1957. Herpetologica 13:203–211, Arkansas; Wright and Wright 1957. Handbook of Snakes, Comstock Publ., Vol. I, 564 pp., Illinois and Michigan; Preston 1970. The Comparative Ecology of Two Water Snakes, *Natrix rhombifera* and *Natrix erythrogaster*, in Oklahoma. Ph.D. dissertation. Univ. of Oklahoma, Oklahoma. 79 pp.). Mating aggregations have been reported in *N. sipedon* (Tinkle and Liner 1955. Field and Lab. 23: 84–87; Mushinsky 1979. J. Herpetol. 13:127–129) but I found no studies describing mating groups of *N. erythrogaster*.

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OXYBELIS FULGIDUS (Green Vine Snake). **PREY**. *Oxybelis fulgidus* is a large opistoglyphous colubrid snake that is known to prey on anoles (genus *Norops*) and other lizards, but also on frogs, small mammals, birds, and insects (Köhler 2001. Reptilien und Amphibien Mittelamerikas. Band 2: Schlangen. Herpeton Verlag, Offenbach, Germany. 174 pp)..

During a recent study of the herpetofauna and avifauna of El Salvador, an adult male *Oxybelis fulgidus* (SVL 1285 mm, TL 1972 mm) was found tangled in a mistnet, attempting to eat an adult Ruddy Woodcreeper (*Dendrocincla homochroa*; Dendrocolaptidae; Passeriformes) that was caught in the net earlier. The snake was discovered at 1600 h on 17 February 2002, in a 20-year old patch of secondary vegetation in Sector La Fincona of Parque Nacional El Imposible, Depto. Ahuachapán, El Salvador, at 750 m elev. (13°50'N, 89°58'W), as it held the head and neck of the *D. homochroa* in its mouth and with several strands of the net's mesh wrapped around its head and caught on its temporal and nuchal scales. The snake was unable to release the bird or extricate itself. Examination of the bird revealed several puncture marks on the left scapular region and upper wing, which corresponded with the width of the snake's mouth, presumably from the initial bite and the subsequent "chewing" for injecting the immobilizing Duvernoy's gland secretion.

The *D. homochroa* entered the net ca. 25 cm above the ground, but weighed down the net sufficiently so that its body almost touched the forest floor. *O. fulgidus* hunts for both terrestrial and arboreal prey, but invariably from an arboreal perch (Henderson and Nickerson 1975. Brit. J. Herpetol. 5:663–667). Because the net was placed in a roughly 2 m-wide lane cleared of vegetation and adjacent branches, the snake could only approach the bird over the ground, making this the first record of *O. fulgidus* descending to the ground to hunt.

These snakes seem incapable of visually locating prey that remains immobile (Henderson and Nickerson 1975, *op. cit.*). The movements of the netted bird must have been sufficient to draw the snake's attention and entice it to descend from a nearby perch and cross the ca. 1.5 m wide cleared net lane from the closest vegetation.

Both the *Oxybelis fulgidus* and the *Dendrocincla homochroa* are deposited in the collection of the Yale Peabody Museum of Natural History (YPM 12348 and YPM F2835, respectively). The specimens were collected under permits from the Ministerio de Medio Ambiente y Recursos Naturales, San Salvador, El Salvador (MARN-DGPN-AIMA-8-01, MARN-DGPN-AIMA-11-1, and MARN-DGPN-AIMA-01-2002). We thank Oliver Komar for confirming the identification of the bird.

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OXYRHOPUS RHOMBIFER (False Coral Snake). **PREDATION**. *Oxyrhopus rhombifer*, a medium-sized colubrid with a coral snake color pattern, occurs from the Amazon River south to central Argentina (Peters and Orejas-Miranda. 1986. Catalogue of Neotropical Squamata. Smithsonian Institution Press, Washington, D.C., 347 pp.). We are unaware of any published accounts of predation on *O. rhombifer*. Here we report an instance of predation by the Burrowing Owl, *Athene cunicularia* (Aves: Strigidae). The observation occurred on 26 May 2001 at 2145 h on an unpaved road crossing an area of pristine "campo sujo" (shrubby grassland of the cerrado, savanna-like formation; 22°12'30"S, 47°54'45"W, 760 m elev.) at Itirapina Ecological Station (IES), municipality of Brotas, São Paulo State, southeastern Brazil. During night driving to search for snakes we spotted a Burrowing Owl on the ground; when approached by the car, the owl flew away carrying a snake within its claws; the owl landed ca. 50 m from the site where we first saw it, quickly got into the grassland, and flew away again. We searched the area and found its prey at roadside. . It was an adult male *O. rhombifer* (estimated SVL ca. 420 mm, tail with tip lacking, probably removed by the owl, 104 mm, estimated mass ca. 24 g). The anterior 190 mm of the body was missing, and injuries were evident in the cloacal region and at midbody.

Martins et al. (2003. Herpetol. Rev. 34:147–148) reported on a *Bothrops alternatus* as prey of a Burrowing Owl at IES and suggested that snakes may be more frequently eaten than the examination of owl pellets suggests. Valdujo and Nogueira (2000. Herpetol. Rev. 31:45) reported on a *B. neuwiedi pauloensis* as prey of a Burrowing Owl in another area of cerrado at Mineiros, Goiás state, central Brazil.

The voucher specimen of *O. rhombifer* is deposited in the Museu de História Natural, Universidade Estadual de Campinas (ZUEC

02476). D. Zanchetta and the staff of Instituto Florestal allowed and facilitated our fieldwork at IES. FAPESP provided a grant to RJS (99/05664-5). We thank M. Martins for suggestions on the manuscript. This is publication number 5 of the project Ecology of the Cerrados of Itirapina.

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PHALOTRIS PUNCTATUS (NCN). **OVIPOSITION.** Very little is know about the life history and ecology of *Phalotris punctatus* (Cei 1993. Reptiles del Noroeste, Nordeste y Este de Argentina; Herpetofauna de las Selvas Subtropicales, Puna y Pampas. Mus. reg. Sc. nat. Torino, Monogr. 14:1–949). I report on a clutch from a specimen captured in a xeric forest of the Chaco region in Argentina (Biological Station Los Colorados; 24°41'S, 63°18'W; Salta, Argentina). A gravid female of *P. punctatus* (365 mm SVL, 20 mm tail length) was collected at 0800 h on 1 December 1995 on a road and subsequently kept in captivity. Six days later this female laid two eggs (32.2 mm x 7.7 mm and 30.2 mm x 7.6 mm). The eggs were incubated in the laboratory, but did not hatch.

Upon death of this specimen, I dissected it to expose reproductive organs and determined the absence of oviduct eggs or vitellogenic follicles. The specimen was added to the snake collection of the Centro de Zoología Aplicada (Universidad Nacional de Córdoba) (CZA n° 120). This is the first report on clutch size in *P. punctatus*.

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PHILODRYAS BARONI (Green Snake). **COURTSHIP BEHAVIOR**. Here, we report the courtship behavior of a neotropical snake, *Philodryas baroni*, from northwestern Argentina. Little is known about this behavioral aspect of the species except for what has been reported by Williams (1984. La Culebra Verde. Fauna Argentina, Centro Editor de América Latina, Buenos Aires, 48:1–32). From 9 to 25 August 2000, we observed courtship in a captive male and female *P. baroni*. The male had been in captivity for 3 months prior to observations. On 9 August 2000 a freshly caught female was placed in the male's terrarium (70 x 50 x 50 cm). The male immediately showed interest in the female, tongue-flicking her, especially the anterior third of her body, and following her around the terrarium. Soon, the male positioned himself on the female and typical colubrid courtship behavior ensued. The male performed chin rubbing followed by body undulations and dorsal advances and retreats (e.g., Carpenter 1977. Amer. Zool. 17:217–223; Gillingham 1987. *In* R. A. Seigel, J. T. Collins and S. S. Novak [eds.], Snakes: Ecology and Evolutionary Biology, MacMillan Publishing Co., New York, pp. 184–209). Chin rubbing consisted of a slight quivering motion of the male's head over the nuchal area of the female. This was followed by a series of 1–5 cephalocaudal waves. Meanwhile, the female remained passive. What was unusual was that the male continued this behavior for the following 14 days. During this time, human interventions were avoided and the snakes were not fed. We visually checked on them every day, mornings and afternoons, always finding the male on top of the female doing occasional chin rubbing and body undulations. We filmed the courtship behavior for a total of 9 h on 5 different days. We found that wave sequences occurred, on average, every 15 min by the third day that the pair had been placed together, increasing to one sequence every 4 min by the ninth and tenth day, and finally slowing down to one every 12 min on the fourteenth day. By the fifteenth day, the male and female were found coiled in different corners of the terrarium. The male showed no further interest. Video analyses show occasional cloaca juxtaposition, in particular by the end of the first week. Although captivity may be a factor, GS observed in a field situation (Bañado de Figueroa, Santiago del Estero province) a male that remained with a female for more than 3 days. We suggest that the male may stay with the female for so long in order to prevent access of other males while the female is still receptive (Gillingham, *op. cit.*) and thus ensure paternity. The pair died a few months later, possibly of a parasite infection (FML 08922 and 10367).

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PHILODRYAS PATAGONIENSIS (NCN). **DIET**. *Philodryas patagoniensis* is a generalist predator known to feed on anurans, lizards, snakes, small mammals, and birds (Achaval and Olmos 1997. Anfibios y Reptiles del Uruguay. Montevideo, Uruguay, 128 pp.; Amaral 1978. Serpentes do Brasil - Iconografia Colorida, 246 pp.; Carvalho-Silva and Barros-Filho 1999. Herpetol. Rev. 30:170; Gonzaga et al. 1997. Herpetol. Rev. 28:154; Lema et al. 1983. Com. Mus. Ci. PUC-RS. Contribuição ao conhecimento da alimentação e do modo alimentar de serpentes do Brasil, pp. 41–121; Marques et al. 2000. Serpentes da Mata Atlântica Guia Ilustrado para a Serra do Mar. Editora Holos, 184 pp.; Rocha and Vrcibradic 1998. Ciência e Cultura 50[5]:364–368). In this note we report a new prey species for *P. patagoniensis*, a bird of the genus *Turdus*.

An adult male *P. patagoniensis*, with an obvious mid-body bulge, was found in Dom Feliciano Municipality, Rio Grande do Sul State (30°25'23.5"S, 52°18'41.4"W) by RLB on 20 January 2001. The snake was basking on the ground at ca. 1100 h in an open area of high grassland.. Upon dissection, a sub-adult *Turdus* sp. (sabiá) was found in its stomach, having been ingested headfirst.

Submitted by **ARLETE BALLESTRIN OUTEIRAL**, Rafael Luchese Balestrin (Laboratório de Herpetologia, Faculdade de Biologia, Programa de Pós-Graduação em Biociências - Zoologia, Pontíficia Universidade Católica do Rio Grande do Sul, P.O. Box 1429, 90.619-900 - Porto Alegre, RS, Brazil (e-mail: arlete@pucrs.br) and **SONIA ZANINI CECHIN**, Departamento de Biologia, Universidade Federal de Santa Maria, Faix Camobi, KM 09, Camobi Santa Maria, Rio Grande do Sul, Brazil (e-mail: cechinsz@ccne.ufsm.br).

PHILODRYAS PATAGONIENSIS (Papa-pinto). **CANNIBALISM.** Cannibalism is known to occur in a number of species of snakes, whether they are customarily ophiophagous or not. *Philodryas patagoniensis* is a terrestrial and diurnal colubrid snake that feeds on small vertebrates such as anurans, lizards, birds, rodents, and snakes (Lema et al. 1983. Comun. Mus. Ci. PUC-RS 26:41–121; Vanzolini 1948. Rev. Bras. Biol. 8:308–311; Yanosky et al. 1996. Herpetol. Nat. Hist. 4:97–110; Di-Bernardo 1998. História natural de uma comunidade de serpentes da borda oriental do Planalto das Araucárias, Rio Grande do Sul, Brasil. Tese de doutorado. Universidade Estadual Paulista, Rio Claro. 119 pp.). Lema (*op. cit.*) recorded two cases of cannibalism in *Philodryas patagoniensis*, one observed in captivity, and another under natural conditions. In the latter, a juvenile regurgitated a conspecific juvenile after being captured. Here we register two cases of cannibalism in *P. patagoniensis*. One was observed directly in an area of sand dunes located in the municipality of Balneário Pinhal (30°18'00"S, 50°15'53"W) in the coastal plain of Rio Grande do Sul, Brazil, and the other was recorded after dissection of a preserved specimen.

At 1045 h on 1 February 2001 we found an adult female *Philodryas patagoniensis* (840 mm SVL) coiled around a smaller conspecific female (578 mm SVL). The anterior portion of the snake had been already ingested. When we approached, the larger individual released its prey and tried to flee, and was then captured. The prey snake was dead and was deposited in the collection of the Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul (MCP 12184); the larger snake was measured and released at the place of capture.

Upon dissection, a preserved gravid female *Philodryas patagoniensis* (MCP 5638; 1068 mm SVL), from the municipality of Cachoeira do Sul (30°02'S, 52°54'W), Rio Grande do Sul, contained an adult male conspecific (500 mm SVL) and one lagomorph of the family Leporidae.

With the incidents of cannibalism reported here, and those reported previously, we suggest that *P. patagoniensis* does not discriminate between conspecifics and other prey items.

We thank John Measey and Robert A. Thomas for useful comments on earlier versions of this manuscript, and Julio César González for the identification of the lagomorph. One of us (RBO) benefited from a graduate fellowship from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

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PITUOPHIS CATENIFER CATENIFER (Pacific Gophersnake). **PREY SIZE.** On 9 September 1999 at 1400 h I found a dead juvenile *Pituophis catenifer catenifer* (298 mm SVL) floating in a small stream at Concord Naval Weapons Station, Concord, California, USA (38°00'N, 121°59'W). The snake had apparently been dead less than 12 h as the skin was still intact and firm, there was no evidence of predation by aquatic scavengers (e.g., crayfish [*Procambarus* sp.]), and the coloration of the pattern was life-like. The snake's stomach was noticeably distended.

I weighed the dead snake and removed the prey item from the stomach. Very little digestion had taken place and the prey item was readily identified as a male house mouse (*Mus musculus*), 76.0 mm in body length. The mouse had been swallowed head-first. The wet mass of the snake was 12.2 g and the wet mass of the mouse was 11.5 g; 94.3% of the snake's body weight. No other food items were present in the stomach.

Such large prey items are not unknown (see references in Greene 1997. Snakes: The Evolution of Mystery in Nature; University of California Press, Berkeley, California, 351 pp.), and may occasionally cause mortality (Godley 1980. Ecol. Monogr. 50:411–436) or injury (Pauley and Benard 2002. Herpetol. Rev. 33:56–57). In this case, the cause of death is unknown. The evidence suggests, however, that the snake may have drowned due to compromised mobility.

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PSEUDOBOA HAASI (NCN). **PREDATION.** Predation on Neotropical snakes from the southern Brazilian araucarian forest region is poorly documented. On 9 August 2001, one of us (CS) observed a *Rupornis magnirostris* (Aves: Accipitridae), a diurnal predator, attacking an adult *Pseudoboa haasi* (128.5 cm total length) in an open, altered area adjacent to araucarian forest near Rio Negrinho Municipality, State of Santa Catarina, Brazil. The bird took flight upon being disturbed. The snake was deposited in the herpetological collection of Museu de História Natural Capão da Imbuia at Curitiba, Paraná State (MHNCI10315). This is the first record of predation for *P. haasi*. The genus *Pseudoboa* is primarily nocturnal (Martins and Oliveira 1998. Herpetol. Nat. Hist. 6:120–121), and *P. haasi* is an endemic species from the araucarian forest domain of southern Brazil, the coldest ecosystem of the country (Morato et al. 1995. Biociências 3[2]:253–264). Our report indicates that this species is at least occasionally diurnal. We thank Renato Silveira Bérnils for verifiying the snake's identity, and Eduardo Ramires for the revision of the English version.

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Prefeitura Municipal de Curitiba, Av. Manoel Ribas, 2727, Curitiba, Paraná, Brazil (e-mail: celsoseger@uol.com).

PSEUDONAJA TEXTILIS (Eastern Brown Snake) **FAILED PREDATION.** Reports of failed attempts at predation by snakes as a result of trying to ingest unmanageable prey exist (Arnold 1993 *In* Seigel and Collins [eds.], Snakes: Ecology and Behavior, pp. 87–115. McGraw Hill, New York; Shine 1993. Australian Snakes: A Natural History. Reed Books Pty Ltd, Sydney, 223 pp.; Gavin Bedford, pers. comm.). Such episodes provide insights into predator capabilities and anti-predator behaviors of prey. Here, I add to these data with the observation of an attempt by an eastern brown snake, *Pseudonaja* textilis, to prey on an eastern bearded dragon, *Pogona barbata*. I made the observation in the course of a telemetry study of *P. barbata* throughout remnant vegetation along roadsides surrounded by agricultural land near the town of Bendigo in the state of Victoria, Australia (36°27'42"S; 143°45'10"E).

At 0730 h on 18 November 1999, while radiotracking a female *P. barbata* (23.6 cm SVL), I noticed a ca. 1.5-m *P. textilis* to my right, coming around the base of a large (1.5 m DBH) Grey Box tree (*Eucalyptus microcarpa*). The snake was moving across my field of view, heading in the direction of my radio signal. The *P. barbata* was perched on a relatively thin (> 5 cm diam) branch ~15 cm above the ground. The female was facing away from me at a distance of ~2 m, but had the antenna of the transmitter (attached to the base of the tail) pointed towards me. The snake lifted its head above the ground and seemed distracted, enough so that it appeared not to notice me. As it continued to move forward slowly, it rapidly jerked its head from side to side constantly flicking its tongue.

The dragon seemed aware of the snake, as it was trying to peer backwards while moving its body as little as possible. Suddenly, the snake lifted its head and its tongue flicked the radio-transmitter. It then slowly opened its mouth and grabbed the right rear thigh of the dragon. The dragon simultaneously arched its head back, opened its mouth, puffed out its beard, then let go of the branch. This caused the snake to lose its grip and the dragon ran towards a wire fence ~1 m away. The snake moved after it quickly, raising about one third of its body off the ground. The dragon appeared to have been momentarily stuck in the mesh of the fence and by the time I had taken the few steps to peer over it, the snake had the dragon's snout in its mouth and had wrapped several coils around its body.

The snake used more than one method in attempting to engulf the large dragon. Initially, it tried to walk its jaws over the dragon's head (Fig. 1). After about 10 minutes, it then wrapped several coils around the animal's body and seemed to be trying to push the dragon into its mouth. Failing this, the snake then uncoiled fully and tried to pull the dragon through the grass, possibly aimed at stretching the animal out to aid its ingestion (Valderrama 2001. Herpetol. Rev. 32:46–47).

Despite moving relatively little and pale in color, the dragon actively pushed its beard outward. Every time the snake loosened its grip to change position, the dragon would quickly suck in air and inflate itself even more. Eventually it appeared distended, as captured wild individuals sometimes appear in the hand (J. Smith, unpubl. data).

FIG. 1. Adult eastern brown snake (*Pseudonaja textilis*) attempting to ingest an adult female eastern bearded dragon (*Pogona barbata*).

About 40 minutes after the initial attack, the snake let go and moved off. Only when I stood up to watch its departure did the snake appear to notice me, inflating its throat slightly and increasing its speed in the opposite direction. The dragon did not move at all in the ensuing minutes and its body retained the same pale color. There were scattered blood spots on top of its head. When I returned at 1100 h, the dragon had moved under a large log nearby that it had frequented previously. Subsequent tracking during the following weeks gave no indication of a change in the behavior of this dragon, and she eventually became gravid.

None of the adult dragons (6 females, 3 males) that I telemetered during this study were killed by snakes. *Pseudonaja textilis* is known to consume juvenile *P. barbata* (Oliver 1998. Herpetofauna 28:54); however, the width of this dragon's head, including the inflated beard, presented a very large prey item for even an adult *P. textilis* to consume. The residual blood seen on the dragon's head may have been left by the snake. I did not see an obvious bite on the dragon but the snake may have broken some teeth off as I could hear them scraping over the dragon's head. If the blood was from the dragon (and assuming the snake injected any venom), this poses interesting questions about the potency of brown snake venom on eastern bearded dragons. Nevertheless, some defense mechanisms of adult *P. barbata* appear sufficient to repel a major predator. Conversely, episodes such as this one may also occur because snakes attempt ingestion when the large size of prey is unrecognized.

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SISTRURUS CATENATUS CATENATUS (Eastern Massasauga). **MALE-MALE AGGRESSION**. Selection for traits that confer a mating advantage (e.g., bright plumages, elaborate ornaments, large body size) can occur through female choice and/or male-male competition (Darwin 1871. The Descent of Man, and Selection in Relation to Sex. Murray, London. 898 pp.). In many species, competition for mates results in aggressive interactions between members of the same sex, usually males. Aggressive behavior has been previously reported for many species of pitvipers in which

males engage in ritualized combat (see Carpenter 1986. Smithsonian Herpetol. Inform. Serv. 69:1–18). Within the genus *Sistrurus*, male aggressive behavior has been observed in captive *S. miliarius* (Carpenter 1979. Copeia 1979:638–642) and *S. ravus* (Armstrong and Murphy 1979. Univ. Kansas Mus. Nat. Hist., Special Publ. 5:1–88). Although male-male aggressive interactions are suspected to occur in *S. catenatus*, they have not been substantiated.

On 20 August 2001 at 1255 h, while radio-tracking a male *S. c. catenatus* at Eldon Hazlet State Park, Clinton County, Illinois, USA, we noticed some aberrant behavior. The snake (#186) was moving through the vegetation while rapidly tongue flicking and probing the ground cover with his head. We followed the snake for ca. 4 m where he encountered a copulating pair of *S. c. catenatus*. The pair was straightened out, but facing opposite directions. Male #186 moved over the pair to an outstretched position on top of the male (#245). Male #186 then elevated the anterior portion of his body vertically, forming an S-shape, and laterally undulated. Male #245 remained still except for hitting male #186 with his thrashing tail. Male #186 continued his elevated body undulations then moved around toward the female resulting in a looped position on top of the male. Male #245 then moved his head to a position above male #186 at mid-body. Next, the female moved her anterior end around to face male #186, who began moving toward her while making jerky head movements. Male #186 assumed an outstretched position on top of the female and started making rapid full-body flexions. Male #186 next moved back toward male #245 while head bobbing and elevating the anterior portion of his body. Male #186 began laterally undulating the elevated portion of his body above male #245 and took a position stretched out on top of him. Next, male #186 paused his elevated undulations, moved toward the female, and began tongue flicking the cloacal regions of the copulating pair. During this time, the female moved around to face the same direction as male #245. Male #186 next moved back toward male #245 while head bobbing and resumed the elevated undulating behavior. The female slowly started moving away, dragging male #245 behind her with male #186 straightened out on top of him. Male #186 moved across and tongue flicked the cloacal regions again then moved to where the female had been previously, elevated his anterior end, and began undulating. After ceasing his undulations, male #186 remained still for a short period then moved away from the pair at 1308 h. Shortly thereafter, the female slowly moved off in the opposite direction dragging the conjoined male #245 behind her. We subsequently captured the snakes and measured snout–vent length (SVL) to the nearest millimeter with a flexible measuring tape and mass to the nearest gram with a Pesola spring scale. Sizes were as follows: male #186 (SVL = 68.1 cm, mass = 426 g), male #245 (SVL = 66.7 cm, mass = 315 g), female #246 (SVL = 61.9 cm, mass = 277 g).

When male #186 was initially encountered, he presumably was following a scent trail exuded by the female. On a previous occasion, one of us (DBS) observed the behavior of rapid tongue flicking and head probing by a different male *S. c. catenatus* after a female had recently been in the area. This behavior is undoubtedly a trail following behavior since male #186 led us to the female several meters away and moved in a seemingly direct path. Some behaviors exhibited by male #186 were not aggressive, but rather courtship behaviors directed toward the female. Specifically, the jerky head movements and full body flexions are involved in courtship and have been observed previously in *S. c. tergeminus* male-female pairs (Chiszar et al. 1976. Herpetologica 32:337–338). The behavior of vertically elevating the anterior portion of the body into an S-shape and laterally undulating has not been reported previously in *S. catenatus* and is probably specific to male-male aggressive interactions. The aggressive behavior of male #186 closely resembled that reported for *S. miliarius* (Carpenter 1979, *op. cit.*) in that both species elevate the anterior portion of the body at about a 45° angle, rarely perpendicular, and always in an S-shape, and laterally undulate with the objective to gain a superior position.

There is little opportunity for female choice in snakes because most mating is determined through male-male competition (Duvall et al. 1993. *In* Seigel and Collins [eds.], Snakes: Ecology and Behavior, pp. 165–200. McGraw-Hill, Inc., New York). In species where males compete directly for females, males are predicted to be larger and the largest males should have the highest reproductive success (Shine 1994. Copeia 1994:326–346). In the genus *Sistrurus*, larger males are more likely to be associated with females during the mating season than smaller conspecifics (Bishop et al. 1996. Herpetologica 52:360–364; Phillips, unpubl. data). Even though male #186 was larger and theoretically should win in a bout, male #245 had already secured the mating. It appears that by tongue flicking the cloacal regions of the snakes, male #186 determined the pair was already copulating, and consequently moved away. In *S. c. catenatus*, males often remain with females for several days as part of an extended courtship/mate guarding association (D. Mauger, pers. comm.; Phillips, unpubl. data). It is during this period when a male is present with the female that the potential for male-male combat is highest as other males may be attracted to the area by female pheromones. Had male #245 not already been copulating, he may have responded aggressively toward the intruding male #186.

We thank the Illinois Department of Natural Resources, Illinois Wildlife Preservation Fund, U.S. Fish and Wildlife Service, and the U.S. Army of Corps of Engineers for funding, the IDNR and ACOE staff at Carlyle Lake for their support, and countless persons for field assistance. DBS also thanks L. Brown for insightful discussions.

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TANTILLA MELANOCEPHALA (Black-headed Snake). **PREDATION.** The small colubrid *Tantilla melanocephala* is widely distributed from southern Guatemala to Peru, Bolivia, Brazil, and northern Argentina. It is considered mostly nocturnal in southeastern Brazil (Marques and Puorto 1998. Amphibia-Reptilia 19:311–318) and diurnal in the Amazonian region (Martins and Oliveira 1998. Herpetol. Nat. Hist. 6:78–150). During a nocturnal driving avian census, we observed predation on *T. melanocephala* by the Burrowing Owl, *Athene cunicularia* (Aves: Strigidae). The observation occurred on 26 February 2002 at 1924

h on the border of an area of "campo cerrado" (shrubby grassland with scattered trees) with a *Eucalyptus* sp. plantation at Itirapina Ecological Station (IES); Brotas municipality, São Paulo State, southeastern Brazil; (22º12'38"S, 47º55'39"W, ca. 780 m elevation). The Burrowing Owl was spotted handling the snake on the border of an unpaved road. As we approached, the owl flew away. We examined the prey, an adult female *T. melanocephala*. Its body was divided in two parts, an anterior with 59 mm long and the posterior measuring 252 mm. The distance between them was ca. 400 mm. Contrary to other owls, *A. cunicularia* (145–185 g) is also diurnal, especially early in the morning and late in the afternoon, and occurs in open areas (Sick 1997. Ornitologia Brasileira. Ed. Nova Fronteira, Rio de Janeiro, Brazil; Voous 1989. Owls of the Northern Hemisphere. MIT Press, Cambridge, Massachusetts). Similarly, *T. melanocephala* occurs in open physiognomies, being the dominant species in the "campo cerrado" (R. J. Sawaya and M. Martins, unpubl. data).

Most South American reports indicate that burrowing owls feed mainly on insects and small vertebrates, with snakes largely absent from the diet (Schlatter et al. 1980. The Auk 97:616–619; Bellocq 1988. Physys, Secc. C 46[110]:17–22; Soares et al.1992. Biotemas 5[1]:85–89). However, the present observation adds to other predation events involving *Athene cunicularia* and snakes at IES (Martins et al. 2003. Herpetol. Rev. 34:147–148; Sawaya et al. 2003. Herpetol. Rev. 34:152–153). Moreover, 21 of 198 burrowing owl pellets from IES contained snake remains, totaling 10.6% of the sample (A. Bueno and J. C. Motta-Junior, unpubl. data). Also, Motta-Junior and Alho (2000. *In* Santos and Pires [eds.], Estação Ecologica de Jataí. Volume I. São Carlos: Rima Editora, 346 pp.) reported two snakes eaten by *A. cunicularia* in an area of cerrado vegetation in São Paulo State.

Thus, the burrowing owl appears to be an efficient predator of snakes in the open "cerrado" areas of Brazil. The voucher specimen of *T. melanocephala* cited above is deposited in the Museu de História Natural, Universidade Estadual de Campinas (ZUEC 02624). D. Zanchetta and the staff of Instituto Florestal allowed and facilitated our fieldwork at IES. We thank Ricardo J. Sawaya for suggestions on the manuscript, and Adriana Bueno for help with the English text. This publication is part of project "Natural History, Ecology, and Evolution of Brazilian Vertebrates" funded by FAPESP (00/12339-2). CNPq provided grant to MAMG (130935/00-0). This is publication number 11 of the project Ecology of the Cerrados of Itirapina.

Submitted by **MARCO A. M. GRANZINOLLI** (e-mail: mgranzi@usp.br) and **JOSÉ C. MOTTA-JUNIOR**, Departamento de Ecologia, Instituto de Biociências, Universidade de São Paulo, C.P. 11461, 05508-900, São Paulo, SP – Brazil.

TANTILLA NIGRICEPS (Plains Black-headed Snake). **MAXIMUM SIZE**. On 8 September 2001 we collected a female *Tantilla nigriceps* (354 mm SVL, 69 mm tail) in an open trench located at 35°07.519'N, 106°51.165'E; ca. 20.4 air km W Albuquerque (jct. Interstate 25 and Interstate 40), Bernalillo County, New Mexico, USA; 1805 m elevation. This exceeds the size record of a female (329 mm SVL, 61 mm tail) reported by Perry and Hauer (1996. Herpetol. Rev. 24:205–206). The specimen was catalogued in the University of New Mexico Museum of Southwest Biology (MSB 62817).

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THAMNODYNASTES STRIGATUS (Corredeira). **DIET**. *Thamnodynastes strigatus* is a terrestrial snake that is found in low shrub and swampy areas. It has been reported to feed on amphibians, lizards and small rodents (Cei 1993. Mon. XIV Boll. Mus. Reg. Sci. Nat. Torino. 949 pp.; Achaval and Olmos 1997. Anfibios y Reptiles del Uruguai. Série Fauna N°1. 128 pp.; Marques et al. 2001, Serpentes da Mata Atlântica: Guia Ilustrado para a Serra do Mar. Holos Ed. 184 pp.).

On 16 February 2000 during a faunal rescue operation (Operação Graxaim) necessitated because of the flooding of Itá hydroelectric power plant reservoir, we collected a female specimen of *T. strigatus*. The snake was found on the east bank of the Uruguai River (27°22'42"S, 51°28'58"W), near Itá, Santa Catarina, Brazil (Centro de Estudos e Pesquisas Biológicas, Goiânia, Goiás - CEPB/IFS 043, SVL 557 mm). The snake had fed on a specimen of *Astyanax bimaculatus* (Actinopterygii: Characidae), SL/H = 59.32/17.6 mm. This represents the first record of a member of the genus *Thamnodynastes* preying on fishes.

We thank Rafael Braga do Amaral and Ricardo Brenner de Souza of Centro de Biologia Aquática (C.B.A.) of Universidade Católica de Goiás for helping with fish identification.

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THAMNOPHIS ATRATUS (Coast Garter Snake). **ARBOREAL BEHAVIOR.** Although not typically considered arboreal, thamnophine snakes show arboreal tendencies on occasion (Rossman et al. 1996. The Garter Snakes: Evolution and Ecology. University of Oklahoma Press, Norman, 332 pp.). *Thamnophis proximus* may be the most arboreally inclined (Tinkle 1957. Ecology 38:69–77), and arboreal courtship behavior has been reported for *T. sirtalis* (Galbraith 2001. Can. Field-Nat. 115:347–348). Here I report arboreal behavior in a population of *T. atratus* in northern California.

On 12–13 June 2001, I observed > 20 adult *Thamnophis atratus* in shrubby growth (*Salix* sp. and *Populus fremontii*) bordering streams at Stebbins Cold Canyon Reserve, Solano Co., California, USA (38°29'N, 122°06'W). The snakes were in full sun or partial shade, usually looped loosely upon the branches, and appeared to be basking. Snakes were 20–200 cm above the water surface and usually solitary; however, there were instances when 2–4 snakes

were observed at different heights in the same shrub. On 13 June I observed a courtship event on the ground, but did not observe arboreal courtship behaviors or arboreal intraspecific interactions. All snakes appeared to be 30 cm TL or larger and several appeared heavy-bodied, although smaller snakes may have gone unnoticed. When disturbed, snakes dropped into the water and escaped into large cobble and boulders lining the stream. Observations on both days were made between 0900 h and 1400 h, temperatures varied between 24° and 30°C, and cloud cover was < 10%.

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THAMNOPHIS BRACHYSTOMA (Short-headed Gartersnake). **DEFENSIVE BEHAVIOR.** Limited information exists regarding antipredator or defensive behavior in *Thamnophis brachystoma*. Tennant and Bartlett (2000. Snakes of North America: Eastern and Central Regions. Gulf Publishing, Houston, Texas. 588 pp.) report that this species is excitable, and not prone to bite. Hulse et al. (2001. Amphibians and Reptiles of Pennsylvania and the Northeast. Cornell University Press, Ithaca, New York. 419 pp.), reports that *T. brachystoma* does not bite, and that it will often thrash about violently, releasing feces and musk. Here I report a novel defensive behavior for *T. brachystoma*.

The observation was made on 6 May 2002, ca. 1100 h, just south of PA 36, adjacent to the Clarion River at Cook Forest State Park, Cooksburg, Pennsylvania, USA. An adult female *T. brachystoma* was found beneath a small flat rock. The snake immediately attempted to flee, making rapid undulations with its body. Upon being grasped, it thrashed about, musked, and voided the contents of its cloaca. After ca. 10 seconds of energetic writhing, the snake flattened its body dorsoventrally, opened its mouth, and began repeatedly striking at my left hand. Most of the strikes failed to make contact. Although it struck with open mouth, the snake never closed its mouth upon hitting my hand, and therefore did not bite. Additionally, its teeth never caught onto my skin, nor caused any abrasions. It continued to display this behavior for ca. 1 min, until placed on the ground and allowed to crawl beneath a rock. Flattening of the body caused the snake to appear larger than it was; whereas open-mouth strikes gave the snake a more threatening appearance. A second *T. brachystoma*, a mature male, was found in the same area. This individual did not display any behavior that was atypical for the species.

I thank W. Shane Snyder for accompanying me in the field. I also thank Arthur C. Hulse, James Ball, David Chiszar, and Hobart Smith for reviewing the manuscript.

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THAMNOPHIS RUFIPUNCTATUS (Narrow-headed Garter Snake). **REPRODUCTION.** Information on reproduction in *Thamnophis rufipunctatus* consists of data from Arizona (Rosen and Schwalbe. 1988. Status of the Mexican and Narrow-Headed Garter Snakes (*Thamnophis eques megalops* and *Thamnophis rufipunctatus rufipunctatus*) in Arizona. Arizona Game and Fish Department, Phoenix, Arizona. 50 pp. + appendices) and Chihuahua, Mexico (Rossman et al. 1996. The Garter Snakes. Evolution and Ecology, University of Oklahoma Press, Norman, 332 pp.). Here I report additional information on *T. rufipunctatus* reproduction from Chihuahua, Mexico.

Eight males (mean snout–vent length, SVL = 381 mm ± 58 SD, range: 290–479 mm) plus two immature males (SVL = 260 and 270 mm), and eight females (SVL = 470 mm ± 67 SD, range: 365–562 mm) plus two immature females from Chihuahua, Mexico were examined from the herpetology collection of the University of Arizona, Tucson (UAZ). Snakes were collected between 1958 and 1973. The left gonad was removed (except for UAZ 34335 which contained fetuses, and two immature females [UAZ 34160 and UAZ 34269]), and embedded in paraffin. Histological sections were cut at 5 µm, mounted on glass slides and stained with Harris' hematoxylin followed by eosin counterstain.

Three females from June were not undergoing yolk deposition (= secondary vitellogenesis, *sensu* Aldridge 1979. Herpetologica 35:256–261) (UAZ 34163, 562 mm SVL; UAZ 34271, 365 mm SVL; UAZ 35922, 450 mm SVL). One female from 17 June (UAZ 34335, 482 mm SVL) contained six fetuses. Two June females, UAZ 34160, 280 mm SVL and UAZ 34269, 286 mm SVL had small translucent follicles and were presumably sub-adults. Two females from July (UAZ 34276, 469 mm SVL; UAZ 36290, 400 mm SVL), one from September (UAZ 35236, 552 mm SVL) and one from December (UAZ 26461, 478 mm SVL) were not undergoing yolk deposition.

Six males from June were undergoing spermiogenesis (UAZ 34159, 332 mm SVL; UAZ 34266, 430 mm SVL; UAZ 34267, 360 mm SVL; UAZ 34272, 405 mm SVL; UAZ 34273, 479 mm SVL; UAZ 34274, 380 mm SVL). The testis from UAZ 34270, 270 mm SVL contained spermatogonia and primary and secondary spermatocytes. It may have started spermiogenesis later that year. Two males from July were undergoing spermiogenesis (UAZ 34275, 373 mm SVL; UAZ 34277, 290 mm SVL). The testis from (UAZ 34279, 260 mm SVL) contained spermatogonia and no spermatocytes. This snake was presumably a sub-adult.

Rosen and Schwalbe (1988, *op. cit.*) reported a mean clutch size of 11.3, range: 8–17 for three *T. rufipunctatus* from Arizona. Rossman et al. (1996, *op. cit.*) reported a clutch of 18 on 8 July for a female from Chihuahua, Mexico. The clutch of 6 reported herein is the smallest reported for *T. rufipunctatus*. The finding of non-reproductive females from June, July, September, and December suggests that only part of the female population produce young each year.

The presence of males undergoing spermiogenesis in June and July may suggest the testicular cycle of *T. rufipunctatus* is similar to that of *Thamnophis cyrtopsis* from Arizona (Goldberg 1998. Texas J. Sci. 50:229–234) in which spermiogenic males also occured during these months. My data have shown that in Chihuahua, Mexico male *T. rufipunctatus* reach maturity at 290 mm SVL

I thank G. Bradley (University of Arizona) for permission to examine specimens.

Submitted by **STEPHEN R. GOLDBERG,** Department of Biology, Whittier College, Whittier, California 90608, USA; e-mail: sgoldberg@whittier.edu.

THAMNOPHIS SAURITUS SAURITUS (Eastern Ribbon Snake). **DIET.** Ribbon snakes are semi-aquatic natricine snakes inhabiting low-lying wet areas. Amphibians appear to comprise the bulk of their diet, along with occasional invertebrates. Only one ambystomatid salamander (*Ambystoma maculatum*) has been documented as a prey item of *T. s. sauritus* (Carpenter 1952. Ecol. Monogr. 23:235–258; Rossman 1963. Bull. Florida St. Mus. Biol. Sci. 7:99–178). Here we report *A. talpoideum*, the mole salamander, as a prey item of the eastern ribbon snake.

On 22 July 2001 at 2212 h, a *Thamnophis s. sauritus* (38.3 cm SVL, 19.1 cm tail length, 15.0 g), was observed crossing U.S. Hwy 29 in Tuskegee National Forest, Macon County, Alabama, USA (32°26'31.4"N, 85°39'29.4"W). Upon capture the snake regurgitated one live adult and one partially digested adult *Ambystoma talpoideum* (3.8 g combined mass). The undigested salamander showed signs of tail movement upon regurgitation. The salamander was dead when examined ca. 16 h later. Both salamanders were deposited (AU 35565) in Auburn University's Paleo-Herp Museum and the snake was released at the point of capture.

We thank Craig Guyer, Bob Reed, and Robert Mount for comments.

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THAMNOPHIS VALIDUS (Mexican Pacific Lowlands Garter Snake). **REPRODUCTION.** Data on reproduction in *Thamnophis validus* is limited. Grismer (2002. Amphibians and Reptiles of Baja California, including its Pacific Islands, and the Islands in the Sea of Cortés. University of California Press, Berkeley. 399 pp.) found newborns during late summer and a female that produced ten young in August from Baja California del Sur. De Queiroz et al. (2001. Herpetol. Rev. 32:266) reported 13 offspring from a captive *T. validus* from BCS, Mexico. There are two accounts of *T. validus* litters from Sinaloa. Scott (1962. The Reptiles of Southern Sinaloa, Mexico. A taxonomic and Ecological Study. M. Sc. thesis, Humboldt State College, Arcata, California. 92 pp.) reported 20 young born on 13 July and Dixon and Webb (1965. Southwest. Nat. 10:140–141) reported 34 young born on 6 June. Conant (1969. Bull. Amer. Mus. Nat. Hist. 142:1–140) presented data on 7 litters born in captivity (mean = 17.4 ± 10.2 SD, range = 4–34). Rossman et al. (1996. The Garter Snakes: Evolution and Ecology, University of Oklahoma Press, Norman. 332 pp.) reported young born from 6 June to 1 August that varied from 165 to 223 mm in total length. Herein I provide additional information on the female reproductive cycle of *T. validus* from the Mexican mainland.

Reproductive data is presented from six females (mean snout–vent length, SVL = 608 mm ± 115 SD, range: 421–720 mm) from the herpetology collections of the Natural History Museum of Los Angeles County (LACM) and the University of Arizona, Tucson (UAZ). Snakes were collected 1963–1977. Information is also provided on a litter size deposited in UAZ from 1984. The left ovary was removed from LACM 103976, UAZ 37854,UAZ 37855 and embedded in paraffin. Histological sections were cut at 5 µm, mounted on glass slides and stained with Harris' hematoxylin followed by eosin counterstain.

Three females (LACM 103976, 709 mm SVL) collected 19 July from Sonora and (UAZ 37854, 421 mm SVL and UAZ 37855, 720 mm SVL) collected 2 August from Jalisco were undergoing yolk deposition (= secondary vitellogenesis, *sensu* Aldridge 1979. Herpetologica 35:256–261). One female (UAZ 37853, 535 mm SVL) collected 2 August from Jalisco contained eight enlarged ovarian follicles (11–15 mm length). Another female (LACM 103944, 600 mm SVL) from Sinaloa collected 16 August contained sixteen enlarged ovarian follicles (11–14 mm length). These females would have presumably finished yolk deposition the following year and ovulated. It appears yolk deposition in *T. validus* is completed over two reproductive seasons.

One female (LACM 103951, 663 mm SVL) collected 5 June from Sinaloa contained 22 developing young that were approximately one month from being born. Another female (not in UAZ) collected 21 September in Sonora produced 29 neonates, (UAZ 45436–45464, mean SVL = 157 mm ± 12 SD, range: 115–171 mm). Four were stillborn on 21 September, while 25 were born live on 26 October. Mean SVL of the full-term snakes (160 mm ± 7 SD, range: 143–171, N = 25) was significantly larger than that of the stillborn snakes (136 mm ± 15 SD, range:115–150, N = 4) Mann-Whitney U-statistic = 2.00, P = 0.003.

I thank D. Kizirian (Natural History Museum of Los Angeles County) and G. Bradley (University of Arizona) for permission to examine specimens. K. Beaman (Natural History Museum of Los Angeles County) provided comments on the manuscript.

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TALLGRASS PRAIRIE AMPHIBIAN AND REPTILE ASSEMBLAGE. FIRE MORTALITY. On 30 October 1999, from ca. 1000 h to 1300 h, I surveyed ca. 33 ha of a 65-ha virgin tallgrass prairie (Penn-Sylvania Prairie) in Dade County, Missouri, USA, for evidence of vertebrate mortality resulting from a prescribed burn conducted on 28 October 1999 at ca. 1600 h. The 30th of October was a cool (< 10°C) and overcast day, with a light drizzle of rain. I walked the prairie in a zig-zag pattern traveling back and forth the length of the burned area. I observed a total of 72 individual herps, consisting of 8 species of reptiles and 1 species of amphibian on the burned portion of the prairie. The species followed by the numbers observed alive and dead, respectively, included: *Bufo americanus* 1, 0; *Terrepene carolina* 22, 20; *T. ornata* 3, 4; *Ophisaurus attenuatus* 0, 2; *Coluber constrictor* 0, 3; *Elaphe obsoleta* 1, 1; *Lampropeltis calligaster* 0, 12; *Opheodrys aestivus* 1, 0; *Thamnophis sirtalis* 1, 1; Total 29, 43.

Several *T. carolina* and *T. ornata* (both dead and alive) were found partially hidden in shallow burrows or forms. Over 50% of *T. carolina* were found in several formerly brushy draws, now denuded of vegetation from the burn. Four days of warm weather (> 18°C daytime temps) preceded the burn date and temperatures on 28 October were > 20°C, which probably stimulated reptile activity and resulted in higher reptile mortality than during other fall burns. These observations emphasize the need to implement prescribed burns during cool, overcast periods or after most reptiles are dormant as to avoid high reptile mortality.

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GEOGRAPHIC DISTRIBUTION

Herpetological Review publishes brief notices of new geographic distribution records in order to make them available to the herpetological community in published form. Geographic distribution records are important to biologists in that they allow for a more precise determination of a species' range, and thereby permit a more significant interpretation of its biology.

These geographic distribution records will be accepted in a **standard format** only, and all authors *must* adhere to that format, as follows: SCIENTIFIC NAME, COMMON NAME (for the United States and Canada as it appears in Crother 2000. *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding*. SSAR Herpetol. Circ. 29:1–82; for Mexico as it appears in Liner 1994, *Scientific and Common Names for the Amphibians and Reptiles of Mexico in English and Spanish*. Herpetol. Circ. 23:1–113), LOCALITY (use metric for distances and give precise locality data), DATE (day-month-year), COLLECTOR, VERIFIED BY (*cannot* be verified by an author—curator at an institutional collection is preferred), PLACE OF DEPOSITION (where applicable, use standardized collection designations as they appear in Leviton et al. 1985, *Standard Symbolic Codes for Institutional Resource Collections in Herpetology and Ichthyology*, Copeia 1985[3]:802–832) and CATALOG NUMBER (required), COMMENTS (brief), CITATIONS (brief), SUBMITTED BY (give name and address in full—spell out state names—no abbreviations).

Some further comments. This geographic distribution section does not publish "observation" records. Records submitted should be based on preserved specimens which have been placed in a university or museum collection (private collection depository records are discouraged; institutional collection records will receive precedence in case of conflict). A good quality color slide or photograph may substitute for a preserved specimen *only* when the live specimen could not be collected for the following reasons: it was a protected species, it was found in a protected area, or the logistics of preservation were prohibitive (such as large turtles or crocodilians). Color slides and photographs *must* be deposited in a university or museum collection along with complete locality data, and the color slide catalog number(s) must be included in the same manner as a preserved record. Before you submit a manuscript to us, check Censky (1988, *Index to Geographic Distribution Records in Herpetological Review: 1967–1986*; available from the SSAR Publications Secretary) to make sure you are not duplicating a previously published record. The responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extensions unless a thorough literature review has been completed.

Please submit any geographic distribution records in the **standard format only** to one of the Section Co-editors: **Alan M. Richmond** (USA & Canadian records only); **Jerry D. Johnson** (Mexico and Central America, including the Caribbean islands); **Hidetoshi Ota** (all Old World records); or **Gustavo J. Scrocchi** (South American records). Short manuscripts are discouraged, and are only acceptable when data cannot be presented adequately in the standard format. **Electronic submission of manuscripts is required** (as Microsoft Word or Rich Text format [rtf] files, as e-mail attachments. Refer to inside front cover for e-mail addresses of section editors.

Recommended citation for new distribution records appearing in this section is: Marques, O. A. V., and G. Puorto. 1996. Geographic Distribution. *Chironius laevicollis*. Herpetol. Rev. 27:212.

CAUDATA

AMBYSTOMA OPACUM (Marbled Salamander). USA: VIRGINIA: Scott Co: Rikemo Lodge, ca. 1 km SW of Dungannon. 8 May 1999. Christopher S. Hobson, Steven M. Roble, Anne C. Chazal. Verified by Richard Hoffmann. Virginia Museum of Natural History (VMNH) 10337. Sub-adult found in a small pit (ca. 0.25 m deep) covered by a piece of plywood at Rikemo Lodge, situated on a slope just above the floodplain of the Clinch River. First record for Scott Co., and first published record for southwestern Virginia (Mitchell and Reay 1999. Atlas of Amphibians and Reptiles in Virginia. Spec. Publ. No. 1, Virginia Department of Game and Inland Fisheries, Richmond, Virginia. 122 pp.; Tobey 1985. Virginia's Amphibians and Reptiles: A Distributional Survey, Virginia Herpetological Survey, Purcellville, Virginia, 113 pp.). The nearest published records within the Ridge and Valley physiographic province are from Knox County, Tennessee (ca. 160 km SW), and Montgomery County, Virginia (ca. 180 km NE) (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, Center for Field Biology, Austin Peay State University, 94 pp.; Tobey 1985, *op. cit.*). This record partially fills a hiatus in the known range for this species that includes much of the southern Appalachians; northeastern Kentucky and Tennessee, western North Carolina, and southwestern Virginia (Conant and Collins 1991. Reptiles and Amphibians of Eastern/Central North America. Houghton Mifflin Co., Boston, Massachusetts, 450 pp.).

Submitted by **CHRISTOPHER S. HOBSON** (e-mail cshobson@dcr.state.va.us) and **STEVEN M. ROBLE** (e-mail: sroble@dcr.state.va.us), Virginia Department of Conservation and Recreation, Division of Natural Heritage, 217 Governor Street, Richmond, Virginia 23219, USA.

AMBYSTOMA MACRODACTYLUM (Long-Toed Salamander). USA: CALIFORNIA: Tehama Co: Lassen National Forest, Cascade Range, Carter Meadow (40°1324.78"N, 121°24'43.76"W) 1860 m elev. 5 August 2002. Chris R. Feldman and Daniel G. Mulcahy. CAS 225059–60. Verified by Jens Vindum. New county record (Vindum and Koo 2002, Amphibians and Reptiles of the Lassen National Forest: Results of 02-CS011050650-029, the 2002 California Academy of Sciences Survey). The nearest known localities are: 18.5 km S (Coon Hollow, Butte Colorado; MVZ 60909), 12.6 km E (6.4 km SW of Chester, Plumas Co.; MVZ 50204), and 18.3 km N (Bunchgrass Creek, Plumas Co.; CAS 225057). We found the two adult salamanders inside decaying logs in a closed canopy portion of the meadow. In northeastern California, *A. macrodactylum* occurs in mid-elevation meadows, ponds, and lakes. Such habitat is common in the northern Sierra Nevada and southern Cascade Mountains, and *A. macrodactylum* is likely contiguous throughout this region.

We thank Michelle Koo, Jens Vindum, Melanie McFarland, and Ken Roby for supervision during field surveys, which were funded by Challenge Cost-Share Agreement #02-CS-11050650–029, Forest Service Region 5, Lassen National Forest.

Submitted by **CHRIS R. FELDMAN** (e-mail: elgaria@biology.usu.edu) and **DANIEL G. MULCAHY** (e-mail: dmulcahy@biology.usu.edu), Department Biology, Utah State University, Logan, Utah 84322-5305, USA.

HEMIDACTYLIUM SCUTATUM (Four-toed Salamander). USA: TENNESSEE: Sullivan Co: South Holston Weir Dam, 50 m E of intersection of Holston View Dam Road and TVA Road South (36.5218N, 82.1064W). 7 March 2002. Kevin Hamed and Phil Gentry. Verified by A. Floyd Scott, Austin Peay State University Museum of Zoology, APSU 3344. First record from Sullivan County and second record from upper East Tennessee (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ.


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The Quarterly News-Journal of the Society for the Study of Amphibians and Reptiles

Society for the Study of Amphibians and Reptiles

www.ukans.edu/~ssar

The Society for the Study of Amphibians and Reptiles, the largest international herpetological society, is a not-for-profit organization established to advance research, conservation, and education concerning amphibians and reptiles. Founded in 1958, SSAR is widely recognized today as having the most diverse society-sponsored program of services and publications for herpetologists. Membership is open to anyone with an interest in herpetology—professionals and serious amateurs alike—who wish to join with us to advance the goals of the Society.

All members of the SSAR are entitled to vote by mail ballot for Society officers, which allows overseas members to participate in determining the Society's activities; also, many international members attend the annual meetings and serve on editorial boards and committees.

Annual Dues and Subscriptions: Annual membership dues for the year 2003 in the Society for the Study of Amphibians and Reptiles are as follows: **REGULAR** membership US$60 (Student $30)—includes *Journal of Herpetology* and *Herpetological Review*; **PLENARY** membership US$80 (Student $45)—includes *JH*, *HR*, and annual subscription to the *Catalogue of American Amphibians and Reptiles*; **INSTITUTIONAL SUBSCRIPTION** $115—includes JH and HR. Additional fee for airmail postage outside USA $35 for one year. Additional membership categories available on the SSAR webpage: http://www.ukans.edu/~ssar/membership.html.

All members and institutions receive the Society's primary technical publication, the *Journal of Herpetology*, and its news-journal, *Herpetological Review*; both are published four times per year. Members also receive pre-publication discounts on other Society publications, which are advertised in *Herpetological Review*.

Payment must be made in USA funds, payable to "SSAR," or by International Money Order, or with Visa or MasterCard (account number and expiration date must be provided). Payment should be sent to: Theodora Pinou, SSAR Treasurer, Peabody Museum of Natural History, P.O. Box 208118, New Haven, Connecticut 06520-8118, USA. Fax: (203) 432-5176; e-mail: theodora.pinou@yale.edu

Future Annual Meetings

2003 — Hotel Tropical, Manaus, Brazil, 26 June–1 July (with ASIH, HL)
2004 — University of Oklahoma, Norman, Oklahoma (with ASIH, HL)
2005 — University of South Florida, Tampa, Florida (with ASIH, HL)

SSAR BUSINESS

SSAR Announces the Dean E. Metter Memorial Award

Dean E. (Doc) Metter (1932–2001) was a long-time member of the biology faculty at the University of Missouri-Columbia, where he taught zoology, comparative anatomy, evolution, and herpetology. A believer in putting knowledge to the test in the field, Doc provided frequent opportunities for students to engage in fieldwork. In addition, he frequently assisted his graduate students as they ventured out to collect data.

Doc was a co-founder of the Bobby Witcher Society, the legacy of which is a scholarship fund. For many years, the interest earned served to reward outstanding herpetology students who intended to continue their education and seek a career in vertebrate biology. That fund now serves a similar purpose by honoring Doc's memory while helping to fund the SSAR-administered Dean E. Metter Memorial Award.

The purpose of the Award is: (1) to honor the memory of Dean E. Metter; (2) to encourage students to pursue field research in herpetology; and (3) to facilitate field research in herpetology by providing funds for relevant expenses. Grants made from the award will be no less than US $300 and no more than US $1,000. Efforts will be made to fund as many eligible proposals as possible. Applicants must be currently enrolled as an undergraduate or graduate student in an accredited college or university and be conducting field-based research in herpetology. This research may occur anywhere in the world, but priority will be given to research conducted in the state of Missouri. Expenses eligible for funding include: (1) travel expenses (e.g., mileage, airfare) associated with the field research project; and (2) equipment for field-based research (e.g., materials for drift fences, traps, etc.). Funds may not be used for salaries or any other personnel expenses, travel to

About Our Cover: *Echis carinatus*

The genus *Echis* Merrem, 1820—the saw-scaled vipers—includes, depending on authority, between 8 and 12 xeric-region species, widespread from Africa to southern Asia (Cherlin 1981. Proc. Zool. Inst. Acad. Sci. U.S.S.R. 1981:92–95; 1990. Proc. Zool. Inst. Leningrad 207:193–223; Cherlin and Borkin 1990. Proc. Zool. Inst. Leningrad 207:175–193 [all in Russian, with English abstracts]; David and Ineich 1999. Les serpents venimeux du monde: systématique et répartition. Dumerilia 3:3–499; McDiarmid et al. 1999. Snake Species of the World. A Taxonomic and Geographic Reference. Volume 1. The Herpetologists' League, Washington, D.C. xi + 511 pp.). These small snakes arguably take the greatest toll of human lives among all venomous snakes because of their extremely toxic venom, and are thus of great medical importance. In India, a densely populated country with a large rural population, annual snake-bite mortality was estimated to be as high as 20,000–40,000 a year (Swaroop and Grab 1954. Bull. World Health Org. 10:35–76), with a high proportion attributed to the saw-scaled viper.

When threatened, these snakes produce a characteristic sizzling sound, likened to "water sprayed on hot coals" (Leviton et al. 1992. Handbook to Middle East Amphibians and Reptiles. SSAR Contrib. Herpetol. 8, Oxford, Ohio. vi + 252 pp; 33 pl.) that is produced by rubbing the parallel body coils against each other, causing the obliquely aligned keel of the third through ninth dorsal scale rows to come in contact (see Kimmich and Blaney 1973. HISS News-J. 1(3):85). The sound thus produced is a stridulation, replacing hissing in many other members of the family, and is presumably an adaptation for living in xeric regions (hissing or expiration results in some moisture loss).

The eastern representative of the genus is the widespread *Echis carinatus*, known from Pakistan, peninsular India, and Sri Lanka, its distribution extending to the Middle East. Several subspecies names have been applied, under the Biological Species/Typological Species Concepts, to the Subcontinent's populations (see for instance, Auffenberg and Rehman 1991. Bull. Florida Mus. Nat. Hist., Biol. Sci. 35[5]:263–314), including the nominate *carinatus* (Schneider, 1801) from the Indian Peninsula, *astolae* Mertens, 1970 from Astola Island, off the Balochistan coast of Pakistan, *multisquamatus* Cherlin, 1981 from the mountains of northern Pakistan, Afghanistan, Iran, Central Asia and the Middle East, *sinhaleyus* Deraniyagala, 1951 from northern and eastern Sri Lanka, and *sochureki* Stemmler, 1969 from Afghanistan, the lowlands of Pakistan, northern India, and seemingly also Bangladesh. Phylogenetic relationships of these populations remain unstudied.

The cover photograph depicts an adult *Echis carinatus* on the sand dunes of Thar Desert, Rajasthan State, western India, at sunrise. The population is allocated to the subspecies *sochureki*, named for the Austrian herpetologist, Erich Sochurek (1923–1987). On dunes, the typical mode of locomotion is sidewinding, and such tracks are commonly seen over undisturbed sandy stretches of the Thar. This easily-roused species is nocturnal, feeding on small mammals such as rodents, as well as birds and perhaps also lizards, and up to 20–25 live young are produced at a time (Whitaker 1978. Common Indian Snakes: A Field Guide. Macmillan India Limited, New Delhi. xiv + 154 pp; Khan 2002. The Snakes of Pakistan. Edition Chimaira, Frankfurt am Main. 265 pp).


PHOTO BY AARON BAUER

Indraneil Das, who photographed the snake on 27 October 2002, used a handheld Nikon F5, with a 24–50 mm 1:3.3–4.5 D AF Nikkor lens to record the image on Fujichrome Velvia (50 ASA) film. Illumination was provided by a F-28 Speedlight flash unit, with an additional SB-27 Speedlight flash unit set on a tripod as a slave.

Das is Associate Professor with the Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, and has worked on the herpetofauna of tropical Asia for about 20 years. He received his doctorate from the University of Oxford, and was a Fulbright Fellow at the Museum of Comparative Zoology, Harvard University, and Scientific Officer at the Centre for Herpetology, Madras Crocodile Bank Trust. Among his publications are works on ethnobiology, biogeography, systematics, nomenclature, and field guides to Asian amphibians and reptiles, including a new guide to Indian reptiles, **"A Photographic Guide to the Snakes and other Reptiles of India"** (New Holland Publishers [UK] Ltd, 2002). He is also the Editor of the herpetological journal *Hamadryad*, now in its 27th volume.

meetings, equipment or supplies for laboratory-based research (even if applicable to the project), or overhead or indirect costs.

Application details and selection criteria are available on the SSAR webpage (www.ssarherps.org). *Please note that the application deadline is 15 July 2003.*

2002 Annual Meeting: Kansas City, Missouri

The 45th annual meeting of SSAR took place from 3 to 8 July 2002 in Kansas City, Missouri. The Society met jointly with the American Elasmobranch Society (AES), the American Society of Ichthyologists and Herpetologists (ASIH), and The Herpetologists' League (HL). This event was hosted by Ed Wiley and the University of Kansas at the Westin Crown Center Hotel. More than 1100 registrants packed the Westin's facilities during the Independence Day weekend. Approximately 725 oral and poster presentations on herpetological and ichthyological research activities provided the focus for scientific discussion over the 5 days of the event.

Social Programs

A series of social events provided lively diversion from the daily scientific presentations. Wednesday evening saw the presentation of the SSAR President's Travelogue. Slide presentations featured stories and images of the herpetofauna of Africa. SSAR President David Green's presentation entitled "Travels in Kenya: Pondscape with Frog," highlighted anurans from a variety of ecological settings. David was quick to point out the occasional squamate as well. Wolfgang Böhme (Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany) kept an appreciative crowd entertained with his presentation entitled "Between Rainforest and Desert: Herpetofaunal Travels in West and Central Africa," which featured crocodiles living in extreme environments. Evening activities were augmented by a cash-bar social at the *Brasserie Lounge*, in the lobby area of the Westin Crown Center Hotel. This venue served as a focal point for many social gatherings. On the morning of 4 July, the Opening Plenary Session began with a series of introductory comments by Bob Cashner, who gave way to presentations by Brooks Burr (ASIH), and Merry Camhi (AES). George Zug gave the Distinguished Herpetologist Lecture. In honor of The Herpetologists' League 50th Anniversary Presentation, Whit Gibbons had the audience wondering why he did not take up a career as a stand-up comic. Following the opening session, hordes of attendees gathered on the roof of the hotel lobby to pose, in the mid-summer heat and humidity, for the obligatory meeting photograph. Thursday evening, 4 July, provided meeting participants with the opportunity to view the latest versions of the David Dennis and Eric Juterbock slide presentations of regionally distinct herpetofauna, coupled with a historically oriented slide show by Dennis, Juterbock, and Kraig Adler. A patriotic explosion of herpetological sights and sounds were a treat for the crowd that packed the Liberty Room of the conference facilities.

SSAR sponsored the Eighth Annual Student Awards Frameable Art Silent Auction to raise funds to offset student travel expenses. Glen Lubcke and John Campbell organized this successful activity that saw active bidding on numerous items of herpetological art, literature, and culture on Thursday through Saturday of the meeting. Kirsten Nicholson organized the SSAR Graduate Student Reprint and Book Grab to provide young herpetologists with the opportunity to gain access to scientific literature. Thanks are extended to the many contributors to these special events.

On Friday (5 July), the annual meeting auction was again cosponsored by SSAR and The Herpetologists' League with pro-

During the Plenary Session, SSAR honored the two Society founders Kraig Adler and David Dennis (left and right, above), with plaques of appreciation presented by SSAR President David Green. Adler and Dennis, who founded The Ohio Herpetological Society in 1958, together with a small group of mostly teenaged amateur herpetologists developed the OHS into an organization with national and even international activities. The society changed its name to SSAR in 1967. Jim Murphy was instrumental in the production of the plaques and in the conspiracy of secrecy leading up to their presentation.

Whit Gibbons (left) confers with Herpetologists' League President Ken Dodd following Whit's humorous retrospective of meetings and personalities over the first 50 years' of HL history.

ceeds from the event being split between the two societies. David Morafka and John Moriarty conducted the auction while a variety of students helped with displaying items for members of the audience. Key SSAR Board members generously passed out drink tickets, adding to active bidding on a variety of herpetological items, thus carrying activities well into the evening and providing significant financial support for this year's meeting. Some truly outstanding items saw exceptional bidding, but all auction material was well received and greatly appreciated. The evening of Saturday, 6 July, saw meeting participants congregated in the confines of the historic Union Station Sprint Festival Plaza for the Annual Barbecue. Attendants dined on famous Kansas City barbeque and a variety of side dishes. Many herpetologists and ichthyologists found the locally produced ales and lagers to be quite pleasing, and kept the taps flowing into the evening. Live music filled the spacious venue while participants ate, drank, and engaged in stimulating conversation.

Business Meeting and Board Meeting Summary

The Annual SSAR Business Meeting was called to order by Society President David Green at 1605 h on 6 July 2002 at the Westin Crown Center Hotel in Kansas City, MO. In addition to board members, journal editors, and committee coordinators, the business meeting was sparsely attended by approximately two dozen Society members.

President Green summarized reports made by the SSAR Board of Directors by outlining key points from that meeting earlier in the week: President Green announced several new appointments made during 2002. New appointments included Maureen Kearney (Elector for 2002 elections), Julian Lee (Chair of Nominations Committee), and Al Savitzky (SSAR representative to AIBS). Additionally, President Green appointed several individuals to serve on several committees for the Society: Brian Crother (Chair), Beth Dawson, Malcolm McCallum, and Laurie Vitt (representatives to the joint SSAR/HL Task Force on electronic publishing), and Breck Bartholomew, Lee Fitzgerald (Chair), John Matter, and George Pisani (as an *ad hoc* Task Force to make recommendations on SSAR's new website). All outgoing editors and officers were thanked for their thoughtful and diligent service to the Society.

Outgoing Society Treasurer Robert Aldridge, in conjunction with his successor, Theodora Pinou, reported that SSAR remains financially viable with total assets of $481,038 ($241,432 being represented by restricted funds). Bob reported that Society budget items for FY 2002 came to $252,296, while SSAR realized income totaling $303,351 from the preceding year. Looking to the future, Dora Pinou stated that various Society entities could be viewed as small businesses and need to set individual goals for financial stability. Aldridge and new Publications Secretary Breck Bartholomew reported that the sale of SSAR publications totaled $110,807. Of this amount, significant revenues were realized from the sale of Bill Duellman's revised edition of "Hylid Frogs of Middle America" and David Dennis' original watercolors from the 1970 edition of that volume. Both Aldridge and Bartholomew noted that the Society sees significant expenses in housing and transporting the current volume of published material. President Green requested that Bartholomew identify ways to decrease the current inventory and recommend adjustments to future publication runs. Bob Aldridge reported that SSAR membership remained relatively stable, at 2255 for FY 2002. Domestic regular and student members represent the largest of the various Society membership categories, while declines in foreign memberships are viewed as the most significant losses. Discussions by the Board considered the formation of a working group to collaborate with ASIH on how to deal with endowment funds. President Green appointed Dora Pinou, Gabriela Parra, and Robert Aldridge to make recommendations with respect to managing funds for the Bailey, Metter, Gordon, and Minton endowments.

Journal of Herpetology Editor, Brian K. Sullivan (*in absentia*), submitted a report outlining significant happenings with the *JH* for 2001–02. A number of personnel changes were reported. David Sever resigned as Associate Editor, while Maureen Donnelly, Mike Harvey, and Howard Whiteman accepted positions to the Editorial Board. Brian reported that submissions to the *Journal* continue to grow, being 284 in 2001, up from 262 manuscripts during 2000. Of these submissions, 81 were accepted, representing a 34% acceptance rate. Submissions as of June 2001 were running 20% higher than a comparable date in recent years, and could reach record levels. Sullivan reported that publication lag times of 9–12 months could be expected for accepted manuscripts, noting that decreasing that time could incur significant costs for the Society. Sullivan endorsed several recommendations made by the Publications Task Force that had been chaired by William Cooper: 1) Changing the *Journal of Herpetology* to a glossy paper stock (a change that Sullivan reports has been implemented and well received). 2) Increasing the font size of the *Journal* from its current 9 pt (for Article text) and 8 pt (for citations and Shorter Communications) to 10/9 pt (for text and citations in Articles) and 9 pt (for Short Communications). Sullivan estimated that increasing font

Meeting attendees crowded into the Union Station Sprint Festival Plaza for the annual barbecue. From left to right, Wolfgang Böhme, Karl-Heinz Jungfer, and Edgar Lehr offered diplomatic assessments of American beer.

size represents a potential increase in page numbers that would result in added publication costs. 3) Implementing the addition of abstracts to Shorter Communications (a change that is anticipated for 2003). The Board approved the idea of adding abstracts to Shorter Communications. However, it felt more information was needed before deciding on the issue of increased font size for the *Journal of Herpetology*. Sullivan reported that budgetary costs of *JH* for FY 2001 were $87,996—$6,486 over that approved with significant increases in mailing costs being responsible for the overrun. Brian's budget request of $101,000 for FY 2003 is designed to increase pages published in the *Journal of Herpetology* and decrease the lag in publication time.

Herpetological Review Editor, Robert Hansen, reported numerous personnel changes in the *Herp Review* editorial staff. Joseph Collins stepped down as Section Editor (Geographic Distribution) following 12 years of distinguished service in that post. Alan Richmond has been appointed to fill the position vacated by Collins. Outgoing Associate Editors for 2002 include Adam Summers and Sharyn Marks. Robert Espinoza was appointed to replace Summers, and other candidates are being considered for the remaining position. Other personnel changes at *Herp Review* include the departures of Brian Hauge (Section Editor, Natural History Notes), Winston Card (Section Editor, Herpetological Husbandry, replaced by Ruston Hartdegen), Jennifer Pramuk (Copy Editor, replaced by Hugo Alamillo), and Brian Butterfield (Section Editor, Natural History Notes). Additional new appointments include Marc Hayes (Section Editor, Natural History Notes—lizards, crocodilians) and Jim Harding (Section Editor, Natural History Notes—turtles). Jim Murphy serves as Section Editor for the "Zoo View" feature that made its debut in 2002. Hansen reported that Volume 32 of *Herp Review* consisted of 292 pages (an increase of 20 pages from the preceding volume) and projected that Volume 33 would run 320 pages. Hansen noted that *Herp Review* seems to be able to maintain its current, expanded production size (80 pages per issue) and hopes to decrease publication lag time. Hansen reported that production of *Herp Review* has evolved to an increasingly digital process, noting that Volume 32 was sent to the printer on CD, and that this has allowed for increased page numbers at a constant cost to the Society.

Robert Powell, Editor of the *Catalogue of American Amphibians and Reptiles* (*CAAR*), reported on the status of this publication effort. Bob noted that the 2001 contributions to *CAAR* consisted of 20 accounts (Nos. 721–740; 1 caecilian, 1 salamander, 1 frog, 2 turtle, 4 lizard, and 11 snake accounts) for a total of 108 printed pages. Color plates were included in 17 of the accounts. Bob anticipated the completion of 20 accounts for 2002 (with 19 of these having color plates) and has plans for another 20 accounts for 2003. Powell is concerned that there are insufficient numbers of individuals submitting species accounts (particularly on Central and South American taxa) to maintain the annual production rate of 20 *CAAR* accounts. Bob's requested budget ($12,000) would allow for much-needed technology upgrades in addition to the usual production and mailing charges. Powell expressed a desire to convert *CAAR* accounts from hardcopy material to CD ROM format to keep production costs down.

Kraig Adler (Editor) reported on the publication activities of *Contributions to Herpetology*. Recent publications in this series include the two-volume, revised edition of "Hylid Frogs of Middle

The annual banquet made for a lively ending to the meetings. From left to right: José Rosado, Greg Watkins-Colwell, Chuck Crumley, Al Richmond, Eric Hilton, and Nate Kley salute the high quality of scientific presentations they witnessed throughout the course of the meetings.

America," by William E. Duellman (with new artistic renderings by David Dennis; released at the annual meeting in Indianapolis, July 2001) and "Amphibians of Honduras," by James McCranie and Larry David Wilson (February 2002). Adler reported on publication projects due in 2003. These projects include the long-anticipated "Field Guide to Amphibians and Reptiles of the West Indies," by S. Blair Hedges (the first color-illustrated guide to the herpetofauna of the entire West Indies) and "Biology of the Reptilia, Volume 20 (Morphology)," edited by Carl Gans and Abbot Gaunt. Ernie Liner's comprehensive index to "Biology of the Reptilia," is anticipated shortly after the publication of Volume 20, and would represent Volume 21 of this long-running series. "Lizards of Southern Africa," to be edited by William Branch and Aaron Bauer, is expected in the foreseeable future and will have contributions from authorities on this specific geographic location.

Editor of the *Facsimile Reprints in Herpetology*, Aaron Bauer, reported on the successful completion of a project through this Society series as well as anticipated contributions expected in the future. The reprint edition of "Anatomy of the Salamander," by Eric Francis, including a new introduction by James Hanken and editorial ministrations by Kraig Adler, was published in March 2002. Originally issued in 1919, "Herpetology of Cuba," by Thomas Barbour and C.T. Ramsden, will receive an updated taxonomic treatment (including cross listing of nomenclature used in the original with their currently recognized names), and is expected by May of 2003. Rodolfo Ruibal is providing a new introduction to this reprinted monograph. Herpetological bibliophiles will also relish the reprinting of 65 papers from the late 1880s through 1917 by Italian Mario Giacinto Peracca. Due to be published late in 2003, "The Herpetological Contributions of Mario Giancinto Peracca," will be edited by Franco Andreone and Elena Gavetti and have an English translation of the introduction. Bauer outlined future projects that include "Les Tortues de l'Indochine," by René Bourret and "The Herpetological Contributions of John Edward Gray." The work on Indochinese turtles will include a biography of Bourret and current taxonomy and systematics for turtles of this region. The other project will combine many of the shorter herpetological works by Gray that have not been included in earlier SSAR reprints by this classical author.

Herpetological Circulars Editor, John Moriarty, reported that

completion of *HC No. 31*, "Conservation Guide to the Eastern Diamondback Rattlesnake," by Walt Timmerman and Marty Martin, has been delayed. The Guide is expected to be completed and available in 2003. "Herpetological Collecting and Collections Management, revised edition," (*HC No. 32*) by John Simmons was published in September 2002, and represents a fully revised and expanded version of *Herp Circular No. 16*.

Stephen Corn, departing Editor of *Herpetological Conservation* reported that Volume 2 in this series, "Ecotoxicology of Amphibians and Reptiles," has been terminated. Corn noted that there was insufficient material in the submitted manuscripts to warrant publication of a book, and that authors of those chapters had been referred to *Applied Herpetology* as a viable outlet for this material. Volume 3, "Conservation and Status of Reptiles in Canada," edited by Carolyn Seburn and Christine Bishop, with additional editorial support by Patrick Gregory, has been reassigned as Volume 2 in the *Herp Conservation* series. In addition to publication support by SSAR, financial backing by The Canadian Amphibian and Reptile Conservation Network ensures the completion of this work during 2003. Members of the SSAR Board discussed the future of this series, which is in need of an editor and seems to (in Corn's opinion) lack sufficient manuscript submissions to exist as a regular publication. The Board felt that *Herpetological Conservation* is a worthy series; an ad hoc committee of Board members was formed to suggest names of potential editors to the President.

A proposal was made to the Board to change the election schedule from annual elections to biennial elections. Discussion followed and another recommendation was to increase the size of the Board from 6 members to 8 members. The membership at the Business meeting voted in favor of these recommendations. Increasing the size of the Board and changing the length of Term of Office requires a change in the SSAR bylaws and will be voted on in the 2003 election.

The Board received reports from Committee Chairs for Grants-in-Herpetology (Erik Wild), Kennedy Student Award (Robert Gatten), and Seibert Awards (Marion Preest). Details have been published in *HR* (33:161–162 and 33:242).

Related to issues of student support and funding, Robert Powell announced a new award that will be implemented by SSAR. The Dean E. Metter Memorial Award is designed to make funds available for student projects related to field research in herpetology. Funds for this award were made available by the Bobby Witcher Society and are in recognition of the late Dean E. Metter, a long-time member of the faculty at the University of Missouri at Columbia and SSAR member. The Metter Awards will generally be in the amount of $300 to $1000.

Mike Plummer, Chair of the Conservation Committee, reported that the committee continues to build on a strong web-based education effort. To date, 35 of 50 U.S. states have been linked to material on the SSAR Conservation Website. Members of the committee include Kurt Buhlmann, Ken Dodd, Mike Dorcas, Lee Fitzgerald, John Jensen, Andy Price, Steve Sheffield, and Mike Sredl. Other efforts for the year consisted of writing and sending a position letter to the U.S. Fish and Wildlife Service (USFWS) endorsing the listing of *Clemmys guttata*, all North American *Apalone* spp., *Crotalus adamanteus*, *Crotalus horridus*, and *Lampropeltis zonata* to Appendix II of CITES.

Richard Wassersug presented a proposal to the Board to set up a service in which SSAR members would do preliminary editing of manuscripts written in English by our colleagues who do not have English as a first language. A list of SSAR members willing to be involved in this project will be available on the SSAR website (http://www.ssarherps.org/pages/presub.html). Persons who have manuscripts ready for submission (to any journal) can peruse this list of SSAR members and select an appropriate person with whom to correspond. Members of the SSAR community may offer to read and edit up to three English language manuscripts per year within their specific area of herpetological expertise. This service would be provided free to herpetologists whose first language is not English, but who are striving to publish their findings in peer-reviewed English language journals. The Board unanimously approved this project.

Henry Mushinsky presented information on plans for future meetings. The SSAR Board approved and accepted meeting invitations for the next several years. These meetings will be joint events with the American Society of Ichthyologists and Herpetologists (ASIH) and The Herpetologists' League (HL). In 1999, SSAR entered into a Joint Meeting Planning Committee relationship with members of ASIH, HL, and the American Elasmobranch Society (AES). Mushinsky provided details for future dates: 2003, Manaus, Brazil (June); 2004, Norman, Oklahoma (27 May–2 June); 2005, Tampa, Florida; 2006, New Orleans, Louisiana; and 2007, Ithaca, New York. The 2003 meeting will take place at the Hotel Tropical, which is situated along the banks of the Rio Negro in Manaus. Local committee member Richard Vogt provided videotaped scenes of celebrations in Manaus and details about the meeting location and early registration and travel information. Vogt stated that the Hotel Tropical is a top-rated resort with many amenities and comfortable accommodations. He personally guaranteed that meeting delegates would have a memorable experience.

Dawn Wilson, Chair of the SSAR Travel Awards Committee, noted that money from the silent auction this year will be used to provide travel awards for the 2003 meeting in Manaus. 2003 travel awards will be $400 instead of the usual $200 because of the distant locale of the meeting.

Ron Heyer requested that SSAR donate $5000 toward the next World Congress of Herpetology. After considerable discussion, the Board indicated its willingness in principle to support WCH; however, it was felt that more information on the venue and timing of the next congress would be necessary before funds could be committed.

Logistical concerns related to growth of the Annual Meeting have led to increased involvement between the societies with herpetological interests. A number of policy changes have been considered by the SSAR Board in association with mandates set down by the Meeting Planning Committee (MPLN). Henry Mushinsky serves as SSAR representative to the MPLN, and he provided information on Joint Meeting policy changes. The most notable of these policies deals with number of presentations, no shows/cancellations, and symposia proposals for the Annual Meeting. Members of all societies agreed to the policies, which will be published separately.

Issues related to the SSAR webpage and online publishing were reported on by the Website Task Force (Lee Fitzgerald [Chair], Breck Bartholomew, John Matter, and George Pisani), which had been established in January by President Green to consider a vari-

ety of potential functions for the SSAR website. Current webmaster, George Pisani, was acknowledged for his dedicated service to the Society, but indicated his desire to be relieved of this position. To that end, the Society implemented a search for a new web coordinator.

The Society did not receive a report from the Joint SSAR/HL Task Force on Electronic Publishing (Brian Crother [Chair], Beth Dawson, Malcolm McCallum, and Laurie Vitt) in time to consider the issue at the meeting. The issue was discussed, however, with the most notable concern being the potential loss of revenue to the Society. This issue remained unresolved at the meeting, but the Board realized the necessity of coming to a decision as soon as possible.

Reluctantly, the Board noted the necessity of increasing dues for the coming year. Most membership categories are subject to a $10 increase, while maintaining the present cost of student memberships. Several new contributing member levels were outlined, to be reflected in the next dues notice, and it was hoped that the Society will see significant financial stability from this dues restructuring.

In one of his final public actions as SSAR President, David Green passed the engraved Presidential gavel, that treasured totem-of-office, to President-Elect Janalee Caldwell. Jan commented on the aesthetics of the item before closing the meeting at 1800 h.

—Respectfully submitted by John M. Matter, SSAR Secretary

New Policies for Presentations at Annual Meetings Approved by the Society, July 2002

Number of Presentations at Annual Meetings

Background.—Participation at the Joint Meetings of ASIH, AES, HL, SSAR, and Early Life History Section of AFS has increased over the past several years. As participation has increased the consequences of scheduling become more critical to the attendees at the Annual Meeting. Many members of the Societies have raised concerns over the length and timing of the meeting. The Meeting Planning Committee (MPLN) has struggled with constraining the length of the meeting, number of concurrent sessions, and ensuring that we do not schedule the same individual at the same time in different sessions. The MPLN has developed a policy that was approved at the 2002 Annual Business Meeting. The policy will be implemented beginning in 2003.

Policy.—Beginning at the 2003 Annual Meeting and continuing from then on, participants may submit only one abstract as a senior authored oral presentation for either an Invited Symposium or Oral Paper presentation. Participants may submit only one senior-authored poster presentation. In total, individuals shall only present one oral and possibly one poster presentation at Annual Meetings. Co-authorship via junior authorship is not limited. Notification of this policy will appear in the Call for Papers and on the ASIH, AES, HL, and SSAR web sites.

No Shows and Cancellations at Annual Meetings

Background.—Over the past several years the number of no-shows has begun to obstruct the flow of the meeting, disrupt sessions, and become a burden to the Societies. ASIH Governor Clark Hubbs raised this concern during the ASIH Business Meeting at the 2001 Annual Meeting at Pennsylvania State University. ASIH President Burr charged the MPLN to develop a policy to address this problem. This policy was approved at the SSAR Business Meeting and will be implemented beginning in 2003.

Policy.—If it is necessary to cancel a presentation (invited, oral, or poster) you must notify the designated member of the MPLN one month prior to the scheduled date of the Annual Meeting. For emergency circumstances, presentations must be cancelled 24 hours prior to the beginning of the first scheduled day of the Annual Meeting. Failure to do so shall result in a suspension of presentation privileges for 1 year.

Symposium Proposal Process

Symposia are important components of the Annual Meeting. These components provide useful information to the membership of participating Societies and contribute to a compelling and interesting experience. To provide a clear process the MPLN has developed the following set of guidelines.

Submission for consideration.—Proposals (3-page maximum) for consideration by MPLN should contain the following:

1. Symposium Title (or Topic)
2. Name of the Symposium Chair (phone number and e-mail address)
   a. Names of Associated Co-organizers
3. Information on topic and background
4. What benefit is the topic to the Society?
5. List of potential speakers and topics
6. Length of symposium (1/2 day, 1 day, etc.)—keep in mind the preference is for a one-day symposium with a likely maximum (in rare situations) of 2 days.
7. Sources of funding other than SSAR
8. SSAR funding requested and rationale (maximum per request = $1,500)

PROPOSALS DUE TO MPLN CHAIR by 1 March of the YEAR PRIOR to the meeting (i.e., 2004 Symposium Proposals are due 1 March 2003).

Responsibilities of the Symposium Chair(s):

1. Work with the participants to obtain titles and abstracts.
   a. Abstracts MUST be submitted to the SSAR meeting committee by the Annual Meeting abstract deadline using announced SSAR abstract submission procedures.
2. Develop and submit schedule for the symposium to the MPLN Chair by 1 March (year of the meeting). This includes the order, length (15 or 30 minutes), and scheduled times for all talks. Symposium Chair must provide the names of the moderators for the symposium at the same time.

MPLN Committee Review Process:

1. Proposals received by MPLN Chair and distributed to the MPLN for review by 5 March.
2. MPLN Chair collects comments and ranking of proposals by 30 March.
3. Consensus ranking redistributed to MPLN for review and comment.
4. MPLN selects two proposals for each Annual Meeting by 30 April.
5. All Symposia Chairs notified of acceptance or rejection by 30 April.

Journal of Herpetology: Notice of Mailing Error

The mailing labels for issue No. 1 of the *Journal of Herpetology* (mailed in April 2003) inadvertently had the subscriber's name omitted. This error occurred only for the U.S. subscribers. If you did not receive your journal, please contact your local mail sorter to see if your journal can be located. If it cannot be located, please contact the SSAR Publications Secretary (e-mail: ssar@herplit.com or phone 801-453-0489), and a replacement will be sent to you. The Society apologizes for this inconvenience.

NEWSNOTES

New Director of Sam Nobel Oklahoma Museum of Natural History

Ellen J. Censky, director of the Connecticut State Museum of Natural History at the University of Connecticut and long-time SSAR member (and current SSAR Board Member), has been named the new director of the Sam Noble Oklahoma Museum of Natural History at the University of Oklahoma. Censky will assume her new post May 1. Censky has served as director of the Connecticut State Museum of Natural History since 1998. The Sam Noble Oklahoma Museum of Natural History, one of the two largest natural history museums in the world associated with a university, opened the doors of its 198,000-square-foot, $44.5 million facility in May 2000. Prior to joining the Connecticut State Museum of Natural History, Censky served as chairman of the division of life sciences at the Carnegie Museum of Natural History in Pittsburgh from 1996 to 1998. She also served that museum as head of the amphibians and reptiles section as well as the section's assistant curator and collection manager. A 1979 graduate of the University of Wisconsin-Milwaukee, Censky earned her doctoral degree in biological sciences from the University of Pittsburgh in 1994.

Virginia R. Fitch Memorial Fund

Virginia R. Fitch passed away at home on 2 December 2002, at the Fitch Natural History Reservation near Lawrence, Kansas. The Fitch family and the University of Kansas Field Station and Ecological Reserves announce the establishment of the Virginia R. Fitch Memorial Fund for the purpose of honoring the memory of Virginia and her contribution to over 50 years of research and teaching at the Reservation. She contributed in many important ways to the field research that was conducted by her husband, Dr. Henry S. Fitch, many colleagues, and students. The Reservation is named in honor of the entire Fitch Family: Henry, Virginia, John, Alice, and Chester. The Fitch Nature Trail is named to specifically honor Henry and now, in memorial to Virginia, an open-sided covered shelter is planned to accommodate visiting classes of public and University students. This structure is to be built on the Reservation to facilitate public education involving nature, natural history, and ecology. This seems particularly appropriate considering Virginia's role not only as a contributor to many diverse research projects, but to the great hospitality she always provided to visitors to the Reservation.

Tax deductible (for U.S. residents) contributions may be made to the Virginia R. Fitch Memorial Fund in care of the Center for North American Herpetology (www.cnah.org), 1502 Medinah Circle, Lawrence, Kansas 66044, USA. Make checks payable to "CNAH Fitch Memorial."

Wanted: Photographs of Native North American Snakes

The North America Brown Tree Snake Control Team needs your help! We are a newly-formed organization whose mission is to keep brown tree snakes (*Boiga irregularis*) from establishing in North America. We desire to place photos of brown tree snakes and native North American snakes on our web site (www.NABTSCT.orgwww.NABTSCT.org) to aid the general public in brown tree snake identification. We need good quality photos (200– 600 dpi) of native North American snakes that can be used on our web site. Photographs, slides, CD's, or e-mail attachments (Jpeg files) can be sent. All photos, slides, and CD's will be returned. Please provide the name of the photographer for each photograph so that proper acknowledgment can be given. Send photos to: Scott E. Henke, MSC 218, Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville, Kingsville, Texas 78363, USA or as e-mail attachments to: scott.henke@tamuk.edu.

California Academy of Sciences Grants

Charles Stearns Grant-in-Aid for Herpetological Research

The Department of Herpetology is pleased to provide limited financial aid - mostly to cover round trip transportation and limited per diem expenses - to graduate students who wish to visit our collections to support research in systematics. Proposals should include a short—no more than one page—description of the research project, a budget, and a letter of support from the student's faculty advisor. Proposals are due on 15 October 2003, with notification by 1 December 2003. Grantees are expected to complete their Academy visit by 15 September 2004. Please call 415-750-7037 for further information. Send proposals to: Herpetology Research Grants, Department of Herpetology, California Academy of Sciences, Golden Gate Park, San Francisco, California 94118-4599, USA.

The CAS holdings are included in the Department of Herpetology database:

http://research.calacademy.org/herpetology/catalog/

Brett Stearns Award for Chelonian Research

The Department of Herpetology is pleased to provide limited financial aid—mostly to cover round-trip transportation and limited per diem expenses—to researchers who wish to visit our collections to support their work in chelonian biology. Preference will be given to graduate students. Proposals should include a short, one page description of the research project and a budget. In the case of graduate students, a letter of support from the student's faculty advisor is required. Proposals are due on 15 October 2003; notification will be made by 1 December 2003. Awardees are expected to complete their Academy visit by 15 September 2004. Please call (415) 750-7039 for further information.

Proposals should be sent to: Herpetology Research Grants, Department of Herpetology, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118-4599, USA.

The CAS chelonian holdings are included in the Department of Herpetology database: http://research.calacademy.org/herpetology/catalog/.

Gopher Tortoise Council Research Awards

Annually, the Gopher Tortoise Council awards the J. Larry Landers Student Research Award to the best student proposal submitted to the Council. Proposals can address undergraduate or graduate research concerning the biology of gopher tortoises (*Gopherus polyphemus*) or any other relevant aspect of southeastern U.S. upland habitat conservation. The amount of the award is variable, but has averaged US $1000.00 over the last few years.

The proposal should be limited to four pages and should include a description of the project, a concise budget, and a brief resume of the student applicant. Proposals should be submitted to Bob Herrington, Chair of Research Advisory Committee, Georgia Southwestern State University, Department of Biology, Americus, Georgia 31709, USA by 31 August 2003. Additional information can be found at <http://gophertortoisecouncil.org/>.

For SSAR Members in Indiana and Illinois

The Field Museum is conducting a survey of academic institutions, government agencies, and private organizations throughout Indiana and Illinois to determine how many teaching or research collections of fishes, amphibians, and reptiles exist in each state (preserved specimens only, not live animals). We believe that significant contributions can be made to the natural history of both Indiana and Illinois by reporting on the existence and status of small collections that are not well known by the scientific community. If your organization or institution maintains such a collection, please contact Jamie Ladonski (e-mail: jladonski@fieldmuseum.org) for more information on how your collection can be counted. Even if your department or office does not have such a collection, that information is valuable to our survey and we ask that you please contact us simply to note that fact. Please consider that collections might be at other locations if your institution has satellite campuses, field stations, or a similar network of offices.

MEETINGS

Meetings Calendar

12–16 August 2003—12th Ordinary General Meeting of Societas Europaea Herpetologica, St. Petersburg, Russia. Information: Natalia Ananjeva (e-mail: agama@NA4755.spb.edu).

3–6 September 2003—International Herpetological Symposium, 27th Annual Meeting, Houston, Texas, USA. Information: http://www.kingsnake.com/ihs/index.html.

15–20 November 2004—VI Symposium of Zoology, Havana, Cuba. Information:Executive Secretary: DrC. Daysi Rodríguez Batista (zoologia.ies@ama.cu) or www.geocities.com/zoologiacubana/simposio.

CURRENT RESEARCH

The purpose of **Current Research** is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, **Eli Greenbaum** or **Omar Torres-Carvajal**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can now be found at: http://www.herplit.com/contents.

Systematics of Gymnophthalmid Lizards

Phylogenetic relationships among members of the family Gymnophthalmidae are poorly known. The author performed a phylogenetic analysis of species of three genera (*Cercosaura*, *Pantodactylus*, and *Prionodactylus*) currently included in the tribe Cercosaurini, subfamily Cercosaurinae. The analysis was based on 61 external morphological characters; maximum parsimony criterion was used. Polymorphic characters were analyzed with the generalized frequency method. The author proposed a classification consistent both with the recovered history and a previously published hypothesis based on molecular data. *Pantodactylus* and *Prionodactylus* were considered junior synonyms of *Cercosaura*, and the latter genus was redefined to include 11 species.

Doan, T. M. 2003. A new phylogenetic classification for the gymnophthalmid genera *Cercosaura*, *Pantodactylus*, and *Prionodactylus* (Reptilia: Squamata). Zoological Journal of the Linnean Society 137:101–115.

Correspondence to: Tiffany M. Doan, Biology Department, Vassar College, Box 555, 124 Raymond Avenue, Poughkeepsie, New York 12604-0555, USA; e-mail: tiffperu@yahoo.com.

Phenotypic Variation and Fitness of Hatchling Lizards

Variation in phenotype reflects variation in fitness; therefore, it is important to study the sources of phenotypic variation in order to understand the processes of natural selection. Phenotypes of hatchling reptiles are influenced by environmental factors, quantity or quality of yolk, and genetic contribution of the parents. The authors used eastern fence lizards (*Sceloporus undulatus*) to explore the effects of incubation moisture, maternal yolk investment, and clutch affiliation on phenotypes of hatchlings in the laboratory. Eggs from 28 clutches were distributed among wet and dry treatments, as well as a treatment in which yolk was removed. Hatchling performance traits were measured in the laboratory. Growth and survival under natural conditions were assessed by release and recapture of hatchlings in the field. The authors found that hatchlings from the wet treatment were bigger than those from the dry and yolk-removed treatments. However, only clutch affected hatchling performance and survival. These results suggest that variation in reptile phenotypes is strongly associated with clutch of origin.

WARNER, D. A., AND R. M. ANDREWS. 2002. Laboratory and field experiments identify sources of variation in phenotypes and survival of hatchling lizards. Biological Journal of the Linnean Society 76:105–124.

Correspondence to: Daniel A. Warner, Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, 100 Eighth Avenue S.E., St. Petersburg, Florida 33701, USA; e-mail: warner@fwc.state.fl.us.

Trematodes and Limb Deformities in *Rana*

Limb abnormalities in natural populations of amphibians might be caused by chemical pollution, UV-B radiation, predation, and parasites including trematodes. Disruption of spatial organization of cells in the limb bud is one of the mechanisms leading to outgrowth of limb deformities. These cells produce signaling molecules that set up the primary limb axes. The authors investigated how trematode cyst infection caused limb deformities in *Rana sylvatica* and *R. pipiens*. Infected and uninfected tadpoles were raised to metamorphosis and then examined for limb abnormalities. Deformities by surgical limb bud rotations also were performed for comparison. Trematode cercariae actively targeted hind limb bud regions and histological analysis showed that cysts induced abnormal tissue growth at early stages. Abnormalities resulting from trematode cyst-infestation closely resembled those induced by limb bud rotation, as well as those found in natural populations. These results suggest that cysts induce limb deformities in frogs by perturbing spatial organization of cells in limb buds. Because there is no direct evidence that chemical teratogens or UV-B radiation induce limb deformities in amphibians, trematode cysts might play a major role in causing limb abnormalities.

STOPPER, G. F., L. HECKER, R. A. FRANSSEN, AND S. K. SESSIONS. 2002. How trematodes cause limb deformities in amphibians. Journal of Experimental Zoology 294:252–263.

Correspondence to: Stanley K. Sessions, Department of Biology, Hartwick College, Oneonta, New York 13820, USA; e-mail: sessionss@hartwick.edu.

Dispersal of Viviparity in Fire Salamanders

Retention of ancestral states or lineage sorting in diverging populations are usual explanations for discordance between nuclear and mitochondrial DNA gene trees. However, this discordance may also result from gene introgression during reticulation events. Females of fire salamanders *Salamandra salamandra* either give birth to individuals that bypass the aquatic larval stage entirely (viviparity), or give birth to small aquatic larvae (ovoviviparity). Based on mtDNA sequences from 45 populations of fire salamanders in the Iberian Peninsula and data on nuclear markers from the literature, the authors performed a phylogeographic analysis to elucidate evolutionary processes acting on the populations and their influence on the evolution of viviparity. Two major discordances were found by plotting the geographic ranges defined by mtDNA and nuclear genes. Given that nuclear markers show high concordance in geographic distribution with life history, anatomy, and color pattern markers, the authors hypothesize that mtDNA markers reflect relatively deep history that has been obscured by geographic range expansion of the viviparous populations. This implies that nuclear genes have crossed contact zones fast and spread through the populations in contact producing admixture, whereas mtDNA has remained stationary resulting in a process of mtDNA capture. The authors suggested that demographic replacement via range shifts is the mechanism responsible for admixture of differentiated populations. Finally, they conclude that viviparity within fire salamanders arose only once.

GARCÍA-PARÍS, M., M. ALCOBENDAS, D. BUCKLEY, AND D. B. WAKE. 2003. Dispersal of viviparity across contact zones in Iberian populations of fire salamanders (*Salamandra*) inferred from discordance of genetic and morphological traits. Evolution 57:129–143.

Correspondence to: M. García-París, Museo Nacional de Ciencias Naturales, CSIC José Gutiérrez Abascal, 2, 28006 Madrid, Spain; e-mail: mcnp505@mncn.csic.es.

Similarities Between Ovarian and Bidderian Oocytes

In vertebrate embryos, the gonadal primordium is colonized by the primordial germ cells and differentiates into either testis or ovary. Nonetheless, the anterior portion of the gonadal primordium fails to develop into testis in male bufonids resulting in an undeveloped ovary known as Bidder's organ. Bidderian oocytes grow and undergo vitellogenesis if testes are removed. The authors compared oogenesis between Bidder's organ and ovary in *Bufo marinus* by analyzing morphology and differentiated expression of the lamina-associated polypeptide 2 (LAP2). Isoforms of LAP2

are specific markers of frog germ and somatic cell differentiation. Bidderian oocyte growth was studied in male *Bufo marinus* for three months. Oocytes from Bidder's organ and ovary were examined with sodium dodecylsulfate polacrylamide gel electrophoresis and immunoblotting. Based on the *Xenopus laevis* staging of oogenesis, the authors classified *B. marinus* oogenesis into six stages. After orchidectomy, Bidder's organ became larger and more vascularized, and oocytes advanced to stages 2–3 of oogenesis. In addition, molecular similarities between ovarian and Bidderian oocytes were found. LAP2w, one of the isoforms of LAP2, was similarly upregulated in ovary and Bidder's organ. Moreover, large oocytes of both organs expressed LAP2w as the major isoform.

BROWN, F., E. M. DEL PINO, AND G. KROHNE. 2002. Bidder's organ in the toad *Bufo marinus*: effects of orchidectomy on the morphology and expression of lamina-associated polypeptide 2. Development, Growth, and Differentiation 44:527–535.

Correspondence to: Eugenia del Pino, Departamento de Ciencias Biológicas, Pontificia Universidad Católica del Ecuador, Avenida 12 de Octubre y Patria, Apartado 17-01-2184, Quito, Ecuador; e-mail: edelpino@puce.edu.ec.

Evolution of Viviparity in Montane Reptiles

Transition from oviparity to viviparity in squamate reptiles offers an ideal model system to explore adaptationist hypotheses. The primary stimulus for the evolution of viviparity seems to be the invasion of cold climates. The strong correlation between viviparity and cold climates suggests that the selective force for viviparity involves incubation temperature. In an attempt to test the "cold-climate" hypothesis for the evolution of reptilian viviparity, the author performed laboratory and field experiments with the oviparous Australian three-lined skink *Bassiana duperreyi*. The effects of low-temperature incubation and brief retention at higher temperatures (to stimulate uterine retention) were investigated. Eggs incubated at higher temperatures completed development sooner, and "uterine retention" accelerated hatching to a greater degree in eggs that were then transferred to lower rather than higher incubation temperatures. The same pattern was observed for survival rate, running speed, and snout-vent length at one week; the latter was the only trait not affected by "uterine retention." In addition, incubation periods were longer in higher-elevation nests and in eggs that were not kept initially at uterine temperatures. These results support several predictions of the "cold-climate" hypothesis; however, other putative selective forces involved in the transition from oviparity to viviparity in reptiles need to be tested.

SHINE, R. 2002. Reconstructing an adaptationist scenario: what selective forces favor the evolution of viviparity in montane reptiles? American Naturalist 160:582–593.

Correspondence to: Richard Shine, School of Biological Sciences, Building A08, University of Sydney, Sydney, New South Wales 2006, Australia; e-mail: rics@bio.usyd.edu.au.

Assessing the Conservation Status of Amphibian Assemblages

Amphibian global decline should be analyzed with quantitative data gathered through long time scales. Unfortunately, these data are usually scarce, which makes long-term population analyses difficult. The authors compared present and past densities and distribution ranges to evaluate the conservation status of amphibian populations from the Peñalara Natural Park in Spain. The study area is located between 1800–2430 m and contains an amphibian community of nine breeding species including *Salamandra salamandra*, *Bufo calamita*, and *Alytes obstetricans*. Larval density and distribution data of all species were obtained from 73 ponds during two time periods, 1982–1986 and 1999. A chi-square analysis was used to compare the observed ratio of extinctions to colonizations to an expected ratio of 1:1. Presence of a species in a pond was recorded only if there was evidence of reproduction of that species. The authors found no variation in species composition of the amphibian community in the park; however, a significant decrease in species per pond was observed. Larval densities of *A. obstetricans* and *B. calamita* decreased significantly; chytrid infection was detected in both species. In contrast, tadpole density of *Rana perezi* increased. Larval density also increased in ponds at high elevations, and decreased more in temporal than in permanent ponds. These results suggest that a decrease in number of species does not necessarily indicate a regional decline, and the actual general trend of a community might be obscured by expansions and declines occurring simultaneously. This is one of the few studies that report quantitative data on amphibian population decline at the community level.

MARTÍNEZ-SOLANO, I., J. BOSCH, AND M. GARCÍA-PARÍS. 2003. Demographic trends and community stability in a montane amphibian assemblage. Conservation Biology 17:238–244.

Correspondence to: Iñigo Martínez-Solano, Museo Nacional de Ciencias Naturales, Consejo Superior de Investigaciones Científicas José Gutiérrez Abascal 2, 28006 Madrid, Spain; e-mail: mcnim548@mncn.csic.es.

Skeletal Development of the Spiny Softshell Turtle

Turtles have skeletal features that are very different from other tetrapods. Nonetheless, ontogenetic studies of their osteology are rare. Upon examination of 48 specimens, the author described in detail the osteology and skeletal development of the spiny softshell turtle *Apalone spinifera* and compared his results with published data of other turtles, as well as other reptilian taxa. Embryos were collected as eggs from a commercial turtle farm and incubated in the laboratory. Eggs were sampled at 3–4 day intervals, and developmental stages of embryos were determined with external morphological criteria. Data were obtained from skeletons and cleared and stained specimens. The author compared the chondrocranium of the spiny softshell turtle with chondrocrania of *Emys orbicularis* and *Caretta caretta*. In addition, differences and similarities in sequence and patterns of ossification between *A. spinifera* and *Chelydra serpentina* were described. For example, patterns of chondrification in the fore- and hindlimb of *A. spinifera* are similar to those of *C. serpentina*, but patterns of ossification in

both appendages are different. Finally, the author compared the ossification pattern in both species of turtles with those of *Lacerta* and *Alligator*. For instance, the first elements of the dermatocranium that ossify in *Apalone* and *Chelydra* are components of the skull table, whereas in *Lacerta* and *Alligator* palatal elements ossify first. These data have potential to provide phylogenetically informative characters.

SHEIL, C. A. 2003. Osteology and skeletal development of *Apalone spinifera* (Reptilia: Testudines: Trionychidae). Journal of Morphology 256:42–78.

Correspondence to: Christopher A. Sheil, Division of Herpetology, Natural History Museum & Biodiversity Research Center, 1345 Jayhawk Blvd., Dyche Hall, The University of Kansas, Lawrence, Kansas 66045-7561, USA; e-mail: csheil@ku.edu.

Aggregation Behavior of Tadpoles of *Phrynomantis microps*

Severe climatic conditions, clumped food sources, mating advantages, and predation risk can lead to aggregation behaviors in many animal species. The author studied aggregation of tadpoles of *Phrynomantis microps* in the Comoé National Park, Ivory Coast. Water clarity and depth were estimated for each pond; tadpole size and age were also recorded. In addition, the standardized Morisita index was used to analyze dispersion of larvae with data from photographs. The author found that tadpoles form swarms during the day and are randomly distributed at night. Group size was significantly correlated with water clarity, water level, and age and size of tadpoles. However, water clarity explained most of the variability in aggregation size, which supports the idea that the selective force inducing aggregation behavior in *P. microps* larvae stems from visually hunting predators.

SPIELER, M. 2003. Risk of predation affects aggregation size: a study with tadpoles of *Phrynomantis microps* (Anura: Microhylidae). Animal Behaviour 65:179–184.

Correspondence to: Marko Spieler, Museum of Natural History, Humboldt-University, Invalidenstr. 43, 10115 Berlin, Germany; e-mail: marko.spieler@museum.hu-berlin.de.

Estimating Maturity in Fossil Squamates

Accurate estimates of relative maturity in fossil vertebrates is critical for determining whether a series of specimens represents an ontogenetic series of one species or individuals of different species. Although body size is a potential indicator of maturity, it is not necessarily accurate and has sometimes led to mistaken observations. Terminal fusions between skeletal elements can be used as a size-independent criterion to estimate specimen maturity. The author examined the relationship between terminal fusions and sexual and skeletal maturity upon study of postnatal skeletal development of 21 extant species of lizards. Fusions were considered to be correlated with sexual maturity if their completion fell within 10% of average size at sexual maturity. Percentage of maximum size at which terminal fusions occurred was used to denote the relationship between fusions and skeletal maturity. The author found that terminal fusions were not reliable indicators of sexual maturity in all species examined. However, some fusions were good indicators in particular crown squamate clades. For example, the onset of fusion of the prootic and otoccipital ventrally correlated with sexual maturity in teiioids. More studies of the timing of terminal fusions in extant taxa are needed before we can use fusions as indicators of maturity in fossil squamates.

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Effects of Climatic Change on Speciation of Palearctic Brown Frogs

Climatic changes since the Pliocene have allowed repeated events of allopatric speciation that resulted in present day species communities of the Northern hemisphere. With 20 species, *Rana* (water frogs and brown frogs) is the most specious genus among Western Palearctic amphibians and represents an ideal taxon for testing vicariance hypotheses. In this study, the authors tested the hypothesis that recent climatic oscillations were responsible for radiation of Western Palearctic brown frogs. They performed phylogenetic analyses of all species of brown frogs using mitochondrial and nuclear DNA sequence data. Neighbor joining, maximum parsimony, maximum likelihood, and Bayesian analysis were used as methods of phylogenetic inference. A molecular clock was calibrated and used to date speciation events. All phylogenetic analyses resulted in the same topology consisting in a basal radiation into five lineages. The authors found that the basic radiation among brown frogs can be dated to the post-Messinian (ca. 4 mya). The *Rana temporaria* species group split into five lineages 3.0 mya, the Anatolian lineage radiated around 2.4 mya, and *R. temporaria* split into two lineages about 1.0 mya. These estimates of major speciation times are congruent with post-Messinian climatic fluctuations, which suggests that radiation of Western Palearctic brown frogs was triggered by the onset of glaciers with cycles of repeated cold and warm periods.

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ZOO VIEW

Sadly, two zoo herpetologists have died prematurely after long struggles with medical problems: Sean McKeown and John McLain. Both were visionaries, thoroughly committed to conservation and the captive management of threatened amphibians and reptiles. They will be missed by their friends in the zoo community.

For two decades beginning in 1975, Sean McKeown was the herpetological curator at the Honolulu Zoo and later at the Chaffee Zoo in Fresno, California. McKeown published many papers on geckos, especially day geckos of the genus *Phelsuma*. His 1993 book "The General Care and Maintenance of Day Geckos" is the standard guide covering this diverse group.

His first book, published in 1978, was on Hawaii herpetofauna: "Hawaiian Reptiles and Amphibians." His second, written 18 years later and entitled "Field Guide to the Reptiles and Amphibians in the Hawaiian Islands," documented the establishment of alien species: red-eared sliders, Jackson's chameleon, and Madagascar day geckos. Sean was concerned about the possibility of accidental releases of the brown tree snake from Guam into Hawaii and was a member of the "Brown Tree Snake Control Group," an active assemblage of conservationists who implemented detection and removal plans.

Sean was a fervent supporter of the ecosystem approach for managing and displaying reptiles and amphibians in zoos. He always felt that herps should be exhibited in naturalistic settings. In 1989, he documented the first captive breeding of the Madagascar ground boa in North America from long-term captive adults.

Sean loved tortoises and wrote papers on managing and breeding them in captivity, such as those on the reproductive biology of the Asian brown and Angonoka tortoises at the Honolulu Zoo in 1982. The next year, the Zoo received the AZA's Edward H. Bean Award, given annually for the most prestigious accomplishment in the captive management and breeding of zoo animals, for Sean's efforts in reproducing the Angonoka tortoise. He was a consultant for the Republic of the Seychelles Conservation Department to assist in developing a captive tortoise colony. Sean died on 11 July 2002 after a heart transplant roughly two years earlier and is survived by his wife Wendy and two daughters. See Breese (2002. Bull. Chicago Herpetol. Soc. 37:152) for an expanded description of his importance to zoo herpetology. An obituary also appeared in *HR* earlier this year (see Chun and Beaman 2003. Herpetol. Rev. 34:9–11).

John McLain had been battling liver cancer for over a year and succumbed on 7 December 2002. He was past chair of the Snake Advisory Group of the American Association of Zoos and Aquariums (AZA) and former Curator of Herpetology at the San Antonio Zoo in Texas. John began his zoo career as a keeper, and later assistant supervisor at the Houston Zoo in the 1980's under curator Hugh Quinn and director John Werler. His interest in snakes, especially boas and pythons, was well known in the zoo community and he cared for one of the finest collections of these ophidians in the world (see McLain. 1982. Notes on boid reproduction at the Houston Zoological Park, pp. 248–264. Proc. 6th Int. Herpetol. Symp. Captive Propagation Husbandry). The Houston Zoo had a magnificent collection of boas and pythons: all three Madagascan boas, Angolan dwarf python, Calabar boa, white-lipped python, black-headed python, ringed python, Panamanian woodsnake, all of the Pacific boas, Argentinian boa, black python, and many insular Caribbean forms. As Species Survival Plan (SSP) coordinator for Dumeril's ground boa (*Acrantophis dumerili*), he started one of the first reptile SSPs for the AZA.

John was among the astounding number of zoo herpetologists who worked in Houston over the years (the late Joe Laszlo, Tim Jones, John Banks, Ardell Mitchell, Bern Tryon, R. Andrew Odum and Karl Peterson), and later held curatorial posts. No other zoo can duplicate this placement of so many former employees on this administrative level.

John had a sardonic wit and it was always fun to listen to him assess the state of the world with his unique brand of humor. He is survived by his wife Judy and daughter Kelsea.

Don Nichols is a pathologist in the Department of Pathology at the National Zoological Park in Washington, DC. He has done research on a number of herps: use of methohexital sodium as an anesthetic in two species of colubrid snakes, radiation therapy of a malignant chromatophoroma in a yellow rat snake, perivertebral mineralization in a giant tree frog (*Phyllomedusa bicolor*), gout in giant day geckoes, infectious diseases of amphibians, neoplasia in snakes, isolation and experimental transmission of a reovirus pathogenic in ratsnakes, and paramyxovirus infection in caiman lizards (*Dracaena guianensis*). He has assessed the health status of cricket frogs (*Acris crepitans*) and environmental quality in areas of abundant and reduced populations as well as forms and prevalence of intersexuality and effects of environmental contaminants on sexuality in this taxon.

Don has also focused on brown tree snakes (*Boiga irregularis*) in an attempt to develop a biological control on Guam with studies on reference hematologic and plasma chemistry values, fatal mycotic dermatitis, and pathology of experimental ophidian paramyxovirus infection.

Several years ago, Don described his experiences to me as he tracked down the elusive chytrid organism responsible for amphibian mortality in wild and captive populations. It is an intriguing herpetological detective story which would be of interest to any sleuth so I asked him to document his experiences in the following article.

—James B. Murphy, Section Editor

Herpetological Review, 2003, 34(2), 101–104.

Tracking Down the Killer Chytrid of Amphibians

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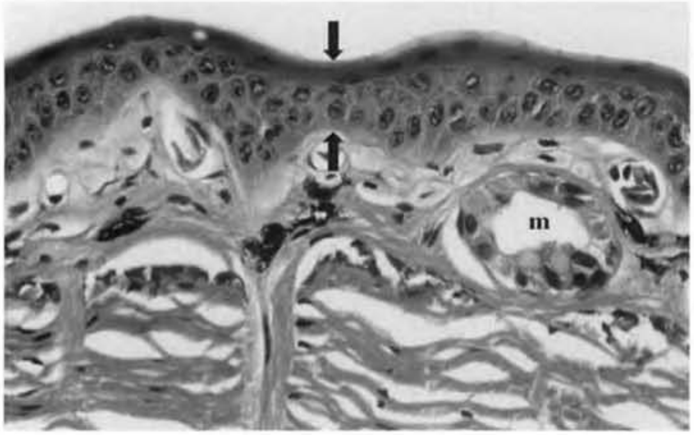
Most species of fungi in the Phylum Chytridiomycota (chytrids) are saprophytic decomposers of organic matter. Some are known to be parasites of other fungi, plants, or invertebrate animals. Until recently, no chytrids had ever been recognized as pathogens in vertebrate animals. However, one chytrid species, *Batrachochytrium dendrobatidis*, has now been shown to cause fatal skin disease in frogs and toads. This disease has had devastating impacts on captive collections of amphibians and is believed to be a significant factor in the declines of many wild anuran populations. The following is an account of the role I played in the discovery of this novel amphibian pathogen.

After completing a residency in veterinary pathology at the National Zoological Park (NZP) in 1987, I accepted a position as a staff pathologist at the National Institutes of Health (NIH) in Bethesda, Maryland. My work at NIH mostly involved rodents and other standard laboratory animals. However, my primary professional interests continued to be the diseases of exotic animals and wildlife, especially reptiles and amphibians. Therefore, while employed at NIH, I also had a part-time consulting pathology service for several zoos and other institutions that housed non-domestic animals.

It was as a consulting pathologist that I received three dead formalin-fixed California Arroyo Toads (*Bufo microscaphus*



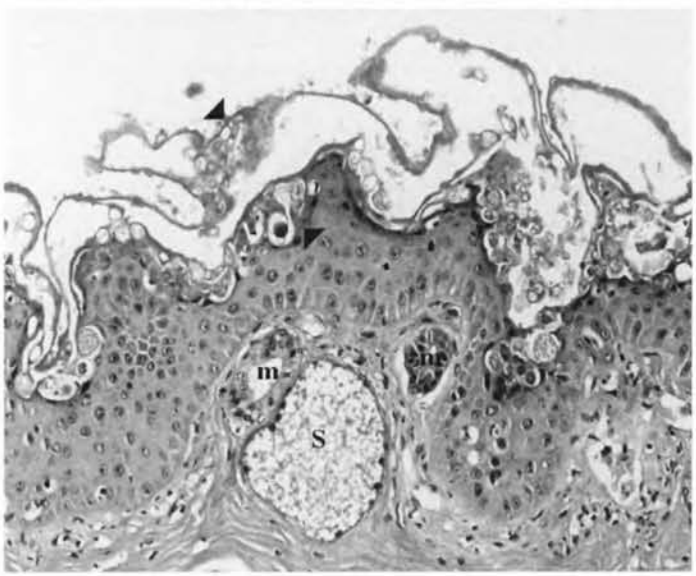


FIG. 1A (top). Photomicrograph of normal skin from a California Arroyo Toad (*Bufo microscaphus californicus*). The epidermis (between arrows) is three to four cell layers thick and only the outermost layer is keratinized. A circular mucous gland (m) is located in the dermis just beneath the epidermis. Magnification is 200x. 1B (bottom). Photomicrograph of skin from an affected California Arroyo Toad. The epidermis is diffusely thickened, especially the keratinized layers (between arrowheads). Within the keratinized layers are numerous variably-sized round nucleated organisms. Two mucous glands (m) and one serous gland (S) are located beneath the epidermis. Magnification is 120x.

californicus) in early November 1991. These animals had been part of a captive colony consisting of approximately 120 animals kept at the University of California-Santa Barbara. A disease outbreak of unknown cause had already led to the deaths of approximately 60% of the toads in this colony during the two months before the carcasses were sent to me. On histologic examination of all major organs from these toads, I discovered that all three had a skin disease characterized by moderate to marked thickening of the epidermis, especially the outer keratinized layers (Figs. 1A–B). Within these lesions (primarily in the keratinized layers) were numerous microscopic single-cell eukaryotic organisms unlike anything I had ever seen before (Figs. 1B, 2). Other organs from the toads did not contain any significant lesions. Therefore, I concluded that the skin disease was responsible for the deaths of the toads by interfering with normal skin function, which in amphibians includes maintenance of hydration and electrolyte balance, thermoregulation, and even respiration to varying extents. I also concluded that the microscopic organisms were most likely the cause of the skin lesions.

I then began a quest to determine exactly what those microorganisms were; it would eventually take more than five years to satisfy my curiosity. As the first step in this process, I performed a thorough search of the published literature and I did not find any reports of similar organisms affecting the skin of amphibians or any other animal.

My initial impression from examining standard histology slides of the toad skins was that the organisms most closely resembled sporozoan-type protozoa. Therefore, I next showed the slides to an expert on protozoal parasites, Dr. Chris Gardiner, who was stationed at the Armed Forces Institute of Pathology (AFIP) located in the Walter Reed Army Medical Complex in Washington, DC. Following his suggestions, I had additional histology slides prepared and stained with several different "special stains" (e.g., Gram, acid-fast, and periodic acid-Schiff). We also examined the organisms using transmission electron microscopy (TEM). After examining all this material, Dr. Gardiner concluded that the organisms definitely were not protozoa; he suggested that they were probably algae or fungi.

I then showed the histology slides and photographs from the TEM examinations to Dr. Maria Faust. She is an expert on algae at the Smithsonian's National Museum of Natural History. Her conclusion was that the organisms definitely were not algae, but were probably fungi or protozoa.

At this point, I concluded that the organisms must be some type of fungi. However, their morphology and staining characteristics in the special stains were unlike any fungal pathogens commonly encountered in human or veterinary medicine. To try to determine what kind of fungi they were, I next traveled to the National Library of Medicine located on the NIH campus to consult textbooks on the morphology of fungi by TEM. Unfortunately, the samples that I had from the arroyo toads had undergone some post-mortem decomposition and had been fixed in formalin, which is not an ideal fixative solution for TEM. Thus, these samples had many artifacts in them that interfered with interpretation. Also unfortunate was the fact that entire arroyo toad colony had died by this time, making it impossible to collect fresh samples and fix them in a proper TEM fixative.

The TEM examinations did clearly demonstrate that at one stage of development, the organisms consisted of cystic structures containing flagellated spore-like forms (Fig. 3). However, no types of fungi had flagellated spores in the TEM textbooks that I consulted; much later I realized that the fact that all of these books were written in the mid-to-late 1980's was very important (see footnote below).

At this point, I still had no idea what the organisms were; I could only say what they were not: fungi, algae, protozoa, animals, plants, or bacteria. Because I could not obtain further samples for study, I decided to give up trying to identify them for a while.

In the fall of 1991, I accepted a staff position as Associate Pathologist and returned to NZP. Shortly thereafter, I performed a retrospective search of the pathology files at NZP to see if any similar organisms had been seen in amphibians from the zoo's collection. My search revealed three cases of skin disease in frogs associated with organisms that closely resembled those in the ar-

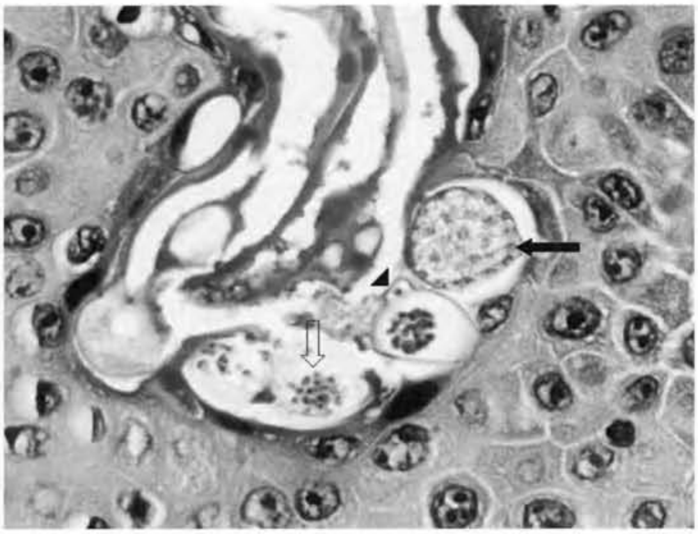


FIG. 2. Higher magnification of Fig. 1B demonstrating three forms of the organisms in the epidermis at the junction between the non-keratinized and keratinized layers. One form has multiple nuclei separated by lacey cytoplasm (solid arrow). Multiple spore-like forms are present in a cystic structure; this cyst has a flat papilla (arrowhead) through which the spores are released. A clump of discharged spores (open arrow) is also present. Magnification is 480x.

royo toads: a White's Tree Frog (*Litoria caerulea*) that died in 1988, an Ornate Horned Frog (*Ceratophrys ornata*) that died in January 1990, and another *L. caerulea* that died in September 1990. I then retrieved archived tissue samples from these cases and had the same special stains done on them as were done before; results were the same as with the arroyo toad samples. The results of TEM were also similar to before, including the artifacts that prevented definitive identification of the organisms.

Because this disease had occurred in NZP collection animals on at least three separate occasions, I reasoned that it might occur again. Over the next several years, whenever an amphibian was presented for necropsy, I instructed the pathology residents to collect numerous samples of skin for histologic examination. If I was asked why, my reply was "Because I am looking for something and I don't really know what it is."

By the spring of 1996, I had just about given up on finding the organisms again. Therefore, I decided that I would present the information that I had on this new amphibian disease at the annual conference of the American Association of Zoo Veterinarians (AAZV) that year. While preparing my abstract for the meeting, I stumbled across a textbook titled *Handbook of Protoctista* (Margulis et al. 1990). This 900+ page book contains detailed descriptions (including photographs of morphology by TEM) for each group of organisms in the Kingdom Protoctista (aka Kingdom Protista).

In this book were several phyla of aquatic organisms that produce flagellated spores and were originally classified as fungi; these so-called "zoosporic fungi" consisted of the Phyla Chytridiomycota, Hyphochytridiomycota, Oomycota, Labyrinthulomycota, and Plasmodiophoromycota. The morphology of the amphibian pathogens resembled those of these "zoosporic fungi" closely enough that I felt confident in calling them "aquatic fungal-like protists" in the paper that I presented at the 1996 AAZV meeting (Nichols et al. 1996). However, the artifacts in the TEM material from the organisms still prevented determination of which "zoosporic fungi" they were.

The event that finally allowed me to determine exactly what these organisms are came in the Fall of 1996. In September that year, an outbreak of the skin disease began in the NZP collection animals. Over the next several months, this outbreak resulted in the deaths of 24 juvenile Blue Poison Dart Frogs (*Dendrobates azureus*), 4 Green-and-Black Poison Dart Frogs (*D. auratus*), 3 White's Tree Frogs, and 1 Ornate Horned Frog. Once we realized that there was an ongoing outbreak, we were able to collect skin samples from freshly dead frogs and place them in a proper fixative solution for TEM. Morphology of these organisms by TEM closely resembled those in the Phylum Chytridiomycota.

Dr. Allan Pessier, our pathology resident at the time, then ran an Internet search and found the webpage of one of the few chytrid experts in the world, Dr. Joyce Longcore at the University of Maine. We sent her photographs of our TEM findings and she confirmed that the morphology of the organisms was consistent with a chytrid species (Pessier et al. 1999). We then sent her fresh skin samples from an affected *Dendrobates azureus* and she was able to isolate the organisms into culture. She also isolated the identical organism from an infected *D. auratus*, and later from a *Litoria caerulea*. Subsequent studies of the organisms by Longcore confirmed that not only was this a new chytrid species but it represented a novel genus as well. We eventually named this organism *Batrachochytrium dendrobatidis*, which has its roots in Greek and translates roughly as "frog chytrid of dendrobatids" (Longcore et al. 1999).

While Allan, Joyce, and I were characterizing this organism and the disease it causes, I received word in 1997 that other groups had seen something very similar associated with marked declines in wild populations of anurans in Australia and Central America. Drs. Rick Speare, Alex Hyatt, and Lee Berger headed the group in Australia and the group working on the disease in Central America consisted of Drs. Karen Lips, Peter Daszak, Andrew Cunningham,

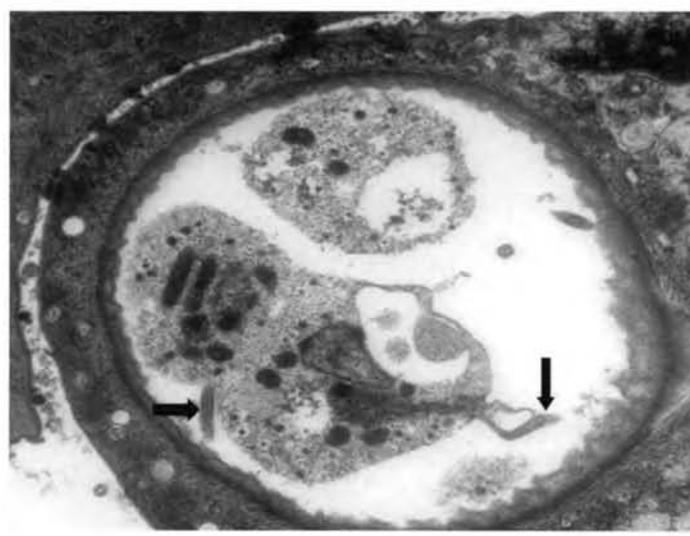


FIG. 3. Transmission electron photomicrograph of the epidermis from an affected California Arroyo Toad. Within one epidermal cell, there is a thick-walled cyst-like structure with an undulating interior border. Three round spores are present within the cyst (the cell membranes of two of these spores overlap). Flagella (arrows) are present, indicating that the spore stages of the organisms are aquatic. Magnification is 27,308x.

and David E. Green. My correspondence with these groups revealed that they were indeed seeing an identical disease and this was associated with organisms that appeared to be very similar to the chytrids we were studying. Although these groups had not been able to culture the organisms, they had concluded that the organisms were chytrids through the use of TEM and molecular genetics (Berger et al. 1998). Suddenly the interesting disease that I had been seeing in captive amphibians had taken on much more importance!

Cutaneous chytridiomycosis appears to be an emergent fatal disease of both captive and wild amphibians. Many now consider it to be one of the leading causes for the global declines of wild amphibian populations (Berger et al. 1998; Bosch et al. 2001; Daszak et al. 1999; Lips 1999; Ron and Merino 2000). Within the last six years, this disease has been recognized as the cause of death of captive and/or wild amphibians in Australia, New Zealand, North America, Central America, South America, Africa, and Europe (Speare and Berger 2002). The reasons for the apparent sudden appearance of this disease in so many areas of the world remain subjects for conjecture and ongoing research.

Joyce Longcore has more than 70 isolates of chytrids from various outbreaks of amphibian chytridiomycosis and from multiple amphibian species. So far, all of these have been *Batrachochytrium dendrobatidis*, indicating that this single chytrid species is responsible for causing the disease worldwide. Molecular studies are underway to determine how much genetic drift has occurred among the different isolates in an effort to establish when the organisms might have been dispersed and their geographical origin. Other researchers are looking at preserved amphibian specimens in museum archives to determine when chytrids first appeared in various amphibian populations. Efforts to develop sensitive tests for detecting chytrid infections in amphibians are also underway.

Early reports that cutaneous chytrid infections were fatal to amphibians and were a cause for declines in wild populations were met with some skepticism. In response to this, we conducted several experiments in our lab at NZP to prove the pathogenicity of the chytrids. We have consistently been able to infect recently metamorphosed dendrobatid frogs of three different species and these infections have resulted in 100% mortality (Nichols et al. 2001; Nichols and Lamirande, unpubl. data).

In other studies, we have shown that dendrobatid tadpoles can be infected and remain asymptomatic for as long as 87 days, but then 100% of them die at the last stages of metamorphosis or shortly thereafter (Lamirande and Nichols 2002). We have also developed treatment protocols that can be used to cure chytrid infections in captive frogs (Nichols and Lamirande 2000) and tadpoles (Nichols and Lamirande, unpubl. data).

Much remains to be discovered about *Batrachochytrium dendrobatidis* and the factors that influence the development of chytridiomycosis in amphibians. Other chytrid-related research that I hope to be able to conduct someday includes looking at the effects of temperature on the disease, determining how long the chytrids can survive in environments without the presence of amphibian hosts, and determining exactly what causes chytrid-infected amphibians to die.

Footnote.—Organisms in the Phylum Chytridiomycota were originally classified as unique types of fungi. In the early 1980s, taxonomists agreed that these organisms, along with the other phyla of "zoosporic fungi" should be removed from the Kingdom Fungi and placed in the Kingdom Protista. Molecular DNA studies conducted in the late 1980s and early 1990s resulted in the Phylum Chytridiomycota being placed once again in with the fungi. The other phyla of "zoosporic fungi" remain classified as organisms other than fungi.

In 1991–92, when I was looking for information on fungal morphology by TEM, I consulted textbooks published in the mid-to-late 1980s. Chytrids were not included because they were not considered to be fungi at the time the books were written. Ironically, if I had used older "out-of-date" texts on fungi, chytrids would have been included, and thus I might have saved myself five years of frustration in trying to identify the organisms.

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ARTICLES

Herpetological Review, 2003, 34(2), 105–109.

The Black Racerunner (*Cnemidophorus nigricolor* Peters, 1873) in Los Roques Archipelago, Venezuela

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The name *Cnemidophorus lemniscatus nigricolor* had been applied to the black race runner of numerous Caribbean islands (Burt 1931) for nearly 60 years when Sites et al. (1990) and Vyas et al. (1990), without explanation, used the original combination *C. nigricolor* Peters, 1873 for this taxon in their genetic study of the hybrid origin of two parthenogenetic members of the *C. lemniscatus* complex. Subsequently, Wright (1993) and Paulissen and Walker (1994) also used the name *C. nigricolor* for lizards from islands included in the range of this form by Burt (1931); however, they did not specifically discuss issues relating to the status of the taxon.

Our major objective is to recommend formally that the name *C. nigricolor*, based on four cotypes from "Insel Gruppe Los Rocques, im Norden von La Guayra, Venezuela" (from Peters 1873, in Burt 1931), be applied to a species comprising all insular populations subsequently found to be diagnosed by the characters summarized herein. To facilitate the evaluation of other insular populations for possible allocation to *C. nigricolor*, we present a modern diagnosis, description, and analysis of variation based on a large sample of this species from Grand Roque, the largest island in Los Roques Archipelago. We also supplement Paulissen and Walker's (1994) observations on the natural history of the species.

Los Roques Archipelago National Park comprises over 50 islands and 200 keys situated above coral reefs around a central lagoon located between 11°42'–12°04'N and 66°30'–67°00'W in the Caribbean Sea (ca. 166 km north of La Guaira on the central coast of Venezuela). Annual climatic means for the archipelago are 28.9°C temperature, 84% humidity, and 271 mm of precipitation. Selected characteristics of islands and keys in the archipelago from which we report *C. nigricolor* are included in Table 1.

The dorsal pattern in *C. nigricolor* consists of linear series of spots apparently derived from the four pairs of primary stripes (= ventrolaterals, laterals, dorsolaterals, and paravertebrals) and 2–3 secondary stripes (= middorsals) between the paravertebrals characteristic of certain mainland South American populations of *C. lemniscatus*. Color pattern descriptions were facilitated by five color photographs of *C. nigricolor* in situ taken by one of us (DDR) in Los Roques Archipelago.

We used counts of 11 meristic characters and one ratio for 45 specimens of *C. nigricolor* from Grand Roque Island and 71 specimens of *C. lemniscatus* from two sites in Suriname. All lizards examined bear University of Colorado Museum (UCM) numbers. Characters examined, including some used in studies of *Cnemidophorus* by Duellman and Wellman (1960), Duellman and Zweifel (1962), Walker (1981), and those considered for the first time in this study, are granules (scales) around midbody (GAB), granules from occiput to rump (OR), ratio x 100 of the granules around midbody to the granules from occiput to rump (GAB/OR), femoral pores combined (FP), subdigital lamellae of longest toe of left pes (SDL), right and left supraocular scales combined (SO), circumorbital scales combined (COS), lateral supraocular granules combined (LSG), parietal scales (PS), mesoptychial scales (posterior most transverse row of enlarged scales of the mesoptychium) (MS), scale rows anterior to the edge of the posterior gular fold (Burt 1931) (SAG), and scales bordering the outer edges of the parietal scales between the circumorbital series on each side (SBP).

Individuals of *C. lemniscatus* and *C. nigricolor* were measured to the nearest mm in snout–vent length (SVL). Clutch size for each gravid female of *C. nigricolor* was based on counts of either vitellogenic follicles >3 mm in diameter or oviductal eggs. Means, standard errors, and Duncan's Multiple Range Tests for statistical significance ($P = 0.05$) were processed using SAS software administered by the University of Arkansas Computing Services.

Diagnostically, *C. nigricolor* differs from *C. lemniscatus* as characterized by Cole and Dessauer (1993) in having gray dorsal and ventral surfaces and longitudinally arranged gray-white dorsal spots in hatchlings and juveniles, mostly black dorsal and ventral surfaces in adults, granular postantebrachial scales on the posterior surface of each forearm, small scales at the edge of the gular fold, circumorbital scale series usually ending posterior to the midpoints of the third supraocular scales, eight rows of ventral scales, a pointed scale (= anal spur) on each side of the cloaca in males, five parietal scales, moderately high mean numbers of granules around midbody (103.0 ± 0.69) and granules from occiput to rump (221.7 ± 1.29), unusually high mean number of femoral pores (54.1 ± 0.40), and maximum body length of 101 mm.

TABLE 1. Selected characteristics of the parts of Los Roques Archipelago, Venezuela, known to be inhabited by *Cnemidophorus nigricolor*.

Island or Key	Area of Island	Part of Archipelago	Permanent Settlements?	Source
Grand Roque	4.0 x 0.8 km	NE of Lagoon	Yes - Villages	T. Maslin; Burt (1931); this study
Francisqui	Tiny by comparison	NE of Lagoon	No (only visitors)	this study
Crasqui	Tiny by comparison	NE of Lagoon	No (only visitors)	this study
Noronquises	Cluster of tiny keys	NE of Lagoon	No (only visitors)	this study
Cayo Sal	Sand spit ± 30 m wide	S of Lagoon	No (only visitors)	this study

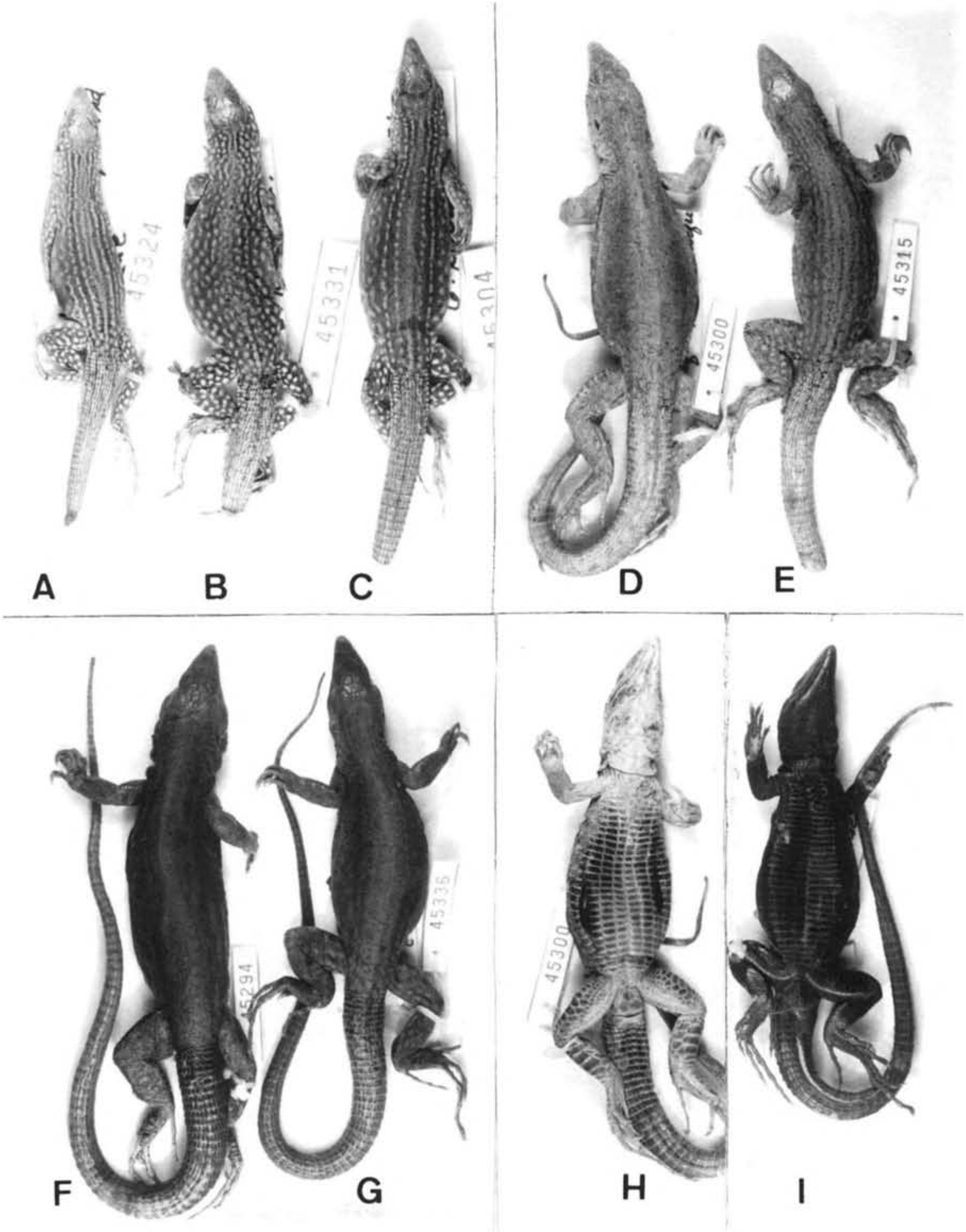

FIG. 1. Color pattern variation in females (A, UCM 45324, SVL 47 mm; B, UCM 45331, SVL 55 mm; C, UCM 45304, SVL 57 mm) and males (D, H, UCM 45300, SVL 91 mm; E, UCM 45315 SVL 84 mm; F, UCM 45294, SVL 101 mm; G, UCM 45336, SVL 86 mm; I, UCM 45314 SVL 90 mm) of *Cnemidophorus nigricolor* from Grand Roque Island, Venezuela.

Descriptively, in *C. nigricolor* small mesoptychial scales precede the most posterior row of enlarged scales on the gular fold (2–5 rows in 19 females and 2–6 rows in 26 males); the supraocular scales seldom vary from 4-4 (44 of 45 specimens), there are usually five parietal scales on the dorsal surface of the head (13 of 19 females and 23 of 26 males), and the circumorbital scale series medial to the supraocular scales are short (to middle of fourth supraoculars in 10 of 19 females and 21 of 26 males). Compared with *C. lemniscatus* and its derivatives (Cole and Dessauer 1993; Markezich et al. 1997) the species has equivalent, somewhat higher, or somewhat lower means and ranges of variation for the meristic variables GAB, OR, FP, SDL, SO, COS, LSG, PS, MS, SAG, and SBP and the GAB/OR ratio (Table 2).

Hatchlings and juveniles of *C. nigricolor* have medium (Fig. 1A) to dark gray or pewter (Fig. 1B, C) dorsal and ventral surfaces, numerous small white spots on the hind limbs (Fig. 1A–C),

TABLE 2. Data reductions for a sample of *Cnemidophorus nigricolor* from Grand Roque Island, Venezuela, and two samples of *C. lemniscatus* from Suriname. Numbers are means ± SE, followed by ranges, with sample size in parentheses (abbreviations for characters are given in the text).

Character	*nigricolor* Grand Roque	*lemniscatus* Baboensanti	*lemniscatus* Bigi Poika
GAB	103.0 ± 0.69	117.8 ± 1.29	108.4 ± 0.79
	92–111 (45)	106–129 (30)	100–120 (31)
OR	221.7 ± 1.29	245.5 ± 1.88	234.3 ± 1.30
	202–246 (45)	225–273 (30)	218–248 (30)
GAB/OR	46.5 ± 0.35	48.0 ± 0.58	46.1 ± 0.40
	41.8–52.6 (45)	42.8–53.1 (30)	43.0–50.2 (30)
FP	54.1 ± 0.40	45.7 ± 0.40	46.0 ± 0.37
	47–61 (45)	41–50 (30)	42–49 (31)
SDL	35.2 ± 0.23	33.5 ± 0.28	33.3 ± 0.25
	32–39 (45)	30–37 (29)	30–35 (30)
COS	7.7 ± 0.21	12.3 ± 0.23	12.1 ± 0.33
	6–13 (45)	10–15 (30)	8–15 (30)
LSG	17.9 ± 0.36	25.3 ± 1.07	22.9 ± 0.74
	14–25 (45)	16–37 (30)	16–31 (30)
SO	8.0 ± 0.02	8.3 ± 0.13	10.1 ± 0.30
	8–9 (45)	8–11 (30)	7–14 (31)
PS	5.3 ± 0.09	5.1 ± 0.06	4.9 ± 0.05
	5–8 (45)	5–6 (30)	4–5 (20)
MS	17.2 ± 0.23	14.8 ± 0.35	14.6 ± 0.20
	14–20 (45)	11–19 (35)	13–17 (36)
SAG	3.8 ± 0.13	4.1 ± 0.24	4.2 ± 0.20
	2–6 (45)	2–7 (34)	2–6 (34)
SBP	15.0 ± 0.21	15.3 ± 1.03	16.5 ± 1.09
	12–18 (45)	7–22 (33)	8–26 (32)

and longitudinal series of white spots and/or middorsal stripes or their fragments (Fig. 1A–C). Both sexes develop melanistic dorsal and ventral colorations except for the dark gray to brown areas of the middorsal region, dorsal surface of tail, and scales around the femoral pores (Fig. 1F, G, I). Black to dark brown pigment initially develops on the sides of the body (in a "peppered" distribution in females; Fig. 1D, E) and ventral surfaces (Fig. 1H). Faint evidence of the middorsal stripes might persist even in the largest adult males.

Among 19 females of *C. nigricolor* (SVL 47–77 mm) from Grand Roque Island are 11 individuals of SVL 47–76 mm that retain either a pattern similar to that of juveniles or have only slight evidence of ontogenesis. Also present are eight females of SVL 67–77 mm that show 60–75% completion of pattern development (based on the final pattern attained by males). Pattern ontogenesis is initiated in most females at SVL 67–69 mm; however, there were too few large adult females in the UCM sample to determine whether they develop the same color pattern as large males (Fig. 1F, G, I).

Among 26 males of *C. nigricolor* (SVL 38–101 mm) from Grand Roque are eight individuals between SVL 38–67 mm that had either retained their juvenile pattern or undergone very little pattern ontogenesis. The largest male with delayed pattern development and a gray rather than black dorsal coloration is UCM 45300 (SVL 91 mm; Fig. 1D); two additional adult males of SVLs 76 mm (UCM 45322) and 84 mm (UCM 45315; Fig. 1E) are similarly patterned. The other 14 males in the sample between SVLs 76–101 mm exhibit complete to nearly complete color pattern ontogenesis.

Nine gravid females in the UCM sample of *C. nigricolor* from Grand Roque Island collected on 3 July 1971 have a mean SVL of 70.6 ± 2.07 mm, mean clutch size of 1.3 ± 0.16 eggs, and clutches of one egg in females of SVL 57, 68, 69, 69, 74, and 77 mm and two eggs in females of SVL 69, 76, and 76 mm. The presumed missing age class of large females of *C. nigricolor* that would have been included in the SVL 80–101 mm range of 46% of the males in the UCM sample most likely reflects collecting bias. The size of the smallest gravid female with one egg of >10 mm in diameter (UCM 45304; SVL 57 mm) indicates that *C. nigricolor* is similar to the recently described derivative of *C. lemniscatus*, namely *C. arenivagus* of the Peninsula de Paraguana, Venezuela (Markezich et al. 1997), that is early-maturing and likely multiple-brooded in its tropical habitat. Most rainfall in Los Roques Archipelago occurs between September and January; however, the presence of gravid females in the UCM July sample of *C. nigricolor* indicates that reproduction is not limited to the wet season.

Cnemidophorus nigricolor is an ubiquitous species in sandy beach strands frequented by tourists on Grand Roque Island and the much smaller land masses Francisqui, Crasqui, Noronquises, and Cayo Sal (Table 1). On Francisqui, Noronquises, and Cayo Sal this species responded to the presence of humans by emerging from nearby sea purslane or red mangrove vegetation to vie for handouts. Lizards would often approach to within a few inches from a person to eat bits of apple and lettuce; however, *C. nigricolor* showed an aversion to tomato and bread (this study). Literature

for tourists published in Venezuela, using the names "black lizard" and *C. lemniscatus*, indicated that *C. nigricolor* feeds on booby eggs (not confirmed in this study) and cactus flowers and fruits. These anecdotes and the observations of DDR supplement Paulissen and Walker's (1994) report that *C. nigricolor* eats some plant material, as do certain mainland populations of *C. lemniscatus* studied by Vitt et al. (1997).

Except for Grand Roque, all island populations of *C. nigricolor* in Los Roques Archipelago are herein reported for the first time (Table 1). This species should be expected through much of the archipelago on islands with suitable habitat. Insular populations also currently allocated to *C. nigricolor* are found on the Venezuelan islands Las Aves (Burt 1931), Orchila (Peters and Donoso-Barros 1970), and Blanquilla (Burt 1931; Sites et al. 1990). Margarita Island, 288 km east of Grand Roque, was listed in the range of the species by Burt (1931); however, this population was allocated to *C. lemniscatus* by Peters and Donoso-Barros (1970). With our formal taxonomic recommendation for *C. nigricolor*, since 1987 *C. lemniscatus* has been partitioned into two parthenogenetic (Cole and Dessauer 1993) and four gonochoristic species (McCrystal and Dixon 1987; Markezich et al. 1997; Sites et al. 1990; this study). *Cnemidophorus nigricolor*, as known from Los Rocques Archipelago, is the most divergent of the sexual forms related to *C. lemniscatus* in color pattern, though not in body size, reproductive characteristics, and scutellation. The transition from the striped pattern of *C. lemniscatus* to the melanistic coloration of *C. nigricolor* might represent an adaptation for island life. There are also numerous melanistic insular populations of *Cnemidophorus* in the *tigris* species group in the Gulf of California (Walker and Maslin 1969, 1981; Walker 1983); however, none of those forms undergo such marked changes from gray juvenile to black adult as *C. nigricolor*. Substrate matching might explain the basis of the gray coloration in juveniles of *C. nigricolor* that prefer open sandy areas along beach strands. Cryptic coloration might account for the advantage conferred by black coloration in adults. Photographs of melanistic individuals of *C. nigricolor* taking refuge in the dark shadows cast by low-growing vegetation suggest crypsis.

Additional data are needed to assess the relationship of *C. nigricolor* to other insular taxa (e.g., *C. arubensis* and *C. murinus*) in the Caribbean Sea (Sites et al. 1990). Also, whether all insular populations presently allocated to *C. nigricolor* outside of Los Roques Archipelago are conspecific is open to question given their geographic positions and the tendency of islands and banks in the Caribbean Sea to support endemic species of lizards (Williams 1969). Burt (1931) found considerable inter-island variation in color pattern among the specimens he examined from populations allocated to this species. Moreover, the specific status of the Margarita Island *Cnemidophorus* population is in immediate need of study because of its wide separation from Los Roques Archipelago and controversial taxonomic status (Peters and Donoso-Barros 1970).

Acknowledgments—The UCM sample of *C. nigricolor* was collected by T. P. Maslin whose past field activities continue to impact contemporary studies of whiptail lizards. We are grateful to S.-K. Wu for the privilege of examining specimens of *Cnemidophorus* in his care. We also acknowledge the significance of observations on *C. nigricolor* made by M. L. Rhoads in Los Roques Archipelago.

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Appendix I
Specimens Examined

Cnemidophorus nigricolor: Grand Roque Island (females, N = 19; UCM

45295, 45301, 45303, 45304, 45311, 45312, 45317, 45319, 45321, 45323, 45324, 45326–45328, 45330–45332, 45335, 45337; males, N = 26; UCM 45293, 45294, 45296–45300, 45302, 45305–45310, 45313–45316, 45318, 45320, 45322, 45325, 45329, 45333, 45334, 45336).

Cnemidophorus lemniscatus: Suriname: Baboensanti (females, N = 15; UCM 53491–53494, 53496, 53497, 53499, 53500, 53525, 53527, 53530, 53566, 53568, 53571, 53573; males, N = 20; UCM 53487–53490, 53508–53512, 53524, 53528, 53529, 53557–53563, 53578) and Bigi Poika (females, N = 15; UCM 52836, 54020, 54034, 54036–54038, 54040–54043, 54051–54054, 54056; males, N = 21; UCM 54021, 54023–54032, 54044, 54046, 54048–54050, 54055, 54057, 54068, 54069, 54073).

Appendix II

Comparison of meristic data for males and females of *Cnemidophorus nigricolor*

Meristic data [mean ± SE (range)] for 19 females followed by data for 26 males are: GAB, 101.7 ± 1.11 (92–111) and 104.0 ± 0.85 (93–111); OR, 225.4 ± 2.15 (202–246) and 219.0 ± 1.40 (207–235); GAB/OR x 100, 45.1 ± 0.38 (42.2–47.9) and 47.5 ± 0.45 (41.8–52.6); FP, 54.1 ± 0.70 (49–61) and 54.1 ± 0.46 (47–58); SDL, 35.3 ± 0.39 (32–39) and 35.2 ± 0.28 (32–38); COS, 8.2 ± 0.38 (6–13) and 7.3 ± 0.21 (6–9); LSG, 18.0 ± 0.60 (14–25) and 17.9 ± 0.46 (14–24); SO, 8.1 ± 0.05 (8–9) and 8.0 ± 0.00 (8); PS; 5.3 ± 0.11 (5–6) and 5.2 ± 0.14 (5–8); MS, 16.9 ± 0.30 (14–19) and 17.3 ± 0.33 (15–20); SAG, 3.8 ± 0.16 (2–5) and 3.7 ± 0.20 (2–6); and SBP, 15.3 ± 0.28 (13–18) and 14.8 ± 0.30 (12–17).

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Sexing *Cnemidophorus* Lizards Using a Postanal Scale Character

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Distinguishing between male and female individuals of a species is very important for field studies of reptiles because sex-related differences in ecology, life history and general natural history might exist. Therefore, it is essential that the sex of every individual be determined accurately. Several methods exist for differentiating between live males and females of species of reptiles. Firstly, the presence or absence of hemipenes can be determined by either inserting a probe into the cloaca or pressing on the tail of an animal to force the hemipenes to evert (Fitch 1960; Gregory 1983); however, everting the hemipenes might be difficult for some species. Secondly, sex might be determined by the presence of enlarged follicles in pregnant females or sperm in the cloaca of adult males and recently mated females (Fitch 1960). This method is obviously restricted to sexing adult, reproductive animals. Thirdly, secondary sexual characters can be used, but again this technique is limited to adult animals. Fourthly, external, postanal scale characters might be used. For instance, male phrynosomatids, and at least some other species of lizards formerly considered iguanids (*sensu lato*), possess a pair of enlarged postanal scales that can be used to identify easily the sex of a live individual in the field (see Smith 1946; Stebbins 1985). The advantage of this scale character is that it can be used to identify accurately the sex of any individual, regardless of age or reproductive status.

Pietruszka (1981) suggested that a postanal scale character, the presence or absence of a postanal plate, might be used to identify the sex of individuals of *Cnemidophorus* (see Fig. 1 of Pietruszka (1981) for a photograph of the postanal plate). Pietruszka (1981) examined specimens of 10 *Cnemidophorus* species (5 bisexual, 5 unisexual) and found that the postanal plate allowed accurate sexing of 613/614 specimens. Interestingly, this character seems to have been known for some time. While reorganizing files of correspondences housed at the University of Colorado Museum of the late T. Paul Maslin, I found a letter from T. Rodgers dated 28 November 1941 with the title "Method of sexing *Cnemidophorus tesselatus*." Rodgers writes:

> "In the males the last row of fine granules is distinctly larger than the rest, and the first two or three transverse rows of ventral tail scales are very little if any, smaller than the two or three rows posterior to them. Also, in males, the most anterior scale in the second longitudinal rows out from the mid-ventral line is conspicuously exposed or larger than the second and third scales."

Despite the description of the postanal plate by Rodgers in the

Table 1. Species and numbers of specimens examined to determine the taxonomic breadth of the postanal plate for discrimination between males and females. * = data reported by Pietruszka (1981).

Taxon	Number Examined Male	Female
Bisexual		
Ameiva festiva	12	11
Ameiva undulata	6	11
Cnemidophorus angusticeps	10	11
C. burti	10	10
C. communis	9	11
C. costatus	10	10
C. deppii	10	10
*C. gularis**	21	6
C. guttatus	10	10
C. hyperythrus	10	10
*C. inornatus**	13	12
C. labialis	11	10
C. lineatissimus	10	10
C. maximus	12	9
C. motaguae	10	12
C. parvisocius	12	13
C. sacki	12	10
*C. scalaris**	9	5
*C. sexlineatus**	18	7
*C. tigris**	238	160
Unisexual		
C. cozumela	–	20
*C. exsanguis**	–	25
C. lemniscatus	–	20
*C. neomexicanus**	–	25
C. sonorae	–	20
*C. tesselatus**	–	25
*C. uniparens**	–	25
*C. velox**	–	25

1941 letter, and formally by Pietruszka (1981), this character is not well known in the literature and, further, it is unclear whether it is useful for all *Cnemidophorus*, and possibly teiids in general.

The objective of this study was to discern further the taxonomic breath, particularly among species of *Cnemidophorus*, of this scale character, the postanal plate in males, for sex identification. The genus *Cnemidophorus* consists of approximately 50 species, a third of which are unisexual (Maslin and Secoy 1986; Wright 1993, 1994). *Cnemidophorus* lizards are a prominent member of the fauna of North and South America in terms of both abundance and diversity. Accordingly, many studies of their ecology, life history, and natural history have been performed (see Wright and Vitt 1993). However, such studies have typically only differentiated between the characteristics of adult males and females, while lumping the data for all juveniles (e.g., Echternacht 1967; Pianka 1970; Vitt and Ohmart 1977; but see Fitch 1958). Presumably the sex of live juveniles was not determined because the researchers were unable to use secondary sexual characters or reproductive traits to differentiate between males and females. In this paper I show that the scale character described by Pietruszka (1981) accurately identifies the sex of *Cnemidophorus* in general and also can be used for at least one other genus (*Ameiva*) of teiids as well.

I examined preserved males and females of 13 bisexual and three unisexual species of *Cnemidophorus* (Table 1). The species were chosen to supplement, but not repeat, the species examined by Pietruszka (1981). I also examined museum specimens of two species of *Ameiva* to test whether the postanal plate could be used for sex discrimination in another genus within the family Teiidae (Table 1). For each museum specimen I first assessed whether the postanal plate (see Fig. 1 of Pietruszka 1981) was present or absent. Next I determined the sex of the individual by making a ventral incision in the abdomen and noting whether follicles or testes were present. For some individuals, the presence or absence of hemipenes was used to determine sex because either the hemipenes were everted or they were already exposed by a prior incision in the ventral aspect of the tail.

The presence or absence of the postanal plate allowed 100% discrimination between males and females of the thirteen bisexual species of *Cnemidophorus* included in this study (Table 1). All males possessed postanal plates and all females lacked postanal plates. Further, individuals of all three unisexual species (Table 1) did not have a postanal plate, as expected because the unisexual species consist solely of females. Both species of *Ameiva* (Table 1) showed the enlarged postanal plate in all the males and none of the females examined.

Pietruszka (1981) found that the postanal plate accurately determined whether an individual *Cnemidophorus* was male or female for 613 out of 614 specimens that he examined, representing five bisexual and five unisexual species (Table 1). I found that this postanal scale character was useful in distinguishing between males and females for 332 individuals representing 13 bisexual and three unisexual species of *Cnemidophorus*, and for 40 individuals of two species of *Ameiva* (Table 1). Therefore, the postanal plate has been shown to accurately reflect the sex of an individual in roughly half of the species of *Cnemidophorus*, including members of all six species groups (Wright 1993). Accordingly, this character provides a simple method to differentiate between the sexes of live *Cnemidophorus* of all ages. Whether the postanal plate occurs in males of all species of Teiidae awaits further study.

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Appendix

Material examined (museum acronyms follow Leviton et al. 1985)—*Ameiva festiva* UCM 22291, 22292, 22294–22311, 22313, 22315, 22316. *A. undulata* UCM 28354–28358, 28360, 28361, 28363, 28364, 30259–30261, 30263–30265, 30267, 54171. *Cnemidophorus angusticeps* UCM 17609, 17614, 17616, 17617, 17620, 17621, 17625, 28461–65, 28467, 28468, 28471–28473, 28475, 47452, 50768, 50769. *C. burti* UCM 35403, 35408, 35411, 35418, 35423, 35425–35427, 35429–35432, 42045, 42049, 42053–42058. *C. communis* UCM 22481, 22483, 22485, 22487, 22490, 22494, 22495, 22499, 22500, 22506–22510, 22512–22514, 22519, 22521, 22522. *C. cozumelus* UCM 15400, 15402, 15403, 15408, 15421, 15427, 15431, 15439, 15449, 15465, 15467, 15474, 15476, 15479, 15481, 15491, 15493, 15494, 15496, 15499. *C. costatus* UCM 8580, 8583, 8626–8629, 8632, 8634–8637, 8640–8644, 8646, 8652, 8657, 8658. *C. deppei* UCM 19020, 22558, 22559, 22562, 22563, 22565, 22566, 22570, 22572, 22573, 22576, 22578–22580, 22582, 22589, 22591, 22592, 22594, 22667. *C. guttatus* UCM 22623, 22628, 22631, 22632, 22637, 22643, 22646–22648,

22651–22659, 22662, 22663. *C. hyperythrus* UCM 26114, 26115, 26121–26124, 26126, 26180–26183, 29282, 29294, 29296, 31315, 40809, 40810, 40812, 40814, 51321. *C. labialis* UCM 29299, 29301, 29302, 29306, 29311, 29316–29318, 29322, 29325, 29329, 29340–29343, 29345, 29359, 29362, 29365, 29371, 29373. *C. lemniscatus* UCM 52839–52843, 52927, 53168–53170, 53181–53184, 53192–53196, 53246, 53654, 53688. *C. lineatissimus* UCM 27163, 27165, 27167, 27168, 27170, 27172–27174, 27177, 27180, 27181, 27187, 27190–27192, 27196, 27198, 49804, 49806, 49813. *C. maximus* UCM 26256, 26258–26260, 26262–26265, 26269–26271, 45922–45929, 45939, 51206. *C. montaguae* UCM 34854, 34855, 34857–34863, 34865–34867, 34869, 34873–34879, 34881, 34884. *C. parvisocius* UCM 38448, 38453, 38464, 38465, 38468–38470, 38472, 38473, 38476–38481, 38483, 38485–38487, 38493, 38501, 38511, 38512, 38518, 38536. *C. sacki* UCM 38881–38887, 38889, 38890, 38893–38896, 38908–38910, 38922, 38940, 38943–38945, 38996. *C. sonorae* UCM 8665, 15176, 22599, 22601, 22602, 22607, 22608, 35560, 35561, 35563, 42086–42089, 42092–42097.

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Courtship and Copulation in the Grand Canyon Rattlesnake, *Crotalus viridis abyssus*

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Pitvipers are useful organisms for the study of relationships between social structure and mating system (Duvall et al. 1992; Duvall et al. 1993). Courtship and copulatory behaviors have been described for a variety of free-ranging taxa (Brown 1991; Klauber 1972; MacCartney and Gregory 1988). These observations have been complemented by quantitative laboratory studies (Armstrong and Murphy 1979; Chiszar et al. 1976; Gillingham et al. 1983; Hayes 1986; Schuett and Gillingham 1988). However, behaviors exhibited in the lab might not be identical to those displayed by free-ranging individuals (Hayes et al. 1992), and additional field observations are required to establish baseline criteria for ontogeny and duration of courtship behavior within and between species.

In this paper, I report detailed observations of an incident of courtship and copulatory behavior of free-ranging Grand Canyon rattlesnakes (*Crotalus viridis abyssus*). These snakes are limited to the Grand Canyon of the Colorado River and its side canyons. Individuals approach one meter in length and have a red, salmon, or pink ground color, with slightly darker oval-shaped body blotches that fade with age (Ernst 1992; Stebbins 1985). My observations were made during a radiotelemetric study of the ecology of *C. v. abyssus* in the Little Colorado River Canyon (Coconino Co., Arizona). Although the observations reported herein are based on only two courtships and one copulation, they provide valuable data on reproductive behavior of a poorly known rattlesnake, and greatly extend the known duration of courtship in vipers as a group.

On 12 July 1993, a male *C. v. abyssus* (male #1993-13, 395 g, 765 mm SVL) was observed coiled around a radiotelemetered conspecific female (female #1992-2, 198 g, 655 mm SVL). Both snakes were coiled on packed sand under an overhanging boulder less than 3 m from the Little Colorado River. The recently shed skin of the female was found 2 m away. The pair was observed continuously from 1800 to 2300 h, at which time the male initiated forward-jerking (with simultaneous chin-rubbing) and tail-search copulatory attempts (TSCA, Gillingham 1977). The male jerked his head (averaging 2 jerks/sec) along the dorsum of the coiled female, continuously maintaining contact via the chin. Chin-rubbing was accompanied by rapid tongue-flicking. Chin-rubbing sequences (including the brief TSCA which ended each sequence) were followed by pauses (chin-rubbing sequence duration mean ± standard deviation = 29.9 ± 9.7 sec; pause duration = 67.4 ± 110.9 sec, N = 52 sequences observed). The pause length was cyclical, with longer pauses of 7–10 min. every 12 ± 2 min. Chin-rubbing sequences were more uniform in length, and each was immediately followed by TSCA, effecting cloacal apposition. During each TSCA, the male visibly strained against the cloaca of the female, often lifting the entire posterior third of her body from the substrate. Tail whipping by the female (Hayes 1986; Hayes et al. 1992; Schuett and Gillingham 1988) was observed periodically, and resulted in a pause in male courtship activity. Cloacal gaping by the female (Gillingham et al. 1983) was not observed.

Observations were stopped at 0055 h (13 July) and resumed at 0400 h, at which time both snakes had resumed resting coils. The snakes were monitored hourly until 2300 h when courtship resumed; courtship continued until 0315 h (14 July). After this, the pair was monitored every other hour. Courtship again resumed at 2110 h (14 July); however, at this time the female repeatedly withdrew her tail from the male, resulting in long and erratic tail searches by the male, as well as repeated lingual examination of the female's tail and cloaca. Activity ceased at 0030 h (15 July), then resumed from 2130 to 2300 h. Courtship did not re-commence until 1900 h the following evening (16 July).

Copulation was observed at 1950 h on 16 July. During copulation, the male actively searched the area around the pair with the anterior third of his body and tongue-flicked rapidly (1.04 ± 0.2 tongue flicks per sec over one typical five min. period). The male periodically thrusted with the hemipenis (7.6 thrusts per min. over 5 min.). Every fifth or sixth thrust was of greater magnitude and resulted in complete cloacal apposition. The pair was checked hourly, and copulation terminated at 0400 h. Following copulation, the male repeatedly pushed his cloaca onto the substrate, apparently forcing the hemipenis to revert into the tail. The male's rattle was coated with dried blood and a 25 cm^2 area under the pair was stained pink. Blood appeared to be a major component of this dilute fluid. At this time the male was captured. The hemipenis was fully inverted and no further fluid loss occurred.

Two days later (18 July), a different telemetered male (male #1992-4, 374 g, 834 mm SVL) moved 91 m from his previous position and was observed with the same female (#1992-2) at her original location. Courtship behaviors similar to those described above were initiated that evening and were observed for two nights. I terminated the field trip on 20 July, and had not observed copulation by this time.

Courtship behavior of many viperid and colubrid snakes follows a triphasic scheme of tactile-chase, tactile-alignment, and

intromission (Gillingham 1977; Schuett and Gillingham 1988). I did not observe the tactile-chase phase, which is usually of minor consequence in viperid snakes. Rather, I found both males accompanying the motionless female, and observed chin-rubbing and TSCA events shortly thereafter. The duration of courtship activities by male #1993-13 was striking in its duration (at least 92 h, including periods of quiescence between first observed TSCA and actual intromission). In contrast, free-ranging prairie rattlesnakes (*C. v. viridis*) court on average only 20 min. before successful intromission (Duvall et al. 1985), while among western diamondback rattlesnakes courtship averages nine minutes between the first TSCA and intromission (Gillingham et al. 1983). The length of this courtship raises the question of whether female Grand Canyon rattlesnakes choose mates based on relative courtship stamina. Duration of copulation (ca. 8 hours) was intermediate between 70 min. in *C. v. viridis* (Duvall et al. 1985) and 20–28 h in *C. atrox* (Gillingham et al. 1983). Additional copulations may have occurred either before observations were begun on 12 July or during times when snakes were not observed, although the latter seems unlikely considering that I made observations at two hour intervals. The sequential, non-simultaneous courtships of a single female provides circumstantial evidence for the occurrence of multiple mating in *C. v. abyssus*, as has been observed in conspecific *C.v. viridis* (Duvall and Schuett 1997) and some other viperids (Duvall and Beaupre 1998; Madsen and Shine 1994; Schuett and Gillingham 1988).

Courtship mechanics were similar to those described by Hayes (1986) for captive *C. v. oreganus*. However, I am unaware of any published account documenting the cyclical nature of pause-length in snake courtship. I speculate that longer pauses between periods of intense courtship might facilitate aerobic recovery and reduce anaerobic energy expenditure by males during female persuasion. Lastly, diurnal ambient temperatures over 40°C are common in the Grand Canyon in July. Nocturnal reproductive activity may thus reflect the infeasibility of maintaining energy-intensive behaviors at high body temperatures.

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Additions To Our Knowledge Of Anuran Sesamoids

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Sesamoid bones may be a true ossification of hyaline cartilage, or may be a thickening or nodule of cartilage without ossification (Pearson and Davin 1921a). They have been found in all classes of vertebrates, but not always at the same position. Pearson and Davin (1921a, b) described sesamoid bones in all vertebrate classes, introducing a new nomenclature for some of them. Haines (1942, 1969) described these elements for lizards, and Nussbaum (1982) for frog families.

Alexander and Dimery (1985) studied sesamoid bones of mammals and their relationship with the mechanics of joints. Maybe the best work about heterotopic bones in frogs was done by Nussbaum (1982). He discovered that these elements have an important role for resolving phylogenetic hypotheses about relation-

ships of families and subfamilies in frogs, even so he asserted that "There are few and scattered reports of sesamoid elements in frogs" (p. 312). He identified three tarsal sesamoids (which he called heterotopic skeletal elements): cartilago plantaris, cartilago sesamoides, and os sesamoides tarsale—from Ranidae, Pipidae, and Sooglossidae. The first one is found on the plantar surface of the foot between the fibulare and the fourth metatarsal; the second one slides over the proximal head of the tibiale, and the last one is continuous with the proximal and distal portions of the aponeurosis plantaris near the distal end of the tibiale, and being always bigger than the cartilago sesamoides.

In the same way, Olson (2000) studied heterotopic elements (which she called "extraskeletal bones") but only in one species (*Hymenochirus boettgeri*). However, she provided a detailed description of some of the elements previously described by Parsons and Davin (1921a, b) and by Nussbaum (1982), and incorporated new descriptions and names to heterotopic elements.

I examined some sesamoid bones of the hands and feet, which have not been studied in a systematic way, and are often neglected in species descriptions and anatomical studies. It is important to consider that we should pay more attention to these elements for resolving frog relationships (e.g., Laurent 1940, 1961). In ranoid species, some reports as those by Laurent (1942, 1961) have shown the existence of subarticular sesamoids found below the carpus in Arthroleptinae (*Arthroleptis wahlbergi*, Ranidae); however, Laurent (1961) stated that this bone may be present in the other Arthroleptinae although fused with the second, fourth, and fifth carpals. Thus, he found in Hyperoliidae a sesamoid bone behind the tibio-tarsal articulation, and subarticular sesamoids in *Dendrobates trivitatus* and in *Atelopus varius*. In this paper I report heterotopic elements not previously mentioned in the literature for these species of ranids; likewise, I report hand and foot sesamoid bones that have not been mentioned in the majority of papers in some ranoid (*sensu* Dubois 1992) and leptodactylid species, and instances of the sesamoids mentioned by Nussbaum (1982) in species not reported by him.

I examined one to ten specimens in each of 53 species of the family Ranidae (*sensu* Dubois 1992); two specimens and one species of the family Mantellidae (*sensu* Dubois 1992); two specimens and one species of the family Phrynobatrachidae (*sensu* Dubois 1992); four specimens and two species of the family Arthroleptidae; five specimens and three species of the family Microhylidae; two specimens and one species of the family Hyperoliidae, and two specimens and one species of the family Leptodactylidae (see Appendix 1). All specimens were cleared and stained following Dingerkus and Uhler's (1977) clearing and double-staining method.

The cartilago sesamoides (Fig. 1) occurs in the following taxa that lack the os sesamoides tarsale: Arthroleptidae: *Arthroleptis poecilonotus*, *Astylosternus occidentalis*; Hyperoliidae: *Leptopelis christyi*; Microhylidae: *Breviceps mossambicus*; Leptodactylidae: *Eleutherodactylus martinicensis*; Ranidae: *Amolops monticola*, *Conraua crassipes*, *Conraua alleni*, *Euphlyctis cyanophlyctis*, *Hoplobatrachus occipitalis*, *Hoplobatrachus rugulosus*, *Ingerana tenasserimensis*, *Limnonectes blythii*, *Limnonectes kuhlii*, *Limnonectes pileatus*, *Mantella madagascariensis*, *Nanorana parkeri*, *Occidozyga lima*, *Paa blanfordii*, *Paa vicina*, *Phrynobatrachus accraensis*, *Phrynoglossus laevis*, *Phrynoglossus magnapustulosus*, *Phrynoglossus martensii*, *Ptychadena superciliaris*, *Rana albolabris*, *Rana chapaensis*, *Rana clamitans*, *Rana erythraea*, *Rana esculenta*, *Rana lessonae*, *Rana perezi*, *Rana taipehensis*, *Rhacophorus leucomystax*, *Rhacophorus nigropalmatus*, *Taylorana hascheana*, and *Tomopterna breviceps*.

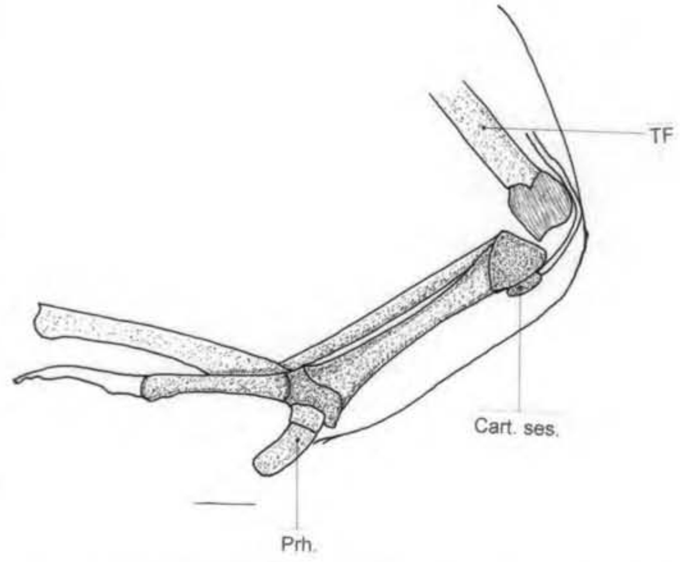

FIG. 1. Ventral aspect of the foot in *Occidozyga lima* CAS 195994. Cart. ses. = Cartilago sesamoides; Prh. = prehallux; TF = Tibiofibula. Scale = 1 mm.

Two of the three heterotopic elements described by Nussbaum (1982), the os sesamoides tarsale and the cartilago sesamoides, occur only in some species of the family Ranidae examined (Fig. 2): *Limnonectes limnocharis*, *Ptychadena tourneri*, *Rana arvalis*, *Rana dalmatina*, *Rana graeca*, *Rana galamensis*, *Rana iberica*, *Rana nigrovittata*, and *Rana temporaria*. Olson (2000), stated that the cartilago sesamoides is unique (an autopomorphy) to *Hymenochirus*; this is an odd observation, because Nussbaum (1982) found this element in many species that he examined.

I found sesamoid bones at the forelimb and hind limb in *Phrynoglossus martensii* (Fig. 3a): in the hind limb at the distal end of the metacarpals, and between the distal end of the first phalange and the proximal one of the second phalanx. In the same

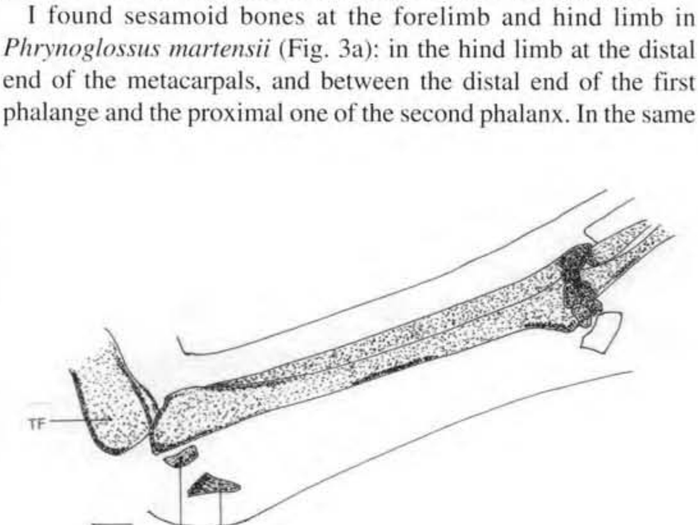

FIG. 2. Medial aspect of the left foot proximal elements in *Rana nigrovittata*. MNHN 1997. 4045. Cart. ses. = Cartilago sesamoides; Ses. tars. = Os sesamoides tarsale; TF = tibiofibula. Scale = 1 mm.

manner, in this same species, I found some sesamoid elements at the distal end of the radioulna, and at proximal one of the first metacarpal (presumably the "radial sesamoids" of Olson [2000]): *Hoplobatrachus occipitalis* (phalanges), *Ptychadena tourneri* (phalanges and metacarpal zone), *Ptychadena pujoli* (phalanges and metacarpal region), *Limnonectes limnocharis* (dorsal and ventral level of phalanges; distal level of the humerus), *Ingerana tenasserimensis* (phalanges and the distal end of the radio-ulna), and *Rana arvalis* (between tha radiale and ulnare).

Subarticular elements at the level of feet phalanges (Fig. 3b) exist in *Phrynoglossus martensii*, *Ptychadena tourneri*, *Limnonectes limnocharis* (double sesamoids in phalanges), *Astylosternus occidentalis* (at the distal end of the ventral region of tarsals, but this does not correspond to the cartilago plantares), *Ingerana tenasserimensis*, and *Mantella madagascariensis*. These sesamoid elements were not noted by Nussbaum (1982) or Olson (2000).

Pearson and Davin (1921b) reported a sesamoid bone ("mesial posterior lunula") in *Leptodactylus pentadactylus* and *Docidophryne gigantea*. This is located ventrally at the popliteal (back of the knee) region (medial region between the femur and the tibiofibula). Because only two species were included in the Pearson and Davin (1921b) study and the "mesial posterior lunula" was not figured, I am unable to determine if this is the same structure I describe in this paper (Fig. 4), referring specifically to the sesamoid in the popliteal region.

Therefore, I believe that the sesamoid in the popliteal region is a mesial fabella, in the same manner that Hoyos (1999) and Olson (2000) claimed; this element is present in the following taxa examined: *Anodonthyla boulengeri*, *Arthroleptis poecilonotus*, *Aubria subsigillata*, *Boophis brachychir*, *Chiromantis rufescens*, *Conraua alleni*, *Kaloula poulchra*, *Leptopelis christyi*, *Nanorana parkeri*, *Occidozyga lima*, *Paa blanfordii*, *Platymantis vitiensis*, *Ptychadena floweri*, *Ptychadena mascareniensis*, *Ptychadena pujoli*, *Ptychadena superciliaris*, *Pyxicephalus adspersus*, *Rana angolensis*, *Rana clamitans*, *Rana nigrovittata*, *Rana lessonae*, *Rana perezi*, *Rana pipiens*, *Rana temporaria*, *Rhacophorus leucomystax*, *Tomopterna breviceps*, and *Tomopterna marmorata*. Owing to its occurrence in many taxa, it is now clear that this element is not an autapomorphy for *Hymenochirus* as proposed by Olson (2000).

Using the nomenclature applied by Pearson and Davin (1921a, b), I believe that this last sesamoid bone is a mesial fabella because it is found in the tendons of the *musculus gastrocnemius*. This element is present also in mammals (Budras et al. 1989; Pearson and Davin 1921a), but as lateral and mesial fabellae. The mesial fabella might be confused with a mesial cyamella, a term introduced also by Pearson and Davin (1921a) for the sesamoid that is found in the tendon of the *M. popliteus*, a muscle placed near from the *M. gastrocnemius*, not present in frogs. Because this bone was not reported by Nussbaum (1982), his discussion about morphology and phylogeny of frogs was based upon the cartilago sesamoides and the os sesamoides tarsale. He noted the fact that the cartilago sesamoides occurs in many species of frogs that lack the os sesamoides tarsale, such as I found in a number of species, emphasizing the widespread occurrence of the cartilago sesamoides among frogs. At the same time, Nussbaum's hypothesis that the os sesamoides tarsale is of much more limited occurrence in frogs

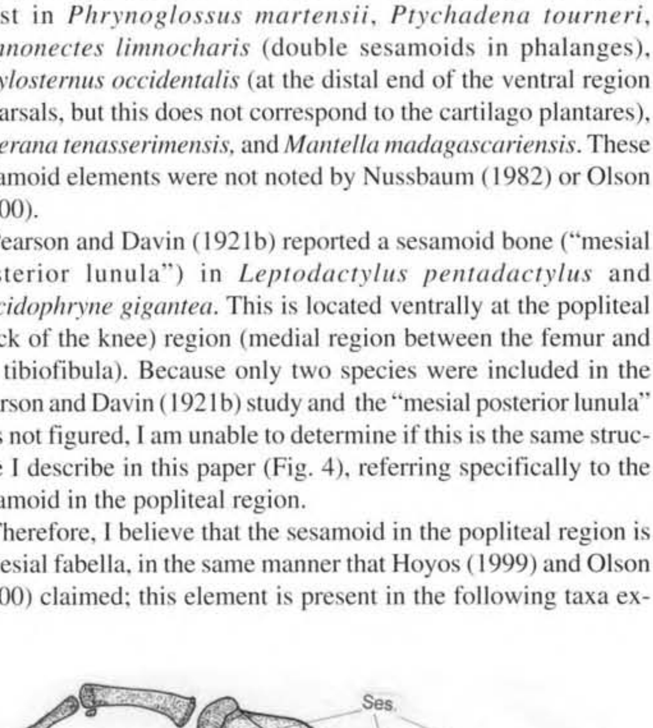

FIG. 3. a. Dorsal aspect of the right hand in *Phrynoglossus martensi*. MNHN 1987.5376. Ses. = ossa sesamoidea; Prp. = prepollex b. Ventral aspect of he right hand in *Phrynoglossus magnapustulosus* .MNHN 1997.5376. Ses. = Os sesamoides. Scale = 1 mm.

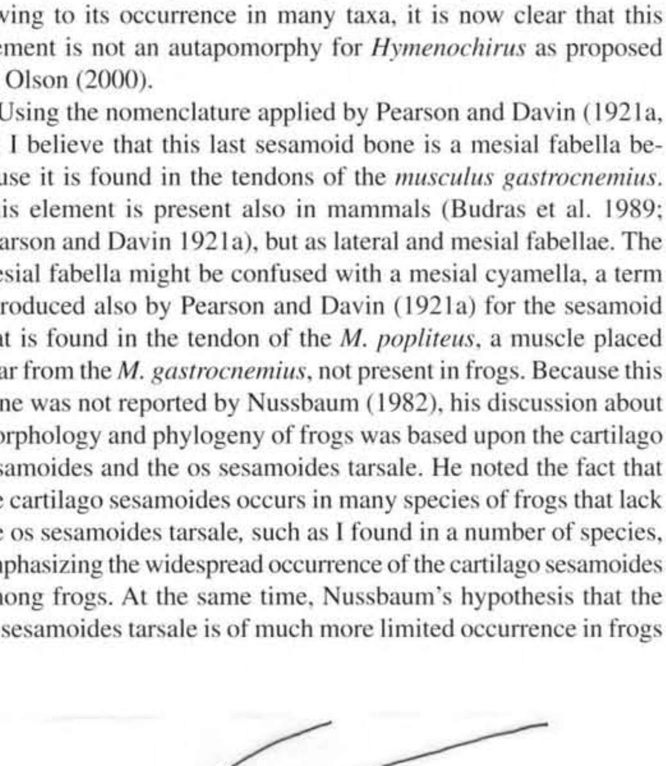

FIG. 4. Ventral aspect of the right hindlimb in *Rhacophorus nigropalmatus* showing the mesial fabella between the femur and tibiofibula. MNHN 1997.4094. TF = tibiofibula. Fe = femur. Scale = 1 mm.

was verified by my results. It is also important to emphasize that the os sesamoides tarsale never appeared without the presence of the cartilago sesamoides, whereas the later was often found without the former.

Nussbaum (1982) reported the os sesamoides tarsale from only three groups of frogs—*Pipa*, Sooglossidae, and Phrynobatrachinae—but I found this element in additional species not examined by Nussbaum. Therefore, the hypotheses of phylogenetic relationships proposed by Nussbaum should be examined carefully in light of this additional information. If the os sesamoides tarsale is present in fewer taxa than compared with the cartilago sesamoides, the former could be more useful in frog systematics, but the contrary, that the cartilago sesamoides is present in fewer taxa than the os sesamoides tarsale, is also true. In following Nussbaum's rationale, we could say that the presence of the os sesamoides tarsale is derived and its absence is primitive. But I think we will need an actual cladistic analysis in using outgroups to corroborate this assessment.

As I did not find the os tibialis anticus, we could support the proposal by Olson (2000) that considers this element as an autapomorphy for *Hymenochirus*. Likewise, I did not find the posterior lunula examined by Olson (2000), therefore I think we need to consider that this character is an autapomorphy for *Hymenochirus*, as this was stated by Olson (2000). It is important to stand out that although papers by Laurent et al. (1989–1990), Fabrezi (1992, 1996, 2001), Fabrezzi et al. (1996), and Fabrezzi et al. (2001) mention phalanx and carpal elements, they did not treat sesamoid elements in an explicit way.

It is clear that, opposed to Olson (2000), heterotopic elements are common in amphibians, bearing in mind that anurans comprise majority of amphibians. However, we need to investigate more about these sesamoid bones, namely the os sesamoides tarsale and the mesial fabella, to discover their taxonomic and phylogenetic importance in frog systematics.

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Appendix 1

Material examined. CAS: California Academy of Sciences, San Francisco; MNHN: Muséum National d'Histoire Naturelle, Paris.

Ranidae: *Amolops monticola* (MNHN 1987.2077, 9533); *Aubria subsigillata* (MNHN 1989.2051; 1993.1470.); *Boophis brachychir* (MNHN 2495); *Boophis goudoti* (MNHN 1975.2732); *Chiromantis rufescens* (MNHN 1993.5702; MNHN 1995.4032); *Conraua alleni* (MNHN 1979.7007); *Conraua crassipes* (MNHN 1979.6145); *Euphlyctis cyanophlyctis* (MNHN 1977.1364, 1977.1368, 1979.1379, 1979.1392); *Hoplobatrachus occipitalis* (MNHN 1979.764, 1979.766); *Hoplobatrachus rugulosus* (MNHN 1997.4900); *Indirana gundia* (MNHN 1985.626); *Ingerana tenasserimensis* (MNHN 724); *Limnonectes blythii* (MNHN 1988.2468), *Limnonectes kuhlii* (MNHN 1987.3334. Phu Kradung, Thailand; 1997.4100); *Limnonectes (Fejervaria) limnocharis* (MNHN 1987. 2371; 1997.5329); *Limnonectes (Bourretia) pileatus* (MNHN 1987 3139); *Nanorana (Altirana) parkeri* (MNHN 1982.1082); *Occidozyga lima* (MNHN 3366; CAS 195994); *Paa blanfordii* (MNHN 1994.6783); *Paa vicina* (MNHN 1985.1105), *Phrynoglossus laevis* (CAS 137092); *Phrynoglossus magnapustulosus* (MNHN 1997.5375, 1997.5376); *Phrynoglossus martensii* (MNHN 1987.2885; 1987.2919; 1987); *Platymantis vitiensis* (MNHN 1992.5264); *Ptychadena floweri* (MNHN 1996.6147), *Ptychadena mascareniensis* (MNHN 1995.1952, 1995.1962, 1995.1965, 1995.1979, 1995.2066, 1995.2067, 1995.2085, 1995.2091, 1995.2092, 1995.3069); *Ptychadena pujoli* (MNHN 1995.1446. Nimba, research station, Liberia); *Ptychadena tourneri* (MNHN 1970.949, 1970.963);); *Ptychadena arnei* (MNHN 1996.8909, 1996.8948); *Pyxicephalus adspersus* (MNHN 1994.5528. Africa); *Rana (Amnirana) albolabris* (MNHN 1989.764, 1989.793. Africa; 1989.4148, 1985.4197); *Rana (Afrana) angolensis* (MNHN 1989.49, 1989.108); *Rana (Rana) arvalis* (MNHN 1982.2156, 1982.2201, 1982.2213); *Rana (Nididrana) chapaensis* (MNHN 1938.64); *Rana (Aquarana) clamitans* (MNHN 1997.4903-4904); *Rana (Rana) dalmatina* (MNHN 1988.7106); *Rana (Hylarana) erythraea* (MNHN 1988.4330, 1988.7467); *Rana*

(Pelophylax) kl. esculenta (1856T); *Rana (Hydrophylax) galamensis* (MNHN 1979.7143); *Rana (Rana) graeca* (MNHN 1985.2431, 1985.2460); *Rana (Rana) iberica* (MNHN 1970.1074; 1970.1078); *Rana (Pelophylax) lessonae* (MNHN 1991.167, 1995.9770, 1995.9770); *Rana (Sylvirana) nigrovittata* (MNHN 1997.4043, 1997.4044, 1997.4045, 1997.4046); *Rana (Pelophylax) perezi* (MNHN 1981.536, 1981.543; 1980.1013); *Rana (Pantherana) pipiens* (MNHN 1997.4901–4902. North America); *Rana taipehensis* (MNHN 1987.3404, 1987.3416); *Rana (Rana) temporaria* (MNHN 1988.7883, 1988.7888 1985.5727); *Rhacophorus leucomystax* (MNHN 1987.3554, 1987.3574); *Rhacophorus nigropalmatus* (MNHN 1997.4904); *Taylorana hascheana* (MNHN 1997.5264) *Tomopterna breviceps* (MNHN 1989.2117); *Tomopterna marmorata* (MNHN 1995.2138).

Mantellidae: *Mantella madagascariensis* (MNHN 1931.14, 1991.1807).

Arthroleptidae: *Astylosternus occidentalis* (MNHN 1995.3208, 1995.3211); *Arthroleptis poecilonotus* (MNHN 1979.1818, 1979.1829).

Phrynobatrachidae: *Phrynobatrachus accraensis* (MNHN 1970.119, 1970.134).

Microhylidae: *Breviceps mossambicus* (MNHN 1995.9910); *Kaloula pulchra* (MNHN 1986.2771, 1988.4362); *Anodonthyla boulengeri* (MNHN 1973.611, 1973.692).

Hyperoliidae: *Leptopelis christyi* (MNHN 1989.2455, 1989.2457).

Leptodactylidae: *Eleutherodactylus martinicensis* (MNHN 755, MNHN 1997.4917).

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Mosquito Control By Pond-Breeding Salamander Larvae

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The benefits of pest control attributed to amphibians are usually based on anecdotes rather than on experimental field tests (Matheson and Hinman 1929; Minton 1972). One study testing the effect of adult European frogs on mosquito density established that the frogs ate mosquitoes, but had no regulatory effect (Blum et al. 1997). In a North American study on adult eastern newts (*Notophthalmus viridescens*) the authors (Matheson and Hinman 1929) concluded that newts are efficient at reducing mosquito populations. However, the conclusions were based on qualitative observations at just three wetlands and upon the predatory behavior of three newts in a small glass jar. The hypothesis that amphibians can reduce mosquito population density has not been tested quantitatively on aquatic salamanders in a natural setting or with adequate replication.

Pond-breeding salamander larvae of the genus *Ambystoma* are opportunistic carnivores that often occur at high densities in temporary ponds (Brodman 1995; Peterson et al. 1992; Van Buskirk and Smith 1991). Because larval mosquitoes are confined to the aquatic habitat, opportunities to escape predation are more limited compared to flying adults. These factors suggest that the larvae of pond-breeding salamanders might be better candidates than adults for reducing larval mosquito density. The diet of the larvae of North American pond-breeding salamanders generally consists of zooplankton, aquatic insects, benthic crustaceans, and occasionally amphibian larvae (Freda 1983; Gehlbach 1965; Holomuzki 1989; Morin 1981; Nyman 1991; Sever and Dineen 1978; Smith and Petranka 1987). Pest dipteran species including mosquito larvae are often components of the diet (Hutcherson et al. 1989; Sever and Dineen 1978; Smith and Petranka 1987). Several studies have had mixed results, indicating that some but not all invertebrate prey taxa are reduced in population density or biomass because of predation by certain species of salamander larvae (Harris 1995; Holomuzki 1989; Holomuzki et al. 1994; Petranka 1989). Whereas marbled salamander larvae (*A. opacum*) do not affect zooplankton biomass, tiger salamander larvae (*A. tigrinum*) can reduce zooplankton biomass and densities of microcrustaceans and dipterans (Holomuzki 1989; Holomuzki et al. 1994). Spotted salamander (*A. maculatum*) larvae reduce densities of benthic crustaceans but not microcrustaceans (Harris 1995). There have been no studies on the effect of coexisting salamander species representing two size classes of larvae on aquatic invertebrates nor on the effect of salamander larvae on mosquito populations.

The purpose of this paper is to couple natural observations, using a set of wetlands that either have or lack salamander populations, with an experiment using mesocosms to test the hypotheses that: 1) presence or absence of salamander larvae influences the aquatic invertebrate community; 2) two species of coexisting salamander larvae of differing size classes have an interactive effect on the aquatic invertebrate community; and 3) salamander larvae can reduce mosquito populations.

For the natural observations we surveyed 100 wetlands in Jasper, Pulaski, and White counties in northwest Indiana for the presence and relative abundance of amphibians from 1994 to 1998. The primary methods employed in this survey were assessment of frog calling intensity and directed sampling, which included searches under cover objects adjacent to wetlands and sampling wetlands with aquatic seine, dipnet and minnow traps. Relative abundance of each species was determined by the number caught in directed sampling per person hour of effort and by applying a breeding index scale from 0 to 5 (see Karns 1986). Voucher specimens were taken for new site and county records and deposited in the Saint Joseph's College repository (Brodman 1999).

To correlate amphibian abundance with habitat characteristics, physical parameters of each wetland were determined on site and with the aid of National Wetland Inventory maps and aerial photographs (Smallwood and Osterholz 1990). Parameters recorded include the area of the wetland, estimated percentage of wetland covered by emergent vegetation during spring, and the presence of wood stands (> 1 ha) within 200 m of wetland. We $\log_{10}$-transformed wetland size before statistical analysis. Hydroperiod was determined by using National Wetland Inventory maps, and modified based on five years of observation. Each wetland was given values reflecting hydroperiod as follows: saturated (value = 0.1), temporary (value = 0.3), seasonally flooded (value = 0.5), semipermanently flooded (value = 0.7), intermittently exposed (value = 0.9), and permanently flooded (value = 1.0). These values approximate the probability of the wetland holding water through-

out the summer.

Water samples were collected from three random locations in each wetland by lowering a 1 L container from surface to bottom such that the water sample would represent the entire water column. Water samples were analyzed for chemical composition using LaMotte water testing kits (Renn 1970). Dissolved oxygen, carbon dioxide and pH were determined on site. Water samples were brought to the lab to test for concentrations of phosphate, silica, ammonia, nitrate, sulfate, hardness, and turbidity.

TABLE 1. Comparison of mean (± standard error) wetland characteristics between wetlands with and without salamanders. *P*-values are from one-tailed Mann-Whitney *U* tests.

Wetland Characteristic	With Salamanders	Without Salamanders	*p*
Anuran species richness	3.0 ± 0.6	3.7 ± 0.7	0.24
Abundance (calling intensity)	7.3 ± 1.8	10.2 ± 2.0	0.15
Wetland area (log m^2)	7.3 ± 0.9	7.5 ± 0.4	0.43
Percent emergent vegetation cover	43.2 ±10.0	48.3 ± 7.5	0.34
Percent with woods within 200 m	66 ± 14	83 ± 11	0.18
Hydroperiod	0.42 ± 0.15	0.33 ± 0.14	0.34
pH	6.9 ± 0.2	6.9 ± 0.2	0.82
Dissolved Oxygen ppm	10.2 ± 1.4	8.8 ± 0.9	0.20
Carbon dioxide ppm	41.3 ± 10.5	50.8 ± 7.8	0.24
Phosphate ppm	0.74 ±0.39	0.34 ± 0.08	0.17
Silica ppm	5.0 ± 1.2	6.5 ± 0.9	0.17
Ammonia ppm	0.30 ± 0.07	0.20 ± 0.06	0.11
Nitrate ppm	125 ± 26	92 ± 16	0.15
Sulfate ppm	31 ± 5	30 ± 4	0.41
Hardness ppm	125 ± 33	111 ± 16	0.36
Turbidity jtu	46 ± 12	64 ± 9	0.12

From our pool of 100 wetlands, we selected 12 sites that had salamander larvae present and matched them with 12 sites that lacked salamanders. Each set of 12 sites included four temporary or seasonally flooded wetlands that hold water from late winter through spring, four semi-permanently flooded wetlands that held water from late winter through three of the five summers, and four intermittently exposed or permanent wetlands that held water throughout all five years. Six pairs of sites were located at state nature preserves, two pairs of sites were located on Saint Joseph's College property, and the remaining four pairs of sites were wetlands located on rural private properties. The salamander sites included four sites with tiger salamanders, two sites with blue-spotted salamanders (*A. laterale*), and six sites with two or three species that included combinations of tiger salamanders, blue-spotted salamanders, small-mouth salamanders (*A. texanum*), eastern newts, and lesser sirens (*Siren intermedia*). Salamander and salamander-free sites were matched based on having similar locations, frog faunas, physical parameters and water chemistry. All 24 sites were fish-free. We used the non-parametric one-tailed Mann-Whitney *U* test of the null hypothesis that there are no differences among the wetland characteristics between sites with and without salamander larvae. The chosen wetland sites with salamander larvae present did not significantly differ from our salamander-free sites (Table 1).

We sampled each of these 24 wetlands for aquatic invertebrates on four dates (early April, late April, early May, and late May). Three 1 L water samples were collected on each date from each wetland by lowering a 1 L container (with a 6 cm diam circular opening) from surface to bottom such that the water sample would represent the entire water column. Water samples were brought back to the lab and aquatic invertebrates were identified and counted under dissecting microscopes. The site-specific mean density for each taxon was determined for all four collecting dates. ANOVA was used as an exploratory analysis to test for differences in invertebrate densities between sites with and without salamander larvae.

Mesocosms were established in a common garden experiment to test for the effect of tiger salamander (*Ambystoma tigrinum*) and blue-spotted salamander (*A. laterale*) larvae on the aquatic invertebrate community. Tiger salamanders and blue-spotted salamanders were chosen because they are the two most abundant salamander species in the study area (Brodman and Kilmurry 1998) and represent two size-classes of wetland predator. The SVL of 30 d old tiger salamander larvae are on average 33% longer than coexisting blue-spotted salamander larvae (Jaskula and Brodman 2000).

Uniform mesocosms were created in 85 L (0.15 m^2) plastic tubs with 70 L of pond water (depth 47 cm) and 10 cm leaf litter covering the tub bottom. Colonies of algae, zooplankton, benthic crustaceans, and aquatic insects were established in each mesocosm Mesocosms were placed outdoors within an oak forest and left open to the air to allow colonization of breeding insects. Forty northern leopard frog (*Rana pipiens*) eggs were added to each mesocosm to serve as an alternate prey for the salamander larvae. Salamander eggs were collected from breeding sites and hatched in the lab. Each mesocosm was supplemented with 400 ml of pond water containing zooplankton 30 d and 60 d after the experiment began.

TABLE 2. Comparison of mean aquatic invertebrate densities (number per L of water) in wetlands with and without salamander larvae. Aquatic invertebrate taxa categories are Ostracods (Ostr), Cladocerans (Clad), Mosquitoes (Mosq), Copepods (Cope), all other taxa (Other) and Total. *P*-values are from exploratory one-way ANOVA.

	Ostr	Clad	Mosq	Cope	Other	Total
Without salamanders	71.4	56.2	28.8	13.7	6.1	176.2
With salamanders	14.4	50.2	0.7	11.8	5.6	107.5
p-values	0.01	0.27	0.003	0.36	0.43	0.05

In a 2 x 2 factorial design, the control and treatments were randomly assigned to mesocosms within six blocks. Each block had a control mesocosm with no salamander larvae, a treatment with four tiger salamander hatchlings added, a treatment with six blue-spotted salamander hatchlings added and a treatment with two tiger salamander and three blue-spotted salamander hatchlings added. The initial densities of 27–40 salamander larvae/m^2 in each mesocosm are within the range of natural densities for *Ambystoma* hatchlings (Brodman 1995; Cortwright 1988; Stangel 1988; Van Buskirk and Smith 1991). The asymmetry in the number of each species of salamander used reflects the size difference between the large tiger salamander larvae and the small blue-spotted salamander larvae.

TABLE 3. Results from common garden experiment: Leopard frog tadpoles (number surviving) and aquatic invertebrate densities (number per L of water) in the presence and absence of tiger salamander and blue-spotted salamander. *P*-values are from 2 x 2 factorial ANOVA testing for the effect of salamander presence and interaction effect of the two species on aquatic community.

	Tadpoles	Zooplankton	Mosquitoes	Other diptera
Control	29.4	45.2	9.0	2.0
Blue-spotted	4.3	4.8	0.8	0.3
Tiger	0.2	0.8	0.8	0.0
Tiger+blue-spotted	0.5	1.0	0.5	0.0
p-values (vs. control)				
Salamanders present	< 0.0001	< 0.00001	< 0.0002	< 0.01
Interaction	< 0.04	< 0.0003	1.0	0.36

Water samples were collected from each mesocosm after 90 d when some of the salamander larvae were beginning to metamorphose. One-L samples were brought to the lab where aquatic invertebrates were identified and counted under dissecting microscopes. Surviving leopard frog tadpoles were also counted in each mesocosm. A 2 x 2 factorial ANOVA was used to test the effect of salamander presence on leopard frog tadpole and aquatic invertebrate densities.

After the completion of the common garden experiment, a small aquarium dipnet was used to transfer mosquito larvae and zooplankton from control to treatment mesocosms. Predatory acts by salamander larvae were observed for several days.

Cladocerans, ostracods, mosquito larvae, and copepods were the four most abundant taxa of aquatic invertebrates, making up 94–97% of the invertebrates. Wetlands with salamander larvae had significantly lower densities of mosquito larvae, ostracods, and the total number of aquatic invertebrates than salamander-free wetlands (Table 2). Mosquito larvae densities were 98% lower in wetlands with salamander larvae compared to salamander-free wetlands. There were no significant differences in the densities of cladocerans, copepods, and all of the rarer taxa.

Mesocosms with tiger salamander or blue-spotted salamander larvae had significantly lower densities of leopard frog tadpoles, zooplankton (cladocerans, ostracods, and copepods), mosquito, and other dipteran larvae after 90 d than salamander- free mesocosms (Table 3). Densities of mosquito larvae in mesocosms with salamander larvae were 91–94% lower than controls. Treatments with tiger salamanders had significantly lower densities of leopard frog tadpoles and zooplankton than treatments with blue-spotted salamanders, but there was no difference in dipteran densities with respect to salamander species (Table 3). There were significant interactive effects of the salamander species on tadpole and zooplankton densities, but not on dipteran densities.

After completion of the common garden experiment, salamander larvae were observed to prey upon mosquito larvae and zooplankton that had been transferred from the control mesocosm. Both tiger salamander and blue-spotted salamander larvae ate most of the mosquito larvae within a few days.

The field results were consistent with experimental results from mesocosms. Wetlands and mesocosms with salamander larvae had lower densities of aquatic invertebrates, including an order of magnitude reduction of mosquito densities compared to salamander-free wetlands and mesocosms. These are the first data that demonstrate that amphibian populations can greatly reduce larval mosquito densities.

Predation by aquatic salamanders has a large and often keystone effect on wetland community structure (Fauth and Resetarits 1991; Morin 1981). Studies have indicated that aquatic salamanders can reduce densities of invertebrates (Harris 1995; Holomuzki 1989; Holomuzki et al. 1994) and tadpoles (Morin 1981; Van Buskirk and Smith 1991). We provide evidence that tiger and blue-spotted salamander larvae can reduce aquatic invertebrate and leopard frog tadpole densities.

We suggest that the larvae of pond-breeding salamanders have the potential for pest control of mosquitoes and other biting flies that use temporary wetlands. Because insecticides have been implicated as a possible cause of amphibian malformations (Fort et al. 1999; La Clair et al. 1998; Madden 1993; Ouellet et al. 1997) as well as other sub-lethal and lethal effects (Boone and Bridges 1999; Boone and Semlitsch 2001; Zaga et al. 1998), an undesirable side-effect of insecticide use might be the decline of a natural predator capable of controlling mosquito populations.

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TECHNIQUES

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Evaluation of Fluorescent Marking Techniques Using Cannibalistic Salamander Larvae

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Many marking techniques are available for identifying amphibians in ecological studies, including toe clipping, tattooing, freeze branding, staining, transponder implants, and injected fluorescents (reviewed in Donnelly et al. 1994; Brown 1997). The main concerns associated with any marking technique are retention of marks over time (e.g., Davis and Ovaska 2001), direct effects on mortality or morbidity (Clarke 1972; Daugherty 1976; Jehle and Hödl 1998), and more indirect effects on predation risk or growth (Travis 1981; Turner 1960). Subcutaneous injection of fluorescent gels is gaining wide use because, in comparison to other techniques, it is relatively inexpensive, long lasting, and noninvasive (Nishikawa and Service 1988; Seale and Boraas 1974; Wolley 1973). I conducted laboratory experiments to evaluate two injection-based alternatives for marking aquatic salamander larvae: organic dye (Seale and Borass 1974) and Visual Implant Elastomer (VIE; Anholt et al. 1998).

These experiments were motivated by two specific concerns. Firstly, Anholt et al. (1998) reported successful use of VIE for marking ranid tadpoles, but that use of organic dyes was not successful. I was interested in determining whether this was also the case for another taxon, namely aquatic salamander larvae. Secondly, there are concerns that fluorescent gel marking might affect predation risk, either by increasing visibility of marked individuals or the viscosity of marks near tail musculature hampering escape responses (Anholt et al. 1998; Davis and Ovaska 2001; Wolley 1973). In cannibalistic species, high interaction rates among predators and prey might exacerbate such effects. Aggressive encounters among Arizona tiger salamander (*Ambystoma tigrinum nebulosum*) larvae are frequent and often result in loss of extremities or cannibalism (Brunkow and Collins 1998; Collins and Cheek 1983). Marked individuals might then effectively be carrying fluo-

rescent bulls-eyes on their backs that draw the attention of cannibalistic larvae hunting for conspecifics, especially in turbid habitats. The relatively high risk of predation and injury in these largely visual predators makes *A. t. nebulosum* ideal for evaluating fluorescent marking in cannibalistic salamanders, and comparing results to previous studies conducted with anurans.

Experimental *A. t. nebulosum* larvae came from a single lab-bred clutch. Embryos hatched in shallow pans, were placed in a 180-liter aquarium, and fed brine shrimp (*Artemia* sp.) nauplii until 5 July 2000 when mean snout–vent length (SVL) was approximately 20 mm. Ten larvae each were then randomly assigned to 24 35-liter aquaria, and aquaria were randomly assigned one of three treatments in a randomized block design: 1) larvae marked with VIE (N = 6 aquaria); 2) larvae marked with organic dye-based gel (N = 6 aquaria); and 3) unmarked control larvae (N = 12 aquaria). The larger number of control replicates was required to accommodate the second experiment described below. Experimental larvae were marked using a 25 G needle to inject a stripe of gel ca. 2 mm long into the dorsal fin above the tail musculature. The organic dye was mixed to match the color of red VIE such that they were visually indistinguishable. Each tank was given daily aliquots of brine shrimp nauplii (the amount hatching from 1.5 g of cysts), and partial water changes were performed weekly. After 30 days, the numbers of larvae that survived and retained marks were recorded, and larvae were examined for signs of injury that may have concealed marks (i.e., damage to the tail fin at the marking site).

A second experiment was performed to determine whether marked larvae were more likely to be cannibalized than unmarked larvae. Individuals from the previous experiment were used because marked larvae had retained marks for one month, reducing the likelihood that lost marks would confound results. Cannibalism in *A. t. nebulosum* also only occurs when there is an approximately 2:1 size ratio between predator and prey (Ziemba et al. 2000). On 10 August 2000, when larvae ranged in size from about 25 to 50 mm SVL, the remaining 48 marked larvae from the organic dye replicates were placed in a 180-liter aquarium with 48 haphazardly selected unmarked control larvae. Likewise, 48 haphazardly selected marked larvae from the VIE replicates were placed in a separate 180-liter aquarium with 48 control larvae. Both tanks received equal daily aliquots of brine shrimp nauplii. After 60 days, surviving marked and unmarked larvae were counted and inspected for damage.

Survivorship in the first experiment was uniformly high (9 or 10 larvae survived in all replicates), and not different among treatment levels (Kruskal-Wallis H = 1.42, p = 0.492). Retention of marks was higher in the VIE treatment (mean ± SEM = 100% ± 0%) than the organic dye treatment (84.3% ± 2.27%). All surviving larvae marked with VIE retained their marks, while at least one larva in each organic dye replicate lost its mark (Mann-Whitney U = 0.0, p = 0.002). Marked larvae in the second experiment were not more likely to be cannibalized than unmarked larvae for either the VIE or organic dye treatment (Table 1; Mantel-Haenszel c^2 = 0.0219, p = 0.882). Although some larvae died for reasons other than cannibalism (presumably from complications associated with attempted cannibalism; N = 12 of 118 deaths across both treatments), outright cannibalism was the main source of mortality (N = 106 of 118 deaths). Because there were relatively few non-cannibalistic deaths and these were likely a consequence of cannibalism attempts, all deaths were included in the analysis. All larvae incurred at least some damage to limbs, gills, or tail tips from intraspecific encounters, but injuries occurred well away from the marking site such that identifying marked versus unmarked individuals was unambiguous.

Table 1. Results of cannibalism experiment where equal numbers of marked and unmarked larvae were placed together to assess the effect of marking on the incidence of deaths from intraspecific predation and aggression.

	V.I.E.			Organic Dye		
	Lived	Died	Sum	Lived	Died	Sum
Marked	22	26	48	15	33	48
Not marked	19	29	48	18	30	48
Sum	41	55	96	33	63	96

Neither gel-based marking technique reduced survivorship of larvae relative to unmarked larvae. Similarly, neither marking technique affected cannibalism rate. However, the cannibalism experiment was conducted in a well-lit laboratory in clear water, and colored marks may increase visibility of larvae to potential predators in turbid waters of natural habitats. Salamander larvae retained VIE marks better than organic dye, but two additional considerations might offset this advantage. Firstly, VIE is more expensive than the organic dye gel. A 15 cc kit of VIE (enough to mark about 1500 larvae) costs US $190 versus approximately US $19 for a comparable amount of organic dye gel. Secondly, VIE must be prepared immediately prior to use. Although keeping VIE refrigerated will slow the hardening process, it must be used within a few days of mixing ingredients (Northwest Marine Technology, Inc. 1999). Organic dye gel seems to last indefinitely (pers. obs.), allowing one to mix large batches that can be used for years. If maximum retention of marks is a priority, however, the extra cost and effort associated with the VIE system might be worthwhile.

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A Simple Model for Estimating the Age of Morelet's Crocodile Embryos

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Crocodile research and management often requires information on the timing of various aspects of reproduction (Magnusson and Taylor 1980). The ability to determine accurately embryo age allows estimation of oviposition dates, monitoring embryo mortality within nests, and prediction of hatching peaks (Hall 1985; Magnusson and Taylor 1980; Webb et al. 1983a, b). Crocodilian embryos have been aged on the basis of ontogenetic stages (Ferguson 1987; Magnusson and Taylor 1980) and the extent of opaque egg banding (Ferguson and Joanen 1983; Webb et al. 1983a, b), but these methods are time consuming, highly subjective, and difficult for non-embryologists to apply in the field (Deeming and Ferguson 1990; Hall 1985). Instead, Webb et al. (1983a, b) and Hall (1985) recommend the development of species-specific growth models that relate selected morphometric measurements to embryo age. Such models are available for *Crocodylus johnstoni* (Webb et al. 1983a), *C. novaeguineae* (Hall 1985), *C. palustris* (Hall 1985), and *C. porosus* (Hall 1985; Webb et al. 1983b), and in this paper we provide a model for Morelet's crocodile (*C. moreletii*), a little-studied species inhabiting the Caribbean and Atlantic lowlands from northern Mexico south to Guatemala and southern Belize (Groombridge 1987; Platt et al. 1999).

This study was conducted from June through September 1996 at Gold Button Lagoon (17°50' N; 88°45' W), a 142-ha man-made impoundment in Orange Walk District, Belize inhabited by an estimated 175 non-hatchling crocodiles (Platt 1996). At the onset of the nesting season (mid- to late June), we inspected potential nest sites every two days and determined the oviposition date of each clutch to within 48 h. Beginning two to three weeks post-laying, a single viable egg was randomly collected from every nest each week. Linear measurements of eggs and embryos were obtained with dial calipers (± 0.1 mm). Egg length (EL) was measured and the embryo extracted after euthanization by chilling at approximately 10°C for one hour (Platt et al. 2000). Previous studies (Deeming and Ferguson 1990; Hall 1985) have identified dorsal cranial length (DCL: measured from the anterior tip of the snout to the median posterior edge of the supraoccipital) as the best morphological attribute for predicting embryonic age in crocodilians. Unlike other attributes, DCL exhibits isometric growth with respect to embryo age and can be easily measured (Hall 1985). On young embryos lacking cranial ossification, DCL was measured from the anterior tip of the snout to the flexion of the cranial region (see Fig. 1 of Hall 1985), and care was taken to ensure calipers did not indent soft tissue. Embryos were preserved in formalin and later deposited in the Campbell Museum, Clemson University, Clemson, South Carolina, USA. Weekly egg collection continued until clutches were lost to predation or flooding, or hatched. In most cases, the date of hatching was unknown and thus incubation period could not be precisely determined.

Thirty-two embryos ranging from 17 to 73 days old were collected from seven *C. moreletii* nests between 6 July and 14 September. There was a significant positive relationship between embryo age and DCL, and DCL explained most of the variation in embryo age ($r^2 = 0.91$; $P < 0.001$; Fig. 1). The average difference between predicted embryo age and actual age was 4.0 days (range

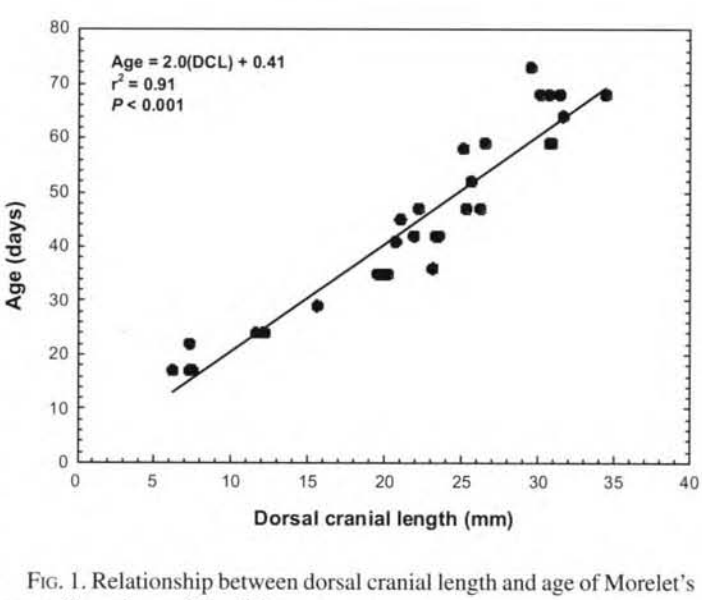

FIG. 1. Relationship between dorsal cranial length and age of Morelet's crocodile embryos (N = 32).

= 0.4–13.6 days), with the greatest deviation occurring in embryos older than 50 days. Some authors have speculated that egg size might affect the relationship between DCL and age (Hall 1985; Webb et al. 1983a, b), and Webb et al. (1983a) recommended scaling morphometric measurements to egg length when calculating linear regression models. We found a significant linear relationship between DCL/EL and embryo age in *C. moreletii* ($r^2 = 0.88$; $P < 0.001$; Fig. 2). Embryo age predicted by this model differed from actual age by an average of 4.5 days (range = 0.25–14 days), with the greatest deviation noted in embryos older than 35 days. However, while the relationship between DCL/EL and embryo age was significant, scaling did not improve the fit of this model. Likewise, Deeming and Ferguson (1990) found EL only affected embryo size during the final stages of incubation and concluded that scaling is unnecessary for developing predictive models. DCL measurements alone thus provide a simple, rapid method for estimating the age of *C. moreletii* embryos.

Although our method is lethal, the sacrifice of a small number of eggs for aging purposes is unlikely to prove detrimental to the fitness of wild crocodile populations. *Crocodylus moreletii* produce large clutches (mean = 25.0 ± 7.6 eggs; range = 9–42; N = 73) and natural losses to predators and flooding are generally high, approaching 100% in some years (Platt 1996). Moreover, eggs and hatchlings are demographically expendable and large numbers are harvested to stock commercial ranches with little effect on natural populations (Rice et al. 1999). Indeed, *Alligator mississippiensis* populations at several lakes in Florida, USA increased over an 11-year period even when 50% of the eggs and hatchlings were annually removed (Rice et al. 1999).

In contrast to previous studies where eggs were collected shortly after oviposition and incubated under constant temperatures in the laboratory (Hall 1985; Webb et al. 1983a, b), our model was derived from embryos developing *in situ*. Incubation temperatures under natural conditions vary both within and among nests, and consequently incubation periods are often highly variable (Deeming and Ferguson 1989; Lang et al. 1989). For example, in an earlier study of *C. moreletii* nesting in Belize, significant differences were found in incubation temperatures between nests, and incubation periods ranged from 61 to 86 days (Platt 1996). Because embryonic development is highly dependant on incubation temperature, incubating eggs under constant temperatures in the laboratory minimizes variation in embryonic development rates and yields predictive equations that are less applicable to field studies (Deeming and Ferguson 1989). Conversely, models derived from embryos collected from wild nests better account for variation in developmental rates, and are likely to more accurately predict embryo age. Therefore, we recommend that future studies develop predictive growth models from embryos developing under natural rather than laboratory conditions.

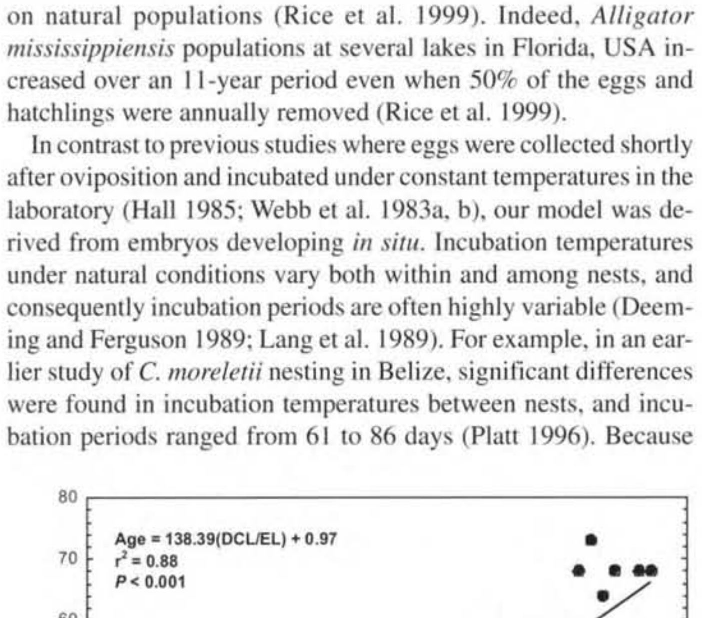

Fig. 2. Relationship between dorsal cranial length/egg length and age of Morelet's crocodile embryos (N = 32).

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A Technique for Locating and Recovering Radiotransmitters at Close Range

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When radiotracking amphibians, reptiles, and other small vertebrates, determining the location of an animal to within less than a meter is frequently desirable. This is often difficult because most antennas are optimized for locating signals that are several meters to several kilometers away, and because of the complex habitat structure where many small vertebrates are found. For example, one might want to determine the location of a turtle in a large logjam, the position of a snake in a rock fissure, or the site of a frog sitting in a thicket. Being able to locate a transmitter to within centimeters can add valuable information to a tracking study as well as greatly facilitate the recovery of lost transmitters.

When trying to locate a nearby transmitter in locations where a normal multi-element antenna is ineffective, biologists often remove the antenna from the end of the coaxial cable and use the cable as a weak, omnidirectional antenna. Careful sweeps in a grid pattern can sometimes help locate the transmitter in grasslands and similar habitats, but this technique is not practical in many settings. To solve this problem, we have modified and greatly simplified a technique originally used by FWS biologists to recover lost duck transmitters from ponds (anonymous, unpublished FWS report).

Firstly, we modify a coaxial cable by removing the connector at the antenna end of the cable and stripping back the insulation and ground wire sheath about 2 cm. By separating the two wires in the cable, a small omnidirectional antenna is created. We then cut a 75–150 cm length of 1.4 cm (1/2") schedule 80 PVC pipe and seal one end with a PVC cap. The antenna cable is fed into the PVC pipe and the other end is connected to the radio receiver. The modification to the end of the cable creates a small antenna that is much more efficient compared with a plain cable that many biologists use. Although an unmodified cable does detect some radio signals, it does not allow one to localize the signal nearly as well. The use of a PVC pipe allows researchers to probe more easily into crevices and underwater, compared with a loose cable.

We have used this system to locate the exact position of red-legged frogs (*Rana aurora*) during an ongoing study of habitat use. Red-legged frogs often sit in dense vegetation (e.g., cattails, poison oak, blackberry, nettles) or in logjams along creeks. Without the antenna pole, we would only have a general idea of where the frogs were located.

Recovering lost transmitters, or recapturing animals with expiring transmitters, is often a time-consuming part of telemetry studies. The antenna pole is extremely useful for these tasks. Gluing a magnet to the antenna pole with epoxy can facilitate the recovery of transmitters no longer attached to animals. The best magnets for this purpose are rare earth magnets, as they have far more pull (for their size) than ceramic magnets. We currently use a grade 30 neodymium disc magnet (2.5 cm diameter x 1.0 cm high, Catalog number NE150, US $18.00 from Dowling Magnets, 1-800-624-6381, www.dowlingmagnets.com/index1.html), although a wide range of sizes and strengths are available. Note that rare earth magnets are more brittle than standard ceramic magnets, so a thick magnet is preferable. The magnet can be attached to the capped end of the antenna pole so that one can locate and retrieve a transmitter simultaneously. Because we often use our antenna pole for locating animals that we do not want to disturb or capture, we use a separate wooden pole for the magnet.

We bolted a small angle bracket to the end of a broom handle and expoxied the rare earth magnet to the end. The bracket provides a secure attachment to the pole and a good surface for gluing the magnet. A rare earth magnet such as the one we use will pick up (and firmly hold) a small radiotransmitter from ca. 3–4 cm away.

When trying to locate a lost transmitter, we typically use the antenna pole to locate the transmitter as closely as possible. If we happen to bump the transmitter or touch the transmitter antenna, the signal often changes to a slightly higher or lower pitch. We then either reach down and simply pick up the transmitter, or switch to the magnet pole. When using the magnet pole, it is best to monitor the signal; the magnet can cause a notable change in signal (distortion or change of pitch) at close range, or can turn off the transmitter if the transmitter has an internal reed switch. In either case, changes in the signal are a clear indication that the transmitter is within 6–8 cm of the magnet. Of course, the distance over which a change might occur depends on intervening objects (e.g., mud, water, rocks, sticks) and the performance of the transmitter.

We have used the above technique for the last five years and have found lost transmitters in root masses, on the bottom of ponds, in dense cattails, and other difficult situations. Without the antenna pole, we would have spent far more time locating transmittered frogs and we would have frequently obtained only a general location. Additionally, because used transmitters can be refurbished with a new battery for about half the cost of a new transmitter, we have saved thousands of dollars by recovering nearly all our transmitters.

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A Rapid Technique to Detect Chytrid Infection in Adult Frogs

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Investigations into worldwide population declines in amphibians are under way. A wide range of causes have been identified, e.g., habitat destruction (Ferraro and Burgin 1993a, b) and the introduction of non-native fish (Knapp and Matthews 2000). However, a newly discovered chytrid fungus has been consistently found in mass mortality events in wild populations of frogs in Australia, Panama (Berger et al. 1998), and Spain (Bosch et al. 2001). This is the first known instance of a keratinophilic fungus pathogenic to amphibians. The chytrid fungi present in all of these events were morphologically and ultrastructurally identical and given the name *Batrachochytrium dendrobatidis* gen. et sp. nov. Longcore. To date, there seems to be only the one species but molecular techniques will be needed to confirm this (Berger et al. 1999). The disease caused by *B. dendrobatidis* was called chytridiomycosis (Berger et al. 1998; Longcore et al. 1999).

The fungus has been found inside the keratinized cells of the epidermis of adult or newly metamorphosed animals (particularly the ventral body, limbs, and feet areas); it has also been observed to invade the keratinous teeth of tadpoles (Berger et al. 2000). Histological sections made from frog toe clippings have revealed the fungus to occur within the inner layers of the epidermis, within thickening or erosions of the epidermis, and occasionally within ulcers (Berger et al. 1999). The fungus is predominantly unicellular, spherical or subspherical in shape averaging 15 μm in diameter, with one to several discharge tubes that are usually 2 μm in diameter and range from several microns to 2–4 mm in length. A small percentage of the fungal thalli become colonial following the formation of internal walls (Berger et al. 2000). Fine, thread-like structures (rhizoids) grow out from the base of the fungus through, and out of, the invaded epidermal cells (Pessier et al. 1999).

Skin scrapings, histological sections from toe clippings and elsewhere, transmission and scanning electron microscopy, and immunocytochemistry are all methods that have been used to detect the presence of chytrid fungus in frog skin. All of these have associated problems. Unstained wet mounts (Berger et al. 1999) and Diff-Quick-stained smears of skin scrapings (Pessier et al. 1999) have been used as a first step in determining the presence of the chytrid in host tissue. With this approach the mature zoosporangium could be recognized because of size, shape, and the refractive nature of the fungal wall, but other stages posed problems in differentiation from host cells (Berger and Speare 1998; Pessier et al. 1999). Histological sections stained with haematoxylin and eosin (H & E) are commonly used to confirm the presence of the fungus in the infected animal. Preparation of these sections requires great skill and is a time consuming process. While the H & E dyes used clearly identify the mature zoosporangia, the immature stages can still be confused with nuclei (Berger et al. 2000) or other unicellular organisms, for example protists that are the same size and shape and have the same staining response as the fungus (Pessier et al. 1999). Furthermore, not all sectioned zoosporangia will display the discharge tube(s) and empty zoosporangia can be confused with the various types of ducts from the frog's dermal glands (Berger et al. 2000). The fungal walls in histological sections can also be stained using the periodic-acid-Schiff's reaction (PAS) (Berger et al. 2000), but this staining procedure stains all carbohydrates with 1:2 glycol groups (Pearse 1968) and consequently is not specific for chitin, the principal wall component in chytrid cell walls (Bartnicki-Garcia 1968). Immunocytochemical tests involving polyclonal antibodies have recently been developed to detect *B. dendrobatidis* in lightly infected animals (Berger et al. 2002). While this test reveals rhizoids, walls, internal septa, and zoospores within the frog tissue, it was not specific for *B. dendrobatidis*; other chytrid fungi also gave positive reactions (Berger et al. 2002). However, once again this method is a time consuming and expensive process, because it is used on paraffin-embedded sections involving numerous steps with expensive reagents and requires a reasonably high skill level. All immunocytochemical procedures have inherent problems and require testing of reagent concentrations, pH, temperature of incubation, etc., to determine the correct procedure to avoid non-specific staining (Briggs and Ashford 2001).

To address the above problems we sought to develop a rapid, cost-effective method suitable for non-mycologists to distinguish clearly the chytrid fungus in frogs suspected of being infected with chytridiomycosis. Because the cationic dye Congo red stains cellulose and chitin, and has been used to reveal fungal hyphae in histological sections of human tissue (Slifkin and Cumbie 1988), we investigated the feasibility of this dye to reveal the chytrid fungus in frog skin scrapings and intact skin.

Materials and Methods

We developed and tested our methods on three *Litoria peronii* adults with symptoms of chytridiomycosis that had been frozen following death, 12 *Limnodynastes tasmaniensis* adults that had been preserved in 10% neutral buffered formalin (six of these animals had the chytrid fungus) and 11 *Limnodynastes tasmaniensis* adults that were collected in pitfall traps.

A 0.01% solution of Congo red dye was prepared by dissolving Congo Red Indicator [3,3'-[[Biphenyl]-4,4'-diylbis(azo)]-bis[4-amino-1-naphthalrnesulfonic acid] disodium salt CI 22120] (Merck Art. 1340, CI 22120/360) in phosphate buffered saline (PBS) pH 7.4. The dye was stored in a dark bottle at room temperature and replaced when precipitate appeared. To prepare PBS we dissolved 0.154g of $NaH_2PO_4.2H_2O$, 0.7126g of Na_2HPO_4, and 4.01g NaCl in 500 ml of sterile water.

Each formalin-preserved frog was briefly rinsed with distilled water, and frozen animals were allowed to thaw slightly. A sterile scalpel blade was gently but firmly scraped across the pelvic patch or right inner thigh of each animal. The scraping was smeared onto a microscope slide within a 14 x 12 mm hydrophobic barrier

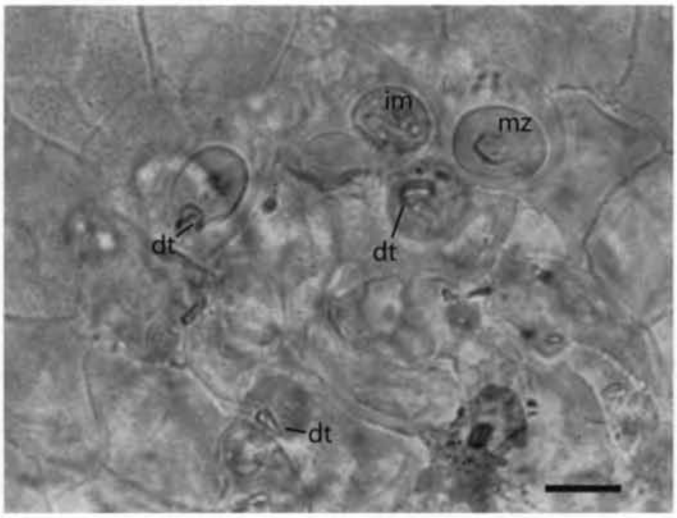

Fig. 1. Skin scraping from a leg of an adult thawed *Litoria peronii*. The emergent discharge tubes (dt) stain brick red after 20 minutes staining. The refractive walls of the mature zoosporangia (mz) are unstained but can be seen against the background. An immature zoosporangium (im) with refractive bodies is also present in the focal plane. Scale bar = 10 µm.

created by using a Liquid blocker super Pap Pen (Daido Sangyo Co Ltd. Tokyo Japan). These samples were air dried for 5 minutes, covered with 60 µl of Congo red solution, stained for 10, 20, 30, or 60 minutes, then covered with a 22 x 40 mm coverglass. If the stain dries out, crystalization of the salts will occur.

Small (4 x 6 mm) pieces of unpigmented skin were cut from the ventral surface of the inner left thigh of each preserved animal; these were scraped, rinsed with distilled water, and placed onto a clean glass microscope slide. The pieces of skin were covered with the Congo red solution, stained for 10, 20, 30, or 60 minutes, rinsed with distilled water and examined.

Scrapings taken from live animals in the field were obtained with a small sterile plastic spoon (attached to the lid from a 76 x 20 mm feces tube from Sarstedt 80.734.301). This spoon was scraped over the inner thigh and the underside of the feet. The spoon and scraping was put into the vial containing 200 µl of PBS, transported back to the laboratory in plastic bags surrounded by ice. The entire scraping solution was deposited inside a 14 mm x

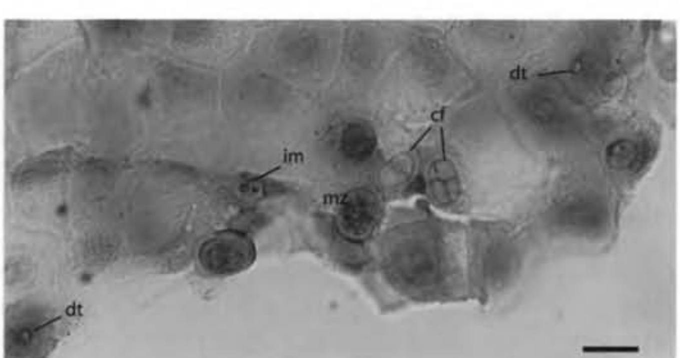

Fig. 2. Skin scraping from a preserved *Limnodynastes tasmaniensis* adult 60 minutes after staining with Congo red. The walls of the immature zoosporangia (im), colonial forms (cf), mature zoosporangia (mz), and discharge tubes (dt) are well stained. The frog nuclei are lightly stained. Scale bar = 10 µm.

25 mm hydrophobic rectangle created on a clean microscope slide. After most of the solution had been evaporated, the scraping was covered with 80 µl of the dye, stained for 60 minutes, covered, and examined.

Results and Discussion

The keratinized epidermal cells could not be confused with the chytrid fungus. In both *Limnodynastes tasmaniensis* and *Litoria peronii* the epidermal cells were flat, 4–6 sided polygons with a single round or oval nucleus (4.5–7 x 7.5 µm) and no refractive bodies (Figs. 1, 2). There was no alteration in shape or size following preservation in formalin or freezing. The cell membrane did not stain with Congo red, although the nucleus stained in damaged cells.

The skin scrapings from infected and non-infected animals resulted in sheets of keratinized epidermal cells, clusters of subepi-

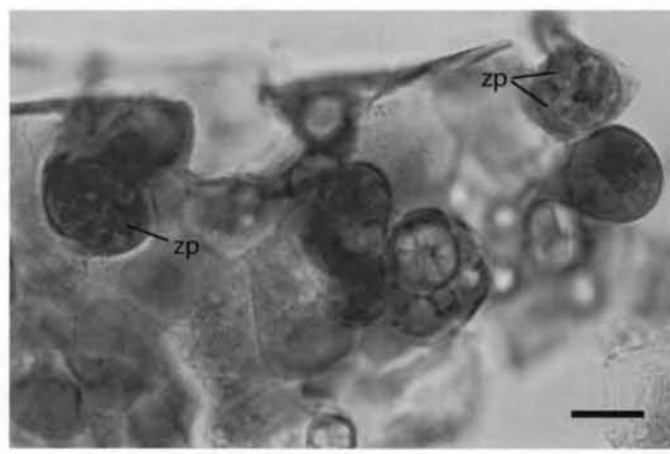

Fig. 3. Skin scraping from a preserved *Limnodynastes tasmaniensis* adult 60 minutes after staining with Congo red. The mature zoospores (zp) can be seen through the stained wall of the zoosporangia. Scale bar = 10 µm.

dermal cells, isolated cells, and nuclei; fungal spores and hyphae were occasionally present. When smears from uninfected formalin-preserved animals were stained for between 10 and 60 minutes, the nuclei of the subepidermal cells were stained orange, but nuclei in the epidermal cells were only stained orange when the cell's plasmalemma had been breached. The stained nuclei in the epidermal cells were still readily distinguishable from the fungus. When smears from infected animals were stained for 10 minutes, there was no staining of the fungus. After 20–30 minutes, the walls of all empty zoosporangia and the exposed discharge tubes of mature zoosporangia were stained a distinctive brick-red color but the dye did not penetrate the intact plasmalemma to stain the immature stages or the host nuclei (Fig. 1). However, the immature stages could still be recognized inside intact epidermal cells (Fig. 1) and distinguished from the host nucleus by the presence of many, small to medium-sized refractive bodies, the clear zone surrounding them, and a thin wall. Often more than one zoosporangium was in the same cell. After a longer staining period (i.e., 45–60 minutes), the walls of the majority of immature, mature, colonial, and empty zoosporangia were stained a brick-red color and the

host nuclei were stained a paler orange (Figs. 2 and 3). It is not possible to say whether the staining in these circumstances was because of an initial breach in the cell plasmalemma or a breach resulting from the prolonged staining in the dye. However, trials in which the dye had been dissolved in distilled water or phosphate buffer were not as successful. The staining time required was at least two to three times longer, the walls of the immature stages did not stain, and the intensity of the color was less.

Skin scrapings from the live animals contained small sheets of epidermal cells, soil debris, unicellular and colonial green algae, fungal hyphae and spores. Although the algal cells were similar in size and shape to the chytrid fungus, they did not have the numerous refractive bodies found in the immature zoosporangia nor the discharge tubes found in the mature zoosporangia: they were also green in color. The colonial algae were easily distinguished from the colonial chytrid fungus, again by the green color as well as by the lack of binding of the dye. The mucilage surrounding living algal cells prevents the penetration of Congo red to the wall beneath and the mucilage does not stain. The fungal spores present were not similar in size or shape to the chytrid fungus and many were naturally pigmented brown (not shown).

In all of the skin scrapings, the hydrophobic barrier was successful in retaining the scraped off cells on the slide. When sheets of cells became trapped on top of the hydrophobic barrier after the lowering of the coverslip, the chytrid zoosporangia were still easily seen because they had already been stained with Congo red.

These simple procedures were very cost effective in time (ca. 1 h for preserved/frozen animals) and materials relative to other procedures such as histological sections, TEM, immunocytochemistry. Although the dye will be absorbed by the host nuclei and other structures such as muscle fibers, the color is less intense and quite different to the color produced when it binds to the wall of the chytrid fungus. Congo red might thus be considered a useful dye to detect the fungus within the host tissue as well as distinguish it from other unicellular organisms. While the extent of the chytrid infections of an animal is better achieved through examination of the whole skin mounts, the scraping technique successfully collects infected cells. It might be applicable to all living amphibians, especially those where toe-clipping is not feasible, and could be successfully incorporated into monitoring or ecological studies to check for the spread of the chytrid fungus in frog populations. The scraping of preserved museum animals would allow collections to be quickly checked without apparent damage to the specimens.

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A New Underwater Trap for Catching Turtles

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Cylindrical, collapsible, baited hoop nets have been used to catch freshwater turtle for decades (Legler 1960; Plummer 1979). The basic design has been modified because of the availability of new materials (Feuer 1980), and hoop traps have been combined with a separate holding section to reduce turtle escapes (Kennett 1992). Iverson (1979) described a cheaper, baited, aquatic trap with the shape of a rectangular box made of chicken wire that was also combined with drift fences to catch turtles during terrestrial movements (Iverson 1991).

A common feature of traditional hoop traps is that they either require placement in shallow water to allow captured turtles to breath at sections of the trap that protrude into the air, or, if set in deep water, they must be checked frequently to prevent turtles

from drowning. This limits the trap's usefulness in catching large, highly aquatic turtles (for example *Elseya dentata* and *Erymnochelys madagascariensis*) that prefer deep water. To some degree this problem can be overcome by constructing tall chicken wire traps, but those traps cannot be easily collapsed and require a lot of space during transport.

Here I describe a collapsible trap with a rectangular frame and netting. Approximately 2.8 m of 1 m wide stretched netting with knotted or knotless 30 mm (stretched) mesh is required per trap. A rectangular 10 mm aluminum rod or tube frame of 80 x 60 cm forms the base. Two half-rectangle aluminum bars are hinged to the middle of the long sides of the base frame. These bars give stability to the two entry funnels when the trap is set (Fig. 1) and lie neatly on the frame when the trap is collapsed. Two strong cords are tightened to and stretch between the sides of each half-rectangle bar to form the entry slit of the funnel. The netting is stitched to the bottom frame and the funnel sections. Along the slit of the funnel the net is threaded to the cords that stretch between the sides of each bar. The two entries of the trap are thus formed by narrow, elastic slits of 60 cm length (Fig. 1). Netting is stitched from the base of the frame and the bars to form a cylindric section that extends upwards. The vertical cylindrical net section is tied shut on top with cord to close the trap and is untied when necessary to allow removal of turtles (Fig. 2). The material and construction cost per trap is US$ 40–50, which is higher than the cost of hoop nets or chicken wire traps because more netting and some welding is necessary.

Traps are transported in the collapsed state, and typically five to ten traps are strapped together or carried in a canvas bag. Traps are set and held open by stretching a cord along the mid-line between the two movable bars which holds the bars and the two entry funnels in place. If bait is used it is enclosed in wire mesh and/or fly-screen mesh and knotted to the centre of the stretch-cord (Fig. 1). The bait is suspended in the middle between the entry throats and touches neither the bottom nor the side netting. Because of the weight of the aluminum frame, traps sink underwater. Traps are set so that they rest on the bottom or touch slopes or tree trunks. The upper end of the vertical cylindrical net section is tied with a cord to a tree branch or a stake above the water surface to allow trapped turtles access to air for breathing. Plastic floats can be placed inside the net to ensure that its top always

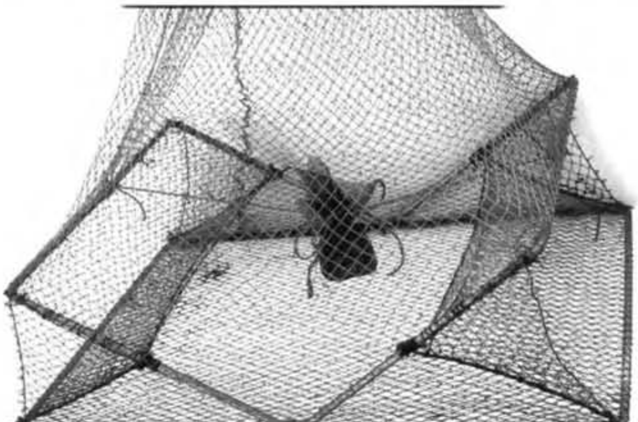

FIG. 1. Close up of frame section of erected turtle trap with bait.

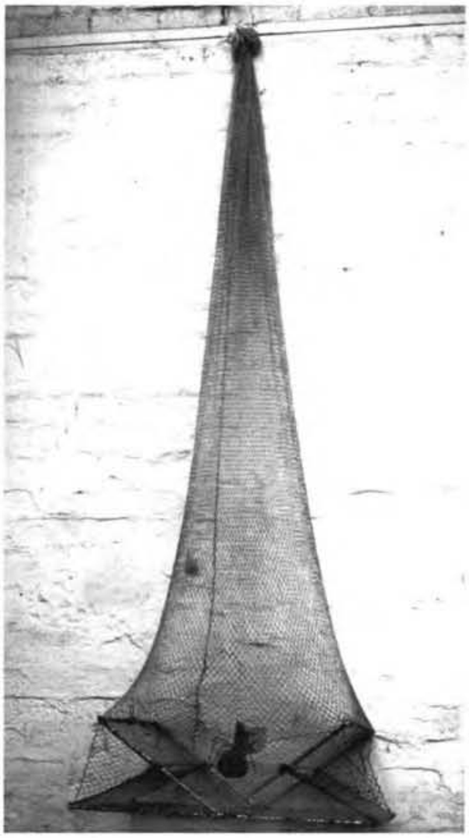

FIG. 2. Hanging turtle trap ready for positioning in deep water.

remains above the water surface. Because the upward reaching cylinder stretches when the trap is suspended (Fig. 2), traps can be set at a water depth of about 2 m and trapped turtles will still have access to air.

About 60 of these traps have been used in freshwater turtle field studies in Western Australia since 1994 and in Madagascar since 1996. Several thousand turtles of the genera *Chelodina*, *Elseya*, *Emydura*, *Erymnochelys*, *Pelomedusa*, *Pelusios*, and *Pseudemydura* have been caught. If traps hang in deep water, it is important to use stakes or submerged tree trunks to stabilize them. Once ten large turtles had entered one trap that was checked every 12 hours. The trap was quite congested with turtles, and their movements caused the vertical net to rotate and twist. Three of the ten turtles were trapped in the lower part of the net under the twisted section and were unable to reach the air. Although all turtles recovered and survived, the accident demonstrates the importance of securing the traps so that they cannot rotate and the vertical net compartment cannot be twisted. Small crocodiles (*Crocodylus niloticus*, *C. johnsoni*, < 1.2 m total length) sometimes entered the traps and in two instances a *C. johnsoni* entangled its long snout and teeth in the net and could not reach air. The crocodiles seemed at first drowned, but both recovered some minutes after removal from the traps.

Long-necked turtles of the genus *Chelodina* show high escape rates from conventional baited hoop nets without a separate holding section (Kennett 1992). When trapping medium-sized turtles such as *Chelodina*, I constrict the funnel slits in the middle with a piece of wire or string to tighten the entries further by creating two slits of 30 cm length rather than one of 60 cm. Theoretically, a holding compartment (Kennett 1992) could also be added to the trap described here.

The critically endangered Western Swamp turtle (*Pseudemydura umbrina*) in southwestern Australia does not enter baited traps (Burbidge 1981; pers. obs.). Terrestrial drift fences with pitfall traps around swamps were used to catch *P. umbrina* during the 1960s and 1970s (Burbidge 1981), but because of predation of trapped turtles in the pits by introduced foxes (*Vulpes vulpes*), drift fence trapping was discontinued in the early 1980s. Less than 50 wild individuals of *P. umbrina* survived into the 1990s, a situation requiring capture techniques that minimize risk to individuals. Since 1994 I combined the traps described here with drift fences (10 mm black plastic mesh) to catch *P. umbrina* in seasonal swamps. I use drift fences only in water, with traps joined to the drift fence by threading a metal stake through netting as well as fence mesh. With this set up, turtles entering traps remain in the water and are not subjected to desiccation, direct solar radiation, or predation. Because of the height of the net, the risk of drowning turtles when water levels suddenly rise due to flooding is eliminated. The traps worked best when the water was deep enough to cover the throat of the trap. Because the traps lie flush with the substrate and the bars can be positioned lower if necessary, the traps can be set in shallower water than most conventional traps. Vogt (1980) described the use of unbaited fyke nets with long leads as underwater "drift fences" to catch turtles. Fyke nets obviously are suitable to catch turtles in rivers, lakes, and ponds, but in shallow swamps with fluctuating water levels drift fences with the traps described here are more suitable. They are currently the only acceptable and successful trapping method for *P. umbrina*.

There are many advantages of the new trap design: When collapsed the traps are flat rectangles that can easily be stacked and bundled together. In contrast to hoop nets, stretchers or stiffeners in the form of wooden dowels or stakes with hooks are not necessary. The traps are easy to transport, even in small boats or when hiking over difficult terrain. Traps can be used with bait and positioned underwater shallowly or relatively deeply (about 2 m). They are particularly useful for trapping large, aquatic swimming and bottom-walking species that may be reluctant to enter shallow water. The narrow entry slit of the funnels is a less likely escape route for turtles than the round or elliptical openings of hoop traps. The traps are useful to trap hatchlings as well as large turtles. Finally, unbaited traps can be combined with drift fences in shallow water and under changing water levels.

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Quantitative Sampling of Stream Salamanders: Comparison of Dipnetting and Funnel Trapping Techniques

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In recent years, increased awareness of amphibian declines has resulted in widespread efforts to inventory and monitor amphibian populations, thus initiating the development of standardized and quantitative sampling techniques. Accepted sampling methods for aquatic adult and larval amphibians include dipnetting, seining, and funnel trapping (Heyer et al. 1994). Numerous types of funnel traps have been employed and include simple wire minnow or eel traps (Fronzuto and Verrell 1999), expensive, species-specific traps (Mushet et al. 1997), and traps made from plastic jugs or soda bottles (Calef et al. 1973; Griffiths 1985; Richter 1995; Smith and Rettig 1996). While funnel trapping has proven to be a valuable technique for amphibian sampling in many lentic habitats, it has seldom been applied to lotic ecosystems.

The most widely accepted method for sampling lotic habitats for amphibians is timed dipnetting (Shaffer et al. 1994). Dipnetting, while effective for sampling some amphibian species, is sometimes difficult to standardize because of variation in effort among investigators. Partly because of a lack of standardized sampling techniques, stream-dwelling amphibian populations have not been monitored as closely as those in other habitats (Heyer et al. 1994). Here, we describe an inexpensive and quantitative method for sampling stream-dwelling salamanders using funnel traps constructed from plastic soda bottles. This technique, employed in small streams in the western Piedmont of North Carolina, yielded a greater diversity of salamander species and life-stages than did dipnetting.

Funnel traps were constructed from 3.0 L, 2.0 L, 1.0 L, and 0.6 L plastic soda bottles as described by Griffiths (1985). A range of bottle sizes were used to trap various microhabitats within streams. Larger (3.0 L and 2.0 L) bottles were used in stream pools and other deep-water areas while smaller bottles allowed trapping in shallow water along stream edges and were especially effective in trapping undercut banks, along submerged logs, and other areas frequented by adult salamanders. To create each trap, the top of the bottle was cut off and inverted. Holes were punched, using a metal single-hole punch, through the top and bottom of the trap mouth and a bamboo garden stake was passed through the holes to hold the inverted bottle top in place. The trap was anchored horizontally to the streambed by pushing the stake into the substrate. Traps were set in water slightly shallower than the diameter of each bottle, resulting in a layer of air inside of each bottle.

To test the efficacy of funnel trapping in small streams, we trapped a total of eight streams located within 11 km of Davidson, North Carolina. Each stream was trapped for two, one-week sessions, once in mid-February and again in mid-April 2001. During

each trapping session, 12 traps were set approximately 1 m apart along the stream edge and in slow-current areas where leaves and debris had collected. Traps usually were set facing into the current and were not baited. Each set of 12 traps contained one 3.0 L, four 2.0 L, three 1.0 L, and four 0.6 L bottles to allow for trapping in a variety of depth and current velocity locations. Traps were checked every other day during each week-long trapping session, at which time all animals found in the traps were removed. No in-trap mortality was observed. After checking, traps were moved a short distance (< 1 m) to ensure thorough trapping of all microhabitats within the stream. All salamanders captured in traps were taken to the laboratory for the remainder of the one-week trapping session to avoid recaptures and were subsequently released.

We compared the effectiveness of funnel trapping to timed dipnetting, the method recommended by Shaffer et al. (1994) for sampling amphibian larvae in streams. Dipnetting was conducted for two 2-day periods during the trapping period (late February and mid-April). During these periods, each of the eight streams was netted for a period of 30 minutes per stream. Netting concentrated on areas of submerged leaves, rocks, logs, and other cover objects and was confined to underwater microhabitats (Shaffer et al. 1994).

Funnel trapping and timed dipnetting both yielded high numbers of salamanders; however, trapping yielded a greater diversity of species and life-stages than dipnetting (Fig. 1). Dipnetting produced high numbers of *Desmognathus fuscus* and *Eurycea cirrigera* but the vast majority (97%) were larvae. Funnel trapping also yielded high numbers of *D. fuscus* and *E. cirrigera*, but with a much larger percentage (27%) of adult salamanders (Fig. 1). In addition, we captured three *Pseudotriton ruber* larvae and five adult anurans, of three different species (*Rana clamitans, R. catesbeiana*, and *Pseudacris triseriata*), in funnel traps. Of these species, only *R. catesbeiana* also was detected by dipnetting.

We estimated the time required to construct, set, and check the funnel traps used in this study and compared it to the time re-

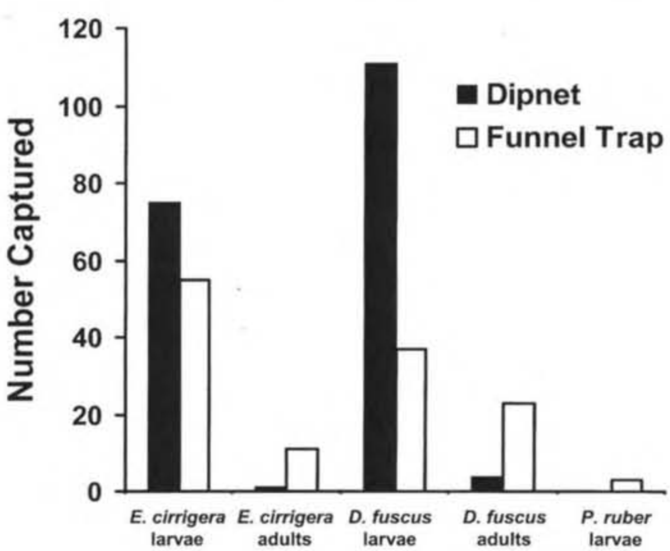

FIG. 1. Species and life-stage composition of salamanders captured by funnel trapping and by dipnetting. Note that while dipnetting yielded a greater total number of salamanders, funnel trapping captured many more adult salamanders. In addition, *Pseudotriton ruber* was detected only by funnel trapping.

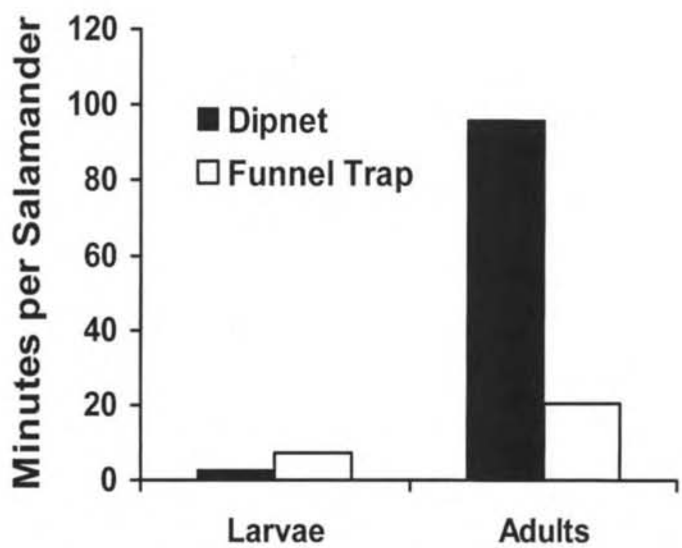

FIG. 2. Average time invested per salamander captured for funnel trapping and dipnetting. Note that while dipnetting captured more salamander larvae per unit of time, funnel trapping was much more efficient for capturing adult salamanders.

quired for dipnetting. Although time invested per salamander larva was lower for dipnetting, funnel trapping was much more efficient in capturing adult salamanders (Fig. 2). In addition, over the two-month study period, dipnetting only sampled each stream at two time points, while funnel trapping sampled each stream continuously over two week-long periods. This is important, considering that many amphibian species are only active at night or under specific climatic conditions (Peterson and Dorcas 1992). Finally, the cost of these funnel traps is negligible when compared to standard wire funnel traps, which generally sell for about US $10 each.

We demonstrate that utilizing funnel trapping in small streams in the western Piedmont of North Carolina yielded a greater diversity of amphibian species and much higher numbers of adult salamanders than dipnetting. Thus, this technique offers an inexpensive complement to traditional lotic sampling techniques in the surveying and monitoring of amphibian populations.

Acknowledgments.—We thank A. Tuscano and M. Seifert for conducting initial testing, landowners F. Bragg, P. Zimmerman, L. Davis, J. Tevepaugh, and the Runny Meade Equestrian Center for use of their property. J. Sealy, K. Grayson, and D. Stroupe provided useful advice on the manuscript. Funding was provided by the Department of Biology at Davidson College and a National Science Foundation grant (DUE - 9980743) to MED.

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Herpetological Review, 2003, 34(2), 130–132.

Reconstructing Thermochron iButtons to Reduce Size and Weight as a New Technique in the Study of Small Animal Thermal Biology

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Recent developments in small electronic temperature recorders designed for use in the food industry have the potential to revolutionize the collection of thermal data in small animals. Collecting temperature data in small reptiles is most often restricted to laboratory studies in thermal gradients (Greenberg 1976; Licht et al. 1966; Sievert and Hutchison 1991), by the use of physical models placed in the field (Hertz 1992; Porter et al. 1973), or by inserting a cloacal thermocouple/thermometer soon after capture in field studies (Avery 1982; Schwarzkopf and Shine 1991). Thermal gradients measure selected thermal preferences in an artificial environment, models estimate operative temperatures in the field, and cloacal thermocouple/thermometer measurements in field studies can only measure active individuals or those that take refuge in accessible areas. Each of the above techniques alone does not provide a true representation of the animal's "natural" or "field" thermal biology, particularly in periods of inactivity, hibernation or within inaccessible refugia.

With modification, the DS1921 Thermochron iButtons manufactured by Dallas Semiconductor (Texas, USA) (www.ibutton.com/ibuttons/thermochron.html), a small lightweight real time and temperature recording device, can be attached externally or implanted internally into small animals. The unmodified DS1921 Thermochron iButton weighs approximately 3.0 g, is 17 mm in diameter and 6 mm in thickness. By disassembling units and then reconstructing without the external stainless steel housing, the weight can be halved to approximately 1.5 g or less and the dimensions reduce to the size of the circuit board which is 14 mm in diameter and the thickness depends upon the new battery size.

The DS1921 Thermochron iButton integrates a thermometer, real time clock and memory for storing temperature readings. It accurately measures temperatures ± 1°C from as low as –20°C to +85°C in 0.5°C increments. Temperature readings are available in two formats which run concurrently 1) time vs. temperature mode that records temperature and date-stamps when it occurred, 2) histogram mode that measures the frequency of temperature in 2°C increments rather than specific times of occurrence. The DS1921 Thermochron iButton can log up to 2048 consecutive temperature readings in read-only memory, after which readings can be either stopped or enabled to roll over. The histogram mode has 63 bins of memory set at 2°C intervals, and each bin can store 65,000 readings (Greaves 1999). The DS1921 Thermocron iButton's can be launched and downloaded with the use of a reader (Blue Dot Receptor®) connected to an existing PC computer with free software downloaded from Dallas Semiconductor (available at www.iButton.com). Recordings are made at user defined time and rates, with a maximum start delay of 45 days and recording rate ranging from 1 every minute to one every 255 minutes. The life expectancy of the DS1921 Thermochron iButton is more than 10 years or greater than 1 million samples, whichever occurs first (Greaves 1999). To date, our reconstruction of the DS1921

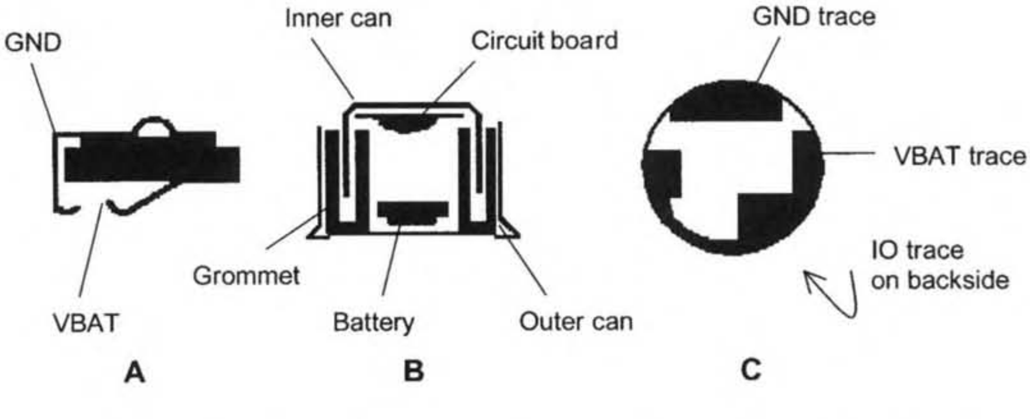

FIG. 1. Construction of the DS1921 Thermochron iButton, (A) Battery (B) Complete unit (C) Circuit board. See text for explanation of components.

Thermochron iButton has not altered the performance or the life expectancy and not a single unit has failed.

Construction of the DS1921 Thermochron iButton.—The DS1921 Thermochron iButton is constructed (Fig. 1) of two stainless steel cups that make up the housing separated by a plastic grommet. The plastic grommet isolates the IO (data) and GND (ground) sections of the circuit board externally and the VBAT (power) and GND connections internally. Springs are welded to the positive and negative terminals of the battery. It is important that the positive and negative terminals do not touch or the battery will short out causing rapid battery drain. The battery "snaps" into the plastic grommet. The circuit board is positioned in the bottom of the inner housing with the crystal facing up. The semicircle trace on the front side of the circuit board is VBAT. The other large trace is GND, corresponding to the springs on the battery. The back of the circuit board is one large IO trace, which makes contact with the bottom of the inner housing. The grommet and battery slides on top of the inner housing with the VBAT and GND terminals aligned. This combination then slides into the outer housing and the GND battery spring makes contact to the outer housing. The outer housing is crimped over the grommet and inner housing, holding the construction together.

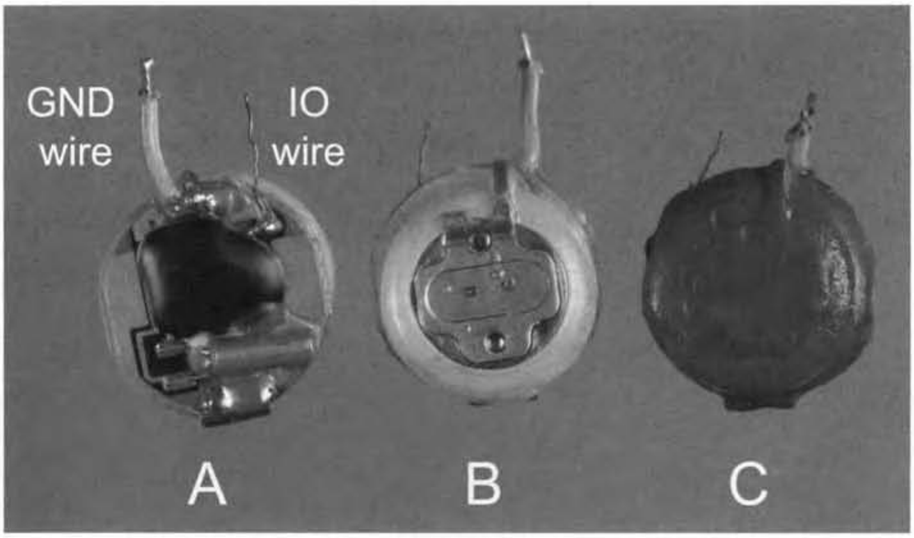

FIG. 2. Reconstructing the DS1921 Thermochron iButton without housing (A) Circuit board soldered to battery with rigid exposed wires attached (B) Insulated battery soldered to circuit board viewed from above (C) Modified unit complete and coated in red Plastidip®.

De-housing of the DS1921 Thermochron iButton.—To reduce the size and weight of the DS1921 Thermochron iButton for use on small animals the iButton can be opened to remove the internal components and reconstructed without the stainless steel housing that accounts for a large proportion of the weight. A vise should be used to hold the DS1921 Thermochron iButton and a small tooth hacksaw (32 teeth/inch) can be used to make vertical cuts through the outer housing in 3 or 4 evenly spaced cuts around the housing. By using a pair of needle nosed pliers, the outer housing can be pulled away from the inner, not unlike pealing a banana.

Reconstruction of the DS1921 iButton without the housing.—Outside of the housing the circuit board should be soldered to the battery (Fig. 2). To avoid damage to the battery it is best to use new batteries with solder tabs attached which are available upon request from most major battery suppliers. The DS1921 uses a 3 Volt lithium BR1225 battery; a smaller battery such as BR1216 or CR1025, can be substituted, but they have a shorter lifetime. The bottom tab is VBAT and the tab that comes over the top of the battery is GND. If the battery is not insulated, a piece of plastic tape should be used to prevent the GND tab touching the side of the battery which would cause the battery to short. It is important to line the tabs up with the traces on the circuit board and solder them.

To attach the unit to the reader (Blue Dot Receptor®) a rigid wire needs to be soldered to the IO trace and another to the GND trace on the reconstructed unit (Fig. 2). One wire should be thicker in diameter or color coded for easy identification when attaching to the reader. These two wires provide exposed leads for attachment to the reader (Fig. 3). The wire attached to the IO trace connects to the inner contact on the reader and the wire attached to the GND trace connects to the outer contact on the reader. To connect the unit to the reader, one end of a wire needs to be coiled around the inner contact of the reader and the other end with a small alligator

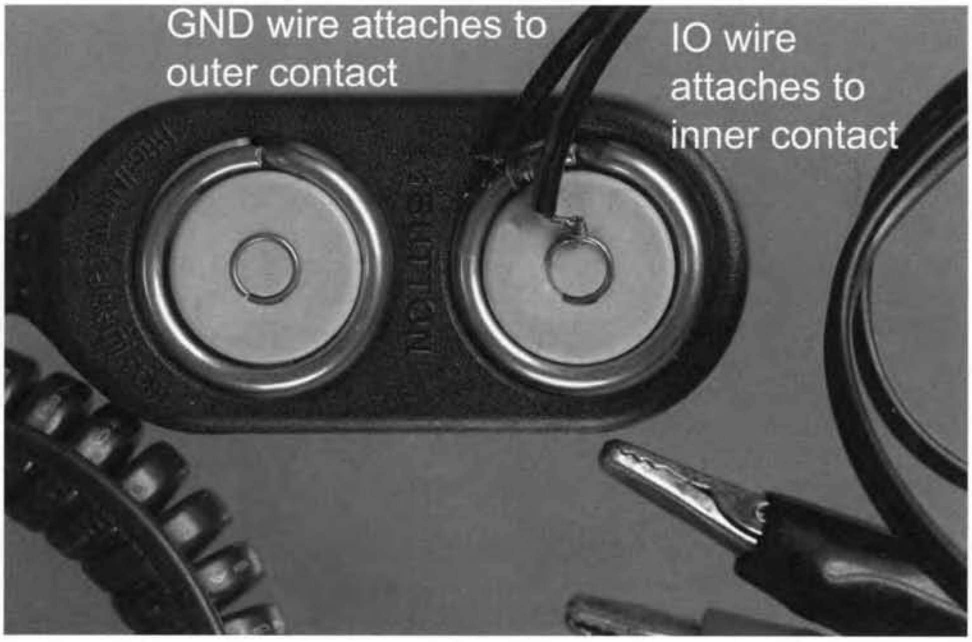

FIG. 3. Reader (Blue Dot Receptor®) showing wires coiled around contact points that then attach to exposed leads on the modified units via alligator clips.

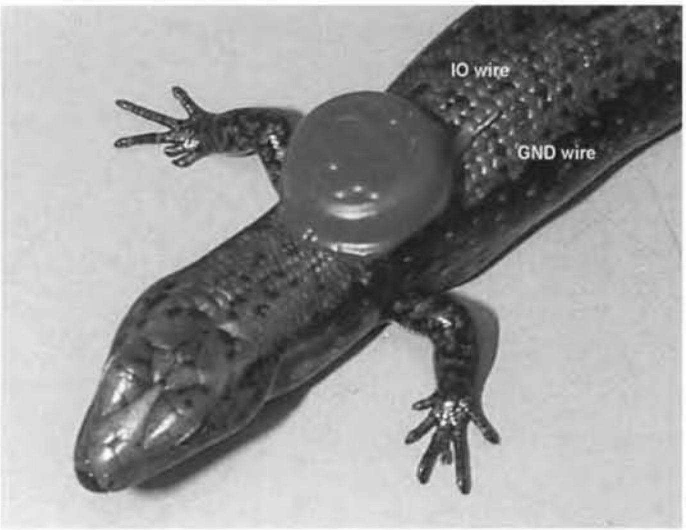

FIG. 4. A female *Eulamprus tympanum* fitted with a modified Thermochron iButton.

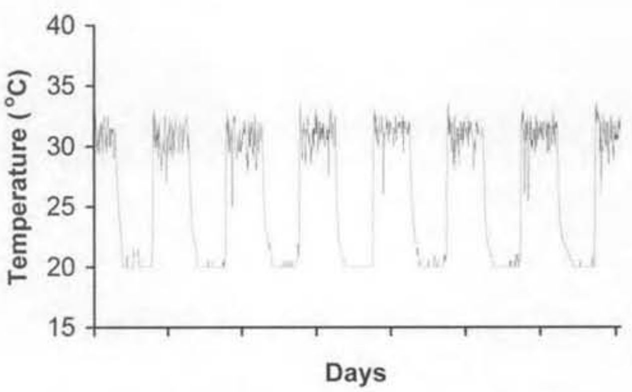

FIG. 5. Thermal profile of a captive female *Eulamprus tympanum* over one-week at a 5-minute sample rate.

clip can then be attached to the exposed IO wire on the unit. Another wire should be coiled around the outer contact of the reader with the opposite end attached to the exposed GND wire on the unit also with a small alligator clip (Fig. 3). After testing the soldered unit, it should be sealed to ensure it is watertight with Plastidip™ (Minnesota, USA) (www.PLASTIDIP.com) with the exposed ends of the IO and GND wires emerging from the Plastidip™ (Fig. 2).

We tested the modified unit on six gravid female *Eulamprus tympanum* over several weeks in laboratory enclosures. Lizards were housed individually in 620 x 400 mm enclosures with 20–30 mm depth of soil, flat rocks and leaf litter for shelter. Lizards were provided with heat from 100 W incandescent bulbs at one end of their enclosure to allow them to thermoregulate. Enclosures provided a thermal gradient of 20 to 40 ± 1°C during daylight hours and 20 ± 1° C during the night. The modified units where attached to the backs of lizards with Super Glue™ (cyanoacrylic glue) behind the head, between the shoulder blades (Fig. 4) and gave continuous measurements of temperature at 5-minute. intervals (Fig. 5). Measurements can be downloaded and units can be re-launched while the unit remains attached to the animal. The unit will detach from reptiles upon shedding or acetone can be applied to the site of attachment to remove the unit prior to shedding.

Acknowledgments.—I thank Patrick Evans from iButton support, Joerg Suckau and Basil Panayotakos from the School of Biological Sciences workshop for technical advice. Lizards were collected under scientific licence from the New South Wales National Parks and Wildlife Service (B2082) and research was approved by the University of Sydney Animal Care and Ethics Committee (L04/10-98/1/2855). The project was supported in part by an ARC Large Grant to M. B. Thompson and by an Ethel Mary Read Research Grant from the Zoological Society of New South Wales to K. A. Robert.

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NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 34, Number 1 (March 2003).

CAUDATA

AMBYSTOMA TIGRINUM **(Tiger Salamander). PREDATION.** Although a wide variety of birds have been documented or implicated as predators of *Ambystoma tigrinum* (Lannoo and Phillips, *in press*. *In* M. J. Lannoo [ed.], Status and Conservation of U.S. Amphibians. Univ. California Press, Berkeley), most of the species target aquatic larval forms. On 19 June 2001 in Taylor County, Georgia, USA, I encountered a cache of numerous animals impaled on a barbed-wire fence by loggerhead shrikes (*Lanius ludovicianus*). Herpetofauna found among the cache included several adult *Hyla squirella* and *H. cinerea*, and one post-metamorphic *A. tigrinum*. Although amphibians have been reported in the diet of loggerhead shrikes (Yosef and Grubb 1993. Condor 95:127–131), I believe this is the first reported observation of loggerhead shrikes predating a salamander.

GEOGRAPHIC DISTRIBUTION

Herpetological Review, 2003, 34(1), 76–77.

New Records and Natural History Notes for Amphibians and Reptiles from Southern Morocco

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In an historical context, Morocco has been suitably explored with herpetological expeditions dating back to Gervais (1835). The distribution of amphibians and reptiles in Morocco is thoroughly outlined in the herpetofaunal atlas by Bons and Geniez (1996); this atlas is used as a primary reference in this paper. The following is a composite of significant findings from five months of data gathered in southern Morocco during the periods of May–July 1985, October 1999, and September–October 2000. Such has resulted in notable range extensions for six species of lizards and three species of snakes and several novel comments on natural history. Voucher specimens were deposited in the Zoologisches Forschungsinstitut und Museum Alexander Koenig (ZFMK), Bonn, or the Hessisches Landesmuseum (HLMD), Darmstadt, Germany. Localities were determined by the use of a handheld Garmin© global positioning system (GPS) device or by the use of maps. Specimen identification relative to range extensions were confirmed by Wolfgang Böhme, Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn.

Anura

Bufo brongersmai – Tafraoute, 29°43.30'N, 8°58.76'W, 11 October 1999. At ca. 2100 h hundreds of animals were encountered in the flat-packed sand basin between the rocky hills adjacent to the town. The toads were active and orienting apparently at random, along with equally abundant *Bufo viridis* and numerous *Bufo mauritanicus*. This was after the second day of heavy rain following what locals reported as a two-year drought. No amplectant pairs were observed. No standing water was encountered. In Tafraoute on 18 June 1985, during the dry summer period, only one toad was found. It was located at night under plants which were routinely watered and was within the town limits. On 9 and 10 October 2000, two nights of searching at the Tafraoute locality revealed no toads. This was also during an extended dry period. This illustrates the periodic abundance of this reportedly rare toad species (Bons and Geniez 1996).

Lacertilia

Stenodactylus petrii – Oued Tissinnt, ca. 5 km E of Mrhimina, 29°49.14'N, 7° 08.18'W, 5 October 2000. This area is characterized by low-lying sand dunes interspersed with lava flows and large lava boulders. Two specimens were collected while searching the Oued Tissinnt dunes at night (ZFMK 73504: SVL 50 mm, TL 97 mm; ZFMK 73505: SVL 38 mm, TL 72 mm). This find extends the range of this species by ca. 100 km to the west and is the first reported locality away from major sand dunes. Dry riverbed routes may be used by this psamnophilous species as dispersal pathways.

Stenodactylus sthenodactylus – Tendrara, ca. 9 km N of the town, 33°05.05'N, 1°59.27'W, 4 October 1999. This male specimen (ZFMK SA2001:1) was found during the day, in a flat, hard-packed sand desert, under a rock. This find extends the eastern range of this species by ca. 50 km in Morocco, thus bringing it to the Algerian border.

Ptyodactylus oudrii – Oued Tissinnt, ca. 5 km E of Mrhimina, 29°49.14'N, 7°08.18'W, 5 October 2000. This gecko is cited in the literature as a dweller of steep and smooth rocks, boulders, and cliffs (Bons and Geniez 1996; Schleich et al. 1996). Here we report the use of a tree as a habitat for this species. A night search revealed two specimens ca. 1.6 m above ground in an *Acacia* tree. Ants, which are a prey item of this species, were also active on the tree at this time. The immediate surrounding habit was low-lying sand dunes with occasional volcanic rocks. In the distance, larger rock formations could be found.

Tarentola hoggarensis – Oued Drâa, ca. 20 km S of Âouïnet-Torkoz, 28°29.00'N, 9°51.17'W, 4 October 2000. This species has a lengthy and involved history of taxonomic revision (Schleich et al. 1996). Due to recent findings within the *Tarentola ephippiata* group, the taxon should be elevated from subspecific status of *Tarentola ephippiata hoggarensis* to full species rank (Böhme et al. 2001; Böhme, pers. comm.). This Oued Drâa specimen (ZFMK 73503) was found by torchlight at night on an *Acacia* tree trunk. This find represents the third discovery of this species in Morocco and is ca. 50 km east of a previously documented locality (Bons and Geniez 1996).

Lacerta andreanszkyi – Imlil, ca. 5 km NE of town, 5 July 1985. The discovery of this specimen (ZFMK 44116) at an alpine meadow at ca. 2400 m elevation confirms its presence in a questionable locality as listed in Bons and Geniez (1996).

Acanthodactylus boskianus – Taroudant, ca. 3 km S of town, 25 May 1985. This species is known to be an inhabitant of dry environments (Bons and Geniez 1996; Schleich et al. 1996). The discovery of this specimen (ZFMK 44079) resting underneath some small bushes marks its first known occurrence in a relatively moist habitat, the Souss River Valley. This report contrasts the findings of Bons and Geniez (1996) whereby they state that *A. boskianus* is absent from the western parts of Morocco, as the Anti Atlas appears to constitute an insurmountable barrier. This finding shows the species to have crossed the Anti Atlas, although the westernmost portion of the Haut Atlas lies due north as a border of this locality. This find is ca. 80 km from the nearest documented locality, though more significantly, it places the species for the first time on the north side of a significantly high mountain range.

Mesalina olivieri – Oued Torkoz – Oued Drâa confluence, 28°29.00'N, 9°51.17'W, 3 October 2000. The discovery of these specimens (ZFMK 73511–512) confirms a suspected locality (Bons and Geniez 1996) in the Oued Drâa. This population is ca. 120 km from the closest confirmed population. Some authors (e.g., Le Berre 1989) regard *Mesalina pasteuri* (Bons 1960) and *olivieri*, both taxa are reported from Southern Morocco (Bons and Geniez 1996),

as conspecific.

Eumeces algieriensis – Tafraoute, 20°43.30'N, 8°58.76'W, 22 September 2000. The diet of this large endemic Mograbin skink consists of invertebrates (Schleich et al. 1996). After hand capture, our specimen regurgitated a gecko which, although partially digested, could be identified as a *Tarentola mauretanica*.

Serpentes

Leptotyphlops macrorhynchus – Amtoudi (Id-Âïssa), 29°13.66'N, 9°13.24'W, 11 June 1985. This specimen (ZFMK 44098) was found in an area lacking vegetation within this oasis village. Though suspected to be a wideranging species in Morocco, secrecy and subterranean habits have surely restricted this species from being routinely encountered and is thus far listed from but ten localities. This discovery in the southern Anti Atlas foothills represents a distance of ca. 80 km from the closest documented record.

Macropodon cucullatus – Plage Blanche, 28°57.73'N, 10°32.89'W, 28 September 2000. According to Bons and Geniez (1996), M. cucullatus is represented by three subspecies in Morocco. The Plage Blanche specimen (ZFMK SA2001:2) keys out to the subspecies *brevis* according to head coloration (Schleich et al. 1996; Wade 1988). Our specimen falls within a ca. 160 km gap between the ranges of the subspecies *cucullatus* and *brevis*.

Bitis arietans – Plage Blanche, 28°57.73'N, 10°32.89'W, 117 m elevation, 28 September 2000. A ca. 90 cm adult female gave birth two days after capture to eight live and two dead neonates. This is a very small litter size as this species is known to commonly have litters of 20–30 with litters of up to 50–60 not being rare (Schleich et al. 1996). *Bitis arietans* from southern Morocco, however, are known to be much smaller in size than their tropical conspecifics.

Echis leucogaster – Oued Torkoz–Oued Drâa confluence, 28°22.00'N, 9°50.00W', 120 m elevation, 19 October 1999. This is one of the rarest of Moroccan snakes (Bons and Geniez 1996), and although known from the Oued Drâa, ours is only the fifth Moroccan specimen (Herrmann and Herrmann 2000). Adult female (SVL 41 cm, TL 44.5 cm) (HLMD RA2888) was found dead, killed by bedouins, and hanging in a bush.

Acknowledgments.—We thank the Philipps University, Marburg, student participants in the 2000 Moroccan Desert Ecology excursion for their participation and companionship. W. Böhme verified some of our species identifications and provided discussion on the taxonomic status of Tarentola hoggarensis. We thank our Moroccan field assistants, especially Blell with his extraordinary knowledge of the herpetofauna of southern Morocco.

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The Distribution of *Nerodia erythrogaster* in the Lower Cumberland River Basin of Kentucky and Tennessee

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Scott and Snyder (1968) reported the plain-bellied watersnake (*Nerodia erythrogaster*) from the lower Cumberland River basin (LCRB) based on specimens they collected from Montgomery Co., Tennessee, USA. This population has been shown as disjunct from the remainder of the species' geographic range (Conant and Collins 1998). Scott and Snyder (1968) described their Montgomery Co., Tennessee specimens as having the copper-bellied watersnake (*N. e. neglecta*) phenotype. Conant and Collins (1998) depict the Montgomery Co., Tennessee population as *N. e. neglecta*, even though they show the yellow-bellied watersnake (*N. e. flavigaster*) occurring further down the LCRB. McCranie (1990) mapped *N. erythrogaster* from this region as *N. e. flavigaster* x *N. e. neglecta* intergrades with a continuous distribution throughout the LCRB terminating in Montgomery Co., Tennessee, near Clarksville.

Our collecting efforts, from August 1996 to June 1999, resulted in several new voucher specimens of *N. erythrogaster* from the area within and around the distributional hiatus shown in the LCRB by Conant and Collins (1998). Cheatham Co., Tennessee, specimen APSU 4316 was collected prior to this work, but is included here to document the easternmost point of this species' distribution in the LCRB. Following are the museum numbers and latitude/longitude coordinates for the new voucher specimens, all of which were verified by David H. Snyder and deposited in Austin Peay State University's Museum of Zoology (APSU). Stewart Co., Tennessee. – APSU 5459 (36°25'48"N, 87°42'05"W), 5462 (36°32'26"N, 87°53'08"W), 5465 (36°24'31"N, 87°36'44"W), 5497 (36°24'40"N, 87°36'16"W), 5498 (36°31'14"N, 87°52'53"W). Montgomery Co., Tennessee. - APSU 5457 (36°23'37"N, 87°17'18"W), 5463 (36°29'23"N, 87°27'20"W), 5481 (offspring of APSU 5463), 5488 (1–8, offspring of APSU 5463), 5491 (1–4, offspring of APSU 5463), 5492–96 (offspring of APSU 5463), 5499 (36°25'42"N, 85°37'12"W), 5977 (36°27'15"N, 87°22'31"W), 6013–14 (36°27'00"N, 87°29'25"W). Cheatham Co., Tennessee. – APSU 4316 (36°17'35"N,

87°05'57"W), 5967 (36°17'28"N, 87°,05'58"W).

Nerodia erythrogaster occurs throughout the LCRB, from Barkley Dam in northern Land Between the Lakes (LBL, Lyon Co., Kentucky) upstream to just below Ashland City, Cheatham Co., Tennessee (Bufalino 1999). The region downstream of Barkley Dam to the confluence of the Cumberland and Ohio Rivers (Smithland, Livingston Co., Kentucky) lacks voucher specimens (Bufalino 1999). *Nerodia erythrogaster* from northern LBL (Lyon Co. and Trigg Co., Kentucky) express an intermediate phenotype, whereas specimens from southern LBL (Stewart Co., Tennessee) upstream throughout the remainder of the LCRB to Ashland City (Cheatham Co., Tennessee), express the *N. e. neglecta* phenotype (Bufalino 1999).

Acknowledgments.—We thank Edward Burchett for allowing us to collect specimens from his property and Jim Wiggington for granting us unrestricted access to Cross Creeks National Wildlife Refuge. Specimens were collected under authorization of the Tennessee Wildlife Resources Agency (permit no. 1112). Austin Peay State University's Center of Excellence in Field Biology supported this research.

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New Herpetofaunal County Records for Georgia

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Publication of *Distribution of Amphibians and Reptiles in Georgia* (Williamson and Moulis 1994) provided the basis for further study of the county by county distribution of the state's herpetofauna. Additions have been reported, mostly as accounts published in the geographic distribution section of *Herpetological Review*. The majority are from the ongoing Georgia Herp Atlas under the auspices of the Georgia Department of Natural Resources Nongame-Endangered Wildlife Program.

The following new voucher specimens are amphibians and reptiles mostly collected DOR (dead on road) from 1975 to 1999. Photograph vouchers are of live animals that were captured, photographed, and released at the place of capture. Voucher specimens have been verified by Lawrence A. Wilson and are deposited in the collection of the Fernbank Science Center, Atlanta, Georgia. For succinctness and accuracy the sites are reported as longitude and latitude acquired by GPS and/or appropriate U.S. Geological Survey topographical maps.

Caudata

Ambystoma maculatum. CHEROKEE Co: 34°14'40"N, 84°36'50"W. 6 March 1989. M. Rubio and G. Greer. FSC 98.90.155. CARROLL Co: 33°33'26"N, 84°53'8"W. 27 February 1996. M. Rubio and G. Greer. FSC 98.90.156.

Ambystoma opacum. DOUGLAS Co: 33°41'24"N, 84°53'34"W. 27 February 1997. M. Rubio and G. Greer. FSC 01.6.08 Photo.

Ambystoma talpoideum. CARROLL Co: 33°40'7"N, 84°57'53"W. 26 March 1993. M. Rubio and G. Greer. FSC 98.90.157. CHEROKEE Co: 34°18'49"N, 84°26'1"W. 5 March 1989. M. Rubio and G. Greer. FSC 98.90.420.

Eurycea guttolineata. PAULDING Co: 33°52'54"N, 85°2'6"W. 9 June 1992. M. Rubio and G. Greer. FSC 98.90.113.

Hemidactylium scutatum. CHEROKEE Co: 34°15'3"N, 84°41'3"W. 14 January 1992. M. Rubio and G. Greer. FSC 01.6.01 Photo. HARALSON Co: 33°44'58"N, 85°7'17"W. 9 June 1992. M. Rubio and G. Greer. FSC 01.6.09 Photo. PAULDING Co: 33°56'3"N, 84°56'40"W. 22 February 1994. M. Rubio and G. Greer. FSC 98.90.47.

Plethodon glutinosus. PAULDING Co: 33°56'47"N, 84°54'41"W. 22 February 1994. M. Rubio and G. Greer. FSC 98.90.94.

Plethodon serratus. BARTOW Co: 34°23'29"N, 84°39'34"W. 16 February 1991. M. Rubio and G. Greer. FSC 98.90.97. CARROLL Co: 33°33'33"N, 84°54'50"W. 27 February 1987. M. Rubio and G. Greer. FSC 98.90.260. CHEROKEE Co: 34°20'40"N, 84°38'21"W. 5 March 1989. M. Rubio and G. Greer. FSC 98.90.139. COWETA Co: 33°27'25"N, 84°52'35"W. 27 February 1997. M. Rubio and G. Greer. FSC 98.90.262.

Pseudotriton ruber ruber. BARTOW Co: 34°20'44"N, 84°42'34"W. 3 May 1989. M. Rubio and G. Greer. FSC 98.90.131. CHEROKEE Co: 34°14'58"N, 84°36'28"W. 6 March 1989. M. Rubio and G. Greer. FSC 98.90.81. PAULDING Co: 33°58'39" 84°52'44"W. 22 February 1994. M. Rubio and G. Greer. FSC 98.90.458.

Notophthalmus viridescens viridescens. GORDON Co: 34°34'5"N, 84°46'2"W. 31 December 1989. M. Rubio and G. Greer. FSC 98.90.173.

Anura

Acris crepitans crepitans. WALTON Co: 33°44'49"N, 83°43'50"W. 26 June 1992. M. Rubio and G. Greer. FSC 98.90.192.

Hyla chrysoscelis. CARROLL Co: 33°47'0.8"N, 85°1'20"W. 9 June 1992. M. Rubio and G. Greer. FSC 98.90.147. COWETA

Co: 33°22'5"N, 84°55'11"W. 14 August 1998. M. Rubio and R. T. Bryant. FSC 98.90.496. HEARD Co: 33°21'21"N, 85°0'6"W. 14 August 1998. M. Rubio and R. T. Bryant. FSC 98.90.488. MURRAY Co: 34°42'12"N, 84°42'41"W. 22 July 1989. M. Rubio and G. Greer. FSC 98.90.319. PAULDING Co: 33°53'44"N, 85°1'53"W. 9 June 1992. M. Rubio and G. Greer. FSC 98.90.158. POLK Co: 33°58'55"N, 85°8'18"W. 24 July 1998. M. Rubio and R. T. Bryant. FSC 98.90.364.

Hyla cinerea. COWETA Co: 33°19'12"N, 84°54'27"W. 14 August 1998. M. Rubio and R. T. Bryant. FSC 98.90.497. DOUGLAS Co: 33°35'12"N, 84°51'55"W. 27 February 1997. M. Rubio and G. Greer. FSC 01.6.06 Photo. HEARD Co: 33°22'7"N, 85°0'56"W. 14 August 1998. M. Rubio and R. T. Bryant. FSC 98.90.491. PAULDING Co: 33°46'4"N, 85°2'33"W. 9 June 1992. M. Rubio and G. Greer. FSC 98.90.189. ROCKDALE Co: 33°43'28"N, 84°0'40"W. 29 June 1992. M. Rubio and G. Greer. FSC 98.90.179.

Pseudacris brachyphona. CHEROKEE Co: 34°15'24"N, 84°41'34"W. 14 January 1992. M. Rubio and R. T. Bryant. FSC 98.90.460. PAULDING Co: 33°56'10"N, 84°56'32"W. 22 February 1994. M. Rubio and G. Greer. FSC 98.90.459. Southernmost record for Georgia; ca. 30 km SSW of previous Cherokee Co. record.

Pseudacris crucifer crucifer. BARTOW Co: 34°20'40"N, 84°42'34"W. 5 March 1989. M. Rubio and G. Greer. FSC 98.90.28. DOUGLAS Co: 33°36'3"N, 84°49'24"W. 15 February 1991. M. Rubio. FSC 98.90.438. HEARD Co: 33°22'6"N, 85°1'20"W. 14 August 1998. M. Rubio and R. T. Bryant. FSC 98.90.492. PAULDING Co: 33°54'48"N, 85°1'18"W. 9 June 1992. M. Rubio and G. Greer. FSC 98.90.159.

Pseudacris feriarum. DOUGLAS Co: 33°39'53"N, 84°53'32"W. 27 February 1997. M. Rubio and G. Greer. FSC 98.90.53 and FSC 98.90.284.

Rana catesbeiana. CHEROKEE Co: 34°23'28"N, 84°36'37"W. 25 May 1989. M. Rubio and G. Greer. FSC 98.90.326. PAULDING Co: 33°53'7"N, 85°1'58"W. 9 June 1992. M. Rubio and G. Greer. FSC 98.90.202. WALTON Co: 33°44'39"N, 83°43'52"W. 26 June 1992. M. Rubio and G. Greer. FSC 98.90.210.

Rana clamitans clamitans x *melanota.* PAULDING Co: 33°48'50"N, 85°1'5"W. 9 June 1992. M. Rubio and G. Greer. FSC 98.90.143. POLK Co: 33°54'54"N, 85°91'41"W. 22 July 1998. M. Rubio and R. T. Bryant. FSC 98.90.351. GORDON Co: 34°30'29"N, 84°46'25"W. 21 July 1989. M. Rubio and G. Greer. FSC 98.90.328. HARALSON Co: 33°44'58"N, 85°7'17"W. 9 June 1992. M. Rubio and G. Greer. FSC 98.90.465–467. PICKENS Co: 34°26'22"N, 84°34'60"W. 30 August 1989. M. Rubio and G. Greer. FSC 98.90.58–59.

Rana palustris. BARTOW Co: 34°19'21"N, 84°45'41"W. 9 May 1989. M. Rubio and G. Greer. FSC 98.90.320. CHEROKEE Co: 34°20'54"N, 84°36'15"W. 5 March 1989. M. Rubio and G. Greer. FSC 98.90.117. PAULDING Co: 33°55'10"N, 85°0'17"W. 9 June 1992. M. Rubio and G. Greer. FSC 98.90.127. PICKENS Co: 34°26'55"N, 84°34'23"W. 30 August 1989. M. Rubio and G. Greer. FSC 98.90.322. POLK Co: 33°59'53"N, 85°5'39"W. 22 July 1998. M. Rubio and R. T. Bryant. FSC 98.90.36.

Rana sphenocephala. COWETA Co: 33°19'27"N, 84°53'7"W. 14 August 1998. M. Rubio and R. T. Bryant. FSC 98.90.499. HARALSON Co: 33°44'58"N, 85°7'17"W. 9 June 1992. M. Rubio and G. Greer. FSC 98.90.468. PAULDING Co: 33°58'39"N, 84°52'35"W. 22 February 1994. M. Rubio and G. Greer. FSC 98.90.19. PICKENS Co: 34°25'23"N, 84°33'21"W. 4 June 1989. M. Rubio and G. Greer. FSC 98.90.335. POLK Co: 33°58'0"N, 85°19'7"W. 24 July 1998. M. Rubio and R. T. Bryant. FSC 01.6.10 photo.

Rana sylvatica. CHEROKEE Co: 34°15'44"N, 84°42'13"W. 14 January 1992. M. Rubio and G. Greer. FSC 98.90.451. Southernmost specimen recorded in Georgia, ca. 18 km S of nearest record (Williamson and Moulis 1994). 34°16'56"N, 84°33'49"W. 5 March 1989. M. Rubio and G. Greer. FSC 98.90.138.

Gastrophryne carolinensis. COWETA Co: 33°22'51"N, 84°59'12"W. 14 August 1998. M. Rubio and R. T. Bryant. FSC 98.90.504. PAULDING Co: 33°53'33"N, 85°1'51"W. 9 June 1992. M. Rubio and G. Greer. FSC 98.90.197. PICKENS Co: 34°26'41"N, 84°34'42"W. 30 August 1989. M. Rubio and G. Greer. FSC 98.90.306. POLK Co: 33°59'29"N, 85°7'25"W. 24 July 1998. M. Rubio and R. T. Bryant. FSC 98.90.347. WALTON Co: 33°44'58"N, 83°43'53"W. 26 June 1992. M. Rubio and G. Greer. FSC 98.90.180.

Scaphiopus holbrookii holbrookii. BARTOW Co: 34°8'42"N, 84°46'15"W. 5 March 1989. M. Rubio and G. Greer. FSC 98.90.355. CHEROKEE Co: 34°23'27"N, 84°35'53"W. 7 June 1992. M. Rubio and G. Greer. FSC 98.90.21. FULTON Co: 33°35'30"N, 84°42'40"W. 22 June 1990. M. Rubio and G. Greer. FSC 98.90.211. MURRAY Co: 34°28'60"N, 84°46'55"W. 21 July 1989. M. Rubio and G. Greer. FSC 98.90.304.

Bufo americanus americanus. BARTOW Co: 34°12'53"N, 84°42'3"W. 6 March 1989. M. Rubio and G. Greer. FSC 01.6.05 photo. FULTON Co: 33°34'31"N, 84°47'51"W. 1 September 1989. M. Rubio and G. Greer. FSC 98.90.50. PAULDING Co: 34°1'5"N, 84°51'26"W. 17 May 1991. M. Rubio and G. Greer. FSC 98.90.98. GORDON Co: 34°29'39"N, 84°47'26"W. 21 July 1989. M. Rubio and G. Greer. FSC 98.90.39. HARRALSON Co: 33°51'34"N, 85°4'40"W. 7 March 1995. M. Rubio and G. Greer. FSC 98.90.206.

Bufo fowleri. HARALSON Co: 33°46'55"N, 35°3'31"W. 9 June 1992. M. Rubio and R. T Bryant. FSC 98.90.149. PAULDING Co: 34°2'14"N, 84°51'43"W. 17 May 1991. M. Rubio and G. Greer. FSC 98.90.77.

Testudines

Trachemys scripta scripta. BARTOW Co: 34°17'35"N, 84°44'25"W. 14 June 1991. M. Rubio and G. Greer. FSC 98.90.103.

Lacertilia

Eumeces inexpectatus. DEKALB Co: 33°42'41"N, 84°10'30"W. 23 May 1975. M. Rubio. FSC 98.90.430.

Eumeces laticeps. NEWTON Co: 33°30'17"N, 83°57'38"W. 18 August 1995. M. Rubio. FSC 98.90.428.

Scincella lateralis. FORSYTH Co: 34°8'57"N, 84°10'46"W. 22 July 1992. M. Rubio. FSC 98.90.431.

Sceloporus undulatus undulatus. BARTOW Co: 34°20'48"N, 84°39'37"W. 22 June 1989. M. Rubio. FSC 98.90.1.

Ophisaurus attenuatus. DOUGLAS Co: 33°34'45"N, 84°48'37"W. 7 June 1987. M. Rubio. FSC 01.6.04 photo.

Serpentes

Cemophora coccinea copei. BARTOW Co: 34°15'18"N, 84°41'31"W. 7 June 1992. M. Rubio and G. Greer. FSC 98.90.230. GORDON Co: 34°35'20"N, 84°46'4"W. 25 August 1989. M. Rubio and G. Greer. FSC 98.90.375. POLK Co: 33°55'24"N, 85°9'32"W. 22 July 1998. M. Rubio and R. T. Bryant. FSC 01.6.08 photo.

Coluber constrictor constrictor. BARTOW Co: 34°20'43"N, 84°42'24"W. 22 May 1989. M. Rubio and G. Greer. FSC 98.90.291. DOUGLAS Co: 33°38'21"N, 84°44'17"W. 29 June 1990. M. Rubio. FSC 98.90.238. GILMER Co: 34°44'28"N, 84°31'41"W. 25 August 1989. M. Rubio. FSC 98.90.311.

Diadophis punctatus edwardsii. PAULDING Co: 33°50'47"N, 84°58'28"W. 9 June 1992. M. Rubio and R. T. Bryant. FSC 98.90.424.

Diadophis punctatus punctatus x *edwardsii.* GORDON Co: 34°27'5"N, 84°41'34"W. 7 July 1989. M. Rubio and R. T. Bryant. FSC 98.90.236.

Elaphe guttata guttata. GWINNETT Co: 34°3'18"N, 84°2'7"W. 11 June 1996. M. Rubio. FSC 98.90.78. PICKENS Co: 34°26'20"N, 84°36'34"W. 29 July 1989. M. Rubio and G. Greer. FSC 98.90.273.

Elaphe obsoleta obsoleta x *spiloides.* CHEROKEE Co: 34°24'6"N, 84°38'41"W. 25 May 1989. M. Rubio and G. Greer. FSC 98.90.32. PAULDING Co: 34°0'59"N, 84°41'20"W. 17 May 1991. M. Rubio and G. Greer. FSC 98.90.70.

Lampropeltis calligaster rhombomaculata. DOUGLAS Co: 33°41'23"N, 84°50'3"W. 29 June 1990. M. Rubio. FSC 98.90.168.

Lampropeltis getula getula. PAULDING Co: 33°49'17"N, 85°1'16"W. 9 June 1992. M. Rubio and G. Greer. FSC 98.90.162. DOR. *Diadophis punctatus punctatus* (FSC 98.90.163) in stomach.

Lampropeltis triangulum elapsoides. CANDLER Co: 32°22'32"N, 81°57'36"W. 28 April 1995. M. Rubio and J. Bockowski. FSC 98.90.372. JENKINS Co: 32°46'24"N, 81°52'15"W. 30 May 1991. M. Rubio. FSC 98.90.114.

Nerodia sipedon sipedon x *pleuralis.* PICKENS Co: 34°30'2"N, 84°23'58"W. 27 June 1991. M. Rubio. FSC 98.90.277.

Nerodia sipedon pleuralis. COWETA Co: 33°38'48"N, 84°46'2"W. 19 June 1990. M. Rubio and G. Greer. FSC 98.90.382. GILMER Co: 34°45'50"N, 84°31'49"W. 21 June 1989. M. Rubio. FSC 98.90.232. HARALSON Co: 33°46'57"N, 85°7'57"W. 9 June 1992. M. Rubio and G. Greer. FSC 98.90.379.

Opheodrys aestivus. CHEROKEE Co: 34°20'35"N, 84°36'59"W. 23 July 1989. M. Rubio and G. Greer. FSC 98.90.29. GORDON Co: 34°30'45"N, 84°48'37"W. 6 May 1990. M. Rubio and R. T. Bryant. FSC 98.90.373. MURRAY Co: 34°38'8"N, 84°42'37"W. 22 August 1989. M. Rubio and G. Greer. FSC 98.90.31. PAULDING Co: 33°52'54"N, 85°2'6"W. 9 June 1992. M. Rubio and G. Greer. FSC 98.90.110.

Regina rigida rigida. BULLOCH Co: 32°13'58"N, 81°34'12"W. 4 April 1995. M. Rubio. FSC 98.90.475.

Regina septemvittata. COWETA Co: 33°19'34"N, 84°55'11"W. 14 August 1998. M. Rubio and R. T. Bryant. FSC 98.90.502.

Storeria dekayi wrightorum. BARTOW Co: 34°21'34"N, 84°44'17"W. 2 July 1989. M. Rubio and G. Greer. FSC 98.90.34. GORDON Co: 34°34'16"N, 84°44'58"W. 27 August 1989. M. Rubio and G. Greer. FSC 98.90.238. HARALSON Co: 33°46'54"N, 85°2'33"W. 9 June 1992. M. Rubio and G. Greer. FSC 98.90.461. MURRAY Co: 34°37'36"N, 84°52'38"W. 25 August 1989. M. Rubio and G. Greer. FSC 98.90.100. PAULDING Co: 33°52'27"N, 84°51'36"W. 17 May 1991. M. Rubio and G. Greer. FSC 98.90.6. WALTON Co: 33°45'34"N, 85°43'21"W. 29 June 1992. M. Rubio and G. Greer. FSC 98.90.175.

Storeria occipitomaculata occipitomaculata. BARTOW Co: 34°18'24"N, 84°45'44"W. 4 June 1998. M. Rubio and G. Greer. FSC 98.90.5. DOUGLAS Co: 33°38'49"N, 84°46'4"W. 29 September 1990. M. Rubio. FSC 98.90.407.

Tantilla coronata. GILMER Co: 34°33'38"N, 84°33'59"W. 7 June 1990. M. Rubio. FSC 98.90.24.

Thamnophis sirtalis sirtalis. MURRAY Co: 34°42'52"N, 84°44'18"W. 4 May 1990. M. Rubio and G. Greer. FSC 98.90.406.

Virginia striatula. JENKINS Co: 32°46'24"N, 81°52'15"W. 30 May 1991. M. Rubio. FSC 98.90.244.

Virginia valeriae valeriae. BARTOW Co: 34°24'21"N, 84°40'40"W. 21 July 1989. M. Rubio and G. Greer. FSC 98.90.453. GORDON Co: 34°35'28"N, 84°44'49"W. 27 August 1989. M. Rubio and G. Greer. FSC 98.90.24. MERIWETHER Co: 33°9'22"N, 84°52'10"W. 10 May 1998. R. McCarthy. FSC 98.90.387.

Agkistrodon contortrix mokasen. GILMER Co: 34°34'42"N, 84°45'3"W. 15 June 1990. M. Rubio and G. Greer. FSC 98.90.16.

Agkistrodon contortrix contortrix x *mokasen.* FORSYTH Co: 34°8'57"N, 84°10'46"W. 18 June 1993. M. Rubio. FSC 98.90.413. PAULDING Co: 33°53'55"N, 84°55'18"W. 1 July 1998. M. Rubio and R. T. Bryant. FSC 98.90.341. POLK Co: 34°2'44"N, 85°8'13"W. 22 July 1998. M. Rubio and R. T. Bryant. FSC 98.90.338.

Crotalus horridus. BARTOW Co: 34°16'13"N, 84°43'35"W. 23 August 1989. M. Rubio and G. Greer. FSC 01.6.02 photo. POLK Co: 33°54'54"N, 85°91'41"W. 22 July 1998. M. Rubio and R. T. Bryant. FSC 01.6.03 Photo. Extends range of the species in Georgia ca. 61 km WSW of previously recorded Cherokee Co. specimen (Williams and Moulis 1994).

Sistrurus miliarius miliarius. CHEROKEE Co: 34°34'38"N, 84°37'52"W. 15 June 1990. M. Rubio and G. Greer. FSC 98.90.22. Extends range ca. 35 km N of previously reported Douglas Co. record, and ca. 77 km W of previously recorded Habersham Co. specimen (Williamson and Moulis 1994. GORDON Co: 34°34'16"N, 84°42'59"W. 14 June 1991. M. Rubio and G. Greer. FSC 98.90.65.

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BOOK REVIEWS

Herpetological Review, 2003, 34(1), 81–84.

The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas, by Jay M. Savage. 2002. The University of Chicago Press, Chicago and London. xx + 934 pp., 96 pp. pls., hardcover. US $75.00. ISBN 0-226-73537-0.

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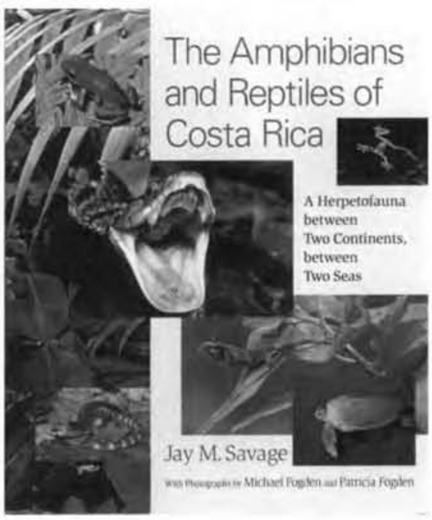
Jay M. Savage, the author of this magnificent and unparalleled book, stepped into Costa Rica in 1960, and, in the ensuing years, became a legend. Now, this legendary figure has produced a fitting culmination to his four-plus decades of research into the composition and distribution of the herpetofauna of Costa Rica.



Savage, now retired and living in San Diego, California, spent most of his career at two institutions, the University of Southern California and the University of Miami. Although his importance to the field of herpetology was apparent before beginning his tenure at USC, it was at this institution and at UM that his full measure was realized. His understanding of the Costa Rican herpetofauna took shape there, of course, but Savage also mentored and sent on their way to distinguished careers a succession of herpetologists, many of whom now hold important positions in the field. The names of some of his intellectual descendents will be familiar to anyone in herpetology: Brian Crother, Maureen Donelley, Ron Heyer, Arnold Kluge, Carl Lieb, Karen Lips, Roy McDiarmid, Norm Scott, David Wake, and Marvalee Wake. Jay Savage was also instrumental in the development and establishment of the Organization of Tropical Studies, which has been hugely influential in education and research in tropical biology. As if this work were not sufficient, Savage has also distinguished himself as a major force in modern biogeography, a talent he again demonstrates in the volume under review (see below).

Costa Rica is world-renowned for its biodiversity, for its government's commitment to protecting that biodiversity, and for its stature as a major ecotourist destination. Its herpetofaunal diversity is no less astounding, and Savage records 390 native species and six introduced ones from the country. This figure includes 172 + 2 amphibians and 218 + 4 reptiles. The area/native species figure for the country is 130.5 (50,900 km^2/390). By comparison, the figure for the much larger Honduras, the centerpiece of my research, is 338.6 (112,088 km^2/331), which is about 2.6 times larger than that for Costa Rica. Costa Rica, thus, possesses an exceedingly rich herpetofauna.

Savage's book will be a rich source of information and analysis for a very long time, not only for professional herpetologists, but for students, resource managers, and ecotourists as well. The broad range of potential users is due to several features of the book not usually seen in treatments of a country's herpetofauna.

The book is organized into four major parts, preceded by a list of keys for identification, a preface, author's acknowledgments, photographers' acknowledgments, and illustration credits. The major parts are also followed by an addendum containing discussion of eight species added to the herpetofauna while the book was in press, a glossary of 831 terms, a literature cited section of 51 pages, a systematic index, and a subject index.

The two-page preface documents Savage's involvement with the Costa Rican herpetofauna. Since 1960, he made more than sixty trips to Costa Rica, which ought to qualify him for honorary citizenship. This experience certainly positions him as the reigning authority on the herpetofauna, which is further evidenced by the number of species with which his name is associated as author. By my count, there are 21 such species, including the famous *Bufo periglenes*, the so-called "golden toad," (a misnomer, according to Savage; the males in this dichromatic species are bright orange, not "golden"), which has become a standard-bearer of amphibian population decline in Mesoamerica. Many of these 21 species were named as a result of broad-based systematic studies undertaken over the years by Savage, for example, on members of the hyper-speciose genus *Eleutherodactylus*.

Part 1, entitled "The Basics," contains three chapters of information introductory to the accounts of taxa. The first chapter (57 pages), "Discovering a Tropical Herpetofauna," is both interesting and peculiar, inasmuch as it contains information not usually seen in treatments of a country's herpetofauna. For example, Savage discusses the basics of systematics, taxonomy, phylogeny, and nomenclature, with especial reference to the cladistic approach. In addition, there is a lengthy discussion of the nature of the conduct of herpetological field research, from locating the animals to captive husbandry of them. This section is followed by two fascinating discussions of the history of Costa Rica and that of the study of its herpetofauna. Costa Rica's history is summarized from pre-Columbian times to the present, the latter characterized by Savage as *la lucha sin fin* (the endless battle). This historical summary assists readers in understanding the cauldron in which the democratic ideal for which Costa Rica is rightly famous was simmered and the stage thus set for the realization of the importance, both scientific and economic, of the immensely valuable biota and its conservation. Savage's summary of herpetological study in Costa Rica is masterful, similarly beginning in pre-Columbian times. This discussion emphasizes the relatively large number of herpetologists who have contributed to our knowledge of Costa Rica's herpetofauna, especially during the twentieth century. We are reminded, for example, of the feud between Emmett R. Dunn and Edward H. Taylor, one chapter of which involved Taylor's entrance into Costa Rica in the wake of Dunn's work there. As Savage recounts the story, Dunn had planned

to write a herpetology of lower Mesoamerica, and had amassed an outline and notes on such a work. This project was delayed, however, when Dunn received a fellowship allowing study in Colombia. Savage speculates that it is during this time that "Taylor was able to copy Dunn's outline and notes for Taylor's subsequent forays into Costa Rican herpetology." Chapter 1 also includes a short section on "Conservation and Protection," including a listing of the many protected areas in the country, which have set the stage for the surge in ecotourism, the country's major economic asset. The chapter concludes with a summary of information sources, species of possible occurrence, and erroneous records, as well as a discussion of the "challenges for readers of this book." It is in this final section of chapter 1 that Savage essentially turns over the reins of responsibility for the study and the protection of the country's herpetofauna to those who will follow him.

Chapter 2 contains a detailed summary (31 pages) of the features of the Costa Rican environment, treating physiography and hydrography, climate, and vegetation and habitats, the last primarily based on the well-known Holdridge system of forest formations.

Chapter 3 (12 pages) deals with the organization of the systematic accounts, which comprise Parts 2 and 3 of this book on the amphibians and reptiles, respectively. The topics covered are the means of identification of these creatures, the use of these sections as an introduction to the biology of the members of the herpetofauna, the purpose of the description of the major systematic groups (family and above) and the genera, the rationale and use of the dichotomous keys, the makeup of the species accounts, the abbreviations used for museums and other collections, and the key to the major groups within the Costa Rican herpetofauna.

The bulk of the book, as expected, consists of the systematic accounts. Part 2 (comprising four chapters) deals with the living amphibians, of which there are 174 species (including two introduced taxa, *Eleutherodactylus johnstonei* and *Osteopilus septentrionalis*). Chapter 4 (eight pages) introduces the class Amphibia, including the living amphibians, members of the subclass Lissamphibia. This chapter also discusses the reproductive modes practiced by Costa Rican amphibians and provides a key to the principal groups of Costa Rican anamniote eggs and developing embryos. Finally, there is a brief discussion of the phenomenon and possible causes of amphibian population decline globally and in Costa Rica. The baffling nature of these declines is alluded to by Savage, who concludes by saying, "It remains open whether anthropogenic stresses are involved and what serious consequences to the health of the global environment may be signaled by declining amphibian populations."

Chapter 5 (eight pages) covers the three genera and four species of caecilians known from the country, all members of the family Caeciliidae. The organization of this chapter is exemplary of the remainder in parts 2 and 3. Initially, the order (here the Gymnophiona) is characterized and the phylogenetic relationships of its components are discussed. Next, the matter of identification is treated and a key to the genera presented. Finally, each of the taxa below the ordinal level are presented and discussed, with identification keys provided at the appropriate points. Each of the species accounts contains the following subsections: diagnostics; description; similar species; habitat; biology; remarks; and distribution (larvae and voice are also discussed in the anuran accounts). In addition, suitably sized distribution ("spot") maps are provided for each species and several line drawings illustrate features of use in identification of taxa.

It is at this point that two of my principal adverse criticisms of Savage's book emerge. First, no synonymies are provided for the species-level taxa that would allow the reader access to the literature on these taxa in Costa Rica. Some of this literature is discussed in the Remarks section of the species accounts, but herpetologists like me who work in another region of Mesoamerica would benefit significantly from such additional knowledge for use in the construction of accounts of species also occurring in such a region. My second major concern is that none of the species accounts contains a list of locality records or specimens examined. From the perspective of one who will make major use of Savage's book in his own research in Honduras, the lack of this information is a serious concern. I understand the interest of editors and publishers (and, perhaps, authors) to contain the size of books of this nature, in order to limit the cost of production and the eventual price of the book, and to not drive off the potential purchasers of the work; however, provision of information on synonymies and available specimens and their localities would save a lot of broadcast searching of the available literature and inquiry to museum curators as to the nature of the holdings of Costa Rican material. This lack also places Savage himself in the position of having to respond to an untold number of inquiries about literature and museum material. In adopting this approach, Savage essentially asks his readers to take his identifications (and the remainder of the information in the species accounts that depends on these identifications) on faith, an approach not terribly popular in the sciences.

Chapter 6 (37 pages) deals with the three genera and 37 species of Costa Rican salamanders, all belonging to the family Plethodontidae. One of these genera, *Bolitoglossa*, is the largest genus of salamanders, with 76 species, according to Savage. The organization of these accounts is like that for the caecilians. It is within this chapter that the first of six sections of color plates is found. This set of 48 plates includes a map of the national parks, biological reserves, wildlife refuges, and other protected areas in Costa Rica, a map of the generalized distribution of Costa Rican vegetation, 16 excellent photographs of vegetation types, six mostly good to excellent photographs of caecilians (not the easiest creatures to photograph), and 24 good to excellent photographs of salamanders. Several line drawings to assist identification are also included.

Chapter 7 (247 pages) covers the anurans, of which there are 133 species in the country, including two introduced species, as noted above. The introductory section preceding the accounts of anuran species is a long one and covers much information on anurans in general and tropical anurans specifically that will be of interest to professionals and non-professionals alike. This information includes discussion of anuran reproductive patterns, ecomorphological tadpole guilds, developmental patterns in anurans based on nutritional sources, keys to adults and larvae, and an index to published illustrations of Costa Rican tadpoles. The 133 Costa Rican anurans are arranged in eight families, about 29% of the 28 families recognized worldwide. These families are the Rhinophrynidae (one species), Bufonidae (14 species), Leptodactylidae (46 species), Hylidae (43 species), Centrolenidae (13 species), Dendrobatidae (eight species), Microhylidae (three

species), and Ranidae (five species). Two sections of color plates are also found within this chapter. The first contains 13 salamander photographs and 79 anuran photographs. The second contains 92 anuran photographs and one lizard photograph. Illustrations of many tadpoles and their mouthparts also accompany this chapter, as well as several of adults indicating diagnostic features and variation in color pattern.

Part 3 (with six chapters) treats the living reptiles, of which there are 222 species (including four introduced forms, *Ctenotus cristatellus*, *Hemidactylus frenatus*, *H. garnotii*, and *Lepidodactylus lugubris*). Chapter 8 is a short (three pages) introduction to the living nonvolant (i.e., non-avian) reptiles, covering diagnostic features and some aspects of biology. Chapter 9 (of two pages) is another short introduction, this time to the squamate reptiles, covering the same subjects as in the preceding chapter.

Chapter 10 deals with the lizards in 121 pages. Seventy-three species are arranged in 22 genera and 11 families (about 39% of the 28 families currently recognized). The families are the Corytophanidae (four species), Iguanidae (three species), Phrynosomatidae (three species), Polychrotidae (27 species), Eublepharidae (one species), Gekkonidae (11 species), Xantusiidae (two species), Scincidae (three species), Teiidae (seven species), Gymnophthalmidae (six species), and Anguidae (seven species). A fourth set of 96 plates is set within this chapter, 94 of lizards and two of snakes. The quality of the photographs in this section ranges from satisfactory to excellent (one shot of a *Norops biporcatus* on a bird of paradise leaf in the forest at the La Selva Biological Station is too small to be of much use, but the understory of the forest is shown to advantage).

Chapter 11 covers the 133 species of Costa Rican snakes in 203 pages. These species are organized into 63 genera and nine families (about 58% of 19 families presently recognized). The families are the Anomalepididae (three species), Typhlopidae (one species), Leptotyphlopidae (one species), Loxocemidae (one species), Boidae (four species), Ungaliophiidae (one species), Colubridae (103 species), Elapidae (five species), and Viperidae (14 species). The final two sets of color plates are located within this chapter. The first set consists of 93 photographs of snakes; the second is of an equal number of the remainder of the snakes, the turtles, and the two crocodilians.

In general, the photographs comprising the color plates are good to excellent in execution, the animals were shot in natural or naturalistic settings, the specimens illustrated are almost all from Costa Rica (by my count, only 29 photographs of a total of 498 are of animals from outside Costa Rica or of unknown provenance), and have good locality data (but no specimen numbers). Most of the photographs were taken by the photographic team of Michael and Patricia Fogden, whose work, it must be acknowledged, will have a lot to do with the popularity this book will enjoy, as Savage himself indicates in the Acknowledgments section.

The 14 Costa Rican turtles are dealt with in Chapter 12 (34 pages) and arranged in nine genera and five families (about 42% of the 12 families currently recognized). The families are Kinosternidae (three species), Dermochelyidae (one species), Cheloniidae (five species), Chelydridae (one species), and Emydidae (four species).

The crocodilians are discussed in Chapter 13 (eight pages). The two crocodilians known from Costa Rica are placed in two genera and a single family, the Crocodylidae (not two families, as indicated in Table 3.1). Savage here regards the Alligatorinae (including *Caiman*) as a subfamily.

Part 4 (with three chapters) examines biogeographic and evolutionary patterns of the Costa Rican herpetofauna. The information and analyses in this final part of the book go significantly beyond those one generally finds in books of this nature and, as such, materially expands the usefulness the book will have to professional herpetologists, especially those working in Latin America.

Chapter 14 is an 11-page discussion of the ecological distribution of the herpetofauna, with about seven of those pages occupied by lengthy tables cataloguing distribution by elevation and forest formations. The raw distributional data found in five tables are summarized in differing ways in three additional tables and four graphs. The analyses point to patterns of distribution that are typically seen in Mesoamerica, for example that salamanders and anurans are most diverse in Premontane Rainforest, most members of the herpetofauna are found in humid lowland forests and Premontane Rainforest, and amphibians are more diverse in the Atlantic lowlands than those of the Pacific.

Chapters 15 and 16 will have broad interest to herpetologists in general and herpetogeographers in particular, inasmuch as they deal with patterns of geographic distribution and evolution of the herpetofauna of Tropical Mesoamerica as a whole, not simply Costa Rica. Savage, of course, has assayed these subjects in earlier papers, especially those published in 1966 and 1983 (see below). Savage justifies treating this subject in such an expansive fashion by indicating that Lower Mesoamerica (principally Costa Rica and Panama) constitutes an isthmian link between the continents to the north and south separating the Caribbean Sea and the Pacific Ocean, which bodies of water were in contact with one another during most of the Cenozoic, noting that "… any attempt to explain the biogeography of amphibians and reptiles in this region must recognize that the Costa Rican herpetofauna is embedded with a broader Tropical Mesoamerican faunal unit" (page 794).

In Chapter 15 (21 pages), Savage places the 215 genera and 42 families of amphibians and reptiles in Tropical Mesoamerica in four major distributional groupings, i.e., widespread tropical (eight genera), South American (62 genera), Tropical Middle American (119 genera), and Extratropical North American (34 genera, of which eight have the southern limit of their range only marginally tropical). Savage also recognizes seven major herpetofaunal assemblages, including an Eastern and Western Lowland Herpetofauna (found in humid regions), a Pacific Lowland Herpetofauna (found in semiarid to subhumid regions), a Mexican Highland Herpetofauna, a Nuclear Highland Herpetofauna (found in Nuclear Middle America), a Talamancan Herpetofauna (highlands of Costa Rica and western Panama), a Panamanian Herpetofauna (subhumid lowland habitats on the Pacific versant), and a Chocoan Herpetofauna (entering eastern Panama in lowland areas). As noted by Savage, Costa Rica is the "meeting ground" of the Eastern and Western Lowland Herpetofauna, the Pacific Lowland Herpetofauna, and the Talamancan Herpetofauna. Savage next identifies the generalized tracks and historical source units evident in tropical Mesoamerica. Four such tracks are identified, familiar to herpetogeographers working in Latin America; they are the North American-Central American track, the South

American-Caribbean track, the Middle American-Caribbean track, and the Western North American-Central American track. Genera and some sub-generic groups whose distributions correspond to a particular track are placed by Savage in a historical unit, of which there are three that have contributed to the Tropical Mesoamerican herpetofauna, i.e., an Old Northern Element (90 genera or subgenera) of largely Laurasian affinities, a South American element (64 genera or subgenera) of Gondwanan relationships, and a Middle American element (66 genera or subgenera), autochthonous in nature. The membership of these elements has been modified substantially from that established earlier by Savage ("1982" 1983), based on current phylogenetic understanding. Savage concludes this chapter with a discussion of nine faunal areas and of endemism within Costa Rica and within the faunal areas recognized. This discussion is used "as the basis for evaluation the history of the Costa Rican herpetofauna" (page 806), which evaluation is presented in the concluding chapter. The nine faunal areas fall into three groupings, viz., lowlands, foothills and uplands, and highlands. Analysis of patterns of distribution within these nine faunal areas and endemism with reference to relative representation of historical elements allows for simplification of the faunal areas recognized to five, whose separate histories are traced in Chapter 16.

Chapter 16 (23 pages) is entitled "Development of the Herpetofauna," and represents a masterful synthesis of paleogeographic, paleoclimatic, biogeographic, and biosystematic data that presents a robust and very satisfying picture of the events that have lead to the composition and distribution of the modern-day herpetofauna of Costa Rica. This type of synthesis is a particular forte of Savage, as he has demonstrated a number of times over his career. As noted above, Savage's approach is a broad-based one, such that his analysis and conclusions will be of significant use to other herpetologists working in Mesoamerica. In approaching this subject, Savage brings together an array of recent geological literature to present the complicated series of geohistorical changes that have shaped the whole of Mesoamerica and especially lower Central America. Thus is the reader introduced to the Maya, Chortis, Chorotega, and Chocó crustal blocks, the Middle American and Colombian trenches, and the five tectonic plates (North American, Caribbean, South American, Cocos, and Nazca) that were the principal players in the geohistory of this region.

Savage next deals with the available paleoclimatic data and the effect paleoclimates had on the evolution of the vegetation in Mesoamerica. Geohistorical and paleoclimatic data are integrated to form a basis for a discussion of the role of dispersal and vicariance in creating the "big picture" concerning faunal assemblages in Mesoamerica. This "big picture," as explained by Savage, has involved the alternation of vicariance (V_0 through V_3) and dispersal (D_1 through D_4) events affecting the historical elements contributing to the modern herpetofauna in complex ways. Of special interest is his exploration of the double-pulse hypothesis of the involvement of the South American Element in the present-day Mesoamerican herpetofauna, especially that of the isthmian region. This hypothesis states that two dispersals of members of the South American Element took place in the Pliocene, at intervals separated by about a million years.

The final section of this chapter provides a satisfying answer for why there are so many species between the two continents and the two seas that bracket Costa Rica. Savage presents this play in five acts. Act one introduced the Mesoamerican Element and the Central American Component of the Old Northern Element to the isthmian island chain when it became sutured to the Chortis block. Act two involved continuing uplift and vulcanism on the emerging isthmus. Act three encompassed the alternating cooling and warming cycles during the latter portion of the Cenozoic. Act four commenced with the reattachment of Central America to South America by the completed isthmian link. Act five involved the dispersal of dry-adapted taxa into northwestern Costa Rica and the Meseta Central. The conclusion of act five brings us to the present, with Savage summarizing the development of the herpetofauna by demonstrating that three historical elements arriving from different directions and at varying times have contributed 97% of the principal players in the herpetofaunal drama that has enjoyed a long run on the Costa Rican stage.

This book is very clean and I have found few errors. However, on page 44, "Stejneger's topological procedures" should read "Stejneger's typological procedures." On page 662, Fig. 11.41 of heads of species of *Leptophis* is placed near accounts of *Drymobius* instead of where it should be, about six pages beyond. The name *Tantilla supracincta* is not italicized in the legend for Plate 457. Finally, the map of the upland areas of tropical Mexico (Fig. 16.9) has a legend placing these areas to the east of the Isthmus of Tehuantepec, instead of west.

I am sure Jay Savage was asked more times than he cares to remember about when this book would see light, but it is abundantly evident that the wait was well worth it. I know of no other herpetological work that purports to cover a country's herpetofauna that is blessed with greater breadth of coverage, attention to detail, freedom from error, quality of illustration, or extent of appeal than is this one, even given my concerns about the absence of synonymies and specimen lists. For those of us who know Jay Savage, we would expect nothing less. This stupendous achievement is only the latest in a long line of distinguished contributions to the field of herpetology from his fertile mind. A copy of this book must be in the library of every person who calls himself a student of herpetology, in every university library, and in the libraries of resource managers and conservationists all over Latin America. Even well educated ecotourists with 75 bucks burning a hole in their pockets will find much of interest in this book, although it is a bit bulky to fit within a daypack. In this day of inflated book prices, this is one book that is definitely worth the monetary outlay. From this point, I can only wait with considerable anticipation to see what comes next from the hand of this talented man.

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The Cuban Treefrog in Florida. Life History of a Successful Colonizing Species, by Walter E. Meshaka, Jr. 2001. University of Florida Press, Gainesville, Florida. xxiii + 191 pp., hardcover. US $69.95. ISBN 0-8130-2909-X.

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Preservation of biodiversity requires more than simply establishing preserves and protecting them from human encroachment and direct habitat degradation. Invasive species constitute a very real and present threat to biodiversity of protected areas, and nowhere is this threat more apparent than in southern Florida, where exotic species have profoundly altered the landscape and affected the region's biota.

The impact of invasive species on native forms is often assumed to be negative, but quantitative information on this point is lacking in most cases. Thus, a detailed analysis of the ecology of the Cuban Treefrog—one of the most successful of exotic vertebrates in southern Florida—and of its impact on native species, would be a welcome addition to the literature on invasive species. With this book, based largely on his doctoral dissertation, Walter Meshaka attempts to provide such an analysis. His treatment includes consideration of the geographic distribution of the Cuban Treefrog, its relationship to other members of its genus, and the history of its colonization of Florida. The environment of southern Florida is described with special reference to the Everglades, and a brief chapter outlines the author's methods and the organization of the study. The bulk of the book treats reproduction, larval development and post-metamorphic growth, behavior, habitat selection, stomach contents and diet overlap with potentially competing species, predation, and sexual size dimorphism. The book includes a one and a half page conjecture on the possibility of future geographic expansion of the Cuban Treefrog into other parts of the United States and in the Caribbean, and it concludes with an equally brief chapter on the future of the Cuban Treefrog in the Everglades.

The Cuban Treefrog in Florida is a data-rich volume, the result of the author's energetic and enthusiastic pursuit of his study of this species. He has amassed a large volume of information on this important invasive species. Sadly, the deficiencies in editing, peer review, organization, and production seriously detract from the usefulness of this slim, overpriced volume.

Substantial portions of the book are of little or no relevance to the biology of the Cuban Treefrog, or to its impact as an invasive species. For example, in describing the Everglades the author tabulates the plant communities (Table 3.1) and provides a listing of all species of amphibians and reptiles known to occur in southern Florida (Table 3.2), but this information is not clearly related to treefrog biology.

The manuscript apparently received little, if any, copyediting. How else to explain the numerous run-on sentences, incomplete sentences, awkward constructions, and pronouns with ambiguous antecedents? It is an unusual paragraph that doesn't suffer some grammatical defect. A copy editor would have detected such non-sentences as: "Resting Cuban treefrogs, and especially small individuals, wedged into folds (e.g., palm boots, roof shingles), and large ones often packed into crevices, such as tree cavities or pipes (Meshaka 1996b)" (p. 151). Likewise, a copy editor would never have allowed the following: "Even in all but the most sterile cities that are too developed and antiseptic for its existence, the Cuban Treefrog is a ubiquitous member of the new and as yet unsettled exotic and almost endemic community of the increasingly urban landscape of Florida, itself a barometer of humanity" (p. 177). Surely a copy editor would have noticed that there is much redundancy between some of the tables (e.g., Tables 2.3 and 2.4), or that in many instances the author uses the wrong word or an awkward construction in attempting to convey his meaning, as for example: "One step behind biogeography is origin, both of the genus and the species."

The manuscript cannot have been subject to rigorous peer review, for a knowledgeable reviewer would have pointed out that time should be plotted as a independent variable on the X-axis, not as a dependent variable on the Y-axis, as it is in Figure 1. A reviewer would likely have insisted that the map depicting the distribution of the Cuban Treefrog in Florida (Fig. 1A) have a north arrow, a scale, and an indication of latitude and longitude. A reviewer familiar with the literature of *Osteopilus septentrionalis* would have corrected the author's assertion that "Over the past two hundred years the Cuban treefrog has been a subject of 100 published scientific papers." In fact there have been considerably more than 100 papers published on that species during that time; among others, the author has overlooked Smith and Kohler (1987), Goldberg et al. (1994), and Bartlett and Bartlett (1996). A reviewer familiar with amphibian biology could not have failed to point out that the section entitled "larval growth" (pp. 74–76) actually deals with the duration of the larval period and size at metamorphosis. A reviewer would have advised that it is unnecessary and wasteful of space to illustrate bivariate plots of non-significant regressions (e.g., Figs. 9.3–9.5, 9.11–9.17, 9.20—some with coefficients of determination as low as 0.002!) and that many of the regressions that are reported as statistically significant are of doubtful biological significance, owing to violation of statistical assumptions and/or to the enormous leverage of a few outlying data points (e.g., Figs. 8.2, 8.3).

Overall the production values are poor. In the legends to figures, probabilities are abbreviated as uppercase "P" on some (e.g., Fig. 9.11), or as lower case "p" on others (e.g., Fig. 9.13). F-ratios are reported inconsistently to two, three, or four decimal places. Most figure legends present statistics of dispersion as ±, but in Figures 5.3 and 5.4, they are symbolized as + . Many of the 33 black-and-white photos that illustrate various habitats are repro-

duced too dark (Fig. 4.2C) , are out of focus (Fig. 4.8B), or both (Fig. 4.4B). Many of these photos provide comparison of habitats before and after Hurricane Andrew, but because most are taken from different perspectives, direct comparisons are difficult or impossible (e.g., Fig. 4.12A, B). Many graphs are defective in various ways. Some have different font sizes within a single graph (e.g., Fig. 5.5). Some include regression equations (e.g., Figs. 5.1–5.4), others do not. (e.g., Figs. 5.5, 5.6). Some have broken regression lines (e.g., Fig. 8.5), others have peculiar symbols and lines appearing on them without explanation (e.g., Figs. 8.6, 9.1, 9.24). The axis labels are miss-set on some graphs (e.g., Fig. 8.5), and others have inset labels that overlap, and thus obscure, data points (e.g., Fig. 9.7). The book is severely over-illustrated, with unnecessary graphs and tables that contain much duplicated material. In the scant space of 191 pages, there are 142 figures and tables, an average of one figure or table for every 1.3 pages.

Exacerbating the chaotic writing style are the author's misdirected attempts at humor. In the preface, for example, he sets about framing the study as a mystery in need of solving. A biological crime was committed, he asserts, when an exotic species was "... set loose in a foreign land." The culprit, he would have us believe, was the Cuban Treefrog, and humanity was an accomplice. He then asks rhetorically, "The mystery (my dear Watson) is *why*?" Indeed, as I struggled through this book and reflected on what a properly researched, written, and edited volume on the biology of the Cuban Treefrog could have been, I had the same question.

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PUBLICATIONS RECEIVED

New Perspectives on the Origin and Early Evolution of Birds: Proceedings of the International Symposium in Honor of John H. Ostrom, edited by Jacques Gauthier and Lawrence F. Gall. 2001. Peabody Museum of Natural History, Yale University, New Haven, Connecticut 06520-8118. 613 pp. Softcover. US $49.00 + $7.50 postage and handling. ISBN 0-912532-57-2.

This volume includes 31 papers derived from a symposium held at Yale University in February 1999. The symposium itself was linked to an exhibit of feathered theropod dinosaurs from China, but the book deals with broader issues of the phylogeny of theropods, the evolution of birds, the origin of feathers and flight, and the functional morphology and physiology of birds and their ancestors. The contributions range from strictly paleontological to largely neontological and many deal with inferences derived from living archosaurs and other reptiles. Of special interest are a series of papers grouped under the heading "Controversial Topics in Bird Origins." The book is illustrated by 156 black and white photos and line drawings and includes numerous tables and appendices, as well as a comprehensive index. The volume should be a valuable addition to the libraries of ornithologists, paleoherpetologists, vertebrate morphologists, and systematists.

SigmaPlot 2000/2001 for Scientists, by M. Brent Charland. 2002. Riparian House, P.O. Box 721, Merrickville, Ontario K0G 1N0 Canada. 464 pp. Softcover. US $39.95. ISBN 0-9689929-0-0.

This publication serves as a resource for users of the SigmaPlot graphics package and covers the three most recent versions of the software (2000, 2001, and 8.0). It includes information on designing graphs, creating and modifying the graph types supported by SigmaPlot, writing transforms using the built-in programming language, complex curve fitting, and a diversity of other topics. The book is designed with the needs of practicing scientists in mind and aims to maximize the utility of SigmaPlot for both the beginning and advanced user.

Turtles and Tortoises, by Vincenzo Ferri. 2002. Firefly Books, 4 Daybreak Lane, Westport, Connecticut 06880, USA. 255 pp. Softcover. US $24.95. ISBN 1-55209-631-9.

This is an English translation of an Italian book originally published in 1999. It provides an introduction to chelonians and their biology and conservation and provides color photographs of approximately 170 species. More than 150 species are treated in short species accounts consisting of small range maps and text overviewing "Distribution and habitat," "Characteristics," and, in some cases, "Situation" (conservation status). Unlike most such guides, this volume is organized geographically, with major sections on Seas and Oceans and the Palearctic, Afrotropical, Oriental, Nearctic, Neotropical and Australian regions. The book is illustrated by 400 photos of turtles and their habitats and also features partly illustrated keys to the genera of living turtles. A species index is combined with a list of all valid turtle species and, along with a glossary, short bibliography, and list of relevant journals, societies and websites, completes this compact volume. Although aimed at a general audience, the book will also serve as a handy and inexpensive guide to turtles of the world for professional herpetologists.

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TECHNIQUES

Herpetological Review, 2003, 34(1), 31–32.

The Thermochron: A Truly Miniature and Inexpensive Temperature-Logger

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Miniature temperature-loggers (e.g., HOBO, Watchdog) have become valuable tools for herpetologists, and biologists in general. Being lightweight and self-contained, miniature temperature-loggers make it easy to record simultaneously temperatures at separate sites. Certain models are waterproof and can be attached to or implanted in large organisms, providing detailed profiles of body temperature that are otherwise difficult to obtain (e.g., Butler and Woakes 2001; Litzgus et al. 1999). In some microhabitats, temperature-loggers can even be used to estimate operative environmental temperatures (Vitt and Sartorius 1999). Miniature temperature-loggers are accurate and reliable under field conditions and are generally easier to program and deploy than larger, more expensive systems (Mueller and Rakestraw 1995). Although the use of miniature temperature-loggers has increased rapidly in the last decade, reductions in the size and cost of these devices have not kept pace.

Recently, a novel temperature-logging device has emerged that could enhance studies of behavioral and physiological ecology. The Thermochron iButton, manufactured by Dallas Semiconductors (Dallas, Texas, USA), is a remarkably small and light temperature-logger than meets or exceeds the specifications of temperature-loggers that are commonly used by biologists. Each Thermochron is a mere 5.9 mm thick and 17.4 mm in diameter, and has a mass of 3.1 g. The outer casing is stainless steel, permitting the unit to function normally during complete submersion in water. The Thermochron is powered by an non-replaceable, internal battery that provides approximately 10 years of service (or one million readings). The manufacturer specifies a resolution of 0.5°C and an accuracy of ± 1°C within the operating range of –20° to 85°C. The thermochron was developed primarily as an inexpensive tool for commercial shipping companies to document that perishable goods have been stored and transported within an acceptable range of temperatures. Current pricing is approximately US $14 per unit, and discounts are available for purchases of 25 or more units. Thus, the Thermochron is a high-performance temperature-logger that is approximately 10% of the cost of similar products.

Thermochrons are launched (or "missioned") using free software downloaded from the manufacturer's website and hardware included in a startup kit (US $25). The interface between a computer (Macintosh or PC) and a Thermochron is established with an iButton reader (Blue Dot Receptor, Model DS1402D-DR8), which attaches to a serial port. The software (32-Bit iButton-TMEX Runtime Environment) provides an intuitive interface that allows one to toggle among windows enabling one to mission a logger, display the status of the current mission, and report output from a mission in progress. A mission "wizard" provides an easy to follow, step-by-step process of starting a mission. Advanced features and ranges of settings are almost identical to those offered for competing brands of temperature-loggers (e.g., HOBO Temp loggers used with BoxCar Pro 4.5, Onset Computer Corporation). For example, the output can be obtained in the form of a text file or a histogram of temperatures, and each file is marked with a 48 bit serial number that identifies the logger generating the data. Each mission can record up to 2048 data points, at rates ranging from one point per min to one point per 255 min. The start of the mission can be delayed up to 45 days, so that the user has time to position the Thermochron prior to the onset of data collection.

Thermochrons also possess several unique features. Firstly, the Thermochron can add temperatures to the histogram after the maximum number of time-stamped data points have been stored; therefore, the mean temperature and its variance can be obtained for durations that far exceed the duration of the mission. Secondly, Thermochrons are equipped with an alarm feature that permits monitoring the number and duration of deviations from minimum and maximum temperatures (set by the user). The alarm feature is extremely useful for applications such as monitoring the occurrence of lethal temperatures in nests or hibernacula. Lastly, the Thermochron features 512 bytes of memory that enables the user

to create directories and store the results of a mission. The memory feature of the Thermochron is based on EPROM technology, meaning that data can be accessed even after subsequent missions have been launched and completed.

We obtained 170 Thermochrons (Model DS 1921-F51) to evaluate their performance under laboratory and field conditions. A certified thermometer and a circulating water bath were used to assess the accuracy of Thermochrons over a biologically-relevant range of temperatures (5–50°C). The clock of each Thermochron and a digital watch were synchronized to ensure that our temperature readings from the thermometer corresponded temporally to the temperature readings of the Thermochrons. One hundred Thermochrons were placed in a porous bag and suspended in the water bath with the thermometer. Prior to each temperature recording, the temperature of the water bath was stabilized for ten minutes. On average, Thermochrons deviated 0.3°C from the actual temperature. The magnitude of deviation from actual temperature was fairly consistent across the range of biologically-relevant temperatures (Fig. 1).

To evaluate the effects of prolonged submersion on the performance of Thermochrons, we placed 10 loggers in a water bath at 32°C for a period of one week. Each day we recorded the temperature of the water using a certified thermometer and compared this to the temperatures recorded by the Thermochrons. The average deviation from actual temperature on d 7 (0.3 ± 0.1°C) was not significantly different from that measured on d 1 ($t = 1.24$, df $= 9$, $P > 0.05$). Therefore, prolonged submergence did not affect the operation or accuracy of Thermochrons.

To assess the reliability of Thermochrons under field conditions, 60 Thermochrons were used to monitor soil temperatures in the Pine Barrens of New Jersey. In June of 2001, Thermochrons were buried 6 cm deep at random sites. After 75 days, the loggers were exhumed and data were transferred to a laptop computer. None of the loggers failed during the study, and the data agreed with soil temperatures recorded previously with HOBO data loggers at the same locality (Angilletta et al. 2000).

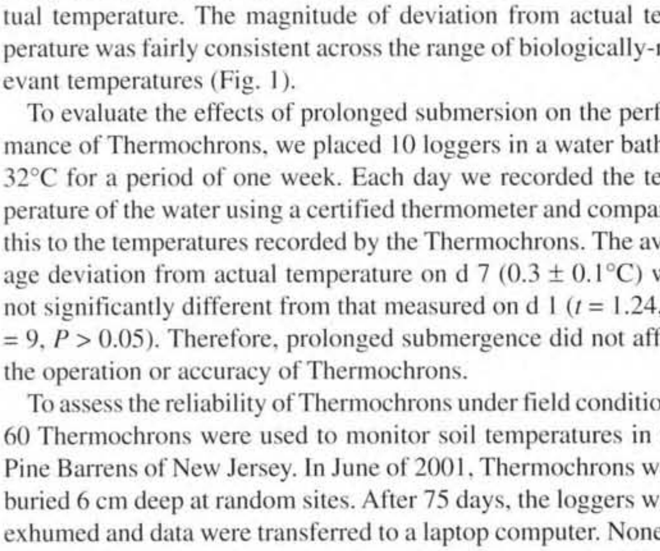

FIG. 1. Over the range of 5 to 50°C, the accuracy of the Thermochron was always better than ± 0.5°C. Accuracy was estimated by calculating the absolute value of the difference between the temperature reported by a Thermochron and the temperature measured with a certified thermometer. Error bars denote 95% confidence intervals.

We found the Thermochron iButton to be an accurate and reliable device for monitoring temperatures in the laboratory and field. Because the Thermochron is much smaller than any other commercially available temperature-logger and can be purchased for a fraction of the cost, they will undoubtedly replace many existing loggers as the model of choice. Their diminutive size and stainless steel exterior enable direct implantation into small organisms (Wang and Adolph 1995), making it possible to monitor the body temperatures of species that could only be studied previously through difficult and time-consuming methods (e.g., cloacal thermometers, radiotelemetry). Their affordable price tag ensures that researchers with modest budgets can benefit from the advantages that Thermochrons provide. More importantly, researchers with ample budgets can ask questions that were logistically impossible to answer in the past. With a reasonable budget, one might afford to thermally "tag" an entire population of individuals. Similarly, environmental monitoring can be carried out at hundreds of random sites in addition to those sites of interest (e.g., nest sites), permitting powerful experimental designs. Based on our experience with the Thermochron, we anticipate that this technology will have a profound impact on the ways in which researchers study the thermal biology of organisms.

Acknowledgments.—We thank Jacques Veilleux for bringing thermochrons to our attention. George Bakken and two anonymous reviewers helped to improve the manuscript.

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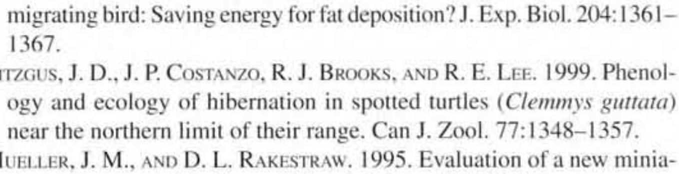

Hyla ebraccata (Hourglass Treefrog tadpole; KU 59986), 14 mm TL. Guatemala: El Petén: Toocog. Illustration by Julian C. Lee.

Herpetological Review, 2003, 34(1), 33–34.

Two New Traps for Sampling the Black Pond Turtle (*Melanochelys trijuga*) in the Tropical Rainforests of the Western Ghats (India)

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To study the population ecology of chelonians, researchers have employed numerous trapping methods in different habitats. Pitfall traps, when used in conjugation with drift fences, can be an efficient method to capture terrestrial reptiles (Bury and Corn 1987; Corn and Bury 1990; Gibbons and Semlitsch 1981). Direct methods for capturing turtles include hand collecting with dip nets, snorkeling, and approaching in concealed blinds. Indirect methods include baited hoop nets, fyke nets, snares, basking traps and funnel traps with or without bait (Iverson 1979; Jones 1986; Legler 1960; Vogt 1980; Vogt and Hines 1982). We used capture-recapture methods for estimating the population size of the Indian black pond turtle (*Melanochelys trijuga*), a semi-aquatic species that is terrestrial during the day and forages in water during the night. *Melanochelys trijuga* occurs in the dense tropical rain forests of the Western Ghats in southern India. The forest and terrain of the Western Ghats present unique conditions in which most of the conventional trapping methods do not work satisfactorily.

We tried to capture *M. trijuga* using hoop nets, funnel traps, fyke nets, basking traps and baited pitfall traps. The success rate was generally low for all the devices except baited pitfall traps. Hoop nets and the fyke nets did not work in the shallow and fast flowing streams in our study area, and basking traps were ineffective because these turtles do not bask. Funnel traps did catch some turtles, but the bait got either mixed up or washed off in water. Terrestrial pitfall traps were more effective in catching turtles, especially when used in conjunction with drift fences. However, we encountered problems with non-target animals such as owls, raptors, and otters taking bait from pitfall traps.

To sample this unusual turtle from this imposing habitat, we had to design our own traps. In this paper we describe two traps that were designed to address two of our needs: 1) an aquatic trap that allows thorough sampling of turtles while they are active (floating pitfall trap); and 2) a terrestrial trap in which the bait is protected from non-target animals (see-saw trap).

Floating Pitfall Trap.—We constructed traps from leak-free vegetable oil cans (23 x 23 x 45 cm) made of galvanized iron, which are locally available. The top of the can was cut open and 4-5 kg of stones were added for ballast. "Thermocol" polystyrene sheets (4-cm thick, manufactured by Pidilite Industries Ltd., Mumbai, India) were used to make the boarding platform. A 1 m^2 sheet served as the boarding platform, with a 30 x 30 cm square hole cut in the center (Fig. 1A). The sheet was attached to the top

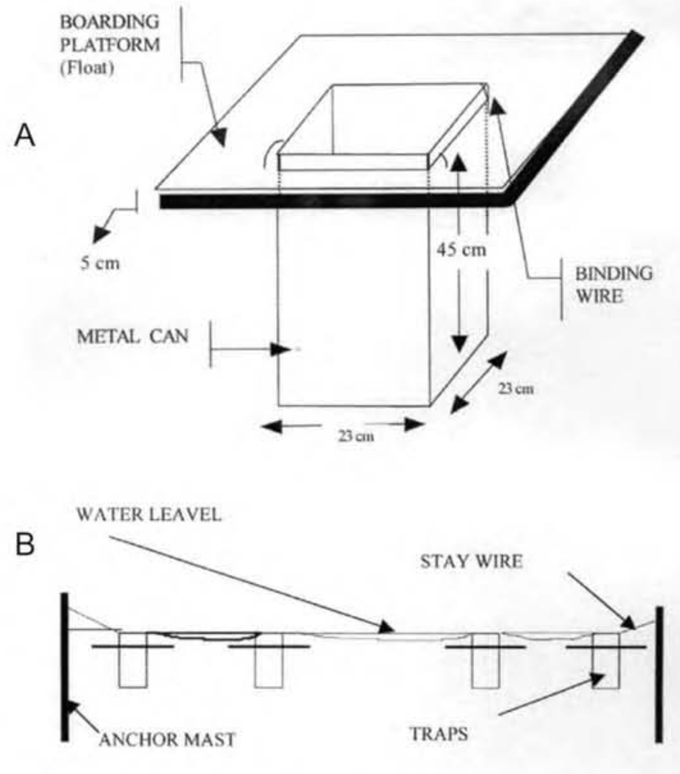

FIG. 1. (A) Front view of the floating pitfall trap. (B) Diagram of floating pitfall traps set in a series.

of the can with thin metal wires in such a manner to allow the can to move freely within the hole. The traps were anchored at a location with stay wires, singly, or several strung together (Fig. 1B). We used chicken viscera to bait the trap. Turtles were attracted by the bait at night, climbed onto the boarding platform, and in an attempt to reach the bait fell into the can. This trap was

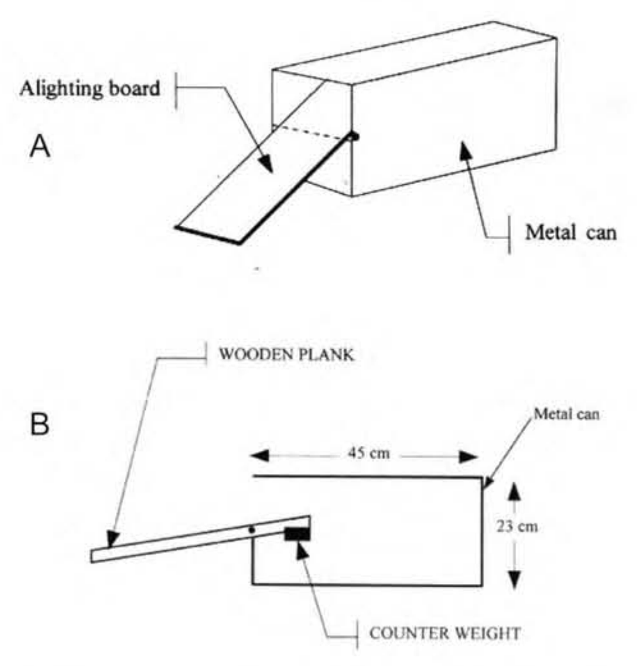

FIG. 2. (A). Diagram of a see-saw trap. (B) Cutaway side view of a see-saw trap.

TABLE 1. Capture efficiency of the two new traps as compared with the conventional pitfall traps.

Trap Type	Bait	Number of traps	Trap nights	Turtles captured	Trapping efficiency
Pit fall	Chicken Viscera	140	8400	452	53.8
	None	5	280	2	7.1
See-Saw	Chicken Viscera	150	4500	416	92.4
	None	5	150	1	6.7
Floating pitfall	Chicken Viscera	25	125	10	80
	None	5	25	0	0

handy for us to capture turtles in shallow and flowing water. It attracted turtles when they were in water but kept the bait dry and exposed so the odor would continue to attract more turtles. However, the trap would sink if there was a puncture in the can, and would get washed away if not anchored properly.

See-Saw Trap.—The same empty oil cans described above with its top cut open was used to make this trap. A wooden see-saw board measuring 45 x 20 cm was inserted through the top so that two-thirds of the board remained outside. A metallic counter weight was attached to inner end of the board (Fig. 2A). The board was loosely hinged to the sides of the can with two galvanized iron nails and was positioned in such a way that it swung freely like a see-saw. The can was then placed on its side so that a turtle could climb into the mouth of the trap (Fig. 2B). As the turtle entered the can, the board dropped, trapping the turtle inside the can. Again we used chicken viscera as bait. This trapping method was especially useful to us as we could trap the turtles when they were on land or were returning to the water. This trap is light and can be set easily, then can be transported to other sites after use. The trap covers the bait and prevents it from being taken away by non-targeted animals. In addition this trap can capture more than one animal at a time.

Laboratory Testing.—First we tested the utility of both these traps in controlled conditions at the Department of Applied Zoology, Mangalore University, Mangalore (Karnataka, India). We used an existing pond measuring 10 x 5 x 3 m where we kept 10 black pond turtles for more than a year. Four see-saw traps were set along the shoreline of the pond and two were set a few meters away. All were baited with chicken viscera, and all remained set for five days. All six traps captured turtles. Later, we set two floating pitfall traps in the tank, also baited with chicken viscera. Both of these traps caught turtles the first night of trapping.

Field Testing.—We field-tested these traps at the Neria field station (12°58'N and 75°26'E), and compared capture rates with capture rates from pitfall traps. The traps were set along the course of two perennial, first order streams, which pass thorough dense tropical rain forests. We analyzed the trapping results of 140 pitfall traps, 150 see-saw traps and 25 floating pitfall traps (Table 1). These traps were baited with chicken viscera. A total of 60 pitfall traps were laid along the banks of hill steams in different habitat types, 40 were laid 10 m away from the stream and another 40 were laid 20 m away from the stream. No drift fences were used in the trials. The see-saw traps were laid randomly along the banks of the stream, but their locations were marked with wooden stakes. The floating pitfall traps were anchored randomly in side pools and deeper regions of the stream. In addition to these baited traps, a smaller set of traps were set without bait (Table 1). All trials were conducted in the dry season only (November to May).

We evaluated the success of the traps by converting the result into the number of turtles trapped per 1000 trap days. The see-saw trap had a capture index of 92.4 and proved to be the most efficient (Table 1). The floating pitfall trap was the second most efficient with an index of 80, and the pitfall trap had an index value of only 51.7 (Table 1).

The two traps described here have since been used successfully, in combination with baited pitfall traps with drift fences made of aluminum, in our efforts to estimate population density of the black pond turtle.

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Testing for Repeatability in Measurements of Length and Mass in *Chthonerpeton indistinctum* (Amphibia: Gymnophiona), Including a Novel Method of Calculating Total Length of Live Caecilians

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Individual size remains an important part of any study of reptiles and amphibians, be it systematic or ecological, with countless studies demonstrating the importance of measurements of body length in most taxa (snout to tail tip, snout–vent length, etc., e.g., Lowcock et al. 1992; Scolaro et al. 1985; Vrcibradic and Rocha 1996). However, very few studies have included measurements of live caecilians (Amphibia: Gymnophiona), relying instead on external measurements from museum specimens. For example, Gudynas et al. (1988:16) found that all body measurements were significantly correlated with total length in the semi-aquatic caecilian, *Chthonerpeton indistinctum*: "of 14 significant correlations, eight presented coefficients greater than 0.8." In ecology, size range can be useful in comparisons between populations, and the combination of length and mass is often used to infer the relative condition of individuals over time or between populations.

During ecological fieldwork there is a constant trade-off between collecting as much information as possible, and the reduction of handling time of each individual animal. Ultimately, it is the welfare of the animal that must remain paramount, especially when the normal behavior of the individual is a necessary requirement (such as in mark-recapture experiments). Thus, when an animal is alive, it is not possible to take the ideal full complement of measurements; this makes the precision of measurements that are taken all the more important. Of the numerous publications that include morphometric measurements of live animals, few test to see whether such measurements are repeatable. We believe that testing for repeatability of measurements from live animals should be an integral part of any ecological study that relies on morphometric data.

We consider three conditions important when undertaking measurements from a collection of live animals. Firstly, measurements should be taken by a single operator. Multiple operators tend to have undesired confounding effects on measurements, note taking, and behavior of animals. Secondly, anesthetic should not be used simply to measure an animal. We realize that some procedures require anesthetics (e.g., tagging) and it would seem prudent to take measurements from an animal at such a time. Lastly, we believe that the method chosen should be consistent for future comparison of data. A mixture of data taken with various methods and when animals are under different conditions (e.g., conscious versus unconscious) are likely to be less repeatable.

There are only two principal methods to determine the length of elongate amphibians and reptiles, although we are aware that there are variations on each theme.

1. A fixed rule with calibrated marks to which the animal is straightened, often having to measure the animal in parts as its movements allow. Variations on this theme range from a simple ruler to a rigid calibrated tube through which a live animal is persuaded to move.
2. The string method, in which string is placed along the length of the animal. The length of the string is then retrospectively determined.

The consistent difference between these methods, including all their variants, is that in the first, the measurement apparatus is fixed and, in the second, it is flexible. From a theoretical viewpoint the first method suffers from the problem that animals are not straight and forcibly straightening an animal is bound to lead to errors. Although a tube might seem an ideal way to measure elongate animals, animals tend not lie straight within tubes and in some burrowing taxa (including some caecilians) total length can vary during movement (see Gans et al. 1978; O'Reilly et al. 1997). The string method can also be problematic, especially when measurements need to be taken by a single operator, for example when venomous snakes or slippery caecilians are to be measured.

The magnitude of measurement error in morphometric characters is often surprisingly high (Merilä and Björklund 1995 and references therein). During our fieldwork with the caecilian, *Chthonerpeton indistinctum* (and previous fieldwork by GJM with caecilians, MDB with snakes, and JBS with amphisbaenids) we have experienced considerable difficulty using the aforementioned methods. In particular, we were concerned that measurements using our preferred method—a fixed ruler—were not repeatable. We decided to test this hypothesis by statistical analysis of repeated measures, using the caecilian *Chthonerpeton indistinctum* as a model. We also compare the fixed ruler to another method using the flexible string principle, involving images acquired with a digital camera. At the same time we tested the repeatability of field methods to measure mass, with spring balances and a digital balance.

TABLE 1. Informal terms to describe the measure of repeatability r_i, from Martin and Bateson (1986). Note that these can only be used if results are statistically significant.

R_I	Term
r_i *less than 0.2*	*Slight repeatability*
r_i *between 0.2 and 0.4*	*Low repeatability*
r_i *between 0.4 and 0.7*	*Moderate repeatability*
r_i *between 0.7 and 0.9*	*High repeatability*
r_i *greater that 0.9*	*Very high repeatability*

The semi-aquatic caecilian *Chthonerpeton indistinctum* was collected by excavation during ecological field studies in May 2001 from the Litoral Norte region of Rio Grande do Sul, Brazil. It was necessary to transport 19 specimens from two localities to the laboratory to assess the suitability of marking techniques (see Donnelly et al. 1994; Measey et al. 2001), and it was during this period that the following procedures were made.

To test for repeatability and measurement error in measurements of total length and mass, all 19 animals from both localities were used. Caecilians were temporarily placed within individual containers with a small amount of the substrate in which they were captured. Each container was labeled with a number (1 to 19) and a letter to denote the site of collection. Random numbers were generated using a hand-held calculator to determine the order in which each animal was measured. Animals were treated as if measurements were being taken in the field. Thus, individuals were carefully removed from their containers, cleaned of excess mud (if necessary), placed onto paper towel to remove excess moisture, weighed and then measured before being replaced. Note that were animals to be multiply measured and then replaced, this would constitute pseudoreplication. To avoid potential inter-operator bias, each procedure was carried out by a single operator (1, 2, and 3 by GJM, 4 by JBS):

1. Total live mass was measured using an ACCULAB® Pocket Pro® 250-B (Sartorius Group, Denver, USA), taped with a plastic dish on top of the pan. The animal was placed entirely within the dish and the mass of the stabilized reading recorded.
2. Total length was measured using a fixed plastic ruler with divisions in mm. The animal was placed venter first to the zero end of the ruler. If calmly handled the animal responded by relaxing the posterior body portion, allowing relatively swift measurement of at least two thirds of the body length. The length of this portion was noted on the ruler. The anterior third required some coercion of the animal to lie along the ruler, especially the head and collar region, although minimum manipulation was used to obtain the total length.
3. Two PESOLA® (Pesola, Switzerland) precision spring-balances (10g and 100g) were suspended from a fixed point and zeroed with a length of clear plastic folded to form a sling (ca. 150 x 150 mm, cut from a plastic bag) in which the animal was placed. The measurement of total live mass was then read from the scale.
4. An Olympus C-2100 digital camera was mounted on a tripod 0.5 m from a piece of laminated graph paper. Animals were placed in the center of the graph paper and an exposure made as soon as the caecilian lay in a single plane on the plastic. For most animals the exposure could be made within a couple of seconds as the animal was carefully placed. Occasionally the animal coiled around itself and it was necessary to reposition it before making an exposure. The image was saved as a JPEG file onto a personal computer and was later written to a CD. The image was loaded into Image Tool software (for Windows, Version 2.0). Image Tool is freeware, and the current version can be downloaded from the internet (Wilcox et al. 1997).

   Each image was magnified by a ratio of 1:2 for calibration on a 10 mm section of graph paper. This calibration was then checked by returning the image to 1:1 and measuring 100 mm of graph paper. A result within 1 mm was accepted, otherwise calibration was repeated. A continuous sequence of lines was then drawn over the image in the center of the dorsum of the animal from the snout to tail tip (total length); care was taken to keep the angle between preceding and following lines between 140° and 200° (Fig. 1). The software automatically calculated the total length of the line formed by the sequence of all lines. Image and software distortion is bound to have occurred, although we consider such problems to be insignificant given calibration accuracy.

This process was repeated on all 19 *C. indistinctum* four times, so that each animal was processed five times in total. Records were made without reference to previous measurements. Note that no anesthetic was used, nor were the animals cooled. The whole process took under three hours (excluding time required for analysis of images). The animals were returned to their collection location the following day.

Data were tested for normality using MINITAB. The repeatability of measurements was then tested with one-way analysis of variance (ANOVA, MS EXCEL). Two-tailed paired-sample *t* tests were conducted on averaged data of different methods (MS EXCEL).

The repeatability index or intra-class correlation coefficient (r_i equation 1) can be used to assess precision, i.e., whether an observer makes consistent measurements and whether a trait varies. It cannot be used to measure accuracy of measurements, or differences between observers. Table 1 shows the allocation of classes from the results of repeatability (equation 1). Measurement error (ME) is the percentage of total phenotypic variation in a trait attributable to errors during measurement, calculated on the proportion of within-individual variation to total variation (equations 2 and 3 from Bailey and Barnes 1990).

equation 1 (1 = perfect; 0 = none)

$$r_i = \frac{MS_{between} - MS_{within}}{\left(MS_{between} + (n-1)MS_{within}\right)}$$

equation 2

$$ME = \frac{MS_{within}}{\left(s^2 + MS_{within}\right)} \times 100$$

equation 3

$$s^2 = \frac{\left(MS_{between} - MS_{within}\right)}{n}$$

equation 4

$$AverageDeviation = \sum \frac{\left|\bar{x} - x\right|}{n}$$

Where n is the number of repeated measurements (here five), $MS_{between}$ is the Mean Squares between groups, MS_{within} is the Mean

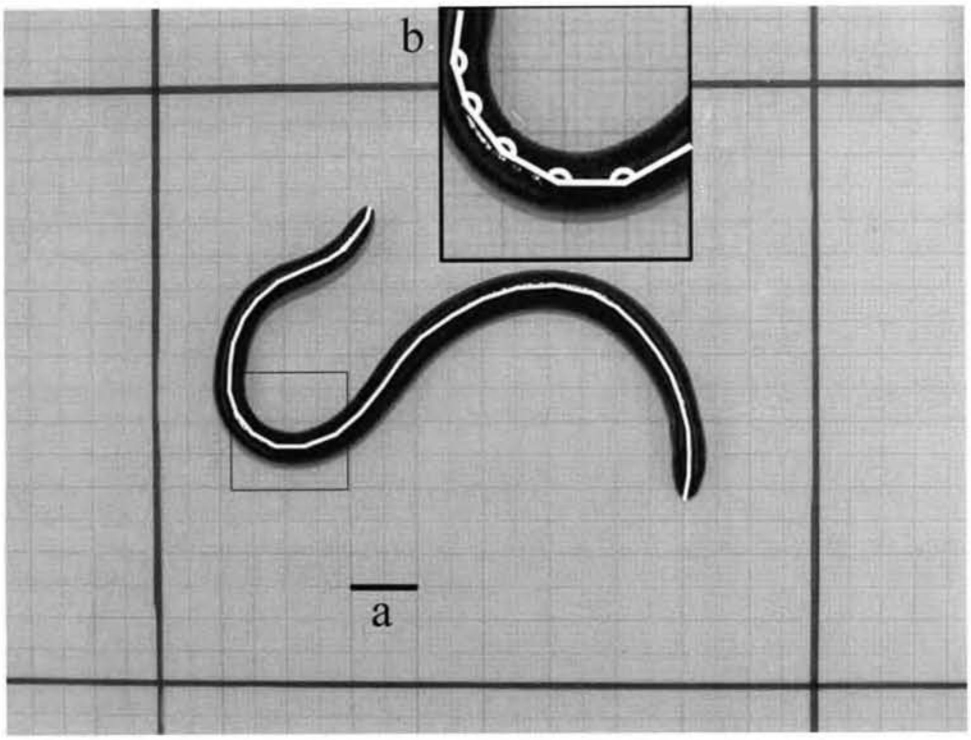

FIG. 1. A typical digital image of a *Chthonerpeton indistictum* juvenile with a sequence of lines drawn along the dorsum. a) 10 mm calibration line and b) inset of increased magnification showing a series of lines with angles (from left to right) of 150°, 163°, 154°, 154°, 166°.

Operation of the camera itself was swift, but more time was spent obtaining length from digital images, approximately 2 minutes for each image. This time involved transfer of data, processing of images with the Image Tool software, and backing up of image files.

The ruler was found to produce significantly longer measurements ($t_{2, 18} = 6.235$, $P < 0.0001$) with an average of 5.7 mm (3.3%). No consistent increase or decrease of length was noted with measurements over time, and differences between trials were not significant (ruler $F_{4, 90} = 0.002411$; $P = 0.999$; camera $F_{4, 90} = 0.008118$; $P = 0.999$).

For valid application of parametric analyses of variance and *t* tests, we must be able to assume that data from each group are obtained randomly from a normal distribution; also that the sampled populations have equal variances (homoscedastic) and have factors with additive levels (Zar 1999). Data in this study were found to deviate significantly from the normal distribution, however we consider that as the sampled populations are essentially the same (being the same animals) this would not invalidate the analysis of variance and *t* tests (see discussion in Zar 1999:185). Data were found to be log-normal, and application of statistical methods to log transformed data did not alter in significance within three decimal places.

Harper (1994) cautions against errors, when making conclusions from repeatability (r_i) calculations, when animals of greatly varying sizes or species are used. In this study two considerably larger adult animals were included, while all others were juveniles (see Fig. 2). It is possible that inclusion of these individuals would

Squares within groups and $\bar{x}$ is the mean of the samples (x).

Measurement of mass.—Both spring balances and pocket balance were easy to use and offered no special difficulties in operation or recording of mass. Operation time of the pocket balance was considerably faster than spring balances resulting in a shorter duration of handling. Fig. 2 shows the mean mass and variation in total length for each method.

Table 2 shows a summary of the data for repeated measures of mass with a very high repeatability for both the electronic and spring balances. Over the five measurements of mass, animals showed consistent loss between first and fifth measurements for the spring balance ($\bar{x} = 0.232$ g) and for the electronic balance ($\bar{x} = 0.159$ g), although this loss was not significant (spring $F_{4, 90} = 0.0021$, $P = 0.999$; electronic $F_{4, 90} = 0.0009$, $P = 0.999$). Weight probably changed as a result of urination, which is common in caecilians when first handling them (GJM, pers. obs.). The *t* test showed significant difference between weights using the two methods ($t_{2, 18} = -2.924$, $P = 0.009$), although the mean difference was smaller than could be measured with these instruments (0.04 g or 0.65%).

Measurement of total length.—Manipulation of individuals for measurement of total length with the ruler was generally easier for larger animals which offered least resistance to being forcibly straightened. Smaller animals often coiled around themselves and were generally harder to work with. Similar behavior was observed when animals were placed on the graph paper under the camera, although the image was usually taken prior to this causing difficulties. Measurement using the ruler was far faster than using the digital camera, but the handling time and severity of handling was far greater with the ruler than when using the camera.

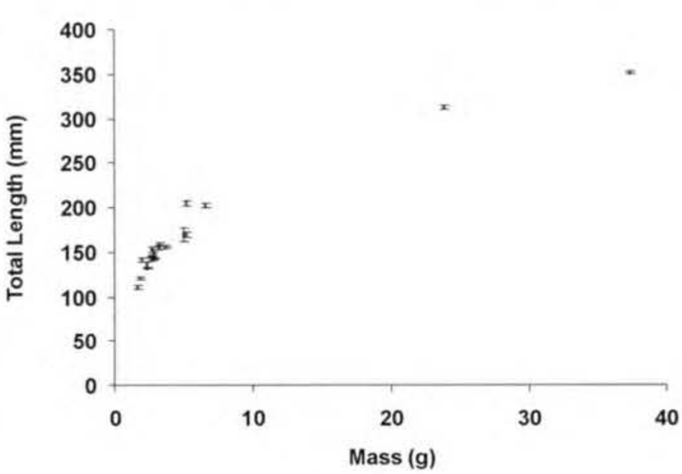

FIG. 2. The distribution of total length and mass of *Chthonerpeton indistinctum* from two localities in Litoral Norte, Rio Grande do Sul, Brazil. Points show the range of length data and averaged mass obtained using a fixed ruler and spring balance (the graph for digital camera and digital balance is visually identical).

produce a bias for the index of repeatability and so the calculations were repeated excluding them (see Table 2).

Precision refers to the closeness to each other of repeated measurements of the same quantity (Zar 1999). All methods presented are precise, showing 'very high repeatability' and an insignificant (i.e., less than 5%) amount of measurement error. This held true (with slightly reduced indices) when only animals of a similar size were measured (by removing the two large animals, Table 2). We do not consider the precision of many operators, as this is known to be considerable (up to 30% in measurements of skulls; Palmeirim 1998); for this reason we suggest that single operators are mandatory.

Accuracy is the nearness of a measurement to the actual value of the variable being measured (Zar 1999). Although it is possible to determine the accuracy of each balance, the accuracy of measurements of total length is somewhat more difficult. The fixed ruler method proved slightly more repeatable, but gave significantly longer measurements, than measurements made from digital images. We suggest that the choice of technique should therefore concentrate on the relative merits of each technique.

The fixed rule is a simple and inexpensive method for measuring the total length of live animals. Equipment is easily obtained, transported, replaced (if broken, stolen, etc.) and can be autoclaved to prevent transport of pathogens; this last point is especially important for herpetologists working with fossorial species (see Halliday 1998). However, we do acknowledge that operation of this equipment requires experience to produce repeatable measurements. Also, data taken with a fixed rule represent a "one off" measurement that cannot be checked by another authority.

The digital camera offers an archive image of each animal enabling measurements to be taken by various operators of the image analysis software. Images can also be used for taking various other measurements (ventral images can be recorded through glass), and other measurements can be obtained retrospectively, given that images are of sufficient quality and have been stored well. Further, images could also be used for identification of individuals (e.g., Donnelly et al. 1994), and charting the occurrence of scars and marks (known to occur in caecilians: e.g., *Scistometopum thomense,* Teodecki et al. 1998; *Gegeneophis ramaswamii,* Measey et al. 2001) on individually marked animals. However, this equipment is presently very expensive and comparatively complicated to use. Moreover, like many electronic products, it is prone to un-repairable error in the field. Time taken to analyze images with the software is significant.

We follow the philosophy of Fellers et al. (1994) who advocate the reduction in handling and handling time. In this study, a general reduction in handling would be made by using an electronic field balance and digital camera to determine the mass and total length of individual *Chthonerpeton indistinctum.* We caution against using the results from this study for other taxa, as behavior of each taxon during measurement might be different. However, we recommend that particularly in studies of growth where measurements are taken from live animals, a method of estimating measurement error is used.

TABLE 2. Results of the multiple measurements on 19 *Chthonerpeton indistinctum* from Rio Grande do Sul, Brazil. Mean Squares, F and Critical value of F were derived from one-way ANOVA (MS Excel). Average deviations calculated from positivized data set. (Figures in parentheses are those from calculations excluding the two adult specimens, N = 17.) † indicates that the same measurement of an animal is producing the maximum or minimum measurement and percentage. * shows the same individual producing maximum and minimum percentages.

Measurement	Mass (electronic)	Mass (spring)	Total Length (ruler)	Total Length (camera)
Mean Squares between groups	399.8549 (9.643529)	404.3236 (9.656882)	20573.32 (3218.224)	18881.92 (2999.054)
Mean Squares within groups	0.006421 (0.005529)	0.031579 (0.005882)	9.289474 (9.911765)	19.69082 (13.91397)
F	62272.49 (1744.043)	12803.58 (1641.67)	2214.692 (324.6872)	958.9197 (215.5427)
Critical value of F	1.741189 (1.794557)	1.741189 (1.794557)	1.741189 (1.794557)	1.741189 (1.794557)
P	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Index of Repeatability (r_i)	0.999157 (0.99714)	0.9992 (0.996962)	0.996022 (0.984788)	0.992473 (0.977225)
Term	Very high repeatability	Very high repeatability	Very high repeatability	Very high repeatability
Measurement Error (ME)	0.008029% (0.286034%)	0.039039 % (0.303828%)	0.225358% (1.521203%)	0.519254% (2.277462%)
Max/Min deviation from mean	+0.20 g –0.20 g	+0.16 g –0.14 g	+12.8 mm † –6.2 mm †	+14.99 mm –15.17 mm †
Max/min as a % of measurement	+6.7% * –8.9% *	+4.3% –5.4%	+7.0%† –4.0%†	+8.9% –10.8%†
Average deviation ± Std error	0.052105 g ± 0.004965	0.093053 g ± 0.013291	1.991579 mm ± 0.191999	2.713053 mm ± 0.298792
% average deviation ± Std error	1.463956% ± 0.158015	1.744285% ± 0.111033	1.213712% ± 0.116015	1.597892% ± 0.166096

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Comparative Effectiveness of Two Trapping Techniques for Surveying the Abundance and Diversity of Reptiles and Amphibians Along Drift Fence Arrays

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In the northeastern United States, there are growing concerns about the effects of habitat loss and degradation on vernal pool herpetofauna (Gibbs 1993; Kittredge 1996; Melvin and Roble 1990; Windmiller 1996). Conservation of these species requires effective and efficient methods for surveying their populations. Perhaps the most common method of surveying for adult amphibians involves drift fence arrays in combination with pitfall traps. This method has been used successfully to capture a variety of forest floor vertebrates (Bury and Corn 1987; Gibbons and Semlitsch 1981), including ambystomid salamanders (DeGraaf and Rudis 1990; Madison 1998; McWilliams and Bachmann 1988; Pechmann 1995; Stenhouse 1985; Whiteman et. al. 1994), other salamander species (Gill 1978a,b) and frogs (Guttman et. al. 1991; Yanosky et al. 1997).

Previous studies from around the world have compared the effectiveness of various terrestrial amphibian and reptile trapping techniques. These studies have found varying effectiveness of drift fence/pitfall trap arrays when compared to other methods such as cover boards, pipe traps, visual surveys, box traps and calling surveys (Christiansen and Vandewalle 2000; Crosswhite et al. 1999; Lohoefener and Wolfe 1984; Parris et al. 1999; Sutton et al 1999; Webb 1999). Another method, terrestrial funnel traps, was found to be successful for capturing amphibians along drift fence arrays in the southeastern United States (Enge 1997a). Comparisons of funnel traps to pitfall traps in the Pacific Northwest and the Southwest have shown that snakes and some lizards are more susceptible to capture in funnel traps (Bury and Corn 1987; Jorgensen et al. 1998).

To our knowledge, the only study in the northeastern United States comparing terrestrial trapping techniques for amphibians and reptiles found funnel traps in conjunction with drift fence arrays to be more effective than plastic cover sheets (Kjoss and Litvaitis 2001). A rigorous comparative evaluation of the effectiveness of funnel traps and pitfall traps has not been conducted in the Northeast. Because of rocky soils and wet conditions often found adjacent to amphibian breeding sites in the northeast comparing the effectiveness of terrestrial trapping techniques that can be used in these situations will be valuable.

The goal of this study was to evaluate the effectiveness of terrestrial funnel traps and pitfall traps for capturing amphibians and reptiles by placing the traps along drift fence arrays that encircle

wetlands used by amphibians for breeding. Our specific objectives were to: (1) quantify differences between trap types in capture rates for individual species; (2) quantify community resemblance and differences in species diversity between trap types; and (3) describe mortality rates and logistic constraints associated with each trap type.

We established a drift fence completely around the perimeter of five pools with breeding populations of marbled salamanders (*Ambystoma opacum*) in the town of South Hadley, Massachusetts. Drift fences were installed ca. 2–5 m from the shore (high water) of the pool to intercept all individuals moving to and from the pool. Drift fences consisted of 35 cm aluminum flashing buried 10 cm in the ground and held in place with wooden stakes. We installed pitfall traps and funnel traps alternately every 10 m along each fence for a total of 94 pitfall traps and 102 funnel traps. More funnel traps were used at 4 of the 5 pools because of an odd number of trap sites. A single trap was placed at each location on both sides of the fence. Pitfall traps were made from single #10 tin cans as opposed to double #10 tin cans recommended by Dodd and Scott (1994). We decided to use single cans due to the wet and rocky situations that are often found adjacent to amphibian breeding in the northeast. Each trap contained a wetted sponge and was covered by a board that was leaned against the drift fence to provide shade and prevent desiccation but would not interfere with the capturing of animals. Funnel traps were constructed from aluminum screen by creating a cylinder (41.4 cm long and 18.4 cm diam) and attaching an inverted funnel on either end (Enge 1997b). Like pitfalls, each trap contained a wetted sponge and was covered by a board.

We checked all traps daily between August 20 and November 30 for a total of 103 trap nights per trap. Each trap was checked by removing the sponge and searching through any organic material that may have accumulated in the trap. All animals captured were recorded and released approximately 2 m from the trap on the opposite side of the fence.

To compare the relative effectiveness of each trapping technique, we used a variety of simple descriptive statistics and a series of two-sample t-tests. Specifically, we determined the number and percentage of individuals caught in each trap type across all pools. We used paired t-tests to test the null hypothesis that mean capture rates did not differ between trap types. Here, the pool was the experimental unit. Mean capture rates for each technique were paired by pool to account for differences in overall capture rates among pools. In effect, this tested the null hypothesis that the mean difference in capture rates between techniques did not differ from zero (i.e., zero difference in mean capture rates between techniques exists when the relative capture rates between the two techniques is the same at each pool, regardless of differences in the absolute magnitude of capture rates among pools). For this analysis, capture rates for each species were calculated at all five pools by dividing the number of animals captured in a given trap type by the number of traps of that type. This step was necessary to account for minor differences in the number of traps of each type at a pool.

To compare the relative effectiveness of each trapping technique at estimating amphibian and reptile diversity, we computed Simpson's diversity index (Simpson 1949) for each trap type at each pool. Simpson's diversity index is calculated as the proportion of each individual species' abundance relative to the total abundance of all species squared. The squared proportions for all species are then summed, and the reciprocal is taken. We tested the null hypothesis that diversity did not differ between trap types using a paired t-test, as described above. In addition, we compared the community structure as determined by each technique using two different community resemblance measures. Specifically, we computed Jaccard's Coefficient of Community Similarity (Mueller-Dombois and Ellenberg 1974:212–214) to assess similarity in species composition. Jaccard's index is defined as the number of species common to both trap types divided by the total number of species found in both trap types, and is zero when two communities have no species in common and is a maximum of one when two communities share all species. We also computed percentage of similarity (Wolda 1981) to assess similarity in community composition and structure between trap types. Percentage of similarity is defined as the sum of each species' lowest percent composition from either trap type. Percent similarity is zero when two communities have no species in common and is a maximum of one when species composition and relative abundances are identical. For this analysis, we computed community resemblance for each pool separately and then summarized these results across all five pools.

Collectively, a greater number of species (15 vs. 10) and more individual amphibians and reptiles (1622 vs. 764) were caught in funnel traps than in pitfall traps (Table 1). Based on total number of captures 14 of 15 species were captured more frequently in funnel traps than in pitfall traps. However, when we only looked at species with > 20 captures, eight species had higher capture rates with funnel traps compared to only one species with pitfall traps. Despite these results, because of high variability among pools, capture rates were significantly different at the $P < 0.1$ level for only three species (*Ambystoma opacum*, *Plethodon cinereus*, and *Rana sylvatica*) and at the $P < 0.05$ level for only one species (*Rana sylvatica*) based on paired t-tests. The only species to have significantly greater capture rates in pitfall traps was the marbled salamander (*Ambystoma opacum*).

Funnel traps consistently captured a higher diversity of species across the five pools (Fig. 1), although this difference was only mildly significant ($t = 2.36$, $P = 0.077$). The similarity in community composition between trap types was low (mean Jaccard's Coefficient of Community Similarity = 0.54). Similarity in community structure (i.e., composition and relative abundances) was

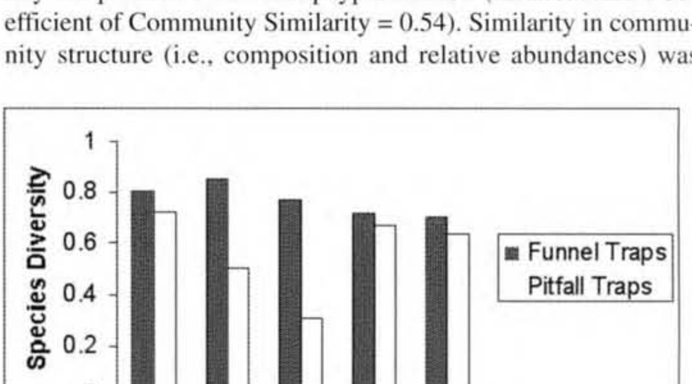

FIG. 1. Reptile and amphibian diversity captured in each trap type (funnel and pitfall) in Fall 1999 at 5 pools in South Hadley, Massachusetts.

TABLE 1. The number and percentage of captures in funnel (N = 102) versus pitfall (N = 94) traps, mean deviation in capture rates between trap types, and P-values from paired t-tests for individual species captured along drift fences around five vernal pools in South Hadley, MA during 1998. Deviations between trap types were computed for each pool separately and then averaged across pools. Positive deviations represent higher funnel trap capture rates; negative deviations represent higher pitfall trap capture rates. Mean deviations between trap types and associated P-values are only reported for species with greater than 20 total captures.

Species	Total Captures				Mean	
	Funnel Traps		Pitfall Traps		Deviation	P-value
Rana sylvatica	273	(93%)	19	(7%)	5.007	0.001
Bufo americanus	57	(78%)	16	(22%)	0.909	0.111
Hyla crucifer	4	(80%)	1	(20%)	—	—
Rana catesbeiana	2	(100%)	0	(0%)	—	—
Rana palustris	2	(100%)	0	(0%)	—	—
Rana clamitans	1	(100%)	0	(0%)	—	—
Ambystoma opacum	254	(42%)	342	(58%)	- 3.959	0.052
Plethodon cinereus	314	(87%)	47	(13%)	5.941	0.056
Notophthalmus viridescens	499	(71%)	207	(29%)	5.272	0.147
Hemidactylium scutatum	19	(66%)	10	(34%)	0.112	0.221
Ambystoma maculatum	117	(51%)	113	(49%)	- 0.784	0.365
Eurycea bislineata	20	(77%)	6	(23%)	0.356	0.391
Thamnophis sirtalis	52	(95%)	3	(5%)	1.076	0.120
Nerodia sipedon	6	(100%)	0	(0%)	—	—
Diadophis punctatus	2	(100%)	0	(0%)	—	—

slightly greater, but also low (mean Percentage of Similarity = 0.61).

Overall, mortality rates were low (< 2% of captures) and were similar between trap types, although there were notable differences among species (Table 2). Funnel traps accounted for higher amphibian mortality rates, primarily because animals captured in them were more susceptible to desiccation. Two species seemed especially prone to desiccation in funnel traps, *Notophthalmus viridescens* and *Plethodon cinereus*. Ambystomid species appeared to be less susceptible to desiccation, yet suffered greater mortality in pitfall traps due to predation by shrews. In addition, pitfall traps accounted for more small mammal mortalities, most likely due to high metabolic rates of carnivorous shrews (Churchfield 1990).

TABLE 2. Total number of mortalities associated with funnel traps and pitfall traps for species captured along drift fences around five vernal pools in South Hadley, Massachusetts during 1999.

Species	Funnel Trap	Pitfall Trap
Ambystoma maculatum	0	1
Ambystoma opacum	1	3
Eurycea bislineata	0	1
Hemidactylium scutatum	1	0
Notophthalmus viridescens	7	2
Plethodon cinereus	6	1
Rana sylvatica	3	0
Total Amphibians	18	8
Small Mammals	1	16
Total Mortalities	19	24

From a practical and logistical standpoint, both trap types required roughly an equal amount of initial labor (i.e., construction and installation), but funnel traps required more time to check and maintain and were more expensive to construct. In particular, funnel traps required resetting after they were checked. Resetting involved placing the trap tightly against the fence and the ground so that no gaps existed where animals might circumvent the trap. This proved not to be a problem in relatively wet areas, but in dry uplands, it took approximately 30 sec longer to reset a pair of funnel traps properly than to reset a pair of pitfall traps. Hence, with over 100 funnel traps to check in our study, funnel traps required almost an additional one hour of labor per day.

Clearly, species' capture rates and estimates of community composition and structure can differ markedly when different trap types are used in combination with drift fence arrays (Bury and Corn 1987; Lohoefener and Wolfe 1984). No one trap type is equally effective for capturing all species. However, pitfall traps are often employed as the only trap type in amphibian surveys. In our study, funnel traps were more successful for capturing most amphibians and reptiles and sampling a greater diversity of species than pitfall traps, with the exception of marbled salamanders. The differential vulnerability to trap types among species can be explained by the physical structure of the two trap types in relation to species' physical capabilities. In our study, we used relatively shallow pitfalls

(one #10 tin can) compared to recommended pitfall depths (two #10 tin cans) (Dodd and Scott 1994) because shallow, rocky soils prevented us from installing deep pitfalls at all sites. Thus, in order to maintain constant trapping effectiveness among sites, we were limited to the use of relatively shallow pitfalls. Preliminary work suggested that shallow pitfalls were sufficient for capturing our target species, the marbled salamander. The shallow pitfalls allowed snakes and frogs to readily escape, yet were quite effective for ambystomid salamanders. Conversely, funnel traps were quite effective for snakes, frogs, and some salamanders because they function as confusion traps that make it difficult for animals to find their way out. Our results indicate that funnel traps provide a viable and potentially more effective alternative to traditional pitfall traps when used in combination with drift fences, especially in situations that prevent the use of pitfalls altogether (e.g., wet areas) or prohibit the use of deep pitfalls (e.g., in shallow and rocky soils).

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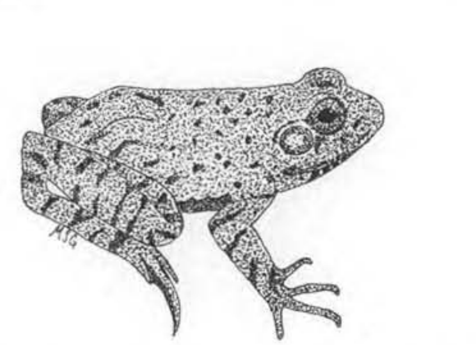

Rana heckscheri (River Frog). USA: Florida: Leon County: Ochlockonee River. Illustration by Margaret Gunzburger, Florida State University.

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A Technique for Manual Restraint of Helodermatid Lizards

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Heloderma horridum (Beaded Lizard) and *H. suspectum* (Gila Monster) are the only extant species of venomous lizards. Because of this, they are popular animals in both public and private reptile collections and are subjects of considerable herpetological interest. Although their venom is rarely fatal to human beings, helodermatid bites can be extremely painful and can have systemic effects, including a rapid drop in blood pressure, which can result in hypotensive shock (Burnett et al. 1985, Preston 1988). Bites are surprisingly common, but often go unreported in the literature (Lowe et al. 1986). Thus, extreme caution should be used when handling these lizards. Although there are many published techniques for handling venomous snakes (e.g., Mauldin and Engeman 1999; Murphy 1971), little attention has been given to venomous lizards.

At times, helodermatids may be handled by mechanical means (hooks and tongs) although these tools can be cumbersome and possibly cause injury to the lizard. Therefore, manual handling may be necessary. Often, zoo workers don heavy leather gloves in the belief that this minimizes the likelihood of being envenomated. We are aware of individuals who have been bitten through leather welding gloves, not only by *H. suspectum,* but by small viperids as well. These gloves create a false sense of security. Other workers are confident that one can handle these lizards by the ends of their tails, believing that the lizards are not flexible enough to allow mouth contact with the hand holding the tail. We have had experiences (without being bitten) that negate this belief. Though slow in movement, helodermatids are surprisingly quick to strike (especially laterally) at objects that approach their heads. Additionally, they can contort their bodies in a U-shape that places the mouth adjacent to the tail. Therefore, it is foolhardy to attempt to grasp these animals unless the head is also restrained.

FIG. 1. Placement of locking hemostat during restraint of a small *Heloderma horridum.*

FIG. 2. Placement of hand behind hemostat during restraint.

We have used the following technique for several years, which we believe adds to the safety of workers attempting manual restraint of helodermatids. We use a common 18–24 inch (46–61 cm) locking hemostat as a flared yoke that compresses the neck of the lizard to the substrate, virtually eliminating the lizard's ability to move the head laterally, and positions a protective barrier between the grasping hand and the lizard's head. Initially, the hemostat is placed over the neck of the lizard just behind the posterior margin of the jaw (Fig. 1). Once the animal is restrained in this manner, one can safely grasp the lizard behind the hemostat (Fig. 2), remove the hemostat while maintaining a firm grip around the neck of the lizard, and then use the free hand to raise and support the lizard's body (well away from its head). To release the animal, reverse the process and end with both hands clear of the animal before removing the hemostat from around the lizard's neck. The ratcheting lock of this type of hemostat allows one to adjust the yoke width to accommodate most lizards of different head sizes.

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NATURAL HISTORY NOTES

The Natural History Notes section is analogous to Geographic Distribution. Preferred notes should 1) focus on observations with little human intrusion; 2) represent more than the isolated documentation of developmental aberrations; and 3) possess a natural history perspective. Individual notes should, with few exceptions, concern only one species, and authors are requested to choose a keyword or short phrase which best describes the nature of their note (e.g., Reproduction, Morphology, Habitat, etc.). Use of figures to illustrate any data is encouraged, but should replace words rather than embellish them. The section's intent is to convey information rather than demonstrate prose. Articles submitted to this section will be reviewed and edited prior to acceptance.

Electronic submission of manuscripts is requested (as Microsoft Word or Rich Text format [rtf] files, as e-mail attachments). Authors without the ability to send manuscripts electronically may supply hard copy instead. Figures can be submitted electronically as JPG files, although higher resolution TIFF or BMP files will be requested for publication. If figures cannot be provided in this format, you may send them to the section editor for scanning. Additional information concerning preparation and submission of graphics files is available on the SSAR web site at: http://www.ukans.edu/~ssar/HRinfo.html. Manuscripts should be sent to the appropriate section editor: **Marc P. Hayes** (amphisbaenids, crocodilians, lizards, and *Sphenodon*; mhayesrana@aol.com); **Charles W. Painter** (amphibians; cpainter@state.nm.us); **Gordon W. Schuett** (snakes; Gschuett@zooatlanta.org); and **James Harding** (turtles; hardingj@pilot.msu.edu).

Standard format for this section is as follows: SCIENTIFIC NAME, COMMON NAME (for the United States and Canada as it appears in Crother [2000. *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding*. Herpetol. Circ. 29:1–82]; for Mexico as it appears in Liner [1994, *Scientific and Common Names for the Amphibians and Reptiles of Mexico in English and Spanish*, Herpetol. Circ. 23:1–113]), KEYWORD. DATA on the animal. Place of deposition or intended deposition of specimen(s), and catalog number(s). Then skip a line and close with SUBMITTED BY (give name and address in full—spell out state names—no abbreviations). (NCN) should be used for common name where none is recognized. References may be briefly cited in text (refer to this issue for citation format).

Recommended citation for notes appearing in this section is: Lemos-Espinal, J., and R. E. Ballinger. 1994. *Rhyacosiredon leorae*. Size. Herpetol. Rev. 25:22.

CAUDATA

AMBYSTOMA CALIFORNIENSE (California Tiger Salamander). **PREDATION.** *Rana catesbeiana* was introduced into California in the late 1800s (Jennings and Hayes 1985. Herpetol. 41:94–103). *Rana catesbeiana* is a generalist predator, known to consume a wide variety of prey (Bury and Whelan 1984. Ecology and Management of the Bullfrog. USDI Fish & Wildlife Service Res. Publ. 155. 23 pp.). Until now, published documentation of predation on *Ambystoma californiense* (a species petitioned for federal listing as threatened) by *R. catesbeiana* has been lacking.

We removed bullfrogs from a private stockpond near Rancho Murietta, Sacramento County, California, USA (38°25'09"N, 121°03'19"W) on three separate occasions between March and June 2000. Bullfrogs were collected by hand, net, or gig and then euthanized. We dissected and preserved all stomachs in the field and later identified stomach contents to order (for invertebrates) or species (for vertebrates). Most stomachs contained arthropods; primarily adult and larval beetles (Coleoptera) (66%) and clam shrimp (Conchostraca) (20%). One larval *A. californiense* was recovered from the stomach of a male *R. catesbeiana* (150 mm SVL, 346 g). The salamander, ca. 9.5 cm in total length, had been recently ingested and was easily identified (now deposited at California Academy of Sciences; CAS 222659).

Our report corroborates an unpublished observation by Anderson (1968. The Reproductive and Developmental History of the California Tiger Salamander. Unpubl. Master's thesis. Fresno State College. 82 pp.), who found one larval *A. californiense* in the stomach of a 79 mm SVL bullfrog taken in early April 1968 from a temporary pond on the eastern side of the San Joaquin Valley in Madera County.

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AMBYSTOMA MACULATUM (Spotted Salamander). **VERNAL MIGRATION.** Immigration of ambystomatid salamanders to breeding ponds may be triggered by changes in temperature and rainfall, and may be affected by endogenous circannual and circadian clocks. Blanchard (1930. Am. Nat. 64:154–167) concluded that immigration in *A. maculatum* is initiated by the first rains following snowmelt and ground surface thaw. Hillis (1977. Bull. Maryland Herpetol. Soc. 13:84–91) and others also stressed the importance of rainfall as an effector of immigration. Sexton et al. (1990. Copeia 1990:781–787), however, concluded that 3-day average temperature (mean of daily high, low temperatures) is the most useful predictor of *A. maculatum* immigration, though all immigration in that study was associated with rainfall. Sexton et al. (*op. cit.*) also concluded that the lack of immigration during December and January despite favorable conditions of temperature and rainfall represented a refractory period perhaps based upon an endogenous circannual clock.

We report here very early immigrations of *Ambystoma maculatum* in central Virginia (USA). The first occurred on 7 January 1998 in northern Albemarle County, Virginia; this was the first observed migration of the 1997–1998 season. The immigration was observed as *A. maculatum* crossed State Road 643 to reach ephemeral ponds in the floodplain of the South Fork of the Rivanna River. A total of 20 individuals (15 live, 5 dead) were observed; all were male. Other species observed at the same time and location were *Bufo sp.* and *Pseudacris crucifer*. The sightings occurred between 2145 and 2330 h during rain. Temperature and precipitation preceding this migration were as follows (low temp., high temp., total daily precipitation, respectively): 5 January: 2.8°C, 18.9°C, 0 cm; 6 January: 12.8°C, 20.0°C, 0.41 cm; 7 January: 16.1°C, 20.0°C, 1.1cm (mean 3-day temperature 15.1°C). Mean 3-day temperature recorded at the Charlottesville 2 W station (13 km south of observation site) for these dates from 1948 to 1995 was 2.0°C. There was no measurable rainfall two days prior to observed activity, but 0.41 cm and 1.1 cm of rainfall were recorded the day before and the day of immigration, respectively.

The next noted migration was observed in rain around 2140 h on 11 February 1998; 9 *A. maculatum* (7 live, 2 dead) were observed, 8 of which were male. Temperature and precipitation preceding this migration were as follows (low temp., high temp., total daily precipitation, respectively): 9 February: -2.8°C, 11.7°C, 0 cm; 10 February: -1.7°C, 15.6°C, 0 cm; 11 February: 0.0°C, 8.9°C, 1.4 cm (mean 3-day temperature 5.3°C). Mean 3-day temperature recorded at the Charlottesville 2 W station for these dates from 1948 to1995 was 1.7°C. There was no measurable rainfall

for the two days prior to observed activity, but 1.4 cm rainfall was recorded the day of immigration.

This report represents the earliest documented observation of vernal immigration of *A. maculatum* at this latitude. Our observations support previous general conclusions that increased temperature and nocturnal rainfall influence immigration of ambystomatid salamanders to vernal breeding ponds (Hillis, *op. cit.*; Douglas 1979. Can. J. Zool. 57:2303–2310; Sexton et al., *op. cit.*), and that male *A. maculatum* immigrate before females (Hillis, *op. cit.*; Douglas, *op. cit.*). They also concur with Sexton et al.'s (*op. cit.*) model of immigration induction by a minimum 3-day average temperature of approximately 5.5°C in conjunction with 0.127 cm minimum rainfall the day of immigration. However, these observations are at odds with Sexton et al.'s (*op. cit.*) hypothesis that a clock-derived refractory period prevents immigration during December/January (in St. Louis Co., Missouri).

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DICAMPTODON COPEI (Cope's Giant Salamander). **COLORATION**. On 7 August 2001, one of us (LLCJ) collected a partial albino *D. copei* in a tributary of Iron Creek in Skamania County, Washington, USA (T10N R7E SE 1/4 W 1/8 Sec. 8). It was found under a 15 x 4 cm rock on gravel in a small riffle just below Forest Road 25. The larval specimen (University of Washington Burke Museum; UWBM 2310) was 44.1 mm SVL, 72.8 mm TL, and 2.9 g. Water temperature was 12°C and air temperature was 23°C at the time of capture, 1402 h. A normally pigmented *D. tenebrosus* of about the same size was found < 2 cm from this specimen. Both species are common in the stream. This specimen was identified as *D. copei* based on the presence of discrete dorsal patches lacking dermal and epidermal melanophores. This is the first record of an albinistic specimen for this species (Dyrkacz 1981. SSAR Herpetol. Circ. 11). The specimen is essentially leucistic, based on criteria of Dyrkacz (*op cit.*). The only pigmentation on the head, body, and tail consisted of scattered epidermal black melanophores on the dorsal and lateral surfaces, giving the salamander a light gray appearance. Melanophores were most concentrated along the base and tip of the tail. The venter lacked pigmentation and appeared translucent. The specimen had melanic eyes with some coppery chromatophores above the pupil. The most conspicuous feature was the lack of dense, brown dermal melanophores typical of the species. The specimen was kept in captivity for a few weeks, but did not exhibit marked color changes that might be attributable to the influence of environmental factors (Fernandez and Bagnara 1991. Gen. Comp. Endocrinol. 83:132–141). Three partial albino *D. tenebrosus* larvae reported by Nussbaum (1976. Misc. Publ. Zool. Univ. Michigan 149:1–94) had a similar description: they had reduced dorsal pigmentation and black eyes, but no specific mention of coppery ocular chromatophores was made.

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ENSATINA ESCHSCHOLTZII OREGONENSIS (Oregon Ensatina). **COLONIZATION**. *Ensatina eschscholtzii oregonensis* is one of the most common terrestrial salamanders in managed (Aubry 2000. J. Wildl. Mgmt. 64:1041–1052; Butts and McComb 2000. J. Wildl. Mgmt. 64:95–104; Grialou et al. 2000. J. Wildl. Mgmt. 64:105–113) and unmanaged (Aubry and Hall 1991. *In* Ruggiero et al. [tech. coord.], Wildlife and Vegetation of Unmanaged Douglas-fir Forests, pp. 236–338. U.S. Forest Service, Gen. Tech. Rep. PNW-285; Bury et al. 1991. *In* Ruggiero et al., *op. cit.*, pp. 341–350) forested landscapes in the Pacific Northwest. Despite a general notion of abundance, knowledge of its movement ecology, and thus, colonizing potential, is largely unknown. Hence, we present data from a human-altered landscape in western Washington (USA) that provide preliminary information on this species' colonization ability.

The site is in rural Thurston County northwest of Olympia, 3.2 km S of the end of the Cooper Point Peninsula between Budd and Eld Inlets on the south end of Puget Sound (47°06'59.7"N, 122°56'09.4"W). At 36 m elev., habitat consists of a successionally varied mosaic of Douglas-fir (*Pseudotsuga menziesii*)-western hemlock (*Tsuga heterophylla*) forest (Franklin 1988. *In* Barbour and Billings [eds.], North American Terrestrial Vegetation, pp. 104–130. Cambridge University Press, New York). The focal area is a 0.33-ha unit with its long axis (~130 m) bordering 59th Avenue, a single-lane (4 m wide) paved road with a 1.5-m open shoulder on each side. Most of the unit has 60–100 year old Douglas-fir, but the east quarter, which abuts a 0.6-km gully draining to Eld Inlet, is vegetated with red alder (*Alnus rubra*) and big leaf maple (*Acer macrophyllum*). The area to the immediate north (i.e., along 59th Avenue) is a > 5 ha Douglas-fir forest of similar age, whereas areas to the immediate west, south, and east are variously developed with single-dwellings on large (≥ 0.5 ha), but heavily manicured parcels, or horse pastures. Soil is a high clay fraction, highly compacted glacial till (USDA Soil Conservation Service 1990. Soil Survey of Thurston County).

In January 2001, all trees except one 120-cm DBH Douglas-fir were removed from the middle third of the focal unit, and an understory (mostly English holly [*Ilex opaca*] and Himalayan blackberry [*Rubus discolor*]) was removed from 90% of that area. Thus, except for the trees left standing on the east and west thirds, most of the unit had a relatively uniform exposed compacted clay surface during 2001. On 17 July 2001, 6.1 m^3 gravel-to-small boulder-sized basaltic rock was deposited on this barren surface over a 12-m^2 area at 2 m S of 59th Avenue near the unit mid-point. Between late July and October 2001, hand removal of rocks reduced the volume of this pile about two-thirds with the remnant covering 4 m^2. During removal, the substrate and rocks were dry, and no *E. e. oregonensis* were noted. On 19 February 2002, during preparation to move the remaining pile with a tractor, we found a juvenile (40 mm SVL) *E. e. oregonensis* after turning only a few rocks. To avoid injury to other salamanders potentially present,

we systematically dismantled the rest of the pile by hand prior to tractoring it. This search revealed 11 additional *E. e. oregonensis.* All were concentrated in a 1 m^2 area that had been the least disturbed, had the best developed interstitial spaces (interstitial spacing in much of the pile was limited because mud and crushed rock filled spaces among rocks), and was nearest the road. Of 12 salamanders found, 9 were smaller (SVL: mean = 39.4 mm, range: 34.0–45.0 mm; mass: mean = 1.7 g, range: 1.2–2.3 g) and could not be confidently sexed. The other three were larger (SVL: mean = 53.5 mm, range: 51.0–56.0 mm; mass: mean = 3.5 g, range: 2.6–4.8 g) and were sexed based on development of cirri, oviducts, or eggs (the latter two by candlelighting). Two of the larger individuals were females. The largest (56 mm SVL, 4.8 g mass) was a female carrying at least 6 eggs, each ca. 3 mm in diameter.

Salamanders had to move at least 10 m to reach the rock pile (closest occupied habitat is 10 m N across 59th Avenue). If movements were from other directions, distances moved may have been considerably greater than 10 m; Staub et al. (*op. cit.*) cautioned against long-term sampling of *Ensatina* with small plots precisely because of the frequency of movements > 10 m. Most colonizing individuals were juveniles and the remainder appeared to be young adults, suggesting that young individuals may be the more frequent colonizers. Colonization likely occurred after September 2001. *Ensatina* are known to move following fall rains (Stebbins, *op. cit.*), so we expect that colonization of the pile occurred after 11–15 October, when the first soaking fall rains occurred in 2001. Our observations emphasize that colonization of proximate novel habitat can occur within four months within the same season, given environmental and seasonal conditions appropriate for movement. Because we do not know the precise date of colonization, potential exists for colonization to occur in a few days of novel habitat creation depending on its timing. Lastly, it emphasizes that human alteration of such habitat may require awareness that colonization may have occurred in order to avoid placing salamanders at risk.

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NOTOPHTHALMUS VIRIDESCENS LOUISIANENSIS (Central Newt). **BRANCHIATE ADULT**. The life cycle of *Notophthalmus viridescens* has been described previously by many authors, but only a few branchiate adults (those possessing retained gills) have been reported. We collected 17 *N. viridescens louisianensis* from a small partly wooded, man-made pond on 26 January 2002. This pond was located ca. 0.4 km east of Taylor Road, Randolph Co., Arkansas (T20N R3W Sec 4). Upon examination we discovered one branchiate adult that appeared in every other respect to be an adult male/female aquatic form. The individual possessed external gills, gill slits, and free opercular folds. This observation appears to be the first recorded instance of this morphology from Arkansas (Trauth, Plummer, and Robison. ms. in prep.). The locality where this individual was collected has been subjected to a multi-year drought that undoubtedly spanned the lives of the branchiate individual, its parents, and possibly the grandparents. The pond is permanent and fishless. These combined attributes may have induced the expression of branchiate phenotypes within this Ozark population, since this morphotype had not been discovered during previous visits to the site.

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PLETHODON CINEREUS (Eastern Red-backed Salamander). **CANNIBALISM**. For many species of Plethodontidae, the risk of cannibalism of juveniles by adults is believed to be an important force affecting their socioecology (Camp and Lee 1996. Copeia 1996:78–84; Jaeger and Forester 1993. Herpetologica 49:163–175; Jaeger et al. 1995. Ecology 76:533–543). However, unlike more aquatic salamanders with long larval periods (e.g., *Ambystoma* spp.), evidence of cannibalism for more terrestrial species is rare. Adult cannibalism of juvenile *P. cinereus* has been reported in staged laboratory encounters (Bachmann 1984. Herpetologica 40:436–443; Wareing 1997. Honor's Thesis, State Univ. New York at Binghamton, Binghamton, New York), but a review of numerous studies summarizing the diets of thousands of *P. cinereus* has failed to find a single case of adult cannibalism of a juvenile, and one of us (JCM) has sampled the diets of several thousand adult *P. cinereus* from numerous sites, in all seasons, and under a variety of conditions, and never documented a single event of cannibalism (Maerz, unpubl. data).

On 9 May 2001, within 24 h of rain, we conducted a routine survey of artificial coverboards at a long-term mark-recapture study site in Syracuse, New York, USA. During the survey we collected diet samples from 52 *P. cinereus* by stomach flushing (*sensu* Fraser 1976. Ecology 57:459–471). We recovered a juvenile *P. cinereus* from the stomach of an adult male *P. cinereus*. The juvenile was a striped morph 11 mm in length between the fore and hind limbs (could not determine SVL because of state of digestion). The juvenile's size indicates it was a young-of-year hatched in August 2000. The head of the juvenile was almost completely digested, the forelimbs were partially digested with all the skin gone, and posterior of the mid-trunk was slightly digested with most of the skin intact and stripe clearly visible. This suggests the juvenile was swallowed headfirst. The juvenile's tail was detached and well digested, suggesting the male may have attacked toward the tail first, the tail autotomized and was consumed, and then the male attacked the juvenile a second time. The male that consumed the juvenile was a lead morph, 39 mm SVL, reproductively active, and a recurring resident under the coverboard. On the day we recovered the cannibalized juvenile from the male, we also found another *P. cinereus* young-of-year and a juvenile *P. cinereus* 35 mm SVL under the same coverboard. In addition to the juvenile *P. cinereus*, the male's stomach contained a centipede (1.46 x 0.67 mm), an isopod (1.83 x 1.28 mm), a small dipteran (1.55 x 1.01 mm), and part of an earthworm (4.66 x 0.94). The number and volume of prey in the male's diet was normal to above average

(Maerz 2000. Ph.D. Diss., State Univ. New York at Binghamton, Binghamton, New York). Based on the amount of other prey in the male's stomach and that the sample was collected within 24 h of rain when access to prey is generally not limited for *P. cinereus* (Jaeger 1980. Oecologia 44:335–341; Maerz 2000, *op. cit.*), it is unlikely that the male was food-limited at the time he cannibalized the juvenile.

Our observation of adult cannibalism of a juvenile in a wild *P. cinereus* population is the first such observation that we are aware of. Because the diets of *P. cinereus* have been studied extensively, it is unlikely that the rarity of cases of cannibalism in wild populations is the result of limited observation. Rather, it is likely that behaviors reduce the real occurrence of cannibalism in the wild. Adult *P. cinereus* can identify and avoid cannibalizing their own offspring (probably chemically) (Jaeger et al. 1995, *op. cit.*; Waering 1997, *op. cit.*; Wareing 1998. Master's Thesis, State Univ. New York at Binghamton, Binghamton, New York), and some juvenile *P. cinereus* can use chemical cues to avoid unrelated adults and their territories (Wareing 1997, *op. cit.*; Forester and Anders 2000. *In* Bruce et al. [eds.], The Biology of Plethodontid Salamanders, pp. 407–416, Kluwer Acad./Plenum Pubs., New York, New York; though see Wareing 1998, *op. cit.*). Our observation shows that cannibalism does occur in wild *P. cinereus* populations, and when considered in the context of laboratory studies, supports the inference that cannibalism is an important force shaping *P. cinereus* social behaviors.

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SIREN INTERMEDIA NETTINGI (Western Lesser Siren). **PREDATION**. Natural predators of *Siren intermedia* remain largely undocumented (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Inst. Press, Washington, D.C. 587 pp.), but are known to include mink (*Mustela vison*) and great egret (*Casmerodius albus*) (Frese and Britzke 2001. Herpetol. Rev. 32:99). The following observations, made from the margins of a bald cypress swamp at Lake Martin, St. Martin Parish, Louisiana, USA, represent two previously undocumented predators of *S. intermedia*.

On 30 November 2001 at 0900 h, RCD observed a great blue heron (*Ardea herodias*) standing in shallow (< 50 cm) water, killing and consuming a *S. intermedia*. From a standing position, the heron captured the siren with its bill from at or beneath the surface of the water. For ca. 3 min, the heron bit down on the siren's neck and repeatedly moved the siren back-and-forth through its bill, rapidly biting the entire length of the salamander, including the anterior portion of the tail. The heron then consumed the siren in a single action, by swallowing it headfirst. Based on the size of the heron, the *S. intermedia* was judged to be 30–35 cm TL. This observation was made with 8 x 30 binoculars from a distance of ca. 25 m.

On 15 December 2001 at 0830 h, we observed a red-shouldered hawk (*Buteo lineatus*) carrying a *S. intermedia* in its talons (in flight) to a horizontal bald cypress branch 12–14 m above the surface of shallow water, where it landed and began consuming the salamander. Initially chased by another red-shouldered hawk, the hawk possessing the siren did not interact with any other birds while perched. On its perch, the hawk held the siren's body between its talons and the branch, with the siren's tail dangling over the branch. After perching motionless for 2–3 min, the hawk began tearing, with its bill, and consuming flesh from the neck and head of the siren. Because we did not observe the actual predation event, we are unable to state exactly how the hawk acquired the siren. Based on the size of the hawk, the *S. intermedia* was estimated to be 30–35 cm TL. This observation was made with a 40x spotting scope from a distance of ca. 30 m.

Although neither *S. intermedia* observed could be collected, both were identified based on the presence of conspicuous reddish external gills and a clear absence of rear legs (front legs were visible on both individuals). Both of these characteristics eliminate the only sympatric and superficially similar animal, *Amphiuma tridactylum*. The size of both specimens (30–35 cm TL) is also consistent with the 18–69 cm TL range of *S. intermedia*, and well below the 46–106 cm TL range of *A. tridactylum* (Petranka 1998, *op. cit.*).

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ANURA

ADENOMERA* cf. *ANDREAE (NCN). **VOCALIZATION**. The importance of advertisement calls in species recognition and as pre-mating isolating mechanisms in most species of anurans has long been recognized (Blair 1964. Quart. Rev. Biol. 39[4]:334–344; Blair 1974. Amer. Zool. 14:1119–1125). The distinctiveness and species-specificity of these calls allow workers to identify individual species under field conditions, making them particularly useful in discriminating among cryptic species. Such is the case in the Neotropical leptodactylid genus *Adenomera*, which has typically been a systematically difficult group given the overall similarity among member species. Heyer (1984. Amphibia-Reptilia 5:97–100) suggested that topotypic advertisement call data could help resolve *Adenomera* systematics, and current research involving vocalizations indicates there are cryptic species within some of the more widespread nominal species in the Amazon Basin and southeastern Brazil (Angulo, Cocroft, and Reichle, *in press*, Herpetologica; Boistel, de Massary, and Angulo, *in press*, Amphibia-Reptilia; Kwet and Angulo, *in press*, Alytes).

Adenomera andreae and *A. hylaedactyla* are the two nominal species known to occur over a wide area of sympatry in the Amazon Basin, with *A. diptyx* at the southernmost border of the Basin (I. De la Riva, pers. comm.). Audio recordings of individuals from a population in Campamento Segakiato, on the margins of Rio Camisea, province of La Convención, department of Cusco, southeastern Peru (11°48'23"S, 72°52'51"W, 380 m elev.), have been compared to the call data available for populations elsewhere in the Amazon Basin. Herein we report on a new vocalization for Amazonian *Adenomera*, represented by one vouchered individual (Museo de Historia Natural de San Marcos, Lima, Peru; MHNSM 18219) and three unvouchered recordings (N = 4 frogs).

The vouchered male was calling with other conspecifics, on the forest floor, close to a stream, at an air temperature of 27°C. Of the three unvouchered males, two were recorded at 27°C and one at

TABLE 1. Summary of acoustic parameters of the new vocalization for *Adenomera* cf. *Andreae* (N = 4 frogs; 30 calls per frog, N = 120 calls).

	Call length (ms)	Call rise time (ms)	Call rate (calls/min)	Dominant frequency (DF) (Hz)	Secondary frequencies (Hz)		Change in DF (Hz)
Mean	29	6.44	60.5	2370.06	4682.59	7118.85	558.6
SD	4.09	4.06	13.14	76.57	110.27	114.31	163.74
Range	21.2–37.7	1.6–14.8	30–78	2247.7–2466.5	4475.6–4873.4	6663.7–7304.6	1203.1

26°C. Recordings were obtained on 12 October 1997 between 1730 and 1750 h, using a Sony Walkman Professional WM-D6C tape recorder and AKG D 1200E microphone. Signals were analyzed using Signalyze 3.12, a Macintosh-based program, sampling at a rate of 44100 Hz and 16 bytes resolution. Acoustic parameters measured and their corresponding values are in Table 1. The definition of all parameters, with the exception of secondary frequencies (frequency bands other than the carrier that contain significant energy), and change in dominant frequency, follows Cocroft and Ryan (1995. Anim. Behav. 49:283–303). Change in dominant frequency is defined as dominant frequency at the end of the signal minus dominant frequency at the beginning of the signal.

The vocalization has a mean duration of 29 ms, occurring at a relatively low call rate (ca. 60.5 calls/min). Two individuals consistently presented a call "trail" (Fig. 1b) which follows the main signal in either a sustained or interrupted fashion, but as the other callers did not have this feature, call measurements were done on the main signal. The duration of the main signal plus the trail is highly variable (40–97 ms). The fundamental frequency is at the same time the dominant frequency, with an upward frequency glide of about 500 Hz.

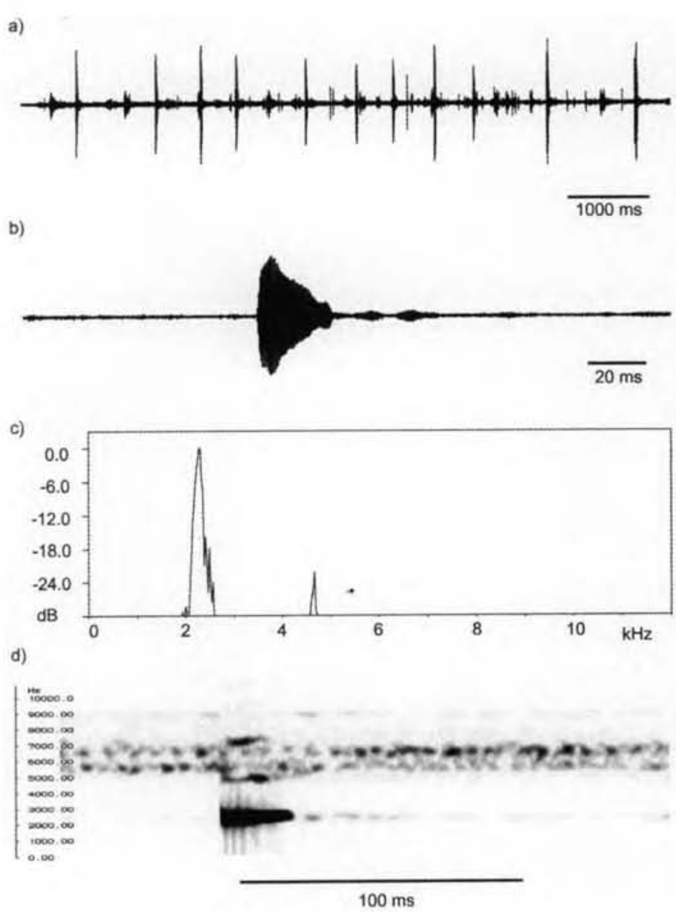

FIG. 1. a) Oscillogram of several calls and b) waveform, c) power spectrum and d) spectrogram of a single call.

In an attempt to determine the identities of these individuals we examined acoustic parameters of Amazonian *Adenomera* from calls reported in the literature. We also compared our results with recordings of a sympatric *A. hylaedactyla* and recordings elsewhere in the Basin (Angulo, Cocroft, and Reichle, unpubl. data.). The new vocalization differs from unpublished recordings and from those previously reported by having a dominant frequency that is at the same time the fundamental frequency, while in all other cases (*A. andreae, A. hylaedactyla*, and *A. diptyx*) the main carrier is the second harmonic. The new call type is notably shorter than that of *A. andreae* (Zimmerman and Bogart 1984. Acta Amaz. 14:473–519), *A. diptyx* (as *A. andreae* in Márquez et al. 1995. J. Zool. Lond. 237:313–336 [I. De la Riva, pers. comm.]), and *A. hylaedactyla* (Heyer 1973. Contr. Sci. Nat. Hist. Mus. Los. Angeles Co. 251:1–50; Straughan and Heyer 1976. Pap. Avulsos Zool. 23:221–245; Schluter 1980. Salamandra 16[4]:227–247; Schneider et al. 1988. Zool. Jb. Physiol. 92:77–103; Márquez et al. 1995, *op. cit.*).

Considering its short call length and peculiar spectral energy distribution, and given that it occurs in sympatry with *A. hylaedactyla* and at least one other *Adenomera*, this vocalization is sufficiently different from any other known Amazonian *Adenomera* call to presume it to represent a distinct but cryptic species. Given that the group is currently the subject of systematic studies and that the taxonomy may change, we have called this population *Adenomera* cf. *andreae* as the specimen shares some characters with nominal *Adenomera andreae* and occurs in forested habitats.

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AGALYCHNIS CALLIDRYAS (Red-eyed Treefrog). **REPRODUCTION.** This species usually deposits eggs on vegetation overhanging temporary and permanent ponds (Duellman. 2001. The Hylid Frogs of Middle America. SSAR Contrib. Herpetol. 18:i–xvi, 1–694, i–x, 695–1159). McCranie and Wilson (2002. The Amphibians of Honduras SSAR Contrib. Herpetol. 19:i–x, 1–625), in addition to these usual breeding sites in Honduras, reported finding an amplectant pair on passion flower vines growing above a trickle of water coming from a pig pen, amplectant pairs in primary rainforest where the only other nearby surface water seen was that in streams and a river and a tree buttress, tadpoles in small water-filled depressions made by human and pack animal traffic along a trail (these depressions lacked overhanging vegetation where eggs are normally laid), tadpoles in a small stationary side pool of a stream in the dry season, egg clutches attached to the rubber walls of a water collecting device with tadpoles in the stagnant water of this device, and eggs attached to the walls below the seat in a latrine (although it is highly unlikely that tadpoles from this egg clutch could survive). Some of these unusual breeding sites were in heavily deforested areas.

On 5 August 2001 in primary lowland rainforest (60 m elev.) at Caño Awawás (14°49'N, 84°52'W), Gracias a Dios, Honduras, at ca. 1200 h, we located a fallen tree with a long cavity of water. Upon examining the log, we found several clutches of greenish colored *Agalychnis* eggs attached to leaves of vines and small trees overhanging the water-filled cavity and *Agalychnis* tadpoles in the water. One egg clutch (USNM 549422) and one lot of tadpoles (USNM 549423) were collected at that time. We returned to the site at dusk (ca. 1600 h) on the same day and waited for dark. The distinctive call of *A. callidryas* was heard in the trees above the log. After dark (ca. 1700 h) we examined the log and saw several *A. callidryas* around the log and in vegetation above the log. We collected two adults (USNM 549331–32) and made another collection of *Agalychnis* tadpoles (USNM 549424). Examination of these two tadpole lots (stages 25–37; Gosner 1960. Herpetologica 16:183–190) confirmed that they were *A. callidryas* tadpoles. Observations over the years in Honduras have revealed that *A. callidryas*, with its specialized mode of reproduction (normally laying eggs on vegetation overhanging temporary and permanent ponds), has surprisingly adapted to breeding in a wide array of habitats. This ability to adapt has allowed the species to remain common in some places even after its primary rainforest habitats are completely deforested.

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BUFO FOWLERI (Fowler's Toad) and ***MALACLEMYS TERRAPIN TERRAPIN*** (Northern Diamond-backed Terrapin). **REFUGIA AND NESTING.** In the context of a nesting and hatchling study of *Malaclemys terrapin* during Summer 2000 and 2001 in Bayville New York, we recorded multiple observations of the use of terrapin nest excavations by *Bufo fowleri*. Our study site is a 1-ha, flat, sandy plot adjacent to an estuarine marsh of Oyster Bay, on the north shore of Long Island.

In our study site, female terrapins frequently begin an excavation and abandon it before it is complete, moving several meters to another location. Such excavations, typically 5–10 cm deep, which we have termed "test holes," are common in our study site. Once the female completes an acceptable nest it is cylindrical, ca. 11–20 cm deep, and the egg chamber usually measures 4–10 cm in diameter (Montevecchi and Burger 1975. Amer. Midl. Nat. 94:166–178). In our study site, when the hatchlings emerge from the nest they often leave a conspicuous oval-shaped emergence hole, which is ca. 3–5 cm across at the surface and extends ca. 4–12 cm deep (Bossert and Draud, unpubl. data). Approximately 25% of the terrapin nests were predated by raccoons in our study site. This predatory action left a hole that was slightly larger in diameter than, and as deep as, the original egg chamber.

During September 2000 we examined 58 emergence holes and found *Bufo fowleri* residing in 3 (5.2%). During June 2001 we examined 28 test holes and found 2 *B. fowleri* (7.1%). In addition, we examined 20 raccoon-predated terrapin nests, and found 1 toad (5%). During September 2001, we examined 63 emergence holes and recorded 5 more resident toads (7.9%). Thus, over the two-season period, 6.5% of the 169 terrapin excavations examined had toads residing in them. Over the same two-season period, seven other toad observations were recorded in the study site (e.g., under various objects or hopping along the ground).

The Fowler's toads found residing in terrapin excavations ranged from 42–63 mm SVL. It is unknown if all 11 occasions were different toads, but from the locations, times, and sizes we believe that they were. In each case, a solitary toad was buried in the soft sandy soil at the bottom of the nest, head facing up. Our data do not allow us to comment specifically on the length of time the toads spent within the terrapin excavations, but in 2001, 2 of the 8 observed toads remained in the same excavation for at least 3 days. Since nest density is high in our study site (mean density = 2.22 nests /100 m^2), it is entirely possible that they would use several different excavations within their home range, which has been conservatively reported to range between 100 and 1000 m^2 (Clarke 1974. Amer. Midl. Nat. 92:257–274).

Bufo species use various naturally occurring depressions for water conservation, crypsis, and thermoregulation, and *B. fowleri* have been reported to use small mammal burrows (Clarke 1974, *op.cit.*), but to our knowledge this is the first published report of their use of turtle excavations. Fowler's toads are thought to dig into loose sand to hibernate and typically are not active at the surface after late September in our study area. Given our discovery of toads buried in terrapin excavations in late September (latest observations was 25 Sept) we believe it is likely that in addition to using the excavations as refugia, they may also use them for hibernacula. Fowler's toads have also been observed in empty terrapin nests in Wellfleet, Massachusetts (Don Lewis, pers. comm.). It is unknown how widespread the use of empty turtle nests by Fowler's toads might be, but we speculate that wherever large populations of toads coincide with active turtle nesting areas, it is likely to be a common occurrence.

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CYCLORAMPHUS BORACEIENSIS (Flattened Waterfall Frog). **CLUTCH ATTENDANCE**. The 25 known species of *Cycloramphus* occur in the coastal Atlantic Forest. Information on reproduction is scarce and is restricted to two species. In both, the eggs are laid outside the water, are large, and are attended by the female (Heyer and Crombie 1979. J. Washington Acad. Sci. 69:17–20) or by the male (Giaretta and Cardoso 1995. Revta Bras. Zool. 12:233–237). On 2 January 2001 (1200 h), at the Cachoeira do Ipiranguinha, (Ubatuba, SP, Brazil; 23°26'S; 45°04'W), we found a clutch of *C. boraceiensis* eggs in a rock crevice near a waterfall. Close (30 cm) to this clutch we found a male hidden under a dead leaf. This male was collected, examined for natural marks, and released at the point of collection. We returned to the site during the night (2030 h) and found that the previously discovered male was sitting beside the clutch (Fig. 1). This male (AAG-UFU 2309, Museu de Biodiversidade do Cerrado, Universidade Federal de Uberlândia) measured 40.9 mm SVL. The clutch contained 43 eggs, and the embryos (10 mm TL) were at stage 22 (Gosner 1960. Herpetologica 16:183–190). Another association between a male *C. boraceiensis* (36.8 mm SVL) and an egg clutch (58 eggs, stage 17 embryos) was observed at the same waterfall on 28 December 1989. This male was in a situation similar to that illustrated in Fig. 1, during the day (0800 h). Male *C. dubius* remain close to their eggs and repel approaching objects. The presence of males of *C. boraceiensis* beside the clutch is suggestive of paternal care in this species, as in *C. dubius*.

FIG. 1. Adult male *Cycloramphus boraceiensis* close to a clutch of eggs in a rock crevice. Note that the eggs are in contact with one another and in a single layer; note also the late stage embryos inside the eggs.

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CYCLORAMPHUS BORACEIENSIS (Flattened Waterfall Frog). **DEFENSIVE BEHAVIOR.** The leptodactylid *Cycloramphus boraceiensis* is restricted to the coastal Atlantic Forest of Brazil (Heyer et al. 1990. Arq. Zool. 31[4]:231–410). During field work between January 2000 and April 2002 at Núcleo Picinguaba (44°50'W; 23°23'S, 10–50 m elev.), Parque Estadual da Serra do Mar, in the municipality of Ubatuba, State of São Paulo, Brazil, we observed bite defensive behavior in *C. boraceiensis*. When disturbed, individuals of this species usually remained motionless with limbs close to the body (death feigning). Although, on 6 occasions we observed individuals biting the hand of one of us when they were hand-captured. This species inhabits wet rock surfaces in forest streams, and due to its concealing coloration the primary defense was crypsis; secondary defense was thanatosis (death feigning) and biting. Bite behavior for the genus *Cycloramphus* was described for *C. dubius* by Giaretta and Cardoso (1995. Revta. Bras. Zool. 12[2]:229–232), and was considered parental care behavior, because individuals were found near clutches. In the present report we have not observed clutches near the individuals of *C. boraceiensis*. One individual of *C. boraceiensis* captured a frog (*Hylodes phyllodes*) used as bait, and another individual was observed preying on a tadpole of *Thoropa miliaris* which inhabits humid rock surfaces. These episodes suggest that *C. boraceiensis* is a voracious predator that may use this biting behavior as a defensive mechanism. Among defensive behaviors, biting is considered one of the ultimate defensive mechanisms (Duellman and Trueb 1986. Biology of Amphibians. McGraw Hill, New York, New York. 670 pp.).

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GASTROPHRYNE CAROLINENSIS (Eastern Narrow-Mouthed Toad). **MAXIMUM SIZE**. On 20 June 1992 an adult *Gastrophryne carolinensis* (39 mm SVL) was collected in T36N R18W Sec 1, Dallas County, Missouri, USA, by K. R. Toal and C. Sheil. This specimen (University of Kansas, KU 220524) exceeds the maximum size reported by Conant and Collins (1998. Reptiles and Amphibians of Eastern and Central North America. Third Ed. Expanded. Houghton Mifflin, Boston, Massachusetts. xviii + 616 pp.).

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HYLA BERTHALUTZAE (NCN). **OVIPOSITION BEHAVIOR**. *Hyla berthalutzae* is a small treefrog with a distribution in the coastal lowlands from the State of Espírito Santo to São Paulo, and Serra do Mar, São Paulo, Brazil (Frost 1985. Amphibian Species of the World. Allen Press, Inc. and Assoc. Systematics Collections. Lawrence, Kansas. 732 pp.). From 29 reproductive modes

recognized by Duellman and Trueb (1986. Biology of Amphibians. McGraw-Hill Book Company, New York. 670 pp.), *H. berthalutzae* fits in mode 18: eggs arboreal, with hatchling tadpoles dropping into ponds or streams. Herein, we report oviposition behavior of this species in a temporary pond at Campo dos Escoteiros Geraldo Hugo Nunes (22°34'S, 43°02'W), Municipality of Magé, in the foothills of Serra dos Órgãos, State of Rio de Janeiro, southeastern Brazil.

The observations took place during the rainy nights of 17 September and 22 November 1996. The schedule of each mating sequence (ms) observed is in parenthesis. On 17 September, we observed a female approaching a calling male. When she jumped onto the same leaf where the male was calling, he immediately jumped on the female's back and grasped her in an axillary amplexus (ms-1, 2215 h). Then, the female carried the male onto another leaf (different from the male's perch) and remained on the middle of the leaf looking downward (ms-2). Only the female grasped the leaf. After a few minutes ($\leq$ 3 min), the pair in amplexus turned up and the female began to descend to the tip of the leaf (ms-3). On the tip of leaf, before liberation of eggs, the female alternately stretched and retracted her hind limbs (2227 h), perhaps verifying the leaf's end or signaling the imminence of liberation of eggs to the male (ms-4). At the moment of oviposition, the pair moved upward as several eggs were released in a thin gelatinous layer onto the top surface of the leaf (2231 h). After about five minutes, the male emitted a tenuous call (2238 h) and left the female (ms-5, 2242 h). The abandoned female began (2248 h) to push (or shake) the clutch with her hind limbs, alternating with intervals of rest (ms-6), for about 50 minutes, she then deserted the clutch. These movements appeared to push the clutch to the tip of the leaf. An alternative explanation suggests that this behavior may influence the fertilization of eggs by shaking the gelatinous mass. Some hours after oviposition the clutch remained hanging on the tip of the leaf above the pond; it had obviously increased in volume, likely influenced by rain or high humidity.

On 22 November, we observed another pair in amplexus. All of the mating sequences described above were observed. However, before amplexus the female performed mating sequences 2–4 alone. Afterwards, she established amplexus with a male that was ca. 40 cm away and then returned to the same leaf and spawned. Quantitative parameters of the clutches are (mean $\pm$ SD): number of eggs = 49 ± 10 (N = 11), diameter of eggs = 4.4 ± 0.5 mm (N = 20), clutch size: length = 4.4 ± 0.5 cm (N = 10), width = 1.8 ± 0.6 cm (N = 10), height above the pond = 24.4 ± 9.0 cm (N = 10).

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HYLA MICROCEPHALA (NCN). **HABITAT.** Many frogs utilize burrows of other animals to avoid heat or desiccation (Lips 1991. J. Herpetol. 25:477–481; Dundee 1999. Herpetol. Rev. 30:91–92), or create their own chambers in mud to aestivate (Duellman and Trueb 1986. Biology of Amphibians. J. Hopkins University Press, Baltimore, Maryland. 670 pp.). However, such behavior is unusual among hylid frogs (but see Tucker et al. 1995. Herpetol. Rev. 26:32–33). During the first two weeks of March 2001, I observed a total of eight small hylids (2.0–2.5 cm SVL) under rocks along the bank of Rio Las Marias, Venezuela (9°10'N, 69°44'W). Based on photos, these frogs have been tentatively identified as *Hyla microcephala* (W. E. Duellman, pers. comm.).

The locality was in the Andean piedmont where a small river (3–5 m wide, 0–1.5 m deep) passes through degraded deciduous forest. One bank was relatively flat and composed of sand, gravel, and cobbles, with many cobbles and small boulders at the surface. While searching under large rocks (10–30 cm diam) along the shoreline, I discovered several frogs. I continued to find them sporadically along a 200 m length of riverbank during a two-week period. Most observations were of a single frog occupying a rock, but two individuals were in contact under the same rock in one case.

As the water level steadily dropped during mid-March, I searched exhaustively for frogs under ca. 100 rocks situated at different distances from the river in an area of ca. 25 m^2. Only two rocks within 20 cm of the water line had frogs underneath, which roughly coincided with the distance at which the soil beneath the rocks remained visibly moist. Given that the rocks where I first observed *H. microcephala* were 2 m away from the water line by the time of the last observation, I infer that these frogs were relocating as the water dropped to stay in a humid environment. Despite working along the river daily during January–March 2001, my only observation of a *H. microcephala* not under a rock was a single individual seen at midnight near the shore in mid-March.

There was no evidence of burrowing near occupied rocks, hence *H. microcephala* probably used only rocks with pre-existing passages. There was no obvious evidence of extreme torpor or specialized secretions among the individuals observed. This is the first record of this species using underground refuges, and short-term use of shoreline rocks as refuges from the prevailing low humidity and high temperatures may have been critical for survival during this particularly dry year.

I thank W. Duellman for identifying the frogs from photos, A. Flecker for facilitating my work at Rio Las Marias, and H. Greene for helpful comments on this note.

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PHLYCTIMANTIS KEITHAE (Wot-wot). **DEFENSIVE BEHAVIOR**. The African Hyperoliidae includes a clade of large terrestrial or climbing frogs in the genera *Kassina*, *Phlyctimantis*, and *Semnodactylus*. When disturbed, many display balling behavior; tucking the limbs in, bending the body forwards, and lowering the head with retracted eyes. We report on a novel anti-predator behavior shown by the wot-wot, *Phlyctimantis keithae*.

Phlyctimantis keithae is restricted to the Udzungwa Mountains, part of the Eastern Arc highlands of Tanzania. Locally the frog is common and known as a wot-wot, an onomatopeic form of the advertisement call. The back and sides are dark purple, with bright orange patches on the thighs. Observations were made at Luisenga,

a nature reserve and man-made lake within a tea plantation (08°36'51.2"S; 035°20'22.8"E, 1855 m) 8–9 November 1999. When disturbed by gentle prodding, the frog rapidly twists onto its back, throwing its limbs across the body (Fig. 1). The position is assumed so quickly that it would be appropriate to describe this action as snapping into position. The frog maintains this cryptic posture for about 20 sec, and then returns to typical position in one or two rapid intermediate jerks, holding each for a few seconds before returning to normal posture. Four frogs tested adopted similar positions. The animal holding this defensive pose looks quite un-froglike, displaying the orange patches and belly pattern, while keeping the eyes open.

Some observations are available for defensive behavior of two of the three other species of *Phlyctimantis*: *Phlyctimantis boulengeri* places the head between the forelegs, while raising the sacral region which displays the red coloration of the hind legs (Rödel and Ernst 2001. Alytes 18:178–186). Rödel and Ernst (*op. cit.*) report that the frog produces a sticky secretion over the skin. In Uganda, *P. verrucosus* secretes a bad-smelling thick mucus over the skin (Drewes and Vindum 1994. J. Afr. Zool. 108:55–70). None of the many *P. keithae* we have handled has produced any defensive mucus.

This behavior is sometimes referred to as "death-feigning," although in the case of the wot-wot the behavior would appear to result in camouflage, by either breaking up the outline or changing the overall shape of the animal, presumably to conflict with a predator search-image.

Although Rödel et al. (2000. Salamandra 36:125–130) did not observe similar behavior in the related *Kassina senegalensis*, *K. fusca*, or *K. cassinoides*, Rödel and Braun (1999. Biotropica, St Louis 31:178–183) record one subadult *K. fusca* lying on its back with limbs outstretched.

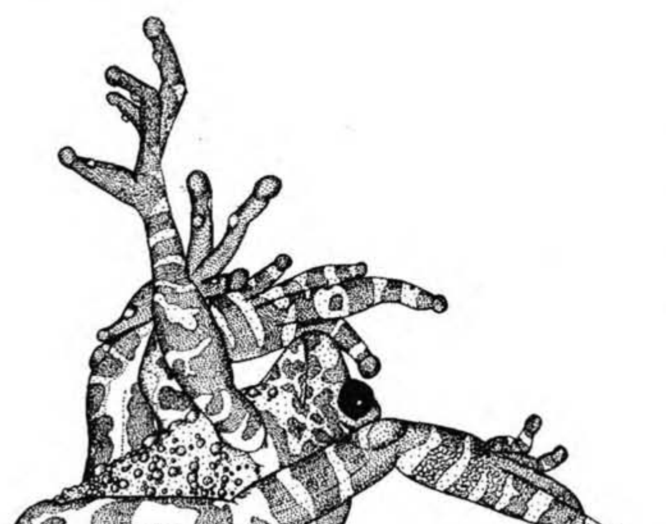

FIG. 1. Defensive posture assumed by *Phlyctimantis keithae* when disturbed. Drawn from a transparency.

The metamorphs of *Phlyctimantis keithae* are only known to ball. At Mufindi 10 metamorphs were found sheltering under a stone. Each was around 10 mm SVL. They resembled small spiders; the head and limbs were tucked in, with the bright orange patches showing. Related frogs we have seen balling include *Kassina kuvangensis* from northwestern Zambia, and *Kassina maculata*. Other reported examples include *Kassina lamottei* and one *K. cochranae* (Rödel et al. 2000., *op. cit.*), which remained in a ball for a few minutes, before slowly stretching out its limbs and moving off.

The Tanzania Commission for Science and Technology (COSTECH) is thanked for a research permit issued to AC. Greg Crutsinger prepared Fig. 1. Alison Channing is thanked for drawing our attention to this behavior in the field.

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PHYSALAEMUS PUSTULOSUS (Tungara Frog). **HABITAT.** Use of burrows created by other animals is common among frogs (Cocroft and Hambler. 1989. Biotropica 21:2–8; Lips 1991. J. Herpetol. 25:477–481). In many cases, spider burrows are used by frog species that are apparently invulnerable to predation by the resident spider (Dundee 1999. Herpetol. Rev. 30:91–92). *Physalaemus pustulosus* use spider burrows in Mexico (Powell et al. 1984. Salamandra 20:273–274), and here I report use of an active crab burrow in degraded deciduous forest within the Andean piedmont of Venezuela (9°10'N, 69°44'W). Throughout a three-week period (late-January to mid-February) of the dry season in 2001, I observed a *P. pustulosus* using this burrow as a refuge.

The burrow opening was ca. 6 cm in diameter, but its depth was not ascertained. On most nights, a tungara frog was sitting near the entrance to the burrow. When I approached, it often retreated into the burrow. On many nights, a crab was also visible just inside the tunnel, but I was unable to capture it for identification. On one occasion, I approached the burrow near midnight and the frog retreated into the tunnel. When the tunnel was illuminated, I could clearly see the frog resting inside with the crab between the entrance and itself. The frog had moved over or under the crab as it retreated into the burrow. Continued checks of the burrow revealed no evidence of the frog or crab from mid-February through mid-March.

Burrowing terrestrial crabs have never been seen at this site despite intensive fieldwork during the last 15 years (A. Flecker, pers. comm.). Thus, the crab in question was likely to have been an aquatic species (probably *Sylviocarcinus piriformis*) burrowing upward from the ground water table. Crayfish burrows linking the soil surface and water table are known to harbor North American frogs during dry conditions (Neill 1951. Ecology 32:764–766) and winter (Carpenter 1953. Ecology 34:74–80). Some crabs consume *P. pustulosus* (Ryan 1985. The Tungara Frog. Univ. Chicago Press, Chicago. 230 pp.), but the unusually severe dry season of 2001 may have enhanced the value of this refuge.

I thank M. Ryan for identifying the frog, G. Pereira for identifying crab photos, A. Flecker for facilitating my work at Rio Las Marias, and H. Greene for helpful comments on this note.

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PSEUDACRIS STRECKERI ILLINOENSIS (Illinois Chorus Frog). **SATELLITE BEHAVIOR**. Satellite behavior has been recognized in many anuran species (Robel 1985. J. Herpetol. 19:432–436). The short breeding season, limited range, and secretive lifestyle of *Pseudacris streckeri illinoensis* have left much of its natural history unknown. On 19 February 2002 we visited a chorus of *P. s. illinoensis* located about 2.5 km NW of Nimmons, Clay County, Arkansas, USA. The chorus was in a cotton field flooded with about 40 cm of water. Six aggregations of male *P. s. illinoensis* were observed. In each of these aggregations, a single male was calling from his perch while several non-calling males hovered within 15 cm of him. Aggregations ranged from 1 to 5 non-calling males (1, 2, 2, 3, 3, 5). Two aggregations were observed separately for about 5 minutes. One of the aggregations consisted of two satellites and the other had five satellites. In both cases only a single calling male was observed. In each instance none of the accompanying non-calling males vocalized despite incessant calling by the vocal male. All cases of apparent satellite behavior were observed in open water where isolated emergent vegetation (3–4 stems) was present. Along the south shore of this pond there was a large aggregation of about 25–30 males with plenty of emergent vegetation. In this area we could not determine if males were acting as satellites or not, although both calling and non-calling males were observed there. Based on these observations, satellite behavior may be facultatively expressed in response to available calling perches in this species. In this scenario, areas with few available calling perches would possess higher levels of satellite behavior, whereas in areas with a plethora of emergent vegetation the behavior should not be evident. Further investigations on the breeding biology and larval ecology of *P. s. illinoensis* are warranted in Arkansas.

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PSEUDACRIS TRISERIATA (Western Chorus Frog) **and *RANA SYLVATICA*** (Wood Frog). **CHYTRIDIOMYCOSIS.** The chytrid fungus *Batrachochytrium dendrobatidis* is a known pathogen of anuran amphibians, and has been correlated with amphibian die-offs worldwide (Daszak et. al. 1999. Emerging Infectious Diseases 5:735–748). In Colorado, *B. dendrobatidis* has infected Boreal toads (*Bufo boreas)* (Muths et. al., *in review*) and has been identified on museum specimens of northern leopard frogs (*Rana pipiens)* (Carey et. al. 1999. Develop. Comp. Immunol. 23:459–472). We report the first verified case of chytrid fungus in chorus frogs (*Pseudacris triseriata)* and wood frogs (*Rana sylvatica)* in the United States. We collected seven *P. triseriata*, and two adult and two juvenile *R. sylvatica* in the Kawuneeche Valley in Rocky Mountain National Park (RMNP) during June 2001. These animals were submitted to the National Wildlife Health Center (NWHC) as part of an amphibian health evaluation in RMNP. Chorus frogs were shipped in one container. Wood frog adults and juveniles were shipped in two separate containers. Histological examinations of all chorus frogs and 3 of 4 wood frogs were positive for chytrid fungus infection. The fourth (adult) wood frog was too decomposed for meaningful histology. Histological findings consisted of multifocally mild to diffusely severe infections of the epidermis of the ventrum and hindlimb digital skin. Chytrid thalli were confined to the thickened epidermis (hyperkeratosis), were spherical to oval, and occasional thalli contained characteristic discharge pores or zoospores (Green and Kagarise Sherman 1999. J. Herpetol 35:92–103; Fellers et al. 2001. Copeia 2001:945–953). We cannot confirm that all specimens carried the fungus at collection, because infection may have spread from one individual to all other individuals in each container during transport. Further sampling of amphibians in the Kawuneeche Valley is warranted to determine the rate of infection and mortality in these populations.

These specimens are catalogued in the National Wildlife Health Center Archives, *P. triseriata* 4761-020 through 4761-024; *R. sylvatica* 4762-001 and 4762-002. This work was funded by the Amphibian Research and Monitoring Initiative and the National Park Service. We thank S. Street, R. Scherer, and T. Barnes for their field support.

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RANA CURTIPES (NCN). **COLORATION**. In the present note, we report partial albino frogs and tadpoles of *Rana curtipes* from the Jog-falls area (14°13'N, 74°45'E) in the Western Ghat region (Karnataka, India). The normal or wild type adult *R. curtipes* is jet black except for a small golden brown patch on the dorsum. Tadpoles grow to a size of 75 mm and are jet black (Fig. 1A).

The population of *R. curtipes* occurring in the puddles of the Jog-falls area contain an albino strain mixed with the normal wild black type. The albinos are light orange or golden yellow, however their eyes are normal and black (Fig. 1A, B). Frazer (1983. Reptiles and Amphibians in Britain. Collins Publishers) considered such frogs as 'partial' albinos in contrast to true albinos having an orange skin and red eyes lacking melanin in the retina.

Field studies during February 1997 revealed that 13,804 of 13,852 tadpoles were black, with the remaining 48 (0.35%) of the semi-albino type. Ten of the partial albino tadpoles were reared with ten wild types (controls) in our laboratory. Periodic examinations during different stages of metamorphosis showed that both the wild and the partial albino types were near the same stages of

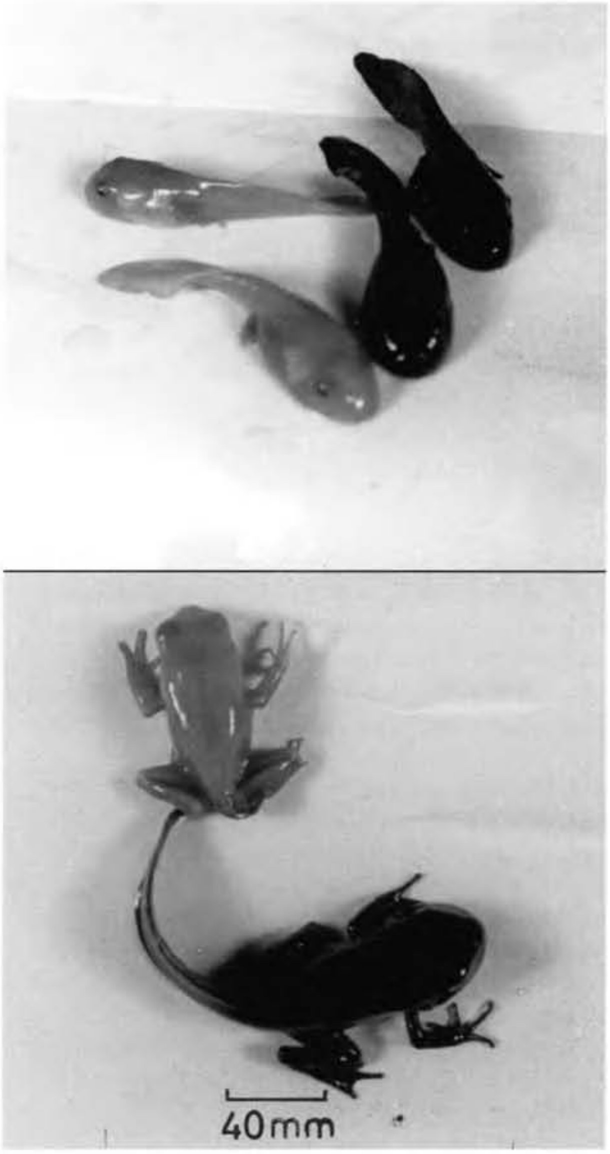

FIG. 1A–B. Live tadpoles and froglets of *Rana curtipes*. Tadpoles of wild type (black color) and of semi-albinos (orange-yellow); note the normal black eyes of the semi-albino type (A). Freshly collected wild (black in color) and semi-albino (orange-yellow in color) froglets of *Rana curtipes* (B).

development. All of the laboratory-reared tadpoles successfully completed metamorphosis. These findings are contradictory to those of Browder's (1972. J. Exp. Zool. 180:149–156) observation that albino *Rana pipiens* were less viable compared to their wild type siblings under the laboratory conditions. Further work on the demographic and ethological aspects of these semi-albino *R. curtipes* is in progress.

The laboratory facilities provided by Prof. V. P. Deshmukhe, and the field assistance provided by M. P. More of Karnatak Science College, Dharwad, are gratefully acknowledged.

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RANA SYLVATICA **(Wood Frog). PHONOTACTIC STALKING.** On 30 January 2002, a breeding chorus of *Rana sylvatica* was observed at Stout Pond, a large woodland pond community that lies within a large depression in an oak-hickory forest in Stone County, Arkansas, USA (T16S R12W Sec 30) just south of State Hwy 14 and ca. 1.12 km E of the Baxter-Stone County line. A large breeding event had occurred the previous night, as ca. 10 x 15 m area of the pond was covered by egg masses, and many male wood frogs persisted calling in the pond. While observing *Pseudacris crucifer* and *R. sylvatica*, the following sequence of events was recorded.

A male *P. crucifer* was calling from a perch ca. 4–5 cm above the water in the fork of an upright emergent plant stem. A male *R. sylvatica* was observed facing this emergent plant from ca. 1 m away. The *R. sylvatica* slowly approached the plant where the *P. crucifer* was calling. Once the *R. sylvatica* reached the emergent stem, he began climbing up toward the still calling *P. crucifer*. The *R. sylvatica* pulled himself up the plant with his forelimbs, toward the calling *P. crucifer*, with his hind limbs freely floating in the water. Upon reaching the *P. crucifer*, the *R. sylvatica* nudged it with his snout causing it to cease calling. The moment the *P. crucifer* deflated its vocal sac, the wood frog grabbed him from his perch and escaped into the leaves and mud at the bottom of the pond. The *R. sylvatica* appeared to be homing in on the call of the *P. crucifer*. Whether phonotactic stalking is prevalent in pond communities where both these species breed is unknown; however, the large numbers of *P. crucifer* present at this site makes the species an available and nutritious food source for *R. sylvatica*.

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RANA SYLVATICA **(Wood Frog). DEATH FEIGNING.** On 30 January 2002, a breeding chorus of *Rana sylvatica* was observed at Stout Pond, a large woodland pond community that lies within a large depression in an oak-hickory forest in Stone County, Arkansas, USA (T16S R12W Sec 30) just south of State Hwy 14 and ca. 1.12 km E of the Baxter-Stone County line. A large breeding event had occurred the previous night, as the area of the pond covered by egg masses was ca. 10 x 15 m, and many male wood frogs persisted calling in the pond. More that a dozen male *R. sylvatica* were observed performing a previously unreported behavior reminiscent of death feigning in *Acris crepitans* (McCallum 1999. Herpetol. Rev. 30:90).

When individual calling male wood frogs were disturbed, they would dive into the debris on the pond bottom. Upon reaching the substrate, they would remain motionless in the leaves where they could easily be picked up by hand. They positioned themselves so their abdomen and snout terminus were simultaneously in contact with the substrate. All the limbs were in their normal resting position but elevated from the substrate so the frog was resting on its venter. The medial digits of the forelimbs were positioned against the tympanum. The hind legs were similarly raised with the femo-

ral portions of the limbs held against the lateral flanks of the abdomen and the plantar region of the foot facing laterally. If the water surrounding a frog was stirred with a net, the animal remained in this position, allowing itself to drift with the current created by the investigator. Once captured, these frogs immediately ceased performing this behavior and proceeded to attempt escape as typically observed in these ranids.

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RANA SYLVATICA (Wood Frog). **PARASITE.** On 21 August 2002, we captured a wood frog (*Rana sylvatica*; 31 mm SVL; 3.4 g) with grossly enlarged eyes in a pitfall trap in Elk Island National Park, Alberta, Canada (53°36'N, 112°53'W; Paszkowski et al. 2002. Research Links 10[1]:13, Parks Canada). Both eyeballs extended abnormally beyond the orbits, with skin on the posterior surfaces stretched taut (Fig. 1b); the eyeballs themselves did not seem to be enlarged, although the tissue surrounding them was swollen. The cornea of the left eye was clear, but the right cornea was covered with whitish tissue (probably including the lower eyelid) that obscured most of the iris and pupil (Figs. 1c–d). The animal had no other signs of deformities or injuries, and did not appear emaciated or stressed.

We returned the frog to the Health Sciences Laboratory, University of Alberta, Animal Services Unit. The animal was sacrificed, processed using standard histological techniques, and serial sections were made through the eyeball and associated tissues. Over 100 trematode mesocecariae were present within connective tissue behind each eyeball, enough that the cysts forced the eyes up and out of the orbits. A single cross-section through the connective tissue behind both eyeballs contained 60 trematodes. The serial sections were examined and based on key morphological traits (width of body and ventral sucker, location of acetabulum, oral spines), the mesocecariae were identified as possible members of the genus *Alaria* (Family Diplostomidae; Schmidt and Roberts 1996. Foundations of Parasitology. Wm. C. Brown Publishers, Dubuque, Iowa. 659 pp). Mesocecariae of *Alaria* sp. are commonly found in anurans, but are usually located between muscle fiber bundles in the hind legs (J. Holmes, pers. comm.).

FIG. 1. (a) Normal *Rana sylvatica*. (b–d) *R. sylvatica* with infestation of trematode mesocecariae behind eyeballs: dorsal (b), left (c), and right (d) views. Note tissue obscuring cornea in (d).

In 2001 we captured 25 wood frogs and 37 western toads (*Bufo boreas*) in pitfall traps at the same site as the parasitized wood frog, but no other individuals displayed any external signs of infestation. The infection seen in the wood frog collected at Elk Island National Park was unusual both because of the location of the parasites in tissue directly behind the eyeballs, and the severity of the infection.

Thanks to N. Nation and colleagues for initially examining and processing the specimen, and A. Shostak and J. Holmes for identifying the parasite. Parks Canada allowed access to the study site. Z. Eaton provided field assistance. Ducks Unlimited Canada, Friends of Elk Island, and Alberta Sports, Recreation, Parks, and Wildlife Foundation provided funding for amphibian sampling at Elk Island.

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SCINAX ALTERA (NCN). **PREDATION**. Spiders, mainly Pisauridae, are important predators of frogs, with most predation events being reported from aquatic environments (Bastos et al. 1994. Herpetol. Rev. 25:118; ; Johnson 1996. Herpetol. Rev. 27:140; Rogers 1996. Herpetol. Rev. 27:75; Schiesari et al. 1995. Herptol. Rev. 26:30–31; Seely et al. 1990. Herptol. Rev. 21:89–90).

On March 2001 at 2035 h, we observed a juvenile male pisaurid spider, *Thaumasia* sp. (10.2 mm body length), that had just seized a juvenile *Scinax altera* (11.5 mm SUL) at the edge of Cabiúnas Lagoon in the Restinga de Jurubatiba (22°17'S; 41°41'W), Macaé, Rio de Janeiro State, Brazil. The spider was on the water surface grasping the anuran by its back using its pedipalps, whereas the frog had its body submerged and was apparently dead. Because this spider usually lives near or on the water surface, our observations indicate that even juvenile spiders may constitute an important source of mortality for *Scinax altera*, especially post-metamorphic and juveniles living at this breeding site.

Renner L. C. Baptista (Invertebrate Department, Aracnology Section) and J. P. Pombal Jr. (Vertebrate Department) of the Museu Nacional do Rio de Janeiro identified the spider and the frog, respectively. This research was supported by CNPq and FAPERJ.

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CROCODYLIA

CAIMAN LATIROSTRIS (Broad-snouted Caiman). **FEEDING.** *Caiman latirostris* feeds on diverse prey, which consist mostly of arthropods (insects), snails, crabs, and frogs (A. Imhof, unpubl. data). Although the species is opportunistic (Magnusson et al. 1987. J. Herpetol. 21:85–95; Pooley 1989. *In* C. A. Ross [ed.], Crocodiles and Alligators, pp. 76–91. Golden Press. Silverwater, Australia), as with other crocodilians, size (Delany and Abercrombie 1986. J. Wildl. Mgmt. 50:348–353) and mouth morphology (Singh and Bustard 1982. British J. Herpetol. 6:253–258) influence its feeding behavior. In particular, the wide and short snout of *C. latirostris* appears better suited to crushing rather than as a tool for active foraging (Verdade et al. 1992. *In* L. M. Verdade and A. Lavorenti [eds.], Anais do II Workshop sobre Conservação e Manejo do Jacaré-de-Papo-Amarelo [*Caiman latirostris*], pp. 77–91. ESALQ / USP, Piracicaba, Brazil). Here, we report a passive feeding behavior that, to our knowledge, is unreported in *C. latirostris*.

In November 1998, during a routine night count for caimans at Estancia 'El Estero,' Santa Fe, Argentina (30°03'S, 59°58'W), we observed a caiman (presumably an adult male based on size) at the discharge of a small dam (ca. 0.60 m high), constructed for watering cattle. The caiman allowed the discharge stream to pass through its open mouth. As we assumed that it was waiting for a prey item to fall into its mouth, we spent 15 min observing it. Whenever an item fell into its mouth, the caiman immediately closed its mouth and swallowed. We saw this behavior four times, but we were unable to identify individual prey. Based on other data (King et al. 1998. Cooperative feeding, a misinterpreted and under-reported behavior of crocodilians. Available at: http://www.flmnh.ufl.edu/natsci/herpetology/crocbiology/bartram.htm; Pooley, *op. cit.*; Schaller and Crawshaw 1982. Copeia 1982:66–72), we suspect that most were fishes.

Similar passive feeding behavior has been reported in *Caiman yacare* (Schaller and Crawshaw, *op. cit.*), *Alligator mississippiensis* (King et al., *op. cit.*), and *Crocodylus niloticus* (Pooley, *op. cit.*), but these observations each involved more then one crocodilian fishing together cooperatively. Our observations suggest that *C. latirostris* feeding behavior is more diverse than previously recognized. Diefenbach (1979. Copeia 1979:162–163) reported that *C. latirostris* dug in the bottom of aquatic sites to feed on snails, but passive feeding had not been reported. Our observation also documents broad-snouted caiman occupation and use of man-made water structures.

We thank A. Woodward and W. King for their suggestions.

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TESTUDINES

CHELYDRA SERPENTINA (Common Snapping Turtle). **DEFORMITY**. On 11 June 2000, an adult female *Chelydra serpentina* (210 mm carapace length, weight 1.70 kg) was collected by Nicholas D'Angelo in a drainage canal on West Napoleon Avenue in Metairie, Louisiana, USA and brought to the Audubon Zoo New Orleans the following day. The carapace and plastron were transversely constricted at mid-body by a plastic ring (142 mm circumference), the type found on milk and water containers (Fig. 1). The ring apparently became lodged on the turtle as a juvenile, causing the constriction as the turtle grew, resulting in this unusual deformity. The ring was removed from the turtle after capture. Two similar cases of this deformity in *Trachemys scripta elegans* (Red-eared slider) have been documented (Odum 1985. Herpetol. Rev. 16:113; McLeod 1994. Herpetol. Rev. 25:116–117). This is the first known instance to occur in *C. serpentina*.

The turtle was taken to the zoo's animal hospital where radiographs indicated that she was gravid with 12 eggs, all located on the posterior side of the constriction (Fig. 2). The eggs were oviposited on 23 June 2000 and set up for incubation. One turtle pipped on 17 September 2000 but died before completely emerging from the egg. The remaining eggs were infertile and addled.

FIG. 1. Lateral view of *Chelydra serpentina* showing plastic ring around constriction site.

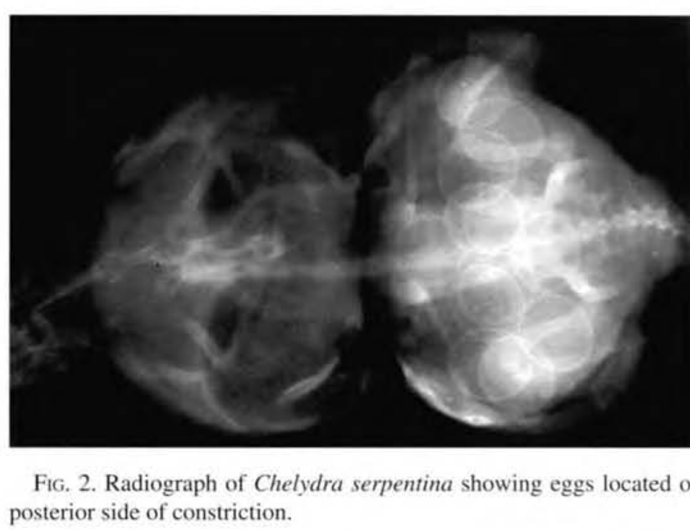

FIG. 2. Radiograph of *Chelydra serpentina* showing eggs located on posterior side of constriction.

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DERMOCHELYS CORIACEA (Leatherback Sea Turtle). **STRANDING**. To date, only two strandings of *Dermochelys coriacea* are known from the Belgian coast. The first one took place in December 1988 (Van Gompel 1989. De Strandvlo 9:102). The second was reported by Haelters and Kerckhof (1999. De Strandvlo 19:30–39). This specimen (total straight-line length ca.170 cm) was cut in two sub-equal parts, most probably by a ship's propeller. The two parts were found a few km apart (off De Haan in trawler nets and on Wenduine beach) on 10 and 11 September 1998. Its skeleton is registered as IRSNB 15129. A third case, here reported, occurred on 19 December 2000, at Mariakerke (Ostend). The still-alive but dying male specimen (carapace curved length 157 cm, total length 194 cm, weight 369 kg), stranded in the evening, was brought to the Blankenberge Sea Life Center where it died during the night. An external examination revealed numerous deep cutaneous lacerations on the ventral and lateral sides of the animal. The internal examination revealed subcutaneous muscular hematomas and muscular degeneration, internally of the cutaneous lacerations. Evidence of focal hepatic necrosis and acute fibrineous peritonitis was also observed. The hepatic lesion and the peritonitis probably both occurred as a consequence of the cutaneous lacerations. The digestive tract was empty. The injuries, from which the animal eventually died, can be attributed to the impact of a ship or a ship's propeller. Mouldings of the whole specimen and its mouth were made by Zephyr Co. (Wellem, Belgium). Cast and skeleton are in the collections of the IRSNB (IRSNB 15516). The heart and samples for histopathology are kept at the Pathology Department of the Faculty of Veterinary Medicine of the Université de Liège. Some *Stomatolepas dermochelys* (Crustacea: Cirripedia) were collected from this animal and the one stranded in 1998 and are deposited in the collections of the IRSNB.

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GOPHERUS AGASSIZII (Desert Tortoise). **CALICHE MINING**. *Gopherus agassizii* have been observed ingesting bone, stones, and soil (reviewed by Esque and Peters 1994. *In* Bury and Germano (eds.), Biology of North American Tortoises, pp. 105–111. Natl. Biol. Surv., Fish Wildl. Res. 13, Washington, D.C.). Desert tortoises may scrape topsoil to access caliche (a source of calcium, as calcium carbonate [Krauskopf 1979. Introduction to Geochemistry. McGraw-Hill Book Co., New York, 617 pp.]) and may alter regular movement patterns to visit such mineral sources (Marlow and Tollestrup 1982. Anim. Behav. 30: 475–478). To date, observations of caliche mining and other means of calcium acquisition (i.e., ingestion of bone) have been documented in adult tortoises of both sexes. Here we report an instance of suspected caliche mining by juvenile desert tortoises.

On August 2, at 1733 h, we observed 3 juvenile desert tortoises (61-, 63-, and 114 mm midline carapace length [MCL]) facing a sheer caliche wall immediately adjacent to a primitive road east of Tucson, Arizona (32°08'N, 110°41'W). All tortoises were within one meter of each other and within 0.5 cm of the wall. The animals were captured, weighed, and measured; a white powder was noted on the beaks of all 3 tortoises. The fine powder formed 3mm-wide rings around their mouths. A fourth juvenile (70 mm MCL) was captured ca. 5 m from the others, walking in the direction of the caliche wall. This tortoise did not have white powder surrounding its mouth. These individuals presumably came to this site to access a calcium source.

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GOPHERUS AGASSIZII (Desert Tortoise). **ELEVATIONAL RANGE**. The Sonoran Desert population of the desert tortoise (*Gopherus agassizii*) inhabits rocky slopes and foothills in the desertscrub community of the Sonoran Desert. Desert tortoises in Arizona are most commonly found between 300–1067 m with a maximum recorded elevation of 1615 m (Ariz. Game and Fish Dept., unpubl. data). In the Mojave Desert population of this species, the maximum recorded elevation is 2200 m (Grover and DeFalco 1995. USDA For. Ser. Gen. Tech. Rept. INT-GTR-316. 134 pp.). High mountains are usually considered inappropriate for tortoise habitation, although some individuals range into juniper woodland communities. On 20 July 2000, a desert tortoise was observed and photographed by the two senior authors at an elevation of 2380 m in the Rincon Mountain District of Saguaro National Park, Pima County, Arizona, USA. The tortoise was actively moving on a trail in a ponderosa pine-dominated coniferous community. It seems unlikely that humans transported the tortoise to this location, which is within a road less national park wilderness area that receives < 300 visitors per year. The nearest road is 13.9 km by trail from this location and > 600 m lower in elevation.

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KINIXYS HOMEANA (Home's Hingeback Tortoise). **PREDATION.** Field records of tortoises predated by snakes are few, both in temperate and in tropical environments (e.g., Rugiero and Luiselli 1995. Amphibia-Reptilia 16:407–411). Indeed, during our long-term studies on the ecology of forest snakes in southern Nigeria, we analyzed stomach contents of hundreds of snakes from more than 30 species (e.g., see Luiselli et al. 1998. J. Zool. (London) 246:125–133; Luiselli et al. 2002. Can. J. Zool. 80:55–63), but did not find any tortoise item as prey. Here we report two cases of predation by snakes upon *Kinixys homeana*, a species found in the rainforests of southern Nigeria (Luiselli et al. 2000. Rev. Ecol.

Terre et Vie 55:3–23).

On 8 April 2001, a villager from Degema (Rivers State, 04°48'N, 06°48'E) carried to us a recently killed, large male Blanding's tree snake (*Toxicodryas* (= *Boiga*) *blandingi*), 168.7 cm SVL, with an obviously enlarged stomach. The snake, which was killed at a site where secondary forest intergraded into a small pineapple plantation, was dissected after routine measurements. It contained the remains of a large male *Agama agama* (common prey for this snake: cf. Luiselli et al. 1998. Amphibia-Reptilia 19:430–436; Hughes 2000. Herpetol. Bull. 74:8–11), and a recently ingested juvenile *Kinixys homeana*. This tortoise measured 11.4 cm in plastron length, and had been ingested head first.

On 17 November 2001 while searching for snakes in a secondary forest near Ogbele (Rivers State, 05°00'N, 06°50'E), we found a Gold's tree cobra (*Pseudohaje goldii*) coiled under an artificial plastic cover-object routinely used by us for sampling snakes. The snake was captured, sexed, measured, marked by ventral scale-clipping, and examined for prey items by palpation of the abdomen. The snake, a male 174.5 cm SVL, regurgitated the remains of the posterior side of the body of a male *Kinixys homeana*. The tortoise was clearly ingested head-first. Based on comparisons with live materials of the same tortoise species, we estimated that the prey would have been ca. 14 cm in plastron length. Photographs of both prey items have been deposited at the Nigerian Agip Oil Company Ltd. environmental office (Victoria Island, Lagos).

Toxicodryas blandingi and *Pseudohaje goldii* both are semi-arboreal species with an eclectic and opportunistic dietary spectrum (Luiselli et al. 1998. Amphibia-Reptilia 19:430–436; Pauwels et al. 1999. Afr. Herp. News 30:32–33), and in both cases noted here the predator was a large adult specimen. Thus, it may be hypothesized that tortoise predation, albeit a rare event, is perhaps confined to the larger-sized population cohorts of these opportunistic snakes.

We are indebted to several companies of the E.N.I. Group, F.I.Z.V., and Institute Demetra, for funding our long-term ecological research in Nigeria. Chelonian Research Foundation (through its Linnaeus Fund Annual Turtle Research Award, years 1999 and 2000) supported the "*Kinixys* conservation ecology project" of which this note is an outcome. M. Capula, E. Filippi, and L. Rugiero critically commented upon a previous draft of the manuscript.

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STERNOTHERUS ODORATUS (Common Musk Turtle) and ***CHELYDRA SERPENTINA*** (Common Snapping Turtle). **REPRODUCTION.** Common musk turtles are known to have great plasticity in nesting behavior. Females may lay eggs on open ground, in shallow nests under leaf litter, or in fully-formed excavations (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Inst. Press, Washington, D.C.). Moreover, the sharing of nesting sites by female conspecifics has been well documented (reviewed in Ernst et al., *op. cit.*). Here we report the use of nest excavations by *Chelydra serpentina* as nesting sites by *Sternotherus odoratus* in southeastern Michigan.

On 7 June 2000, we discovered a clutch of 7 *Sternotherus odoratus* eggs buried in loose sand within a large nest cavity on an earthen dam at Cedar Lake, Livingston Co., Michigan, USA. Soil disturbance adjacent to the nest indicated that the cavity had been recently dug and abandoned by a female *Chelydra serpentina*. On 10 June 2000, on another earthen dam on private property in Sylvan Township, Washtenaw Co., Michigan, we observed a female *S. odoratus* investigating a nest cavity dug the previous day by a female *C. serpentina* and whose eggs we had subsequently removed. The female was then later observed inserting the posterior portion of her body into the cavity, but did not deposit her eggs. Finally, on 11 June 2002, at the dam site in Washtenaw Co., we observed a female *S. odoratus* nesting adjacent to a nesting female *C. serpentina* within a small (ca. 70 cm diam) patch of sand where three clutches of *C. serpentina* eggs had been laid and subsequently removed by us in the preceding two-day period. The female deposited a clutch of 6 eggs within one of the empty nest cavities.

We thank David and Becky Schultz for access to their property. Turtle eggs were collected with permission of Michigan Department of Natural Resources, scientific collecting permit #CO868.

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TERRAPENE CAROLINA BAURI (Florida Box Turtle). **REHYDRATION.** On 15 May 2002 at 1630 h, we discovered three *Terrapene carolina bauri* that had fallen down a brick-lined well on Egmont Key, Hillsborough County, Florida, USA. The smooth-sided well was 75 cm deep and 1 m in diameter, had a dry leaf litter floor, and effectively prevented escape. The turtles were extremely lightweight and dehydrated. Field body measurements of the three animals were: male, 132 mm carapace length (CL), 253 g; male, 120 mm CL, 233 g; juvenile male, 111 mm CL, 138 g. The large male was lethargic, whereas the smaller animals attempted to walk away. All three turtles were returned to the ranger station and provided with fresh water ad libitum until 0800 h the next morning. Re-measurements 14 h after initial capture showed that the 132 mm male drank 52 g of water to increase his mass to 305 g; the 120 mm male drank 32 g of water to increase to 265 g; and the juvenile male drank 20 g of water to increase to 158 g. All were alert and energetic upon release the day after initial capture. Based on data collected between 1991 and 2002 on Egmont Key, mean weights of box turtles of these size classes and sex/life stage are 353 g (N = 62 observations of 132 mm CL males), 266 g (N = 28 observations of 120 mm CL males), and 217 g (N = 11 observations of 111 mm CL juveniles). These data suggest that both the largest and smallest dehydrated turtles may not have fully hydrated upon release, although depleted fat reserves also may account for the below-average body mass. No data are known to us on how much body water a turtle can lose before it dies of dehydration

(but see Ross 1977. Comp. Biochem. Physiol. 56A:477–480; Chessman 1984. Aust. J. Zool. 32:649–655 for information on rates of evaporative water loss and time to recovery in laboratory settings). Under controlled conditions, Rose (1969. Southwest. Nat. 14:67–72) found that *T. ornata* lost 3.5% of their mass in six days without available water at a relative humidity of 18–22%. Although we do not know how long the three box turtles were in the well, park rangers told us that there had been no appreciable rainfall since at least March; Winter 2001 to late Spring 2002 was an exceptionally dry period in west-central Florida. The fact that Florida box turtles can drink from 13.7 to 20.5% of their initial body mass after forced dehydration suggests that they may be adapted physiologically to survive long periods without drinking water.

We thank Vic Hutchison for his insights into turtle water balance and its associated literature.

Submitted by **C. KENNETH DODD, JR.** and **MARIAN L. GRIFFEY**, Florida Caribbean Science Center, United States Geological Survey, 7920 Northwest 71st Street, Gainesville, Florida 32653, USA.

TERRAPENE ORNATA (Ornate Box Turtle). **SUMMER REFUGIUM.** Oppressive summer heat and drought in the southern United States is known to have a detrimental effect on wildlife in general. However, many animals including box turtles are known to escape the effects of the heat by retreating into burrows. On 30 June 1999 at 2225 h near Falls Road, ca. 0.4 km W of Hwy 1189, Hood County Texas, USA, an adult male *Terrapene ornata* was found in the recess of a shelved layer of limestone with a depth of ca. 25 cm. At the back of the recess a small pool of water was present with a depth of no more than 5 mm. Five adult *Rana berlandieri* were also present in the recess.

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TERRAPENE ORNATA LUTEOLA (Desert Box Turtle). **HIGH ELEVATION RECORD.** On 28 July 2001 at 1030 h we observed an adult *Terrapene ornata luteola* in a relatively exposed tributary of Sunnyside Canyon (31°25'25"N, 110°21'37"W), Huachuca Mountains, Cochise Co., Arizona, USA, at an elevation of ca. 2180 m. The habitat consisted of pine-oak forest in mountainous terrain. Stebbins (1985. A Field Guide to Western Reptiles and Amphibians, 2nd Ed, Houghton Mifflin Co, Boston, Massachusetts, 336 pp.) lists maximum elevation at ca. 2010 m and states that *Terrapene ornata* is "primarily a prairie turtle. Over much of its range it inhabits treeless plains and gently rolling country grown to grass or scattered low bushes where the soil is sandy. Also occurs in open woodland." In Arizona, *T. o. luteola* occurs in oak woodlands and mesquite bosque, and the populations there apparently are showing a plasticity in habitat use that has not been reported elsewhere (M. Tuegel, USFWS, pers. comm.) Our observation represents an elevational increase of ca. 170 m and occurrence in a habitat hitherto unreported for Arizona populations of *T. o. luteola*.

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LACERTILIA

CNEMIDOPHORUS SEXLINEATUS (Six-lined Racerunner). **MAXIMUM SIZE.** The reported maximum size for *C. sexlineatus* is 75 mm SVL and 241 mm total length (sex and locality unspecified; Conant and Collins 1998. Peterson Field Guide to Reptiles and Amphibians of Eastern and Central North America. 3rd Edition Expanded. Houghton Mifflin Company, Boston, Massachusetts. 616 pp.). Here, we report a new size record for this species from Missouri.

On 16 August 1991, Kevin R. Toal and Randall S. Reiserer collected an adult female *C. sexlineatus* in an Ozark glade under a limestone rock along Route E, 1.8 mi. E of Route M (T21N, R26W, Sec 2) in Barry County. This individual was 84 mm SVL and 267 mm total length, which exceeds the current size maximum by 9 mm for SVL and 26 mm for total length. The specimen was deposited in the Natural History Museum, University of Kansas, Lawrence (KU 218611).

The specimen was collected with a Missouri Department of Conservation Scientific Collecting Permit issued to Kevin R. Toal.

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SERPENTES

AGKISTRODON CONTORTRIX CONTORTRIX (Southern Copperhead). **ENDOPARASITES.** An adult female *Agkistrodon controtrix contortrix* (57 cm total length; 215 g mass) was captured on 4 April 1998 in Randolph County, Georgia, USA, and later transferred to Central Florida Zoological Park on 18 April 1998. The snake was maintained in a glass aquarium with a perforated (3 mm holes) tight-fitting sheet metal lid. Newspaper was used as a substrate and the snake was fed freshly killed laboratory mice at two-week intervals.

Reports of *Cuterebra* (bot fly) infecting reptiles are lacking, as typical hosts are endothermic. However, on 24 June 1998, a third larval instar *Cuterebra* (ca.15 x 9 mm) was found in the snake's aquarium on the newspaper substrate (Fig. 1). The species was not determined, as accurate identification cannot be made from larvae. The *A. c. contortrix* was examined and a small lesion was located midbody, on the right ventrolateral aspect. The lesion was not septic and healed uneventfully.

Two weeks prior to this event, the snake had been restrained in a plexiglass tube for veterinary examination. No skin or body abnormalities were noted. This finding was inconsistent with *Cuterebra* infection as normally there is a lump in the skin where the "warble" is located and a breathing hole is present which is surrounded by inflammation. This lack of obvious cutaneous involvement suggests the possibility that the larva was in the process of emerging from a mammalian prey item, possibly a cotton mouse

(*Peromyscus gossypinus*), at the time the prey was ingested by the snake. Subsequently, it may have emerged from the mouse and attached itself to the lining of the snake's esophagus, eventually migrating out through the body wall. The prevalence of *Cuterebra* in cotton mice in Georgia ranges from 10 to 59% during the year (Durden 1995. Parasitology 81:787–790).

It is significant that the normal period for the larval development of *Cuterebra* is three to five weeks (Catts 1967. J. Med. Entomol. 4:87–101) and the period of time from when the snake was first captured to larval emergence noted here was about eleven weeks. This extended period of time may be attributed to the challenges of exiting from the gastrointestinal tract of an abnormal host. Although accidental hosts of *Cuterebra* have been reported, their suitability as hosts is limited in that only partial larval development usually occurs (Catts 1965. Trans. 30th North Am. Wildlife Nat. Resources Conf. Wash., D.C. 30:184–186). However in this occurrence, *A. c. contortrix* acted as a successful *Cuterebra* host as the larva was able to emerge and appeared to be the size of a fully developed third instar.

The *Cuterebra* larva reported here (HWML 16389) has been deposited in the collection of the Harold W. Manter Laboratory, Division of Parasitology, Nebraska State Museum.

We thank Kevin Enge for providing the *A. c. contortrix* with collection data and Darryl J. Heard for his assistance with this project.

FIG. 1. *Cuterebra* instar following emergence from an *Agistrodon contortrix contortrix*.

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AGKISTRODON PISCIVORUS LEUCOSTOMA (Western Cottonmouth). **DIET**. We observed an adult female *Agkistrodon piscivorus leucostoma* (54.5 cm SVL; 317 g body mass) regurgitate a partially digested *Coluber constrictor* (100 g body mass) on 29 June 2001 at the Center for Biological Field Studies (CBFS), Walker Co., Huntsville, Texas, USA. The cottonmouth was observed and captured within a meter of a radio-tagged *A. p. leucostoma* (Zone 15; Phelps Quadrangle; UTM $^{340}38^{47}$ m N, $^{2}63^{334}$ m E).

Cottonmouths are known to prey on several snake species including *Nerodia*, *Thamnophis*, *Storeria*, *Farancia*, *Crotalus*, and *Agkistrodon* (Gloyd and Conant, 1990. Snakes of the *Agkistrodon* Complex. SSAR, Oxford, Ohio. 614 pp.). To our knowledge predation on *C. constrictor* has not been reported. The western cottonmouth's prey item (*C. constrictor*) has been deposited in the Herpetological Collection of the Sam Houston State Vertebrate Museum (SHSVM #H-0005-01).

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ANTARESIA MACULOSA (Spotted Python). **REPRODUCTIVE OUTPUT**. The genus *Antaresia* comprises the smallest pythons in the world; typical total lengths average less than one meter among free-ranging individuals. Reported clutch sizes vary by species, but average 6.5–12.6 eggs with a known extreme of 19 eggs in *A. maculosa* (Shine and Slip 1990. Herpetologica 46:283–290). Here I report an exceptionally large clutch of eggs from a captive spotted python.

On 02 April 2002, a captive-born *A. maculosa* (1215 mm snout–vent length) produced a clutch of 25 eggs after a remarkably long gestation (mating had occurred on 05 December 2001). The total clutch mass was 319 g, recorded < 8 h after oviposition. Two of the eggs (5.8 and 5.1 g) were obviously infertile, but the remaining 23 eggs appeared fertile (average mass of fertile eggs = 13.4 g). The female's post-partum mass was 667 g, such that relative clutch mass was 0.32 (calculated following Seigel et al. 1986. Herpetologica 42:179–185). The female was found coiled around the clutch. I did not observe shivering thermiogenesis as has been reported in other pythons. The eggs were removed and artificially incubated, but the majority of the eggs were lost to desiccation after an incubator malfunction. Seven neonates emerged from the surviving eggs between 04 and 07 June; these individuals averaged 8.0 g and 233 mm in snout–vent length. Despite the high number of eggs in this clutch, individual egg masses were similar to egg masses from other clutches from this colony of *A. maculosa*, thus providing no evidence of an intraspecific trade-off between offspring size and number. Similarly, while the body size of the dam approaches the maximal known for the species, females of similar sizes in the colony have not produced clutches of this size. This clutch size is higher than the maximal recorded clutch size of all but two species of Australasian pythons (Shine and Slip 1990, *ibid.*); both of the latter were produced by much larger-bodied pythons of the genus *Morelia*.

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Department of Energy to the University of Georgia Research Foundation.

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BOA CONSTRICTOR (Boa Constrictor). **MAXIMUM BODY SIZE.** Maximum body size for large constrictors has often been a topic of interest in herpetology and is one of the most frequently asked questions of herpetologists by the public. Boos (1992. Brit. Herpetol. Soc. Bull. 40:15–17) suggested that the record length for *Boa constrictor* is 4.2 m and that previous reports of larger specimens involved green anacondas (*Eunectes murinus*). We here report a new record length *Boa constrictor*. The specimen (YPM 12530) is a skin donated by A. P. Rogers on 31 July 1928 and was collected from Brazil. Though the skin had been prepared as a dry specimen by traditional means at the time, stretching does not appear to have affected the specimen's length as the middorsal scales overlap normally (Fig. 1). Mid-line straight length of the re-hydrated specimen is 4.45 m.

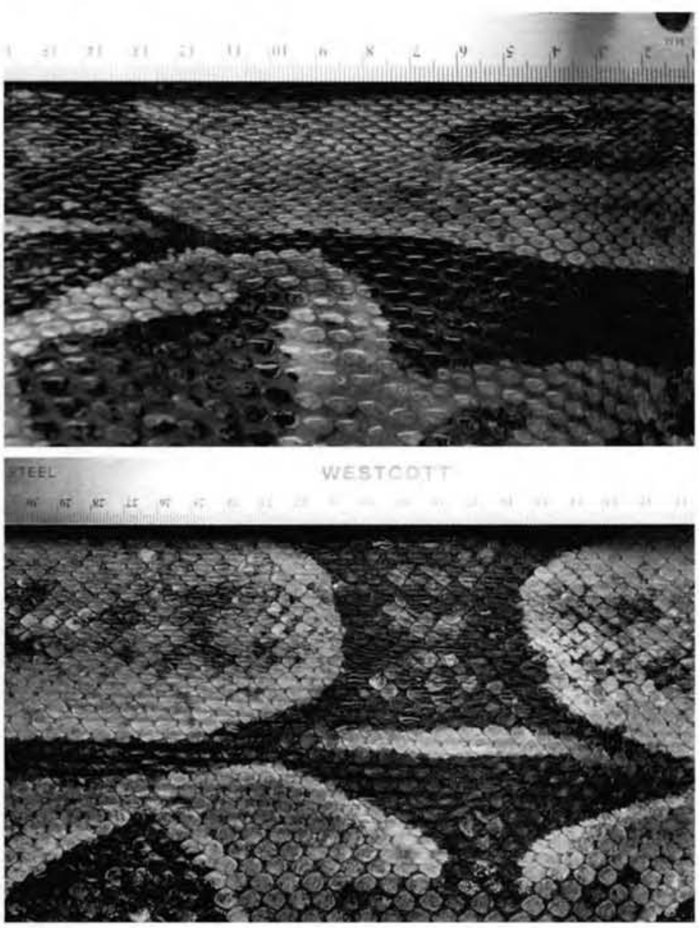

FIG. 1 Dorsal view of *Boa constrictor* dried skin (YPM 12530); occipital region (top) and mid-body (bottom) of YPM 12530. Scales at midline overlap normally.

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BOTHROPS ASPER (Terciopelo). **PARTURITION**. Observations of snakes giving birth or laying eggs in the wild are rarely documented. On 29 August 1995 at 1200 h, one of us (MPS) encountered a female *Bothrops asper* 220 cm in total length basking in full sunlight on a log covered with lianas. The log was 1 m above the water level (just above eye level while sitting in a canoe) in Laguna de Zacatal in Estación de Biología Tropical Los Tuxtlas, San Andres Tuxtla, Veracruz, México. The snake was loosely coiled, just two coils, with her slightly-elevated head in the center of the coil and the tail on the outside of the coil. The tail was parallel to the log, not upraised. The snake was located when it hissed on being disturbed in our search for frog nests. The female exhibited continuous contractions of the muscles along the posterior half of her body for the entire time she was giving birth. Some of the young remained on the log and lianas while others fell into the water as they were born and immediately submerged out of sight. The female continued giving birth until 1430 h at which time she entered the laguna and swam at the surface for 10 m before leaving the water and entering the forest.

During this 2-h interval 35 young were born. Because litter size often reaches 80 for adult females of this size in this population (Buttenhoff and Vogt 1997. *In* E. Gonzales, R. Dirzo, and R. C. Vogt [eds.], Historia Natural de Región de Los Tuxtlas, pp. 478–480. UNAM, Mexico D.F.), we surmise that a significant number of offspring had already been born prior to the start of our observations. Assuming the rate of newborn emergence was relatively steady throughout, it probably took about 5 hours to give birth to the entire brood. Additionally, it is interesting that this primarily nocturnal snake should give birth during daylight hours in a relatively exposed situation.

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BOTHROPS ATROX (Common Lancehead). **PREY.** The diet of *Bothrops atrox* from Central Amazonia consists mainly of mammals, frogs, and lizards (Martins and Oliveira 1998. Herpetol. Nat. Hist. 6:78–150). Here we report an observation of a freshwater eel, *Symbrachus* sp. (Gymnotidae), as prey of *B. atrox*. The snake was an adult female (IB 60751, 1112 mm SVL, broken tail, 560 g mass) collected in the region of "igapó" forests at Rio Jaú, Novo Airão, Amazonas, Brazil. The fish (ca. 320 mm total length, ca. 35–40 g mass) was ingested head-first and its anterior region was partially digested. Gymnotid eels migrate through the seasonally flooded floor of igapó forests, becoming exposed to terrestrial predators. This is the first record of a fish as prey of *Bothrops* and confirms the opportunistic feeding habits of *B. atrox*.

The fish was identified by J. Zuanon and F.C.T. Lima. Financial

support for the study at Rio Jaú was provided by Fundação Vitória Amazônica and Universidade do Amazonas.

Submitted by **M. ERMELINDA OLIVEIRA**, Departamento de Parasitologia, Instituto de Ciências Biológicas, Universidade do Amazonas, 69077-000 Manaus, Amazonas, Brazil (e-mail: oliveiraermelinda@hotmail.com.br), and **MARCIO MARTINS**, Departamento de Ecologia, Caixa Postal 11461, Universidade de São Paulo, 05422-970, São Paulo, Brazil (e-mail: jararaca@ib.usp.br).

BOTHROPS JARARACUSSU (Jararacussu). **SEXUAL DICHROMATISM**. Sex differences in coloration have been reported in several snake species including pitvipers (Shine 1993. *In* Seigel and Collins [eds.], Snakes: Ecology and Behavior, pp. 49–86. MacGraw-Hill, Inc. New York). For instance, adult males of the Brazilian lancehead, *Bothrops moojeni*, have less defined dorsal markings than females, and bear spotted labials, whereas the labials of females are yellow-white (Leloup1975. Acta. Zool. Pathol. Antverp. 62:173–201). Sex differences in color may also occur in juveniles. A yellow tail tip persists for 18 months from birth in males, whereas in females the yellow fades within six months (Leloup 1975, *op. cit.*). Sexual dimorphism or dichromatism is also reported for juveniles of the terciopelo, *Bothrops asper* (as *B. atrox*). Males have yellow tail tips, whereas females lack yellow tail tips (Burger and Smith 1950. Science 112:431–433).

We report herein on an additional instance of sexual dichromatism in Neotropical pitvipers. Newborns of *Bothrops jararacussu* consistently show differences related to sex in both dorsal and ventral color. Ground dorsal color of newborn males is darker (Fig. 1) and yellowish to grayish brown, whereas that of females is yellowish to pinkish brown. Moreover, the dark brown lateral markings on the body are more broken in males than in females. Like in *B. moojeni*, this feature is retained by some adult individuals (see figures in Marques et al. 2001. Serpentes da Mata Atlântica: Guia Ilustrado para a Serra do Mar, Ed. Holos, Ribeirão Preto, São Paulo. 184 pp.). The ventral side of newborn *B. jararacussu* males is yellowish to brownish gray, whereas that of females is yellowish to pinkish beige. Additionally, the chins of males bear distinct dark gray markings, whereas in females such markings are less pronounced and lighter (Fig.1). In addition to the 19 photographed newborns from a litter with no locality data, housed in the collection of the Instituto Butantan (IB), we examined 16 newborns from a litter from Cachoeirinha, Minas Gerais, southeastern Brazil (IB 8687), and 54 newborns from a litter from Curitiba, Paraná, southern Brazil (IB 26326-26394). All individuals from the three examined litters consistently showed the differences described above, which strongly indicate that dichromatism is a characteristic of newborn *B. jararacussu*. We suspect that sexual dichromatism in newborns may be present in other snake species as well, as this kind of dimorphism may be misinterpreted as individual color variation within the litter and thus would remain undetected.

We greatly thank J. Cavalheiro for calling our attention to the dichromatism of newborn *B. jararacussu* (without his keen eyes we would have only recognized individual color variation), M. Martins for fruitful discussion on the subject, and the CNPq and FAPESP for essential financial support.

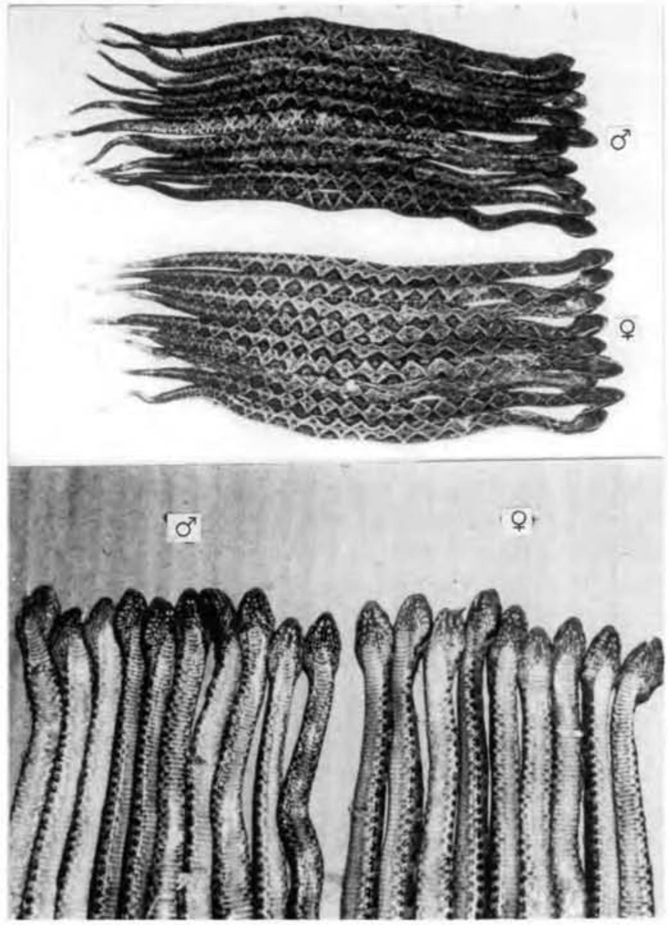

FIG. 1. A freshly-preserved newborn litter (10 males, 9 females) of *Bothrops jararacussu* showing sexual dichromatism in dorsal and ventral views.

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COLUBER CONSTRICTOR CONSTRICTOR (Northern Black Racer). **WINTER ACTIVITY**. A 282 mm SVL unsexed juvenile *Coluber constrictor constrictor* was captured in a pitfall trap on 19 January 2001 in the Shenandoah Valley, 14 km S Waynesboro, Augusta Co., Virginia, USA at an elevation of 488 m. The snake was caught in an outgoing pitfall trap at an ephemeral sinkhole pond that is completely encircled by a drift fence. The juvenile was found in the pitfall trap at 0930 h when the ambient air temperature was 3°C. Pitfall traps had been checked between 1930–2100 h the previous night when ambient temperature was 1°C. Rain and snow fell intermittently throughout the night and early morning, with a total accumulation of 23 mm. Fitch (1963. Univ. Kansas Publ., Mus. Nat. Hist. 15:351–468) found that racers in Kansas were active between 15.5°C and 32.4°C and Brown and Parker (1982. *In* N.J. Scott, Jr. [ed.], Herpetological Communities, pp. 59–81. USDI Fish and Wildlife Service Report 13.) reported a range of 18.6–37.7°C in Utah. Mitchell (1994. The Reptiles of Virginia. Smithsonian Institution Press. Washington, DC.

352 pp.) reported body temperatures of 26.1–38°C for active and 19.0-35.6°C for inactive racers in Virginia. Previous extreme dates of activity for *C. constrictor* in Virginia are 22 March and 30 November, as well as an unknown date in January stemming from observation of a DOR specimen (Mitchell, *op. cit.*). Palmer and Braswell (1995. Reptiles of North Carolina. Univ. North Carolina Press, Chapel Hill. 412 pp.) included a record of a dead juvenile racer on 6 January but did not note temperatures. The ephemeral pond from which the snake we found was exiting rose 6 cm during the night, suggesting that it may have become active in order to escape a flooded burrow or other over-wintering site. The snake appeared healthy and was capable of crawling and tongue flicking at capture. This observation represents the earliest documented record of natural activity for black racers in Virginia at the coldest ambient temperatures known for the species.

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CONOPSIS LINEATA (NCN). **BROOD SIZE.** This nocturnal colubrid snake lives under rocks at high elevations in pine-oak forests and in semi-arid scrublands of south-central Mexico. Although some information about reproduction has been reported, e.g., two snakes copulating under a rock in August (Duellman 1961. Univ. Kansas Pub. Mus. Nat. Hist. 15:1–148), little is known about litter size. All species of *Conopsis* for which reproductive data are available are viviparous. *Conopsis lineata* from Hidalgo (at elevations > 2750 m) produce 2–3 embryos, and *C. lineata* from Veracruz have been reported with 3 and 5 embryos (two of the females were collected in January) (Greer 1966. Copeia 1966:371–373). A *C. lineata* from Veracruz gave birth to four offspring at the Houston Zoo during March; the neonates measured 76–79 mm TL and differed in dorsal coloration (Werler 1970. Int. Zoo. Ybk. 105–116).

On 13 April 2002, a female *C. lineata* (CIB412) measuring 233 mm total length was collected under a rock in xeric mountain scrub at 2490 m, Cerro del Zopilote, Municipality of Pachuca, Hidalgo, México. She was kept in captivity and gave birth to two young on 8 May, the latest parturition date known. Both neonates were dark with a poorly defined vertebral line. They measured 69 mm SVL (17 mm tail) and 71 mm SVL (15 mm tail) at birth. Although individuals from the same locality are known to show great variation, the two neonates reported here strongly resemble their mother in color and markings.

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***CORALLUS* SPP.** (Treeboas). **EVIDENCE OF OVER-WATER DISPERSAL.** The potential for over-water dispersal of animals via flotsam is well known (e.g., King 1962. Quart. J. Florida Acad. Sci. 25:45–52), but direct observations are rare. In the West Indies, Censky et al. (1998. Nature 395:556) reported on the arrival of iguanas (*Iguana iguana*) on Anguilla, likely hurricane-driven from Guadeloupe. Knapp (2000. Herpetol. Rev. 31:244) observed a Bahamian colubrid snake (*Alsophis vudii*) emerge from the surf on an island where the species had not before been recorded, and Henderson et al. (1995. Herpetol. Nat. Hist. 3:15–27) reported the boid snake *Boa constrictor* floating in the water between islands off the Caribbean coast of Belize.

While in Grenada in February 2002, we had a fortuitous meeting with Larry Maul at Mt. Hartman Bay, a former study site for the treeboa *Corallus grenadensis* (Henderson 2002. Neotropical Treeboas: Natural History of the *Corallus hortulanus* Complex, Krieger Publ. Co., Malabar, Florida, 197 pp.; Henderson et al. 1998. Amphibia-Reptilia 19:203–214). Mr. Maul and his wife have been sailing in the West Indies for more than a decade, with annual visits to St. Vincent and the Grenada Bank. When he learned that we had studied treeboas at the site at which we were standing, Mr. Maul immediately knew what snake we were discussing. He accurately described the appearance of *Corallus* and its defensive behavior. Mr. Maul then proceeded to describe two encounters he had with seagoing treeboas off St. Vincent and Bequia. Both episodes occurred in June–July 2001, during mid- to late-afternoon, and in very flat, calm water. Both treeboas were swimming and neither was associated with a mat of vegetation or other flotsam.

One treeboa was encountered swimming ca. 1.5–2.0 km off Chateaubelair, St. David Parish, St. Vincent. At that distance it would have been beyond Chateaubelair Island, and probably out of Chateaubelair Bay. The Mauls rescued the snake and released it near Chateaubelair. Mr. Maul described the snake as appearing "exhausted" but that it recovered quickly and made attempts to bite. Almost certainly the snake was the St. Vincent endemic *Corallus cookii* (rather than the Grenada Bank endemic *C. grenadensis*). To the north, the nearest major land mass is St. Lucia, ca. 60 km from Chateaubelair. Without supporting flotsam, a successful landfall would appear unlikely.

A second treeboa was found swimming ca. 3.5 km off Bequia, in the Bequia Channel between Bequia and St. Vincent. It was off Port Elizabeth and out of Admiralty Bay. The distance from Admiralty Bay to the southern tip of St. Vincent is ca. 15.0 km, with the current pushing from St. Vincent towards Bequia (Doyle 1994. Sailors Guide to the Windward Islands, Chris Doyle Publ., St. Vincent, W.I. 334 pp.). The snake probably originated from either St. Vincent (*Corallus cookii*) or from Bequia (*C. grenadensis*). Again, the Mauls rescued the snake and deposited it on vegetation on Bequia. If it was a *C. cookii* moving south towards Bequia, a successful landfall might have been possible. If the snake was *C. grenadensis*, without supporting flotsam the liklihood of reaching St. Vincent was probably remote.

That the Mauls encountered two treeboas over a relatively short span of time is intriguing, and one wonders how often treeboas (as well as other snakes) are set adrift for whatever reason. At our Mt. Hartman Bay study site on Grenada, *Corallus grenadensis* was often encountered in coastal mangroves (*Rhizophora mangle*), both on the land and sea sides, and treeboas commonly slept by day and foraged by night on vegetation over water (Henderson et al.1998, *op. cit.*). Similarly, by day *C. grenadensis* was observed resting in a mangrove tree completely surrounded by water at Lower Woburn (St. George Parish; Henderson, *op. cit.*). That treeboas occasionally fall into the water would not be a surprise,

and at certain times they may not be able to reach land before being carried out to sea on a prevailing current. Most such episodes probably end with the death of the snake from dehydration, drowning, or predation.

Corallus almost certainly reached the West Indies by over-water dispersal via the Guiana Current from northeastern South America during the Quaternary (Hedges 1996. *In* Powell and Henderson [eds.], Contributions to West Indian Herpetology: A Tribute to Albert Schwartz, pp. 95–127. SSAR Contrib. Herpetol. 12, Ithaca, New York; Hedges 2002. *In* Zanoni [ed.], Flora of the Greater Antilles, New York Bot. Garden, *in press*). A dispersal event of that magnitude surely required a mat of vegetation on which snakes could rest and avoid dehydration, overheating, drowning, and predation. Even under the best of conditions, most reptiles would succumb before reaching a new landfall. Although the possibility exists that the seagoing treeboas encountered by the Mauls represented mainland species (e.g., *C. hortulanus* or *C. ruschenbergerii*), based on the absence of flotsam and the near geographic presence of the West Indian taxa, that potential seems highly unlikely.

We thank Larry Maul, skipper of the Lord Nelson Cutter "Shalom" for realizing this information might be of interest to biologists, and for his enthusiastic willingness to share it with us. Henderson's field expenses were provided by the J. C. Penny Golden Rule Foundation (via Robert W. Bourgeois), the Milwaukee Public Museum, the Windway Foundation, and Paul Bourgeois. Robert Powell made numerous suggestions to improve the clarity of the paper.

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CROTALUS CERASTES (Sidewinder). **PREY/PREDATOR WEIGHT-RATIO.** A key innovation in the evolutionary history of snakes is the ability to ingest large prey items. Vipers are especially renowned for this ability, perhaps aided by the predigestive function of venoms. The largest prey/predator weight-ratio previously recorded was from a neonate viper, *Bothrops atrox*; this snake ingested a *Cnemidophorus* lizard, resulting in a relative prey/predator weight-ratio of 1.56 (Greene 1983. Amer. Zool. 23:431–441). Despite the presumed dietary advantages of such large meals, the size of a meal can render snakes vulnerable to predation (e.g., Pauly and Benard 2002. Herpetol. Rev. 33:56–57). Here we report the largest relative prey item recorded from snakes, which may have contributed to the snake's death. A dead neonate *C. cerastes* was found on a lightly traveled road near the Ranger Station at the Ocotillo Wells State Vehicular Recreational Area, San Diego Co., California, USA, 80 m elev. (N33°9.31', W116°8.98'). Approximately 6 cm of the tail of a *Cnemidophorus tigris* was protruding from its mouth, and the remainder of the lizard formed an obvious bolus. The snake was not visibly damaged in any way, but was slightly decomposed and desiccated prior to preservation. The SVL of the preserved snake is 229 mm, the SVL of the lizard is 73.5 mm, plus a tail length of 196 mm. Dissection revealed that the head of the lizard was located at the level of the lower intestine. The relative prey mass of this food item was 1.72. Dissection revealed dipteran insect larvae (maggots) in both the coelom of the snake and the head of the lizard. It is uncertain if the maggots originated from the snake, or if the snake ingested the lizard as carrion containing maggots. We cannot rule out the possibility that the snake was killed by an automobile, but we observed no apparent vehicle-associated trauma on the specimen. Although the exact cause of death is uncertain, the snake may have been physically incapacitated by the meal it ingested and died of exposure to daytime temperatures—if not as a result of ingesting the meal itself. The snake and the prey item were deposited at the Collection of Vertebrates, University of Texas, Arlington, Texas (UTA R-51519). We thank Harry Greene for insightful discussion on this topic.

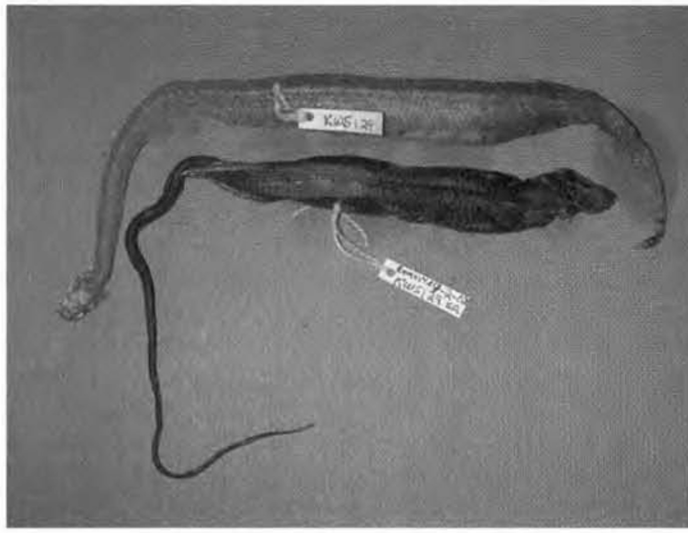

FIG. 1. A neonate *Crotalus cerastes* and the prey item (*Cnemidophorus tigris*) it had consumed; the relative predator/prey mass of this food item was 1.72.

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CROTALUS ENYO (Baja California Rattlesnake). **ENDOPARASITES.** The biology of *Crotalus enyo* was summarized by Beaman and Grismer (1994. Cat. Amer. Amphib. Rept. 589:1–6). There are no reports of endoparasites for this species. The purpose of this note is to report the presence of larvae (tetrathyridium) of tapeworms (Cestoda) and larvae (cystacanth) of spiny-headed worms (Acanthocephala) in *C. enyo*. The body cavities of 52 *C. enyo* (19 from Baja California and 33 from Baja California Sur, Mexico) from the herpetology collections of the California Academy of Sciences (CAS), Natural History Museum of Los Angeles County (LACM), and San Diego Society of Natural History, (SDSNH) were examined for helminths. A mid-ventral incision was made in the body wall, and organ surfaces and mesenteries in the posterior portion of the body cavity were visually examined. Oblong whitish bodies, ca 1 x 3 mm, were found in two snakes

from Baja California Sur which proved upon microscopic examination to be tetrathyridia (larvae) of *Mesocestoides* sp. (CAS 143982) and oligacanthorhynchid acanthocephalan cystacanths (larvae) (CAS 15632). Prevalence of infection (infected snakes/snakes sampled x 100) was 2% for each parasite species. Selected specimens were deposited in the U.S. National Parasite Collection (USNPC), Beltsville, Maryland: acanthocephalan cystacanths USNPC 92196; tetrathyridia of *Mesocestoides* sp. USNPC 92197.

The occurrences of *Mesocestoides* sp. and oligacanthorhynchid cystacanths in North American rattlesnakes have been summarized in Goldberg and Bursey (2000. Herpetol. Rev. 31:104). Rattlesnakes may serve as paratenic (transport) hosts for tetrathyridia of *Mesocestoides* sp. (Bolette 1997a. J. Parasitol. 83:751–752) and cystacanths of oligacanthorhynchid acanthocephalans (Bolette 1997b. Southwest. Nat. 42:232–236). *Crotalus enyo* represents a new host record and Baja California Sur a new locality record for both tetrathyridia of *Mesocestoides* sp. and cystacanths of oligacanthorhynchid acanthocephalans.

We thank B. Hollingsworth (SDSNH), D. Kizirian (LACM), and J. Vindum (CAS) for permission to examine specimens.

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CROTALUS MITCHELLII (Speckled Rattlesnake). **MATING**. Most North American pitvipers have a distinct fall and/or spring mating season, exhibiting the aestival postnuptial pattern of the male reproductive cycle (Saint Girons 1982. Herpetologica 38:5–16). Recent evidence suggests that *C. mitchellii* males undergo spermiogenesis primarily in the spring (Goldberg 2000. Bull. South. California Acad. Sci. 2:101–104) in contrast to other North American rattlesnakes (e.g., Aldridge 1979. J. Herpetol. 13:187–192; Goldberg 1999. Western North Am. Nat. 60:98–100; Jacob et al. 1987. Southwest. Nat. 33:273–276). However, few mating dates for wild *C. mitchellii* have been published. Here we present our own observations as well as those from the literature in order to elucidate when mating occurs in *C. mitchellii* under natural conditions.

On the afternoon of 18 April 1953, a mating pair of *C. mitchellii* was reported by Brattstrom (Brattstrom 1965. Amer. Midl. Nat. 73:376–422.) near Afton, San Bernardino County, California, USA. On 18 April 1980, T. B. Johnson photographed (see Fig. 13 in Lowe et al. 1986. The Venomous Reptiles of Arizona, Arizona Game and Fish Department, Phoenix. p. 115) a pair of mating *C. mitchellii* in the Mohawk Mountains, Yuma County, Arizona, USA. The pair (T. B. Johnson pers. comm.) was courting at 0908 h and mated at 0935 h. The female retreated to the rocks at 1118 h as ambient temperatures increased. The male, with hemipenis still inserted, was dragged along with the female. On 11 June 1964 at 1800 h, G. Ahern found a pair of *C. mitchellii* copulating on the western slope of the San Jacinto Mountains, Riverside County, California, USA (Goldberg 2000, *op. cit.*). At 2248 h on 13 June 1995 (air temperature ca. 29°C, sunny substrate temperature ca. 40°C) RSR found a copulating pair of *C. mitchellii* in the shade of a small bush near an unmarked jeep trail, 2 km SW of the junction of Hwy 247 and Mikisha Blvd., San Bernardino Co., California, USA (34°19'25.6"N, 116° 30' 26.1"W). Rattling by the larger male drew attention to their presence. The male assumed a defensive posture, but remained engaged with the female while photographs were taken. At 2300 h on 23 May 2000 (air temperature ca. 26°C with the asphalt significantly warmer) GEAG discovered a female *C. mitchellii* crossing Kelbaker Rd., north 5 km from the junction of Hwy 40 and Kelbaker Rd., Mojave Natl. Preserve, San Bernardino Co., California, USA (34°44'00"N, 115°40'00"W). A male was 2 m away, crawling rectilinearly towards the female (identification confirmed by H. W. Greene from photographs). Both snakes were briefly restrained in plastic acrylic tubes, sexed, and then released 5 m off the road. Upon release, the male immediately pursued, courted, and mated with the female (hemipenal insertion was noted). Mating continued for more than 30 min., at which time the pair was left alone. GEAG found another two *C. mitchellii*, presumably a courting pair, on the same evening (23 May 2000) 100 m to the south. Both animals were lifted from the road with hooks; no courtship or mating was observed.

During a field study (by RSR) from 1998 to 1999 in Johnson Valley, San Bernardino Co., California, USA, three large male *C. mitchellii* were encountered crossing roads in June. These snakes were many kilometers from rocky retreats, apparently traversing long distances through creosote (*Larea tridentata*) flats. Long distance movements by large adults through atypical habitat are most consistent with mate searching and, despite daily road driving from May to October, no other *C. mitchellii* were encountered away from rocky habitats. RSR collected a post-ovulatory gravid female on 3 August 1998 in the western foothills of Rodman Mountain (34°39'34"N, 116°39'34"W). Mucous removed from her reproductive tract by oviductal lavage was examined microscopically and contained abundant active sperm, suggesting a recent mating.

These data indicate a primarily spring and summer mating season for *C. mitchellii*, with an extension of mating activity up to the time of ovulation (Goldberg 2000, *op. cit.*; RSR, pers. obs.) in June. Goldberg's histological data suggest that mating could occur throughout the month of June. Mating in close temporal proximity to ovulation might reduce reliance on long-term sperm storage (e.g., Schuett 1986. Copeia 1986:807–811), perhaps biasing multiple paternity through an order effect that depends on shear numbers of sperm present rather than on sperm selection by females.

We thank Akito Y. Kawahara and A. Kristopher Lappin for their contributions to this fieldwork.

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CROTALUS PRICEI MIQUIHUANUS (Miquihuanan Rattlesnake). **DIET**. Few prey items have been reported for the montane rattlesnake species *Crotalus pricei*. Klauber (1972. Rattle-

snakes: Their Habits, Life Histories, and Influence on Mankind. 2nd ed. Univ. California Press, Berkeley, California. 1533 pp.) reported a field mouse and *Sceloporus jarrovii jarrovii* as prey items of *Crotalus pricei pricei*. Armstrong and Murphy (1979. The Natural History of Mexican Rattlesnakes. Univ. Kansas Mus. Nat. Hist. Special Publ. 5:1–88) found a juvenile *Sceloporus poinsettii* in an adult *C. p. pricei*. Little published data exist on the natural history of the endemic Mexican subspecies *C. p. miquihuanus* and no prey items have been recorded for this subspecies. Armstrong and Murphy (*op. cit.*) stated that lizards of the genus *Sceloporus* appear to be the main prey of *C. p. miquihuanus*.

On 29 May 2001 we collected an adult male *C. p. miquihuanus* near Santa Rita, Municipio Arteaga, Coahuila, México, in thick agave (*Agave* spp.) and scrub oak (*Quercus* sp.) among exposed limestone. The specimen had a noticeable mid-body bulge. Seven days later the specimen defecated. Analysis of the fecal matter revealed scales and a partially digested front leg of a *Barisia imbricata ciliaris*. Several specimens of this anguid were found in the same general area as the specimen of *C. p. miquihuanus*.

We thank James R. Dixon for his help.

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ELAPHE O. OBSOLETA (Black Ratsnake) **ESCAPE BEHAVIOR, HABITAT**. *Elaphe o. obsoleta* is a terrestrial species with arboreal foraging tendencies (Fitch 1999. A Kansas Snake Community: Composition and Changes Over 50 Years. Krieger Publishing, Malabar, Florida. xi + 165 pp.). Weatherhead and Hoysak (1989. Can. J. Zool. 67:463–468) indicated that in June, males are often wide-ranging and are found in open areas, and Stickel et al. (Amer. Midl. Nat. 103:1–14) reported that individual snakes included a mixture of habitats within their ranges. None of these studies mentioned aquatic behavior in this species.

On 27 May 2002 at 1630 h, while seeking *Nerodia sipedon* in the "400 ponds" enclosure of the Nelson Environmental Study Area [University of Kansas Field Station and Ecological Reserves (KSR)], pond 437 (NE1/4, Section 33, TWP11S RNG20E, Jefferson County, Kansas), I observed a ca 1 m TL *E. o. obsoleta* swimming diagonally across the 20.6 m x 20.6 m pond. The 6.7-ha site of these ponds is not far from wooded habitat and is surrounded by open areas; the enclosure containing these ponds is not wooded and is mowed regularly. The snake's head was elevated ca. 50 mm above the water surface. It swam directly to a small, emergent willow (*Salix* sp.) directly in front of my observation point and ca 2.5 m from shore, climbed into the lowermost branches, and remained still while stretched out on a thin, horizontal branch. The snake seemed unaware of a small bird nest (species unknown) of apparently recent construction, and also was unaware of me. Air temperature was 27°C, no cloud cover, no breeze.

After 15 minutes of observation, I attempted capture of the snake. As the pond bank dropped steeply away and the snake was just beyond effective reach of my tongs, I tossed a twig just beyond it in the hope that it would swim to shore not far from my vantage point. Instead, it dropped into the water, dove, and from the resultant bubble trail from disturbed vegetation swam ca 10 m into the pond, then turned towards the adjacent bank where I saw it emerge. I subsequently lost track of it in vegetation.

Fitch (pers. comm.) indicated that never in 50+ years of observing this species in the area had he seen one utilize an aquatic habitat in this fashion. Of the many specimens I have observed in the area since 1970, none has been in an aquatic habitat. However, Fitch (Copeia 1963:649–658) noted that on the University of Kansas Fitch Natural History Reservation the species is "present in all habitats," and also presented tentative evidence that some individuals include frogs in their diet.

Sincere thanks are expressed to Galen Pittman (KSR Station Manager/Biologist) for ongoing logistic support with my research on the properties.

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ELAPHE OBSOLETA QUADRIVITTATA (Yellow Ratsnake). **ATTEMPTED PREDATION**. During mid-morning on 24 March 2000, we observed a red-shouldered hawk (*Buteo lineatus*) attack an *Elaphe obsoleta quadrivittata* in Corkscrew Swamp Sanctuary near Immokalee, Florida, USA. The hawk landed on a horizontal branch of a large cypress (*Taxodium distichum*) tree near the top of the canopy (~15 m) in a primary stand of cypresses. It seized a large yellow rat snake, and a struggle ensued for ca. 20 sec. After that time, the snake disappeared from view, and the hawk appeared confused. The hawk remained on the branch for another minute, and then departed with nothing in its beak or talons. The snake apparently escaped predation, though we were unable to ascertain its whereabouts following the attack.

During the attack, a large shed skin was knocked off the branch and dangled into our view. We estimated the length of the visible portion as approximately 1 m. This strongly suggests that the snake was shedding its skin while resting on a branch near the top of the forest canopy. We are not aware of any other records of arboreal shedding in *E. o. quadrivittata*, but apparently it is common in *E. o. obsoleta* (Stickel et al. 1980. Amer. Midl. Nat. 103:1–14). Our observation suggests that shedding may increase a snake's visibility to aerial predators or reduce its ability to flee quickly.

We thank R. Root and P. Marks for organizing the trip to Corkscrew Swamp Sanctuary, Cornell University for support of the EEB field course, and H. Greene and P. Marks for helpful comments on this note.

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ELAPHE QUADRIVIRGATA (Japanese Striped Snake). **PREDATION.** On 29 August 2000 at ca. 1900 h, I caught a largemouth bass (*Micropterus salmoides*) (142 mm SL, 173 mm TL) while fishing in an irrigation pond in Higashi-Hiroshima,

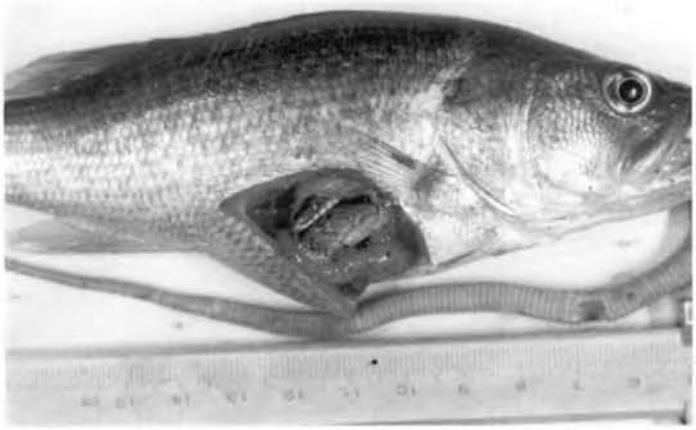

FIG. 1. *Elaphe quadrivirgata* in the stomach of *Micropterus salmoides*.

Hiroshima Prefecture, Japan (34°24'N, 132°43'E, 240 m elev.). I inserted my finger into the fish's mouth to search for stomach contents because the fish had a swollen abdomen. I found the tail of a snake by this process. Upon dissection, I removed a juvenile *Elaphe quadrivirgata* (259 mm SVL, 327 mm TL) (Fig. 1) and a spider (ca. 6 mm TL). This is the first report of predation on a snake by the introduced *M. salmoides* in Japan (Tanaka and Mori 2000. Current Herpetol. 19:97–111).

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ELAPHE VULPINA (Fox Snake). **REPRODUCTION.** Few data are available on the reproductive biology of fox snakes in agricultural regions of the Midwestern U.S. On 16 June 1998, we found a gravid 81.3 cm SVL fox snake under a 1-mm thick 45 cm x 75 cm piece of black rubber in a grassy field at the Middle Fork Fish and Wildlife Area, Vermilion County, Illinois, USA. The fox snake was taken to the laboratory where, on 29 June, 17 eggs were deposited. The eggs were incubated on vermiculite in a ventilated container sitting in a water bath of 28.1°C. On 12 Aug, after 44 days of incubation, all eggs hatched. The hatchlings were released near the site of the mother's capture. According to Ernst and Barbour (1989. Snakes of Eastern North America, George Mason University Press, Fairfax, Virginia. 282 pp.), "mating occurs in early June and July" for fox snakes, and eggs are deposited 30 days later. These authors cite clutch sizes from 7–27, with 15–20 eggs being usual, and the size of the fox snake clutch described herein is within this range. However, gestation for species of *Elaphe* usually takes closer to 45 days at ca. 27–28°C in the laboratory (WLK, pers. obs.). This, coupled with the fact that this fox snake was quite distended when collected on 16 June, suggests that fox snakes in Illinois may start to breed as early as mid-May.

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ENHYDRIS PLUMBEA (Olive Water Snake). **DIET**. Although *Enhydris plumbea* is often reported to feed on amphibians (adults and larvae) and fishes, documented specific predation records from the wild are rare. The stomach of an adult *E. plumbea* (IRSNB 15588; SVL 337 mm) collected at "25 km nordwestlich von Lan-Sak, 65 km nordwestlich von Uthai-Thani, ca 220 km nordwestlich von Bangkok, Thailand, 110 m über 00," in Uthai Thani Province, contained a partly digested *Macrognathus siamensis* (Mastacembeliformes: Mastacembelidae) ingested head first. This fish species was previously recorded from Uthai Thani Province (Monkolprasit et al. 1997. Checklist of Fishes in Thailand. Office of Environmental Policy and Planning, Biodiversity Series 4:1–353). This fish lives in slow-moving or standing waters and begins its foraging activity at dusk (Rainboth 1996. Fishes of the Cambodian Mekong. FAO Species Identification Field Guide for Fishery Purposes, Food and Agriculture Organization of the United Nations, Rome. 265 pp.), similar to *E. plumbea*.

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GYALOPION QUADRANGULARE (Thornscrub Hook-nosed Snake). **REPRODUCTION.** The thornscrub hook-nosed snake, *Gyalopion quadrangulare,* occurs from extreme southern Arizona, USA, south to Nayarit, Mexico (Stebbins. 1985. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin, Boston. 336 pp.). Virtually nothing is known about reproduction of this snake other than that it is oviparous (Bartlett and Tennant. 2000. Snakes of North America Western Region. Gulf Publishing Company, Houston, Texas. 312 pp.). The purpose of this note is to report on an examination of *G. quadrangulare* gonads from Mexico from the herpetology collections of the Natural History Museum of Los Angeles County, Los Angeles (LACM) and The University of Arizona, Tucson (UAZ) and to provide the first information on the reproductive cycle of this species.

Fifteen *G. quadrangulare,* 7 males, mean snout-vent length, SVL = 207 mm ± 26 SD, range = 183–207 mm; 8 females, mean SVL = 234 mm ± 33 SD, range = 183–266 mm were examined. Snakes were collected 1960–1983. The left gonad was removed, dehydrated in alcohol and embedded in paraffin. Histological sections were cut at 5 μm and stained in Harris' hematoxylin followed by eosin counterstain from all snakes except those females that contained enlarged follicles or oviductal eggs.

Females contained enlarged follicles > 9 mm length or oviductal eggs from early June to mid-August. One 12 June female (LACM 38506, SVL = 205 mm) from Sinaloa, Mexico contained 4 oviductal eggs; another collected 22–23 June (LACM 65187, SVL = 257 mm) from Sonora, Mexico contained 4 enlarged follicles. One collected 3 July (LACM 6835, SVL = 183 mm) from Sinaloa, Mexico contained 3 enlarged follicles; another collected 12 July (LACM 127815, SVL = 266 mm) from Sonora, Mexico contained 5 oviductal eggs; another collected 30 July (UAZ 39233, SVL = 215 mm) from Sinaloa, Mexico was not reproductively active. One collected 6 August (LACM 38499, SVL 264 mm) from Sonora, Mexico contained three enlarged follicles; another col-

lected 8 August (UAZ 45197, SVL = 265 mm) from Sonora, Mexico contained three oviductal eggs; another collected 17 August (LACM 50779, SVL = 220 mm) from Sonora, Mexico was not reproductively active. Mean clutch size (N = 6) was 3.7 ± 0.82 SD, range = 3–5.

Spermiogenesis was in progress in the following males: 4 June (LACM 136922, SVL = 209 mm) Nayarit, Mexico; 6 June (LACM 38181, SVL = 257 mm) Sinaloa, Mexico; 30 June (LACM 38511, SVL = 183 mm) Sinaloa, Mexico; 19 July (LACM 38509, SVL = 198 mm) Sinaloa, Mexico; 17 August (UAZ 36446, SVL = 190 mm) Sonora, Mexico; 23 August (LACM 6851, SVL = 203 mm) Sinaloa, Mexico. One 7 September male (LACM 121330, SVL = 206 mm) from Sinaloa, Mexico was in late spermiogenesis. Germinal epithelium was reduced to a few layers, there were small clusters of metamorphosing spermatids and small amounts of sperm.

In view of the presence of females with enlarged follicles or oviductal eggs from June to August and males in spermiogenesis from June to September, it appears *G. quadrangulare* has an extended reproductive season that encompasses both spring and summer.

I thank David A. Kizirian (Natural History Museum of Los Angeles County) and Charles H. Lowe (University of Arizona) for permission to examine *G. quadrangulare*.

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HELICOPS ANGULATUS (Water-Snake). **DIET**. On 05 June 2001 we collected one specimen of *Helicops angulatus* (Centro de Estudos e Pesquisas Biológicas - CEPB 4495, male SVL 440 mm; body weight 28 g), on the left bank (SW) of Piranhas River, Municipality of Piranhas, Southwestern region of the State of Goiás, Brazil (16°35'22"S, 51°47'41"W). The snake was eating a female *Hyla crepitans* (SVL 43.8 mm).

Among South American herpetofaunal studies there is no mention of the biology and life history of *H. angulatus*. The known data about its biology suggests that this species feeds on tadpoles, frogs, and lizards, but especially fishes (Dixon and Soini 1986. The Reptiles of Upper Amazon Basin, Iquitos Region, Peru. Milwaukee Publ. Mus. 154 pp.; Duellman 1978. Misc. Publ. Mus. Nat. Hist. Univ. Kansas 65:1–352).

Our observation is interesting because *H. angulatus* is a semiaquatic snake and the prey item is an arboreal frog. This is the first natural history report of this taxon in central Brazil, and it adds to the knowledge of the biology of this widespread species in South America (Roze 1966. La Taxonomia y Zoogeografia de los Ofidios de Venezuela, Edit. Biblioteca, Caracas. 362 pp.; Pérez-Santos and Moreno 1988. Serpientes de Colombia, Monog. VII, Mus. Reg. Sci. Nat. Torino. 517 pp.; Pérez-Santos and Moreno 1991. Serpientes de Ecuador, Monog. XI, Mus. Reg. Sci. Nat. Torino. 538 pp.).

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LEPTOPHIS AHAETULLA MARGINATUS (Southern Green Parrot-Snake). **DIET**. *Leptophis ahaetulla marginatus* is an arboreal snake with a maximun total length of 1500 mm (Cei 1993. Reptiles del Noroeste, Noreste y Este de Argentina. Herpetofauna de las Selvas subtropicales, Puna y Pampas. Mus. Reg. Sc. Nat. Torino, Monogr. 14:575). It occurs from southeastern Bolivia to western São Paulo State in Brazil, through Paraguay and southern Brazil to northeastern Argentina and Uruguay (Peters and Orejas Miranda 1970. Catalogue of Neotropical Squamata: Part I. Snakes. U.S. Nat. Mus. Bull. 297:163). The diet of *L. ahaetulla* consists primarily of arboreal or semiarboreal hylid frogs, and secondarily of bird eggs, young birds, and lizards (Oliver 1948. Bull. Amer. Mus. Nat. Hist. 92; Duellman 1978. The Biology of an Equatorial Herpetofauna in Amazonian Ecuador. Misc. Publ. Univ. Kansas Mus. Nat. Hist. 65; Cunha and Nascimento 1993. Publ. Avul. Mus. Paraense E. Goeldi, Zool. 107). Limited data pertaining to *L. a. marginatus* suggest that it feeds mainly on hylid frogs and lizards (Achaval and Olmos 1997. Anfibios y Reptiles de Uruguay. Barreiro y Ramos S.A., Montevideo, Uruguay; Yanosky et al. 1996. Herpetol. Nat. Hist. 4:97–109).

We examined 21 specimens of *Leptophis ahaetulla marginatus* (SVL range = 560–967 mm) from Corrientes, Formosa, Misiones, and Santa Fe provinces (Argentina) deposited in the following collections: Instituto Nacional de Limnología, Consejo Nacional de Investigaciones Científicas y Técnicas, Santa Fe (INALI, 14 specimens); Félix de Azara collection, now deposited in the Museo Argentino de Ciencias Naturales, Buenos Aires (MACN, 3 specimens); Centro de Investigaciones Ecológicas Subtropicales, Parque Nacional Iguazú, Misiones (CIES, 3 specimens) Museo Provincial de Ciencias Naturales Florentino Ameghino, Santa Fe (MFA, 1 specimen). Museum numbers for material examined are available from the author upon request. Prey items were deposited in the Instituto Nacional de Limnología (INALI).

Eleven *Leptophis ahaetulla marginatus*, 52.4% of the specimens examined, contained recoverable food items. Of 16 prey

TABLE 1. Prey eaten by *Leptophis ahaetulla marginatus* based on examination of stomach contents of preserved specimens.

Prey taxon	Prey frequency	% of total prey items
Amphibians		
Hyla nana	1	6.25
Scinax sp.	3	18.75
Scinax aff. *acuminata*	2	12.50
Scinax nasica	3	18.75
unidentified Hylidae	1	6.25
unidentified amphibians	1	6.25
Birds		
Zonotrichia capensis	1	6.25
Coryphospingus cucullatus	1	6.25
unidentified bird eggs	2	12.50
unidentified vertebrate	1	6.25

items found, 11 (68.8%) were amphibians, 2 (12.5%) were young birds, 2 (12.5%) were birds' eggs, and 1 (6.3%) was an unidentified vertebrate (Table 1). The two young birds were attacked in the nest in a tree during the morning (and another snake was observed pursuing a frog in a tree at 1600 h (ARG, pers. obs.). Six snakes were observed active between 1100 h and 1740 h, most of them in trees or bushes. These observations and the prey items recovered (Table 1), confirm that this subspecies is diurnal and is an active forager in trees or bushes as suggested by Oliver (1948, *op. cit.*).

We acknowledge the curators of the museums mentioned for allowing us to examine the material in their care, Marcos Di Bernardo for bibliographic data, and the CONICET (Concejo Nacional de Investigaciones Científicas y Técnicas) for support of our investigations.

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LIOPHIS JAEGERI (Jaeger's Ground Snake). **DIET.** *Liophis jaegeri* is a small colubrid occurring in Brazil, Bolivia, Paraguay, Argentina, and Uruguay. This snake lives in humid and aquatic habitats where it mainly feeds on amphibians. After a heavy rainfall on 7 January 2001 at 2130 h, we observed a juvenile *L. jaegeri* (226 mm SVL; 277 mm total length; 7.72 g mass) at a small pond in the CPCN Pró-Mata reserve, municipality of São Francisco de Paula, Rio Grande do Sul, southern Brazil (960 m elevation). The snake's head was inside a small hole in the mud and its tail was slowly moving. After being caught, the snake regurgitated white foam and 11 tadpoles at Gosner stage 19. Inside the hole, we found a foam nest of the leptodactylid *Leptodactylus plaumanni* containing tadpoles of the same stage. To our knowledge, this is the first record of a snake feeding on a subterranean anuran foam nest. To verify our observation, this snake and four other *L. jaegeri* from the same area (two adult females, one adult male, and one juvenile) were kept together inside a terrarium. For one week the snakes were only provided with water, then we offered a new-built foam nest of *L. plaumanni*. The specimen found eating in the hole under natural conditions immediately approached the nest and began to feed on eggs by totally immersing its head in the foam. After 2 min. another snake started eating, and after 10 min. all five snakes were feeding on the nest. These observations confirm that the diet of *L. jaegeri* comprises anuran eggs and tadpoles from foam nests.

We thank Marcos Di-Bernardo for his cooperation.

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LIOPHIS MARYELLENAE (Cobra-d'água). **DIET**. The colubrid snake *Liophis maryellenae* is reported from the tablelands of central and southeastern Brazil (Dixon 1985. Proc. Biol. Soc. Washington 98:301; Dixon 1989. Smithsonian Herpetol. Information Serv. 79:15). Snakes of the genus *Liophis* are primarily terrestrial but some species are semiaquatic or semifossorial, being found near several types of water bodies, including swamps, streams and ponds associated with forests and grasslands (Dixon 1980. Contrib. Biol. Geol. 31:1–40). Species of *Liophis* are known to feed mainly on arthropods, earthworms, fishes, salamanders, adult and larval anurans, lizards and birds (Dixon, *op. cit.*); however, no diet information has been reported from *L. maryellenae*. Herein we report on gut contents of one individual found in the wild.

On 15 February 1999, in the afternoon, JC found an adult male (SVL = 370 mm, tail length = 125 mm) resting in the standing water of a stream at the Parque Nacional da Serra do Cipó, Minas Gerais State, Southeastern Brazil (19°12'–19°20'S, 43°30'–43°40'W). Upon capture it regurgitated one partially digested *Hyla* tadpole. The tadpole was probably *H. saxicola* (Hylidae) because a large number were present in the stream at the time of the capture. The snake and the tadpole are deposited in the herpetological collection of the Universidade Federal de Minas Gerais (UFMG-218), Brazil. Estimated prey/predator mass ratio was 0.0024.

We thank Vinícius Xavier and Claudia M. Jacobi for comments and improvements on this manuscript.

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LIOPHIS POECILOGYRUS (Trash-snake). **DIET**. On 18 November 1999 and 16 June 2001 we collected two specimens of *Liophis poecilogyrus*, at Cana Brava region, on the left bank (W) of Tocantins River, Municipality of Minaçu, northern State of Goiás, Brazil (13°34'17"S, 48°06'58"W). In one specimen of *L. poecilogyrus* (Centro de Estudos e Pesquisas Biológicas - CEPB 4427, male SVL 546.2 mm) we found an adult female *Phrynohyas venulosa* (SLV 61.6 mm) and the other (CEPB 4496, female SVL 432.7 mm) had most of the posterior limbs and pelvic region of a specimen of *Hyla multifasciata* (Femur: 25.2 mm; Tibia: 29.1 mm; Tarsus: 17.2 mm).

Some authors have mentioned that *L. poecilogyrus* feeds on amphibians (Vanzolini et al. 1980. Répteis das Caatingas. Acad. Bras. de Ciencias Ed. Rio de Janeiro. 161 pp.; Marques et al. 2001. Serpentes da Mata Atlântica, Guia Ilustrado para a Serra do Mar, Holos Ed. Ribeirão Preto. 184 pp.), and some have mentioned species of the families Bufonidae (*Bufo granulosus, B. paracnemis*) and Leptodactylidae (*Leptodactylus fuscus, L. ocellatus, Physalaemus cuvieri*) (Norman and Naylor 1994. Amphibians and Reptiles of the Paraguayan Chaco, Vol. I. Private Publication. San José. 281 pp.), lizards (*Teius* sp.), fishes, birds, and small rodents (Cei 1993. Monogr. XIV, Mus. Reg. Sci. Nat. Torino. 949 pp.; Achaval and Olmos 1997. Anfíbios y Reptiles del Uruguai, Série Fauna n°1, Facultad de Ciencias Ed. Montevideo. 128 pp.). Young specimens may feed on insects and small amphibians and reptiles (Cei 1986. Monogr. IV, Mus. Reg. Sci. Nat. Torino. 527 pp.).

Our observations include two different species of hylid frogs in the diet of *L. poecilogyrus*. The most interesting observation is the

fact that both specimens preyed on two species of arboreal frogs, and *L. poecilogyrus* is considered to be a terrestrial species living near or in swamps.

Submitted by **NELSON JORGE DA SILVA JR., IVAN FRANÇA E SOUZA, WILIAN VAZ SILVA,** and **HÉLDER LÚCIO RODRIGUES SILVA**, Laboratório de Herpetologia, Centro de Estudos e Pesquisas Biológicas, Universidade Católica de Goiás, Ave. Universitária, 1440, Setor Universitário, 74.210-010, Goiânia, Goiás, Brazil (e-mail [NJS]: njs@ucg.br).

LYSTROPHIS NATTERERI (NCN). **PREDATION.** *Lystrophys nattereri* is a small terrestrial xenodontini that occurs from central to southern Brazil (Hoge et al. 1975. Mem. Inst. Butantan. 39:37–50). We are unaware of any reports of predators of *L. nattereri*. We present an instance of predation on *L. nattereri* by the white-tailed hawk, *Buteo albicaudatus* (Aves: Accipitridae). The observation occurred on 19 October 2000 at 0605 h on an unpaved road crossing an area of pristine flooded grassland (22°13'30"S, 47°54'00"W, 715 m elev.) in Itirapina Ecological Station (IES), municipality of Itirapina, São Paulo State, southeastern Brazil.

When first seen from a car, the hawk was on the ground pecking a snake held by its claws. The approaching car drove the hawk away from its prey, an adult female *L. nattereri* (404 mm SVL, 57 mm tail length, mass 43 g; with four enlarged follicles). While the still-living snake was examined by us, the hawk hovered over the area. The snake had a scar throughout the frontal scale.

Snakes are not a rare prey item for the white-tailed hawk in Brazil (M. A. Granzinolli, unpubl. data). This hawk hunts vertebrates by standing flight or hovering at 20–30 m above ground and diving over prey (M. A. Granzinolli, unpubl. data; pers. obs.). The color pattern of *Lystrophis nattereri* is similar to that of the syntopic pitviper, *Bothrops itapetiningae*, suggesting the former is a mimic of the latter; indeed, the geographic distributions of both species in Brazil are largely coincident (see Hoge et al., *op. cit.*; Campbell and Lamar 1989. The Venomous Reptiles of Latin America, Comstock, Ithaca, New York. 425 pp.).

The snake is deposited in the Museu de História Natural, Universidade Estadual de Campinas (ZUEC 02472). D. Zanchetta and the staff of Instituto Florestal allowed and facilitated our fieldwork at IES, and M. A. Grazinolli provided unpublished data and discussed with us hawk feeding habits. This is the publication number 4 of the project Ecology of the Cerrados of Itirapina, funded by FAPESP.

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NERODIA ERYTHROGASTER FLAVIGASTER, N. RHOMBIFER,* and *N. SIPEDON PLEURALIS (Yellow-bellied, Diamond-backed, and Midland Watersnakes). **FORAGING BEHAVIOR.** The use of man-made items by animals is varied. The loggerhead shrike (*Lanius ludovicianus*) uses barbed wire in nest construction and prey capture (Burton 1999. Am. Midl. Nat. 142:198–199). Desert tortoises (*Gopherus agassizii*) construct their burrows near roads and the concrete bases of wind energy structures (Lovich and Ramona 2000. Chel. Conserv. Biol. 3:714–721). Here we report the novel use of a man-made structure in the foraging strategy of three sympatric species of water snakes.

We monitored the habitat use by individuals of *Nerodia erythrogaster flavigaster*, *N. rhombifer*, and *N. sipedon pleuralis* in Nashoba Park (Germantown, Shelby County, Tennessee, USA; 35°07'N, 89°48'W) using a mark-recapture technique during summer 1998 (18 June–18 September). The park contains an impoundment ca. 2 acres in area and bounded on the northern end by a concrete retaining wall ca. 50 m long. We noticed that precipitation events of a certain magnitude caused the impoundment to overflow the retaining wall, carrying fish (*Lepomis cyanellus* [green sunfish], *L. macrochirus* [bluegill], *Ameirus melas* [black bullhead catfish], *Gambusia affinis* [mosquitofish], and *Labidesthes sicculus* [brook silverside]) into a recess on the other side. We never observed snakes being washed over the wall, but did observe animals moving across the wall under their own power. On five occasions, we observed animals foraging in the ephemeral pools caused by overflow. We found a single *N. rhombifer* (R8: 42.8 cm SVL, 96 g mass) with a large food bolus indicative of successful prey capture on 11 August 1998 at 21:26 h. Two *N. sipedon pleuralis* (S6: 64.8 cm SVL, 196 g mass; S7: 56.8 cm SVL, 136 g mass) were captured in the pools on 13 July 1998 at 20:47 h and 21:42 h, respectively. A third *N. sipedon pleuralis* (S10: 78.5 cm SVL, 525 g mass) was captured on 30 July 1998 at 21:38 h. A single *N. erythrogaster flavigaster* was captured in the pools on two separate occasions (30 July 1998: 78.0 cm SVL, 375 g mass and 03 August 1998: 79.5 cm SVL, 350 g mass).

During casual monitoring in 1999, we observed two additional occurrences of foraging in the pools. On 21 May 1999, a *N. sipedon pleuralis* (25.8 cm SVL) was found, and a *N. rhombifer* (81.0 cm SVL) was found on 19 July 1999. We did not systematically survey the retaining wall area following every rain, but would expect animals to be found there at those times. We can report that no animals were found in the recessed area during any surveys at times when the pools were dry. We suggest that these observations represent a unique strategy in which the animals inhabiting this impoundment associate precipitation events with the availability of food items in a confined area and forage there to maximize prey capture.

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OXYRHOPUS MELANOGENYS (Calico Snake). **DEFENSIVE BEHAVIOR.** The coiling of the tail and exuding an odiferous musk has been well documented as a defensive ploy used by many snake species (Fitch 1975. Univ. Kansas Mus. Nat. Hist. Misc. Publ. 62:1–53; Greene 1973. J. Herpetol. 7:143–156). Herein I report an incident involving a juvenile *O. melanogenys* using a

defensive tail display.

On 1 January 2000 at 2300 h a juvenile (26.5 cm SVL, 9 cm TL, 5 g mass) was found crossing a trail in secondary forest in the Madre Selva 2 Biological Reserve in Loreto, Peru. When touched, the snake placed its head beneath its body coils, raised the posterior portion of its body, coiled its tail into a raised spiral, and emitted a strong, odiferous musk. This specimen was measured, weighed, and released.

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OXYRHOPUS RHOMBIFER RHOMBIFER (Falsa-coral). **DIET**. Although dietary habits are largely unknown for most snake species of the tribe Pseudoboini, existing data suggest that snakes of this group feed primarily on small mammals and lizards (Duellman 1978. Misc. Publ., Univ. Kansas Mus. Nat. Hist. 65:1–352; Marques et al. 2001. Serpentes da Mata Atlântica: Guia Ilustrado para a Serra do Mar. Holos Editora, Ribeirão Preto, São Paulo. 186 pp.; Martins and Oliveira 1998. Herpetol. Nat. Hist. 6:78–150). *Oxyrhopus r. rhombifer* is a terrestrial, mainly nocturnal, pseudoboine snake that ranges from southeastern and southern Brazil to northeastern Argentina and Uruguay (Bailey 1970. U.S. Nat. Mus. Bull. 297:229–235). Data on the diet of this snake come from different geographical areas, resulting mainly from opportunistic observations, and are fragmentary. Known prey items are small lizards (Cei 1993. Reptiles del Noroeste, Nordeste y Este de la Argentina. Museo Rergionale di Scienze Naturali. 950 pp.; Yanosky et al. 1996. Herpetol. Nat. Hist. 4:97–109), rodents (Lema et al. 1983. Comun. Mus. Ci. PUCRS 26:41–121), and anurans (Yanosky et al., *op. cit.*).

We dissected one adult male *Oxyrhopus r. rhombifer* from the municipality of Santa Maria (29°43'S, 53°42'W), Rio Grande do Sul state, Brazil (Zoology Collection, Universidade Federal de Santa Maria [ZUFSM 1359]; SVL = 390 mm, fixed weight = 38.7 g), and found in its stomach a single glass snake (*Ophiodes* sp., ZUFSM 239 [prey items collection]; SVL = 200 mm, fixed weight = 22.5 g). The glass snake was swallowed head first. This is the first record of *Ophiodes* as a food item of *Oxyrhopus r. rhombifer*, as well as the first record of a relatively large and elongated lizard (SVL = 51% of the snake SVL) for the species.

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***PHILODRYAS PATAGONIENSIS*. DIET**. *Philodryas patagoniensis* is a terrestrial colubrid reaching a maximum total length of 150 cm (Cei 1993. Reptiles del Noroeste, Noreste y Este de Argentina. Herpetofauna de las Selvas Subtropicales, Puna y Pampas. Mus. Reg. Sc. Nat. Torino, Monogr. 14:575), and ranging over a large area of South America (Giraudo 2001. Serpientes de la Selva Paranaense y del Chaco Húmedo. L.O.L.A. Argentina., Monogr. 17:157). Reported prey consists of a variety of vertebrates including amphibians, lizards, snakes, birds, and mammals.

In this note, I report on prey items obtained from stomach dissection of 53 museum specimens (mean SVL = 705 mm; range = 213–1315 mm; N = 46) from Corrientes, Entre Ríos, Formosa, Misiones, Santiago del Estero, and Santa Fe provinces in central and northeastern Argentina and in Uruguay. Specimens were examined in the following collections: Instituto Nacional de Limnología, Consejo Nacional de Investigaciones Científicas y Técnicas, Santa Fe (INALI; 50 specimens), Félix de Azara collection, now deposited in the Museo Argentino de Ciencias Naturales, Buenos Aires (MACN; 2 specimens); Museo Provincial de Ciencias Naturales Florentino Ameghino, Santa Fe (MFA; 1 specimen). Museum numbers for material examined are available from the author upon request. Prey items were deposited in the Instituto Nacional de Limnología.

Twenty-six *P. patagoniensis* (49.05% of the specimens examined) contained recoverable food items. I found 29 prey items, of which 8 (27.58%) were lizards, 6 (20.68%) were amphibians, 6 (20.68%) were mammals, 4 (13.79%) were snakes, 4 (13.79%) were birds (possibly young birds), and 1 (3.4%) was an unidentified vertebrate (Table 1). These data confirm that *Philodryas patagoniensis* is a general predator, consuming a variety of terrestial vertebrates.

I thank Alejandro Giraudo for his unselfish help to conclude this work, assistance in the field, access to his personal library, and valuable suggestions on the manuscript. I thank Vaneza

TABLE 1. Prey eaten by *Philodryas patagoniensis* based on examination of stomach contents of preserved specimens.

Prey taxon	Prey frequency	% of total prey items
Amphibians		
Leptodactylus gracilis	2	6.89
Bufo granulosus aff. *fernandezae*	2	6.89
Unidentified amphibians	2	6.89
Reptiles		
Mabuya dorsivitatta	3	10.34
Mabuya sp.	1	3.44
Pantodactylus schreibersii	3	10.34
Unidentified lizard	1	3.44
Unidentified colubrid snake	3	10.34
Liophis dilepis	1	3.44
Birds	4	13.79
Mammals		
Holochilus brasiliensis	1	3.44
Unidentified mammals	5	17.24
Unidentified vertebrate	1	3.44

Arzamendia for help with field and laboratory work. The Subsecretaría de Cultura de la Provincia de Santa Fe supported my investigations.

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PSEUSTES SULPHUREUS (Amazon Puffing Snake). **DIET.** Forest dwelling snakes are poorly studied because they are difficult to find and catch. Here we report an event of *Pseustes sulphureus* feeding on a little tinamous (*Cryptorellus soui;* Tinamidae) in the Ecuadorian rainforest.

A specimen of *P. sulphureus* was caught on 24 April 2000 at 0930 h at the Tiputini Biodiversity Station (Tiputini River, Amazon Basin), Ecuador. The snake was discovered basking in a tree 1.5 m above ground, in a patch of sunlight that penetrated to the understory. The individual measured 249.5 cm in total length, 211 cm in snout–vent length, and weighed 345 g. After 24 h of captivity in a cloth bag it defecated the remains of a bird that was identified as a *C. soui.* This bird is a fairly common ground-dwelling species with an average mass of 188 g.

Data for this contribution were collected during the activities, and as a byproduct, of a course of tropical ecology by Boston University and Universidad San Francisco de Quito at Tiputini Biodiversity Station. We thank M. Lentino for sharing unpublished information on *C. soui.* We also thank M. Rodriguez and S. Seger for help with fieldwork and identification of the sample.

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REGINA SEPTEMVITTATA (Queen Snake). **ABERRANT PATTERN.** The typical distinguishing pattern for this species of *Regina* within the genus includes four ventral rows of stripes or rarely spots. Tulane University Museum of Natural History TU 15362 from one mile east of Brown's Crossroads, Dale County, Alabama, USA has an immaculate venter. Use of a key such as that by Powell et al. (1998. A Key to Amphibians and Reptiles of the Continental United States and Canada. University Press of Kansas, Lawrence) would yield an identification of *Regina grahamii*, a species unrecorded from Alabama. However, scutellation of the odd *R. septemvittata* clearly separates the two species. *R. septemvittata* has been recorded from Dale County (Mount 1975. The Reptiles and Amphibians of Alabama, Auburn University Agricultural Experiment Station, Auburn, Alabama). Identity verified by Jeff J. Boundy.

Submitted by **HAROLD A. DUNDEE**, Tulane University Museum of Natural History, Belle Chasse, Louisiana 70037-3098, USA; e-mail: dundee@museum.tulane.edu.

RHADINAEA MONTANA (Nuevo Leon Graceful Brown Snake). **HABITAT AND DIET**. Little is known about the ecology or natural history of *Rhadinaea montana*. This species has only been documented in Nuevo León, México, from near Ojo de Agua near Galeana (type locality), La Huasteca, Monterrey (Myers 1974. Bull. Amer. Mus. Nat. Hist. 153:89–91), Ojo de Agua in Pablillo (Chaney and Liner 1986. Herpetol. Rev. 17:67), and near Las Adjuntas (Chaney and Liner 1990. Herpetol. Rev. 21:23). Liner and Chaney (1987. Herpetol. Rev. 18:37) found a specimen near a spring in a riparian area in pine-oak habitat and provided the first habitat description for this species. No specific dietary records exist for *R. montana*. Sazima et al. (1992. Herpetol. Rev. 23:120–121) reported on the diet of *R. bilineata*, and stated that the small size, elongated head, and slender body of this species appeared well-suited to predating on small frogs. Herein we provide an additional habitat description for *R. montana* and report the first recorded prey item for this rare species.

On 31 May 2001 we collected an adult male *R. montana* (308 mm SVL) from under a dead lechugilla (*Agave lechugilla*) in a canyon bottom west of San Isidro, Municipio Santiago, Nuevo León, México. The canyon (ca. 1600 m elevation) is characterized by steep limestone walls covered with various agaves (*Agave* spp.), sotol (*Dasylirion* sp.), and scrub oak (*Quercus* sp.), and has intermittent pools of water. The specimen was found ca. 1 m away from a juvenile *Crotalus lepidus*.

Upon inspection of the *R. montana*, a noticeable mid-body bulge was evident. Dissection of the stomach in the lab revealed the bulge to be a partially digested adult *Syrrhophus longipes* that had been swallowed feet first. Our findings on *R. montana* are in agreement with Sazima et al. (*op cit.*). The specimen and prey item were deposited in the Universidad Autónoma de Nuevo León herpetological collection (UANL 5842).

We thank James R. Dixon for his assistance.

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SENTICOLIS TRIASPIS (Green Ratsnake). **REPRODUCTION.** *Senticolis triaspis* occurs from southeastern Arizona,USA, and southern Tamaulipas, Mexico southward along slopes of the Mexican highlands to Costa Rica (Stebbins. 1985. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin, Boston. 336 pp.). There is reproductive information on female *S. triaspis* from the Yucatan, Mexico in Censky and McCoy (1988. Biotropica 20:326–333) including a mean clutch size of 4.8 ± 1.4 SD, range 3–7 for 11 females and in Dowling (1960. Zoologica 45:53–80) who reported a clutch of two oviductal eggs from October. Rossi and Rossi (1995. Snakes of the United States and Canada: Keeping them Healthy in Captivity. Volume 2 Western Area. Krieger Publishing Company, Malabar, Florida. 325 pp.) reported a female captured on 25 April laid four eggs on 4 July. The purpose of this note is to report on an examination of *S. triaspis* gonads from the herpetology collections of the Natural History Museum of Los Angeles County, Los Angeles (LACM), and The University of Arizona, Tucson (UAZ) and to provide the first information on the testicular cycle.

Fifteen *S. triaspis*, 7 males, mean snout–vent length, SVL = 674 mm ± 95 SD, range = 536–813 mm; 8 females, mean SVL = 852

mm ± 166 SD, range = 675–1063 mm were examined. Snakes were collected 1953–1981. The left gonad was removed, dehydrated in alcohol and embedded in paraffin. Histological sections were cut at 5 μm and stained in Harris' hematoxylin from all snakes except UAZ 27041 which contained enlarged ovarian follicles and LACM 6833 which contained oviductal eggs.

Three of eight (38%) females examined were reproductively active. One July female (LACM 127781; 717 mm SVL) from Sonora, Mexico was in early yolk deposition as evidenced by a ring of yolk granules inside one follicle. One September female (UAZ 27041; 704 mm SVL) from Jalisco, Mexico contained 5 enlarging ovarian follicles, 15–19 mm length. One October female (LACM 6833; 873 mm SVL) from Sinaloa, Mexico, contained 5 oviductal eggs. Other females (LACM 6824, 64447; UAZ 41363, 47028) had inactive ovaries: June (1), July (2), August (1). Ovarian follicles from one October female from Santa Cruz County, Arizona, USA (UAZ 46548, 1005 mm SVL) were undergoing atresia (degeneration).

Five of the seven (71%) male *S. triaspis* were undergoing spermiogenesis: June (LACM 136919, 536 mm SVL) Nayarit, Mexico; July (LACM 6823, 626 mm SVL) Sinaloa, Mexico; September (UAZ 34522, 780 mm SVL) Cochise County, Arizona, USA; November (2) (UAZ 32544, 660 mm SVL) Sonora, Mexico, (UAZ 33293, 670 mm SVL) Santa Cruz County, Arizona, USA. A testis from one December male (UAZ 24913, 813 mm SVL), from Nayarit, Mexico was in late spermiogenesis. The germinal epithelium was exhausted and contained only a few layers of cells. There were small clusters of sperm lining portions of the lumina of the seminiferous tubules. A testis from one June male (UAZ 24916, 632 mm SVL) from Cochise County was in recrudescence (recovery). Numbers of germ cells had increased and primary spermatocytes were the predominant cell.

The above observations on females (yolk deposition in July, enlarged follicles in September and oviductal eggs in November) and males (spermiogenesis from June to September) support the statement of Censky and McCoy (*op. cit.*) that reproduction in *S. triaspis* appears to be aseasonal or continuous.

I thank David A. Kizirian (Natural History Museum of Los Angeles County) and Charles H. Lowe (University of Arizona) for permission to examine *S. triaspis*.

Submitted by **STEPHEN R. GOLDBERG**, Department of Biology, Whittier College, Whittier, California 90608, USA.

SIBYNOMORPHUS VENTRIMACULATUS (Southern Snail-eater). **MATING**. Data concerning the reproductive biology of this South American dipsadine are scarce and copulation in nature is unreported. On 3 February 2000 at 0730 h, one of us (SC) observed a pair of *S. ventrimaculatus* copulating in Pinhal Grande, southern Brazil (29°20'46"S, 53°18'24"W). The tails of the male (SVL 382 mm, TL 105 mm, 24 g) and female (SVL 415 mm, TL 82 mm, 28 g) were intertwined and the right hemipenis of male was inserted into the female's cloaca. The snakes were positioned 1 m above ground on a *Bauhinia forficata* bush (Fabaceae).

Upon dissection of the female, the largest follicle measured 6.7 mm (maximum diameter), suggesting a non-vitellogenic period (Oliveira 2001. Ecologia de Três Espécies de Dormideira, *Sibynomorphus* (Serpentes: Colubridae). MS. Dissertation. Univ. São Paulo, São Paulo, SP. 60 pp.). Females of *Sibynomorphus ventrimaculatus* display a seasonal reproductive cycle. Secondary vitellogenesis occurs mainly from October to December and females lay eggs mostly in November and early December (Oliveira, *op. cit.*). The present observation suggests that there is a delay between mating and fertilization..

The snakes were deposited in the collection of Departamento de Biologia, Zoologia of Universidade Federal de Santa Maria (ZUFSM 1898 female; ZUFSM 1899 male). We thank Ana Beatriz Barros de Morais, Alessandro M. Mazzoni, Felipe Spina, Otávio A. V. Marques, and Selma de Almeida Santos for helpful comments.

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SONORA AEMULA (File-tailed Ground Snake). **REPRODUCTION.** *Sonora aemula* is known from Sonora, Chihuahua, and Sinaloa, Mexico (Flores Villela and Gerez 1994. Biodiversidad y Conservación en México: Vertebrados, Vegetación y uso del Suelo. Comision Nacional para el Conocimiento y uso de la Biodiversidad y Universidad Nacional Autónoma de México, Ciudad Universitaria, D.F. México. 439 pp.). There are no reports on reproduction in this species. The purpose of this note is to report on an examination of gonadal material from 10 *S. aemula* (5 males, mean snout–vent length, SVL = 260 mm ± 28 SD, range 233–307 mm, 5 females, SVL = 257 mm ± 40 SD, range 203–309 mm) from Sonora, México. Snakes were borrowed from Arizona State University (ASU) and the University of Arizona (UAZ). Gonads were dehydrated in ethanol and embedded in paraffin. Histological sections were cut at 5 μm and stained with Harris' hematoxylin followed by eosin counterstain. Enlarged ovarian follicles (> 8 mm length) were counted, no histology was done on them.

Testes of four males from July were undergoing spermiogenesis (sperm formation) (ASU 5850, SVL 307 mm; ASU 5851, SVL 250 mm; ASU 6458, SVL 253 mm; UAZ 46685, SVL 256 mm. One male from November (UAZ 45149, SVL 233) was in the early stages of testicular recrudescence (renewal of germinal epithelium for the next period of spermiogenesis).

One female from July (ASU 6611, SVL 280 mm) contained four enlarged ovarian follicles (> 8 mm length); one July female (ASU 6612, SVL 203 mm) was not undergoing yolk deposition and may have been immature. One female from August (UAZ 45155, SVL 251 mm) contained four enlarged follicles (> 11 mm length). Ovaries from one female from August (UAZ 45157, SVL 309 mm) and one from November (UAZ 45152, SVL 243 mm) were not undergoing yolk deposition.

The finding of two *S. aemula* with clutch sizes of four each are within the range (3–6) reported for the congener *S. semiannulata* from Arizona (Goldberg 2001. Southwest. Nat. 46:387–391). Goldberg *(op. cit.)* reported spermiogenesis in 2/3 July *S. semiannulata* males from Arizona.

I thank G. Bradley (UAZ) and A. Holycross (ASU) for permission to examine specimens.

Submitted by **STEPHEN R. GOLDBERG,** Department of Biology, Whittier College, Whittier, California 90608, USA; e-mail: sgoldberg@whittier.edu.

THAMNOPHIS CYRTOPSIS COLLARIS (Black-Necked Garter Snake). **DIET**. The diet of *Thamnophis cyrtopsis* is well documented within some portions of its range (Fouquette 1954. Texas J. Sci. 6:172–188; Jones 1990. Southwest. Nat. 35:115–122); however, no diet records exist for this snake from southern and central Mexico. The diet of *T. cyrtopsis* consists of anurans (tadpoles and adults), skinks, and fishes (Wright and Wright 1957. Handbook of Snakes of the United States and Canada, 2 vols. Comstock Publ., Ithaca, New York. 1105 pp.). On 28 October 2000 at 0955 h in a semiarid area called "El Charcote," 6 km SW of Zapotitlán Salinas (18°20'N, 97°26'W), Puebla, Mexico, at an elevation of ca. 1600 m, we observed an adult female *T. c. collaris* (799 mm SVL; KAB043) capturing an adult male *Bufo occidentalis* (77 mm SVL; KAB044) near a flowing spring. The snake had taken the toad's forefoot and a portion of the toad's flank into its mouth. The toad struggled and was able to escape when we attempted to photograph the incident. The toad retreated into a puddle and remained motionless for ca. 7 min. This is the first report of *T. c. collaris* preying on *B. occidentalis* from this region of Mexico.

Submitted by **KARLA ABBADIÉ-BISOGNO, LUIS OLIVER-LÓPEZ,** and **AURELIO RAMÍREZ-BAUTISTA,** Laboratorio de Ecología, Unidad de Biología, Tecnología y Prototipos (UBIPRO), Escuela National de Estudios Profesionales-Iztacala, UNAM. Av. De Los Barrios s/n, Los Reyes Iztacala, Tlalnepantla, Edo. de México, C.P. 54090, A.P. 314.

THAMNOPHIS HAMMONDII (Two-striped Garter Snake). **PREY**. *Thamnophis hammondii* is considered one of the most aquatic of the garter snakes and is closely associated with streams, creeks, and pools (Fitch 1940. Univ. California Publ. Zool. 44:1–150). Reported diet of *T. hammondii* includes mostly aquatic prey such as tadpoles, frogs, toads, fish, fish eggs, and to a lesser extent terrestrial species such as earthworms (Jennings and Hayes 1994. Amphibian and Reptile Species of Special Concern in California. CA Dept. Fish Game. Final report contract no. 8023, 255 pp.; Rossman et al. 1996. The Garter Snakes: Evolution and Ecology. University of Oklahoma Press, Norman. 332 pp.). Herein we provide the first report of a terrestrial salamander and an aquatic leech as prey items for *T. hammondii*. In all cases, prey was determined by the examination of stomach contents. Upon capture, each snake was hand palpated until the stomach contents were disgorged.

At 1145 h on 11 May 2001, ELE and MLW captured an adult *T. hammondii* (350 mm SVL, wt. not available) on the shore of a cement-lined reservoir (diameter = 35 m) on the Rancho Jamul Ecological Reserve, San Diego County, California,USA (32°41'11"N, 116°51'14"W; 269 m elevation). The surrounding vegetation community is a mosaic of coastal sage scrub (*Eriogonum fasciculatum, Artemisia californica, Isocoma menziesii*) and non-native grassland (*Avena barbata, Bromus* spp., *Brassica nigra, Erodium botrys*). Upon processing, the material regurgitated from the snake consisted entirely of a terrestrial salamander species, *Batrachoseps major*. In total, two bodies minus tails (27 mm and 36 mm snout–vent length [SVL]), six tail tips (7 mm, 14 mm, 26 mm, 36 mm, 39 mm, 42 mm), and one tail segment (10 mm), were recovered. Limited digestion of the epidermis on only one small tail tip and the single tail segment suggests that these food items had most likely been consumed within a few hours prior to capture (H. Greene, pers. comm.). The *B. major* tissue was deposited in the herpetology department of the California Academy of Science (CAS 223811).

To extend the escape time or prevent capture, *Batrachoseps* have the ability to autotomize their tail in response to a threat. The wriggling motion of the detached tail increases the salamander's chances of survival by distracting the predator's attention (Brodie 1977. Copeia 1977:523–535). The ratio of tail tips to bodies (6:2) suggests that several *B. major* successfully escaped using this strategy, albeit tailless. Additional antipredatory mechanisms exhibited by *Batrachoseps* include looping the tail around a snake's head and neck and immobilizing the snake with adhesive skin secretions. This response to attack proved effective in encounter trials with juvenile garter snakes (Arnold 1982. Copeia 1982:247–253). However, for the snake we captured, it is likely that the relatively small size of the salamanders, in relation to the gape (gape index = 86.8; following Miller and Mushinsky 1990. Copeia 1990:1099–1106) of the adult *T. hammondii,* enabled the snake to successfully consume the salamanders.

The stomach contents of a second adult *T. hammondii* (485 mm SVL, mass not available) captured at 1150 h consisted of one moderately digested *Rana catesbeiana* larva (TL = ~ 70 mm).

On 5 June 2001, ELE and SJM captured twelve *T. hammondii* at Lake-of-the-Woods in the Cleveland National Forest, San Diego County, California, USA [32°52'30"N, 116°27'58"W, 1635 m elevation]. The size of the snakes ranged from 332–480 mm SVL, 17–54 g in mass, and the male:female ratio was 3:1. When the stomach contents were examined, six of the twelve snakes contained identifiable material. The only items recovered from the six snakes were leeches, *Erpobdella* sp. (Hirudinea: Erpobdellidae). The quantity of leeches recovered from the six snakes was 1, 2, 2, 3, 6, and 6, respectively. Of the 20 leeches recovered, 14 were still alive, while 6 were dead and partially digested. As a result of improper preserving techniques of the leech specimens on site, the vouchers could only be positively identified to genus. The series of leeches have been deposited in the invertebrate collection of the University of Colorado Museum, Boulder. (UCM Invertebrates 2409).

We sampled the dense submergent vegetation (i.e., *Myriophyllum* sp., *Potamogeton nodosus*) from which the snakes were captured with ten 1-m sweeps, with a 30.5 cm D-net, to determine what aquatic organisms co-occurred with the leeches. Organisms captured by the net included: Annelida (Hirudinea), Amphipoda (Talitridae), Odonata nymphs (Anisoptera [2 var.], Zygoptera), Hemiptera (Gerridae, Notonectidae, Belostomatidae, Corixidae), Coleoptera larvae (Hydrophilidae), Gastropoda (*Planorbidae, Physidae*), and tadpoles (*Hyla regilla*). It is worth noting that of all the organisms captured by net, only leeches were detected in any of the stomachs of the 12 snakes examined on this date.

On 28 May 2002, SJM and ELE captured an additional 10 *T.*

hammondii at Lake-of-the-Woods. The size of the snakes ranged from 303–431 mm SVL, 12–38 g in mass, and the male:female ratio was 1:1. Two of the *T. hammondii* had leeches only in their stomach contents (the other 8 snakes' stomachs were empty). The quantity of leeches recovered from each of the two snakes was 1 and 3, and all leeches were dead. This information indicates a consistent use of this prey type between years.

Our thanks to Terri Stewart and Tim Hovey of California Department of Fish and Game for providing access to the Rancho Jamul Ecological Reserve and logistical support, Shi-Kuei Wu of University of Colorado Museum for identifying the leeches, and Andrew Bohonak of San Diego State University, Department of Biology, for assisting with arthropod identification. Norman Scott, Kathie Meyer, Rob Lovich, and John LaBonte provided useful comments on the manuscript. Permission to handle specimens was granted under California Department of Fish and Game permits issued to ELE and RNF. Fieldwork was funded in part by USGS, Western Ecological Research Center and Eastern Illinois University (SJM).

Submitted by **EDWARD L. ERVIN**[1], [1]U. S. Geological Survey, Western Ecological Research Center, 5745 Kearny Villa Road, Suite M, San Diego, California 92123, USA (e-mail: eervin@usgs.gov), **STEPHEN J. MULLIN**, Department of Biological Sciences, Eastern Illinois University, 600 Lincoln Avenue, Charleston, Illinois 61920-3099, USA (e-mail: cfsjm@eiu.edu), **MANNA L. WARBURTON**[1] and **ROBERT N. FISHER**[1].

THAMNOPHIS SCALARIS (Mexican Alpine Blotched Garter Snake). **DIET**. *Thamnophis scalaris* is an endemic Mexican species, occurring in high-elevation mountains of central Mexico (Rossman et al. 1996. The Garter Snakes: Evolution and Ecology. Univ. Oklahoma Press, Norman. 332 pp.). Although some information is available on the diet of *T. scalaris*, data from southern populations are lacking.

On 8 July 2000, a female *T. scalaris* (416 mm SVL, 2.9 g) was collected around a high elevation (2520 m) permanent pond located in San Cayetano, Estado de México, México (19°22'15"N, 100°05'22"W). This snake was deposited in Colección Nacional de Anfibios y Reptiles from the Universidad Nacional Autónoma de México (IBH-13762). The snake was forced to regurgitate a partially digested specimen of *Rana neovolcanica* (IBH-RF 017A–B; photographic vouchers). Previously documented prey are lizards, earthworms, and deer mice (Fouquette and Rossman 1963. Herpetologica 19:185–201; Lemos-Espinal and Ballinger 1992. Herpetol. Rev. 23:117; Venegas-Barrera and Manjarrez 2001. Herpetol. Rev. 32:266). This report is the first for an amphibian.

We thank Fausto R. Méndez for suggestions on the manuscript and for confirming identification of the snake and frog.

Submitted by **FELIPE RODRÍGUEZ ROMERO, GUSTAVO CASAS ANDREU**, and **LORENA LOPEZ GONZALEZ**, Departamento de Zoología, Instituto de Biología, Universidad Nacional Autónoma de México, A. P. 70-153, C. P. 04510. México D.F., México; e-mail (FRR): feliper@ibiologia.unam.mx.

THAMNOPHIS SIRTALIS SIRTALIS (Eastern Garter Snake). **PARTURITION**. A female eastern garter snake, *Thamnophis sirtalis sirtalis* (SVL 69.9 cm, incomplete tail 21.9 cm, mass 85.7 g), was collected at 1000 h on 21 July 2001 at the Mason Neck National Wildlife Refuge, Fairfax County, Virginia, USA. When captured, the female's cloaca was prolapsed, at the time considered a prelude to the release of musk. It was measured, weighed, and placed in a sealed bucket for transport to the laboratory for pit-tagging. When the bucket was opened at the laboratory an hour later, it was found that she had given birth to 16 young. A second group of 5 neonates was found at 1300 h, and a third group of 8 young were discovered at 1600 h. Twenty-eight neonates were alive when found, and one dead. Of the 28 live young, 27 were active (two made open-mouth threat displays), but one was limp and seemed weak. The next morning, two additional dead, desiccated neonates were found, but not measured or weighed, bringing the total litter size to 31. All neonates had a 2–3 scale-long umbilical scar on ventral scutes 17–19.

Standard measurements and weights were recorded from the first 29 neonates: total body length (TBL), mean 23.9 CM (21.0–25.1); snout–vent length (SVL), mean 15.7 cm (12.7–17.8); tail length (TL), mean 8.2 cm (7.6–9.7), TL/TBL, mean 34.2% (30.5–39.5); TL/SVL, mean 52.2% (43.9–65.3), and mass, mean 1.65 g (1.2–1.9). Regression of hatchling mass versus SVL was $y = 0.8579x + 14.282$ (R^2 0.026). SVL, mass, and TL/TBL fall within the ranges given for *T. s. sirtalis* by Rossman et al. (1996. The Garter Snakes: Evolution and Ecology. Univ. Oklahoma Press, Norman, Oklahoma. 332 pp.), as does the litter size of 31, although this is a new record for northern Virginia (Ernst et al., 1997. Bull. Maryland Herpetol. Soc. 33:1–62). Total litter mass was 48 g, and the relative clutch mass (RCM) for the first 29 neonates was 0.56. Seigel and Fitch (1984. Oecologia 61:293–301) reported a range of RCMs for *T. sirtalis* of 0.244–0.426. The sex ratio of the 29 neonates was male biased 17:12.

Few data are available on the duration of parturition in *T. sirtalis*. Wood (1945. Copeia 1945:118) reported the birth of 57 young in 90 min (mean 1.57), Boyer (1941. Amer. Midl. Nat. 26:334–336) 27 young in 184.5 min (mean 6.83), and Wright (1988. Catesbeiana 8:31–32) 21 young in only 9 min (mean 0.43). The first 29 neonates in the present litter were born in 6 hours, in three groups of 16 (60 min, mean 3.75), 5 (120 min, mean 24.0), and 8 (180 min, mean 22.4), giving an overall mean duration between births of 2.48 min.

Submitted by **TERRY R. CREQUE, CARL H. ERNST,** and **JOHN M. ORR**, Department of Biology, George Mason University, Fairfax, Virginia 22030-4444, USA; e-mail (CHE): cernst@gmu.edu.

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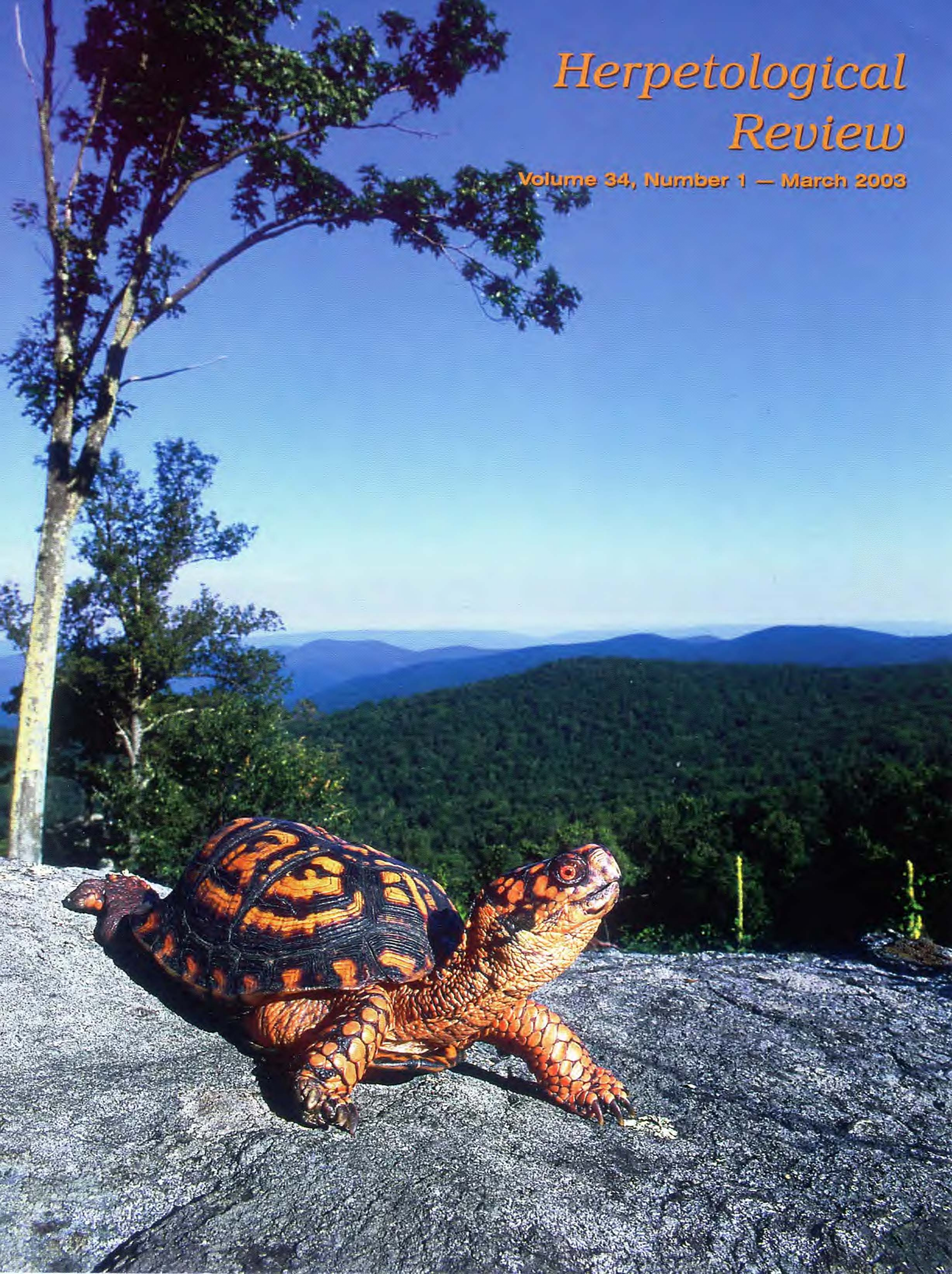

HERPETOLOGICAL REVIEW

The Quarterly News-Journal of the Society for the Study of Amphibians and Reptiles

SOCIETY FOR THE STUDY OF AMPHIBIANS AND REPTILES

www.ukans.edu/~ssar

The Society for the Study of Amphibians and Reptiles, the largest international herpetological society, is a not-for-profit organization established to advance research, conservation, and education concerning amphibians and reptiles. Founded in 1958, SSAR is widely recognized today as having the most diverse society-sponsored program of services and publications for herpetologists. Membership is open to anyone with an interest in herpetology—professionals and serious amateurs alike—who wish to join with us to advance the goals of the Society.

All members of the SSAR are entitled to vote by mail ballot for Society officers, which allows overseas members to participate in determining the Society's activities; also, many international members attend the annual meetings and serve on editorial boards and committees.

ANNUAL DUES AND SUBSCRIPTIONS: Annual membership dues for the year 2003 in the Society for the Study of Amphibians and Reptiles are as follows: **REGULAR** membership US$60 (Student $30)—includes *Journal of Herpetology* and *Herpetological Review*; **PLENARY** membership US$80 (Student $45)—includes *JH*, *HR*, and annual subscription to the *Catalogue of American Amphibians and Reptiles*; **INSTITUTIONAL SUBSCRIPTION** $115—includes JH and HR. Additional fee for airmail postage outside USA $35 for one year. Additional membership categories available on the SSAR webpage: http://www.ukans.edu/~ssar/membership.html.

All members and institutions receive the Society's primary technical publication, the *Journal of Herpetology*, and its news-journal, *Herpetological Review*; both are published four times per year. Members also receive pre-publication discounts on other Society publications, which are advertised in *Herpetological Review*.

Payment must be made in USA funds, payable to "SSAR," or by International Money Order, or with VISA or MasterCard (account number and expiration date must be provided). Payment should be sent to: Theodora Pinou, SSAR Treasurer, Peabody Museum of Natural History, P.O. Box 208118, New Haven, Connecticut 06520-8118, USA. Fax: (203) 432-5176; e-mail: theodora.pinou@yale.edu

Future Annual Meetings

2003 — Hotel Tropical, Manaus, Brazil, 26 June–1 July (with ASIH, HL)
2004 — University of Oklahoma, Norman, Oklahoma (with ASIH, HL)
2005 — University of South Florida, Tampa, Florida (with ASIH, HL)

Society for the Study of Amphibians and Reptiles 2003 Annual Meeting

together with

The Herpetologists' League

and

American Society of Ichthyologists and Herpetologists

26 June – 1 July 2003
Tropical Hotel Conference Center
(on the Rio Negro)
Manaus, Amazonas, Brazil

Richard C. Vogt and Ning Labbish Chao, Local Chairs

Keynote Address: "In Search of El Dorado: The Neotropical Herpetofauna," by William E. Duellman (University of Kansas), The Herpetologists' League Distinguished Herpetologist for 2003.

SSAR President's Travelogue: "From the Amazonian Floating Meadows to the Surumoni Canopy Crane Project: Frog Research in Amazonia," by Walter Hödl (University of Vienna).

Symposium: "Reproductive Biology and Phylogeny of Urodela (Amphibia)." *Organizer:* David M. Sever, Saint Mary's College (dsever@jade.saintmarys.edu).

Symposium: "New Frontiers in Freshwater Turtle Ecology." *Organizers:* Richard C. Vogt, Instituto Nacional de Pesquisas da Amazônia–INPA (vogt@inpa.gov.br) and Paulo Andrade, IBAMA.

Symposium: "Amazonian Frogs: Taxonomic and Ecological Diversity." Organizers: Janalee P. Caldwell, University of Oklahoma (caldwell@ou.edu); William E. Duellman, University of Kansas; Albertina Lima, INPA.

Symposium: "Sequestered Defensive Compounds in Amphibians and Reptiles." *Organizer*: Alan H. Savitzky, Old Dominion University (asavitzk@odu.edu).

Symposium: "Disease Ecology and Global Amphibian Decline." *Organizers*: Mathew J. Parris, Memphis State University (mparris@memphis.edu); Andrew Storfer, Washington State University.

Symposium: "Amphibian Metamorphosis: 30 Years of Progress." *Organizer*: Christopher K. Beachy, Clarke College (cbeachy@keller.clarke.edu).

Symposium: "Exotics and Extinction: Fates of Fishes, Amphibians, and Reptiles in the Americas." *Organizers*: Harry Grier, University of Florida (harry.grier@fwc.state.fl.us) and Maria del Carmen Uribe Aranzabal.

Symposium: "The Biology of Hypogean Fishes, Amphibians, and Reptiles." Organizer: Aldemaro Romero, Macalester College (romero@macalester.edu).

Symposium: "Amazonian Herpetofauna." *Organizers*: Ermelinda Oliveira, Universidade Federal do Amazonas (ermeoliveira@uol.com.br); Richard C. Vogt, INPA.

SSAR Student Travel Awards: Awards of US $400 each are available. An applicant must be a student and a member of SSAR. Refer to page 243 of the December 2002 issue of *HR* for details.

Student Paper Awards: Henri Seibert prizes (US $200 each) will be awarded in five categories: Systematics, Ecology, Evolution, Conservation, and Physiology/Morphology. Refer to the official Meeting Announcement for details and to *HR* 28(4):175 for recommendations to students entering the Seibert competition.

Social Activities: General Reception, Graduate Student Reception, Picnic, Joint Meeting Banquet, SSAR/HL Silent Auction.

Field Trips: Several post-meeting field trips into the Amazon are planned. Refer to the meeting website for details.

Live Animal Exhibit: A large sample of reptiles and amphibians native to the Amazon region on display and available to photographers.

Costs: Preregistration (until 28 February) US $240 regular, $80 student, $110 accompanying person. From1 March–25 June 2003, costs are $290, $130 student. After 25 June, $340 regular, $180 student. Registration information available at: <http://www.aiha.org.br/reginfo.html>

Further Details: Refer to the official Joint Meeting website (www.aiha.org.br) for additional details, including travel requirements to Brazil.

About Our Cover: *Terrapene carolina*

The box turtles, consisting of four species in the genus *Terrapene*, have recently been reviewed in considerable detail by Dodd (2001. North American Box Turtles: A Natural History. Oklahoma University Press, Norman. 231 pp.). The Eastern Box Turtle (*Terrapene carolina*) group is made up of six extant subspecies ranging across much of the eastern United States and south to the Yucatán Peninsula of Mexico (Ernst and McBreen 1991. Cat. Am. Amphib. Rept. 512:1–13; Iverson 1992. A Revised Checklist with Distribution Maps of the Turtles of the World. Privately published. Richmond, Indiana. 363 pp.).

Much of what is currently known about the natural history and population biology of this wide-ranging species comes from a handful of long-term studies. Perhaps the best known of these studies is an ongoing project initiated in 1944 by Lucille Stickel at the Patuxent Research Refuge in Laurel, Maryland (Stickel 1978. Copeia 1978:221–225). The study site consists of an 11.8 hectare forested, floodplain along the Patuxent River. Beginning in 1945 and every ten years thereafter, this site's Eastern Box Turtle (*T. c. carolina*) population is surveyed. In the first 30 yrs of the study Stickel captured and marked 557 individual turtles. Despite the site's relative protection on the center's grounds, there is convincing evidence that a dam created upstream from the study site has contributed to a major decline of this population. The data that she and others (Hall et al. 1999. Biol. Cons. 88:165–172) have collected across five decades demonstrates the vulnerability of this species to human activities.

The turtle on the cover was photographed by **Will Brown** in Virginia's Shenandoah National Park during a 2001 herpetological inventory. Using only natural light, Brown used a 20mm Nikon lens on a Nikon N70 body, recording the image on Fuji Provia slide film. In addition to his work as a photographer, Brown is currently conducting herpetological research on several National Park Service properties. He began what he hopes to be another long-term box turtle study earlier this year. Through the use of radio-telemetry, Brown is studying the ecology of *T. c. carolina* residing at high elevations (760 to > 915 m) within the Blue Ridge Mountains of Shenandoah National Park. He is interested in corresponding with others studying the ecology of box turtles at higher elevations and can be reached at <wbrown@blueridgebiological.com>.

Brown took the photograph below at the Patuxent Research Refuge. This turtle, #3,8.10-11, was determined to be more than 20 yrs old when originally captured and marked by Lucille Stickel on 25 July 1949. Brown found this turtle again on 28 August 1999, making her at least 70 yrs old at that time. Appearing quite healthy, she could very well show up in the 2005 survey.

SSAR BUSINESS

SSAR Election Results

Results of the recent SSAR election are as follows:

President-Elect .... Robin Andrews.
Board of Directors (Class of 2005) ....
.... Ellen Censky, Rafael de Sá.

SSAR Appointments

Owing to other professional demands, SSAR Secretary John Matter resigned in October 2002. The Board appointed Marion Preest (Claremont Colleges) to complete the remainder of Matter's term of office (through 2004). The Society thanks John for his service to the herpetogical community.

George Pisani has very ably served as SSAR's Webmaster for many years, putting in countless hours to keep the site current. The Society extends its appreciation to George for his efforts. Dennis Desmond, of Alexandria, Virginia, has agreed to become the Society's new Webmaster and will undertake a re-design of the web site.

Robin Jung, of the USGS Patuxent Wildlife Research Center, has been appointed Editor of *Herpetological Conservation*. SSAR thanks outgoing Editor, Steve Corn, who inaugurated the series, as he steps down.

New committee appointments for 2003 include: Ron Brooks, University of Guelph (Nominating Committee); Dawn Wilson, California State University, Chico (Resolutions); John Matter, Juniata College (Conservation); and Ruston Hartdegen, Dallas Zoo (Relations with Herpetologists at Zoological Parks). Congratulations to all.

SSAR to Auction Robert E. Gordon Library

SSAR is pleased to announce that the family of the late Robert E. Gordon (1925–1996), the society's president in 1971, has recently donated his collection of herpetological books and stamps to SSAR. The society intends to auction the individual items beginning in April, with proceeds being used to set up The Robert E. Gordon Endowment for the support of book-length publications.

Gordon was a long-time member of OHS and SSAR and spent most of his distinguished career at the University of Notre Dame where he was professor of biology and eventually vice president. He was a leading specialist on salamander behavior and ecology; he also published on his extensive philatelic interests. A full obituary was published in *Herpetological Review*, 27(3):109–110, 1996.

If you wish to be notified about this auction, contact the SSAR Publications Secretary, Breck Bartholomew, e-mail: ssar@herplit.com, phone/fax: 801-453-0489. The auction will be held on-line on or about April 2003.

NEWSNOTES

Nikolai Orlov Awarded Honorary Doctorate

Göteborg University (Sweden) awarded an honorary doctorate to Russian herpetologist Nikolai Orlov at a ceremony in Göteborg on 19 October 2002. Orlov was nominated for this award by Swedish colleagues Claes Andrén and Göran Nilson, both of whom are professors at Göteborg.

Nikolai Orlov began his herpetological career as a field assistant during expeditions in remote areas of Central Asia. Eventually he took over responsibility for these expeditions, arranging collecting trips to many parts of Asia. Today, he is among the most experienced and capable field herpetologists in the world. He has an impressive knowledge of museum techniques, taxonomy, ecology, and conservation biology. During the last ten years, his field work has centered on the remaining rainforests of Vietnam and surrounding countries. Together with American and Canadian colleagues he has described more than 50 new species of amphibians and reptiles from these areas. He and colleagues are preparing a book covering the amphibians of Vietnam and adjacent areas.

SSAR congratulates Nikolai Orlov on this recognition.

Kansas Herpetological Society Annual Meeting

The Kansas Herpetological Society held its 29th Annual Meeting at the University of Kansas in Lawrence, Kansas, on 2–3 November 2002. Over 90 participants attended scientific paper sessions to listen to 24 talks by scientists and students from across the nation. Keynote speaker was Dr. Frank T. Burbrink, professor at the College of Staten Island, Long Island, New York. Dr. Burbrink spoke about the diversity of North American snakes.

During the Society business meeting, Nicole Palenske, graduate student at Emporia State University, received the 2002 Howard K. Gloyd/Edward H. Taylor Scholarship, honoring the memory of two great biologists with strong ties to Kansas. Chris Hutson, student at Tabor College received the Alan H. Kamb Grant for Research on Kansas Snakes.

At the Saturday night auction and social, John Cavitt, professor of biology at Weber State University, Ogden, Utah, was chosen as the fifth recipient of The Suzanne L. & Joseph T. Collins Award for Excellence in Kansas Herpetology, based on his paper being chosen as the best scientific contribution published during the years 2000–2001 on native Kansas herpetofauna.

KHS members James Gubanyi and Robin Oldham were recognized as the fourth annual recipients of The Big Croaker Awards, sponsored by the Kansas Department of Wildlife and Parks. Established in 1999, the awards this year were given to those individuals for their efforts in monitoring anuran choruses during the spring of 2002. Each spring, nearly 100 volunteers census choruses of amphibians on eighty 15-mile routes across Kansas, establishing baseline information that will eventually be used to publish a Kansas Amphibian Breeding Atlas.

MEETINGS

Meetings Calendar

18–22 June 2003—Second International Congress on Chelonian Conservation in Senegal. Conference to be held in English w/ French translations. Information: www.tortues.com; e-mail: soptom@soptom.com.

26 June–1 July 2003—46th Annual Meeting, Society for the Study of Amphibians and Reptiles, together with The Herpetologists' League and the American Society of Ichthyologists and Herpetologists. Hotel Tropical, Manaus, Brazil. Details available elsewhere in this issue and from the meeting web site: http://www.aiha.org.br/.

12–16 August 2003—12th Ordinary General Meeting of Societas Europaea Herpetologica, St. Petersburg, Russia. Information: Natalia Ananjeva (e-mail: agama@NA4755.spb.edu).

3–6 September 2003—International Herpetological Symposium, 27th Annual Meeting, Houston, Texas, USA. Information: http://www.kingsnake.com/ihs/index.html.

CURRENT RESEARCH

The purpose of **Current Research** is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, **Eli Greenbaum** or **Omar Torres-Carvajal**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can now be found at: http://www.herplit.com/contents.

Colubrid Venom Biochemistry

Nearly half of the species in the polyphyletic family Colubridae produce venom in Duvernoy's gland. Several colubrid species produce venoms that have proven fatal to humans, and the author suggests further study might reveal that additional taxa are capable of lethal envenomations. Studies of colubrid venoms are difficult because of the lack of commercially available venoms and difficulty with obtaining venom samples from snakes with rear fangs and low pressure of venom delivery. Anaesthesia was

used in this study to obtain samples and injections of ketamine and pilocarpine increased venom yields. The author discussed toxicity and biochemistry of numerous colubrid venoms and the purification and identification of venom components. In comparison to viperid or elapid venoms, colubrid venoms are poorly known and additional research is needed.

MACKESSY, S. P. 2002. Biochemistry and pharmacology of colubrid snake venoms. Journal of Toxicology-Toxin Reviews 21:33–63.

Correspondence to: Stephen P. Mackessy, Department of Biological Sciences, University of Northern Colorado, 501 20th St., CB 92, Greeley, Colorado 80639-0017, USA; e-mail: spmacke@unco.edu.

Systematics of *Cnemidophorus*

The teiid genus *Cnemidophorus* is composed of approximately 50 species that collectively range from the United States to Argentina and occur in numerous habitats. The ecology, life history, and parthenogenetics of this clade have been studied extensively, but the phylogenetic placement of this genus within the Teiidae and corresponding intrageneric relationships have received little attention. The authors examined: 1) whether *Cnemidophorus* is monophyletic; 2) the relationship of this genus to other teiinine genera; and 3) whether the bisexual species groups are monophyletic, and their relationships to each other. Twenty-seven species of *Cnemidophorus* and 14 additional species (41 ingroup taxa) and five outgroup taxa were examined for DNA data (12S and 16S genes), allozyme data (31 protein loci), and ten morphological characters that have been used in previous studies to identify generic and subgeneric species groups in the family Teiidae. These data were combined into a single data matrix and analyzed with PAUP* 4.0b2. Some reweighting of characters was done *a posteriori* and tested with successive approximations. Results indicated: 1) *Cnemidophorus* monophyly is not supported; 2) the North American species groups (*deppii, sexlineatus,* and *tigris*) form a monophyletic clade; 3) *Ameiva* monophyly is not supported; and 4) karyotype evolution is consistent with phylogeny. The genus name *Aspidoscelis* was resurrected to recognize the monophyly of the North American clade. The majority of unisexual species are in the genus *Aspidoscelis;* about a third are parthenogenetic.

REEDER, T. W., C. J. COLE, AND H. C. DESSAUER. 2002. Phylogenetic relationships of whiptail lizards of the genus *Cnemidophorus* (Squamata: Teiidae): a test of monophyly, reevaluation of karyotypic evolution, and review of hybrid origins. American Museum Novitates (3365):1–61.

Correspondence to: Tod W. Reeder, Department of Biology, San Diego State University, San Diego, California 92182-4614, USA; e-mail: treeder@sunstroke.sdsu.edu.

Airborne Sound Detection in Rattlesnakes

Recent research has indicated that snakes can perceive airborne vibrations more effectively than groundborne vibrations. The authors examined the ability of eight individuals of *Crotalus atrox* to detect airborne sounds in an acoustic isolation chamber. Snakes were recorded during a 30 s control period, 4 s trial period in which sound was played, and a 30 s recovery period. The number of tongue flicks, head jerks, amount of time spent moving, and rattling behavior was recorded from the videotape. During the stimulus period, snakes reduced tongue flicking, became motionless, jerked their heads, and rattled significantly more than in the control or recovery periods. This is the first study to document behavioral responses to airborne sounds in snakes.

YOUNG, B. A., AND A. AGUIAR. 2002. Response of western diamondback rattlesnakes *Crotalus atrox* to airborne sounds. The Journal of Experimental Biology 205:3087–3092.

Correspondence to: Bruce A. Young, Department of Biology, Lafayette College, Easton, Pennsylvania 18042, USA; e-mail: youngab@lafayette.edu.

Digestive Metabolism in a Python

Snakes undergo exceptional morphological responses to a meal following a fast; intestinal mass can be doubled and brush-border transport capacities can increase rapidly. These morphological changes are associated with an increase of metabolic oxygen consumption, but it is not clear if the morphological changes are directly responsible for the increased metabolism. The authors placed eight juvenile *Python molurus* in individual plastic respiratory chambers for the experiments. Measurements of oxygen uptake and carbon dioxide excretion were taken from the snakes twice a day. The snakes were divided into two groups; both groups had the same fasting periods but they differed in the order of fasting durations. The metabolic responses following feeding were large (21–35% of ingested energy), but these responses were independent of fasting duration. Thus, the increased metabolic rate is not correlated with increased function and growth of gastrointestinal organs.

OVERGAARD, J., J. B. ANDERSEN, AND T. WANG. 2002. The effects of fasting duration on the metabolic response to feeding in *Python molurus:* an evaluation of the energetic costs associated with gastrointestinal growth and upregulation. Physiological and Biochemical Zoology 75:360–368.

Correspondence to: Johannes Overgaard, Department of Zoophysiology, Institute of Biology, Building 131, Aarhus University, 8000 Aarhus C, Denmark; e-mail: Johannes.Overgaard@biology.au.dk.

Habitats of Stream-Dwelling Amphibians

The authors examined populations of seven amphibian species in second- and third-order streams of southwestern Oregon and northwestern California. Because amphibian biomass can exceed fish biomass in these streams, it is important to understand how variation of habitat use by amphibians is related to natural and anthropogenic disturbance. Study sites were selected to represent a wide range of vegetation types and age of forest adjacent to streams. Numerous statistical analyses were performed on the data to determine: 1) differences in diversity; 2) presence/absence of taxa; and 3) relationships between environmental variables and amphibian density. Amphibian diversity was greater in streams passing through the oldest forest stands. Different environmental variables explained the presence and density of *Ascaphus truei* and *Dicamptodon tenebrosus;* the remaining five amphibian species were too rare to make comparisons. The authors caution that

resource availability, historical biogeography, interspecific interactions, and demographic stochasticities might also explain amphibian presence and density.

WELSH, H. H., JR., AND A. J. LIND. 2002. Multiscale habitat relationships of stream amphibians in the Klamath-Siskiyou region of California and Oregon. Journal of Wildlife Management 66:581–602.

Correspondence to: Hartwell H. Welsh Jr., USDA Forest Service, Redwood Sciences Laboratory, 1700 Bayview Drive, Arcata, California 95521, USA; e-mail: hwelsh@fs.fed.us.

Species Isolation in Sea Snakes

A recent resurgence of interest in the potential role of sexual selection on generating speciation in closely related, sympatric species has focused little attention on reptiles. The authors examined this phenomenon in laticaudine sea snakes, *Laticauda colubrina* and the relatively smaller *L. frontalis*, which are not known to hybridize in nature. Over a six-week period, the authors collected adults of both species and observed their courtship behavior in open-topped nylon arenas. Skin lipids were obtained on cloth pieces from female snakes, and male reactions to these samples were recorded. Additional lipid samples were examined from both sexes of both species and analyzed with gas chromatography and mass spectrometry. Arena trials confirmed that the two species exhibit a strong preference for conspecific rather than heterospecific mating. Males of both species directed more tongue flicks at conspecific cloth samples than heterospecific samples, but *L. colubrina* was less discriminating than *L. frontalis*. Biochemical analysis of lipid samples confirmed differences between species and between the sexes within species. The conflicting preference results in male *L. colubrina* might be explained by a preference to mate with larger females.

SHINE, R., R. N. REED, S. SHETTY, M. LEMASTER, AND R. T. MASON. 2002. Reproductive isolating mechanisms between two sympatric sibling species of sea snakes. Evolution 56:1655–1662.

Correspondence to: Richard Shine, School of Biological Sciences A08, University of Sydney, NSW 2006 Australia; e-mail: rics@bio.usyd.edu.au.

Mate Choice in *Anolis carolinensis*

When reproductive benefits outweigh the costs of being choosy, males can be associated with mate choice. This sentiment explains the "Coolidge effect," in which males prefer to mate with novel females because the number of inseminated females increases, thus maximizing male reproductive success. Sixteen adult male and 19 adult female *Anolis carolinensis* were collected early in the breeding season and housed in male/female pairs in cages. Pairs of subjects were allowed to acclimate for three days and on the fourth day the pair was videotaped from a darkened blind for 30 min. The resident female was then removed, and 15 min later a female (resident or novel) was introduced into the enclosure. Similar experiments were conducted in the field; novel females were introduced into the territories of males. Males engaged in courtship displays three times more with novel females than with resident females in laboratory experiments. In field trials, males directed ten times more displays toward novel females than resident females in baseline sessions. These results suggest that preference for novel females is a cognitive process in this species.

ORRELL, K. S., AND T. A. JENSSEN. 2002. Male mate choice by the lizard *Anolis carolinensis:* a preference for novel females. Animal Behaviour 63:1091–1102.

Correspondence to: Kimberly S. Orrell, Biology Department, Virginia Tech, Blacksburg, Virginia 24061, USA: e-mail: korrell@vt.edu.

Life History of a Madagascan Frog

The genus *Boophis* consists of numerous species of rainforest treefrogs; the *Boophis albilabris* Group is one of the most poorly studied in this genus. The authors studied the vocalizations, tadpole morphology, and skeletochronology of *B. albilabris occidentalis* at Berara Forest and vocalizations of *B. albilabris* at Anjaharibe-Sud, Madagascar. Morphology, mating behavior, vocalizations, and color of adults were contrasted between the two populations. Lines of arrested growth in the periosteal bone of *B. a. occidentalis* were described; age estimates placed one individual at 11 years. Based on bioacoustic data, keratinized dermal structures, body size, and webbing, the authors recognized *B. occidentalis* as a distinct species. The authors hypothesized that *B. albilabris* and *B. occidentalis* secondarily returned to a discontinuous reproductive activity with breeding aggregations.

ANDREONE, F., M. VENCES, F. M. GUARINO, F. GLAW, AND J. E. RANDRIANIRINA. 2002. Natural history and larval morphology of *Boophis occidentalis* (Anura: Mantellidae: Boophinae) provide new insights into the phylogeny and adaptive radiation of endemic Malagasy frogs. Journal of Zoology, London 257:425–438.

Correspondence to: Franco Andreone, Museo Regionale di Scienze Naturali, Via G. Giolitti, 36, I- 10123 Torino, Italy; e-mail: f.andreone@libero.it.

Molecular Systematics of *Thamnophis*

The garter snakes of the genus *Thamnophis* include approximately 30 species of colubrid snakes, including some of the most intensively studied snakes in the world. The authors obtained samples from 29 species of *Thamnophis, Adelophis foxi,* and four outgroup species. A total of 3809 bases were sequenced from each sample, representing complete mtDNA sequences of cytochrome *b,* NADH dehydrogenase 1 and 2, and half the sequence of NADH dehydrogenase subunit 4. Maximum parsimony and maximum likelihood analyses were conducted (PAUP* 4.0b) on the four genes separately and combined. All analyses placed *Adelophis* and *Thamnophis validus* (= *Nerodia validus*) within the genus *Thamnophis*. Bootstrap analyses of maximum parsimony trees did not identify conflict between any two genes; the combined data tree resolved 28 of 30 possible clades within *Thamnophis*. The combined maximum likelihood tree of all four genes resulted in a phylogeny that had four differences from the maximum parsimony tree, but none of the relationships conflicted with clades that had moderate or strong support from bootstrap values. Biogeographic hypotheses are discussed for Mexican clades. The authors also evaluated whether the support for clades reached a plateau with an increasing number of characters.

DE QUEIROZ, A., R. LAWSON, AND J. A. LEMOS-ESPINAL. 2002. Phylogenetic relationships of North American garter snakes (*Thamnophis*) based on four mitochondrial genes: how much DNA sequence is enough? Molecular Phylogenetics and Evolution 22:315–329.

Correspondence to: Alan de Queiroz, EPO Biology and University Museum, Campus Box 334, University of Colorado, Boulder, Colorado 80309-0334, USA; e-mail: dequeiro@stripe.colorado.edu.

Molecular Systematics of Dwarf Boas

The Tropidophiidae includes about 21 species of New World snakes in four genera. The relationships of these snakes within the family and to other families is not well resolved because of considerable disagreement about the relationships of basal snake lineages. The authors tested three previously proposed hypotheses: 1) the Ungaliophiidae clade (*Exiliboa* + *Ungaliophis*) is not closely related to the Tropidophiidae clade (here including *Trachyboa* + *Tropidophis*); 2) the latter clade is sister to Caenophidia; and 3) Ungaliophiidae is part of a monophyletic Booidea. The authors sequenced 1.9 kb of mtDNA (12S, 16S, and intervening valine t-RNA genes) from 23 species of snakes representing most major snake lineages and all four genera of dwarf boas. Aligned sequences were analyzed in PAUP* 4.0b8 with maximum likelihood; branch support was assessed with bootstrapping and Bayesian analysis. A single best tree indicated that dwarf boas are not monophyletic. Support was found for a clade including *Trachyboa* + *Tropidophis*, and another clade of *Exiliboa* + *Ungaliophis*. The former group was rejected as the sister taxon to Caenophidia, and the monophyly of Booidea was not supported. Bayesian support values estimated true probabilities of recovering respective clades more accurately than bootstrap values. One consequence of this phylogeny is that relatively kinetic skulls emerged early in snake evolution, and secondary reductions in skull flexibility occurred in fossorial lineages.

WILCOX, T. P., D. J. ZWICKL, T. A. HEATH, AND D. M. HILLIS. 2002. Phylogenetic relationships of the dwarf boas and a comparison of Bayesian and bootstrap measures of phylogenetic support. Molecular Phylogenetics and Evolution 25:361–371.

Correspondence to: David M. Hillis, Section for Integrative Biology and Center for Computational Biology and Bioinformatics, The University of Texas at Austin, Austin, Texas 78712, USA; e-mail: dhillis@mail.utexas.edu.

Apalone ferox (Florida Softshell). USA: Florida: Leon County: Lake Jackson. Illustration by Margaret Gunzburger, Florida State University.

OBITUARIES

Herpetological Review, 2003, 34(1), 6–8.

Garth Underwood (1919–2002): A Vision of Reptile Systematics

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Garth L. Underwood, the systematic herpetologist, died in the early hours of the morning on the 15 October 2002 after a brief spell in hospital. He was 83 and still making a useful contribution to the area that so fascinated him (Underwood 2002). Garth was much loved by those who knew him and he will be deeply missed, both as a herpetologist and as a friend.

Garth was born in Isleworth, Middlesex, after the First World War (16 July 1919), the eldest son of the renowned artist Leon Underwood and Mary (nee Colman). He went to University College London in 1938, but was conscripted into the Army (Royal Engineers) on the outbreak of World War II in 1939. He must have had an unpleasantly active first part of the war and was a survivor of Britain's worst maritime disaster. He was in France as part of the British Expeditionary Force after Dunkirk. In June 1940 the troopship (*HMT Lancastria*) on which he was returning to England was bombed and sunk off St Nazaire, Brittany with massive loss of life (estimated by some to be around 5000; see http://www.bbc.co.uk/history/war/wwtwo/lancastria_1.shtml). Garth described to me the bravery of his comrades who could not swim as the ship finally sank under them. Later in the war (1943) he went to India where he had an "intelligence" role. He helped develop a system to play sounds of tank battles in the jungle to amuse the Japanese. He kept the secrecy he was sworn to until, to his amusement, he saw it described in all its bizarre detail on a television program. India had a very considerable impact on Garth. It was there where his interest in zoology focussed into an interest in reptiles, where he started publishing, and where he met his wife Molly.

He continued his studies at UCL after the war (1946), being taught by the eminent geneticist J.B.S. Haldane. He took a First Class Honours in zoology (Special genetics), with subsidiary pure mathematics, in 1948. He chose pure mathematics because he could spend the least time on it, and hence more time on zoology.

After graduating Garth took the post of Demonstrator in Zoology at what was the University College of the West Indies at Jamaica, and what later (1962) became the University of the West

Indies. He was rapidly promoted through the system from Demonstrator to Assistant Lecturer (1949), Lecturer (1953), and Senior Lecturer (1958). Garth did not do a PhD, but submitted his publications in 1960 to the University of London, for which he was awarded a DSc for his " Systematic and evolutionary study of reptiles." In 1960 he also became Professor of Zoology in the Faculty of Agriculture, University of West Indies, Trinidad. He served as Dean of that Faculty from 1961 to 1963. During his time in the West Indies he maintained an association with the Museum of Comparative Zoology, Harvard University.

Garth decided to return to Britain for his daughter's education, and in 1964 he took the post of Principal Research Fellow at the British Museum (Natural History) in London, now the Natural History Museum (NHM). After his temporary fellowship at the museum (1964-67) he took the post of Senior Lecturer and later Principal Lecturer at what was Sir John Cass College and later became the City of London Polytechnic (currently London Metropolitan University). Although he retired from the City of London Polytechnic in 1984 he was still actively researching and was based in the Natural History Museum in London. Initially, this was an informal arrangement, but he was recognized as an Honorary Research Fellow in the Natural History Museum in 1994. He continued to work in the museum and inspire his younger colleagues until his death.

Garth's publications extend across seven decades (1945–2002). In general, his work has been marked by its lasting value rather than by a large volume of ephemera. For example, both Garth's original 1959 publications on anole evolution (Underwood 1959; Underwood and Williams 1959) and his 1967 work on snake classification (Underwood 1967) are still heavily cited in this millennium. The early 1950s saw three major contributions from Garth. His influential work on the evolution of reptilian retinas, inspired by G. L. Walls (1942), was published in *Nature* (Underwood 1951), as was his work on gecko taxonomy and evolution (Underwood 1955). Moreover, in this period he and Angus Bellairs developed their ideas on the fossorial origin of snakes (Bellairs and Underwood 1951). To my mind this remains the benchmark paper, and only convincing hypothesis, for the origin of snakes. Garth's interest in reptilian retinas continued through the next two decades (Underwood 1966, 1968, 1970) and an appreciation of their role in snake systematics, as expressed in his classic work "A Contribution to the Classification of Snakes," endured (Underwood 1967a,b, 1997).

Later on in the 1950s Garth worked on legless lizards (Underwood 1957a,b) and the West Indian fauna (Underwood 1957c, 1959, 1964; Underwood and Williams 1959). His work on Lesser Antillean anole series proved to be of enduring importance. His interest in the West Indian herpetofauna continued, with publications on Lesser Antillean snakes until 1999 (Underwood 1993; Underwood et al. 1999).

Garth pioneered a multiple evidence approach to snake systematics, advocating the use of a wide range of morphological features from visual cells, through oesteology to rictal glands. He used his Fellowship at the museum (1964–67) to develop his ideas in this area. This formed the basis of "A Contribution to the Classification of Snakes" as well as later papers (1967b, 1997, 1999), and his last paper (Underwood 2002) was on a morphological system (rictal glands) that may give evidence for snake relationships. A more quantitative approach to taxonomy was developing around the time of Garth's museum fellowship and Garth saw this as complementing his multiple evidence approach. He learned to program a computer and wrote his own programs to pursue his ideas. He was still working on programming compatibility analysis in his later years.

Garth was a committed and dedicated teacher, publishing papers on biological teaching in *Nature* and elsewhere (Underwood 1963). He was also a conscientious administrator acting as Dean in the University of West Indies and as Head of Department in the City of London Polytechnic for a while, at a time of great transition for that Institute. I think it is fair to say that he saw administration as something that was necessary, rather than a reward in itself, and when I knew him he was most fulfilled by museum research. What little time for research his teaching in London allowed was generally spent in the museum looking at specimens. This is what he loved most and his association with the Natural History Museum lasted from his Fellowship until he died, irrespective of whether he was employed elsewhere or retired.

At the time Garth was working in London, one could be forgiven for thinking that Garth was only interested in museum studies and had little interest in fieldwork. However, this was not really the case. Garth's time in the West Indies was a period when he was able to undertake fieldwork, not only in Jamaica and Trinidad, but also throughout the Eastern Caribbean islands, and he took full advantage of this. Garth's description of his first experiences of Dominica, catching numerous *Alsophis* snakes within walking distance of the capital Roseau contrasts with my current experiences, even though these areas have been less impacted by development than some. Garth then did no fieldwork after leaving the West Indies until after the death of his wife Molly. The loss of Molly, to whom he was entirely devoted, was a severe blow to Garth. After being widowed, he recovered an interest in fieldwork and, in spite of advancing years and health problems, he made a series of adventurous trips. In 1998 he visited southern Africa collecting snakes and in 1999, at the age of 80, he went on an expedition to the Crocker Range in Sabah, Borneo. He later visited his old territory of Trinidad and Tobago, taking his grandchildren with him, and his last trip was to attend the 2002 ASIH/HL/SSAR meeting in Kansas City.

Garth was well respected as a herpetologist. He was made an Honorary Member of The Herpetologists' League in 1978 (one of only five), he had numerous species and a genus named after him, and the 1997 "Venomous Snakes, Ecology, Evolution and Snakebite" volume (edited by R. S. Thorpe, W. Wuster, and A. Malhotra) was dedicated to him. Currently, The Natural History Museum is preparing a special issue of the *Bulletin* in his honor, and a retrospective will soon appear in *Copeia*. Sadly, the latter two will now be posthumous.

Garth's achievements may explain why he was a respected herpetologist, but they do little to explain the enduring loyalty of his students or the affection with which he was held. For this one needs to understand Garth's character. Garth had his gentle, and entirely unaffected, eccentricities. I first met Garth 35 years ago when I tried to convince him he should take me on as a PhD student once I had graduated. This was at the stage at which his Museum Fellowship had just ended. The pre-meeting telephone calls had led me to expect a much older man, but Garth was still in his

forties at this time. He came across as someone with some old mannerisms, but with a youthful, quick, and flexible mind, readily open to new ideas. This open, flexible mind stayed with him throughout and he was always very receptive to new ideas, even when they contradicted his own. He was, for example, very complimentary about the hypothesis of a marine origin for snakes.

I used to see Garth when he came into the museum for his weekly dose of research. There was a constant flow of notable researchers through the museum that Garth would delight in meeting, but he always took time to talk to encourage those that were starting out their academic journey. A very young Harry Greene (yes, even Harry was young once) turned up one day from his military posting in Germany to talk about his tail display-injury hypothesis. Harry was dressed smartly, with a severe military haircut, and bristling with respect for authority. However, Garth, in spite of (or perhaps because of) his own time in the military, was entirely non-authoritarian and non-status orientated in his approach to everything and everyone. Harry must have used the address "Sir" more times than I had heard since my schooldays. In spite of being nonplussed by this, Garth soon got Harry to relax, address him as Garth, and have a sensible conversation about bite marks on sand boas' rears.

He was a great teacher, not just directly, but also by example. He always expected the best possible effort in everything and impartial objectivity when considering evidence. The flow of visitors gave plenty of opportunity to air various viewpoints. His approach to academic debate was completely non-confrontational, and when faced with overconfidence he could be crushingly reasonable. Garth was an excellent model: un-opinionated without being opinion-less, open-minded without being mindless, and highly principled without being a prig. It reflects our limitations, and not Garth's, if we were not always able to learn from him. He cared about doing and publishing good science, and providing quality teaching. He never mentioned the paraphernalia of "citation rates," "grant capture," and "quality assurance" that so burden academia, and are so loved by those who administer because they can no longer do. Such a person was not always well-adapted to life in today's academia, but Garth was almost entirely free from cynicism. He enjoyed herpetology, he enjoyed systematics, he enjoyed teaching, and he enjoyed talking to others and encouraging them.

His daughter Vivienne, an architect, survives Garth. We extend to her our congratulations on having such a father and deepest sympathy for the loss.

Acknowledgments.—I would like to thank Vivienne Hughes and Mark Wilkinson for their communications regarding this obituary, and acknowledge Garth for his initial PhD supervision and 35 years of friendship and advice.

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Coniophanes meridanus (FMNH 153581). México: Yucatán: Dzibilchaltún. Illustration by Julian C. Lee.

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Zoo herpetologist and conservationist Sean McKeown passed away on 11 July 2002, at age 58. Born on New Year's Day, 1944, in Los Angeles, California, he spent his early childhood in western Pennsylvania, roaming the woods in search of salamanders, lizards, and snakes. He returned to California to finish elementary and high school. Sean attended the University of California at Santa Barbara, graduating in 1967 with a bachelor's degree in political science. Two years later, he started graduate school at California State University, Chico, where he was a teaching assistant to Frank Cliff. He received his master's degree "with distinction" in 1973, in a combined biological sciences/anthropology program. The title of his thesis was "An Analysis of Protective Attitudes Concerning the Puma (*Felis concolor*)."

In 1975, Sean moved to Hawaii shortly after receiving his master's degree and began working at the Honolulu Zoo. Surprisingly, his zoo experience had been minimal and was limited to a yearlong stint at the Los Angeles Zoo prior to starting graduate school. Sean brought from California his most cherished possessions, a collection of Chumash Indian baskets and an immaculate, red and white 1955 Chevy. Always proud of his Irish heritage, he kept a large, iron-hard shillelagh hanging in the kitchen of his Diamond Head home.

While in Hawaii, Sean helped acquire a significant collection of reptiles at the Honolulu Zoo, emphasizing captive breeding of endangered species. Before his arrival, the few reptiles on display included green iguanas, American alligators, and Galapagos tortoises, the latter being part of an important captive breeding program. The zoo's 'Animal Lanai' featured a miscellaneous assortment of small animals, the highlight of which was a male red rat snake. Snakes are illegal in the state and the snake enclosure was made possible only through special permission of the Hawaii State Government after extensive petitioning by the zoo-going public. According to Assistant Zoo Director Tommy Higashino, Sean wasted no time in transforming the Animal Lanai into a full-fledged herpetarium. The zoo visitor was then treated to such exotics as green basilisks, matamata turtles, and lace monitor lizards.

More than anything else, Sean wished to instill in the people of Hawaii a healthy respect and appreciation for reptiles and amphibians. Once, at a convention for a well-known clothing manufacturer whose trademark was an embroidered alligator, Sean and reptile keeper Duane Meier offered to bring a live alligator to the exclusive Honolulu Club as a promotion. In exchange, a $50 donation was promised for use in the reptile house. The event was held on the second floor, so imagine the surprise of those attending the convention when the elevator door suddenly opened and two men tethering a 6-foot alligator entered the room!

Soon after his arrival in Hawaii, Sean turned his attention to the study of the local herpetofauna, wishing to expand on earlier published accounts by Stejneger (1899. Proc. U.S. Natl. Mus. 21:783–813), Snyder (1919. Proc. U.S. Natl. Mus. 54:19–25), Oliver and Shaw (1953. Zoologica 38:65–95), and Hunsaker and Breese (1967. Pac. Sci. 21:168–172). In his first book, *Hawaiian Reptiles and Amphibians* (Oriental Publishing Co., 1978), Sean worked with local photographer Grant Uchida to produce some amazing close-up photographs of the various introduced Pacific geckos and skinks. In 1996, a revised and much expanded version of the book was published.

Between 1980 and 1981, Sean traveled to the Indian Ocean in pursuit of his favorite herpetological passion, the geckos of the genus *Phelsuma*. Granted special permission by the Republic of the Seychelles' Department of Conservation, he visited the islands of Mauritius and Reunión, where he conducted behavioral studies on numerous species. As a consultant to the Seychelles government, Sean also designed and supervised the construction of an egg incubator for the captive propagation of the Aldabra giant tortoise (*Geochelone gigantea*).

In 1983, Sean and his zoo staff successfully bred the critically endangered Madagascar angulated tortoise (*Geochelone yniphora*). In recognition of this achievement, the Honolulu Zoo received the prestigious Edward Bean Award for conservation, presented by the American Association of Zoological Parks and Aquariums (now the American Zoo and Aquarium Association). Later that year, Sean left Hawaii and returned to California, where he accepted a position as Curator of Reptiles at the Chaffee Zoological Gardens in Fresno. In 1986 another AZA award was received for the captive breeding of the Madagascar ground boa (*Acrantophis madagascariensis*).

Bitten again by the travel bug, Sean was off to hunt geckos in 1987. Supplied with wildlife permits from the government, he went in pursuit of the New Caledonian giant geckos (*Rhacodactylus*). Later that year, Sean was granted permission by the New Zealand Department of Conservation to study the endemic geckos of the genera *Heteropholis* and *Naultinus*. On one of his last overseas trips, he visited the island of Aruba in the Caribbean. As a member of the AZA's Species Survival Plan, he assisted with the collection of data on the Aruba Island rattlesnake (*Crotalus unicolor*).

In 1990, Sean became the managing editor for the American Federation of Herpetoculturists' magazine, *Vivarium*. He was also a contributing author. In the spring of that year, The First International Symposium on Turtles & Tortoises: Conservation and Captive Husbandry convened at Chapman University in Orange, California. Sean was instrumental in helping to organize the conference and assisted with editing the symposium proceedings. Dur-

ing this period of extracurricular activity, he continued his work at Chaffee Zoological Gardens until 1995, when he took an early retirement to concentrate on his writing. These efforts resulted in the publication of *The General Care and Maintenance of Day Geckos* (1993), *Jackson's Chameleons* (*In:* Care and Breeding of Panther, Jackson's, Veiled and Parson's Chameleons, 1995), *General Husbandry and Management* (*In:* Reptile Medicine and Surgery, 1996), *A Field Guide to Reptiles and Amphibians in the Hawaiian Islands* (1996), and *The General Care and Maintenance of Tokay Geckos and Related Species* (1997). An avid history buff, Sean also enjoyed interviewing well-known zoo herpetologists for a "People Profiles" feature in *Reptile & Amphibian Hobbyist*.

In 1996 Sean was diagnosed with idiopathic cardiomyopathy, or congestive heart failure. Three years later he received a left ventricular assist device that artificially kept his heart functioning. This experience made Sean a strong advocate of organ donation. In April of 2000, he received a heart transplant at Stanford University Medical Center.

Until the very end of his life, Sean continued his involvement in several conservation committees, including the IUCN's Captive Breeding Specialist Group and Tortoise and Freshwater Turtle Specialist Group. He also served as a consultant to Hawaii's State Department of Agriculture, striving to keep the brown tree snake (*Boiga irregularis*) and the coquí común (*Eleutherodactylus coqui*) from becoming established in Hawaii. He continued to conduct surveys on the endangered blunt-nosed leopard lizard (*Gambelia sila*) for the California Department of Fish and Game and wrote a monthly column for *Reptiles* magazine entitled "Ask the Breeder" (he was also a regular contributing author). Sean enjoyed teaching young people about natural history and assisted students with their science fair projects. He was also a judge at the California State Science Fair.

Sean is survived by his wife, Wendy and two daughters, Dorie and Casey. "The country has lost one of its most brilliant, hardworking and active leaders in wildlife conservation of this era. We will dearly miss him," said Paul Breese, former director of the Honolulu Zoo.

We will, indeed, miss you. Aloha, Sean.

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ZOO VIEW

Since 1976, George B. Rabb has been Director of the Chicago Zoological Park, also known as the Brookfield Zoo. George anticipates retirement after many years of professional service to the zoo and conservation community. He began his career as research coordinator at the Zoo in 1956. As former Chairman of the Species Survival Commission (SSC) of IUCN-The World Conservation Union beginning in 1989, he formed and supported the Declining Amphibian Populations Task Force (DAPTF) under the banner of IUCN. For his accomplishments, he was awarded the Peter Scott Award in 1996 by SSC.

George's herpetological research has been impressive. In 1955–1956, he described new salamanders from Mexico and the tadpole of *Hyla robertsorum*. The next year, he named a new race of iguanid lizard (*Leiocephalus carinatus granti*) from Cayman Brac, B.W.I. The same year, George and E. B. Hayden recorded the history of the Van Voast-American Museum of Natural History Bahama Islands Expedition and outlined general features of the Islands. In 1959, George described a new frog of the genus *Plectrohyla* (*P. pycnochila*) from the Sierra de los Tuxtlas, Mexico. With his colleague Hymen Marx at the Field Museum of Natural History in Chicago, George produced a series of seminal papers on snake evolutionary biology. He studied the viperid snake *Azemiops* and compared its cephalic anatomy and phylogenetic position relative to Viperinae and Crotalinae. In 1965, a paper on relationships and zoogeography of the viperine snakes appeared. He investigated morphometrics of the ectopterygoid in advanced snakes (Colubroidea). In 1970 and 1972, two major papers on character analysis of advanced snakes were published. In another, two colubrid snake genera convergent to the vipers (*Pythonodipsas* and *Spalerosophis*) were treated. Rabb published a number of important papers, some with his wife Mary, on amphibian reproductive behavior, based in part on their zoo colony of pipid frogs. For his contributions to the herpetological community, he was elected President of the American Society of Ichthyologists and Herpetologists.

Rabb believed that zoos must change from menageries to conservation and research centers; he wrote many papers on this topic. George and his staff have developed protocols for successful captive management programs, such as designing techniques for surveying and maintaining genetic diversity in zoo animal colonies. George was instrumental in establishing the International Species Information System (ISIS), the inventory listing of captive animal populations which is crucial in providing data to ensure proper pairings of potential breeders and monitoring the population structure.

As a measure of the esteem and respect that he engenders from his colleagues, his career and contributions to zoo biology and conservation have been covered in full in a recent book (Ross, A. 2001. Rabb, George B. 1930– American director of the Chicago Zoological Park. *In* C. E. Bell [ed.], Encyclopedia of the World's Zoos, pp. 1035–1037. Fitzroy Dearborn Publishers, Chicago and London).

George and Hy Marx were important mentors for me during my early years in Chicago. By their example, I learned how herpetology should be approached in a careful and systematic manner. For their friendship, inspiration and guidance, I am eternally grateful.

Recently, approximately 10,000 Asian turtles and tortoises were confiscated in Hong Kong, destined to be used for food and medicinal purposes in China. The chelonians were in deplorable condition, requiring medical evaluations and extensive care before they were fit to be sent to European zoos and other facilities. Curator Gerard Visser from the Rotterdam Zoo oversaw the maintenance of many of these creatures, arranged homes for them, and coordinated shipping, which was no easy task. Gerard demonstrated how important one individual in the zoo community can be when faced with a crisis of this magnitude.

Because the herpetological history of his Zoo is so important, I asked Gerard to write the following article. He took on this project seriously, spending hours in the zoo archives where he unearthed materials long hidden. My hope is that others will find his account as fascinating as I did.

—James B. Murphy, Section Editor

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Herpetology at the Rotterdam Zoo

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The Old Rotterdam Zoo: 1857–1940

The Rotterdam Zoo was founded in 1857, and one of the oldest sources available (Van Bemmelen 1869) shows that reptiles were already represented in the collection. The next year the animal collection consisted of 204 mammals, 659 birds, and 29 reptiles, called "creeping animals" in this report (Fig. 1).

I was unable to discover exactly how and where the reptiles were housed before 1906. The minutes of the "Buildings-committee" of 4 June 1902 show that the decision was made to demolish and rebuild the "winterbuilding" which housed not only reptiles and amphibians during the winter but also those mammals and birds requiring heated houses or stables. Porcupines and snakes are specifically mentioned as residents. In the minutes of 16 November 1904 the Director questioned whether a new reptile building was really necessary for the Zoo. In response to his query, the entire committee decided that a new facility was needed, but that it should not be built too cheaply. This new building cost 35,400 guilders (approx. US $17,000) and construction started in 1905. Zoo herpetologists will be pleased to learn that when a reptile keeper was to be hired for the new Reptile House, the Director in July 1905 (again meeting with the Buildings-committee) claimed: "This is a difficult and complex position. Mr. Winde, a florist, is an educated person, and has even published in magazines. He should therefore be paid better wages than *common* keepers. And only one woman to clean the windows in that building (!)" The Zoo board later rejected the extra salary (again, not surprising to-

1 Groote Ikstern of Kaugek....	Sterna cantiaca, *Gmel.*
7 Landschildpadden...........	Testudo.
4 Moerasschildpadden.........	Emys.
3 Zeeschildpadden............	Chelonia.
1 Afrikaansche Krokodil......	Crocodilus vulgaris, *Cuv.*
1 Krokodil van Borneo........	Gavialis Schlegelii, *S. Müll.*
2 Kaaimannen................	Alligator lucius, *Cuv.* s. missisippiensis (*Daud.*).
4 Sawa-slangen van Java......	Python bivittatus, *Kuhl.*
3 Boa's.....................	Boa constrictor, *Linn.*
1 Ringslang..................	Natrix torquata, *Merr.*
2 Hagedissen;................	Lacerta stirpium, *Daud.*
1 Reuzensalamander van Japan.	Sieboldia maxima (*Schleg.*).

FIG. 1. The 1858 list of zoo specimens contained 7 tortoises (*Testudo*), 4 terrapins (*Emys*); 3 seaturtles (*Chelonia*), 1 African crocodile (*Crocodilus vulgaris*, Cuv.); 1 crocodile from Borneo (*Gavialis schlegelii*, S. Müll.), 2 Caimans (*Alligator lucius*, Cuv. *s. mississippiensis* (Daud.)); 4 sawa-snakes from Java (*Python bivittatus*, Kuhl); 3 Boas (*Boa constrictor*, Linn.); 1 glass snake (*Natrix torquata*, Merr); 2 lizards (*Lacerta stirpium*, Daud.); 1 giant salamander from Japan (*Sieboldia maxima* (Schleg.).

day), but Mr. Winde was allowed to go to the Amsterdam Zoo "Artis" to learn to care for reptiles.

The new Reptile House opened in 1906 (Fig. 2). This house was famous for its central crocodile pond, where a large group of crocodiles could be observed at close range. At first, this exhibit was a barren pool measuring 12 x 6 m with a central concrete island (Fig. 3). In 1915 one of the entries in the "Book of Gifts to

FIG. 2. Exterior of the Reptile House, 1906.

FIG. 3. The famous Crocodile Pool, as it was before 1915.

GEDRANG OP DE ZANDPLAAT OP EEN HEETEN ACHTERMIDDAG

FIG. 4. The Crocodile Pool after 1915, with added rockwork.

the Zoo" reads: "A donation of one hundred guilders to embellish the Crocodile Pool in the Reptile House with rockwork." We can therefore safely assume that photographs showing the (very pretty!) rockwork in the Crocodile Pool date from after 1915 or 1916 (Fig. 4). In the left wing of the house large cages for boids could be found; in the right wing, larger varanids, teiids, and iguanids were exhibited. Along the walls of both wings, medium-sized and small terrariums and aquariums were installed for smaller reptiles, amphibians, and fishes. Along the extreme left wall, behind a glass screen, was the enclosure for giant tortoises. These animals had access to an outside pen on warmer days. During the winter they were allowed to wander around parts of the public area of the house. Along the far right wall there was a large aquarium (initially intended to house a seal!) which contained large indigenous fishes, like catfishes and pikes.

Many of the reptiles were brought to the Zoo by the masters and crews of the Dutch commercial fleet. Rotterdam was already a major seaport at the time, and these ships brought back animals from their runs to the Dutch overseas colonies in the East Indies (now Indonesia) and West Indies (Netherlands Antilles). Often ship owners instructed their captains to bring animals for the zoo. Many owners were members of the Rotterdam establishment who regularly gathered in the Zoo's famous Society Building and that group supported the Zoo in many ways. In fact, Board members were usually selected from their ranks.

The great majority of reptiles brought to the Zoo were acquired in the East Indies. The *Javaansche Sawah slang* (Javan ricefield snake) was one of the commonest species to be presented to the Zoo. Or rather the two most common species, because at the time both *Python reticulatus* and *Python molurus bivittatus* were called *Sawah slang* in Dutch. Other species that were commonly presented to the Zoo were: green seaturtle (*Chelonia mydas*), Amboina box turtle (*Cuora amboinensis*), and water monitor (*Varanus salvator*). In some cases, these reptiles were sold to other zoos in Europe. The names of the zoos in London, Frankfurt, Leipzig, Berlin, and Antwerp appear regularly in these old records[3].

Many reptiles were short-lived, green iguanas (*Iguana iguana*) often not lasting much longer than four weeks (Van der Werff, pers. comm.). The seaturtles were housed in the already overcrowded crocodile pond. They must have had a very unpleasant life and presumably did not live very long.

Although a number of well-respected zoologists were employed

at the Zoo over the years (Kuiper, Van Bemmel, Appelman) none of them specialized in reptiles. Probably the most famous scientist to become director of the Zoo was Dr. Johann Büttikofer (1850–1927), the Swiss-born naturalist who was appointed assistant to the director of the Leiden Museum, Prof. Schlegel, in 1878. Büttikofer became an authority on West African wildlife after major expeditions to Liberia in 1879–1882 and 1886–1887. After completing his account of these travels (Büttikofer 1890–91) he was invited to join a large zoological expedition to Central Borneo. Meanwhile, in 1883, he had become curator of the Leiden Museum Bird Collection. Four years later, he became director of the Rotterdam Zoo; his appointment was a significant event for the Zoo as Büttikofer was one of the most respected scientists of that period. Many taxonomists named West African fishes, birds, and mammals in his honor. Büttikofer's main interests were birds and mammals, but in volume 2 of his books on the Liberian expedition, he covered reptiles and amphibians (Büttikofer 1890:434–447); his accounts were accompanied by black-and-white drawings of a leatherback turtle (*Dermochelys coriacea*), a Nile crocodile (*Crocodylus niloticus*), a slender-snouted crocodile (*Crocodylus cataphractus*), a broad-fronted crocodile (*Osteolaemus tetraspis*), and a delightful color plate of the Rhinoceros viper (*Bitis rhinoceros* Temminck; = *Bitis gabonica rhinoceros* Schlegel) (Fig. 5). He retired from the Zoo in 1924 at age 74, and returned to Switzerland. Van Bemmel, director of the Rotterdam Zoo from 1961 until 1969, published a short essay on Büttikofer, including a photograph of him during his expedition in Borneo (Van Bemmel 1959)

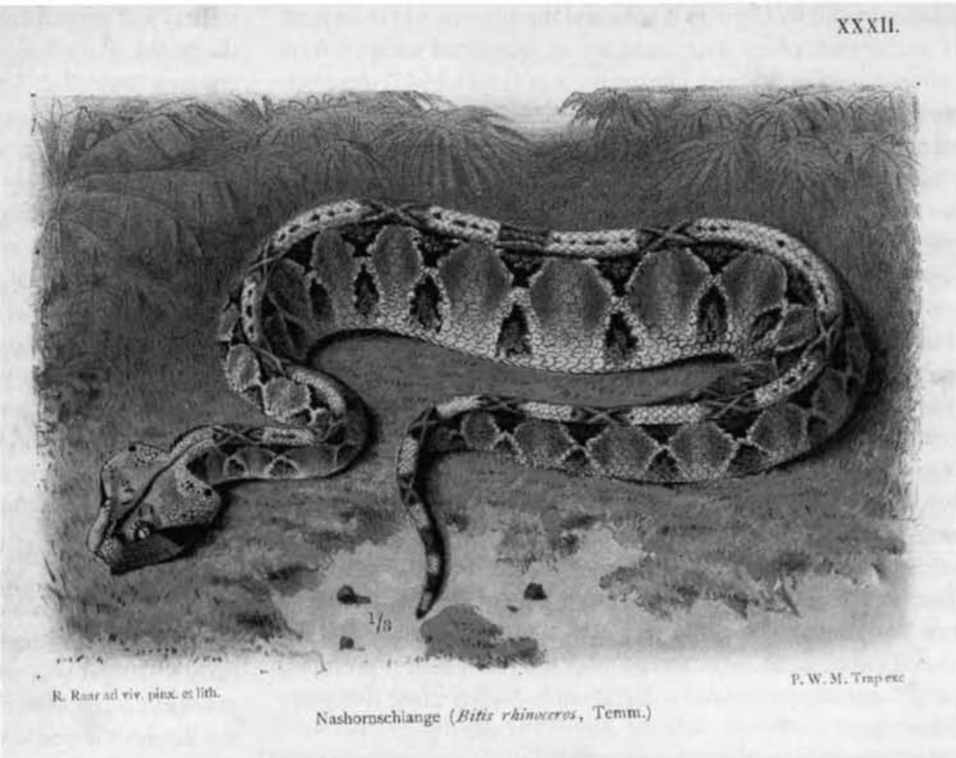

FIG. 5. Büttikofer's 1890 color plate.

Because trained herpetologists were unavailable, not all animals were always identified correctly; for example, in one of the old guide-books a photograph of a tuatara (*Sphenodon punctatus*) is shown and called "green iguana" (Fig. 6). I also found a picture of a Komodo dragon (*Varanus komodoensis*) (Fig. 7) in the old reptile house—so it must have been living in the Reptile House sometime between 1906 and 1940, but so far I have been unable to find any reference to it in the records!

The New Zoo (Diergaarde Blijdorp): 1940–1974

Because the city was growing the zoo had to move from the town center in 1940 to make room for developments. Architect Ir. Sybold van Ravesteijn was given the assignment to design a new zoo, and perhaps typically, an actual reptile house was not included in that plan. Birds and reptiles were housed in the same building, a tropical house that formed one of the two wings of the *Rivièrahal* (Rivièra-Hall) in the heart of the new zoo. Only a few cages in the central area of that tropical house were reserved for reptiles, and probably because of the popularity of the crocodile pool of the old zoo, a large part was reserved for crocodilians. In May 1940 the

FIG. 6. Tuatara, falsely identified as a "groene leguaan" (green iguana).

FIG 7. Komodo dragon in the old zoo.

old zoo was hit by German bombs and the animals had to be hastily transferred, often after recapture as many had escaped from their damaged enclosures. During the war (1940–1945) there was a great shortage of food and other basic needs, and many of the cages could not be heated. Therefore, many reptiles died, and among the reptiles that had lived in the old zoo's Reptile House that survived were—not surprisingly—a pair of American alligators (*Alligator mississippiensis*) and slender-snouted crocodiles (*Crocodylus cataphractus*).

To my surprise, I have been able to find only three photographs of that early period from 1940 to 1954. One shows four heads of adult American alligators (Moerkerk, undated, c. 1950) and another shows the crocodilian exhibit which housed them just after completion, in a book on the architecture of Van Ravesteijn (De Vries 1986). The third photograph pictures nine keepers holding a very large python in front of the new crocodile pool, published in the Zoo's magazine *Blijdorp Geluiden* to accompany a general article on snakes (Appelman 1958). This lack of historical documentation might signify that the popularity of reptiles reached a very low level just after the war. Was this an indication that the general public (and, who knows, also the zoo's staff?) preferred "nicer," cuddlier, and more colorful animals after those five years of hardship?

However, the need for more reptile displays was evident very soon after 1950. It is likely that visitors remembered the old reptile house with its strange and sensational creepy creatures and the zoo staff became aware that a reptile house, even if small, was in high demand. In 1954 one of the two tea-houses was modified into a legitimate reptile house. It opened on 15 April of that year. The reptile cages in the central tropical house became aviaries for birds and in the new Reptile House several large, but somewhat barren, enclosures (Fig. 8) were made for large monitors, common boas, large pythons, iguanas, spectacled caimans, seasnakes, seaturtles, one giant tortoise, and some venomous snakes —and of course two pools for the above -mentioned four crocodilians. This house became the realm of head keeper Joop van der Werff who worked there until 1974. The house had a great tropical atmosphere because of the high humidity and a wealth of tropical plants. Van der Werff added smaller cages for lizards, snakes, turtles, and amphibians along the outer walls. Over the years he decorated all the larger cages and modified them into more modern type "habitats." Again, no true curator was appointed and Van der Werff worked under the supervision of overseer of keepers Pierre van Leeuwen, who was also responsible for the birds and fishes and indeed was content to redirect most of the reptile work to Van der Werff. Hardly any reproduction took place, except for some live-bearing species such as *Boa constrictor* and a notably large brood of 55 Gaboon vipers (Van der Werff 1970).

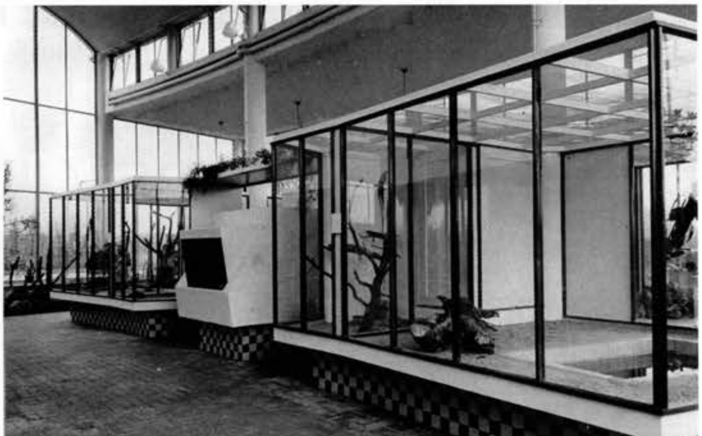

FIG. 8. The interior of the reptile house in the new zoo (1953). It closed again in 1974.

The first scientist with a real interest in reptiles was staff biologist Dr. Hans van Roon, and he incorporated a more systematic approach in keeping and breeding reptiles around 1970. His approach resulted in the first hatching of green iguanas in the Zoo (van Roon 1976) and in a more interesting, diverse collection of reptiles. When I joined the zoo in 1972 I was hired by van Roon as a fish keeper; I got my first training as a reptile keeper by Van der Werff in 1973.

The Rivièrahal as Reptile Center: 1974–c. 2002

After Zoo Director Dick van Dam had been appointed in the early 1970s, it was soon decided that ectotherms should play a more important role in the animal collection of the zoo and that the Rivièrahal would be the central place for fishes, amphibians, and reptiles[3]. Additional staff were hired, but van Roon's successor, Han Assink, although the first person to get the curatorial position, still had to oversee the birds and fishes, as well as reptiles. As in the old days, much of the reptile work was done by the keeping staff, but this time a real curator was available, who was much more actively involved in the herpetological collection than any of his predecessors. In the Rivièrahal more and more terrariums were constructed, and in 1976 a new Crocodile Wing was added. The four large crocodilians, by now in Rotterdam for over 50 years, were moved to new quarters, this time more spacious than ever before[3]. In the same building, spectacled caimans (*Caiman crocodilus*) and a large pair of water monitors were exhibited.

In 1979 the Amazonian Wing was added to the Rivièrahal, and here mainly large osteoglossid fishes were housed in a pool surrounded by Amazonian vegetation. Reptiles exhibited here were red-footed tortoises (*Geochelone carbonaria*), South American giant river turtles (*Podocnemis expansa*) , yellow-spotted giant river turtles (*P. unifilis*), and, although not of Amazonian origin, rhinoceros iguanas (*Cyclura cornuta*).

The number of species of both fishes and reptiles grew rapidly, and also time and money were invested to improve exhibitry, husbandry, and reproduction. In 1984 I was appointed curator for fishes and reptiles, the first curator for just lower vertebrates and invertebrates at the Zoo[4]. Assink, who had become general curator in 1984, left the zoo six years later.

In the period from the late 1970s until the late 1990s, several "difficult" species were being bred: Amboina sail-tailed lizard (*Hydrosaurus amboinensis*; Visser 1984; Belterman and Visser 1996 [on the chromosomes of *Hydrosaurus*]), white-throated monitor (*Varanus exanthematicus albigularis*; Visser 1981), yellow monitor (*V. flavescens*; Visser 1985), lace monitor (*V. varius*; Horn et al. 1997), Chinese crocodile lizard (*Shinisaurus crocodilurus*; Visser 1989), and leopard tortoise (*Geochelone pardalis babcocki*; Visser and Zwartepoorte 1989). Other species that were more or

less regularly bred include: spectacled caiman (*Caiman crocodilus*), spider tortoise (*Pyxis arachnoides*; Zwartepoorte 2000), African spurred tortoise (*Geochelone sulcata;* Zwartepoorte, *in press*), Fiji banded iguana (*Brachylophus fasciatus*), rhinoceros iguana (*Cyclura cornuta*), Philippine sailfin lizard (*Hydrosaurus pustulatus*), African spiny-tailed lizard (*Uromastyx acanthinurus*; Zwartepoorte1995), ridge-tailed monitor (*Varanus acanthurus*), and mangrove monitor (*Varanus indicus*). In all, more than a hundred species have reproduced in the Rivièrahal so far.

Monitor lizards have always played an important role in the zoo's reptile collection and even in the second reptile house (1953–1974) large water monitors were among the more important species; for years a trio of Timor monitors (*Varanus timorensis*) also lived there (Visser 1975). Initiated by the breeding successes with these varanids, a close cooperation with Prof. Hans-Georg Horn of Sprockhövel, Germany resulted in two papers in the "International ZooYearbook" (Horn and Visser 1989, 1997) which provided up-to-date overviews of world-wide varanid captive reproduction, a paper on the perentie (*Varanus giganteus*) in the wild (Horn and Visser 1988) and a paper on the basic biological data of monitors (Horn and Visser 1991). A mainly herpetological journey through Australia in 1986 resulted in a series of popular articles published in German and Dutch hobby magazines as well as in the Rotterdam Zoo's bimonthly magazine, then called *Dieren*. A close relationship was established with the late Dennis King of Perth, Australia, a well-known varanid expert. King visited the Rotterdam Zoo on several occasions. For the Second World Congress of Herpetology in Adelaide (1993), I assisted him as a convener for the special Varanid Symposium, which was a followup to the successful First Multidisciplinary Varanid Symposium held in Bonn, Germany, after the First World Congress of Herpetology in Canterbury. A general paper on Rotterdam's monitors appeared in the American hobbyist magazine *The Vivarium* (Visser 1992).

The Masterplan Developments: from 1990

In 1988, after Van Dam had retired and Ton Dorresteyn had become the new director, a complete renovation of the Zoo was undertaken and the first draft of the Masterplan was completed in 1990. As in any modern zoo, "habitat immersion" was the leading element of the plan. According to this philosophy, animals should be housed in naturalistic enclosures that resemble natural habitats accessible to visitors (whenever possible). At the Rotterdam Zoo, these habitats or "biotopes" were to be organized on a geographical basis. In 1991 an Asian swamp and large bat cave were completed, and this cave was the first mixed habitat where reptiles were (and still are) housed: in this case, bat-eating ratsnakes (*Elaphe taeniura*). In the "Taman Indah," a tropical Asian jungle house, the Asian elephants and rhinoceroses share their indoor riverine forest habitat with gibbons, hornbills, Asian freshwater fishes, and Burmese pythons (*Python molurus bivittatus*). In an Asian Batak-style house, tokay geckos (*Gekko gecko*) are exhibited in a glass fronted cupboard; in fact this house is also the indoor facility for Asian deer, antelope, and leaf monkeys. After having success with taxa which would thrive in these mixed species exhibits, it was decided that not only mammals, birds, and plants, but always also reptiles, fishes, and insects would be combined in all new habitats, departing from the former idea of a building housing only reptiles (or indeed fishes).

The Oceanium: From 2001

The largest Masterplan project to date opened officially in July 2001: the Oceanium. The visitor is encouraged to take a journey of discovery along coasts and through oceans, starting in Europe, via the Atlantic Ocean to the Americas. As this was planned to be our major indoor exhibit featuring the American continent, it was decided that all of our American herp species should be housed in the Oceanium. Because of the uniqueness of the Caribbean island herpetofauna and our political connection with the Netherlands Antilles, focusing on Caribbean Island fauna was a logical choice. The link with the Caribbean Sea (essential in an Oceanium building!) and its coral reefs is apparent to our visitor: after having viewed the lively reef with schools of fishes and live corals, our explorer slowly rises above the surface of the water to see a surf action aquarium and a tidal mangrove forest. After this watery experience, our traveller reaches an Antillean shore, where the rhinoceros iguana (*Cyclura cornuta*), Roatan Island black iguana (*Ctenosaura oedorhina*), Aruba Island rattlesnake (*Crotalus unicolor*), Cuban boa (*Epicrates angulifer*), Cuban anole (*Anolis equestris*), and Montserrat mountain chicken frog (*Leptodactylus fallax*) are exhibited. Gradually, we plan to substitute the more common species in this Caribbean section with endangered species. The threatened leptodactylid frog *L. fallax*, successfully hatched and raised by the Durrell Wildlife Conservation Trust as part of a safety net recovery plan, is an example of this strategy. In the transition between the "Caribbean" and the "Falkland Islands" king penguin habitat, there is a small but nice South American jungle habitat and one of the tropical river exhibits holds Colombian slider turtles (*Trachemys scripta callirostris*) and dwarf caimans (*Paleosuchus palpebrosus*).

Sonoran Desert species from North America and Mexico were traditionally represented in our reptile collection and North American succulent plants were important in our botanical collection; therefore the Sonoran Desert was chosen to be represented in the Oceanium, and to link this exhibit to the sea, this habitat is called "Sea of Cortez" because well known proximal reptile species are shown: Gila monster (*Heloderma suspectum*), giant black chuckwalla (*Sauromalus hispidus*), collared lizard (*Crotaphytus collaris*), among others. To enhance further the "desert-and-the-sea" image, an open 25,000-liter aquarium contains Sea of Cortez fishes. Burrowing owls, roadrunners, rock squirrels, and Saguaro cactus complete this Sonoran community.

Currently, a very large exhibit is being added to the Oceanium's journey of discovery: The Galapagos Islands. The only live animals to be displayed are ten Galapagos tortoises (*Geochelone nigra*). These chelonians hatched at the Zürich Zoo in 1995 (see Fürrer 2002, for details). The 110 m^2 indoor exhibit and the 160 m^2 outdoor habitat are planned for completion by the summer of 2002. A life-size model of a marine iguana (*Amblyrhynchus cristatus*) will be added as living specimens are protected by Ecuador and not available. The model will also be used as an opportunity for the blind (and others!) to feel some of the essence of a large iguanid lizard.

A Glimpse of the Future: the Renovated Rivièrahal

A donation by the City of Rotterdam will allow us to renovate the Rivièrahal in 2003 and to restore it according to the style created by the architect Van Ravesteijn years ago. The central part of

the hall will feature public amenities with a large indoor sitting area and cafe, and only a few, but sophisticated aqua-terrariums while both wings will be reserved for animal exhibits. The east wing (currently tropical birdhouse) will be connected with the Asian continent and Chinese garden and pavilions, and contain mainly Chinese and Indochinese birds as well as an indoor and outdoor facility for our Chinese alligators (*Alligator sinensis*). Already the former Amazonian wing, adjacent to this tropical birdhouse, was transformed into an exclusively Asian reptile facility for Komodo dragons, brown jungle tortoises (*Manouria emys*), and several freshwater turtle species in June 2002 (Visser 2002). Graphics and videos help to explain the Asian turtle crisis (see Buley and Zwartepoorte 2002) to the public.

The west wing, now housing gorillas and giraffes, will be connected to the African savannah in the near future and will be the place where a selection of African reptiles (including the two old African slender-snouted crocodiles) will be housed. The very popular incubation and neonate displays will certainly hold their important central place in the Hall.

It is the goal of the Herpetological Department of the Rotterdam Zoo to be more involved in international herpetological conservation efforts, and, more specifically, in much needed *in situ* conservation programs. Carefully selected groups of reptiles and amphibians in a unique series of habitats will tell that story to the public and hopefully arouse interest and support from the visitors at the Rotterdam Zoo.

Acknowledgments.—Fred Rueb, head keeper of birds at the Rotterdam Zoo, loaned materials from his famous private archives; Fernande Hazewinkel, volunteer at the Zoo, prepared excerpts from the very old minutes in the Rotterdam Municipal Archives and assisted in many other ways; and Lex Noordermeer, of the Zoo's Communication and Marketing Department, and the one in the zoo with the greatest awareness of the history of the Zoo, checked the text to keep me from making horrible mistakes. Thanks!

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Footnotes:

[1] Most of the pre-war records of the Zoo were destroyed in a fire during the war, except for the books that contain the records of animal gifts, births and sales. These happened to be in a metal vault. The book of animals obtained by purchase is no longer available, so it is not possible to determine which reptile species were mostly sought after by the zoo's pre-war management and thus to reconstruct some sort of "collection plan."

[2] The Reptile House would eventually return to its original function as a thematic Indonesian/Chinese restaurant in the Asian part of the zoo.

[3] The pair of alligators died in the nineties of the last century, Bobby the male, in 1991; in 1966, Judith the female was shown post mortem to have been a male as well....Both *Crocodylus cataphractus* survive until today.

[4] Traditionally, and in contrast with the North American Zoos, many of the older and larger European zoos appoint curators for both reptiles and fishes, and of course very often their duties include overseeing amphibians and invertebrates. Examples are: Amsterdam, Rotterdam, Antwerp, Berlin, London, Leipzig, Frankfurt, Stuttgart, and Cologne. Inevitably, curators will be biased toward a specific group of animals. This is often noticeable in the quality of research, collection and exhibition.

LETTERS TO THE EDITOR

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Timing of Reproductive Immigration in Salamanders: Roles of Environmental Cues and Endogenous Biological Clocks

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As a behavioral neuroscientist specializing in sensory systems and the neural bases of circadian rhythmicity, I was intrigued to discover spotted salamanders (*Ambystoma maculatum*) in central Virginia migrating to ephemeral ponds much earlier in 1998 than I had expected. Although it is possible that they were migrating in direct response to the wet weather and unseasonably warm temperatures at the time, it is also possible that their migration was influenced by internal time-keeping mechanisms endogenous to the salamanders. If so, how important are environmental cues, how important are endogenous clocks, and how might the two interact? Most literature accounts stress the importance of abiotic environmental factors in mediating the timing of migration and reproduction in salamanders, though some authors have suggested that endogenous clocks might influence the timing of seasonal reproductive activities. Even so, most discussions of endogenous cues affecting the timing of migratory behavior and reproduction have been cursory, and in some cases have suffered from a lack of depth in understanding the roles and mechanisms of the endogenous oscillators involved.

My goal here is to describe some of the various possible (and likely interacting) mechanisms that control the timing of seasonal migration in salamanders. Future experimental and observational work will be much improved by better understanding and careful discussion of the problems and possibilities generated by a suite of sensory systems and endogenous oscillators that allow exogenous (abiotic) and endogenous factors to interactively modulate the precise timing of reproductive activities within a given season.

En masse breeding migration occurs in many salamander species (see, for example, Gill 1978; Palis 1997; Petranka 1984; Semlitsch 1981; Shoop 1960; Spotila and Beumer 1970; Twitty 1959; Twitty et al. 1964); this behavior might have evolved as an anti-predator mechanism. Large numbers of migrating individuals might saturate the predator pool at a given moment in time, effectively allowing more individuals to successfully reach breeding sites (such as ephemeral ponds) than would do so if migration were asynchronous. Alternately (or in addition), *en masse* migration might increase the likelihood of males and females encountering each other at breeding sites, and might affect competition between individuals for mates.

Regardless of the selective advantage of mass migratory behavior, there is still much to learn about the mechanisms underlying migratory synchrony in salamanders. One complication in understanding these mechanisms is that the timing of synchronous migration and/or breeding varies among species, sometimes greatly. For example, in the eastern United States, *A. maculatum* immigrates to breeding sites and breeds in late winter to early spring (Baldauf 1952; Blanchard 1930; Hillis 1977), whereas *A. opacum* breeds in autumn (Anderson and Williamson 1973; Graham 1971). Although the timing of immigration/breeding is grossly similar from year to year (i.e., spring, autumn…) within species, the exact timing of a species' immigration/breeding can vary significantly (see Semlitsch 1993). That is, while the seasonality of reproductive activities is fixed in a given species, the timing of its migration and reproduction exhibits remarkable plasticity within that season for a given species.

The findings of Blanchard (1930), Hillis (1977) and others suggest that the interacting influences of temperature and rainfall are important effectors of immigration in *A. maculatum*. Blanchard (1930), for example, concluded that vernal immigration is initiated by the first rains following snowmelt and ground surface thaw. Beneski et al. (1986) stated flatly that once permissive temperatures occur, migratory activity in ambystomatid salamanders depends upon the occurrence and/or amount of rainfall. Sexton et al. (1990) concluded that three-day average temperature (mean of daily high and low temperatures) is the most useful predictor of *A. maculatum* immigration, but noted that all immigration in their study was associated with rainfall.

Environmental factors alone cannot fully explain the timing of reproductive activity within a season, however. While factors such as rainfall and temperature certainly serve as cues for breeding activity, and variability in timing of migration/breeding can be influenced by variability in these cues, breeding activities might also be affected by endogenous circannual and circadian clocks. Sexton et al. (1990) hypothesized that the lack of immigration of *A. maculatum* during December and January despite favorable conditions of temperature and rainfall represented a refractory period perhaps based upon an endogenous circannual clock. However, this is a rare example in which internal clock control has been discussed as a mediator of seasonal reproductive behavior in salamanders.

We (Grace and Church 2003) observed *A. maculatum* migrating in early January and early February in Albemarle County, Virginia. Our observations of migration on warm rainy nights support previous general conclusions that increased temperature and nocturnal rainfall influence immigration of ambystomatid salamanders to vernal breeding ponds (Douglas 1979; Hillis 1977; Sexton et al. 1990). Our observations also agree with previous reports that male *A. maculatum* immigrate before females (Douglas 1979; Grace and Church 2003; Hillis 1977), and with Sexton et al.'s (1990) model of immigration induction by a minimum three-day average temperature of approximately 5.5°C in conjunction with 0.127 cm minimum rainfall the day of immigration (Grace and Church 2003). However, the migratory activity we observed occurred significantly earlier than reported in even more southern portions of the species' range (e.g., North Carolina: Brimley 1921; Gray 1941; Harris 1980; Tennessee: King 1939), and corresponded with the earliest reported migration times for the southernmost portion of the range. Mount (1975), for example, documented migrations from late December to early February in Alabama; Walls and Altig (1986) reported late December and early January

migrations in Mississippi.

Though our observations are at odds with Sexton et al.'s (1990) hypothesis that a clock-derived refractory period prevents immigration during December/January (in St. Louis Co., Missouri), they do not negate the possibility that clocks are involved in regulating the timing of reproductive activities. Rather, our observations, together with those of others, suggest that clocks might influence seasonal activities in complicated ways, and that clocks interact with exogenous, abiotic cues in the temporal control of seasonal reproduction.

Locomotor activity in salamanders is affected by internal clocks, and clock-controlled behavior responds to environmental cues (Maerz et al. 2001). Thus, the effects of endogenous clocks on physiology and behavior are not fixed. If a circannual clock produces a refractory period for *A. maculatum* immigration, then the difference in immigratory behavior between salamander populations of the same species (cf. Grace and Church 2003; Sexton et al. 1990) might be due to significant plasticity in clock output, or to differences in the timing of cues that entrain the circannual clock to environmental time. Alternately, the timing of expression of seasonal activities in salamanders might be determined by interaction between circadian clocks and environmental cues.

Photoperiodic time measurement is accomplished through photoperiodic photosensitivity—circadian clocks are differentially sensitive to light according to time of day such that at certain times of year (but not others) light occurs during photosensitive times of the circadian day. Photoperiodic time measurement is a phylogenetically widespread mechanism underlying the timing of seasonal reproduction in vertebrate and other animals (for review, see Gwinner 1981). It could be argued that photic input to endogenous clocks is of little importance in fossorial organisms such as ambystomatid salamanders. Little is known about circadian organization in salamanders, but note that even in a fossorial mammal that completely lacks visual photoreceptors (the blind mole rat *Spalax ehrinbergi*; Cooper et al. 1993), photic input to the circadian timing center is fully developed (David-Gray et al. 1998).

If photoperiodic entrainment of endogenous clocks is involved in seasonal migration, then populations of *A. maculatum* in Missouri and Virginia might have evolved differences in clock-controlled timing of immigration (because seasonal variations in daylength are similar in Virginia and Missouri: for 5–7 January 1996, photophase in Charlottesville was approximately 9 h 38 min, and in St. Louis 9 h 35 min; for 9–11 February 1996, photophase in Charlottesville was approximately 10 h 39 min, and in St. Louis 10 h 35 min). Alternately (and more likely) the immigratory refractory period might be sufficiently plastic to respond to significant annual variation in temperature and rainfall. Finally, temperature and rainfall might be both proximate cues mediating initiation of immigration and seasonal cues mediating entrainment of endogenous circannual clocks in *A. maculatum* (Fig. 1).

It should be noted that Anderson and Williamson (1973) argued against the involvement of photoperiodic time measurement in the control of *Ambystoma opacum* reproduction. They concluded that nesting in *A. opacum* is temperature dependent (Anderson and Williamson 1973), occurring as temperatures drop below some threshold such that northern populations breed prior to southern ones. However, photoperiodic time measurement in vertebrate animals can be very sensitive, and *A. opacum* might be able to distinguish between northern and southern photoperiods on any

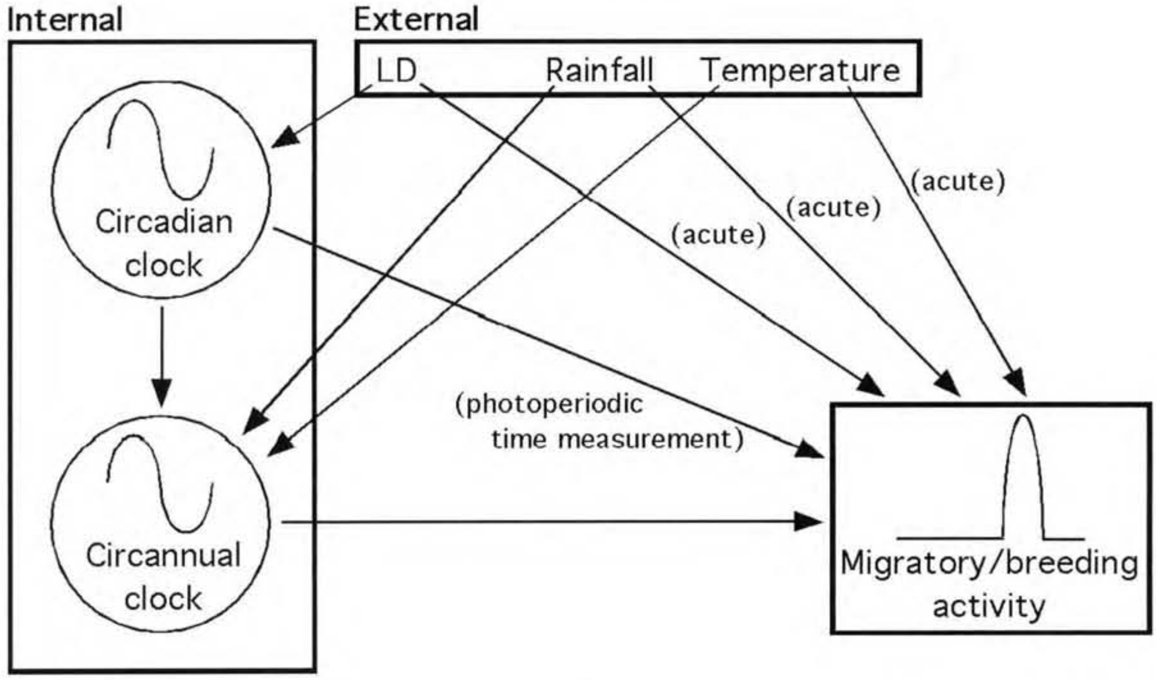

FIG. 1. Model of exogenous cues and endogenous clocks influencing the timing and plasticity of timing of seasonal immigration and reproduction in ambystomatid salamanders. Circadian and/or circannual clocks might mediate seasonal activities, perhaps through photoperiodic time measurement. Light (LD = light/dark cycle), temperature and rainfall might act either as direct acute cues affecting behavior, or entraining cues for clocks, In addition, changing daylength according to time of year might serve as a photperiodic signal for seasonal reproduction. Any or all of these cues and mechanisms might interact in the temporal control of overt behavior.

given day. Therefore, *A. opacum* might exhibit a photoperiodic response threshold, while temperature and/or rainfall might serve as acute permissive or stimulatory factors for reproduction.

Several authors have noted that in vernal immigrations of ambystomatid salamanders, arrival of males precedes arrival of females at breeding sites (see Beneski et al. 1986; Petranka 1984; Semlitsch et al. 1985). Some have suggested that males and females differ in threshold of response to acute cues (rainfall and/or temperature) for migratory activity (Douglas 1979). This might be the case, but circadian and/or circannual clocks might also underlie differential timing of male/female arrival at breeding sites. That is, males and females might differ in the timing of migratory activity relative to internal clock time (the "phase angle" of migratory activity). It is well known that phase angles of responsiveness to environmental cues differ among species, but there has been little exploration of sex-specific differences in phase angle, and none (to my knowledge) related to amphibian clock-controlled behavior. There is precedent, however: Helfrich-Forster (2000) described sex-specific differences in phase angle of daily locomotor activity in *Drosophila melanogaster*. It is reasonable to suspect that if circadian and/or circannual clocks are involved in the control of salamander breeding activities, sex-specific differences in phase angle of seasonal breeding behavior might have arisen as an adaptation promoting male arrival at breeding sites prior to female arrival.

In summary, multiple factors probably control salamander reproductive migration and breeding, and these factors likely include both internal and external components (Fig. 1). The fact that the timing of reproductive activities within a season exhibits remarkable plasticity even though reproductive efforts in a given species are confined to a season, suggests that salamanders consult both external sensors and internal clocks in the control of the timing of reproductive activities. Rainfall, temperature, and the daily light-dark cycle might act as proximate cues mediating acute changes in reproductive activity: ambystomatid salamanders tend to immigrate to breeding ponds at night in rain and at temperatures above some threshold. Each of these factors might also affect endogenous oscillators (circadian and/or circannual) that drive seasonal changes in reproductive physiology and behavior. The daily light-dark cycle likely entrains a circadian oscillator(s), and seasonal changes in daylength, measured by acute effects on the circadian oscillator, might be used as cues for the seasonality of reproductive activity. Rainfall and temperature might then act as permissive cues against a background of internal clock control, which is in turn sufficiently plastic to allow response to acute proximate cues within a window of seasonal opportunity.

Clocks are hot. The cellular and molecular mechanisms of clockworks themselves have been studied extensively in recent years, as have been neural, cellular, and biochemical mechanisms through which environmental cues affect internal oscillators (see almost any recent issue of *Science* or *Nature*). Many clock investigators are now returning to the previously popular study of clock-controlled outputs, including clock-controlled timing of overt behavior; these studies are largely based in the laboratory. However, despite the great number of past laboratory investigations of clock function, little is known about how clocks affect the behavior and physiology of animals in their natural environments (but see DeCoursey et al. 1997, 2000, for excellent studies of clock function in wild rodents living in natural habitats). Highly synchronous mass reproductive events in salamanders provide important opportunities to investigate the interacting roles of internal clocks and acute environmental cues in the control of seasonal and daily timing of complex behavior in amphibians. Furthermore, such studies in salamanders might serve as important models for understanding the regulation of timed behavior in vertebrate animals generally.

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ARTICLES

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Xenodermatid Snakes in America

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Xenodermatid snakes (Dowling 1988), often referred to as "Xenoderminae" or "Xenodermatinae" subfamilies of the century-old, polyphyletic "Colubridae" of Boulenger (1893–1896) [which is equivalent to the current taxon Caenophidia, minus the Viperidae] comprise an ancient clade of moisture-loving caenophidian snakes distantly related to *Acrochordus* and homalopsids (e.g., a member of the Acrochordoidea). Xenodermatid snakes are currently considered to be an Oriental taxon made up of four (Smith 1943:123; Underwood 1967:80–86) to six (McDowell 1987:35; Zaher 1999) genera. Bogert's (1964) summary of "xenodermine-like" characters seemed to confirm that "xenodermines" were an Oriental group with a few genera that were unrelated to other snakes (including those in South America) that possessed some elements of similar morphology.

Thus, most recent studies of American snakes have excluded any consideration of the Xenodermatidae. Instead, the unrecognized xenodermatid genera have been placed in the "Xenodontinae" (Hillis 1990; Myers 1986) or "Dipsadinae incertae sedis" (Zaher 1999), or merely in the Tribe Nothopsini without familial designation other than "colubrid" (Sheil and Grant 2001).

A clarification of the relationships of these snakes seems overdue. We are now engaged in a world-wide review of xenodermatid snakes (Dowling and Pinou, MS) and have discovered eight morphological characters (three of which [1, 2, 7] are unique) that serve to identify clearly the members of this family. To clarify the distinctive nature of this family and to avoid further phylogenetic and taxonomic confusion, we present a brief summary of these characters herewith.

Distinctive Morphological Characters of Xenodermatids

Our recent assessment of newly recognized distinctly xenodermatid morphological characters demonstrates that this ancient family is much larger than is currently acknowledged, comprising more than 20 genera that are distributed from Japan, China, and India to Australia, Africa, and South America (Table 1). We provide a list of the major distinguishing features of the family here because many have been commonly omitted from both past and current taxonomic descriptions—or are erroneously described.

A key morphological feature of xenodermatids is 1) the forward-facing position of the expanded and projecting nostrils, which has been rarely noted in descriptions (although often shown in figures; *v.* Fig. 1) since Boulenger's (1893:175) notice of it. [An excellent photograph showing the expanded nostril in *Nothopsis* is Fig. 3a in Köhler and Schmidt 2001.] Correlated with this, 2) the nasal scute (often described as paired, but see Sheil 1998) is depressed into the supralabial row, often reducing the height of the first supralabial scute so as to make it almost invisible (Pope 1935:182).

Another key feature is the 3) presence of juxtaposed (rather than imbricate) dorsal scales in at least the five middorsal rows. This often leaves extensive areas of bare skin between rows, making the small members of this family highly susceptible to desiccation. Pope (1929; repeated in 1935:186) stated of the xenodermatid *Achalinus:* "It is extremely delicate and dies more readily than almost any other snake. Soon after death it dries and hardens in a most unusual way." A specimen of *Synophis* from Ecuador (USNM 233063) examined by HGD shows this condition.

Another distinctive feature is 4) the shape of the pupil of the eye—which has been misreported in almost every description. Living xenodermatids have eyes with vertically elliptic pupils, thus providing a clearly visible distinction in living individuals from the round pupils of natricids, with which they are commonly confused. It is unfortunate that workers who describe pupil shapes from preserved specimens have not read (or not heeded) Walls's (1932) warning of long ago:

> "It is obvious that the form of the pupil should be accurately noted in descriptions. Contradictory statements abound, most of which could have been avoided if all mention of pupil shape had been omitted when no living material of the species was available to the describer. It does not seem to be fully appreciated that a vertical pupil becomes round in dim light; nocturnal reptiles caught and killed at night when their pupils are dilated, will often exhibit round pupils in the preserved condition. Even when pre-

served in the light, a vertical pupil sometimes distorts artificially into a round form."

Another feature, apparently noted only by Cope (1871) and Underwood (1967:80–86), is 5) the shape of the postorbital bone in xenodermatids. Underwood reported it as "T-shaped" but we believe that "inverted L-shaped" is a more accurate description. The anterior dorsal element of the postorbital bone extends to a variable degree over the orbit, as in *Acrochordus* and homalopsids.

Most of the descriptions of xenodermatids have emphasized the 6) presence of posterior hypapophyses in this family. We find that the "hypapophyses" in xenodermatids are not the distinctive, recurved processes of natricids nor the narrow, straight elements of viperids and some colubrids *(s.s.)*, but vary widely, typically occurring as a slightly expanded, narrow subcentral ridge in small snakes such as *Achalinus*, but are expanded into a large compressed keel in large snakes such as *Mehelya.*

Expansion and ornamentation of the neural spine and the pre-and/or post-zygapophyses have been used as distinguishing features of xenodermatids, but these are found in only a few xenodermatid genera and those outside the Oriental region were dismissed as convergent by Bogert (1964). The 7) expansion and overlapping of the zygapophyses to form lateral ridges on the body and the posterior hypapophyses seem to be the only consistent features of vertebral morphology for members of this family (*v.* Fritts and Smith 1969; Sheil 1998; Sheil and Grant 2001).

As suggested by the name (*xeno-*, strange; *dermis*, skin), most of the snakes in this family have some unusual elements of head scutellation. Although many xenodermatids have the nine dorsal head scutes typical of caenophidians, this number is often reduced through fusion or loss. Also, scales similar to the dorsal body scales might invade the spaces between the scutes (e.g., *Stolizkaia: v.* Rooij 1917:46*)* and in extreme cases (e.g., *Xenodermus: v.* Rooij 1917:45*)* only the internasal (or perhaps, prefrontal) scutes remain. Similarly, loreal, ocular, and/or temporal scutes of the head might be absent through fusion with adjacent scutes (Fig. 1). In some xenodermatids the labials have everted edges, and the ventral scutes of the head region might also be modified to form unusual patterns (*v.* Smith 1943:129).

The 8) morphology of the hemipenis might possess distinctive features but, like the pupil of the eye, is often misrepresented in taxonomic descriptions because of poor specimen preparation, thus casting some doubt on the degree of similarity among genera. As stated by Smith (1943:128) for *Achalinus,* the proximal region is short (ca. 4 subcaudals in length), but a pair of very slender lobes extends to subcaudal (SC) 24. The sulcus is forked and centrifugal and extends to the tips of the lobes. As described in this and other taxa, the ornamentation usually consists of spines near the fork, with the lobes variably ornamented with spines, papillae, flounces, and calyces—thus, quite unlike natricids, which have a purely spinose hemipenis with a centripetal sulcus, or dipsadids, which have capitate hemipenes (Pinou and Dowling 1994). Some of the Ethiopian genera show the *Achalinus* hemipenial pattern (*Mehelya*, AMNH 12053, paired lobes 21 SC; *Pseudaspis*, Fig. 63 in Broadly 1983). Whether the elongate lobes are characteristic of all members of the family is unknown; they are generally incompletely everted in preparations, with the extremely thin lobes mistaken for retractor muscles. The only other taxon showing this pattern to our knowledge is the King Cobra, *Ophiophagus hannah* (HGD-HISS 76152, paired lobes, 55 SC). As shown by the misshapen hemipenial bodies and vast differences shown between species of the same genus, we are confident (*v.* Dowling 2002a) that Zaher's (1999) illustrations of the American xenodermatids *Nothopsis* (Fig. 88, upper; *Synophis* (Figs. 88, lower; 89, upper) and *Xenopholis* (Fig. 95) are photographs of incompletely-everted organs.

The only molecular data on xenodermatids are contained in Cadle's (1994) immunological survey of African snakes, in which he compares antiserum from *Mehelya* with serum of 25 African "colubrids," which include 16 of Bogert's (1940) 18 recognized "Groups." [The two groups missing are both Colubridae *(s.s.)*, but he included a total of seven colubrids *(s.s.)*.] In addition, he included *Leioheterodon* from Madagascar. He found none closer than 70 immunological distances (AID). The usual conversion (1.7 AID = 1 million years) suggests a minimum divergence time of 41 million years ago (mya) (= Upper Eocene).

American Xenodermatids

The recognition of xenodermatids in Tropical America has been delayed because of past emphasis on features of vertebral morphology and head scutellation in current taxonomic descriptions, and the neglect of those eight features (listed above) that are diagnostic. Bogert's (1964) highly restrictive review of American xenodermatids, and his discussion in that paper of the vertebral morphology of the dipsadid, *Ninia,* have contributed to this lack of recognition. By using the characters noted above, we recognize five Central and South American genera as members of the Xenodermatidae. These are *Diaphorolepis* (Jan 1863), *Emmochliophis* (Fritts and Smith 1969), *Nothopsis* (Cope 1871), *Synophis* (Peracca 1896), and *Xenopholis (*Peters 1869*)*.

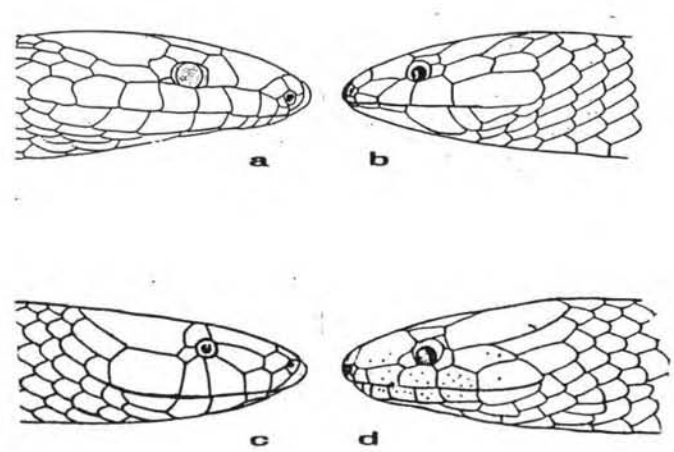

FIG. 1. Lateral views of the head scutellation in four similar genera of xenodermatid snakes. (a) *Emmochliophis fugleri*; (Ecuador); (b) *Xylophis perroteti* (India); (c) *Agrophis sarasinorum* (Celebes); (d) *Aspidura trachyprocta (Ceylon)*. Note the frontal position of the nostrils correlated with the reduction in height of the first supralabial. Note also the various reductions or absences of the loreal, ocular, and temporal scutes. The round pupils of the eyes are drawn from observations of preserved specimens; the pupils of living xenodermatids are vertically elliptic. [Figures are from: (a) Fritts and Smith 1969; (b) Smith 1943; (c) de Rooij 1917; (d) Smith 1943.]

The status of *Nothopsis* as a xenodermatid has been in doubt (e.g., Underwood 1967:85–86). Recently, however, one of us (HGD) had the opportunity to examine four specimens of this genus, including the type specimen of *N. torresi* Taylor (1951) [= *N. rugosus* Cope, *f.* Dunn and Dowling 1957], at the University of Kansas Museum of Natural History. All have the expanded and forward-facing nostrils and juxtaposed dorsal scales along the upper portion of the body that are typical of xenodermatids. Unfortunately, the type specimen, which is a male (KU 25719), is the only adult (BL 278; TL 117). The other three are very small (BL 128–145) so no skulls can be prepared from the KU specimens.

Several genera *(Ninia, Chersodromus,* and *Tretanorhinus)* that have posterior hypapophyses are found in lower Central America, thus overlapping the geographic range and possessing one of the vertebral characters of the xenodermatid snakes (expanded neural spines), as well as having some features of scutellation and color that are similar. However, they are clearly dipsadids on the basis of their short, capitate hemipenes (Pinou and Dowling 1994; pers. observ.) and their immunological similarity to *Dipsas* and other dipsadid genera (Cadle 1984). Bogert (1964) also investigated *Ninia* as a possible xenodermatid, but ultimately decided that neither it nor any other American snake belonged to that taxon.

The reviews by Dunn and Dowling (1957) and by Bogert (1964) utilized only the morphological characters recognized at that time, and the hemipenis drawing of *Nothopsis* (Plate I in the former paper) is uninformative except to show that there are basal spines and the sulcus is forked. The description of the postorbital bone of the skull provided by C. M. Bogert in both papers is so different from that described by Cope (1871), who found elements extending across the orbit, that it brings into question the completeness of the skull examined by Bogert. We encourage workers at institutions with specimens of *Nothopsis* available to investigate this important morphological element, as well as the other distinctive features of xenodermatids.

Because of the incomplete surface coverage of juxtaposed dorsal scales, all xenodermatids need moist conditions for life. Most of the genera are semifossorial dwellers of moist rainforest or cloud forest regions. As might be expected of an ancient group, however, they vary from arboreal *(Stoliczkia)* to surface-terrestrial *(Mehelya)* and stream-dwellers *(Achalinus),* and range in elevation from near sea level to more than 1500 m. Several of both the Asian and the American species have been found in high elevation cloud forests. Most of the small species feed on earthworms, but salamanders, frogs, and lizards are preyed on by some. A few of the larger Old World species have been found to feed on other snakes.

Presumably, the American representatives of this family came into North America from Asia over the Bering Strait during the Middle to Late Miocene 16–10 mya (Dowling 2002b; Holman 2000), during a period when the sea level was low and temperatures were high (McKenna 1983). Like other tropically adapted species, they were forced southward into Central America by the cooling climate of the Pliocene where they remained, along with many similarly-adapted crotalids, elapids, and colubrids. Thus, they did not enter South America until the closure of the Panama gap in the Pliocene (ca. 3 mya).

The restricted habitats and nocturnal habits of xenodermatids have made them a little known group in the Americas. Few species have been described from more than two individuals, and most of the descriptions are incomplete or give erroneous information. The list of characters given above might aid in the recognition of additional taxa in this region. The species that inhabit the highly threatened cloud forests deserve special attention.

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A Survey of New York State Pet Stores to Investigate Trade in Native Herpetofauna

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Although numerous factors have been implicated as contributing to global herpetological declines (e.g., habitat loss or degradation [Cooke 1972; Lannoo et al. 1994], pollution [Beebee et al. 1990], ultraviolet radiation [Blaustein et al. 1994]), commercial exploitation is gaining recognition as an issue for many species (Galligan and Dunson 1979; Jennings and Hayes 1985). Collection of animals for the pet trade is suspected to have contributed to some population declines (e.g., McCollough 1997) although few studies provide direct evidence of this (but see Klemens and Moll 1995; Macmillan 1987).

In New York State, 29 of 75 endemic species of amphibians and reptiles have state or federal status of concern (i.e., classified as endangered, threatened, special concern, or protected game; Title 6 of the New York Code of Rules and Regulations, Part 182). Factors believed to have contributed to declines in New York herpetofauna include habitat loss and degradation, unregulated collection, and illegal collection (Breisch 1997). Little is known about the relationship between the pet trade in New York and wild herpetofaunal populations. Of the 29 species of concern, 14 have endangered or threatened status and two are protected game species; these 16 species cannot be collected or possessed at any time without a scientific collection license (Levell 1997). Thus, collection is legally restricted for over half of the concern species, an action that should remove these taxa from the New York State pet trade. The remaining 13 species of special concern can be collected or sold without limit.

To investigate the relationship between the pet trade and wild populations of amphibians and reptiles in New York, I conducted a survey of pet stores and their suppliers. The primary objectives were to determine if native New York species, especially concern species, are sold in stores and if the animals are collected from the wild to supply the New York pet trade. My survey consisted of informal interviews with employees of pet store and their suppliers, from which I expected to collect general information to approximate the extent and potential impact of trade.

In April 1998, I obtained a list of 711 pet stores in New York State from GTE Superpages (http://yp4.gte.net). I used a random number table to select 100 stores, and then contacted each store to ask whether they sold amphibians or reptiles. Employees at 45 stores responded that they sold these animals; employees at 34 stores said they did not. Telephones were not answered or had been disconnected at the remaining 21 stores.

In June and July 1998, I visited 44 of the pet stores that reportedly sold amphibians and reptiles (I was unable to visit the 45th store because of its location). At each pet store, I showed an employee a list of 74 herpetofaunal species found in New York. I asked: if the store sold any of those animals; how many individuals per species were sold per year; what was the price per individual per species; and from where the animals came. I inspected each store for animals from my list and for signs advertising those animals for sale.

Animal supply companies were indicated as sources for many species. In March 1999, I attempted to contact 10 suppliers indicated as sources by seven pet stores. I was unable to find a phone number or address for three suppliers, but I was able to contact the remaining seven supply companies. I asked each supply company about the species sold in pet stores using that supplier; in a few cases, I asked the supplier about additional animals. In total, I asked suppliers about 24 species, eight of which were concern species. I asked each supplier: if they sold those species; whether the animals were captive-bred or wild-caught; and, if wild-caught, from where the animals came.

Employees at 37 stores responded to my survey and indicated animals they sold. At five stores, I received no help but observed animals on my list, or saw signs advertising those animals for sale. Of 74 amphibian and reptiles species found in New York, 45 (61%) were reported as sold in at least one pet store (Table 1). Pet stores sold 15 of 29 (52%) concern species. This included 4 of 16 (25%) protected species, which require a license for possession: tiger salamander (*Ambystoma tigrinum*), eastern box turtle (*Terrapene carolina carolina*), mud turtle (*Kinosternon subrubrum subrubrum*), and wood turtle (*Clemmys insculpta*). The tiger salamanders, eastern box turtles, and mud turtles sold might have represented species or subspecies not found in the wild in New York; however, it is illegal in New York to sell any subspecies of the tiger salamander and any North American box turtle.

The reported number of individuals sold per species per store per year ranged from 1 to 1000 (mean = 60, SD = 136). With one exception, the average number of individuals of concern species sold per store was low (an average of less than five individuals

TABLE 1. New York State amphibian and reptile species sold in New York pet stores. — indicates that pet stores or suppliers did not provide that information.

Species	Status	Stores selling/ stores sampled	Average no. sold per year	Average price	Suppliers selling/ suppliers sampled
Dusky Salamander, *Desmognathus* spp.		1/37	—	—	—
Four-toed Salamander, *Hemidactylium scutatum*		1/37	12 (1)[1]	$10 (1)[1]	—
Hellbender, *Cryptobranchus a. alleganiensis*	special concern	1/37	—	—	—
Jefferson Salamander, *Ambystoma jeffersonianum*	special concern	1/37	2 (1)	—	0/1
Longtail Salamander, *Eurycea l. longicauda*	special concern[2]	1/37	12 (1)	$10 (1)	—
Marbled Salamander, *Ambystoma opacum*	special concern[2]	4/37	9 (2,4)	$12 (3,3)	0/1
Mudpuppy, *Necturus maculosus*		6/37	45 (4,49)	$10 (4,5)	0/4
Red Salamander, *Pseudotriton r. ruber*		2/37	75 (2,35)	$3 (2,1)	0/2
Redback Salamander, *Plethodon cinereus*		1/37	100 (1)	$4 (1)	—
Red-spotted Newt, *Notophthalmus v. viridescens*		6/37	43 (5,39)	$4 (4,1)	1/3
Spotted Salamander, *Ambystoma maculatum*	special concern	4/37	10 (3,6)	$7 (4,4)	0/1
Tiger Salamander, *Ambystoma tigrinum*	endangered	3/37	7 (2,7)	$24 (3,8)	0/2
Two-lined Salamander, *Eurycea bislineata*		1/37	10 (1)	$13 (1)	—
American Toad, *Bufo americanus*		3/37	160 (2,198)	$2 (2,1)	—
Bullfrog, *Rana catesbeiana*		4/37	162 (2,195)	$8 (1)	1/2
Bullfrog tadpoles		6/37	55 (3,39)	$2 (5,1)	—
Eastern Spadefoot, *Scaphiopus holbrookii*	special concern[2]	3/37	10 (2,0)	$20 (1)	—
Gray Treefrog, *Hyla versicolor*		4/37	40 (1)	$8 (2,1)	1/1
Green Frog, *Rana clamitans melanota*		1/37	—	—	—
Leopard Frog		2/37	150 (1)	—	2/2
Northern Leo. Frog, *Rana pipiens*		4/37	23 (4,8)	$4 (4,0)	0/3
Southern Leo. Frog, *Rana sphenocephala utricularia*	special concern	1/37	500 (1)	$6 (1)	1/1
Leopard Frog tadpoles		1/37	—	—	—
Spring Peeper, *Pseudacris c. crucifer*		5/37	17 (3,12)	$6 (4,2)	1/1
Wood Frog, *Rana sylvatica*		1/37	100 (1)	$12 (1)	—
Diamondback Terrapin, *Malaclemys t. terrapin*	special concern	1/37	1 (1)	$50 (1)	—
Eastern Box Turtle, *Terrapene c. carolina*	protected game/special concern	1/37	10 (1)	—	—
Map Turtle, *Graptemys geographica*		12/37	12 (8,11)	$14 (8,6)	3/4
Mud Turtle, *Kinosternon s. subrubrum*	threatened/endangered[2]	7/37	10 (5,10)	$19 (6,11)	0/1
Painted Turtle, *Chrysemys picta*		25/38[3]	74 (15,155)	$13 (19,3)	0/4
Red-eared Slider, *Trachemys scripta elegans*	non-native	39/41[3]	90 (25,202)	$12 (33,3)	5/5
Snapping Turtle, *Chelydra serpentina*		3/37	—	—	—
Spiny Softshell, *Apalone s. spinifera*	special concern[2]	7/38[3]	4 (3,2)	$19 (5,7)	2/2
Stinkpot, *Sternotherus odoratus*		5/37	10 (3,6)	$11 (1)	1/1
Wood Turtle, *Clemmys insculpta*	protected game/special concern	3/37	1 (1)	$25 (2,7)	—
Five-lined Skink, *Eumeces fasciatus*		6/37	10 (3,6)	$8 (2,2)	—
Northern Fence Lizard, *Sceloporus undulatus hyacinthinus*	threatened[2]	2/37	10 (1)	$10 (1)	—
Ruin Lizard, *Podarcis sicula*	non-native	1/37	10 (1)	$18 (1)	0/1
Brown Snake, *Storeria d. dekayi*		1/37	—	—	—

TABLE 1. Continued.

Species	Status	Stores selling/ stores sampled	Average no. sold per year	Average price	Suppliers selling/ suppliers sampled
Common Garter Snake, *Thamnophis sirtalis*		12/38[3]	123 (6,236)	$11 (8,2)	1/4
Eastern Hognose Snake, *Heterodon platirhinos*	special concern	5/37	2 (3,0)	$83 (3,59)	0/1
Eastern Ribbon Snake, *Thamnophis sauritus*		4/37	305 (2,417)	$12 (2,2)	—
Milk Snake, *Lampropeltis t. triangulum*		7/37	28 (4,48)	$50 (4,36)	0/1
Northern Water Snake, *Nerodia s. sipedon*		3/37	15 (2,7)	$22 (2,11)	0/2
Racer, *Coluber c. constrictor*		1/37	—	—	—
Rat Snake, *Elaphe o. obsoleta*		9/37	7 (4,6)	$42 (4,36)	1/2
Ringneck Snake, *Diadophis punctatus edwardsii*		1/37	—	—	—
Smooth Green Snake, *Liochlorophis vernalis*		3/37	—	—	—

[1] (No. stores providing information, standard deviation)
[2] this is a new status, which the species did not have at the time of the survey
[3] the store sample size is raised when I saw the animal, yet the store did not report selling it

sold per year per store was reported for five species and an average of between 7 and 12 individuals was reported for eight species; Table 1). The exception was the southern leopard frog (*Rana sphenocephala utricularia*), for which one store reported selling 500 individuals per year. The store reporting this exception was a store that reported selling animals in much higher numbers than other stores. Whereas the highest number of animals any other store reported selling was 200 individuals of a species per year, this store reported selling 300 individuals for two species, 500 for one species, 600 for three species, and 1000 for one species (red-eared slider, *Trachemys scripta elegans*). Results on the numbers of individual animals sold per year might be skewed because of this store.

Prices (in US$) of animals also varied among stores and taxa (mean = $15, SD = $17; Table 1). Average prices per animal were: salamander, $10 (N = 24 prices provided by nine pet stores for 10 species); frog, $5 (N = 21 prices, 13 stores, eight species); turtle $14 (N = 75 prices, 36 stores, nine species); lizard $11 (N = 4 prices, three stores, three species); and snake, $34 (N = 23 prices, 10 stores, six species). The most expensive salamander (tiger salamander, $24) was an endangered species, while the most expensive frog (eastern spadefoot, *Scaphiopus holbrookii*, $20), turtle (diamondback terrapin, *Malaclemys terrapin terrapin*, $50) and snake (eastern hognose snake, *Heterodon platirhinos*, $83) were species of special concern. The average price for every concern species, except for the spotted salamander (*Ambystoma maculatum*) and the northern fence lizard (*Sceloporus undulates hyacinthinus*) was higher than the average price for non-concern species in the corresponding order (Table 1).

The higher prices for concern species might reflect scarcity, a premium accorded to rare animals, or a premium associated with illegal sales of animals. Given the willingness of most store employees to answer questions and the evident confusion over New York State conservation regulations (in five pet stores, an employee told me it was illegal to sell any native species), the latter seems an unlikely factor.

Of the 23 pet stores whose employees provided information on the source of their animals, 11 used in-state suppliers and 12 used out-of-state suppliers. One store reported having bought animals at reptile expositions. Six stores received some animals from private individuals, including children. Additionally, one store reported that employees collected some animals (spring peepers [*Pseudacris crucifer crucifer*], and northern leopard frogs, [*Rana pipiens*]) from the wild in their area.

Of seven suppliers contacted, I received useful information from five, three of which supply animals to 20–50 pet stores in New York State. Two suppliers were based in New York, two in New Jersey, and one in Florida. In all, suppliers reported selling 12 of the 24 species about which I asked. Two of the 12 were concern species (southern leopard frog and spiny softshell, *Apalone spinifera spinifera*).

Of the 12 species sold by suppliers, five amphibians and four reptiles were described as primarily wild-caught animals (Table 1). Suppliers reported three reptile species and no amphibian species as captive-bred. Red-eared sliders and spiny softshells were described as both wild-caught and captive-bred. Suppliers did not report selling eastern hognose snakes or eastern milk snakes (*Lampropeltis triangulum triangulum*), but said that those species

were primarily captive-bred.

Specific locations given by the suppliers for some of the wild-caught animals were: Arkansas (map turtles and red-eared sliders), Florida (bullfrogs, *Rana catesbeiana*), Louisiana (gray treefrogs, *Hyla versicolor*), and Minnesota (common garter snakes, *Thamnophis sirtalis*). No supplier reported selling animals taken from the wild in New York.

Information on the source of animals can be compared with information from Enge (1992), who discusses the source of amphibians and reptiles sold in Florida in one year in the early 1990s. Florida has greater herpetofaunal diversity than New York, but comparisons might be useful. In all, Enge found that 2 of 16 frog species and none of the 12 salamander or newt species were bred in captivity. This is similar to what suppliers told me—suppliers did not report any of 12 amphibian species as captive-bred. Regarding reptiles, at least one individual from nine turtle species and from nine snake species sold in Florida was captive-bred (out of 13 turtle species and 32 snake species). Similarly, suppliers told me two of three turtle species could be captive-bred, although all three of these species also were reported as wild-caught. Three of five snake species were described as captive-bred. Of the animals from Florida sold into the pet trade in one year, 61% were reported as collected from the wild; of species I discussed with suppliers, 75% were described as primarily collected from the wild. Both Enge's results and mine suggest that many amphibians and reptiles supplied to pet stores are wild-caught, although reptiles are more likely to be captive-bred than amphibians.

The two animals sold in the most stores were red-eared sliders (sold in 39 of 41 stores) and painted turtles (*Chrysemys picta*) (sold in 25 of 38 stores). Of the remaining species, none was sold in more than 12 stores each. Red-eared sliders are not native to New York and many of the painted turtles sold might have been western painted turtles (*C. picta bellii*) rather than the two subspecies native to New York, *Chrysemys p. picta* and *Chrysemys p. marginata* (in two pet stores, I saw signs advertising western painted turtles). This suggests that the demand in the New York pet trade for native species, as measured by sales volume alone, is smaller than that for non-native species.

There are several limitations to these results. The interviews in stores were conducted with store employees, who might or might not have had clear or reliable knowledge of what was sold or in what quantities. Employees might have reported selling animals they did not actually sell. For example, employees often confused firebelly newts (*Cynops* spp.), which are not found in New York, with red-spotted newts (*Notophthalmus viridescens viridescens*). As already noted, in some cases, animals reported as sold in pet stores might have belonged to species or subspecies not found in the wild in New York. Additionally, employees obviously gave estimations—they provided numbers during the interview without looking in records to find exact information. For the number of animals sold per year, people often gave estimates in multiples of 5s or 6s. Information I received from suppliers was anecdotal; they only told me whether animals were mainly captive-bred or wild-caught, without giving me any numbers.

In summary, 4 of 16 protected New York State species were reported as sold in pet stores. At the time of my survey, nine species of special concern could legally be collected or sold in New York, and at least six of those were sold in pet stores. Of 12 species sold by suppliers, nine were described as primarily wild-caught animals. No supplier reported selling animals taken from the wild in New York. However, one store reported selling frogs collected from the wild in New York. Employees from at least five stores relayed incorrect information about regulations for native herpetofaunal species.

These results highlight several possible conservation issues resulting from the New York pet trade. Despite the higher demand for non-native species, the fact that native herpetofaunal species were reported as sold indicates there is a market for those species. Many of the animals sold by suppliers to pet stores came from the wild and at least a small number sold in pet stores came from the wild in New York. If customers buy animals of concern species, an incentive to collect those animals from the wild might develop. For each concern species, the state or federal government has documented a concern or risk regarding that species' viability; collection of wild specimens of those species might increase the risk for that species.

In consideration of these issues, I have three recommendations. Firstly, further investigation into New York's pet trade would provide more complete and quantitative information. While this study has provided general information regarding trends occurring in the New York pet trade, the limitations of the study prevented an accurate quantitative assessment of the pet trade. This study suggests a possibility that the pet trade might threaten some species and further studies to investigate that possibility are justified. A clearer understanding of the extent of the commercial collection and sale of wild amphibians and reptiles could aid in determining the extent of the threats posed by that commercial use.

Secondly, a review is warranted of the present status of concern species, particularly those currently designated as special concern, along with a review of the current regulations regarding the commercial use of those species. The fact that pet stores sold concern species indicates a possible need for stronger regulations. By comparing a species' current status with information on whether species are sold in pet stores, researchers might determine that regulations restricting commercial collection and sale of some concern species are justified.

Thirdly, an educational program could be developed for the various stakeholders in the pet trade (store owners, employees, suppliers, and customers) to provide correct information on the regulations for commercial use of native herpetofauna and the reasons for those regulations. If the people who could benefit from a sustainable, nonthreatening use of amphibians and reptiles understand how they could benefit from protecting those species, they might become strong supporters for that protection.

These recommendations suggest ways of further understanding the pet trade, the extent of its threat to native herpetofaunal species, and how to lessen the threat. Given the extent of other threats, preventing overcollection for the pet trade might not ensure the survival of amphibian and reptile species, but it might provide populations with an increased chance of survival until problems such as habitat loss can be addressed effectively.

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Description of the Tadpole of *Megaelosia goeldii* (Leptodactylidae, Hylodinae) with Natural History Notes

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The genus *Megaelosia* (Anura, Leptodactylidae) Miranda-Ribeiro, 1923 includes five species of frogs which are little studied because of their scarcity in museum collections and the difficulty of collecting specimens in the field; diurnal adults are wary and plunge into the torrential waters when disturbed (Giaretta et al. 1993).

The tadpoles of this genus have characters in common with the genera *Hylodes* and *Crossodactylus* in the subfamily Hylodinae, such as lateral line well-defined, sinistral spiracle, dextral vent tube, oral disc marginate with a broad anterior gap in the marginal papillae, and tooth row formula 2(2)/3(1). They all live in fast-flowing streams. *Megaelosia* tadpoles are much larger than those of *Hylodes* and *Crossodactylus* and have distinct cranial morphology.

The genus *Megaelosia* is distributed along the Atlantic Rain Forest of southeastern Brazil, especially in the states of São Paulo and Rio de Janeiro. The only known locality of sympatry for two species of this genus is Serra da Bocaina, São Paulo, Brazil, where *M. goeldii* and *M. bocainensis* are found. At every other locality only one species has been recorded, including Teresópolis where the specimens reported herein were collected.

Megaelosia goeldii was described by Baumann (1912), who did not report any measurements for the species. The adult was redescribed by Miranda-Ribeiro (1923, 1926) under the name *M. bufonia* (= *Elosia bufonium*), but the tadpole was only figured in dorsal and lateral views with no further data. Lutz (1930) made a brief description of the tadpole from specimens collected in streams at Petrópolis and Teresópolis, Rio de Janeiro, Brazil and illustrated the dorsal and lateral views but not the mouthparts. Lutz also described the color pattern that he used to compare these tadpoles with *Hylodes* larvae. The later description by Heyer et al. (1990) of a tadpole from Boracéia, Salesópolis, São Paulo, Brazil as *M. goeldii* turned out to be *M. massarti* (Giaretta et al. 1993).

Herein, I describe the tadpole of *M. goeldii* from the type locality of the species, Rio Beija Flor, Teresópolis (22°24'S, 42°69'W), Rio de Janeiro, southeastern Brazil, elevation 910 m.

Material and Methods.—Five tadpoles (Gosner 1960, stages 27, 28, 30, 31, and 35) of *Megaelosia goeldii* were collected in February 2000 and deposited as MZUSP 95879. I compared these topotypic specimens with tadpoles described in the literature (Giaretta et al. 1993; Heyer et al. 1990; Lutz 1930) to confirm their identification. Also *M. goeldii* is the only species of this genus known to occur at the site of collection. The labial tooth formula follows Altig (1970), and all measurements are in millimeters.

The specimen in stage 35 has the following measurements: total length 117.2; body length 48.2; body width 31.8; body height 21.1; eye diameter 3.5, eye-nostril distance 6.4; internostril distance 9.8; and maximal caudal height 28.3. Body ovoid in lateral and dorsal

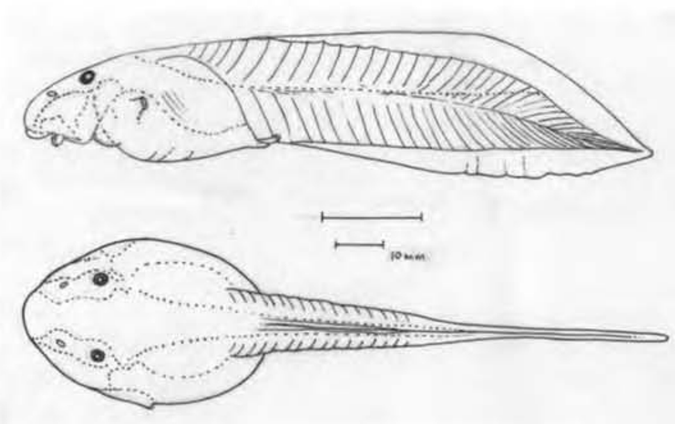

FIG. 1. Lateral and dorsal views of the tadpole of *Megaelosia goeldii* (scale 10 mm).

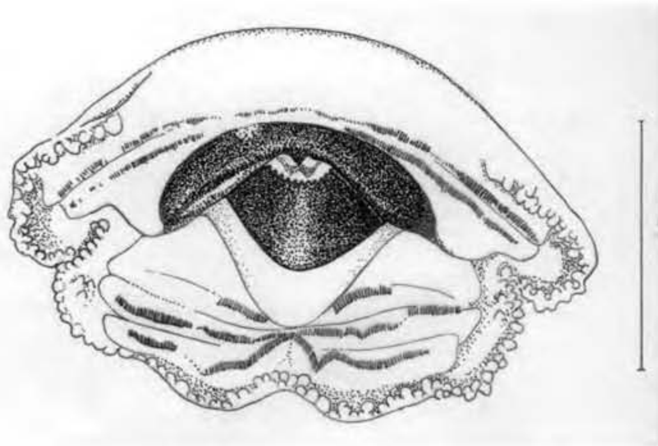

FIG. 2. Mouth parts of the tadpole of *Megaelosia goeldii* (scale 5 mm).

views. Eyes small, dorsolateral, with interorbital distance (from medial eye edge) about four times the eye diameter. Snout rounded, nostrils directed anterolaterally about midway between eyes and tip of snout. Internostril distance (from medial nostril edge) slightly less than interorbital distance. Spiracle short, sinistral with its opening at midbody. Cloacal tube short and broad, opening dextrally. Tail slightly higher than body height and dorsal fin slightly higher than the ventral fin. Both fins thicker proximally. Tip of tail rounded. Oral disc directed anteroventrally with median region of upper labium lacking papillae and lower labium bordered by one row of papillae. One or two rows of marginal papillae near the corners of the disc. Labial tooth row formula 2(2)/(3(1); all rows of teeth of equal length. Beak well developed and serrated (Fig. 2). Lateral line system with 14 lateral branches, 7 on each side of the body and tail (Fig. 1): angular, anterior oral, infraorbital, longitudinal oral, posterior infraorbital, supraorbital, ventral. The lateral line system is similar to that figured in Miranda-Ribeiro (1926, as *M. bufonia*).

In life, dorsum brown with irregular dark spots, ventral surface pale, terminal part of tail lighter brown with dark, clustered blotches. Preserved specimens have a dark brown dorsum and a pale ventral surface; fins are pale brown with small dark spots (0.2–0.5 mm). Tail musculature light brown with clustered blotches. Figs. 1 and 2 depict the largest specimen obtained.

Natural History.—Tadpoles and adults of *Megaelosia goeldii* were observed from the type locality along the Rio Beija-Flor, Teresópolis, Rio de Janeiro, a tributary of Rio Paquequer. Although both rivers were searched inside the borders of the Parque Nacional da Serra dos Órgãos, I observed specimens (adults, juveniles, and tadpoles) only along a 300 m section of the river outside the borders of the park. Over three days, from 0900 to 2100 h, the density of adults varied from 8 to 12 specimens sighted on large emergent rocks in the Rio Beija-Flor. At Rio Paquequer I saw one dead adult, but local inhabitants claim that these frogs are observed daily. The adults are wary and jump into the water when disturbed and were observed only during the day; at night they hide under rocks or might be found on low vegetation on the stream banks (W. R. Heyer, pers. comm.).

Both banks of the Beija-Flor are bordered by masonry houses and walled with bricks lacking vegetation at a distance of ca. 200 m beyond the park borders. At Rio Paquequer, the left bank is walled and the right bank is protected by the park border. In some places people have built dikes in the riverbed to make swimming pools.

The greatest density of tadpoles occurred during the night in these swimming pools, seemingly having emerged from under the rocks to feed. During the day until sunset few tadpoles were observed in the same places the adults were sighted.

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The Identification of New Specimens of *Vipera* from Trabzon, Turkey with Affinities to *Vipera barani* and *V. pontica*

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The taxonomic identification and distribution of the poorly known *Vipera barani* and *V. pontica* have been problematic because of the limited number of specimens available for study (Baran et al. 2001). *Vipera barani* Böhme and Joger, 1983 was described from a single melanistic female from Sapanca, north of Adapazarı at the southwest coast of the Black Sea. Its distribution was expanded to the southeast coast of the Black Sea with the reports of four specimens from Rize and Giresun provinces (Frazen and Heckes 2000) and two additional specimens from the high mountain slopes of Çaykara (1950 m) in Trabzon province (Baran et al. 2001). No specimens have been collected from regions between these areas, but Baran et al. (2001) speculate that its

distribution might extend along the intervening mountains bordering the Black Sea.

The two specimens of *Vipera barani* from Çaykara in Trabzon province showed intermediacy in their morphology and color pattern when compared to *V. pontica*, leading Baran et al. (2001) to question the validity of the latter species. *Vipera pontica* Billing, Nilson, and Sattler, 1990 was described from two specimens from the Coruh Valley in Artvin province and diagnosed from *V. barani* by having an upturned snout and more loreals. Additional specimens of *V. pontica* were reported from Çamlıhemşin in Rize province, extending its range to the west to overlap that of *V. barani* (Baran et al. 1997, 2001).

A total of seven new specimens, from four lowland Black Sea coast locations in Trabzon province, with affinities to *Vipera barani* and *V. pontica*, are reported here. These specimens are compared to *V. barani* and *V. pontica* to determine their identity and to shed light on the problems associated with the diagnosis of these species. The new material was collected from April to September in both 1999 and 2000 and deposited at Karadeniz Technical University (ZKTU). A male (ZKTU 7/1999-1) was collected from Ballıca, ca. 63 km E of Trabzon. At Sugeldi, another male (ZKTU 7/1999-2) was collected near the Baltacı Stream area, 5 km E of Ballıca. Four specimens (two males and two females [ZKTU 7/1999-3-6]) were collected from Çamlık, 68 km W of Trabzon. Of these, one female was large (> 600 mm total length) and the remaining were small (< 200 mm total length). The last specimen collected was a female (ZKTU 8/2000-1) from Çınarlı, 1 km E of Trabzon. The Ballıca, Çınarlı, and Sugeldi specimens were captured near tea plants (*Camellia sirennis)*, while the Çamlık specimens were captured on the short grassland with oak (*Quercus* sp.*)*, alder (*Alnus* sp.), and hazelnut (*Corylus* sp.) trees.

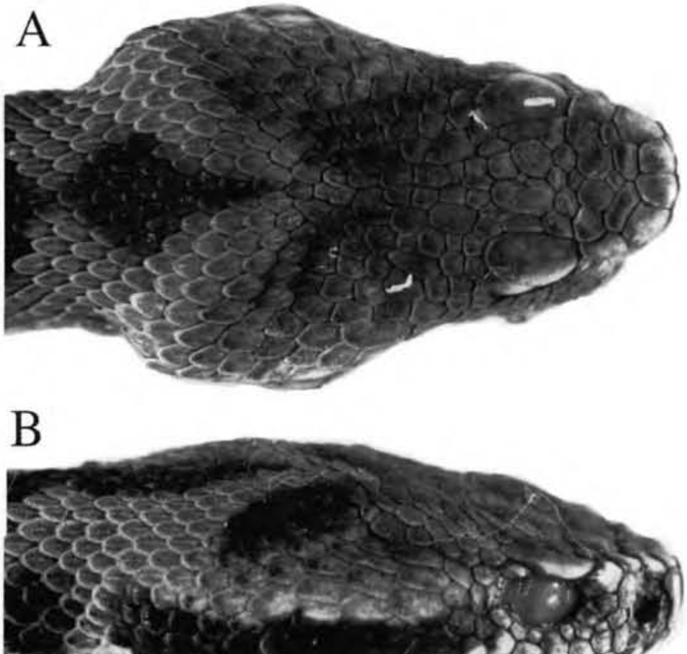

FIG. 1A. Dorsal view of head of the male from Ballıca (ZKTU 7/1999-1). B. Lateral view of same specimen.

FIG. 2. Dorsal view of a normally colored male from Ballıca (ZKTU 7/1999-1).

This new material was compared to five specimens of *Vipera barani* and two specimens of *V. pontica*. Fourteen characters were analyzed, including those traditionally used to separate *V. barani* from *V. pontica* (Table 1). Pattern and coloration of the newly collected specimens (1 melanistic, 6 typically colored) were examined in life subsequent to preservation. Additional data were taken from the literature and another nine specimens collected from Çamlıhemşin, Giresun, and Çaykara that have been previously reported (see Table 1; Baran et al. 2001 and references therein).

The ventral scale number of the specimens from the lowland Black Sea localities (Ballıca, Sugeldi, Çınarlı, and Çamlık) ranges from 140 to 149. With the exception of the two female specimens from Çamlık (both with 149 ventrals), ventral scale numbers fall within the range of specimens identified as *Vipera barani* (142–145) and *V. pontica* (142–147). The number of subcaudals is higher in all males (33–38) compared to females (29–31) and corresponds to the increased tail length to total length in males (0.15–0.17) compared to females (0.11–0.13). Gender specific differences of the new specimens fall within the range of previously known specimens (also see Baran et al. 2001: Table 1).

Two apical scales are present over the rostral scale in all

TABLE 1. External morphology of the Trabzon viper specimens collected from lowland Black Sea coast localities (Ballıca, Sugeldi, Çınarlı, and Çamlık) and related taxa (*Vipera barani* from Adapazarı and Silifke, *V. pontica* from Artvin and the specimens from Çamlıhemflin, Giresun, and Çaykara). Asterisk (*) denotes characters not visible because of damaged specimen.

Characters	Ballıca 1 ♂	Sugeldi 1 ♂	Çamlık 2 ♀	Çamlık 2 ♂	Çınarlı 1 ♀	*V. barani* (N = 5)	*V. pontica* (N = 2)	Çamlıhemflin (N = 5)	Çaykara (N = 2)	Giresun (N = 2)
Tail length (mm)	82	83	32–69	38–46	78	56–69	30 (31)	—	52–57	—
Total length (mm)	518	543	186–627	172–197	634	550	254–277	—	444–590	—
Ventral	140	141	149	140–145	146	142–145	142–147	140–145	142	142–146
Subcaudal	37	33	30/31	37/38	29	26–37	32/36	30–38	28/29	30–36
Mid-body scales	21	21	21	21	21	21–23	21	21–23	21	21
Apicals	2	2	2	2	2	2	2	2	1(2)	—
Canthals	2/2	2/2	2/2	2/2	2/2	2/2	1–1.5	2/2	2/2	2/2
Rostral index	1.18	1.05	1.05–1.07	1.08–1.16	1.10	—	1.05–1.40	—	1.12–1.24	—
Loreals	5/5	5–*	4–5	4–5	4/5	3–6	6–7	4–11	4–5	4–5
Supralabials	9/9	9–*	8–9	9/9	9/8	9–10	9–9	8–9	8–9	8–10
Sublabials	11/11	11/11	10–11	10–11	10/11	10–12	11–12	10–13	9–11	11–12
Circumoculars	13/12	10/10	9–10	8–11	11	10–14	9–10	10–12	8–9	9–11
Crown scales	22	25	22–25	24–33	26	23–40	34	25–33	18–24	14–21
Zig-zag bands	67	*	62–65	64–67	57	—	51–58	—	48(49)	—

specimens (Fig. 1a), with no remarkable difference between their size (Baran et al. 2001). Similarly, the numbers of mid-body scales, canthals, supralabials, sublabials, and circumoculars show little variance or a high degree of overlap between the specimens examined (Table 1). The number of crown scales (intercanthals + intersupraoculars) ranges from 22 to 36 for lowland Black Sea specimens. Specimens of *Vipera pontica* (34), *V. barani* (23–40), Çaykara (18–24), and Çamlıhemşin (25–33) have overlapping crown scale counts, while the two specimens from Giresun province (14–21) have a lower range (but, overlap Çaykara).

The number of loreal scales on each side of the head (Fig. 1b) ranges between 4 and 5 for the lowland Black Sea specimens, which overlap the ranges of *Vipera barani* (3–6), Çamlıhemşin (4–11), Çaykara (4–5), and Giresum (4–5). *Vipera pontica* have a slightly higher range (6–7), but overlaps *V. barani* and specimens from Çamlıhemşin.

The single melanistic male from Sugeldi shows similarities with the melanistic female specimen collected from Çaykara (Baran et al. 2001: Fig. 2). Both have whitish blotches on upper and lower labials and whitish spots of different sizes on the ventral surface of the head. The melanistic male has whitish supralabials edged in black compared to a yellowish-white of the female.

The six typically patterned specimens have a greyish brown ground color with fragmented blackish zig-zag bands (Fig. 2). These *aspis*-like zig-zag bands are similar to the specimens from Çaykara and Çamlıhemşin and *Vipera pontica* (Baran et al. 2001; Billing et al. 1990), as opposed to the unfragmented *berus*-like pattern seen in *V. barani* (Baran et al. 2001; Joger et al. 1997). The lowland Black Sea specimens have a high number of zig-zag bands (62–67) compared to *V. pontica* (51–58) and the high mountains of Çaykara (48–49). The number of zig-zag bands has been correlated to altitude in *V. dinniki*, with higher numbers of bands increasing with altitude (Nilson et al. 1994, 1995; Hoggren et al. 1993; Kutrup 1999). The opposite trend seems to be true with these specimens.

Dark vertical blotches run along the lateral sides of the body and do not connect with the zig-zag bands. Two black bands extend diagonally from the posterior end of the parietal area to the sides of neck (see Fig. 1b), similar to specimens from Artvin, Adapazarı, Çamlıhemşin and Çaykara. The sides of the body of small specimens have white spots extending to the level of the anal plate, while larger individuals have spots to the mid-body. The ventral ground color is black and contain no whitish spots under the tail. The tips of the tails are yellowish in all specimens.

The lowland Black Sea specimens have blunt and expanded snouts, a characteristic of the *berus* complex (see Fig. 1). In comparison, specimens from the Artvin province used in the description of *Vipera pontica* and those collected from Çamlıhemşin have an upturned snout (Baran et al. 2001; Billing et al. 1990).

The addition of seven new specimens from Trabzon province provides useful insights into the variation used to separate the species *Vipera barani* and *V. pontica*. Baran et al. (2001) reported on two specimens from the high elevation location at Çaykara, along with additional material from Artvin, and found intermediacy in the variation used to diagnose the two. Similarly, the seven specimens from the lowland Black Sea coast locations show intermediacy as well. The color pattern in six of the new specimens is similar to *V. pontica*, whereas the melanistic specimen resembles *V. barani*. In addition, our present knowledge of the morphological variation further diminishes the distinctiveness of the two species (Table 1). Baran et al. (2001) recommended the synonymy of *V. pontica* with *V. barani*, which is further supported here. It remains a possibility that *V. barani* has differentiated at the subspecific level along the distribution of the two species (Baran et al. 2001), but, a characterization of this variation will require additional material and more sensitive molecular techniques. Additional specimens of these poorly known vipers collected from throughout their distribution will further clarify the variation seen in *V. barani*.

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TECHNIQUES

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The Thermochron: A Truly Miniature and Inexpensive Temperature-Logger

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Miniature temperature-loggers (e.g., HOBO, Watchdog) have become valuable tools for herpetologists, and biologists in general. Being lightweight and self-contained, miniature temperature-loggers make it easy to record simultaneously temperatures at separate sites. Certain models are waterproof and can be attached to or implanted in large organisms, providing detailed profiles of body temperature that are otherwise difficult to obtain (e.g., Butler and Woakes 2001; Litzgus et al. 1999). In some microhabitats, temperature-loggers can even be used to estimate operative environmental temperatures (Vitt and Sartorius 1999). Miniature temperature-loggers are accurate and reliable under field conditions and are generally easier to program and deploy than larger, more expensive systems (Mueller and Rakestraw 1995). Although the use of miniature temperature-loggers has increased rapidly in the last decade, reductions in the size and cost of these devices have not kept pace.

Recently, a novel temperature-logging device has emerged that could enhance studies of behavioral and physiological ecology. The Thermochron iButton, manufactured by Dallas Semiconductors (Dallas, Texas, USA), is a remarkably small and light temperature-logger than meets or exceeds the specifications of temperature-loggers that are commonly used by biologists. Each Thermochron is a mere 5.9 mm thick and 17.4 mm in diameter, and has a mass of 3.1 g. The outer casing is stainless steel, permitting the unit to function normally during complete submersion in water. The Thermochron is powered by an non-replaceable, internal battery that provides approximately 10 years of service (or one million readings). The manufacturer specifies a resolution of 0.5°C and an accuracy of ± 1°C within the operating range of –20° to 85°C. The thermochron was developed primarily as an inexpensive tool for commercial shipping companies to document that perishable goods have been stored and transported within an acceptable range of temperatures. Current pricing is approximately US $14 per unit, and discounts are available for purchases of 25 or more units. Thus, the Thermochron is a high-performance temperature-logger that is approximately 10% of the cost of similar products.

Thermochrons are launched (or "missioned") using free software downloaded from the manufacturer's website and hardware included in a startup kit (US $25). The interface between a computer (Macintosh or PC) and a Thermochron is established with an iButton reader (Blue Dot Receptor, Model DS1402D-DR8), which attaches to a serial port. The software (32-Bit iButton-TMEX Runtime Environment) provides an intuitive interface that allows one to toggle among windows enabling one to mission a logger, display the status of the current mission, and report output from a mission in progress. A mission "wizard" provides an easy to follow, step-by-step process of starting a mission. Advanced features and ranges of settings are almost identical to those offered for competing brands of temperature-loggers (e.g., HOBO Temp loggers used with BoxCar Pro 4.5, Onset Computer Corporation). For example, the output can be obtained in the form of a text file or a histogram of temperatures, and each file is marked with a 48 bit serial number that identifies the logger generating the data. Each mission can record up to 2048 data points, at rates ranging from one point per min to one point per 255 min. The start of the mission can be delayed up to 45 days, so that the user has time to position the Thermochron prior to the onset of data collection.

Thermochrons also possess several unique features. Firstly, the Thermochron can add temperatures to the histogram after the maximum number of time-stamped data points have been stored; therefore, the mean temperature and its variance can be obtained for durations that far exceed the duration of the mission. Secondly, Thermochrons are equipped with an alarm feature that permits monitoring the number and duration of deviations from minimum and maximum temperatures (set by the user). The alarm feature is extremely useful for applications such as monitoring the occurrence of lethal temperatures in nests or hibernacula. Lastly, the Thermochron features 512 bytes of memory that enables the user

the tube entrance (Fig. 2B). To elicit movement in the desired direction, prodding is best directed towards a crocodile's posterior (e.g., base of tail, thigh) (pers. obs.). Our crocodilians bite at poles that approach or come in contact with their heads, rather than move in the desired direction. Juvenile *Crocodylus porosus* x *siamensis* entered the pipe readily, and most captures were accomplished in < 5 minutes. Once a crocodilian enters the pipe, the entrance side is quickly pulled up and out of the water by means of an attached capture rope (Fig. 2C). The crocodile is thus momentarily in an inverted vertical position and is unable to back out of the smooth, water-filled, pipe. The entrance is quickly sealed with the sliding door and secured. Finally, the pipe is pulled completely out of the water by means of the second load bearing rope handle (Fig. 1; Fig. 2C). Drainage slits allow water to quickly drain from the pipe (Fig. 1). The crocodile is then safely contained in a dark, wet, and smooth pipe. We believe that these characteristics provide a relatively non-stressful environment for the animal and prevent physical injury. A minimum of two people are required to trap a juvenile crocodilian in this fashion, although more may be required to lift and transport the pipe and its occupant. At Shark Reef, the entire process takes place with staff standing along the edge of an eight-foot deep exhibit pool. Although this technique reduces stress during capture and transport, confined crocodilians should not be exposed to excessively warm areas and/or direct sunlight, as thermal stress can also be fatal. To release a crocodilian, the pipe entrance is simply oriented towards a body of water and the door is removed. Tilting the pipe causes the crocodilian to slide out tail first into the water.

The Crocodilian Capture Tube has many advantages over current capture methodologies: (1) No direct physical contact is required between the crocodilian and handlers; (2) there is no need for securing the crocodilians jaws; (3) specimens can be captured underwater with ease; (4) no stressful thrashing or rolling behavior is exhibited by captured crocodilians; (5) there is no longer a need to cover a crocodilian's eyes, as it is in a dark tube; (6) the device serves as a safe short-term holding and on-site transport container; (7) no sedatives are required to capture and/or transport an animal; and (8) the crocodilians body is evenly supported during transport.

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NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 33, Number 1 (March 2002). However, please take note of the updated information below.

Current section editors: **Marc P. Hayes** (amphisbaenids, crocodilians, lizards, and *Sphenodon*; mhayesrana@aol.com); **Charles W. Painter** (amphibians; cpainter@state.nm.us); **Gordon W. Schuett** (snakes; gschuett@asu.edu); and **James Harding** (turtles; hardingj@pilot.msu.edu). Electronic submission of manuscripts is required (as Microsoft Word or Rich Text format [rtf] files, as e-mail attachments). Authors without the ability to send manuscripts electronically may supply hard copy instead. Figures can be submitted electronically as JPG files, although higher resolution TIFF or BMP files will be requested for publication. If figures cannot be provided in this format, you may send them to the section editor for scanning. Additional information concerning preparation and submission of graphics files is available on the SSAR web site at: http://www.ukans.edu/~ssar/HRinfo.html.

CAUDATA

AMPHIUMA MEANS (Two-toed Amphiuma). **OVERLAND MIGRATION**. *Amphiuma means* is a large aquatic salamander with reduced limbs and an eel-like appearance. Amphiumas inhabit relatively shallow, lentic water habitats and water levels in these habitats often fluctuate seasonally and/or annually. During periods of drought, amphiumas are known to aestivate in burrows within organic sediment of dry lake bottoms (Knepton 1954. Copeia 1954:68; Mount 1975. The Reptiles and Amphibians of Alabama. Auburn Printing Co., Auburn, Alabama). There are no published accounts of *A. means* traveling overland, although the possibility of overland migration/dispersal has been suggested (Snodgrass et al. 1999. Copeia 1999:107–113). Here, I report overland migration of an adult amphiuma from a drying lake during a drought.

Lake Jackson in Leon County, Florida, USA is a 1620 ha sinkhole lake that dried to 10% of normal surface area in 1999–2000 during a prolonged drought in northern Florida. In order to monitor the mass migration of reptiles and amphibians from the drying lake, I constructed an 853-m drift fence along U.S. Highway 27N adjacent to the northwest part of Lake Jackson. Animals were migrating to a 7-ha lake (Little Lake Jackson) that did not dry located immediately to the west of U.S. 27. On 10 June 2000 at 1100 h, I found a dead, partially desiccated adult male *A. means* (SVL 40 cm, TL 79 cm) at the drift fence. The body was positioned perpendicular to the fence with the snout touching the fence. The amphiuma apparently moved during the previous night as it was not observed at the fence at 2030 h on 9 June. There were no signs of injury that might suggest it was carried there by a predator. There were clear skies 9–10 June and full sunshine on the morning of 10 June; the only moisture was morning dew on dense vegetation.

There are two possible scenarios to describe the terrestrial movement of this amphiuma: either it migrated from a drying lake pool or it emerged from an aestivation burrow. The latter is unlikely as there was no rainfall since 5 June 2000 (0.05 cm) and, therefore, probably no trigger mechanism that might stimulate emergence from aestivation in an area of lake bottom that was dry for 1–2 years and covered with terrestrial vegetation. Although most amphiumas probably aestivate under organic sediment in the littoral zone of drying lakes (Aresco 2001. Herpetol. Rev. 32:32–33), some individuals may remain active in slowly receding water with little or no aquatic vegetation. Under these conditions, the increased

predation risk posed by dense concentrations of fish, turtles, and wading birds and increased water temperatures may eventually force migration.

The nearest drying pool remaining at Lake Jackson was 250 m to the east of where the amphiuma was found. The water depth of this pool was < 0.25 m and it dried completely by 18 June 2000. If the amphiuma left this drying pool, it would have first moved 50 m over dry, cracked mud and then through maidencane (*Panicum hemitomon*), smartweed (*Polygonum densiflorum*), and dog fennel (*Eupatorium compositifolium*) growing over the dry lake bottom. The location and position of the amphiuma indicates that it was moving in the same direction as migrating turtles (e.g., *Pseudemys floridana*), frogs (e.g., *Rana grylio*), and snakes (e.g., *Seminatrix pygaea*) to Little Lake Jackson located 600 m from the drying pool. This observation suggests that *Amphiuma means* may possess an ability to detect water from some distance away and may attempt terrestrial migration under a unique set of environmental conditions.

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ENSATINA ESCHSCHOLTZII OREGONENSIS* x *PICTA (Oregon x Painted Salamander Intergrade). **REPRODUCTION / BROODING BEHAVIOR.** *Ensatina eschscholtzii* is the most widespread plethodontid in western North America, with a range extending from southern British Columbia to extreme northern Baja California (Stebbins 1985. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin Co., Boston, Massachusetts. 336 pp.). However, little is known about natural intergrade brooding behavior in northern California. Most reports have dealt with cases from the San Francisco Bay region of California and Coos Co., Oregon (Stebbins 1954. Univ. California Publ. Zool. 54:47–124) and Washington, where specimens were removed from their natural environment to a laboratory or preserved (Norman and Norman 1980. Bull. Chicago Herpetol. Soc. 15:99–100; Jones and Aubry 1985. Herpetol. Rev. 16:26; Norman 1986. Herpetol. Rev. 17:89).

An extended period of observation of the brooding behavior of a single adult female *Ensatina eschscholtzii oregonensis* x *picta* intergrade, and the eventual hatching of her clutch is reported herein. On 2 June 2001, the brooding female intergrade was found encircling a cluster of cream-colored ova at a semi-rural, residential area at Westhaven, California (T8N R1E SW1/4 Sec. 31; elev. ca. 100 m). The site was within the coastal redwood region of Humboldt County. The brooding chamber was located under a piece of downed woody debris (53 cm long x 25 cm wide x 30.5 cm high) which rested on the forest floor. Litter components under the object consisted of redwood (*Sequoia sempervirens*) and Sitka spruce (*Picea sitchensis*) needles, introduced English ivy (*Hedera helix*) roots, and decomposing organic matter. The forest canopy consisted of old-growth Sitka spruce and second growth redwood, with few red alder (*Alnus rubra*) and cascara buckthorn (*Rhamnus purshiana*) present in the understory. Old-growth redwood stumps are also present in the immediate vicinity.

The brooding female measured 5 cm SVL (measuring to the anterior edge of the cloaca), ca. 9.2 cm TL, and possessed 13 costal grooves, brassy coloration on the snout, and the upper half of her eyes contained gold flecking (as in *Ensatina eschscholtzii xanthoptica* [see Stebbins 1985]). Her dorsal coloration was brown as in *E. e. oregonensis*, with fine yellow specks; the ventral surfaces were translucent light cream and brownish with shades of blue and gray. Her axillae and rear limb insertions were bright yellow and the entire tail was blotched with light yellow markings on brown as in *E. e. picta*. Her tail tip and toes were complete. The egg cluster consisted of ca. 11–17 ova and was light cream-colored and brownish. When first observed, the cluster was covered with fine particulate organic matter and the ova did not appear translucently gelatinous.

The site was revisited periodically over a span of the next 18 wks. The brooding female was observed in attendance with the egg cluster upon each observation, prior to 5 October 2001, and usually with her head and tail wrapped around the cluster, with her body and pulsating gular region in contact with the eggs. The female appeared to have moved the egg cluster ca. 10 cm from its original position around the date of 23 June 2001, similar to a laboratory observation made by Stebbins (1954:91, *ibid.*). At ca. 2000 h on 23 June 2001 soil temperature was 13.2°C; air temperature was 12.6°C at 2015 h and the cluster chamber measured ca. 6 cm x 4 cm x 2 cm. It was generally apparent that the brooding female would remain motionless unless disturbed, then she would rearrange herself around the cluster.

By 1 August 2001, the eggs had increased in diameter from ca. 5 mm to 7 mm; very dark brown to black shading was perceptible in one hemisphere of each ovum, indicating embryonic development was occurring. Two weeks later, as the dark region grew even darker, the eyes of embryos could be clearly seen through the outer membranes of the ova. Ova now measured 8 mm in diameter.

By 1 September 2001 the eggs had become more developed, appearing more translucent and clearly gelatinous, having lost the dull cream color; the ova had become even more fully hemispherically shaded as embryos reached pre-hatch maturation. Photographs were taken to complement those taken 2 June, the date of initial discovery. The brooding female appeared slightly thinner, possibly due to desiccation from an unseasonably dry summer, with rainfall levels approximately 23 cm below normal for the area (NOAA data).

Finally, on 15 September 2001, after the first hard rain of the summer, and fifteen weeks post-discovery, all ova hatched. A total of 11 hatchlings were counted in the brooding chamber, each measuring ca. 2.2 cm TL. The brooding female was still in attendance and had five hatchlings on top of her back and two under her forelimbs. The remaining hatchlings were in front of her, still inside the brooding chamber, or beside her tail. The bluish-gray blotched hatchlings were active and sought cover immediately under moist leaf litter when disturbed.

The site was inspected again on 23 September 2001 and the adult female was still in attendance with a single hatchling on her head, four others on her back and others next to her tail. Now, the female appeared larger with moist, shiny skin. Again, the hatchlings were active when startled and moved quickly to find cover. Two days afterward the site was again photographed and nine hatchlings were present with the female.

On 5 October 2001 the female was not present for the first time since 2 June 2001. Six hatchlings remained clustered together in a

ball-shaped configuration, they each actively sought cover, moving up to 4–5 cm in just a few seconds. The next day (6 October) four hatchlings remained and one California slender salamander (*Batrachoseps attenuatus*) sub-adult, in coiled position, was present 16 cm away from those hatchlings. Finally, on 14 October 2001 no salamanders were present at the brooding micro-site.

Samantha J. Hadden, Thomas A. Kirk, and Alexander Galeone assisted documenting these observations with photographs. In addition we thank the landowners, John and Carol Wiebe, for their support and enthusiasm for this project and for permission to conduct observations on their property.

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HEMIDACTYLIUM SCUTATUM (Four-toed Salamander). **RECORD SIZE**. Conant and Collins (1998. Peterson Field Guide to Reptiles and Amphibians of Eastern and Central North America. 3rd Ed. Expanded. Houghton Mifflin, Boston, Massachusetts. xviii + 616 pp.) report maximum size for *Hemidactylium scutatum* as 4.0 in (102 mm) total length. Here we report a larger individual, 45.1 mm SVL and 113.6 mm TL. This individual was found on 23 October 2001 at Toft Point State Natural Area, Door County, Wisconsin, USA. After measurement, the salamander was photographed and released. The photograph (136-s) is deposited at the Richter Museum of Natural History, University of Wisconsin, Green Bay.

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RHYACOTRITON VARIEGATUS. (Southern Torrent Salamander). **PREDATION**. On 19 June 1996 at ca. 1400 h I observed a sub-adult northwestern garter snake (*Thamnophis ordiniodes*) in the process of consuming a larval southern torrent salamander (*Rhyacotriton variegatus*) at a small east-facing seep at an elevation of 1049 m in Del Norte County, northwestern California. The seep ran adjacent to and through a culvert under U.S. Forest Service Rd 17N05 (T17N R3E SW1/4 Sec. 55). The seep drains the headwaters of the Siskiyou Fork of the Smith River at variable slopes of ca. 60–80%. Surface flow at the seep site was steady and constant during observations and the seep appeared permanent with heavy moss growth enclosing cobbles and gravels as well as larger more embedded regolith and unembedded finer sediments.

At the time of observation the head of the salamander was fully-engulfed by the snake. The snake was disturbed by my presence. When secured by hand the snake promptly regurgitated the salamander. In captivity, the snake later re-consumed the previously injured salamander within 24 h. Another larval *R. variegatus* from the same seep, also available as prey, was not consumed during the same time period.

The consumed larval *R. variegatus* measured 41.0 mm TL with incomplete tail tip, SVL was 31.0 mm (measured to the anterior edge of the cloacal opening), and a total mass of 0.8 g. The snake measured 130.0 mm TL, 73.0 mm SVL, and had a mass of 3.2 g. Vouchers (BRN 1996-#016A and B) will be deposited in the Humboldt State University Vertebrate Museum Collection, Arcata, California, and were taken under California State Scientific Collecting Permit #9030 issued to the author.

Although *T. ordinoides* is considered a mostly terrestrial species (Brown et al. 1995. Reptiles of Washington and Oregon. Seattle Audubon Society, Seattle, Washington. 176 pp.; Stebbins 1985. A Field Guide to Western Reptiles and Amphibians. 2nd Ed. Houghton Mifflin Co., Boston, Massachusetts. 336 pp.), the snake reported herein was discovered while partially submerged within the flow of the seep during the initial consumption of the larval *Rhyacotriton*. Water temperature was 9.1°C and air temperature was 21.3°C at ca. 1500 h.

Unfortunately, a significant mass-wasting event occurred prior to spring 1997 observations at the site. This slide resulted in a dramatically altered seep course. Limited observations in 1997 did not detect any *Rhyacotriton variegatus* at the site after the slide had occurred (pers. obs. and unpubl. data). To my knowledge this is the first report of *T. ordinoides* preying upon a larval *Rhyacotriton* in a natural setting, although garter snakes have previously been suspected to possibly prey on *Rhyacotriton* (Nussbaum et al. 1983. Amphibians and Reptiles of the Pacific Northwest. Univ. of Idaho Press, Moscow. 332 pp.).

I thank Hartwell H. Welsh, Jr. (Redwood Sciences Laboratory, Arcata, California) for encouraging me to report these observations. Welsh and Karen L. Pope reviewed a draft and provided helpful comments that improved this manuscript.

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SIREN INTERMEDIA NETTINGI (Western Lesser Siren). **MIGRATION and LOCOMOTION**. On 13 and 14 April 2001, a total of 15 (six on 13 April and nine on 14 April) *Siren intermedia nettingi* were observed at Nashoba Park (Germantown, Shelby County, Tennessee, USA; 35°07'N, 89°48'W). The sirens were migrating upstream from one pond to another through a large (2 x 3 m) concrete culvert ca. 40 m long. The flow of water through the culvert is typically a trickle, but precipitation on 11 and 12 April resulted in a rapid flow of water (4–6 cm deep) from the upper to the lower pond. The salamanders were observed at night moving upstream by slowly crawling along the flat bottom of the concrete culvert, relying heavily upon the use of their forelimbs. Any individual that was disturbed by an observer would immediately release its grip on the concrete and be quickly washed downstream by the swift current. The observed difficulty in swimming against the current suggests that the migration may not have been possible without use of the forelimbs. Subsequent observations of a captured *S. i. nettingi* in captivity also suggest that the limbs are vital to the salamander's locomotion. These observations provide evidence contrary to the suggestion by Cochran and Goin (1970. The New Field Book of Reptiles and Amphibians. Putnam, New York. 359 pp.) that the forelimbs are useless in locomotion.

Our field observations coincide with dates reported for oviposition and nesting of *S. i. intermedia* in the Carolinas and *S. i. nettingi* in Arkansas (Petranka 1998. Salamanders of the United States and Canada. Smithsonian, Washington, D.C. 587 pp.). Thus, the animals we observed may have been searching out oviposition sites. The culvert separating the upper and lower ponds in Nashoba

Park could therefore act to limit the available sites for animals on either side. The isolation effect of the culvert would, of course, depend on the frequency of precipitation events during the reproductive period that are sufficient to permit migration.

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ANURA

ACRIS CREPITANS BLANCHARDI (Blanchard's Cricket Frog). **PREDATION**. Although spider predation of anurans is frequently documented (Mitchell 1990. Herpetol. Rev. 21:89–90; McLister and Lamond 1991. Can. Field-Nat. 105:574–575; Johnson 1996. Herpetol. Rev. 27:140; Rogers 1996. Herpetol. Rev. 27:75), we report herein, and to our knowledge, the first account of a wolf spider, *Hogna helluo*, feeding on the Blanchard's cricket frog, *Acris crepitans blanchardi*.

The documentation of this incident is of particular importance because Blanchard's cricket frogs are currently touted as a species in decline in North America, having been extirpated in Canada and thought to be extirpated in Minnesota (Froom 1982. Amphibians of Canada. McClelland and Stewart Ltd., Toronto 120 pp.; Green 1997. Herpetol. Conserv. 1:291–308; Bishop and Petit 1992. Can. Wild. Serv. Occ. Pap. 76:1–120; Oldfield and Moriarty 1994. Amphibians and Reptiles Native to Minnesota. Univ. Minnesota Press, Minneapolis, 237 pp.; Greenwell et al. 1996. Aquaticus 26:48–54; Harding 1997. Amphibians and Reptiles of the Great Lakes Region. Univ. Michigan Press, Ann Arbor, 378 pp.). Although documentation of this species' decline can be traced back to the 1970s, no clear understanding of the factors contributing to this decline exists (Vogt 1981. Natural History of Amphibians and Reptiles of Wisconsin. Mil. Pub. Mus., Milwaukee 205 pp.; Morell 1999. Science 284:728–731). Thus, descriptions of cricket frog mortality may shed insight into causative factors of their decline and offer implications for their conservation.

We observed an adult wolf spider preying upon a juvenile Blanchard's cricket frog on 20 July 2000, between 1500 and 1510 h along the edge of a semi-permanent wetland at the Mary Gray Bird Sanctuary in Connersville, Indiana, USA (39°35'03"N, 85°13'44"W). We observed that the spider's fangs had punctured the dorso-posterior region of the frog. The frog struggled briefly, appeared weakened, and could not free itself. After ca. 5 min, the spider released the frog. A large area of necrotic tissue was immediately visible where the bite occurred. Following several putative attempts to flee, the frog appeared immobilized yet periodically opened its mouth as if gasping for air. On the following day, we returned to the wetland and found the frog's desiccated corpse intact and in the same position as we had left it.

It is not clear whether the spider captured the frog by attacking it or whether it was scavenging. Although wolf spiders have been observed scavenging the remains of dead prey in laboratory settings (Nentwig 1987. Ecophysiology of Spiders. Springer-Verlag, New York, 448 pp.), it is well known that these vagrant, generalist predators usually ambush or actively hunt their prey (Foelix 1996. Biology of Spiders. Oxford University Press, Oxford, 330 pp.). Although we archive a single feeding episode of *A. c. blanchardi* by *H. helluo*, perhaps these syntopic species interact more often than is presently apparent. Investigative endeavors into the impact that these species may have on one another may be valuable to our understanding of their biology, and to the decline of *A. c. blanchardi*.

We thank Gail Stratton and Pat Miller for their assistance in identifying the spider. Also thanks to Deanna Barricklow of Mary Gray Bird Sanctuary and the Indiana Audubon Society for allowing us to conduct amphibian research on the Sanctuary grounds.

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BOOPHIS ALBILABRIS (NCN). **DEFENSIVE BEHAVIOR.** During a herpetological survey along a small forest stream in January 1996 at Anjanaharibe-Sud Massif (Analabe Valley; 14°45.3'S, 49°30.3'E), NE Madagascar, I found a great number of *Boophis*

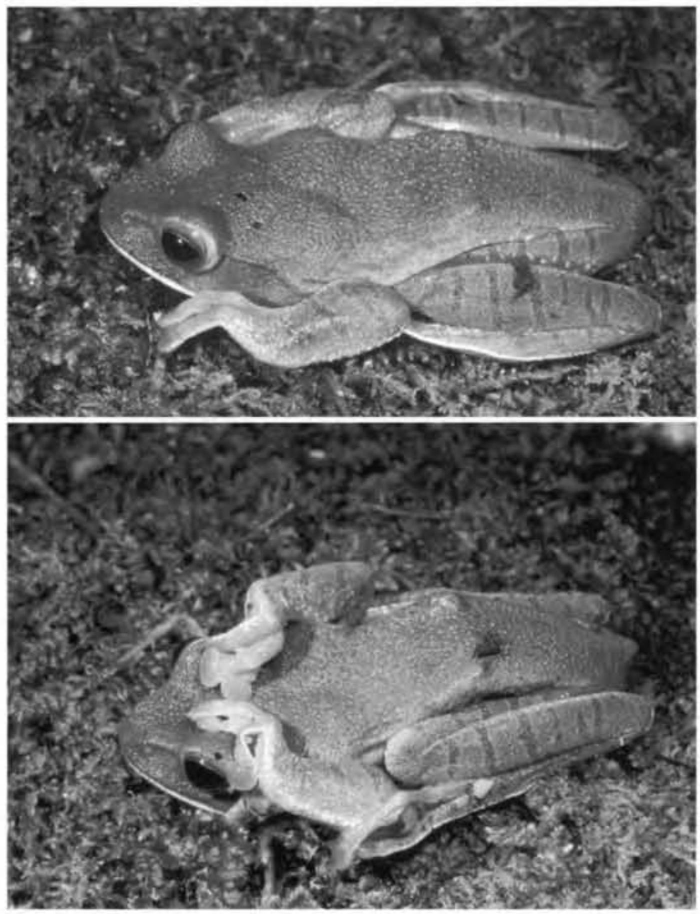

FIG. 1. Top: typical resting position of adult male *Boophis albilabris*. Bottom: defensive posture, with forearms covering the head and eyes. Specimen photographed at Anjanaharibe-Sud Massif, NE Madagascar.

albilabris (Amphibia, Mantellidae), a treefrog typical of the eastern and northwestern rainforests (Raxworthy et al. 1998. Fieldiana Zool., n.s. 90:79–92). In some individuals captured for photographs or museum specimens I noticed a peculiar defensive behavior. As shown in Fig. 1, when touched, the individuals curved the body upwards, and moved the forelegs to cover the head and eyes. At the same time, they emitted a typical release-call and a mossy smell. The observed defensive behavior is intended as a sort of "unken reflex," known for *Bombina variegata* and many other anurans and urodeles (Pough et al. 2001. Herpetology, 2nd Ed. Prentice-Hall, Inc. Upper Saddle River, New Jersey. 612 pp.). Unlike most of these species which usually have an aposematic coloration, *B. albilabris* has a cryptic coloration (Cadle 1995. Zool. J. Linnean Soc. 115:313–345). It is worth noting that the upper parts of the body and head (as well as other body parts) of males during the breeding period are covered by horny spiculae. Males also have a well developed and pointed prepollex, used during scramble competition, as shown not only for *B. albilabris,* but also for the closely related *B. occidentalis* (Andreone et al. *In press.* J. Zool., London). By directing the head and hands towards the predator, the threatened individual effectively defends itself. As far as I know this is the first report of defensive behavior and posture in *Boophis*.

Thanks to H. Randriamahazo and J. E. Randrianirina for the assistance in the field, and to the Malagasy institutions which provided authorization for study.

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BOOPHIS LICHENOIDES (NCN). **ACOUSTIC BEHAVIOR.** The Madagascan treefrog *Boophis lichenoides* was described (Vallan et al. 1998. Amphibia-Reptilia 19:357–368) from specimens from An'Ala Forest (next to Andasibe, Toamasina Province), Tsararano (Antsiranana Province), and Vevembe Forest (next to Vondrozo, Fianarantsoa Province). This species is peculiar in having extended dermal fringes and a cryptic coloration. In the original description no information was provided about the breeding biology nor vocalizations of this species. Although vocalizations were recorded at Tsararano, they were not described, as they were emitted by a "low motivated" male (i.e., a male that is not particularly sexually active). Recently we found this species at two other sites in NE Madagascar, and recorded the advertisement call, which we describe herein. The new localities are: 1) Menamalona Forest, Masoala Peninsula, Antalaha Fivondronana, Province d'Antsiranana, 15°22.87'S, 49°59.27'E 780 m (voucher specimens Museo Regionale di Scienze Naturali [MRSN] A2047–2052, leg. F. Andreone, 13–18.XII.1999), and 2) next to Manantenina River, Parc National de Marojejy, Andapa Fivondronana, Province d'Antsiranana, 14°26.2'S, 49°46.5'E, 450 m (voucher MRSN A2053 leg. J.E. Randrianirina, July 2000) (vouchers and localities confirmed by M. Vences, Cologne, and Konstanz). At Menamalona several specimens were found along a forest river around a small stagnant pool of about 3 m diameter. This observation confirms the assumption that *B. lichenoides* belongs to the *B. tephraeomystax* group and breeds in temporary ponds. The water at this site was ca. 1 m deep, clear, and 18°C. Other amphibians

FIG. 1. *Boophis lichenoides*, calling specimen photographed at Menamalona Forest (Masoala Peninsula).

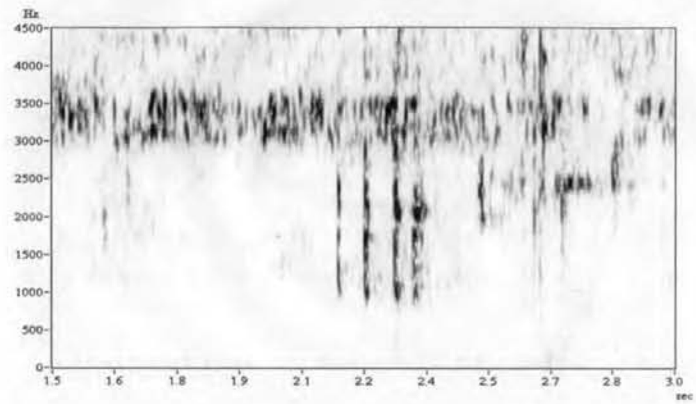

FIG. 2. Sonogram of the advertisement call in *Boophis lichenoides* at Menamalona Forest (Masoala Peninsula), as shown in Fig. 1. Recording temperature = 19°C.

observed at this site were *Mantidactylus tornieri, M. grandisonae*, and *Paradoxophyla palmata*. *Boophis lichenoides* was found on small shrubs around the pool (about 1.5–2.5 m above the ground) and in the water. Some males moved at the surface of the water or stayed hidden under roots of emergent vegetation. During this observation the males on shrubs did not move, although they emitted a croaking vocalization every 1–3 minutes. Males in the water emitted the vocalizations more frequently (each 30–60 sec.), but I did not notice a tendency to initiate a synchronous chorus. The vocalizations emitted from aquatic males consisted of croaking calls composed of several single notes (3 to 6), which corresponded to the rapid inflation of the single subgular vocal sac. The emissions were recorded with a portable Sony and analyzed with the software Voxys 5.1. Duration was 0.22 ± 0.09 sec ($N = 17$; range 0.11–0.43 sec), and frequency ranged from about 800–2500 Hz, with an extension in some cases to about 4000 Hz. The maximum emission peak was around 1000–1200 Hz. A harmonic structure was not clearly visible, although sometimes the presence of two harmonics can be detected, at around 1200 and 2400 Hz. The duration of each single sound was of 0.02 ± 0.009 sec ($N = 66$; range: 0.01–0.05 sec), while intervals between single sounds were 0.05 $\pm$ 0.03 sec ($N = 50$; range 0.005–0.13 sec). Aquatic males emitted the vocalization from the water surface. In this sense, the low fre-

quency of emission of this species is useful in an aquatic medium. At Menamalona we also observed and collected several small tadpoles (MRSN A2052) with a black and yellow banded coloration, similar to that illustrated in Vallan et al. (*op. cit.*), therefore supporting the identification *B. lichenoides*.

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BUFO CALIFORNICUS (Arroyo Toad) **PREDATION**. Herein we report on predation of arroyo toads, observed during the course of a radio-tracking study (Griffin and Case 2001. J. Wildl. Mgmt. 65:633–644) and population surveys in the San Mateo River watershed on U.S. Marine Corps Base Camp Pendleton, San Diego County, California, USA.

Bullfrogs, *Rana catesbiana*, predate other bufonid species (Stuart 1995. Herpetol. Rev. 26:33), including the arroyo toad (Sweet 1993. Second Report on the Biology and Status of the Arroyo Toad (*Bufo microscaphus californicus*) on the Los Padres National Forest of Southern California. Report to USDA Forest Service, Los Padres Natl. Forest). Control of the bullfrog is a priority in the recovery of the arroyo toad (U.S. Fish Wildl. Serv. 1998. Draft Recovery Plan for the Arroyo Toad. Portland, Oregon). During a streamside survey on 24 March 1998, we captured an adult bullfrog, ca. 145 mm SVL. Its stomach contents included three partially digested adult arroyo toads, 57, 44, and 44 mm SVL, now in the Los Angeles County Museum of Natural History (LACM 145293–95). During a streamside survey on 19 May 1998 we captured an adult bullfrog, ca. 140 mm SVL, with stomach contents including one partially digested adult arroyo toad, 58 mm SVL (LACM 145292). On 28 June 1998 we located the radio-transmitter and partially digested body of one adult male arroyo toad, 53 mm SVL (LACM 145296) in the stomach contents of an adult bullfrog, 135 mm SVL (LACM 145297).

On 9 June 1998, we located the transmitter from an adult male arroyo toad in the intestine of an adult two-striped garter snake, *Thamnophis hammondii*, 500 mm SVL (LACM 145298). The toad had been fully digested. On 18 August 1998, we located the transmitter and mostly-digested remains of an adult male arroyo toad in the intestine of another two-striped garter snake, 820 mm SVL (LACM 145299).

On 20 April 1998, one radio-tagged adult female arroyo toad, 58 mm SVL (LACM 145301), was found injured in a dense patch of castor bean plant, *Ricinis communis*. Beak punctures and a severed limb caused by an unidentified avian predator caused the toad's subsequent death. Signs of digging by a bird were also evident at the square meter of sand where the toad had habitually burrowed in the previous 30 days. On 8 July 1998, one radio-tagged female arroyo toad, 63 mm SVL (LACM 145303), was run over and killed by a mountain bicycle on a dirt path by the San Mateo State Park campground.

It appears that males risk predation by aquatic predators during their activities near the stream channel. Effective bullfrog control measures could reduce this risk. We speculate that mortality due to semi-aquatic predators may be less common for females, who spend more time in terrace and upland habitats.

Our thanks to the California Department of Transportation for funding, and to Ed Ervin and Dan Holland for assistance in the field. U.S. Fish and Wildlife Service, California Department of Fish and Game, and U.S. Marine Corps Base Camp Pendleton permitted the study.

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BUFO MAZATLANENSIS (Sinaloa Toad), ***RANA TARAHUMARAE*** (Tarahumara Frog). **ECTOPARASITES.** *Bufo mazatlaensis* is known from the Mexican states of Chihuahua, Colima, Durango, Jalisco, Nayarit, Sinaloa, and Sonora (Flores Villela and Gerez 1994. Biodiversidad y Conservación en México: Vertebrados, Vegetación y uso del Suelo, Comision Nacional para el Conocimiento y uso de la Diversidad y Universidad Nacional Autonoma de Mexico, Ciudad Universitaria, México, D.F. 439 pp). *Rana tarahumarae* ranges from southern Arizona to Sinaloa, Mexico (Stebbins 1985. A Field Guide to Western Reptiles and Amphibians, Houghton Mifflin, Boston, Massachusetts. 336 pp.). There are, to our knowledge, no reports of ectoparasites on *Bufo mazatlanensis;* however, the chigger *Hannemania anurae* has been reported from *Rana tarahumarae* by Welbourn and Loomis (1970. Bull. South. California Acad. Sci. 69:65–73). The purpose of this note is to report new host records for chiggers (larval trombiculid mites) from *B. mazatlanensis* and *R. tarahumarae*.

Twenty *Bufo mazatlanensis* (mean SVL 62 mm ± 7 SD, range = 50–80 mm) collected in 1966 from Sonora, Mexico (ASU 6109, 6111–6113, 6115–6117, 6119–6121, 6123, 6126, 6128–6134, 6194) and 42 *Rana tarahumarae* SVL 71 mm ± 16 SD, range 47–99 mm) collected 1969–1989 from Sonora, Mexico (UAZ 31367, 38708, 38710–38712, 39265, 39266, 40016, 40019, 40116, 44146, 44884, 44885, 44888, 44891, 45185, 45187, 45190–45192, 45194, 45926, 45931, 45932, 45936, 45937, 45942–45944, 45947, 45948, 45952, 46086–46089, 47001–47004, 47065, 50706) were examined for ectoparasites. These specimens were preserved in formalin and stored in alcohol. The body surface was searched for ectoparasites under a dissecting microscope. Ectoparasites (all chiggers) were removed with forceps, placed in a vial of 70% ethanol and shipped to WJW for study where they were mounted in PVA-LP (polyvinyl alcohol-lactophenol) and identified. Voucher slides were deposited in the United States National Chigger Collection, housed at Chaminade University, Honolulu, Hawaii. Fourteen *R. tarahumarae* were infested with *Hannemania monticola* (mean 5 ± 2 SD, range 4–8), 4 *B. mazatlanensis* were infested with *H. bufonis* (mean 2 ± 1 SD, range 1–4), and 14 *B. mazatlanensis* were infested with *H. hylae* (mean 5 ± 4 SD, range 1–12). Two *B. mazatlanensis* had concurrent infestations with *H. bufonis* and *H. hylae*.

Hannemania bufonis was described from *Bufo punctatus* collected in Riverside County, California (Loomis and Welbourn 1969. Bull. South. California Acad. Sci. 68:161–169). *Hannemania hylae* was redescribed from *Hyla cadaverina* collected in San Diego County, California but is also known to infest *Hyla arenicolor* from Arizona, west Texas, southern Utah, and northern Sonora, Mexico and *Hyla cadaverina* from Baja California, Mexico (Loomis and Welbourn, *op. cit.*). *Bufo mazatlanensis* is a new host

record for both *Hannemania bufonis* and *H. hylae;* Sonora, Mexico is a new locality record for *H. bufonis. Hannemania monticola* was originally described from *Hyla eximia* collected in Durango, Mexico but has been reported to infest the salamander *Ambystoma rosaceum* and the frog *Eleutherodactylus* (= *Tomodactylus*) *saxatilis* (Welbourn and Loomis, *op. cit*). *Rana tarahumarae* is a new host record for *Hannemania monticola;* Sonora is a new locality record.

We thank Michael E. Douglas (formerly of Arizona State University) for permission to examine *B. mazatlanensis* and Charles H. Lowe (University of Arizona) for permission to examine *R. tarahumarae*.

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BUFO TALADAI (NCN). **DIET.** The feeding habits of most Cuban toads (*Bufo* spp.) have not been previously investigated. In this paper, the first data on the diet of *Bufo taladai* are reported.

An adult female (103.9 mm SVL) *Bufo taladai* was collected in Altiplanicie de El Toldo, Alturas de Moa, Holguín province, Cuba on 16 September 1998. The specimen was maintained in a cage for some days, during which time three fecal balls were obtained. The specimen has been deposited in the herpetological collection of BIOECO at Santiago de Cuba (BSC.H 1976).

From the feces, we identified eight food items representing three classes and eight orders. In addition, grit and plant material were found, although ingestion of these materials was likely incidental. Further, we could identify three items as *Solenopsis* sp. (Formicidae), *Cynorta* sp. (Opiliones) and *Centruroides anchorellus* (Scorpiones). Ants and mites were present in the greatest numbers, followed by the orthopterans. Types and number of food items are presented in Table 1.

The relatively wide variety of food found in only three fecal balls suggests that *B. taladai* is a dietary generalist. This agrees with the results reported by Sampedro et al. (1982. Poeyana 233:1-14) for *B. peltacephalus* from Cuba and by Parsons (1995. Herpetol. Rev. 26:202) for *B. guentheri* from Hispaniola.

TABLE 1. Types and number of food items recovered from three fecal balls of *Bufo taladai* from Altiplanicie de El Toldo, Holguín province, Cuba.

Food item	Number
Arachnida, Acarina	16
Arachnida, Opiliones	1
Arachnida, Scorpiones	1
Coleoptera	1
Hymenoptera, Formicidae	17
Orthoptera	5
Chilopoda	1
Hemiptera	1

We thank Alexander Sánchez and Rolando Teruel for identification of the arachnids, Iliana Boza for helping us with the English translation, and Renata Platenberg for reviewing this note.

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DENDROPHRYNISCUS MINUTUS (Amazon Toadlet). **DEFENSIVE BEHAVIOR.** *Dendrophryniscus minutus* is a small bufonid that occurs in Amazonian Peru, Ecuador, Colombia, Brazil, southern Guyana, and French Guiana. This species possesses a brown dorsum and a bright orange venter. The palms and soles are either orange or red (Rodríguez and Duellman 1994. Guide to the Frogs of the Iquitos Region, Amazonian Peru. Nat. Hist. Mus. Univ. Kansas. 80 pp.). On 17 February 2001, a male *D. minutus* (SVL 16.3 mm) was collected in primary rainforest (Peru: Loreto: Lower Río Samiria, Pacaya/Samiria National Reserve). As I attempted to take photographs prior to release, this specimen consistently flipped over on its back leaving itself in dorsal recumbency with its legs held upward. While in this position, the frog remained motionless. This behavior exposed the bright orange patch on the venter and the orange palms and soles. It also appeared that the animal may have been feigning death. This behavior was repeated five times.

A behavior similar to the one described above has been reported for the Darwin's frog (*Rhinoderma darwini*) (Pough et al. 2001. Herpetology 2nd Ed. Prentice Hall, New Jersey. 612 pp). I am not aware of any published records of this behavior for *D. minutus*, however, this behavior has been observed in the field by others (W. W. Lamar, pers. comm.).

FIG. 1. Defensive posture of a male *Dendrophryniscus minutus* exposing bright ventral coloration.

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LEPTODACTYLUS KNUDSENI (Knudsen's Bullfrog). **PREDATION**. During May 1999, at the field station of the Nouragues (4°5'N, 52°41'W, 110 m elev.), 8 km N of Saut Pararé, Arataye River, French Guiana, one of us (RB) observed an adult giant tarantula *Theraphosa leblondi* (Theraphosidae) preying on a *Leptodactylus knudseni* (ca. 90 mm SVL) during a rain at dusk. The tarantula was maintaining the freshly dead frog with its chelicera, on the ground along a stream. When disturbed, the tarantula escaped underwater with the frog. This frog could not be found again, but there is a voucher specimen from the same population and locality deposited at the Museum National d'Histoire Naturelle, Paris (MNHN 1999.4934, collected by Jean-Pierre Gasc). In the same locality and month, *T. leblondi* was reported to prey on the caecilian *Oscaecilia zweifeli* (Boistel and Pauwels 2002. Herpetol. Rev. 33:120–121).

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MANTELLA NIGRICANS (NCN). **NOCTURNAL ACTIVITY.** The Malagasy poison frogs of the genus *Mantella* are considered diurnal species. This is corroborated by their aposematic bright coloration, a character which is usually correlated with diurnal activity (Vences et al. 1999. Alytes 17[1–2]:3–72). To my knowledge there are no records of nocturnal activity for any of the 17 species of this genus. Here I report nocturnal activity in *M. nigricans* in NE Madagascar, Masoala Peninsula, Menamalona Site (Antalaha Fivondronana, Antsiranana Faritany, 15°22.87'S, 49°59.27'E, 780 m elev.). Menamalona is also a new site for the species' distribution. Species determination and locality were verified by M. Vences. On 15 December 1999 at 1930 h (ca. one hour after sunset), while searching for other amphibians following standard methods (opportunistic searching and bioacoustic identification), I heard chirping and metallic notes emitted by frogs at ground level. I recorded these calls for several minutes. I then spotlighted the calling frogs—two male *M. nigricans* engaged in territorial/sexual interactions. Vocalizations in this species (as in other *Mantella* spp.) are usually emitted during the daytime when temperatures are sufficiently high. The nocturnal vocalization reported herein may be explained by the high sexual motivation of the frogs (they were likely at the peak of their breeding activity) and the high air temperature (23°C).

The specimens are catalogued in the herpetological collection of Museo Regionale di Scienze Naturali, Torino, Italy (temporary numbers: MRSN-FAZC 10399-10400). Thanks to J. E. Randrianirina for help in the field, and to the Wildlife Conservation Society for logistical assistance.

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RANA AURORA DRAYTONII (California Red-Legged Frog) **PREDATION**. Predation on the federally threatened *Rana aurora draytonii* tadpoles and metamorphs by the introduced bullfrog (*Rana catesbeiana*) has been documented (Cook and Jennings 2001. Herpetol. Rev. 32:182–183). Here, I expand on the life stages of California red-legged frog taken by bullfrogs.

On 16 March, 2001 at Ledson Marsh, Annadel State Park, Sonoma County, California an adult female bullfrog (195 mm SUL, 805 g [including stomach contents], and 71 mm gape) was observed at a known California red-legged frog breeding site. The bullfrog was lethargic and was easily captured. Inspection of its stomach contents produced an adult male California red-legged frog (95 mm SUL, 85 g) with partially digested legs. The bullfrog and prey are catalogued at the California Academy of Sciences; CAS 221058 (*R. catesbeiana*) and CAS 221059 (*R. a. draytonii*).

This predation observation indicates that bullfrogs are capable of taking adult-sized California red-legged frogs. The predator bullfrog was a large individual, although not the largest observed at the marsh. The average SULs of adult bullfrogs at this locality are 167.2 ± 10.3 mm (N = 17 males) and 162.071 ± 31.3 mm (N = 14 females). The ingested *Rana aurora draytonii* was of average size for males. The average SULs at this locality are 99.4 ± 10.4 mm (N = 72 males) and 108.0 ± 14.3 mm (N = 73 females).

Predation on adult *R. a. draytonii* can have a disproportionate effect on a population compared to the predation on younger life stages. The California red-legged frog has an r-strategy approach to reproduction, including production of many offspring; low survival rate at the egg, tadpole, and metamorphic life stages; and few frogs reaching sexual maturity. Therefore, resource managers should be aware that the loss of a few breeding adults could significantly decrease reproductive output and frog numbers in a local population. Also, adult males are likely to be more vulnerable to predation during breeding periods because of their increased activity and congregation at breeding choruses.

My thanks to Philip T. Northen for reviewing the manuscript. Permission to handle and collect specimens was granted under U.S. Fish and Wildlife Service and California Department of Fish and Game permits.

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TESTUDINES

GOPHERUS POLYPHEMUS (Gopher Tortoise). **NEONATE DIET**. Although a variety of food items (principally foliage, but also including insects, carrion, rocks, charcoal, and bone material) are reported to be consumed by adult and young gopher tortoises (Garner and Landers 1981. Proc. Conf. Southeast Assoc. Fish and Wildl. Agencies 35:120–134; Macdonald and Muschinsky 1988. Herpetelogica 44:345–353; Jackson and Ostertag 1999. Herpetol. Rev. 30:40), little is known about the dietary requirements of neonates. On 30 August 2000 a neonate gopher tortoise was found on the apron of an active adult gopher tortoise burrow on the Wade

Tract Preserve, Thomas Co., Georgia, USA (30°45'N, 84°00'W), a privately-owned quail plantation under a conservation easement managed by Tall Timbers Research Station. The preserve contains old-growth longleaf pine forest with a mixed shrub oak and wiregrass understory that is maintained using biennial prescribed fires. The neonate tortoise was in a small depression underneath a large Tomahawk™ trap placed at the entrance of the burrow in order to trap the resident adult tortoise. We noticed that the neonate had fibrous root tissue hanging from its mouth and that within the depression small exposed roots were visible. The neonate was of a size that indicates it had recently emerged from a nest (48 mm CL, 50 mm PL, 34 g) (Cox et al. 1987. Florida Game and Freshwater Fish Commission: Nongame Wildlife Program Technical Report No. 4). The animal was brought to the lab, then marked and released at the same location the subsequent evening. Upon release, the neonate walked < 1 m to an area of exposed roots on the burrow apron and proceeded to unearth and eat the roots. This took place for ca. 15 min. before the neonate walked into the adult burrow and disappeared from view.

A prescribed burn was conducted a week prior (24 August 2000) in the area surrounding the tortoise burrow and the only vegetation available of an appropriate height for the neonate was resprouts of wiregrass *(Aristida stricta* Michx.). We believe the neonate was eating roots because of the scarcity of green foliage available following the burn and that fibrous roots may provide a temporary nutrient source for neonate tortoises during periods of low food availability.

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MACROCLEMYS TEMMINCKII (Alligator Snapping Turtle). **AERIAL BASKING**. *Macroclemys temminckii* is a highly aquatic turtle that rarely leaves the water except to nest (Ernst et al. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington and London. 578 pp.). In fact, we are aware of only one previously published observation (Ewert 1976. Herpetologica 32:150-156) of aerial basking by this species.

On 24 August 1998 one of us (JAS) captured a recent hatchling (yolk scar and egg tooth evident) in a basking trap placed under an emergent snag in the Chickasawhay River, Greene Co., Mississippi, USA. The turtle had a carapace length of 4.2 cm and weighed 19 g. Although the turtle was not seen aerially basking, it is highly unlikely that it could have entered the trap without falling from the above snag. Although the egg tooth was still present indicating recent hatching, the turtle's carapace and head were covered with a thick coat of algae, which it may have been attempting to reduce by basking.

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LACERTILIA

ANOLIS HOMOLECHIS HOMOLECHIS (NCN). **THERMAL BIOLOGY AND MICROHABITAT**. Mean body (29.4–33.8°C) and air temperatures (27.9–32.1°C) have been reported for *Anolis homolechis* at several places in Cuba (Rodríguez Schettino 1999. *In* L Rodríguez Schettino [ed.], The Iguanid Lizards of Cuba, pp. 104–380. University Press of Florida, Gainesville). Previous reports are from several forest types, but do not include microphyllous semi-deciduous forest on limestone. Here, we report dry-season observations of *A. homolechis* from such a forest at El Cenote, 16 km SSE of Playa Larga, Península de Zapata (Zapata Swamp), Matanzas Province, Cuba.

On 9 April 1994 between 0900 and 1130 h, we collected data on 10 males and two females. Lizard body temperatures (T_B) and air temperatures (T_A) at the capture site were obtained with a Schultheis rapid-reading cloacal thermometer. One lizard that was moving when first seen was excluded from the analysis. After taking each body temperature, lizards were released at their place of capture. We also recorded microhabitat data on perch site, orientation, and insolation category.

Both females had a T_A of 31.0°C, and a T_B of 32.0°C. Mean T_B of males (30.6°C; range: 28.0–33.4°C) was higher than their mean T_A (29.9°C; range: 28.0–32.8°C). Air and body temperatures were highly correlated ($r = 0.92$; $p < 0.01$) and increased during the course of the morning from 28.0°C (T_A and T_B) at 0920 h to 32.8°C (T_A) and 33.4°C (T_B) at 1130 h.

Except for one male on the ground, all males were on tree trunks, heads oriented down; mean perch height for males was 0.36 m (range: 0.2–0.5 m; CV = 28.5). Both females were 0.20 m above the ground, also head downwards. Males were as often in the shade as in filtered sun; both females were in filtered sun.

Based on our data, the thermal biology of *A. homolechis* in a microphyllous semi-deciduous forest on limestone during the dry season at Zapata Swamp is similar to that reported by Ruibal (1961. Evolution 15:98–111) during the wet season (T_B = 31.8°C; T_A = 30.5°C) for a population in a broadleaf semi-deciduous forest on limestone located 15 km SW of Camagüey (city). Also, microhabitat use, assessed as position on the tree and body orientation, is similar. However, the mean perch height reported here is less than values reported previously (see summary in Rodríguez Schettino, *op. cit.*), probably because the trees of the forest at El Cenote have thin trunks, are not tall, and are scattered, which provides a homogeneous, structurally low habitat for *A. homolechis*. Our findings suggest that *A. homolechis* maintains a body temperature slightly higher than air temperature during both wet and dry seasons, and that between-site differences in perch height may depend on vegetation structure.

We thank Ramona Oviedo (Institute of Ecology and Systematics, La Habana) for characterizing the forest type.

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ANOLIS SAGREI SAGREI (Cuban Brown Lizard; Chino; Torito). **HABITAT USE AND THERMAL BIOLOGY**. *Anolis sagrei sagrei* is the most common lizard in Cuba, living in almost all vegetation zones, including many habitats modified by humans (Rodríguez Schettino 1999. *In* L. Rodríguez Schettino [ed.], The Iguanid Lizards of Cuba, pp. 104–380. University Press of Florida, Gainesville). Nevertheless, few data address the vegetation types that it uses and its thermal biology. Berovides Alvarez and Sampedro Marín (1980. Cien. Biol. 5:115–122) found this species in a secondary semi-deciduous forest at Tapaste, La Habana Province, Cuba, and Garrido (1980. Peyana 203:1–19) in grasslands and pastures at Península de Zapata (Zapata Swamp), Matanzas Province, Cuba. Ruibal (1961. Evolution 15:98–115) obtained a mean body temperature of 33.1°C and mean air temperatures of 30.7°C in the morning and 33.1°C in the afternoon, during the wet season for a population at Santa Teresa, 9 km W of Camagüey (city). Hence, we report thermal and habitat data on male *Anolis s. sagrei* from a dry swamp forest habitat partly cleared by beekeepers 3 km N of Pálpite, Zapata Swamp.

Data were collected on 8 April (dry season) 1994 between 1500 and 1630 h. Body temperatures (T_B) of active lizards and air temperatures (T_A) at the location of each initial sighting were obtained with a Schultheis rapid-reading cloacal thermometer. We also recorded substrate type and insolation category. Lizards moving when first seen (N = 3) were excluded from the analysis. We collected data for 10 adult males, all first seen on tree trunks situated at the edges of forest clearings. Mean perch diameter was 0.22 m (range: 0.08–0.50 m; coefficient of variation [CV] = 68.3%); mean perch height was 0.57 m (range: 0.2–1.2 m; CV = 64.6%). Seven anoles were oriented head down; three head up.

Although several authors have stated that *A. s. sagrei* perches near the ground, only Llanes Echevarría (1978. University Student Report, University of Havana) and Sampedro et al. (1982. Cien. Biol. 7:87:103) have reported quantitative data on perch height and diameter: Mean height 0.7 m, mean diameter 0.03 m (Llanes Echevarría, *op. cit.*); mean height 0.61 m, mean diameter 0.08 m (Sampedro et al., *op. cit.*). Both of these studies were for populations in semi-deciduous forests. Our values for perch height are lower and for perch diameter higher in a different type of vegetation, suggesting that perch height and diameter of male *Anolis s. sagrei* varies with local vegetation structure.

Mean T_B of males (32.1°C; range: 31.0–34.0°C; N = 7) averaged slightly higher than mean T_A (31.0°C; range: 30.0–32.0°C; N = 7). These values are lower than those obtained by Ruibal (1961, *op. cit.*; T_B = 33.9°C; T_A = 33.1°C), also collected in the afternoon, which may reflect the lower temperatures prevailing in the dry season.

Six of the ten males were in shaded places; the other four were in filtered sun. Ruibal (*op. cit.*) stated that *A. sagrei* is a sun-dwelling species and Rodríguez Schettino (*op. cit.*) noted that it frequently basks in open places, so the observed pattern may reflect the predominance of shade in the study area and/or that lizards sheltering in shade had already achieved their preferred T_B.

We thank Ramona Oviedo (Institute of Ecology and Systematics, La Habana) for characterizing the forest type.

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CROTAPHYTUS COLLARIS (Eastern Collared Lizard). **CAUDOPHAGY.** *Crotaphytus collaris* is a known predator on a variety of lizard taxa (Best and Pfaffenberger 1987. Southwest. Nat. 32:415–426; Lappin 1999. Unpubl. PhD Dissertation. Univ. California, Berkeley; McAllister 1985. Southwest. Nat. 27:358–359). This species also is known to attempt predation on animals larger than itself (Strasser 1931. Bull. Antivenin Inst. America 5:41). Here, I report an unusual instance of predation by a *C. collaris* from Arizona (USA), which, together with information from laboratory feeding experiments, suggests that prey lizard morphology may influence the incidence of caudophagy. Specifically, the evidence supports the hypothesis that caudophagy is more likely to occur when the prey lizard possesses anti-predator integumentary modifications, such as the cycloid scales and osteoderms of skinks.

At 0515 h on 3 May 1996, I encountered an adult (102 mm SVL) male *C. collaris* on a large granite boulder along Boriana Mine Rd. ca. 1 mi N of Wabayuma Peak turnoff going to Prescott, Yavapai Co. The lizard was bleeding from the right corner of mouth and four spots on top of the head, giving the appearance of pinpricks. Subsequent stomach-flushing revealed that the *C. collaris* had recently eaten the tail from a large skink. The tail section consumed was the original (i.e., unregenerated) and measured 92.5 mm. The locality and comparison of the tail with those of museum specimens revealed it to belong to a *Eumeces gilberti*. Further, its size and lack of ventral juvenile coloration suggest that the *Eumeces* to which it belonged was an adult, possibly comparable in size to the *C. collaris*. The injuries to the *C. collaris* appear to have been incurred during the interaction with the *Eumeces*.

Skinks are more likely than other potential lizard prey taxa to be subjected to caudophagy rather than complete consumption by *C. collaris*. During five captive feeding trials I conducted among three individual adult *C. collaris*, caudophagy alone occurred every time a *Eumeces* sp. was the prey item, whereas caudophagy alone occurred in < 4% of trials with other prey lizard taxa (e.g., *Uta*, *Cnemidophorus*) [caudophagy in 2 of 57 trials among 25 *C. collaris* individuals]. During feeding trials with *Eumeces* sp. as the prey item, the *C. collaris* would chase the skink, repeatedly attempt to close its mouth on its body, and inevitably have the skink slip out of its jaws. Usually after multiple attempts to grab the skink by the body, the *C. collaris* would inevitably bite the tail, which was then autotomized and eaten.

Squamates that are skink-eating specialists possess modifications of the trophic apparatus that are proposed to aid in gripping the hard and slippery integument of skinks, such as hinged teeth in *Lialis* (Patchell and Shine 1986. J. Zool. Lond. 208:269–275) and snakes (Savitzky 1981. Science 212:346–349) and a unique intramaxillary joint in *Casarea* (Frazzetta 1970. Am. Nat. 104:55–72; Cundall and Irish 1989. J. Zool. Lond. 217:189–207). Observations herein support the view that integumentary specializations of skinks are effective anti-predator modifications,

at least when the predator does not possess a specialized trophic apparatus to cope with the modifications.

Specimens were handled and collected under Arizona Game and Fish Scientific Collecting Permit SP657703 issued 8 April 1996 to A. K. Lappin.

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CYCLURA CYCHLURA INORNATA (Allen Cays Rock Iguana). **BIRD PREDATION.** Although iguanas are generally considered to be herbivorous (e.g., Pough et al., 2001. Herpetology. Prentice Hall. New Jersey. 577 pp.), some members of the genus *Cyclura* are known to supplement their diet with vertebrate carrion (Iverson 1979. Bull. Florida State Mus., Biol. Sci. 24:175–358.; Glenn et al., *in press*). Based on these observations, it has been suggested that potentially all members of this genus are opportunistic scavengers of vertebrate carcasses (Glenn et al., *op. cit.*). We augment recent observations with data from the Allen Cays, northern Exuma Islands, Bahamas indicating that *C. cychlura inornata* can also prey on nestling birds.

Occasional bird consumption by *C. c. inornata* was first suspected when carcasses of Audubon's Shearwaters (*Puffinus lherminieri*) with missing breasts and heads were periodically found in substantial numbers on both Allen and U Cays (mummified carcasses of at least a dozen now archived with Sandra Buckner, Past President of the Bahamas National Trust). During the summer of 2001, at least 100 such carcasses were discovered on Allen Cay, where a large population of Audubon's Shearwaters resides (Carey et al. 2001. Protected Areas Management Strategy for Bahamian Terrestrial Vertebrates: Iguanas and Seabirds. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, Minnesota). A small population of *C. c. inornata* (at least 11 individuals) was confirmed on this same cay. Rock iguanas on this cay are larger than those on either Leaf or U Cay. Of six captured on Allen Cay, four were males (56.5–62.0 cm SVL), and two were females (51.0–53.0 cm SVL). The largest iguanas recorded on the other islands over 21 years of fieldwork were a male at 48.7 cm SVL and a female at 39.5 cm SVL (Hines, Iverson, and Valiulis, unpubl. data). While this difference in size may be attributable to differences in available food plants (e.g., presence of morning glories, *Ipomea pes-caprae*) or reduced competition due to the low population size, bird consumption may contribute to these differences.

Direct evidence of iguana predation was recorded on 13 May 2001 at 1530 h on U Cay, when an adult female iguana (31.9 cm SVL) was observed (B. Dunham, S. Young, pers. comm.) shaking a shearwater nestling by the head, which it eventually bit off. The iguana immediately took cover in a nearby burrow, but a shearwater nest was discovered within 1 m of the burrow, suggesting that the iguana had taken the hatchling from its nest. Fresh blood around the iguana's mouth, and the fresh, decapitated carcass of the shearwater nestling support the notion of predation.

Another possible predation incident was recorded on Leaf Cay on 1 July 2001, when a nestling white-crowned pigeon (*Columba leucocephala*) disappeared from its nest 120 cm up in a silver thatch palm (*Coccothrinax argentata*). The nest was covered in blood, and the legs of the nestling were found on the ground ~2 m away. The nest appeared to have been visited by a terrestrial predator as one side of it was crushed, and a high local canopy density would have limited access by a raptorial bird. Rock iguanas are often found in trees (Iverson 1979, *op. cit.*) and are the largest terrestrial organism on this mammal-free island, making them a prime suspect in this second predation incident.

Besides the aforementioned incidents, vigorous nest defense by *Mimus gundlachii* (Bahamas Mockingbird) against *C. c. inornata* implies that iguana predation on nestlings may be frequent. On 15 June 2001, we found an active *M. gundlachii* nest (three eggs) 107 cm up in a wild saffron tree (*Bumelia americana*) on the southeast corner of Leaf Cay. Nest development and parental behavior were observed from 15 June to 11 July 2001, when the young fledged. Once the eggs hatched, we observed aggressive encounters between the mockingbirds and several *C. c. inornata*. When iguanas approached the area below the nest, one parent would dive and peck at the iguana's tail from the ground or from a nearby branch or stump. If one parent was insufficient to deter the iguana, both birds would attack by alternately diving at and pecking at the tail. The iguana would respond by slapping its tail at the attacker and trying to deflect the attacks (Quicktime™ movie clip [14.5 MB] of mockingbird aggressive behavior toward iguanas available from JBI [johni@earlham.edu]). In all cases the birds persisted until the iguana had retreated to a distance of at least 3 m from the nest.

Evidence suggesting that rock iguanas hunt adult birds is lacking, but our observations indicate that *C. c. inornata* may opportunistically prey on poorly mobile chicks. The relative importance of predation on hatchling birds in the diet of *C. c. inornata*, which is likely both habitat- and circumstance-specific, remains unclear.

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ELGARIA KINGII NOBILIS (Arizona Alligator Lizard). **MAXIMUM SIZE.** Based on measurement of > 400 *Elgaria kingii* from throughout Arizona (USA), Bowker (1994. Herpetol. Rev. 25:121) reported a maximum size for the species to be 133 mm SVL, a male from Camp Geronimo Boy Scout Preserve, 6 mi E Pine, Gila County. Here, we report on a larger individual from Greenlee County, Arizona.

On 9 September 2000 at 1745 h, we captured a large male *Elgaria kingii nobilis* with an incomplete tail moving among piled rocks in juniper-oak woodland at the bottom of Dry Prong Canyon, Blue Range, Greenlee County, Arizona (33°17'41"N, 109°07'00"W), USA. This male measures 140 mm SVL. Andrew T. Holycross verified its size. We deposited the specimen in the Arizona State University Herpetology Collection (ASU 33047) and was collected under license No. HL101541 from the Arizona Game and Fish Department issued to TCB.

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EUMECES FASCIATUS (Five-lined Skink). **DIET**. Although the five-lined skink is widely distributed in eastern North America, little information on its diet has been published. Several accounts published before the mid-1950s (Fitch 1954. Univ. Kansas Publ. Mus. Nat. Hist. 8:1–156; and refs. within) suggest that five-lined skinks prey on arthropods but that preference for arachnids (spiders and harvestmen), orthopterans (grasshoppers), and blattids (cockroaches) exists. Little information on the natural diet of *E. fasciatus* in the Canadian portion of its range has been published (but see Judd 1962. Can. Field-Nat. 76:88–89).

As part of a continuing long-term study of *E. fasciatus* at Point Pelee National Park, Leamington, Ontario, Canada (42°10'N, 82°30'W) (Hecnar 1991. M.Sc. thesis, Univ. Windsor, Windsor, Ontario; Hecnar 1994. Can. J. Zool. 72:1510–1516; Hecnar and M'Closkey 1998. Biol. Conserv. 85:213–222), we conducted diet analyses. In late June and early July 2000 we collected 21 scats along an 8 km transect of stabilized dune habitat. We collected intact (with uric acid cap), relatively fresh scats that were spatially segregated to ensure that they represented separate individuals. We measured total scat length (mm) and preserved scats in vials containing 40% ethanol.

To identify food items, we separated scat contents in water using probes under a dissecting microscope. Scats consisted of fragments of the hard chitinous exoskeletons of individual arthropods. Remains of individual prey items tended to occur in succession along the length of each scat. This permitted us to determine the number of items per scat and numerous larger fragments facilitated identification. In most cases, parts of food items were missing, suggesting that skinks battered their prey to subdue it prior to swallowing (Fitch 1954, *op. cit.*).

We found a total of 68 individual food items belonging to 11 taxonomic orders among the 21 scats (Table 1). Over 80% of the items belonged to 4 orders: Araneae (25%), Coleoptera (22%), Opiliones (18%), and Blattaria (18%). Nearly half of the items (43%) were arachnids (aranids + opiliones). Individual scats contained an average of 3.2 ± 0.36 items (range 1–6) but the number of items per scat was not correlated with scat length ($r = 0.31$, $p = 0.17$). In many cases we were able to identify prey to taxonomic levels lower than order. Our most detailed identifications and their incidence (% of scats) included: terrestrial ground snail (*Helix*) shells (14%) (Table 1 [A]), jumping spider (Salticidae) and wolf spider (Lycosidae) (57%) (B), harvestmen (Opiliones) (48%) (C), grasshopper (Acrididae) (10%) (D), cricket (Gyrillidae) (10%) (E), cockroach (43%) (F), leafhopper (10%) (G), antlion (Myrmeleonidae) (5%) (H). Beetle (Order Coleoptera) remains consisted of fragments, entire beetles, or grubs (43%) (I). Most were ground beetles (Carabidae) and several individuals were *Bembidion* sp. Other individual items included a weevil (Family Curculionidae, subfamily Brachyderinae) (5%), carpenter ant (Formicidae: *Camponotus* sp.) (5%) (J), and blue-bottle fly (Calliphoridae) (5 %) (K).

Most of the food items were ca. 1–2 cm long and from mobile ground-dwelling arthropods rather than actively flying forms. However, more sedentary prey items such as ootheca (egg cases) and grubs suggest that skinks also rely on chemosensation for locating prey. These results concur with other studies which suggest skinks are gape-limited predators that locate prey by both visual and chemosensory detection (Fitch 1954, *op. cit.*; Judd 1962, *op. cit.*). Five-lined skinks spend most of their time under cover objects, from which they make short foraging forays (Fitch and von Achen 1977. Herpetologica 33:303–313). Most prey we detected were forms that commonly occur among grasses and herbs in open stabilized dune habitat. Most of the beetles we found were ground beetles (Carabidae) which are known to be primarily nocturnal; however, skinks are diurnal. This observation suggests that Pelee skinks must also feed when they are under cover objects where beetles are commonly found in the daytime as previously reported by Fitch (1954, *op. cit.*). Ants are common in our study area (Hecnar 1991, *op. cit.*) but we only found one carpenter ant in a scat. This relatively large ant is probably greater than the minimum size of

TABLE 1. Number of arthropods and other taxa identified in skink scats. A (Phylum: Mollusca, Class: Gastropoda); B (Phylum:Arthropoda, Class: Arachnida, Order: Araneae), C (Order: Opiliones); D (Class: Insecta: Order: Orthoptera, Family: Acrididae); E (Order: Orthoptera, Family: Gryllidae); F (Order: Blattaria); G (Order: Homoptera); H (Order: Neuroptera); I (Order: Coleoptera); J (Order: Hymenoptera); K (Order: Diptera). Note: 1 flower head (*Fragaria* sp.) in scat 2.

Scat	A	B	C	D	E	F	G	H	I	J	K	Total
1					1							1
2			1			1						2
3			1									1
4		1		1				1	3			6
5						1						1
6						2						2
7			1			1						2
8		1							4			5
9	1	1	2									4
10		1	1						1		1	4
11	1	1				1			2			5
12	1	2	1						1			5
13		2										2
14						2						2
15						2			1			3
16		2	1			1						4
17						1						1
18		2	2						1			5
19		1	1		1				1			4
20		2	1							1	1	5
21		1		1			2					4
Total	3	17	12	2	2	12	2	1	15	1	1	68

moving prey that will attract attention by a skink. Fitch (1954, *op. cit.*) also found few ants in Kansas five-lined skink diets and noted that those eaten were individuals of large bodied ant species. We did not sample arthropods in the environment to determine the spectrum of potential prey, but arachnid (spiders and harvestmen) remains in the scats were clearly over-represented (43% of items, 71% incidence) in the diet. Arachnids comprised 52% of food items in scats in Kansas (Fitch 1954, *op. cit.*) and 60% of stomach contents in Kentucky skinks (Barbour 1950. Copeia 1950:100–107). Judd (1962, *op. cit.*) examined stomach contents of seven five-lined skinks from Rondeau Provincial Park (58 km E of Point Pelee) and reported a preponderance of crickets, spiders, and cockroaches. Soft-bodied arthropods may be underrepresented in scat analyses because they would be more easily digested than hard-bodied species. However, Fitch (1954, *op. cit.*) reported similar results from both stomach and scat analyses. Our results strongly suggest that five-lined skinks at Point Pelee National Park are arachnid specialists as they appear to be elsewhere in their range (Fitch 1954, *op. cit.*).

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LEIOCEPHALUS CARINATUS VIRESCENS (Exuma Islands Curlytail Lizard). **INTERSPECIFIC AGGRESSION**. Knapp (2001. Herpetol. Rev. 32:104–105) reported two aggressive interactions between a resident adult male curlytail, *Leiocephalus carinatus virescens*, and two Bahamas mockingbirds, *Mimus gundlachii*, that were each preceded by an aggressive encounter between an intruder curlytail and the resident male. Based on his observations, Knapp (2001) suggested that either high hormone levels in the resident curlytail arising from its interaction with intruders may have prompted unusual aggressive responses towards the mockingbirds, or curlytail-mockingbird aggression is routine. We provide observations that support the latter.

On 15 June 2001, we discovered a *M. gundlachii* nest with three eggs at a height of 107 cm in a wild saffron tree (*Bumelia americana*). The tree was located at the edge of a clearing at the southeastern point of Leaf Cay, northern Exuma Islands, Bahamas (24°44'48"N; 76°50'09"W). Development of the nest and parental behavior were observed from 15 June to 11 July 2001 when the young fledged. Mockingbirds on this island generally ignore adult curlytails, but during this time, we observed at least 15 aggressive interactions between the parent mockingbirds and a male curlytail (~10 cm SVL) defending an area below the nest. All but one or two of these encounters occurred in the absence of other nearby curlytails, so no opportunity existed for aggression in the resident curlytail to be intruder-facilitated. Observed interactions were between the resident curlytail and one parent or the other, but only once or twice included both parents. In instances when the mockingbirds were on the ground, the curlytail would generally chase the birds off by lunging at them with an open mouth. At other times, the birds would dive at the curlytail from an elevated position. In these situations, the curlytail would flee from the birds as they attempted to peck its tail. Aggressive encounters between the curlytail and the mockingbirds at least doubled in frequency once the eggs hatched. The extent of these interactions suggests that curlytail-mockingbird aggression is a routine component of their natural history.

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LEIOCEPHALUS MACROPUS, LEIOCEPHALUS RAVICEPS, AND LEIOCEPHALUS STICTIGASTER (Curly-Tailed Lizards). **CLUTCH SIZE**. Lizards of the genus *Leiocephalus* occur throughout the Caribbean and the Bahamas (Pregill 1992. Univ. Kansas. Mus. Nat. Hist. Misc. Publ. [84]:1–69). Despite this wide distribution, relatively little is known about reproduction in the genus. Hence, we report observations of clutch size in three species of Cuban *Leiocephalus: L. macropus* and *L. raviceps* primarily from the US Naval Base at Guantanamo Bay, and *L. stictigaster* from Cienfuegos, Granma, Holguin, and Villa Clara based on dissection of specimens from the University of Kansas Museum of Natural History.

Using counts of both follicles and eggs, we found mean clutch size to be 1.75 ± 0.25 (N = 4; range = 1–2) in *L. macropus* and 1.67 ± 0.21 (N = 6; range = 1–2) in *L. raviceps*. The lone female *L. stictigaster* examined contained two enlarged follicles.

Our observations on clutch sizes in these three *Leiocephalus* species agree with previous observations of small clutch sizes between 1 and 2 eggs in the genus. Data exist for three additional species: *L. psammodromus* (Caicos Islands) for which Smith and Iverson (1993. Can. J. Zool. 71:2147–2151) reported a mean clutch size of 1.72 (N = 42), and *L. schreibersii* and *L. semilineatus* (both Dominican Republic) for which Schreiber et al (1993. Florida Sci. 56:82–90) and Nelson et al. (2001. Contemp. Herpetol. [http://dataserver.calacademy.org/herpetology/herpdocs/ch/2001/1/index.htm]) reported clutch sizes, respectively, of one (N = 1) and 1–2 (N = 8).

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PHRYNOSOMA CORNUTUM (Texas Horned Lizard). **REPRODUCTION**. To date, only four studies exist describing the nesting behavior of *P. cornutum* in the wild; these reports describe 1–2 nest constructions, and all are from Texas (Edwards 1896. Zool. Anz. 19:108–111; Strecker 1908. Proc. Biol. Soc. Washington 21:72, 165–170; Cahn 1926. Amer. Nat. 60:546–551; Ramsey 1956. Herpetologica 112:239–240). *Phrynosoma cornutum* is of particular conservation concern because of observed declines throughout much of its known range; the species is listed

as threatened in Oklahoma and Texas (Levell 1995. A Field Guide to Reptiles and the Law. Serpent's Tale, Lanesboro, Minnesota. 240 pp.). We augment the few behavioral data on *P. cornutum* reproduction with our observation of nesting from a native tallgrass (*Andropogon* sp.) prairie in northeastern Kansas (USA), near the northeastern limit of its range (Collins 1993. Amphibians and Reptiles in Kansas, 3rd edition. University of Kansas Press, Lawrence. 397 pp.).

We encountered an adult female *Phrynosoma cornutum* at 1530 h on 12 June 2001 along the public trail at Konza Prairie Biological Station (39°06'22.7N, 96°36'32.0W), which includes ca. 3500 ha of native Flint Hills tallgrass prairie (Reichman 1987. Konza Praire. A Tallgrass Natural History. University of Kansas Press, Lawrence. 226 pp.). Heinrich and Kaufman (1985. Prairie Naturalist 17:101–112) recorded Texas horned lizards at Konza, but did not describe reproductive behavior. We initially observed this individual for ca. 20 min directly outside a burrow located in bare soil between the prairie vegetation and the trail. The burrow appeared newly formed, with excavated soil still piled loosely around it. The burrow entrance was ca. 4 cm x 6 cm, but the interior chamber was noticeably larger, extending ca. 10–12 cm below the surface.

Upon returning at 1830 h to renew observations for another ca. 15 min, we found the female depositing eggs with only her head and front legs protruding from the burrow (Fig. 1). One strong lateral abdominal contraction preceded the laying of each egg. Throughout oviposition, the lizard often closed its eyes and our presence did not appear to disturb her. Eggs could be seen behind the lizard, but we could not estimate their number. The female finished laying after ca. 10 min and then began to scrape the excavated soil over the eggs with her hind legs, using one leg at a time. We discontinued observations when the lizard appeared to become more aware of our presence. At 2030 h, we returned to the site a final time; the lizard was gone and the burrow was completely covered. We observed no mound of soil where the entrance had been, which differs from observations of Ramsey (*op. cit.*).

Impending trail maintenance (due to heavy rains in June), led us to remove the eggs from the nest on 1 July to prevent their destruction. We removed 23 eggs that varied slightly in size and color, but were generally ca. 1 cm along the long axis and pink or off-white in color. This clutch size is at the low end of the previously reported means (mean = 23–30: range 7–30+; Burt and Hoyle 1934. Trans. Kansas Acad. Sci. 37:193–216; Howard 1974. J. Arizona Acad. Sci. 9:108–116; Fitch 1985. Univ. of Kansas Mus. Nat. His. Publ. 76:1–76), which may reflect the northern locale of our observation. The eggs were deposited in three distinct layers, each separated by one layer of soil. Strecker (*op. cit.*) and Cahn (*op. cit.*) also reported layering with soil. We also found that many eggs in the clutch were touching and somewhat adherent to one another, which generally differs from the observations of Cahn (*op. cit.*) and Strecker (*op. cit.*), who found sand between all eggs, (not just between layers). However, Strecker (*op. cit.*) did describe a *P. cornutum* nest in a hollow covered by a railroad tie that had little or no soil separating the eggs.

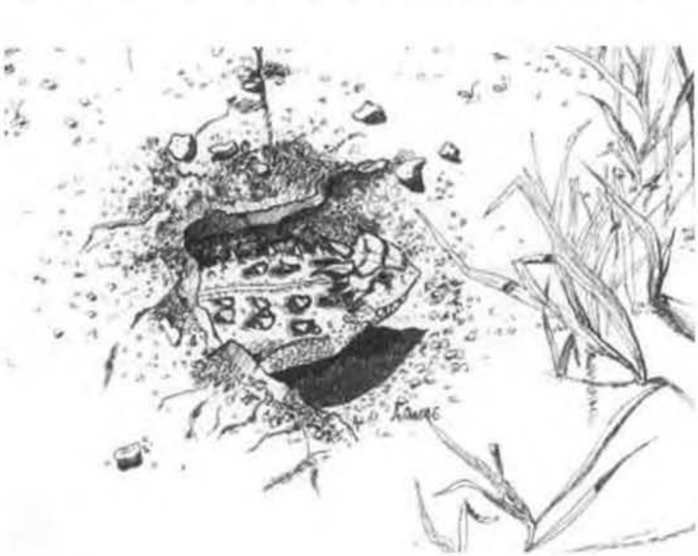

FIG. 1. Female *Phrynosoma cornutum* nesting, Konza Prairie, Kansas.

We incubated the eggs in moist vermiculite at a constant 23°C ± 1°C. On 1 August the eggs averaged 17.4 mm in length (range 13.3–18.5 mm) and 14.3 mm in width (range 13.3–15.5 mm). A dead embryo from a damaged egg found on 1 August measured 17.0 mm SVL and 25.8 mm total length. Of the 23 eggs, 10 hatched between 27 and 31 August, 77–80 days after they had been laid. Three of the eggs were desiccated when we removed them from the nest, four spoiled during incubation, and the others were accidentally punctured during incubation. Hatchlings averaged 22.4 mm SVL (range 20.8–23.8 mm) and 29.7 mm total length (range 28.2–32.7 mm). Hatchling mass was 0.8–0.9 g. The dead embryo measured 31 days earlier on 1 August was 5.4 mm shorter in SVL and 3.9 mm shorter in total length than mean SVL of these hatchlings. The SVL of the dead embryo measured 1 August was 66% of its total length, whereas average SVL of the hatchlings was 75% of their total length. The dead embryo and hatchlings had complete tails, thus, variation in percentage of total length suggests disproportionate growth between the trunk and tail. The hatchlings were kept in an open-topped plastic container with a 40-watt sun lamp (12L/12D cycle) available for basking until ambient temperatures were suitable for release. During this time, hatchlings were fed small ants and were given water ad libitum. We observed them eating and they appeared alert and healthy, despite this, all died within two days of each other at about two weeks of age.

We thank the Nature Conservancy and Kansas State University (KSU) Division of Biology, which owns and manages the Konza Prairie Biological Station, respectively. Collection of animals occurred under permit SC-066-2001 from the Kansas Department of Wildlife and Parks. Collection, care, and handling of animals in captivity followed SSAR guidelines under KSU IACUC approval. A Research Experience for Undergraduates Program-administered NSF grant in grassland ecology supported this project.

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PHRYNOSOMA CORNUTUM (Texas Horned Lizard). **BEHAVIOR**. Studying diurnal activity of *P. cornutum* associated with temperature regulation, Heath (1965. Univ. California Publ. Zool. 64:97–136) found that lizards sought shade at body temperatures of 34–41°C. Shade-seeking behavior was documented as unrelated to ambient air temperature, rather reflecting substrate temperature and radiant heat from the sun. Whitford and Bryant (1979. Ecology 60:686–694) also observed shade-seeking in *P. cornutum,* recording climbing onto low shrubs for shade during "hot" conditions. This note photodocuments *P. cornutum* sitting in the shade of a human-made object, which may reflect a thermoregulatory option in an agriculturally disturbed habitat.

On 15 June 2000 at 1635 h, we observed a *P. cornutum* positioned on the shaded side of a wooden fence-post ca. 20 cm above the ground (Fig. 1). The fence separated a cattle pasture from the surrounding cotton field next to County Road 223 (Wilbarger County, Texas, USA). The pasture had moderate densities (10–15/m^2) of mostly short grasses and soil in the vicinity was loosely packed sand. Air temperature was 36.8°C, the substrate temperature (measured at several points between the surface and 7 cm of depth) in sunlight was 38.9°C and 38.3°C in the area shaded by the fence-post, and relative humidity was low (20.3%). The horned lizard, which we observed on the shaded side of the fence-post for 30 min, made no movement during the observation interval and had its eyelids partly closed. Subsequent capture revealed it to be an adult male 9.4 cm SVL and weighing 41.3 g. We noted several harvester ant (*Pogonomyrmex* sp.) mounds in the turn-row of the cotton field and pasture opposite the fence. No ant mounds were observed in the planted area of the cotton field

Climbing the shaded side of the fence-post is novel because it was a fairly smooth human-made object. Only low-growing plants have been documented as perch sites for *P. cornutum* (Whitford and Bryant, *op. cit.*). The lizard might have also been using the perch as an escape from predators; however, because substrate temperatures were within the range of body temperatures over which shade-seeking has been documented (Heath, *op. cit.*), we suggest the non-mutually exclusive thermoregulatory hypothesis for the observed behavior. Lastly, this observation illustrates one way in which the Texas horned lizard can utilize agriculturally impacted areas.

FIG. 1. *Phrynosoma cornutum* using shaded sided of fence-post for thermoregulation,Wilbarger Co., Texas.

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PHRYNOSOMA MODESTUM (Round-tailed Horned Lizard). **RAIN-HARVEST DRINKING BEHAVIOR**. Rain harvesting is a behavior that lizards use to move rainwater collected on the skin to the mouth for ingestion using (1): inter-scalar capillary forces associated with the integument and/or (2) postural behaviors. It has been reported in two species of horned lizards (Sherbrooke 1990. J. Herpetol. 24:302–308; Peterson 1998. Southwest. Nat. 43:391–394) and five agamids (Gans et al. 1982. Amphibia-Reptilia 3:57–64; Schwenk and Greene 1987. J. Herpetol. 21:134–139; Sherbrooke 1993. J. Herpetol. 27:270–275; Vesely and Modry 2002. J. Herpetol. 36:311–314). Here, I report evidence suggesting that *Phrynosoma modestum*, a small species (43–66 mm adult SVL) in the genus (Sherbrooke and Middendorf 2001. Copeia 2001:1114–1122) with particularly smooth dorsal skin (lacking elongated spines), also utilizes a form of rain-harvesting to collect water on its integumental surfaces for transport to the mouth for drinking. I have assembled observations collected over more than two decades to clarify the occurrence of this phenomenon in *P. modestum*. Unless otherwise noted, observations were made on lizards from eastern Cochise Co., Arizona, and Hidalgo Co., New Mexico (all USA).

At ca. 1700 h on 15 July 1977 while a thunderstorm threatened, 12 adult *P. modestum* (44–65 mm SVL) collected 6 km NE Portal, San Simon Valley, Arizona, were individually tested on a rock in the field as a series of water droplets (ca. 20–40) was released onto their heads from an eye dropper over 3-min periods. When presented with water in this manner, four of these lizards exhibited slow opening and closing jaw motions (upper and lower labial scales barely parted from one another back to the angle of the jaw) suggesting that ingestion of water was occurring; all but one showed movements of the nictitating membrane, suggesting that lizards were wiping water off their eyes. In contrast to experiments with *P. cornutum* (Sherbrooke 1990, *op. cit.*), water droplets beaded on the backs of the *P. modestum* and no evidence of capillary flow was seen.

On 13 June 1984, 10 adult *P. modestum* (50–64 mm SVL; 4 females, 6 males) were individually placed into 250 ml glass beakers surrounded by opaque white paper. Five ml of water was pipetted into each beaker, which covered the bottom of each beaker to a depth of 1 mm except at the sides, where an adhesion meniscus caused water to rise an additional 2 mm. Lizards were observed to ensure that they did not move in a manner that would augment

wetting of skin surfaces. Final examination after 30 min showed that all lizards had dry heads, and the back was dry in all but one animal (this was the largest individual, which could only fit into the beaker with its limbs appressed against the container walls); all lizards had the legs and ventral surfaces wetted. These results contrast with a similar experiment with 10 adult *P. cornutum*, which was conducted using 3.8-liter metal cans in which a 5-mm depth of water was placed (Sherbrooke 1988. Ph.D. dissertation, Univ. Arizona, Tucson). All but the back of one was wet after 30 min, and after 60 min, heads of all 10 were wet.

On 29 August 1984, I further tested the notion of capillary flow by examining 3 adult female *P. modestum* (56–64 mm SVL; including one from Graham Co., Arizona) under a dissecting scope to which droplets of methylene blue-dyed water had been applied to their backs. Two exhibited capillary flow of water and one did not. On 13 and 15 October 1984, four additional, similar tests were conducted on the same two lizards that exhibited capillary flow on 29 August. In one test, one lizard showed rapid inter-scalar flow of water across the skin surfaces, but in the remaining three tests, no capillary flow was observed. On 26 July 1999, I tested 4 additional adult *P. modestum* (46–58 mm SVL; 1 female, 3 males), this time applying drops of methylene blue-dyed water with a syringe onto the lizards' backs. In two cases, the water moved rapidly across the integumental surface, whereas in the other two cases it only did so slowly.

On 9 July 2001, 23 adult *P. modestum* (43–65 mm SVL; 6 females, 17 males) were used to further test inter-scalar flow of water. Methylene blue-dyed drops (0.05 ml each) were applied to the midback using a full 1 cc syringe and the spread of the water was observed for 1 min. Rate of water spread over the back varied considerably, being slow or fast, and may have been influenced by the mass of the "pool" of standing water on the back. Water appeared to move through inter-scalar channels, with a clear and narrow front a few scales wide preceding the dyed water.

On 18 June 2001, to examine ingestion of water collected on skin surfaces from simulated rainfall, I weighed 25 adult *P. modestum* not fed for the previous two days at 1500 h to the nearest 0.01 g (mean = 8.87 g, s = 2.29 g, SE = 0.46 g, range: 4.16–13.15 g) and placed them in an outdoor wire-meshed enclosure (7.0 x 3.8 x 2.4 m high) with sheet metal walls on the lower 60 cm. The substrate was sand and gravel, raked free of leaves, and the enclosure was free of food items. A sprinkler started at 1545 h simulated a heavy shower for 1 h, during which time the sun remained shining. Lizards exhibited jaw motions (duration of six continuous-jaw-motion events determined from video record was 9–20 sec with a mean rate of 1.45 jaw motions/sec) and body postures typical of rain harvesting, suggesting drinking. Postures involved extension of four limbs to raise the abdomen above the substratum, but still horizontal to it, and lowering of the head similar to *P. cornutum* (Fig. 1.; Sherbrooke 1990, *op. cit.*). Behaviors suggesting drinking were not noted after the first 20 min. Posture and water flow patterns, inter-scalar (capillary) or sheet-flow over scale surfaces, may vary with intensity of rainfall and rain droplet size (see raised hindquarters when misted, Fig. 1). Immediately after the "rain" treatment, most (N = 23) of the lizards were puffed up, suggesting inhalation and pulmonary retention of air. This may represent a defensive response (allowing flotation) to potential flooding conditions. Lizards were allowed to dry for 24 h before weighing so that water held in integumental surface channels could evaporate and its mass would not be included in the mass changes affected by water ingestion. Twenty-four animals showed weight gain (mean = 0.32 g, s = 0.22 g, SE = 0.04, range: 0.01–0.87 g; mean % body weight = 3.84%, range: 0.17–8.43%); one lizard lost 0.35 g (or 2.66% of its body weight; it may have defecated).

My data illustrate that when wetted in various ways, some of which simulate different precipitation types, *P. modestum* does not consistently exhibit rapid inter-scalar water flow that can carry water to the mouth. Although capillary flow occurs, it appears less efficient than that described for *P. cornutum* and *Moloch horridus*; interspecific differences in integumentary micro-ornamentation may play a role. Further, physical or chemical factors associated with the skin-shed cycle may influence observed differences in flow rates (Sherbrooke 1990, *op. cit.*). Nevertheless, this lizard is able to make postural adjustments to falling water droplets that result in ingestion of water through the jaws and weight gains. The lizard's stance during rain harvesting is variable, from nearly horizontal to steeply slanted, in that the head is low and the posterior abdomen is held much higher. As with *P. cornutum* under heavy rainfall conditions (Sherbrooke 1990, *op. cit.*), the slanted stance probably allows gravity to assist the flow of water draining from the entire dorsal integumental surface, not just that in capillary channels. Misting of lizards with fine droplets of water also elicits a rain-harvesting stance (Fig. 1), but makes tracing integumental water flow difficult. Nevertheless, it may be during such light rainfall events, which occur during dry seasons when animals may be water stressed, that rain harvesting plays its most vital role in water balance for these lizards (Sherbrooke 1990, *op. cit.*).

A third species of *Phrynosoma* exhibiting rain-harvesting behavior suggests that this postural behavior may be widespread in the genus. These data further indicate that the interscalar-capillary water-flow system may have a variable role among species showing postural adjustments for integumental capture of rainfall or drinking, a role which may vary with rainfall intensity. If true, such variation has the potential to contribute not only to more sophisticated phylogenetic resolution within the genus *Phrynosoma*, but to interesting comparisons that address differences and convergent similarities (in posturing and integumental components), among species of this genus and the Australian agamid genus *Moloch*, for which no postural adjustments are reported (Sherbrooke 1993, *op. cit.*; Sherbrooke 1999. Nature Australia 26:54–63), and other agamids.

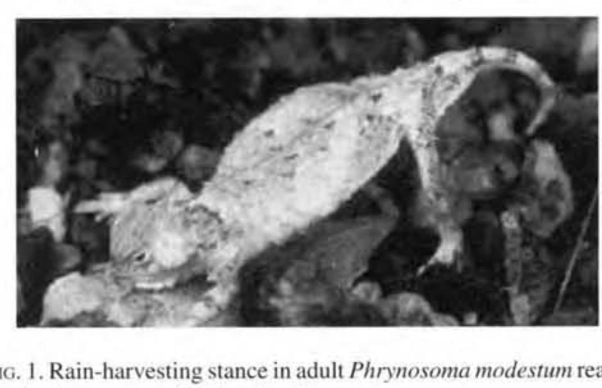

FIG. 1. Rain-harvesting stance in adult *Phrynosoma modestum* reacting to having been sprayed with misted water.

Historical Note: In June 1989, Gordon C. Creel visited me at the Southwestern Research Station and illustrated to me the behavioral response of *P. modestum* to misted water that he had recorded earlier. In June 1968, Creel found a *P. modestum* engaged in an unusual behavior in Tom Green Co. (Texas, USA) during a rain storm. He noted that the lizard's body was elevated off the ground by the hind legs resulting in a 30° forward inclination of the body and the ribs were spread laterally. Interpreting the directing of flow of water down the body to the jaw as drinking behavior, he was later able to obtain other round-tailed horned lizards to repeat the behavior and film it when artificial "rain" was applied. Portions of his filming (which I have viewed) were presented in 1968 at the Texas Academy of Science meeting in Nacogdoches, Texas, but no abstract was published (G. C. Creel, pers. comm.).

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PHRYNOSOMA MODESTUM (Round-tailed Horned Lizard). **DEATH DUE TO PREY (BEETLE) INGESTION**. Prey selection involves decisions during the pursuit and capture of prey that potentially have both positive or negative consequences to predator survival, nutritional requirements and dangers posed by lethal prey defenses. Between 28 April and 12 July 2001, 29 round-tailed horned lizards (43–66 mm SVL) collected in Cochise (Arizona) and Hidalgo (New Mexico) Cos. were maintained in an outdoor wire-mesh enclosure (7.0 x 3.8 x 2.4 m high with sheet-metal walls on the lower 60 cm) at the Southwestern Research Station (1645 m elev.), in Cave Creek Canyon, Chiricahua Mountains, Arizona, USA. A pile of constantly replenished, rotting grocery-store fruit was maintained in the enclosure to serve as a breeding site for fruit flies, tiny beetles, and other attracted insects that served as a food source for the lizards. In addition, an UV light (40 cm fluorescent tube) was run in the enclosure each night to attract nocturnal insects that lizards could feed on. Four juvenile *Phrynosoma cornutum* (40–51 mm SVL) were also maintained in the enclosure. All lizards were used intermittently for behavioral studies that did not involve feeding nor absence from the enclosure for more than 48 h, but did involve drinking sprayed water. In previous seasons, individual round-tailed horned lizards thus maintained had occasionally died unexpectedly of unknown causes. Here, I report several instances of unexpected deaths attributable to ingestion of beetle taxa. These instances may provide one potential explanation for the earlier deaths.

On 30 May, an adult male *P. modestum* (62 mm SVL) was found dead in the enclosure. When dissected on 21 June, a dark bombardier beetle (*Brachinus mexicanus* Dejean, Carabidae; total length 12.9 mm) was found in the lizard's coelomic cavity, and the fore-stomach wall had a 7-mm long ragged lesion. On 20 June, a female *P. modestum* (66 mm SVL) that had laid eggs in the cage on 18 May was found dead. A black scarab beetle (*Diplotaxus* sp., Scarabaeidae; total length 11.9 mm) was discovered in the coelomic cavity and an 11-mm lesion existed in the middle portion of the stomach wall. As all of the fragile tarsi on the beetle were missing, the beetle may have burrowed out using the apices of the tibiae and small teeth on the outside of the foretibia. On 5 July, I found a dead male *P. modestum* (58 mm SVL) in the cage. It had two lesions, 8 mm and 5 mm, in its stomach wall. Several tiny unidentified black beetles were still in its stomach and a large carabid (*Helluomorphoides ferrugineus* [LeConte], Carabidae; total length 14.6 mm) was protruding from the stomach wall into the coelomic cavity. The external body walls of all three lizards were intact.

These observations support the hypothesis that these lizards died from physical injuries inflicted by ingested prey (including the chemically noxious bombardier beetle). Beetles may have been eaten in typical horned lizard tongue-flicking fashion, without being bitten or killed (Sherbrooke 1987. Herpetol. Rev. 18:11–13). Although the dietary mainstay of lizards in the genus *Phrynosoma* is ants, beetles are significant in the diet of some species (Pianka and Parker 1975. Copeia 1975:141–162). Some noxious insects, such as blister beetles (Cohen and Cohen 1990. Southwest. Nat. 35:369) and velvet ants (Manley and Sherbrooke 2001. Southwest. Nat. 46:221–222) may be successfully eaten. Under natural conditions, prey-item selection by horned lizards may be influenced by the potential some insects have to inflict internal post-ingestion injuries that can be fatal.

I thank Brett Ratcliffe for identification of *Diplotaxis* and noting the condition of the tarsi, and Terry Erwin for identification of the two carabids.

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SERPENTES

COLUBER CONSTRICTOR (Racer). **REPRODUCTION.** Data on reproduction and nest sites of *C. constrictor* in agricultural regions of the midwestern U.S. are few. On 23 April 1998, we collected a 91.4 cm SVL female *C. constrictor* at the Middle Fork Fish and Wildlife Area (MFFWA), Vermilion County, Illinois, USA. The snake was taken to the laboratory, implanted with a radio transmitter for a study of habitat use (Keller and Heske 2000. J. Herpetol. 34:558–564), then released one day after surgery (26 April) near the site of capture. On 5 May, this female was observed copulating with a male.

On 30 June, the radio signal from this female originated underground in an old field at MFFWA, ca. 4 m W of the forest-field edge. The signal location did not change for the next month. Believing that the snake had died, we proceeded to dig it up on 27 July. Instead of the snake, a clutch of eggs, damaged in the process, was discovered. In all likelihood, the transmitter had accidentally been placed in the oviduct and was passed during oviposition. Several live embryos, without pigment and ca. 50 mm in length, were observed. We could not determine exactly how many eggs were in the clutch because of the damage, but 5 eggs were intact and at least 2 were broken. The temperature at the eggs was 24.4°C, and the surface soil temp was 30.8°C. The intact eggs were taken to the laboratory and incubated on vermiculite in a ventilated container sitting in a water bath of 28.1°C. All 5 eggs hatched on 16 August. Maximum length of incubation would have been 47 days.

The oviposition site appeared to be in an abandoned rodent tunnel ca. 2 cm below the surface. Details of soil characteristics and nearby plants can be found in Keller (2000. Habitat Use by Three

Species of Snakes at the Middlefork Fish and Wildlife Area, Vermilion County, Illinois, with Notes on their Natural History. MS thesis, Univ. Illinois Urbana-Champaign. 40 pp.). Ernst and Barbour (1989. Snakes of Eastern North America. George Mason University Press, Fairfax, Virginia. 282 pp.) note mammal burrows, rotting logs and stumps, and old sawdust piles as oviposition sites for *Coluber constrictor*, with 9–12 eggs per clutch (up to 31 reported) being most common. Adequate nest sites are crucial to the persistence of snake populations in areas of decreasing habitat and declining snake populations such as regions dominated by row-crop agriculture. If shallow burrows are common oviposition sites for *C. constrictor*, cultivation during early summer could reduce the availability of nest sites and destroy clutches of incubating eggs.

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CROTALUS VIRIDIS OREGANUS (Northern Pacific Rattlesnake). **DIET.** The diet of *Crotalus viridis* includes rodents, birds, lizards (Macartney 1989. Herpetologica 45:299–304), and conspecifics (Gloyd 1933. Copeia 1933:98; Klauber 1956. Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind. Univ. California Press, Berkeley. 1476 pp.; Lillywhite 1982. J. Herpetol. 16:95). We report the first incidence of non-cannibalistic ophiophagy by *C. viridis*. An adult male *C. v. oreganus* (716 mm SVL) had partially digested an adult male rubber boa (*Charina bottae*), 220 mm neck–vent, in its stomach. The *C. v. oreganus* was collected by Aaron Feiner on 21 July 2000 in Stanislaus National Forest, California, USA. Both snakes are part of the herpetological collections of the University of Michigan Museum of Zoology (UMMZ 227199).

Submitted by **KAI M. BULLARD** and **GLENN M. FOX**, Department of Ecology and Evolutionary Biology and Division of Reptiles and Amphibians, University of Michigan Museum of Zoology, Ann Arbor, Michigan 48109-1079, USA (e-mail: foxg@umich.edu).

ELAPHE OBSOLETA (Black Rat Snake). **BEHAVIOR.** Behavior is known to influence thermoregulation in lizards and snakes. For example, snakes can limit their heat loss by coiling themselves, and lizards can increase their heating rate by positioning their back at a right angle to the sun's rays, or minimize their heat absorption by facing the sun (Heatwole and Taylor 1987. Ecology of Reptiles. Surrey Beatty & Sons Pty Limited, Chipping Norton, NSW, Australia. 325 pp.; Lillywhite 1987. *In* Seigel et al. [eds.], Snakes: Ecology and Evolutionary Biology, pp.422–477. Macmillan Publishing Co., New York; Tracy 1982. *In* Gans and Pough [eds.], Biology of the Reptiles, pp. 275–321. Academic Press, New York; Stevenson 1985. Am. Nat.126:362–386). Dorsoventral flattening of the body is another behavioral mechanism for increasing the rate of heating as this allows a greater area to be exposed to the sunlight than might be in a normal posture. This flattening of the body has been observed in lizards when ambient temperatures are cool, but the behavior is little known in snakes (Cogger 1974. Australian J. Zool. 26:653-672; Heatwole and Johnson 1979. Zool. J. Linn. Soc. 65:83-101; Heatwole and Taylor, *op. cit.*).

Dorsoventral flattening was observed in a snake on 15 April 2000, when the herpetology class at Yale University sponsored a field trip to Hurd State Park in East Haddem, Connecticut, USA. Despite several warm and sunny spring days from the end of March into the beginning of April (i.e., afternoons reaching an average of 22°C), the entire week prior to this trip was characterized by cold cloudy days with temperatures ranging from 0°C to 4°C. The morning of the trip was overcast with a temperature of 10°C at 0930 h. Thus, the cold and cloudy conditions reduced the expectation that snakes would be visible on such a day.

At 1330 h on 15 April the temperature at Hurd State Park reached its maximum of 15°C, and the conditions were still overcast with a slight drizzle. Unexpectedly, the class discovered a large *Elaphe obsoleta* in a grassy meadow bordered by higher elevation forest and rock ledges. The activity period for *E. obsoleta* is reported to begin around 20–27 April in southern New England and New York (Klemens 1993. Bulletin 112: State Geol. Nat. Hist. Surv. Connecticut. Hartford, Connecticut. 228 pp.), but Ernst and Barbour (1989. Snakes of Eastern North America. George Mason University Press, Fairfax, Virginia. 282 pp.) report activity as early as late March. Thus, our sighting (15 April) of *E. obsoleta* was in accordance with the start of the snake's activity period in this region.

Upon discovery, the snake remained stiff and motionless in the wet grass as we approached it to within 1 m. Initially it appeared to be a gravid female with lumps of eggs alternating along the length of the body. Closer inspection revealed that the body was flattened and contraction of body muscles caused a zigzag pattern along the entire body. Within a minute of being observed, the lumps disappeared, and the motionless snake began to move. It first started flicking its tongue, and rattling its tail defensively (Schulz 1996. A Monograph of the Colubrid Snakes of the Genus *Elaphe* Fitzinger. Koeltz Scientific Books, Havlickuv Brod, Czech Republic. 439 pp.). The snake was identified as an adult male with a total length of 98 cm. Based on natural history information for lizards we believe that this snake may have used this flattened posture to improve its ability to gain heat.

Laboratory studies of snakes have shown similar flattening behavior. Heatwole and Johnson (*op. cit.*) examined temperature changes along the body of the Australian Red-bellied Blacksnake (*Pseudechis porphyriacus*) in the laboratory with subcutaneous thermocouples. They subjected the snake to various degrees of sunlight during the winter months and reported that as the area of sunlight exposed to the surface of the snake increased from the anterior end to the posterior end, the snake progressively flattened its body. This behavioral change in body shape corresponded to sharp rises in subcutaneous temperature. In addition to the increased heat captured from an increased surface area, heating rates when the body is flattened may also be higher because the complex system of integumentary blood vessels known to exist in snakes come into closer contact with the main arterial system (Bartholomew 1982. *In* Gans and Pough [eds.], Volume 12 [Physiology C], pp. 167–211. Academic Press, New York). This

permits more efficient heat exchange between the body core and dorsal surface. Thus, the laboratory experiments of Heatwole and Johnson (*op. cit.*) appear to support our proposition regarding the utility of flattening behavior in increasing heat gain, and helps to explain our field observation of *Elaphe obsoleta*.

Laboratory studies that lack sunlight, however, have not detected behavioral changes in the dorsal surface area of snakes. A study by Lillywhite (1980. Copeia 1980:452–458) which examined behavioral thermoregulation among five species of Australian elapids (one of these species was *P. porphyriacus*, the same species studied by Heatwole and Johnson [*op. cit.*]) reported no dorsoventral change in body shape as the temperature varied between 18°C and 40°C. However, Lillywhite never exposed his snakes to conditions as cold as those in the study by Heatwole and Johnson (*op. cit.*) (e.g., the lowest temperatures reported are 18°C in Lillywhite [*op. cit.*] versus 5°C in Heatwole and Johnson [*op. cit.*]). Another study which examined the physiological responses of *E. obsoleta* and *Pituophis melanoleucus* to low ambient temperatures (ranging from 0–20°C) also fails to mention behavioral body shape changes corresponding to thermoregulation (Landreth 1972. Herpetologica 28:376–380).

These limited data suggest that sunlight may be the critical factor stimulating behavioral changes in body shape, rather than ambient temperature alone. It also helps to explain why we observed this flattening behavior in the field, despite the cool Spring temperature. Solar rays can reach the surface of the earth despite cloud cover, and it is likely that these rays, rather than ambient heat, were primarily being absorbed by the snake's dorsal surface when we encountered *E. obsoleta* on the wet field.

Other herpetologists have also observed this dorsoventral flattening behavior in nature. Herndon G. Dowling (pers. comm.) has observed this behavior in *E. obsoleta* while driving down a road in western Alachua County on a sunny day, ca. 15 March 1957. He stated that the contracted muscles made the snake "as stiff as a stick and he thought when he first picked it up that it was dead and dried out."

Jan Jenner (pers. comm.) has observed adult *Elaphe obsoleta*, *E. guttata*, and *Lampropeltis getula* lying in the contorted, zigzag posture in north-central Alabama (Talladega County). She notes that they are especially easy to spot because they seem to prefer to lie in the middle of a sunny road in early spring. When picked off the road she found that the snakes usually stay stiffly "kinked" for several seconds before reacting to being handled.

Dorsoventral flattening is not typically reported in the literature for snakes. This omission could be due to three reasons. First, most field-based thermoregulation studies on snakes have taken place when the snakes are at their peak activity period and can easily be encountered by the investigator in the field. Second, this behavior is unfavorable because it restricts the snake's ability to move, rendering it more subject to predation. Thus, snakes may restrict this behavior to activity times during cooler temperatures when their choices for thermoregulation are limited. The inability of the snake to move while flattened can be explained by the anatomical and mechanical relationship that the vertebrae and ribs have to the subcutaneous muscles (Gasc 1981. *In* Gans and Parsons [eds.], Biology of the Reptilia: Volume 11 [Morphology F], pp. 355–435. Academic Press, New York). Thus, if the muscles and bones are participating in the flattening of the body, they cannot be used simultaneously for sinusoid mobility. A third reason that explains why this behavior is not typically observed in the field is because this behavior may be limited to a small number of snake species, particularly those in temperate climates that require a thermoregulatory mechanism to protect them during drops in temperature typically experienced during the spring season.

Without field data it is difficult to say whether the *E. obsoleta* we observed on the field was heating or cooling its body. The cool ambient temperature makes it unlikely that this snake would choose to use a mechanism of body cooling that rendered it inactive and more susceptible to predation. Therefore, although heat gained by absorbing solar radiation likely outweighs heat lost by conduction to the substrate on this cold morning, we cannot dismiss the possibility that the body heat that is lost by conduction may decrease the overall benefit (in terms of an increased overall rate of heat gain) of dorsoventral flattening. Quantitative data that can explain the biological relevance of this behavior must be collected for snakes before we can be sure of the explanation for the snake behavior we observed. For this reason, we encourage scientists interested in thermoregulatory studies and dorsoventral flattening to consider studying snakes and comparing their behavioral thermoregulatory mechanisms to those known for lizards.

We thank Peter Warny and Chuck Annicelli for guiding the class through Hurd State Park on 15 April 2000, and the Department of Ecology and Evolutionary Biology at Yale University for sponsoring this field trip. Also, thanks goes to HGD and JJ for sharing their field observations, and to Christopher T. Winne for his editorial suggestions in reviewing this report.

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HETERODON PLATIRHINOS (Eastern Hognose Snake). **DIET.** *Heterodon platirhinos* is often considered a toad specialist. However, frogs (*Rana pipiens*), lizards, salamanders, arthropods, birds, and mammals have been reported as prey items (Platt 1969. Univ. Kansas Mus. Nat. Hist. Publ. 18:253–420). Bullfrogs (*Rana catesbeiana*) have been consumed by captive eastern hognose snakes (Platt 1969, *op. cit.*) and a wild-caught juvenile snake disgorged a small bullfrog (Palmer and Braswell 1995. Reptiles of North Carolina. Univ. of North Carolina Press, Chapel Hill, North Carolina. 412 pp.). Here, we report the predation upon an adult bullfrog by an adult wild hognose snake. Two hognose snakes, a male (not measured) and a female (68.8 cm SVL; 82.4 cm TL; 220 g without prey item), were encountered together at ca. 1500 h on 27 February 2001 in Tuskegee National Forest, Macon County, Alabama, USA. Upon capture, the female initiated a defensive display and regurgitated an adult male bullfrog (10.6 cm SVL; 89.7 g; 41% of the snake's mass) that had been swallowed headfirst. The frog showed no signs of digestion but the left hind leg was broken at the knee and some skin had peeled off of that leg. Both snakes were melanistic, a common feature of most Alabama populations (Mount 1975. The Reptiles and Amphibians of Alabama. Alabama Agri. Exper. Sta. Auburn, Alabama. 347 pp.). The snakes were later released at the point of capture. We thank Robert Mount and Craig Guyer for comments.

Submitted by **KRISTIN A. BAKKEGARD*** and **MATTHEW P. GREENE**, Department of Biological Sciences, Auburn University, Auburn, Alabama 36849, USA (e-mail: greenmp@auburn.edu). *Present address of KAB: Department of Biology, Utah State University, Logan, Utah 84321-5305, USA.

Correction: *Tupinambis* Predation

In the last issue of *Herpetological Review*, we provided the first record of amphibian prey identified to species for *Tupinambis teguixin* (Souza et al. 2002, Herpetol. Rev. 33:209). Review of the herpetological collection in the Centro de Estudos e Pesquisas Biológicas (CEPB) together with new data provided by Ayrton K. Péres Jr. and G. R. Colli (Universidade de Brasília - UnB, Brazil), who are reviewing the systematics of *Tupinambis*, allowed us to redetermine specimen CEPB/IFS 227-01 from our report as a juvenile *T. merianae*. *Tupinambis merianae* is a terrestrial forager reported to feed primarily on fruits, invertebrates (annelids, gastropods, arachnids, and insects), and small vertebrates (toads [*Bufo* sp.], owls [probably *Otus* sp.], and rice rats [*Oryzomys* sp.]; Avila-Pires 1995. Zoologische Verhandelingen 209:1–706; Kiefer and Sazima 2002. Amphibia-Reptilia 23:105–108). Thus, our record of amphibian prey applies to *T. merianae*.

Submitted by **IVAN FRANÇA E SOUZA** and **NELSON JORGE DA SILVA JR.**, Laboratório de Herpetologia, Centro de Estudos e Pesquisas Biológicas, Universidade Católica de Goiás, Ave. Universitária, 1440, Setor Universitário, 74.210-010, Goiânia, Goiás, Brazil; e-mail: souzai@terra.com.br.

GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 33, Number 1 (March 2002). Additional note: The responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extensions unless a thorough literature review has been completed.

CAUDATA

AMBYSTOMA MACULATUM (Spotted Salamander). USA: MINNESOTA: Pine Co: Nemadji State Forest, 46°17'49"N, 93°18'43"W. 26 April 2001. Carol D. Hall and Tim Pharis, Minnesota County Biological Survey, Minnesota Department of Natural Resources. Verified by Tony Gamble. Bell Museum of Natural History (JFBM 14250). One of seven egg masses was collected from a forest wetland and held in captivity. Larvae emerged mid–May confirming identification after which several larvae were reared through transformation. This state record extends the known range 44 km W of the nearest record in Wisconsin (Casper 1996. Geographic Distributions of the Amphibians and Reptiles of Wisconsin. Publ. Milwaukee Public Museum. 87 pp.).

Submitted by **CAROL D. HALL**, Minnesota County Biological Survey, Department of Natural Resources, 500 Lafayette Road, St. Paul, Minnesota 55155, USA; e–mail: carol.hall@dnr.state.mn.us.

AMBYSTOMA OPACUM (Marbled Salamander). USA: TENNESSEE: Scott Co.: 50 m W of a farm pond in Appaloosa Field on the south side of Bandy Creek Road ca. 0.8 km NW of Bandy Creek Campground in Big South Fork National River and Recreation Area. 20 September 2002. Bonnie Wood. Verified by A. Floyd Scott. APSU 3343. Single male crossing a mowed field at night during a torrential rainstorm. Scott County record (Campbell 2002, Herpetol. Rev. 33:230–231; Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Austin Peay State University Misc. Pub. No. 12, Clarksville, Tennessee;.

Submitted by **TODD S. CAMPBELL**, Institute for Biological Invasions, 569 Dabney Hall, University of Tennessee, Knoxville, Tennessee 37996, USA (e–mail: lizardman@utk.edu); **BONNIE WOOD, KENT BAILEY, DEBBIE LASHLEY**, and **KATHY BLAIR**, Life Development Center, P.O. Box 570, Clinton, Tennessee 37717, USA; **KYM ROUSE CAMPBELL**, The Cadmus Group, Inc., 78A Mitchell Road, Oak Ridge, Tennessee 37830, USA.

AMBYSTOMA OPACUM (Marbled Salamander). USA: ILLINOIS: Gallatin Co: pond adjacent to Hill Cemetery, S side Pounds Hollow Road 1.9 km NE Co. Rd. 690E (37°35'58"N, 88°16'39"W). 9 February 2002. Kurt J. Regester and Philip A. Jellen. Verified by Ronald A. Brandon. SIUC H–07084. Larval specimens. Pond south side York Lane and 1.0 km E Pounds Hollow Road (37°36'14"N, 88°15'46"W). 23 March 2002. Kurt J. Regester. Verified by Ronald A. Brandon. SIUC H–07087. Larval specimens collected in Shawnee National Forest wildlife pond. Hardin Co: Shawnee National Forest wildlife pond 29–7, 0.2 km S side Co. Rd. 1125N and 2.1 km E Co. Rd. 700E (37°34'19"N, 88°15'17"W). 19 February 2002. Kurt J. Regester and Philip A. Jellen. Verified by Ronald A. Brandon. SIUC H–07085. Larval specimens; Shawnee National Forest wildlife pond 31–6, 0.8 km N side FR 1726 and 1.3 km E Co. Rd. 700E (37°33'38"N, 88°16'29"W). 19 February 2002. Kurt J. Regester and Philip A. Jellen. Verified by Ronald A. Brandon. SIUC H-07086. Larval specimens. Pope Co: Shawnee National Forest wildlife pond 75–1, N side FR 470 and 5.6 km NE Co. Rd. 1200E (37°24'58"N, 88°26'38"W). 18 February 2002. Kurt J. Regester and Lee J. Walston. Verified by Ronald A. Brandon. SIUC H–07088. Larval specimens. The localities reported here constitute first records for Gallatin, Hardin, and Pope counties (Philips et al. 1999. Illinois Nat. Hist. Surv. Manual 8:1–282).

Submitted by **KURT J. REGESTER, PHILIP A. JELLEN**, and **LEE J. WALSTON**, Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901, USA.

AMBYSTOMA TIGRINUM (Tiger Salamander). USA: NORTH DAKOTA: Dickey Co: State Hwy 11, 16.9 km E Ellendale (46°00'N, 98°19'W). 20 July 1999. Dean A. Croshaw. Sam Noble Oklahoma Museum of Natural History (OMNH 38270). Verified by Janalee P. Caldwell. Branchiate adult found on road. First county record (Hoberg and Gause 1992. North Dakota Outdoors 55:7–19).

Submitted by **DEAN A. CROSHAW**, Department of Zoology, University of Oklahoma, 730 Van Vleet Oval, Norman, Oklahoma 73019, USA; e–mail: croshaw@srel.edu.

DESMOGNATHUS AENEUS (Seepage Salamander). USA: GEORGIA: Pickens Co: Big Canoe Development, McDaniel Meadows, a conservation easement held by North American Land Trust (34.46241081N, 84.26860222W). 27 March 2002. Christopher R. Wilson. Georgia Museum of Natural History (GMNH 46878). Verified by Elizabeth McGhee. First county record (John Jensen, pers. comm.). Three individuals observed. Two were females found tending separate clutches of eggs under sphagnum moss at edge of small creek in wetland. Photographed and released. Funding for biological surveys provided by Big Canoe Company, LLC.

Submitted by **CHRISTOPHER R. WILSON**, 425 Roxanna Street, Boone, North Carolina 28607, USA; e-mail: critterfro@boone.net.

GYRINOPHILUS PALLEUCUS (Tennessee Cave Salamander). USA: TENNESSEE: Bedford Co: Privately owned cave near Normandy, Tennessee. 16 February 2002. Stephen T. Samoray, Heather Garland, Thany Mann, Brian Roebuck, Lynn Roebuck, Joseph C. Douglas, Melinda Welton, and John Noel. Austin Peay State University Museum (APSU Color Slide 3325). Photos by Lynn Roebuck. Verified by Addison Wynn. In light of this species' status as threatened in Tennessee and because of the extremely localized habitat at this site, precise locality data are being withheld, but are on file at APSU. One individual found ca. 75 m inside cave in a shallow pool to the left and below the main passage, at or slightly above stream level. The pool was 0.5–1 m deep with a silt bottom. New county record (Redmond and Scott 1996. Austin Peay State Univ. Center Field Biol. Misc. Publ. 12:1–94); fills a gap between previous sightings in the Nashville Basin and on the Western Escarpment of the Cumberland Plateau.

Submitted by **STEPHEN T. SAMORAY**, Department of Biology, Middle Tennessee State University, Murfreesboro, Tennessee 37132, USA and **HEATHER R. GARLAND,** Cave Program Coordinator, The Nature Conservancy of Tennessee, Nashville, Tennessee 37212, USA.

PLETHODON ANGUSTICLAVIUS (Ozark Salamander). USA: ARKANSAS: Johnson Co.: Ozone Recreation Area, Ozark National Forest NE, NE, Section 28, R23W, T12N (N35.6725° W093.4436°). 9 April 2002. K.J. Irwin. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 27173). Verified by Stan Trauth. Two juveniles in leaf litter along margin of ephemeral stream in mature upland oak-hickory forest. First record for county and fills hiatus between records in Franklin and Pope counties (Trauth, Robison, and Plummer, ms. in prep.).

Submitted by **KELLY J. IRWIN**, Arkansas Game and Fish Commission, 915 East Sevier Street, Benton, Arkansas 72015, USA; e-mail: kirwin@agfc.state.ar.us.

PSEUDOBRANCHUS STRIATUS (Northern Dwarf Siren). USA: FLORIDA: Santa Rosa Co: Vicinity of Chumuckla Springs, in the mucky bed of a seepage streamlet draining the northern valley wall of McDavid Creek, 100 m upstream from its confluence with Escambia River in W 1/2 of Section 30, T4N, R30W (30°50'00"N, 87°17'30"W). 6 June 2002. D. Bruce Means and Guy H. Means. A series of six juveniles scraped from the fluid muck developed from the litter of baldcypress (*Taxodium distichus*) and black tupelo (*Nyssa sylvatica*) in the perennial seepage of the local surficial aquifer. Florida Museum of Natural History (UF 132983–87). Verified by Paul E. Moler and Kenneth L. Krysko. Santa Rosa Co. was included on the range map for this species in Ashton and Ashton (1988. Handbook of Reptiles and Amphibians of Florida, Part 3, The Amphibians, Windward Publ., Miami, Florida. 191 pp.) but voucher specimens on which this record is thought to have been based cannot be located (Ray Ashton, Kenneth L. Krysko, pers. comm.). This collection verifies the species in Santa Rosa Co. and extends the range of the genus about 115 km WNW of the previously westernmost known site (Moler and Thomas 1982. Herpetol. Rev. 13:130).

Submitted by **D. BRUCE MEANS** and **GUY H. MEANS**, Coastal Plains Institute and Land Conservancy, 1313 Milton Street, Tallahassee, Florida 32303, USA and Florida Geological Survey, 903 West Tennessee Street, Tallahassee, Florida 32314, USA.

ANURA

AGALYCHNIS SALTATOR. HONDURAS: GRACIAS A DIOS: Kaska Tingni (14°48'N, 84°46'W), 70 m elev. 27 July 2001. James R. McCranie, Josiah H. Townsend, and Larry D. Wilson. USNM 549333–43 (11 adults); SMF 81522–23 (2 adults). Verified by Steve W. Gotte (USNM specimens) and Gunther Köhler (SMF specimens). Previous Honduran records are one adult female collected ca. 90 km N of the new locality and a second adult female collected ca. 40 km NW of the new locality. (McCranie and Wilson 2002. The Amphibians of Honduras. SSAR, Contrib. Herpetol. 19:i–x, 1–625).

Submitted by **JAMES R. McCRANIE**, 10770 SW 164th Street, Miami, Florida 33157-2933, USA (e-mail: jmccrani@bellsouth.net), **LARRY DAVID WILSON**, Department of Biology, Kendall Campus, Miami–Dade Community College, Miami, Florida 33176, USA, and **JOSIAH H. TOWNSEND**, Division of Herpetology, Florida Museum of Natural History, University of Florida, Gainesville, Florida 32611, USA.

ELEUTHERODACTYLUS AUGUSTI CACTORUM (Western Barking Frog). USA: ARIZONA: Pima Co: Quinlan Mts. (31°58.187N, 111°36.620W). 24 July 2001. E. F. Enderson. First county record. Extends range ca. 74 km NW (Slevin 1931. Copeia 1931 [3]:140–141). Photo voucher deposited at the University of Arizona (UAZ 54046–PSV). Verified by Caren S. Goldberg.

Submitted by **ERIK F. ENDERSON**, 3234 East Patricia Street, Tucson, Arizona 85716, USA.

HYLA ELEGANS. BRAZIL: PARANÁ: Municipality of Morretes (25°23'S, 48°52'W), Porto de Cima. 03 and 05 February 2002. Rodrigo Lingnau. Museu Nacional, Rio de Janeiro (MNRJ 29756 and 29757). Verified by José P. Pombal Jr. Collected in Atlantic Forest. Previously known from the states of Bahia to São Paulo, Brazil (Frost 1985. Amphibian Species of the World. Allen Press and Association Systematics Collections, Lawrence, Kansas), in Atlantic forest, from sea level to ca. 800 m (Lutz 1973. Brazilian Species of *Hyla*. Univ. Texas Press, Austin), and from state of Minas Gerais in localities of transition Atlantic forest–Cerrado and Caatinga Domains (Nascimento and Feio 1999. Herpetol. Rev. 30:50). New record for the State of Paraná.

Submitted by **RODRIGO LINGNAU** and **ROGÉRIO P. BASTOS**, Departamento de Biologia Geral/ICB/UFG, caixa postal 131, 74001–970, Goiânia, GO, Brazil.

HYLA REGILLA (Pacific Treefrog). MÉXICO: BAJA CALIFORNIA SUR: San Juan de la Costa (24°21.4'N, 110°42.9'W), 53 m elev. 16 December 2001. Ricardo A. Escobar III, Timothy M. Youmans, and Jessie L. Grismer. La Sierra University Photographic Collection (LSUPC-F1387). Verified by L. Lee Grismer. Record fills a 145 km distributional gap between oases of the La Presa region and San Pedro (Grizmer 2002. Amphibians and Reptiles of Baja California, including its Pacific Islands and the Islands in the Sea of Cortez. Univ. California Press, Berkeley. 413 pp). Frogs were observed in high densities midday along a rocky stream that ran through the oasis.

Submitted by **RICARDO A. ESCOBAR III** (e-mail ricaesco@hotmail.com), **TIMOTHY M. YOUMANS**, and **JESSE L. GRISMER**, Department of Biology, La Sierra University, Riverside, California 92515–8247, USA.

HYLA VERSICOLOR (Gray Treefrog). CANADA: ONTARIO: Algoma District. Thessalon Twp., 0.8 km N of Hwys 129 and 17 intersection (NAD 27: UTM Zone 17: N5127200m, E304000m). 7 June 1999. Wayne F. Weller. Royal Ontario Museum (ROM 38443 [segment 23], audio cassette tape). All tape recordings and photographs verified by Ross D. MacCulloch. Intense calling from marsh behind homes in rural setting at 2425 h. This record is the westernmost location among 17 others where calls were recorded (ROM 38443 [segments 6 to 22], audio cassette tape), and 9 other locations where calling was noted within 650 km^2 of the Thessalon/Basswood Lake area. Algoma District. Tarentorus Twp., N of Kinsman Park, Sault Ste. Marie (NAD 27: UTM Zone 16: N5163800m, E708600m). 14 June 2001. Wayne F. Weller. Royal Ontario Museum (ROM 39374 [segment 19], audio cassette tape). Moderate calling from wetland behind homes in rural setting at 2210 h (air temperature 25°C) under overcast sky. This record is the westernmost location among 4 others where calls were recorded (ROM 39374 [segments 4, 5, 20, 21], audio cassette tape), and 9 other locations where calling was noted within 450 km^2 of the Sault Ste. Marie area. Algoma District. Martel Twp., 2.7 km S of Lane and Martel Twp. boundary (NAD 27: UTM Zone 17: N5211600m, E336800m). 12 June 2001. Wayne F. Weller. Royal Ontario Museum (ROM 39374 [segment 16], audio cassette tape). Intense calling from roadside wetland along Hwy 129 at 2300 h (air temperature 15°C). This record is the northernmost location among 6 others where calls were recorded (ROM 39374 [segments 1 to 3, 15, 17, 18], audio cassette tape), where 1 specimen was photographed (ROM 39373), and 11 other locations where calling was noted within 750 km^2 of the Aubrey Lake area. The documented western range limit in central Ontario is represented by specimens from the Walford/Massey area in extreme southwestern Sudbury District: Sugar Lake area (National Museum of Canada [NMC] 7456 – August 1963); Cameron Falls area (NMC 33487 – August 1990); Massey (NMC 7397, 7452, 7495 – August and September 1963). The 18 documented records from the Thessalon/Basswood Lake area extend the range 100 km W of the Walford/Massey area. The 5 documented records from the Sault Ste. Marie area extend the range 160 km to the WNW, and the 8 documented records from the Aubrey Lake area extend the range 115 km to the NW. Collectively, these 31 documented records represent the first vouchered records for Algoma District in Ontario, and substantiate observations received from several people over the period of 1974 to 1997 for Algoma District.

Submitted by **WAYNE F. WELLER**, 250 Chercover Drive, Thunder Bay, Ontario P7G 1A2, Canada.

HYLODES HEYERI (NCN). BRAZIL: SÃO PAULO: Cananéia Municipality: Ilha do Cardoso (25°06'03.6"S, 47°55'53.2"W). 25 March 2002. L. F. Toledo and R. Lingnau. Célio F. B. Haddad collection, Departamento de Zoologia, Universidade Estadual Paulista, Rio Claro, São Paulo (CFBH 4998–99). Verified by Célio F. B. Haddad. This species has a restricted distribution, known only at Municipality of Eldorado, São Paulo (type locality – Haddad et al. 1996. Copeia 1996:965–969) and Municipality of Morretes, Paraná (Lingnau 2000. Herpetol. Rev. 31:251). This is the first record of the species on this island and extends its distribution ca. 65 km SE from the type locality.

Submitted by **LUÍS FELIPE TOLEDO**, Departamento de Zoologia, Universidade Estadual Paulista, caixa postal 199, cep 13506-900, Bela Vista, Rio Claro, São Paulo, Brazil (e-mail: toledolf@hotmail.com) and **RODRIGO LINGNAU**, Departamento de Biologia Geral, Universidade Federal de Goiás, caixa postal 131, cep 74001-970, Goiânia, Goiás, Brazil (e-mail: rlingnau@lycos.com).

INSUETOPHRYNUS ACARPICUS. CHILE: IX Region (Valdivia): Rio Queule (39°38'S, 73°14'W) 124 m elev. January 2002. E. R. Soto and M. Méndez. Herpetological collection of Departamento de Biología Celular y Genética de la Universidad de Chile. Santiago (DBGUCH 3102, 3114, 3125–26, 3128, 3130). Verified by A. Veloso. Colegual Alto (39°24'S, 73°06'W), 10 km E of Queule, 500 m elev. January 2001. F. Torres-Pérez and H. Ibarra-Vidal. Zoological collection of Museo de Zoología de la Universidad de Concepción (MZUC 26930–31). Verified by J. C. Ortíz. Previously known only from type locality, Mehuín (Barrio 1970. Physis 30:331–341); new records extends known distribution 100 km N of Mehuín.

Submitted by **EDUARDO R. SOTO** (e-mail: eroman@ciencias.uchile.cl), and **MARCO A. MENDEZ-TORRES** (e-mail: mmendez@icaro.dic.uchile.cl), Departamento de Ciencias Ecológicas, Facultad de Ciencias, Universidad de Chile, Casilla 653, Santiago, Chile. **FERNANDO TORRES-PÉREZ** (e-mail: ftorres@udec.cl), Departamento de Zoología, Universidad de Concepción. Casilla 160-C, Concepción, Chile. **H. IBARRA-VIDAL,** Exp Ediciones al Conocimiento, Casilla 2916, Concepción, Chile.

KALOPHRYNUS PLEUROSTIGMA (Black-Spotted Narrow-Mouthed Frog). WEST MALAYSIA: PAHANG: Pulau Tioman. 22 March 2002. Ricardo A. Escobar III, Jesse L. Grismer, and Timothy M. Youmans. Zoological Reference Collection at The University of Singapore, Singapore (ZRC 1.9660). Verified by L. Lee Grismer. Species previously reported from southern Thailand, southward through Singapore, and again on Sumatra, Borneo, and the southern Philippines (Matsui et al. 1996. Copeia 1996:440–445). One juvenile (14 mm SVL) was found during the day hopping

through the leaf litter along the partially decayed base of a living dipterocarp tree on Gunung Kajang (02°46'40"N, 104°10'48"E). First record for Pulau Tioman (Grismer et al. 2002. Herpetol. Rev. 33:26–29), and extends Malayan distribution eastward to the Serabuat Archipelago.

Submitted by **RICARDO A. ESCOBAR III** (e-mail ricaesco@hotmail.com), **JESSE L. GRISMER**, and **TIMOTHY M. YOUMANS**. Department of Biology, La Sierra University, Riverside, California 92515–8247, USA.

PHYLLOBATES VITTATUS (Golfodulcean Dart Frog). COSTA RICA: SAN JOSE: Tres Piedras, 15 km NW of Platanillo, 26 km SW of San Isidro de General (9°19'30"N, 83°52'00"W), Quebrada Terciopelo. 25 January 2001. Mason Ryan. Verified by Federico Bola Hos and Gerardo Chavez. Museo de Zoologia de la Universidad de Costa Rica (MZUCR). MZUCR 15981. This colorful, secretive dendrobatid is endemic to the Golfo Dulce region of southwestern Costa Rica. Herein I report a 75 km extension north of the Golfo Dulce region, and a new provincial record for San Jose. An unsubstantiated observation was made 17 km N of Dominical in Matapalo (9°19'45"N, 83°80'00"W) on 21 February 2001. A male was observed calling along a stream, but I did not have the landowner's permission to collect animals. These extensions are especially interesting because the climate changes from very humid to sub-humid from south to north (Campbell 1999. *In* W. E. Duellman [ed.], Patterns of Distribution of Amphibians: A Global Perspective, pp.111–210, Johns Hopkins Univ. Press, Baltimore, Maryland), and Tres Piedras and Matapalo are roughly in the middle of the moist southern and drier northern life zones, respectively. These new localities suggest that *P. vittatus* is able to occupy a slightly drier life zone than previously thought.

Submitted by **MASON RYAN**, Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901, USA.

PHYLLODYTES KAUTSKYI (NCN). BRAZIL: BAHIA: São José do Macuco, Fazenda Unacau (15°09'S, 39°18'W), 15–22 October 1986. M. T. Rodrigues, field number 86.7227, 86.7415. Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil (MZUSP 63672–73). Verified by C. A. G. Cruz. Previously known only from the type locality in the State of Espírito Santo, southeastern Brazil (Peixoto and Cruz 1988. Rev. Brasil. Biol. 48:265–272; Frost 2002. Amphibian Species of the World: An Online Reference. V2.21 [15 July 2002] http://research.amnh.org/herpetology/amphibia/index.html. First state record; extends northern range ca. 600 km airline from the type locality.

Submitted by **OSWALDO LUIZ PEIXOTO**, Departamento de Biologia Animal, Universidade Federal Rural do Rio de Janeiro, 23851–970 Seropédica, RJ, Brazil, and **ULISSES CARAMASCHI**, Departamento de Vertebrados, Museu Nacional/UFRJ, Quinta da Boa Vista, 20940-040 Rio de Janeiro, RJ, Brazil.

RANA AURORA (Red-legged Frog). CANADA: BRITISH COLUMBIA: QUEEN CHARLOTTE ISLANDS (HAIDA GWAII): GRAHAM ISLAND: ca. 3.5 km SW of village boundary of Port Clements on the banks of Yakoun River. 53°38'20"N, 132°12'40"W. 3 July 2002 (locality 1). L. Hyatt, K. Ovaska, L. Sopuck, J. Gray. Adult, 56 mm SVL. Royal British Columbia Museum, RBCM 1945.00. Verified by Theodore M. Davis. First record of the species from the archipelago and the northernmost reported locality (ca. 400 km north from the species' known distributional limits on Vancouver Island and mainland British Columbia). The specimen was found along a grassy riverbank about 3 m from the water's edge in an old growth stand of sitka spruce (*Picea sitchensis*). We also observed the species at nine other localities. Three of these (localities 2–4) were northeast and southeast of Port Clements adjacent to Hwy 16 in roadside ditches and ponds. Locality 2: Mallard Creek. 53°42'2"N, 132°7'58"W. 3 July 2002. 2 adults and 1 juvenile. Personal photograph files of KO. Locality 3: ca. 3.5 km NE of the village boundary. 53°43'15"N, 132°7'40"W. 30 July 2002. 1 juvenile. Locality 4: Kumdis Creek by Eli Tingley Bridge, ca. 4 km SE of the village boundary. 53°39'54"N, 132°7'35"W. 30 July 2002. 1 juvenile.

The remaining six localities (5–10) were south of Port Clements in a mixed stand of old growth and second growth forest, where the species was widespread. Locality 5: 53°34'8"N, 132°6'39"W. 1 and 2 July 2002. 4 observations of juveniles and adults. Locality 6: 53°34'19"N, 132°6'57"W. 30 July 2002. 1 adult and 1 juvenile. Locality 7: 53°33'52"N, 132°5'36"W. 30 June 2002. 1 juvenile. Locality 8: 53°34'25"N, 132°6'7"W. 28 July 2002. 1 adult. Locality 9: 53°34'31"N, 132°6'14"W. 28 July 2002. 1 adult. Locality 10: 53°34'25"N, 132°6'47"W. 29 July 2002. 2 adults. Personal photograph files of KO. The frogs were found in or adjacent to a creek, bog pools, and lakeshores, and ranged in size from juveniles (SVL ca. 30 mm) to large adults (SVL up to 78 mm). The straight-line distance between the two farthest localities (3 and 7) was about 18 km.

Previously, only two species of amphibians were known from the archipelago: *Bufo boreas* (Western Toad) and *Pseudacris* (= *Hyla*) *regilla* (Pacific Treefrog). *Bufo boreas* is native to the islands (Green and Campbell 1984. Amphibians of British Columbia, British Columbia Provincial Museum Handbook 45), whereas the presence of *P. regilla* appears to be the result of a primary introduction in the early 1960s, multiple secondary introductions thereafter, and dispersal from these points of origin (Reimchen 1991. Can. Field-Nat. 105:288–290). *Rana aurora* may also have been introduced, although no record of such an event exists. Four of our records (1–4) are from areas that receive frequent human use. The remaining localities, however, are from a more remote area, accessible only through hiking from a logging road. This suggests that, if introduced, the species has dispersed throughout the forest and hence has been present in the area for many years. The possibility that the species is indigenous cannot be ruled out without further information on its distribution and genetic relationships to populations farther south.

The first observations took place while we were conducting surveys for Weyerhaeuser Canada, Nanaimo office, and we thank Glen Dunsworth for his support. Janet Gray, Kelly Sendall, Christian Engelstoft, and Brian Watson also provided assistance.

Submitted by **KRISTIINA OVASKA** (e-mail: kovaska@jdmicro.com), **LUKE HYATT** (e-mail: jhyatt@qcislands.net), and **LENNART SOPUCK** (e-mail: biolinx@shaw.ca), Biolinx Environmental Research Ltd., 1759 Colburne Place, Sidney, British Columbia, Canada V8L 5A2.

RANA CATESBEIANA (American Bullfrog). USA: COLORADO: WASHINGTON CO: pond at Messex State Wildlife

Area, County Road P, 0.6 mi. N junction County Road 59 (UTM: 0633439, 4475535). 9 July 2002. UNC-MNH 4244. Verified by David Chiszar and Hobart M. Smith. First county record (Hammerson 1999. Amphibians and Reptiles of Colorado. Second Ed. Univ. Colorado Press, Niwot. xxvii + 484 pp.). The bullfrog is an invasive species in Colorado and now appears to be established in most permanent waters of the eastern plains.

Submitted by **RON MALECKI, AMBER LAWSON, LORI CRAFT,** and **STEPHEN P. MACKESSY**, Department of Biological Sciences, University of Northern Colorado, 50 120th Street, CB 92, Greeley, Colorado 80639-0017, USA (e-mail [SPM]: spmacke@unco.edu).

RANA CATESBEIANA (American Bullfrog). BRAZIL: RIO GRANDE DO SUL: municipality of Barão (29°22'S, 51°29'W), Arroio Canoas. 20 December 1994. J. C. Gonzales. Coleção de Anfíbios, Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul (MCP 1539, SVL 114 mm, male). Municipality of Caxias do Sul (29°10'S, 51°10'W). 3 March 1976. T. de Lema. Coleção de Anfíbios do Museu de Ciências Naturais da Fundação Zoobotânica do Rio Grande do Sul (MCN 9930–9936, juveniles). Municipality of Caxias do Sul, Vila Cristina (29°18'S, 51°10'W). 8 May 1994. M. Borges-Martins (MCP 1468, SVL 42 mm, juvenile). Municipality of Derrubadas (27°15'S, 53°51'W). 12 December 1996. A. Kwet (MCP 2557, 59 mm, juvenile). Municipality of Erechim (27°38'S, 52°16'W). 26 September 1984. P. C. Braun (MCN 2074, male). Municipality of Gravataí (29°56'S, 50°59'W). May 2000. A. Ramirez (MCP 4062, 45 mm, juvenile). Municipality of Nova Petrópolis (29°22'S, 51°06'W), locality of Treze Colônias. 13 March 2000. M. Monzel (MCP 4970–73, 45–82 mm, juveniles). Municipality of Porto Alegre (30°02'S, 51°13'W), neighborhood of Bonfim, Parque Farroupilha. December 1997. P. C. A. Garcia (MCP 3560, 145 mm). Municipality of Tenente Portela (27°22'S, 53°45'W). 27 January 2001. A. Kwet and T. Miranda (MCP 4535–38, 49–61 mm, juveniles). Municipality of Veranópolis (28°56'S, 51°32'W): Rio das Antas. 13–16 October 1998. G. Vinciprova. Coleção de Anfíbios do Departamento de Zoologia, Instituto de Biociências, Universidade Federal do Rio Grande do Sul (UFRGS 2093). Municipality of Viamão: Vila de Itapuã (30°16'S, 51°01'W), source of Arroio Amoras. 20 March 2001. F. Vilela (UFRGS 2092, two larvae). SANTA CATARINA: municipality of Jaraguá do Sul (26°29'S, 49°04'W), locality of Francisco de Paula. 15 January 1993. M. A. A. da Silva. (MCP 1256, 1260, 53 and 67 mm, juveniles). All specimens verified by A. Kwet, Staatliches Museum für Naturkunde, Stuttgart, Germany. These are the first records of invasive populations of this frog in Santa Catarina and extends considerably the known distribution in Rio Grande do Sul, currently only reported from Turvo State Park (Kwet 1999. Salamandra 35:19–36). The species is widespread in the northern and central portions of Rio Grande do Sul, and recent additional sightings (lacking voucher specimens) have been made by us. Records of invasive populations in Brazil include Paraná (Bernarde and Machado 2001. Cuad. Herpetol.14:93–104) and São Paulo (Guix 1999. Grupo Estud. Ecol. Ser. Doc. 2:32–34). The known range of this species now includes all southern Brazilian states. Introductions are believed to be associated with cultivation and meat production since the 1930's. We believe that there has been a recent increase in distribution of this species due to changes in agricultural land use.

Submitted by **MARCIO BORGES-MARTINS, MARCOS DI-BERNARDO**, Laboratório de Herpetologia, Museu de Ciências e Tecnologia da PUCRS, Av. Ipiranga, 6681, CEP 90619-900, Porto Alegre, Rio Grande do Sul, Brazil (e-mail: marbm@pucrs.br and madibe@pucrs.br), **GIOVANNI VINCIPROVA**, Setor de Herpetologia, Departamento de Zoologia, Instituto de Biociências, Universidade Federal do Rio Grande do Sul, Av. Paulo Gama, 40, prédio 12105, CEP 90040–060, Porto Alegre, Rio Grande do Sul, Brazil (e-mail: gvinci@zaz.com.br), and **JOHN MEASEY**, Department of Zoology, The Natural History Museum, Cromwell Road, London SW7 5BD, United Kingdom (e-mail: J.Measey@nhm.ac.uk).

RHACOPHORUS GAUNI (Short-nosed Tree Frog). BRUNEI: TEMBURONG: Belalong Basin; two tributaries of Sungai Belalong; Sungai Engkabang (maximum width 6 m, maximum depth 1.2 m) and Sungai Mata Ikan (maximum width 3 m, maximum depth 0.8 m), both streams well shaded, waters clear with swift currents and predominantly rocky substrata (04°32'N, 115°09'E; ca. 100 m elev.). 5–9 October 2001. Heok Hui Tan and Kelvin K. P. Lim. Raffles Museum of Biodiversity Research: Zoological Reference Collection (ZRC) 1.8836, one larva, Gosner stage 37, total length 26.5 mm; ZRC.1.8913–8915, three larvae, Gosner stages 30–31, total lengths 18.6–20.7mm; all larvae exhibiting diagnostic labial tooth row formula of 4(3–4)/3(1) (Inger and Tan 1990. Raffles Bull. Zool. 38[1]:3–9). Verified by Kelvin K. P. Lim. New country record, in addition to surrounding areas of Sabah and Sarawak (Inger and Stuebing 1997. A Field Guide to the Frogs of Borneo. Natural History Publications, Kota Kinabalu, Sabah, Malaysia. ix + 205 pp.). This represents the seventh species of the genus *Rhacophorus* recorded from Brunei (Das 1995. Raffles Bull. Zool. 43[1]:157–180).

Submitted by **TZI MING LEONG** (e-mail: scip0132@nus.edu.sg) and **HEOK HUI TAN** (e-mail: betta@singnet.com.sg), Systematics and Ecology Lab, Department of Biological Sciences, National University of Singapore, Singapore 119260.

SCAPHIOPUS HOLBROOKII (Eastern Spadefoot). USA. TENNESSEE: BLOUNT CO.: Candora Rd. 12 April 2001. LA Welch. Verified by B. T. Miller. Middle Tennessee State University (MTSU 120A). New county record, decreases suspected distribution hiatus in eastern Tennessee (Redmond and Scott 1996. Atlas of Tennessee Amphibians. Center for Field Biol. Austin Peay St. Univ. Misc. Pub. No.12. 94 pp.).The specimen was observed foraging and was photographed following an evening rain shower.

Submitted by **LINN ANN WELCH**, Radnor Lake State Natural Area, Nashville, Tennessee 37220, USA, **JUDY DULIN**, 329 Candora Road, Maryville, Tennessee 37804, USA, and **ROBIN PEELER**, Picket State Park 4605 Picket Park Hwy., Jamestown, Tennessee 38556, USA.

SPEA BOMBIFRONS (Plains Spadefoot). USA: MONTANA: TOOLE CO: Goedertz Lake on SW edge of Kevin (Sec. 34/35, T35N, R3W; UTM Zone 12: N5399810m, E428802m). 15 July 2002. Whisper Maillet. USNM 550134–5. Verified by Steve Gotte.

Extends known range in Montana ca. 64 km NW of sighting along Marias River by Mosimann and Rabb (Copeia 1952:23–27). Adults were first heard calling 25 May 2002. On 21 July, numerous metamorphs were observed moving west of Goedertz Lake. An extended drought in this area ended spring 2002.

Submitted by **WHISPER R. MAILLET, JANENE LICHTENBERG**, Confederated Salish and Kootenai Tribal Wildlife Department, P.O. Box 278, Pablo, Montana 59855, USA, and **J. KIRWIN WERNER,** Salish Kootenai College, P.O. Box 117, Pablo, Montana 59855, USA.

TESTUDINES

APALONE FEROX (Florida Softshell). USA: FLORIDA: Jefferson Co: Wacissa River, Goose Pasture, Aucilla Wildlife Management Area (30°12.186'N, 83°58.156'W). Hatchling captured in shallow water. 25 July 2002. Matthew J. Aresco. Verified by K. L. Krysko. Color Slide UF 133886. First county record (Iverson and Etchberger 1989. Florida Scientist 52:119–144; Ashton and Ashton. 1991. Handbook of Reptiles and Amphibians of Florida, Part Two: Lizards, Turtles, and Crocodilians. Windward Publ., Miami, Florida. 191 pp.). On 5 June 2002, a nesting female *A. ferox* was observed at the intersection of Sawdust Pile Rd and the unnamed north-south road that parallels the west side of the Wacissa River (A. F. Johnson, Florida Natural Areas Inventory, Tallahassee, Florida, pers. comm.).

Submitted by **MATTHEW J. ARESCO, MARGARET GUNZBURGER**, and **JOSEPH TRAVIS**, Department of Biological Science, Florida State University, Tallahassee, Florida 32306–1100, USA (e–mail [MJA]: aresco@bio.fsu.edu.)

APALONE SPINIFERA HARTWEGI (Western Spiny Softshell). USA: COLORADO: Phillips Co.: Haxtun Pond on County Road 3, 0.5 mi. S junction County Road 28. (UTM: 0699337, 4499173). 26 June 2002. UNC-MNH Photograph #30. Verified by David Chiszar and Hobart M. Smith. First county record (Hammerson 1999. Amphibians and Reptiles of Colorado. Second Ed. Univ. Colorado Press, Niwot. xxvii + 484 pp.).

Submitted by **RON MALECKI, AMBER LAWSON, LORI CRAFT,** and **STEPHEN P. MACKESSY**, Department of Biological Sciences, University of Northern Colorado, 501 20th Street, CB 92, Greeley, Colorado 80639-0017, USA (e–mail [SPM]: spmacke@unco.edu).

GOPHERUS AGASSIZII (Desert Tortoise). USA: ARIZONA: Santa Cruz Co: Atascosa Mountains, just W of Ruby Townsite; 3.5 miles S of FR 39 on FR 217 (California Gulch), ca. 1524 m elev. 13 August 2001. Tim Burkhardt and Justin Martin. Verified by David B. Wake, Museum of Vertebrate Zoology. MVZ 232831 (photo vouchers). One adult tortoise observed and photographed. The present report corroborates the unvouchered field observations by Cecil Schwalbe and Roy Averill-Murray in 1991 on the Coronado National Forest in Santa Cruz County. Their findings, summarized in Murray and Schwalbe (1993. Unpubl. report to USDA Coronado, Prescott, and Tonto National Forests, 51 pp.), included the observation of one live tortoise on Bartlett Mountain. Additonally, there is an unvouchered record included in the Nongame Data Management System (Arizona Game & Fish Department) from west of Sentinel Peak.

All of these records are from isolated pockets of Arizona Upland desert scrub (saguaro/paloverde-dominated south-facing slopes nestled among patches of grassland and lower oak woodland) within the Atascosa Mountains.

We thank Sabra Schwarz (Heritage Data Base Management System for Arizona Game and Fish Department) for providing specific locality data.

Submitted by **TIMOTHY BURKHARDT**, 49 Blossom Drive, San Rafael, California 94901, USA (e-mail: TriprionCO@aol.com), and **CECIL R. SCHWALBE**, USGS Western Ecological Research Center, Sonoran Desert Field Station, University of Arizona, Tucson, Arizona 85721, USA.

GRAPTEMYS GEOGRAPHICA (Common Map Turtle). USA: IOWA: Lafayette Co.: 1.5 mi SE of Lansing, Power Plant Road, 91°07'30"N, 43°20'30"W, R3W T98N, Sec. 2. 15 June 2002. Harlan D. Walley. Northern Illinois University HDW-NIU photograph collection 2002:1–8. Verified by Julie Ray. New county record. A nesting female having dug a nesting site 6 cm in diameter, and 127 cm in depth when observed at 1000 h, and another adjacent nest site having been exposed by predators also noted. County record; fills gap between Houston Co., Minnesota (Oldfield and Moriarty 1994. Amphibians and Reptiles Native to Minnesota, University of Minnesota Press, Minneapolis) on the north, and Crawford Co., Wisconsin (Casper 1996. Geographic Distributions of the Amphibians and Reptiles of Wisconsin, Milwaukee Publ. Museum, 87 pp.). All previous localities for Iowa are of a generalized nature, only listing the Mississippi River.

Submitted by **HARLAN D. WALLEY**, Department of Biology, Northern Illinois University, Dekalb, Illinois 60115, USA; e–mail: hdw@niu.edu.

KINOSTERNON SUBRUBRUM (Eastern Mud Turtle). USA: ARKANSAS: Perry Co.: Harris Brake Wildlife Management Area, SW, SE, Sec. 14, T4N, R17W (N34.9862° W092.7772°). 25 April 2002. K.J. Irwin. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 27172). Verified by Stan Trauth. DOR adult on paved roadway, bounded by bottomland hardwood forest slough and reservoir dam planted in brome grass. First record for county and fills hiatus between records in Conway and Pulaski counties (Trauth, Robison, and Plummer, ms. in prep.).

Submitted by **KELLY J. IRWIN**, Arkansas Game and Fish Commission, 915 East Sevier Street, Benton, Arkansas 72015, USA; e–mail: kirwin@agfc.state.ar.us.

KINOSTERNON SUBRUBRUM SUBRUBRUM (Eastern Mud Turtle). USA: NORTH CAROLINA: Gates Co: 6.4 km NE of Gatesville, Merchants Mill Pond State Park (36°25'52"N, 76°41'34"W) 7 June 2002. Brian S. Gray and Mark Lethaby. Verified by Alvin Braswell. An adult female was caught, photographed, and released near the shore of family camp site #1. A photograph is deposited in the North Carolina State Museum of Natural Sciences (field no. ALB10735). New county record (Palmer and Braswell 1995. Reptiles of North Carolina. Univ. North Carolina Press, Chapel Hill. xiii + 412 pp.).

Submitted by **BRIAN S. GRAY**, 1217 Clifton Drive, Erie, Pennsylvania 16505, USA, and **MARK LETHABY**, 535 East 29th Street, Erie, Pennsylvania 16504, USA.

STERNOTHERUS CARINATUS (Razor-backed Musk Turtle). USA: ARKANSAS: GRANT Co.: Saline River, NW, Sec. 8, T6S, R14W (N34.2137° W092.5477°). 19 April 2002. Clifton Jackson and K. J. Irwin. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 27171). Verified by Stan Trauth. Adult female drowned in commercial fishing hoop net. First record for county and fills hiatus between records in Saline and Dallas counties (Trauth, Robison, and Plummer, ms. in prep.).

Submitted by **CLIFTON JACKSON** and **KELLY J. IRWIN**, Arkansas Game and Fish Commission, 915 East Sevier Street, Benton, Arkansas 72015, USA (e-mail [KJI]: kirwin@agfc.state.ar.us).

LACERTILIA

ANOLIS CAROLINENSIS (Green Anole): BRITISH WEST INDIES: GRAND CAYMAN ISLAND: Seven-Mile Beach (grounds of Holiday Inn). 10 November 2001. Robert Powell. Bobby Witcher Memorial Collection, Avila College (BWMC 06820). First record for this species from Grand Cayman Island and only the second record for the West Indies (Eaton et al. 2001. Herpetol. Rev. 32:118). Verified by Arthur C. Echternacht. A previous report from Georgetown (F. Burton, pers. comm.), for which no specimen is available, suggests that these anoles are either established on Grand Cayman or are being imported on a regular basis. Based on pattern of dewlap color, this imported animal probably originated in an area northeast of Naples to east of Fort Myers, Florida (A. C. Echternacht, pers. comm.).

Submitted by **ROBERT POWELL**, Department of Biology, Avila University Kansas City, Missouri 64145, USA; e-mail: powellr@avila.edu.

CNEMIDOPHORUS EXSANGUIS (Chihuahuan Spotted Whiptail). USA: ARIZONA: COCHISE CO: Winchester Mountains, Davis Canyon, west-central Sec. 11, T13S R22E, Coronado National Forest, ca. 1670 m elev. UAZ 52129–30. 23 August 1999. Trevor B. Persons. Verified by John W. Wright. First record for the Winchester-Galiuro Mountains complex. Extends known range ca. 96 km WSW from the upper Gila River drainage of extreme east-central Arizona and ca. 77 km WNW from records in the northern Chiricahua Mountains of extreme southeastern Arizona (Stuart 1991. Cat. Am. Amph. Rept. 516.1–516.4).

Submitted by **TREVOR B. PERSONS**, USGS Forest and Rangeland Ecosystem Science Center, Colorado Plateau Field Station, Box 5614, Northern Arizona University, Flagstaff, Arizona 86011, USA, and **PHILIP C. ROSEN**, Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, Arizona 85721, USA.

COLEONYX VARIEGATUS (Western Banded Gecko). USA: ARIZONA: COCONINO CO: Lake Powell, Glen Canyon National Recreation Area, Antelope Point, UTM 12 461757E 4088760N (36°56'46"N, 111°25'47"W), 1152 m elev. 4 May 2001. Thomas C. Brennan, Martin J. Feldner, Hans F. Koenig, and Emily N. Taylor. University of Arizona Color Slide (54036 PSV). Verified by George Bradley. Adult female, collected at 1745 h under a flat piece of sandstone in Great Basin Desert habitat characterized by *Artemisia* and *Ephedra*, outcrops of sandstone interspersed with and areas of aeolian sand. An extensive review of museum specimens revealed one other specimen of *Coleonyx* (LACM 132434) collected at Bright Angel Creek, Grand Canyon National Park, Coconino Co., Arizona on 12 August 1929 by C. M. Bogert. The specimen collected by Bogert is from southern portion of the North Kaibab Plateau, north of the Colorado River in Arizona, where the range of *Coleonyx* was previously thought to terminate. This is the first record of *Coleonyx* from east of the North Kaibab Plateau and east of the Colorado River in northern Arizona. The nearest record of *Coleonyx* from Utah is from St. George, Washington Co., Utah (BYU 438, 523, 1450, 1544). The specimen reported herein represents a northeast range extension of ca. 100 km.

Submitted by **THOMAS C. BRENNAN**, 13201 South Wakial Loop, Apt. 3055, Phoenix, Arizona 85044, USA (e-mail: mail@brennanart.com), **MARTIN J. FELDNER** 1918 East Redfield Road, Tempe, Arizona 85283, USA (e-mail: Mjfinaz@aol.com), and **HANS F. KOENIG**, Arizona Game & Fish Department Region V, 555 North Greasewood Road, Tucson, Arizona 85745, USA.

CTENOSAURA PECTINATA (Spinytail Iguana). USA: FLORIDA: CHARLOTTE CO: 100 m W of junction State Highways 771 and 775 at the Placida public boat ramp. 29 August 2001. M. J. McCoid. Deposited at the Texas Cooperative Wildlife Collection (TCWC 84723). Verified by R. Kathryn Vaughan. Although not a new county record, this report clarifies distribution and presents an important range expansion. Bartlett and Bartlett (1999. A Field Guide to Florida Reptiles and Amphibians. Gulf Publ. Co., Houston, xiv + 280 pp.) correctly noted that *C. pectinata* are found on Gasparilla Island, Charlotte Co., Florida. They failed to note that only the northern 1/3 of Gasparilla Island is Charlotte Co. while the southern 2/3 of the island is Lee Co. Bartlett and Bartlett also incorrectly diagrammed the distribution and showed the species as occurring in Pinellas Co., Florida. For the past three to five years, there have been unsubstantiated sightings of *C. pectinata* from the Placida area (directly east of Gasparilla Island) northward several miles along the coast to the city of Englewood. Prior to this report, all documented records of *C. pectinata* on the west coast of Florida were restricted to Gasparilla Island. This specimen is not from Gasparilla Island and suggests that the species is established on west coast peninsular Florida. Two additional juvenile *C. pectinata* were also observed at the collection site.

Submitted by **MICHAEL JAMES McCOID**, Florida Fish and Wildlife Conservation Commission, 1481 Market Circle, Port Charlotte, Florida 33953, USA; e-mail: mccoid@isni.net.

EUMECES ANTHRACINUS (Coal Skink). USA: GEORGIA: PICKENS CO: Big Canoe Development, McDaniel Meadows, a conservation easement held by North American Land Trust (34.46241081N, -84.26860222W). 3 March 2002. Christopher R. Wilson. Georgia Museum of Natural History (GMNH 46877). Verified by Elizabeth McGhee. First county record (John Jensen, pers. comm.). One male individual, in breeding condition, found crawling on leaf litter in sphagnum wetland. Photographed and released. Funding for biological surveys provided by Big Canoe Company, LLC.

Submitted by **CHRISTOPHER R. WILSON**, 425 Roxanna Street, Boone, North Carolina 28607, USA; e-mail: critterfro@boone.net.

HEMIDACTYLUS BROOKII BROOKII (Brook's Gecko). THAILAND: RANONG PROVINCE: Muang District: Pak Nam Subdistrict, Ban Pak Nam; on building walls near brackish water canal (9°57'N, 98°36'E). 2000 (exact dates of collection not recorded). M. Sumontha. Institut Royal des Sciences naturelles de Belgique (IRSNB 16530–31). Verified by Ned Gilmore, Academy of Natural Sciences of Philadelphia. First verified record for Thailand. Taylor (1963. Univ. Kansas Sci. Bull. 44:687–1077) did not include this species in the Thai fauna. Chanard et al. (1999. Amphibians and Reptiles of Peninsular Malaysia and Thailand, Bushmaster Publications, Wuerselen, Germany, 240 pp.) first noted its presence in the country, but this was not based on any specific localities and those authors did not themselves confirm its occurrence (W. Grossmann, pers. comm., August 2002). This widely distributed house gecko ranges more or less continuously from Pakistan to Myanmar, with only scattered records from more eastern localities (Smith 1935. Fauna of British India Including Ceylon and Burma. Reptilia and Amphibia. Vol. II. – Sauria, Taylor & Francis, London, xiii + 440 pp., 1 map, 1 pl.). An older, doubtful record from Singapore is the only other locality from the Malay Peninsula (Denzer and Manthey 1991. Raffles Bull. Zool. 39:309–322).

Submitted by **AARON M. BAUER**, Department of Biology, Villanova University, 800 Lancaster Avenue, Villanova, Pennsylvania 19085, USA (e-mail: aaron.bauer@villanova.edu), **OLIVIER S.G. PAUWELS**, Department of Recent Vertebrates, Institut Royal des Sciences naturelles de Belgique, Rue Vautier 29, 1000 Brussels, Belgium (e-mail: osgpauwels@hotmail.com), and **MONTRI SUMONTHA**, Ranong Marine Fisheries Station, 157 M. 1 Saphan Pla Road, Pak Nam, Muang, Ranong 85000, Thailand (e-mail: knotsnake2211@yahoo.com).

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). USA: FLORIDA: WAKULLA Co: Panacea, US 98 ca. 0.3 km N of Ochlockonee Bay, on wall of Oaks Motel, (29.979°N, 84.384°W). 24 July 2002. Steve A. Johnson, William J. Barichivich, Jennifer S. Staiger. Florida Museum of Natural History, University of Florida, Gainesville (UF 133844–133846). Verified by K. L. Krysko. We collected 3 adults with SVLs of 57, 57, and 52 mm. This apparently is the first county record for the species. *H. turcicus* individuals have been collected in Leon Co. to the north (Means 1990. Herpetol. Rev. 21:96) and in Franklin Co. to the west (Means 1996. Herpetol. Rev. 27:152). Collins and Irwin (2001. Herpetol. Rev. 32:276) overlooked the Franklin Co. record published by Means (*op. cit.*) and erroneously reported specimens collected on 4 April 2001 as a new county record.

Submitted by **STEVE A. JOHNSON**, **WILLIAM J. BARICHIVICH** and **JENNIFER S. STAIGER**, US Geological Survey, Florida Caribbean Science Center, 7920 NW 71st Street, Gainesville, Florida 32653, USA.

HEMIDACTYLUS TURCICUS (Mediterranean House Gecko). USA: FLORIDA: CHARLOTTE Co.: Port Charlotte, 2121 Ivy Street. 7 June 2002. M. J. McCoid. Texas Cooperative Wildlife Collection (TCWC 84910). Verified by R. Kathryn Vaughan. The species has a spotty distribution in Florida (Bartlett and Bartlett 1999, A Field Guide to Florida Reptiles and Amphibians. Gulf Publ. Co., Houston, Texas, xiv + 280 pp.). First record for this county.

Submitted by **MICHAEL JAMES McCOID**, Florida Fish and Wildlife Conservation Commission, 1481 Market Circle, Port Charlotte, Florida 33953, USA; e-mail: mccoid@isni.net.

LEIOCEPHALUS CARINATUS (Curlytail Lizard). USA: FLORIDA: COLLIER Co: Chokoloskee Island. North side of island at Outdoor Resorts RV Park. 7 November 2001. M. McCoid and J. DeRosa. Texas Cooperative Wildlife Collection (TCWC 84724–725). Verified by R. Kathryn Vaughan. This population represents a ca. 60 airline mile range extension from the population in the Miami area (Conant and Collins 1998. A Field Guide to Reptiles & Amphibians Eastern and Central North America. Houghton Mifflin Co., Boston, Massachusetts, xviii + 616 pp.) and is the first record for the county and west coast of Florida. Outdoor Resorts is a popular destination for vacationers from the greater Miami area and it is likely that introduction occurred through frequent travels to the area. A life-time resident of Chokoloskee Island and the manager of Outdoor Resorts (K. Brown, pers. comm.) stated that the population has been established at the resort for ca. 10 years. Although lizards are fairly common (we observed ca. 50 individuals), the population appears to be confined to the resort.

Submitted by **MICHAEL JAMES McCOID**, Florida Fish and Wildlife Conservation Commission, 1481 Market Circle, Port Charlotte, Florida 33953, USA; e-mail: mccoid@isni.net.

MESOSCINCUS MANAGUAE (Managua Skink). EL SALVADOR: SANTA ANA: N side of Lake Güija, Cantón Tecomapa, Metapán, San Diego y La Barra (14°18.5'N, 89°32'W), 425 m elev. 16 September 2000. Néstor Herrera, Ricardo Ibarra, and Roberto Rivera. YPM 12468. Found under log in tropical dry forest. SONSONATE: El Zope Mariculture Station, ca. 2 km W Playa Los Cóbanos (13°32'N, 89°49'W), 5 m elev. 10 November 1994. Oliver Komar, Ricardo Ibarra, Roberto Rivera. KU Color Transparency Collection (KU CT 11862). Both records verified by Gunther Köhler. New country record (Dueñas et al. 2001, *In* Johnson et al. [eds.], Mesoamerican Herpetology: Systematics, Zoogeography, and Conservation, pp. 93–99. Centennial Museum, Special Publ. No. 1, The University of Texas at El Paso, El Paso). Extends the western range of this species 260 airline km from the nearest locality at Punta Ratón, Choluteca, Honduras (Diaz et al. 1979. Herpetol. Rev. 10:26–27).

Submitted by **ELI GREENBAUM,** Division of Herpetology, Natural History Museum & Biodiversity Research Center, The University of Kansas, 1345 Jayhawk Boulevard, Lawrence, Kansas 66045–7561, USA (e-mail: elig@ku.edu), **NÉSTOR HERRERA,** Colonia El Roble, Av. C, Pje. 3, No. 141, San Salvador, El Salvador (e-mail: nealhd@telesal.net), **RICARDO IBARRA PORTILLO,** Colonia Miramonte, Av. Tecana No. 618, San Salvador, El Salvador (e-mail: ribarra@telesal.net), **OLIVER KOMAR,** Division of Ornithology, Natural History Museum & Biodiversity Research Center, The University of Kansas, 1345 Jayhawk Boulevard, Lawrence, Kansas 66045-7561, USA (e-mail: okomar@ku.edu), and **ROBERTO RIVERA,** 8° Av. Norte No. 523, San Salvador, El Salvador (e-mail: rivera@saltel.net).

SCELOPORUS JARROVII (Mountain Spiny Lizard). USA: ARIZONA: COCHISE Co.: Winchester Mountains, Davis Canyon, NW/4 of SW/4 Sec. 11, T13S R22E, Coronado National Forest,

ca. 1660 m elev. UAZ 51868. 23 August 1999. Trevor B. Persons. Verified by George Bradley. First record for the Winchester Mountains (Stebbins 1985. Peterson Field Guide to Western Reptiles and Amphibians. Second Ed. Houghton Mifflin Co., Boston, Massachusetts, 350 pp.). Together with the recent report of *S. jarrovii* from the eastern Galiuro Mountains (Enderson et al. 2001. Herpetol. Rev. 32:57–58), demonstrates broader occurrence on smaller and less elevated mountain islands near the northern end of its distribution than previously known.

Submitted by **PHILIP C. ROSEN**, Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, Arizona 85721, USA, and **TREVOR B. PERSONS**, USGS Forest and Rangeland Ecosystem Science Center, Colorado Plateau Field Station, Box 5614, Northern Arizona University, Flagstaff, Arizona 86011, USA.

SCINCELLA LATERALIS (Little Brown Skink). USA: ILLINOIS: Alexander Co: S side FR 272 and 3.2 km W Bean Ridge Road (37°15'13"N, 89°24'38"W). 12 August 2002. Kurt J. Regester and David W. Butler. Verified by Ronald A. Brandon. SIUC R-03869. Adult collected on hillside near Shawnee National Forest wildlife pond. New county record (Philips et al. 1999. Illinois Nat. Hist. Surv. Manual 8:1–282).

Submitted by **KURT J. REGESTER** and **DAVID W. BUTLER**, Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901, USA

SERPENTES

BUNGARUS BUNGAROIDES. VIETNAM: YEN BAI PROVINCE: Van Yen District: Na Hau Commune: stream near 21°46'N, 104°32'E; 540 m. Collected by Nguyen Quang Truong and David Kizirian on 1 October 2001. Institute of Ecology and Biological Resources (IEBR) 1172 (= LACM FS 843). Verified by Neil Vora. First record for Vietnam (Bourret 1936. Les Serpents de L'Indochine. Imprimerie Henri Basuyau & Co, Toulouse; Welch 1988. Snakes of the Orient: A Checklist. Krieger, Malabar, Florida; Sang and Cuc 1996. Checklist of Reptiles and Amphibians of Vietnam. Sci. Tech. Publ. House, Hanoi). The species is known from a few old records in Myanmar (Burma) and India (Smith 1943. Fauna of British India, Ceylon and Burma, including the Whole of the Indo-Chinese Sub-Region. Reptilia and Amphibia. Vol. III. Taylor and Francis, London) and recent records from Nepal (e.g., Shah 1999. J. Nat. Hist. Mus. Kathmandu 18:99–111). The new specimen extends the known range nearly 1000 km SE of the closest locality (NE Putao, Myanmar; 27°22'N, 97°27'E) and is the only record from the heavily populated Red River system. No record of this species is known from vast intervening regions such as Yunnan Province, China (Zhao and Adler 1993. Herpetology of China. SSAR Contr. Herpetol., Oxford, Ohio, 522 pp.) or Lao PDR (Duckworth et al. 1999. Wildlife in Lao PDR, 1999 Status Report. IUCN, Vientiane). Meristic and other characters (1273 mm snout–vent length; 142 mm tail; hemipenis with well defined calyculate and spinose zones; 229 ventrals, [37] subcaudal pairs) are in agreement with published data (Cantor 1839. Proc. Zool. Soc. Lond. 7:33; Boulenger 1896. Catalog of Snakes in the British Museum [Natural History], Vol. 3. Taylor and Francis, London; Smith, *op. cit.*; Slowinksi 1994. J. Herpetol. 28:440–446), however, its color pattern differs from some published descriptions. For example, whereas IEBR 1172 possesses 33 rings on the trunk, the type has 48, and, in contradistinction to a specimen figured in Boulenger (1896: Plate 18: Fig. 5), the white rings in IEBR 1172 are wider, less angular, and the scale sutures in the white rings are bordered with black. This specimen seemed to be foraging around stones in the stream where it was collected and where *Bungarus candidus* and *Paa* sp. were also found.

Submitted by **DAVID KIZIRIAN** and **APRIL ERIKSSON**, Herpetology, Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, California 90007, USA (e-mail: kizirian@nhm.org), and **NGUYEN QUANG TRUONG**, Department of Zoology, Institute of Ecology and Biological Resources, National Center for Natural Science and Technology of Vietnam, 18 Hoang Quoc Viet Str, Cau Giay, Hanoi, Vietnam (e-mail: truongqt@iebr.ncst.ac.vn).

CEMOPHORA COCCINEA (Scarletsnake). USA: ARKANSAS: Saline Co.: NE, NE, Sec. 12, T1N, R18W (N34.7537° W092.8646°). 11 April 2002. Jim Apel and K. J. Irwin. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 27170). Verified by Stan Trauth. Adult found under rock in abandoned rock quarry, surrounded by pine plantation. First record for county (Trauth, Robison, and Plummer, ms. in prep.).

Submitted by **JIM APEL**, 2209 Karen Lane, Alexander, Arkansas 72002, USA and **KELLY J. IRWIN**, Arkansas Game and Fish Commission, 915 East Sevier Street, Benton, Arkansas 72015, USA (e-mail: kirwin@agfc.state.ar.us).

DIPSAS INDICA INDICA. BRAZIL: BAHIA: Municipality of Aurelino Leal (14°19'S, 39°19'W). 30 November 1989. L. Matos. Coleção Zoológica Gregório Bondar of the Centro de Pesquisas do Cacau (CZGB 888); Municipality of Dário Meira (14°26'S, 39°54'W). 17 August 1994. Collector unknown. CZGB 3110; Municipality of Firmino Alves (14°59'S, 39°56'W). 24 November–8 December 1997. Collector unknown. CZGB 6171; Municipality of Ilhéus (14°47'S, 39°03'W). 22 September 1986. V. Nascimento. CZGB 125; Municipality of Itabela (16°35'S, 39°33'W). 25 August 1997–8 September 1997. J. Francelino. CZGB 5905; Municipality of Itacaré (14°17'S, 39°00'W). 23–29 May 1992. F. Gally. CZGB 1796; Municipality of Mascote (15°34'S, 39°18'W). 1 May–30 June 1997. Collector unknown. CZGB 5365; Municipality of Nova Ibiá (14°38'S, 39°38'W). 2 December 1997–12 March 1998. Collector unknown. CZGB 6808; Municipality of Valença (13°22'S, 39°04'W). 1 March–31 August 1993. Collector unknown. CZGB 3008. The localities listed above show that *D. i. indica* occur in wet forest and in mesophytic forest at different latitudes of southeastern Bahia. Other specimens from intervening localities are also in the CZGB collection. In some cases the dates of capture are unknown and, in these instances, dates indicate periods between visits to the farms. All specimens were verified by Ronaldo Fernandes. *Dipsas i. indica* is known from the Amazon drainage in Brazil, Colombia, Guyana, Ecuador, and Peru (Peters and Orejas-Miranda 1970. Bull. U.S. Nat. Mus. 297:87) and French Guiana (Chippaux 1986. Les Serpents de la Guyane Francaise. Orstom, Paris).

Two specimens from Bahia without locality data were previously cited as *D. bucephala* (Boulenger 1896. Catalogue of the Snakes

in the British Museum [Natural History]. London III:461) and *D. i. bucephala* (Peters 1960. Misc. Publ. Mus. Zool. Univ. Michigan 144:77). The single specimen from Bahia examined by Peters (*op. cit.*) has faded coloration. Peters considered this an intergrade between *D. i. bucephala* and *D. i. indica*, but recognized its similarity to *D. i. indica*. We suspect that the specimens examined by both authors are in fact *D. i. indica*, and we have never found *D. i. bucephala* in Bahia. Indeed, this subspecies is known in Brazil only from the central and southeastern regions (Hoge and Romano 1975. Mem. Inst. Butantan 39:51–60). The records presented here are the first for state of Bahia reliably identified as *D. i. indica*. It is likely that the specimens reported here are from a disjunct population of *D. i. indica* in the Atlantic forest not represented in other Brazilian collections.

Submitted by **ANTÔNIO JORGE SUZART ARGÔLO,** Universidade Estadual de Santa Cruz - UESC, Km 16 Rodovia Ilhéus-Itabuna, CEP 45650-000, Ilhéus, Bahia, Brazil and **FÁTIMA QUEIROZ ALVES,** Rua D, Loteamento Santa Teresa, n. 34, Banco Raso, CEP 45600-000, Itabuna, Bahia, Brazil.

DRYMOLUBER DICHROUS. BRAZIL: MINAS GERAIS: Parque Nacional do Rio Doce, near Marliéria municipality (19°43'S, 42°45'W). 27–28 April 1986. Ulisses Caramaschi. Museu Nacional, Rio de Janeiro, Brazil (MNRJ) 9297, adult male 660 mm SVL, 270 mm TL). Verified by Ronaldo Fernandes. First record from the State of Minas Gerais, and third record from the Atlantic Forest, extending the known range ca. 500 km SW of Porto Seguro, State of Bahia (Franco et al. Répteis na Estação Vera Cruz. Rio de Janeiro, Veracel Celulose, 1998).

Submitted by **PAULO PASSOS** (e–mail: ppassos@mn.ufrj.br) and **FERNANDA BRANDÃO** (e-mail: fernandabrandao@ufrj.br), Departamento de Vertebrados, Museu Nacional, Universidade Federal do Rio de Janeiro, Quinta da Boa Vista s/n, Rio de Janeiro, Rio de Janeiro, 20940-040, Brazil.

ERIDIPHAS SLEVINI SLEVINI (Slevin's Night Snake). MÉXICO: BAJA CALIFORNIA SUR: San Juan de La Costa, 80 km N of La Paz. 16 December 2001. Ricardo Escobar III, Timothy M. Youmans, and Jesse L. Grismer. La Sierra University Collection (LSUPC S3256). Verified by L. Lee Grismer. This record fills a distribution gap of ca. 100 km between Rancho La Presa and La Paz (Grismer 1996, Herpetol. Rev. 27:33–34). The specimen was found in a sandstone exfoliation on a south-facing canyon wall ca. 1 m above ground.

Submitted by **TIMOTHY M. YOUMANS, RICARDO ESCOBAR III**, and **JESSE L. GRISMER**, Department of Biology, La Sierra University, Riverside, California 92515–8247, USA (e–mail: timoyoum@lasierra.edu).

FARANCIA ABACURA REINWARDTII (Western Mud Snake). USA: TEXAS: Marion Co: 4.0 km SSW Smithland off Texas 43, vic. Kitchen's Creek watershed. 4 June 2002. C. T. McAllister. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 26994). Verified by Stanley E. Trauth. New county record partially filling six-county hiatus in NE Texas (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station. 421 pp.; Werler and Dixon 2000. Texas Snakes: Identification, Distribution, and Natural History. Univ. of Texas Press, Austin. 437 pp.). Also reported previously from adjacent Caddo Parish, Louisiana (Dundee and Rossman 1989. The Amphibians and Reptiles of Louisiana. LSU Press, Baton Rouge. 300 pp.).

Submitted by **CHRIS T. McALLISTER** Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA (e–mail: chris.mcallister@tamut.edu); **JENNIFER L. HOLLIS**, Department of Biology, University of Northern Iowa, Cedar Falls, Iowa 50613, USA; and **SHELLY B. SMITH**, Department of Biology, Texas A&M University–Texarkana, Texarkana, Texas 75505, USA.

HYDROPS TRIANGULARIS NEGLECTUS. BRAZIL: PARÁ: Santarém (2°26'S; 54°42'W). Month and day of collection unknown, 1999. Linha de Pesquisa em Herpetologia da Amazônia (LPHA), Laboratório de Pesquisas Zoológicas (LPZ). Faculdades Integradas do Tapajós (FIT), Santarém, Pará State (LPHA 092). Verified by A. P. dos Santos-Jr. Species known from Trinidad and western Guiana, (Roze 1957. Acta Biologica Venezuelica 2[8]:51–95). First country record, enlarges known distribution ca. 1044 km from Mazaruny in Guiana (Roze, *op. cit.*).

Submitted by **ANDREI GUIMARÃES GUEDES, AUGUSTO RODRIGUES MAIA**, and **RUBENS NOBUO YUKI**, Linha de Pesquisa em Herpetologia da Amazônia (LPHA), Laboratório de Pesquisas Zoológicas (LPZ). Faculdades Integradas do Tapajós (FIT). Rua Rosa Vermelha, 335, Santarém, Pará, Brazil, CEP: 68.010–120 (e-mail: herpeton6@hotmail.com).

LIOPHIS MILIARIS AMAZONICUS (Common Watersnake). BRAZIL: PARÁ: Municipio Itaituba (4°17'S, 55°59'W), left bank of the Tapajós River. J. G. da Frota. 9 April 2002. Linha de Pesquisa em Herpetologia da Amazônia (LPHA), Laboratório de Pesquisas Zoológicas (LPZ), Faculdades Integradas do Tapajós, Santarém, Pará State (LPHA 2235). Verified by Rubens N. Yuki. Subspecies occurs in the Santarém municipality, Brazil, SSW to Itenez River, Beni, Bolivia, east and south into Mato Grosso, Brazil (Dixon 1983. Copeia 1983:791–802). This specimen represents the second record from the basin of Tapajós River, Pará State, and extends the range ca. 240 km S from the nearest record (Municipio Santarém), also in Pará State.

Submitted by **ALFREDO PEDROSO DOS SANTOS-JR** (e–mail: alphredojr@mailbr.com.br) and **JOSSEHAN GALÚCIO DA FROTA**, Linha de Pesquisa em Herpetologia da Amazônia, Faculdades Integradas do Tapajós, Rua Rosa Vermelha, 335, Santarém, Pará, Brazil, CEP: 68.010-200.

MICRURUS CLARKI (Clark's Coral Snake). COSTA RICA: Puntarenas: ca 2 km N of Dominical, Hacienda Baru National Wildlife Refuge (09°16'00"N, 83°52'20"W, 10 m elev.). 13 July 2000. M. Ryan. Verified by Federico Bola Hos. Museo de Zoologia de la Universidad de Costa Rica MZUCR 14816 (formerly FB 2562). A juvenile was found dead on the coastal highway in the morning following heavy night rains. Range extension of 85 km and represents the northern limit for this South American species. Previously recorded from the Golfito area of southern Costa Rica.

Submitted by **MASON RYAN**, Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901, USA.

NERODIA ERYTHROGASTER (Plain–bellied Watersnake). USA: ARKANSAS: PERRY CO.: SW1/4, Sec. 3, T3N, R17W. 11 May 2002. Bobby Elliott. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 27175). Verified by Stan Trauth. Adult female killed by human. First record for county and fills hiatus between records in Conway and Pulaski counties (Trauth, Robison, and Plummer, ms. in prep.).

Submitted by **KELLY J. IRWIN**, Arkansas Game and Fish Commission, 915 East Sevier Street, Benton, Arkansas 72015, USA; e-mail: kirwin@agfc.state.ar.us.

NINIA ESPINALI (Espinal's Coffee Snake). EL SALVADOR: CHALATENANGO: Cerro El Pital (14°23.3'N, 89°07.0'W), 2270 m elev. 15 May 2001. Roberto Bolaños. KU 291246 and El Salvador National Museum of Natural History (MUHNES C–30–1538). Verified by Gunther Köhler. New records for El Salvador. A recent border change removed the Morazán, El Salvador record (Hidalgo 1981. Herpetol. Rev. 12:67–68) to Honduras (Dueñas et al. 2001. *In* Johnson et al. [eds.], Mesoamerican Herpetology: Systematics, Zoogeography, and Conservation, pp. 93–99. Centennial Museum Special Publ. No. 1, The University of Texas at El Paso, El Paso). The new record is 12 km SSW of the nearest reported locality at Ocotepeque, Honduras (McCranie and Wilson 1995. J. Herpetol. 29:224–232). Both specimens were collected under the same log ca. 5 m from primary cloud forest.

Submitted by **ELI GREENBAUM** and **OLIVER KOMAR**, Division of Herpetology and Division of Ornithology, respectively, Natural History Museum & Biodiversity Research Center, The University of Kansas, 1345 Jayhawk Blvd., Lawrence, Kansas 66045-7561, USA (e-mail: elig@ku.edu and okomar@ku.edu) and **ROBERTO BOLAÑOS**, Col. Miramonte Pte., Pje. El Rosal, Casa No. 24, San Salvador, El Salvador (e-mail: snakeman01_2000@user.kingsnake.com).

STORERIA DEKAYI TEXANA (Texas Brownsnake). USA: TEXAS: MARION CO: 10.0 km N Harleton off FM 1968 at southcentral shore of Lake O' the Pines. 23 September 2002. L. R. Twilley. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 27251). Verified by Stanley E. Trauth. New county record completely filling hiatus along counties bordering eastern part of the state (Dixon 2000. Amphibians and Reptiles of Texas. Texas A&M Univ. Press, College Station. 421 pp.; Werler and Dixon 2000. Texas Snakes: Identification, Distribution, and Natural History. Univ. of Texas Press, Austin. 437 pp.). Also reported previously from Karnack at nearby Caddo Lake and just east of Harleton in Harrison County, Texas (Hardy 1995. Checklist of the Amphibians and Reptiles of the Caddo Lake Watershed in Texas and Louisiana. Bull. Mus. Life Sci.10:1–31), and adjacent Caddo Parish, Louisiana (Dundee and Rossman 1989. The Amphibians and Reptiles of Louisiana. LSU Press, Baton Rouge. 300 pp.).

Submitted by **CHRIS T. McALLISTER** (e-mail: chris.mcallister@tamut.edu) and **LOMA R. TWILLEY** (e-mail: Lobo7041999@cs.com), Department of Biology, Texas A&M University-Texarkana, Texarkana, Texas 75505, USA.

STORERIA OCCIPITOMACULATA (Red-bellied Snake). USA: ILLINOIS: DEKALB CO: Kirkland. Three specimens were found under old roofing shingle, in a grassy area, ca. 10–15 m from the edge of Owens Creek within the old Boy Scout Camp, Franklin Twp., 88°52'30"N, 42°07'30W, R3E T43N. 10 May 2002. Michael A. Andre. Northern Illinois University HDW-NIU 1927–1929. Verified by Julie Ray and Kristin Stanford. New county record, extending the range from the adjacent eastern Kane and northern McHenry county records (Burbrink and Wilson 1994. Herpetol. Rev. 25:35; Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois, Illinois Nat. Hist. Surv. Manuel [8]:1–282) and southern LaSalle County record (Bittner and Bittner 2001. Herpetol. Rev. 32:280).

Submitted by **MICHAEL A. ANDRE** and **HARLAN D. WALLEY**, Department of Biology, Northern Illinois University, Dekalb, Illinois 60115, USA (e-mail:hdw@niu.edu).

TANTILLA GRACILIS (Flat-headed Snake). USA: LOUISIANA: VERNON PARISH: Fort Polk Military Reservation; 6 km W and 3.2 km N of jct. Hwy 117 and Hwy 465 (31°21'35.2"N, 93°14'10.4"W). 27 March 2002. Beau B. Gregory. Louisiana State University at Eunice Vertebrate Collection (LSUE 730–1). Verified by Jeff Boundy. First Parish record. This record extends the range south from Sabine and Natchitoches Parishes and west from Rapides Parish, as mapped by Dundee and Rossman (1989. The Amphibians and Reptiles of Louisiana, Louisiana St. Univ. Press, Baton Rouge. 300 pp.). Both of these specimens were collected from under the same rock.

Submitted by **AVERY A. WILLIAMS**, Division of Sciences, Louisiana State University at Eunice, Eunice, Louisiana 70535, USA, and **BEAU B. GREGORY**, Environmental and Natural Resource Management Division, Directorate of Public Works, Fort Polk, Louisiana, 71459, USA.

THAMNOPHIS SIRTALIS (Common Gartersnake). USA: LOUISIANA: AVOYELLES PARISH: Hessmer area, Hwy 3041, ca. 7 mi E of Bunkie. 27 June 2000. L. Walls. Louisiana State University at Eunice Vertebrate Collection (LSUE 732). Verified by Jeff Boundy. First Parish record. This record fills the gap between Rapides and Point Coupee Parishes, as mapped by Dundee and Rossman (1989. The Amphibians and Reptiles of Louisiana, Louisiana St. Univ. Press, Baton Rouge. 300 pp.). This specimen was discovered within the house of the collector.

Submitted by **AVERY A. WILLIAMS**, Division of Sciences, Louisiana State University at Eunice, Eunice, Louisiana 70535, USA.

THAMNOPHIS VALIDUS VALIDUS (Pacific Gartersnake). MÉXICO: CHIHUAHUA: Río Batopilas (27°1'37.3"N, 107°44'20.4"W), 550 m elev. 18 June 2001. Herpetological Collection of Unidad de Biología, Tecnológico y Prototipos (UBIPRO 7332). Verified by Richard L. Holland. First record from Chihuahua and ca. 75 km range extension SE of Alamos, Sonora (Conant 1969. Bull. Am. Mus. Nat. Hist. 142:1–140).

Submitted by **JULIO A. LEMOS-ESPINAL**, under CONABIO project U003, Laboratorio de Ecología, IBIPRO, Facultad de Estudios Superiores Iztacala, UNAM, Tlalnepantla, Estado de México, 54090 México (e-mail: lemos@servidor.unam.mx); **DAVID L. AUTH**, 425 N.E. 7th Street, Gainesville, Florida 32601, USA (e-mail: davidauth@hotmail.com); and **DAVID CHISZAR**

and **HOBART M. SMITH**, University of Colorado Museum, Boulder, Colorado 80309, USA (e-mail: hsmith@spot.colorado.edu).

***TROPIDOPHIS FUSCUS*.** CUBA: GUANTÁNAMO PROVINCE: Maisí Municipality: Sabana, NW of Punta de Maisí. 16 April 1998. Rolando Teruel and Ansel Fong G. Herpetological Collection of Centro Oriental de Ecosistemas y Biodiversidad, Santiago de Cuba (BSC.H 1730). Verified by S. Blair Hedges. New record for Maisí municipality and a 50 km range extension SE of closest records in northeastern Guantánamo Province (Hedges and Garrido 1992. Copeia 1992:820–825).

Submitted by **ANSEL FONG G.,** Centro Oriental de Ecosistemas y Biodiversidad, Museo de Historia Natural "T. Romay," Enramadas #601, Santiago de Cuba 90100, Cuba; e–mail: ansel@bioeco.ciges.inf.cu.

VIRGINIA VALERIAE ELEGANS (Western Smooth Earthsnake). USA: KENTUCKY: Breckinridge Co: near Mooleyville. 26 May 1981. Albert and Doris Westerman. Thomas More College Herpetology Collection (TMC R200–201). Verified by Christopher N. Lorentz. Validates a previous county record cited without a voucher specimen by Meade (1993. Ph.D. Dissertation, University of Southern Mississippi).

Submitted by **JOHN W. FERNER**, **MARCUS THOMAS**, Department of Biology, Thomas More College, Crestview Hills, Kentucky 41017, USA, and **JODI P. FERNER**, Honors Program, Northern Kentucky University, Highland Heights, Kentucky 41099, USA.

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New County Records of Amphibians and Reptiles from West-Central Illinois

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Surveys of the herpetofauna of Illinois have become quite common over the past few years in an effort to determine species ranges and develop management plans (Markezich and Beckett 2001; Petzing et al. 1998; Petzing et al. 2000; Redmer and Ballard 1995; Wilson 1999). Although many sites throughout Illinois have been well sampled, several areas remain unstudied (Markezich and Beckett 2001). The 14 new county records presented are the result of field work conducted in west central Illinois where amphibian and reptile presence and species composition are poorly documented. Unless otherwise noted, specimens were verified by Christopher A. Phillips and deposited in the herpetological collection at the Illinois Natural History Survey (INHS). County records were verified by consulting published distributions in Phillips et al. (1999) and the Illinois Herpetological Database maintained by the Illinois Natural History Survey. The Illinois Herpetological Database contains information on Illinois amphibian and reptile species from 30 U.S. collections and can be accessed at the following URL:

http://www.inhs.uiuc.edu/cbd/herpdist/herp.html

Anura

Bufo fowleri (Fowler's Toad). Stark Co: Along 1500 N, just W of 935 E. 14 June 2001. J. A. Crawford and M. J. Meyer. Verified by C. A. Phillips. INHS 17452. New county record. Two newly metamorphosed toadlets (catalogued under the same museum number) collected along a roadside ditch.

Hyla chrysoscelis/Hyla versicolor (Gray Treefrog Complex). Knox Co: Green Oaks Biological Field Station. 13 June 2001. M. J. Meyer and J. A. Crawford. Verified by C. A. Phillips. INHS 17354. New county record. One male collected from a chorus at Gate Pond. Stark Co: Along 1500 N, just W of 935 E. 13 June 2001. J. A. Crawford and M. J. Meyer. Verified by C. A. Phillips. INHS 17355. New county record. One male collected from a small chorus in a roadside ditch.

Pseudacris triseriata (Western Chorus Frog). Stark Co: 0.1 mi S of 1100 N, 0.8 mi east of 950 E. 4 April 2001. J. A. Crawford and M. J. Meyer. Verified by C. A. Phillips. INHS 17234. New county record. One male collected from a chorus in a small farm pond.

Rana blairi (Plains Leopard Frog). Stark Co: Along 1500 N, just W of 935 E. 13 June 2001. J. A. Crawford and M. J. Meyer. Verified by C. A. Phillips. INHS 17356. New county record. Collected in a roadside ditch.

Rana clamitans (Green Frog). Stark Co: On 1200 E, 3.1 mi N of 1425 N. 13 June 2001. J. A. Crawford and M. J. Meyer. Verified by C. A. Phillips. INHS 17357. New county record. AOR adult.

Testudines

Chelydra serpentina (Snapping Turtle). Knox Co: Green Oaks Biological Field Station. 15 June 2001. M. J. Meyer and J. A. Crawford. Verified by C. A. Phillips. INHS 2002.02–2002.03 (photo vouchers). New county record. Two adult specimens were trapped, photographed, and released at Little John Trail Pond.

Chrysemys picta (Painted Turtle). Knox Co: Green Oaks Biological Field Station. 19 April 2001. M. J. Meyer and J. A. Crawford. Verified by C. A. Phillips. INHS 17240. New county record. Dead adult found in Little John Trail Pond.

Trachemys scripta (Pond Slider). Knox Co: Snakeden Hollow State Fish and Wildlife Area. 14 June 2001. M. J. Meyer and J. A. Crawford. Verified by R. Kniseley. New county record. Shell housed at the field office of Snakeden Hollow State Fish and Wildlife Area.

Serpentes

Coluber constrictor (Eastern Racer). Knox Co: On 1800 E, 1.7 mi S of Victoria. 13 June 2001. M. J. Meyer and J. A. Crawford. Verified by C. A. Phillips. INHS 17421. New county record. DOR adult. Stark Co: On 1120 N, 0.3 mi W of 1175 E. 15 June 2001. J. A. Crawford and M. J. Meyer. Verified by C. A. Phillips. New county record. DOR adult.

Elaphe vulpina (Western Foxsnake). PEORIA CO: On IL Rte 150, 0.2 mi N of Illinois Rte 78 junction. 15 June 2001. J. A. Crawford and M. J. Meyer. Verified by C. A. Phillips. INHS 17361. New county record. DOR adult.

Lampropeltis triangulum (Milk Snake). KNOX CO: On 1700 N (Snake Den Road), 0.9 mi W of 1950 E. 14 June 2001. M. J. Meyer and J. A. Crawford. Verified by C. A. Phillips. INHS 17360. New county record. AOR adult.

Storeria dekayi (DeKay's Brown Snake). STARK CO: On 1425 N, 0.1 mi W of 1200 E. 13 June 2001. J. A. Crawford and M. J. Meyer. Verified by C. A. Phillips. INHS 17417. New county record. DOR adult.

Acknowledgments.—We thank Stuart Allison and Joe Deviney for granting us access to the biological field station at Green Oaks, and Rick Kniseley for permitting us to use the Snakeden Hollow State Fish and Wildlife Area. We are grateful to Christopher A. Phillips and John E. Petzing of the Illinois Natural History Survey for verifying specimen identifications and providing various data. We thank Andrew R. Kuhns and Jarrett R. Johnson for critically reading the manuscript. We also thank the Illinois Wildlife Preservation Fund of the Illinois Department of Natural Resources, Division of Natural Heritage for grants 01-058W (to JAC) and 01-046W (to MJM) that partially supported this field work. Lastly, MJM would like to thank the Illinois Chapter of the Wild Turkey Federation for monetary assistance. Specimens were collected under Illinois Department of Natural Resources permit numbers A01.0205 (JAC), A01.0162 (MJM), and IDNR Division of Natural Heritage Special Permit for Snakeden Hollow State Fish and Wildlife Area (MJM).

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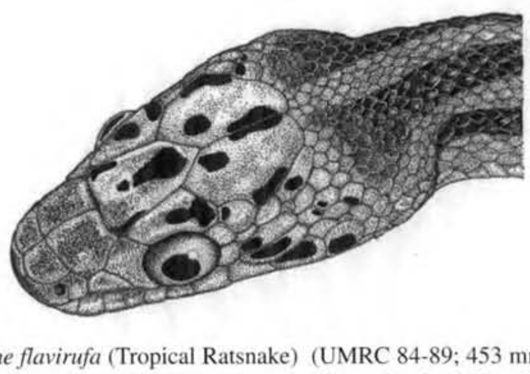

Elaphe flavirufa (Tropical Ratsnake) (UMRC 84-89; 453 mm SVL). México: Yucatán, 6.9 km W Yokdzonot. Illustration by Julian C. Lee.

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Filling in the Gaps I: New County Records for Amphibians and Reptiles in Illinois

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This article is a continuation of recent contributions published in *Herpetological Review* focusing on new amphibian and reptile county records in Illinois. Recent articles include Petzing et al. (1998, 2000), Wilson (1999), and Markezich and Beckett (2001). Specimens reported herein are housed in the Illinois Natural History Survey (INHS) and Southern Illinois University at Carbondale herpetological collections. County records were verified by checking the Illinois Herpetological Database, located at the Illinois Natural History Survey, which contains data on Illinois amphibians and reptiles from 30 museum and private collections and unvouchered records from herpetologists and other reliable biologists. Using information from the database, a web page was developed to provide county-level distribution data for amphibians and reptiles in Illinois. This web site can be accessed at:

http://www.inhs.uiuc.edu/cbd/herpdist/herp.html

The database can be searched by either species or county and distribution maps or county species lists may be printed out for field reference.

Caudata

Ambystoma maculatum (Spotted Salamander). PERRY CO: 5.7 km SW Pinckneyville (NW 1/4 Sec. 4, T6S, R3W; NAD 83 UTM Zone 16: N4212648m, E285781m). 14 March 2000. J. M. Mui, J. E. Petzing, and M. J. Dreslik. Verified by C. A. Phillips. INHS 15697. New county record. Adult found under log near ephemeral pond.

Ambystoma tigrinum (Tiger Salamander). SALINE CO: 6.6 km NW of Carrier Mills, N of new Illinois Rt. 13 alignment and 1 km E of Williamson Co./Saline Co. line (SE 1/4 Sec. 18, T9S, R5E; NAD 83 UTM Zone 16: N4177846m, E350574m). 27 April 2001. J. E. Petzing, J. M. Mui, and J. A. Koontz. Verified by C. A. Phillips. INHS 17144. New county record. Larva collected in emergent wetland.

Hemidactylium scutatum (Four-toed Salamander). CARROLL CO: 1.3 km W jct. Ridge Rd. and West Camp Creek Rd. (NW 1/4 SW 1/4 Sec. 4, T25N, R3E; NAD 83 UTM Zone 15: N4674659m, E733578m). 19 April 2001. C. A. Phillips and W. C. Handel. Verified by J. E. Petzing. INHS 17130. New county record. Adult found under log near intermittent stream.

Plethodon glutinosus (Northern Slimy Salamander). EDGAR CO: 3.5 km SSE of Logan, N side of Brouilletts Creek (NE 1/4 Sec. 35, T15N, R11W). 19 October 2000. J. A. Crawford and M. J. Meyer. Verified by C. A. Phillips. INHS 16874. New county record. Single specimen.

Necturus maculosus maculosus (Common Mudpuppy). EDGAR CO: NNE of Clays Prairie in Brouilletts Creek (NW 1/4 Sec. 32, T15N, R10W). 15 April 2000. J. A. Crawford and C. G. Gutmann. Verified by C. A. Phillips. INHS 16875. New county record. Single specimen.

Anura

Bufo americanus (American Toad). STARK CO: 3 km W of Bradford, East Fork Spoon River at Co. Rd. 1400N (NAD 83 UTM Zone 16: N4561942m, E273253m). 1 April 2000. J. A. Crawford, C. G. Gutmann, and M. J. Meyer. Verified by C. A. Phillips. INHS 16872. New county record. Single specimen.

Hyla chrysoscelis/Hyla versicolor (Gray Treefrog Complex). Dewitt Co: 7.7 km NNE of Maroa, gravel pit S of Weldon Springs State Park and S of Salt Creek (NE 1/4 NE 1/4 Sec. 13, T19N, R2E; NAD 83 UTM Zone 16: N4441691m, E336217m). 11 July 2000. C. A. Phillips, E. E. Conrad, J. M. Mui, and J. R. Jakubanis. Verified by J. E. Petzing. INHS 15854. New county record. Adult male; MOULTRIE CO: 0.7 km N of Allenville; 0.2 km N of Co. Rd. 1100N and 0.45 km W of Illinois Rt. 121 (SE 1/4 SW 1/4 SE 1/4 Sec. 16, T13N, R6E; NAD 83 UTM Zone 16: N4380686m, E368295m). 19 July 2000. J. M. Mui, E. E. Conrad, T. Griffith, and J. R. Jakubanis. Verified by C. A. Phillips. INHS 15870. New county record. Adult male.

Pseudacris crucifer (Spring Peeper). CLARK CO: E of Patton, S of Co. Rd. 2250N and W of State Line Rd. (NW 1/4 Sec. 21, T12N, R10W; UTM Zone 16: N4369869m, E454220m). 24 February 2001. C. A. Phillips, J. M. Mui, D. B. Shepard, B. C. Jellen, A. R. Kuhns, and M. J. Dreslik. Verified by J. E. Petzing. INHS 16951. New county record. Adult collected from ephemeral pond; JOHNSON CO: 3.14 km S of Main St. in Belknap on Karnak Rd. (NW 1/4 NW 1/4 NW 1/4 Sec. 14, T14S, R2E). 16 March 2000. J. G. Palis. Verified by J. Stewart. SIUC H-6598. New county record. AOR adult male on Karnak Rd. at 0237 h.

Pseudacris triseriata (Western Chorus Frog). GRUNDY CO: 1.4 km SSE of Morris (SW 1/4 Sec. 11, T33N, R7E; NAD 83 UTM Zone 16: N4578550m, E383080m). 6 April 2000. J. E. Petzing and J. M. Mui. Verified by C. A. Phillips. INHS 15705. New county record. Adult under log in dry ephemeral wetland basin east of the Mazon River; KNOX CO: NE of Co. Rt. 5 (DeLong Blacktop), W of DeLong at Brush Creek (Sec. 30, T10N, R1E). 24 April 2000. T. G. Anton. Verified by C. A. Phillips. INHS 16829. New county record. Another specimen (INHS 16871) was collected at Knox College Green Oaks Field Station on 20 April 2000 by M. J. Meyer and J. A. Crawford; PUTNAM CO: 0.8 km SSE of Moronts, tributary Allforks Creek N of New York Central RR/Chicago, Milwaukee, St. Paul and Pacific RR trestle (SW 1/4 SW 1/4 SE 1/4 Sec. 36, T33N, R2W; NAD 83 UTM Zone 16: N4572331m, E308291m). 19 October 2000. J. E. Petzing, J. M. Mui, A. R. Kuhns, D.B. Shepard, and M. J. Dreslik. Verified by C. A. Phillips. INHS 16450. New county record. Adult collected under slab rock in dry creek bed.

Rana areolata circulosa (Northern Crawfish Frog). JOHNSON CO: 1.37 km N of Main St. in Belknap on Belknap Rd. (SW 1/4 NW 1/4 NW 1/4 Sec. 6, T14S, R3E). 18 May 2000. J. G. Palis. Verified by J. Stewart. SIUC H-6599. New county record. AOR adult male on Belknap Rd. at 2218 h.

Rana blairi (Plains Leopard Frog). HANCOCK CO: 2.2 km S of Elvaston, West Fork Bear Creek at Co. Rd. 1300E (NE 1/4 Sec. 1, T4N, R8W; NAD 83 UTM Zone 16: N4477475m, E138770m). 1 May 2001. M. E. Retzer and R. S. Steinberg. Verified by C.A. Phillips. INHS 17159. New county record. Single specimen; KNOX CO: Snakeden Hollow State Fish and Wildlife Area. 20 April 2000. M. J. Meyer and J. A. Crawford. Verified by C. A. Phillips. INHS 16870. New county record. Gravid female.

Rana catesbeiana (American Bullfrog). MENARD CO: Rock Creek at Illinois Rt. 97 (SE 1/4 Sec. 13, T17N, R7W; NAD 83 UTM Zone 16: N4422642m, E257264m). 26 April 2000. C. A. Phillips. Verified by J. E. Petzing. INHS 15717. New county record. Single specimen; STARK CO: 3 km W of Bradford, East Fork Spoon River at Co. Rd. 1400N (NAD 83 UTM Zone 16: N4561942m, E273253m). 1 April 2000. J. A. Crawford, C. G. Gutmann, and M. J. Meyer. Verified by C. A. Phillips. INHS 16873. New county record. Tadpole.

Rana clamitans (Green Frog). BUREAU CO: 4.75 km W of Hennepin (NE 1/4 NW 1/4 Sec. 25, T15N, R9E; NAD 83 UTM Zone 16: N4570496m, E298623m). 23 June 2000. J. E. Petzing and W. C. Handel. Verified by C. A. Phillips. INHS 15788. New county record. Adult collected from water-filled depressions in seep area near a gravel pit; CRAWFORD CO: 5.1 km WNW of Birds; 0.3 km N Co. Rd. 000N on Co. Rd. 1150E (NW 1/4 SW 1/4 SE 1/4 Sec. 22, T5N, R12W). 25 October 2000. D. B. Shepard, M. J. Dreslik, J. E. Petzing, and J. M. Mui. Verified by C. A. Phillips. INHS 16480. New county record. Collected from small, wooded pond on the east side of Co. Rd. 1150E. Single specimen; PEORIA CO: NNE of North Hampton; 0.4 km E of Senachwine Creek (NE 1/4 Sec. 13, T11N, R8E; NAD 83 UTM Zone 16: N4535400m, E287061m). 11 May 2000. J. E. Petzing, J. M. Mui, and M. J. Dreslik. Verified by C. A. Phillips. INHS 15730. New county record. Collected from forested pond. Single specimen.

Rana sphenocephala (Southern Leopard Frog). CRAWFORD CO: ditch E of Honey Creek and N of Co. Rd. 600N (SE 1/4 SE 1/4 SW 1/4 Sec. 20, T6N, R12W; NAD 83 UTM Zone 16: N4310035m, E433398m). 2 November 2000. M. J. Dreslik, J. E.

Petzing, D. B. Shepard, and J. M. Mui. Verified by C. A. Phillips. INHS 16526. New county record. Adult.

Testudines

Chrysemys picta (Painted Turtle). SHELBY CO: 1.6 km N of Effingham Co. line on Interstate 57. 3 June 1969. E. O. Moll. Verified by C. A. Phillips. INHS 15437. New county record. Male.

Emydoidea blandingii (Blanding's Turtle). IROQUOIS CO: Iroquois County Conservation Area. June 1979. E.O. Moll. Verified by C. A. Phillips. INHS 15641. New county record. Hatchling.

Trachemys scripta elegans (Red-eared Slider). LASALLE CO: 0.3 km W of creek on CSX RR tracks; 1.6 km W of Blackball Mine. 29 August 2000. T. G. Anton and D. Mauger. Verified by C. A. Phillips. INHS 16425. New county record. Single specimen; WHITE CO: 9.7 km E Carmi, Browns Pond Ditch at Co. Rd. 1800E (SE 1/4 Sec. 13, T5S, R10E; NAD 83 UTM Zone 16: N4215352m, E408605m). 31 October 1999. L. M. Page and M. H. Sabaj. Verified by C. A. Phillips. INHS 15749. New county record. Single specimen.

Sternotherus odoratus (Stinkpot). JOHNSON CO: 3.4 km S of Main St. in Belknap on Karnak Rd. (NE 1/4 NE 1/4 Sec. 15, T14S, R2E). 22 June 2000. J. G. Palis. Verified by J. Stewart. SIUC R-3802. New county record. DOR juvenile on Karnak Rd. at 1724 h.

Apalone spinifera (Spiny Softshell). MARION CO: Kaskaskia River near Centralia. 13 October 1970. E.O. Moll. Verified by C. A. Phillips. INHS 17202. New county record. Skull and partial skeleton of an adult.

Lacertilia

Eumeces laticeps (Broad-headed Skink). WHITE CO: 5.5 km WNW of Crossville on Hanks Ferry Bridge above the Little Wabash River (SE 1/4 SE 1/4 SE 1/4 Sec. 33, T3S, R10E; NAD 83 UTM Zone 16: N4230031m, E404109m). 21 July 2000. M. J. Dreslik, J. M. Mui, and J. E. Petzing. Verified by C. A. Phillips. INHS 15874. New county record. Juvenile collected on old bridge.

Cnemidophorus sexlineatus (Six-lined Racerunner). PUTNAM CO: 0.8 km SSE of Moronts, New York Central RR/Chicago, Milwaukee, St. Paul and Pacific RR at tributary Allforks Creek (SW 1/4 SW 1/4 SE 1/4 Sec. 36, T33N, R2W; NAD 83 UTM Zone 16: N4572265m, E308295m). 19 October 2000. J. E. Petzing, A. R. Kuhns, D. B. Shepard, J. M. Mui, and M. J. Dreslik. Verified by C. A. Phillips. INHS 16456. New county record. Juvenile collected along RR tracks just east of the trestle over Allforks Creek.

Serpentes

Coluber constrictor (Eastern Racer). LAWRENCE CO: 0.6 km S of mile marker 3 on Illinois Rt. 33, S of Russellville. 24 October 2000. A. R. Kuhns. Verified by C. A. Phillips. INHS 16496. New county record. DOR adult.

Diadophis punctatus (Ring-necked Snake). EDGAR CO: 3.5 km SSE of Logan, N side Brouilletts Creek (NE 1/4 Sec. 35, T15N, R11W). 8 April 2000. J. A. Crawford, M. J. Meyer, and C. G. Gutmann. Verified by C. A. Phillips. INHS 16876. New county record; JO DAVIESS CO: 3.2 km NW jct. Blackjack Rd. and West Beaty Hollow Rd., Witkowski Fish and Wildlife Area (SW 1/4 Sec. 26, T27N, R1E; NAD 83 UTM Zone 15: N4686951m, E717654m). 19 April 2001. C. A. Phillips and W. C. Handel. Verified by J. E. Petzing. INHS 17156. New county record. Male.

Elaphe spiloides (Central Ratsnake). MARSHALL CO: N of Hopewell, Illinois Rt. 29 at Rattlesnake Hollow (Sec. 26, T12N, R9E; NAD 83 UTM Zone 16: N4540549m, E294253m). 29 August 2000. T. G. Anton and D. Mauger. Verified by C. A. Phillips. INHS 16828. New county record. DOR. Single specimen.

Elaphe vulpina (Western Foxsnake). PUTNAM CO.: 0.8 km SSE of Moronts, New York Central RR/Chicago, Milwaukee, St. Paul and Pacific RR at tributary Allforks Creek (SW 1/4 SW 1/4 SE 1/4 Sec. 36, T33N, R2W; NAD 83 UTM Zone 16: N4572077m, E308278m). 19 October 2000. D. B. Shepard, A. R. Kuhns, J. E. Petzing, J. M. Mui, and M. J. Dreslik. Verified by C. A. Phillips. INHS 16482. New county record. Single specimen collected under piece of sheet metal at base of RR trestle.

Heterodon platirhinos (Eastern Hog-nosed Snake). EDGAR CO: 2 km W of Saint Bernice, S of Co. Rd. 700N (NW 1/4 NE 1/4 Sec. 32, T15N, R10W). 15 April 2000. J. A. Crawford and C. G. Gutmann. Verified by C. A. Phillips. INHS 16877. New county record. Adult; PEORIA CO: NNE of North Hampton, E side of Senachwine Creek (NE 1/4 Sec. 13, T11N, R8E; NAD 83 UTM Zone 16: N4535224m, E287192m). 11 May 2000. J. E. Petzing, J. M. Mui, and M. J. Dreslik. Verified by C. A. Phillips. INHS 15733. New county record. Juvenile found in floodplain forest/upland forest interface.

Lampropeltis calligaster calligaster (Prairie Kingsnake). LAWRENCE CO: 0.72 km S of Birds–Chauncey Rd. on Illinois Rt. 1 (NW 1/4 NW 1/4 NW 1/4 SW 1/4 Sec. 31, T5N, R11W). 25 October 2000. D. B. Shepard, M. J. Dreslik, J. M. Mui, and J. E. Petzing. Verified by C. A. Phillips. INHS 16488. New county record. DOR adult on east shoulder of Illinois Rt. 1.

Lampropeltis triangulum triangulum (Eastern Milksnake). PUTNAM CO: 0.8 km SSE of Moronts, New York Central RR/Chicago, Milwaukee, St. Paul and Pacific RR at tributary Allforks Creek (SW 1/4 SW 1/4 SE 1/4 Sec. 36, T33N, R2W; NAD 83 UTM Zone 16: N4572291m, E308263m). 19 October 2000. A. R. Kuhns, J. E. Petzing, J. M. Mui, D. B. Shepard, and M. J. Dreslik. Verified by C. A. Phillips. INHS 16742. New county record. Single specimen found under old RR tie along embankment.

Opheodrys aestivus (Rough Greensnake). SHELBY CO: 8.45 km ESE Oconee at Becks Creek. 19 September 2000. M. E. Retzer. Verified by C. A. Phillips. INHS 16975. New county record. DOR adult.

Pituophis catenifer sayi (Bullsnake). SCOTT CO: 3.7 km SSW of Oxville on Illinois Rt. 100 (SW 1/4 Sec. 8, T14N, R13W). 29 April 2001. M. E. Retzer. Verified by C. A. Phillips. 17155. New county record. DOR adult.

Storeria dekayi wrightorum (Midland Brownsnake). LAWRENCE CO: 1.5 km S of Chauncey, The Slough at Co. Rd. 200E (Sec. 4, T4N, R13W; NAD 83 UTM Zone 16: N4296822m, E424424m). 2 November 2000. M. J. Dreslik, J. M. Mui, J. E. Petzing, and D. B. Shepard. Verified by C. A. Phillips. INHS 16514. New county record. AOR juvenile; MARION CO: N of Omega at Stephen A. Forbes State Park, W of Lost Fork (NW 1/4 SE 1/4 Sec. 32, T4N, R4E). 16 May 2001. R. Phillippe and D. Ketzner. Verified by C. A. Phillips. INHS 17203. New county record. Adult found dead

with crushed head; PUTNAM Co: 1.5 km SW of McNabb (SW 1/4 SW 1/4 SW 1/4 NE 1/4 Sec.9, T31N, R1W). 19 October 2000. J. E. Petzing, A. R. Kuhns, D. B. Shepard, M. J. Dreslik and J. M. Mui. Verified by C. A. Phillips. INHS 16457. New county record. DOR adult; SANGAMON Co: 5.6 km ENE of Pleasant Plains. 22 October 2000. R. Mosher. Verified by C. A. Phillips. INHS 16864. New county record. DOR adult; SCOTT Co: 0.56 km W of Co. Rd. 1600E on Co. Rd. 500N; 6.1 km NW of Manchester (SE 1/4 Sec. 6, T13N, R11W). 5 April 2001. J. E. Petzing, J. M. Mui, and M. J. Dreslik. Verified by C. A. Phillips. INHS 17098. New county record. Single specimen; SHELBY Co: 4.3 km N of Beecher City, Co. Rd. 100N just W of Co. Rd. 1900E (NE 1/4 NE 1/4 NE 1/4 NE 1/4 Sec. 18, T9N, R4E; NAD 83 UTM Zone 16: N4343893m, E345738m). 22 October 2000. J. E. Petzing. Verified by C. A. Phillips. INHS 16461. New county record. AOR. Single specimen.

Thamnophis proximus (Western Ribbonsnake). PERRY Co: 0.3 km S of Illinois Rt. 154 in Beaucoup Creek, E of Pinckneyville (NW 1/4 Sec. 19, T5S, R2W; NAD 83 UTM Zone 16: N4217116m, E292419m). 26 April 2001. J. E. Petzing, J. M. Mui, and J. A. Koontz. Verified by C. A. Phillips. INHS 17157. New county record. Adult collected in Beaucoup Creek.

Thamnophis sirtalis sirtalis (Eastern Gartersnake). CRAWFORD Co: 2.1 km S of Co. Rd. 550N on Co. Rd. 400E (SE 1/4 Sec. 32, T6N, R13W; NAD 83 UTM Zone 16: N4307408m, E424581m). 24 October 2000. A. R. Kuhns. Verified by C. A. Phillips. INHS 16504. New county record. Single specimen; Stark Co: 1.5 km N of Wyoming, 0.8 km E of Co. Rd. 1050E on Co. Rd. 800N (NAD 83 UTM Zone 16: N4552511m, E267096m). 20 April 2000. J. A. Crawford and M. J. Meyer. Verified by C. A. Phillips. INHS 16878. New county record. Adult male.

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BOOK REVIEWS

Herpetological Review, 2002, 33(4), 330–332.

Sea Snakes of New Caledonia/ Les Serpents Marins de Nouvelle-Calédonie, by Ivan Ineich and Pierre Laboute. 2002. IRD (Institut de Recherche pour le Développement) Éditions/ Muséum National d'Histoire Naturelle, Paris (publication XXXIX in the Collection Faune et Flore Tropicales series). 302 pp. Hardcover. 51 € (48.34 € without VAT) (approx. US $48 or US $46 without VAT). ISBN 2-7099-1492-1/ 2-85653-540-2.

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There are several books that deal specifically with aspects of the biology of sea snakes worldwide (e.g., Dunson 1975; Heatwole 1999). No one region of the world, however, has been the focus of a book length treatment of sea snakes before. New Caledonia, with 14 species of sea snakes, is relatively rich in these reptiles, including several regionally endemic forms (e.g., *Hydrophis coggeri*, *H. laboutei*), a few probable vagrants (*H. spiralis*, *Lapemis curtus*), the widely distributed pelagic species *Pelamis platurus*, and numerous species with chiefly Australian or Asian distributions that reach their easternmost range limits in New Caledonian waters.

Despite its focus on New Caledonia, this volume provides a useful introduction to sea snakes as a whole and, with more than 135 color photos, it is certainly the most well-illustrated book on marine elapids to date. Further, with its bilingual text (English and French on facing pages), the book is accessible to a broad spectrum of readers.

An introductory overview of sea snakes (pp. 15–50) discusses 16 different topics including diversity, phylogeny, feeding, reproduction, mimicry, parasitism, diving, and conservation. This is an excellent and up-to-date review of sea snake biology that will be informative for professional herpetologists and yet still fully comprehensible to a non-technical audience. Thirty-six footnotes explain terms or concepts that may be unfamiliar to some readers (e.g., proteroglyphic teeth, monotypic, fouling organisms). The only term that struck me as requiring, but lacking, such a footnote was "nycthemeral" (p. 86).

Like the book as a whole, the introduction is illustrated by numerous color photos of sea snakes, their habitats, predators and

prey. These are mostly the work of Pierre Laboute, who has spent years observing and photographing sea snakes in New Caledonia. While nearly all of the photos are excellent, perhaps the most intriguing illustrates a juvenile *Emydocephalus annulatus* captured by a sea anemone—the first documentation of this particular cross-phylum predation.

The bulk of the book (pp. 51–264) deals specifically with the sea snakes of New Caledonia. This section begins with a series of color maps, illustrating the areas (chiefly near Nouméa) where Laboute's observations were made. This is followed by a short overview of the history of sea snake studies in New Caledonian waters, a discussion of the morphological features important for the identification of sea snakes, and a key to the 14 species reported from New Caledonia. These sections are well-illustrated by both line drawings and diagnostic photos of selected features. The species accounts themselves include Latin and common names, an introductory paragraph about each species and its biology, and more detailed information under the headings: taxonomy, description, coloration, body size, sexual dimorphism, geographic distribution, habitat and ecology, feeding, reproduction, predators, venom and snake bite, and the status of populations in New Caledonia. All accounts are also accompanied by a shaded distribution map.

Each account discusses the species as a whole, but emphasizes what is known about the variation and/or biology of the snake in New Caledonia. For example, the account of *Hydrophis ornatus* is full of useful information about the morphology of the local population, based on material in the Muséum National d'Histoire Naturelle in Paris. Much of the biological data is derived from Laboute's personal experience around the reefs and islets of the New Caledonian lagoon and represents previously unpublished information. In particular, welcome new observations regarding diet, reproduction, and depth and time of activity are described. These are sometimes presented in a summarized form in the main text, but elsewhere appear in the form of direct quotes describing behaviors seen on particular dives.

Not surprisingly the length of each account, as well as the number and variety (although not the quality) of illustrations, is highly variable. The sea kraits (*Laticauda*), by far the most commonly encountered sea snakes in the region, are the most terrestrial of all sea snakes and have been the subject of much research, most notably the detailed study in New Caledonia by Saint Girons (1964). As a consequence, the text for *L. colubrina* extends over 28 pp (70–97) and includes 13 photos. Other accounts range from eight pages for *Hydrophis laboutei* (newly described in 2000 and known from only two specimens) to 18 pages for the more abundant and well known *Acalyptophis peroni* and *Aipysurus laevis*. All of the accounts are well-illustrated and only those *H. laboutei*, *H. spiralis*, and *Lapemis curtus* (the latter two species are each known from only one New Caledonian specimen) lack photos of living animals from the New Caledonian region. Among the most biologically interesting photographs are those of freshly laid *Laticauda laticuadata* eggs (p. 109), foraging by several species (including one of a swimming *Acalyptophis peroni* with a fish in its mouth; p. 123), and courtship of *Aipysurus laevis* (p. 150).

The last full chapter is one on venom, snake bite, and envenomation. Thankfully, there are only two known fatalities from sea snake bites in New Caledonia, but data gathered from clinical cases as well as experimental studies, both in New Caledonia and elsewhere, permit a reasonably detailed picture of sea snake toxinology to be presented. There is a widespread belief in New Caledonia that sea snakes in general are not dangerous. While this is true of *Emydocephalus annulatus*, which feeds on fish eggs, all of the remaining species, even if not aggressive, are potentially hazardous to humans. Ineich and Laboute review the risk from sea snakes, provide information about symptoms and both first aid and hospital treatment. They also cross reference several websites that provide current information on the treatment of sea snake bites.

The book concludes with a literature cited section of 101 references, three appendices (New Caledonian sea snake abundance—based on individual dives by Pierre Laboute, relative abundance of New Caledonian sea snakes in the Muséum National d'Histoire Naturelle collection, and sea snake distribution within the New Caledonian region—New Caledonia, Loyalty Islands and Chesterfield Reefs), and a (primarily taxonomic) index.

Laboute's photographs alone are worth the price of the book. Sea snakes are notoriously difficult to photograph (or at least photograph well). Many published photos (excluding those of the semi-terrestrial sea kraits) show preserved animals or those recently removed from trawler nets. In contrast, Laboute's photos give a real sense of sea snakes as living organisms and add substantially to the reader's appreciation of their biology.

I noted only a few minor problems in the book. In a very few places the English is somewhat awkward (e.g., caption, p. 20; caption, p. 88; text, p. 268) or misspellings occur (e.g., "mangoose" instead of "mongoose" on p. 94). In only one instance is the English translation potentially misleading (p. 36; "bandes," correctly translated as bands or rings elsewhere, is here translated as stripes). In general the English translation follows the French text quite precisely, and both are well written. With regard to the illustrative material, one photo, that of a foraging *Emydocephalus* (p. 168), is printed upside down and one map (Figure 1) needs a minor correction. The map illustrates the range of *Pelamis platurus* as including the waters around the whole of the North Island of New Zealand (where this species, as well as *Laticauda colubrina*, occasionally occurs as a vagrant; Gill 1997), but does not include the south coast of South Africa or the central Namibian coast, where the species is also a rare vagrant (Branch 1998). Finally, one might take issue with the over-generous margins; on pages without photos, the text occupies only 27–36% of the page area!

Sea Snakes of New Caledonia is a valuable contribution to the study of both sea snakes and Pacific herpetology. It should be on the shelves of herpetologists with interests in either topic, as well as those of marine biologists and divers. I also recommend it highly to anyone who appreciates good snake photography.

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Herpetological Review, 2002, 33(4), 332–333.

North American Box Turtles: A Natural History, by C. Kenneth Dodd, Jr. 2001. University of Oklahoma Press, Norman, Oklahoma. xiv + [4] + 231 pp., 9 pp. color pls., hardcover. US $59.95. ISBN 0-8061-3294-9 (Softcover. US $34.95. ISBN 0-8061-3501-8).

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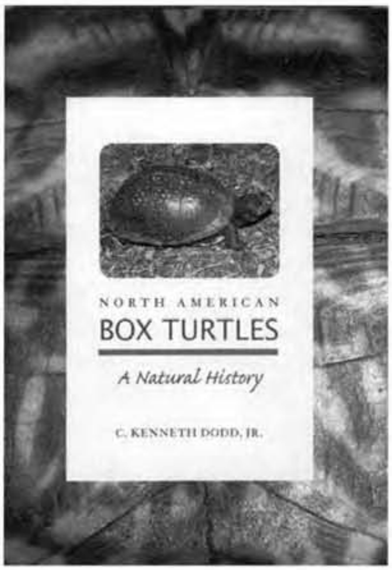
I am like many herpetologists that were born in the eastern United States: my introduction to our chosen field began with a box turtle. My father picked up a colorful specimen crossing the road in Prince George's County, Maryland, not far from our home in Alexandria, Virginia. He brought it home, thus launching my career in herpetology when I was only six years old. Ken Dodd, who was also raised in northern Virginia box turtle country, has successfully captured the allure of the engaging box turtle in this landmark book: surprisingly, the first comprehensive treatment of the wide-ranging and ever-popular *Terrapene carolina* and its relatives.



The book is nicely divided into two parts. The first covers the biology, life history and conservation of box turtles in an engaging style that will appeal to both professionals and lay people alike. The second part focuses on more technical details related to systematic accounts of each species. Chapters include an Introduction to the Box Turtle; The Evolution of Box Turtles; Habitats and Habitat Requirements; Activity, Movements and Orientation; Behavior and Senses; Courtship and Reproduction; Food and Feeding Behavior; Population Structure and Demography; Predators, Parasites and Disease; Conservation Biology; species accounts for *Terrapene carolina*, *T. coahuila*, *T. nelsoni*, and *T. ornata*; a Glossary, and an extensive Literature Cited. The book is well illustrated with graphs and photographs, but the photographs are rather small, and some are of poor quality.

One of the real strengths of the book is the concluding section in each of the chapters on natural history where Dodd examines gaps in our knowledge of box turtles and proposes questions for future research. Again, for such visible and widespread species, it is amazing how much we don't know about box turtles, especially the Mexican forms. Graduate students and scientists who are interested in box turtles will find a wealth of ideas for fruitful study in Dodd's recommendations for future research.

The book is very readable and Dodd's interest and passion for his study animal is conveyed throughout. At times, that passion turns to editorializing about the species as a whole based on his research experience at Egmont Key, off the west coast of Florida. As Dodd states in his Preface, "Much of the basis for this book rests on the shells of Egmont's box turtles." It is not unusual for scientists who have studied an organism at one site for several years to consider their population representative of the species or group as a whole. This is rarely true, however, as a single population represents only one set of ecologic and demographic parameters during a relative short period of study. If the reader keeps that caveat in mind, the editorializing is a minor detraction.

It is difficult to write a book that appeals to both a professional and a non-scientific audience, as Dodd admits in the Preface to the book. He then offers a quote from Henry Pilsbry: "If you want to learn how much you can overlook or forget, just write a book." Despite this prophecy, Dodd managed to write a book that will appeal to both audiences. It is in the spirit of the Pilsbry quote and constructive criticism that I offer the remainder of this review.

While the author states in the Preface that the bibliography is not exhaustive with respect to popular turtle books, especially those on captive care, several important scientific papers are also missing from the discussions, or not cited in strategic locations. For example, the discussion of North American versus Asian box turtles does not cite Bramble (1974) on differences in shell closure morphology, although the presence of that citation in the literature cited presumes that it occurs elsewhere in the book. In the section on Senses, the author cites the classic paper by Yerkes (1904) in discussing the aversion of some turtles to the visual cue of a cliff. However, he fails to cite more recent papers by Ashe et al. (1975) and Patterson (1971) that present data on *T. coahuila* and *T. carolina*, respectively.

In the section on coping with the environment, no mention is made of the findings of Ernst (1968) regarding evaporative water loss in *Terrapene*. While other dissertations are cited, the winter thermal ecology and movement data of Boucher (1999) are missing. Helminth parasite references are given, but the reference by Ernst and Ernst (1979) on protozoans is missing. In addition, important papers by Bels et al. (1992) and Summers et al. (1998) on the kinematics of aquatic and terrestrial prey ingestion are not discussed. Additional missing papers are cited in Ernst and McBreen (1991a, b) and Ernst et al. (1994).

Some of the figures are confusing or in error. For example, Figure 4.4, presenting temperature data from Egmont Key, appears to be flawed as the graphed and printed ranges do not match one another. Similarly, Figures 4.5 and 4.6 have captions suggesting that the means for each category are the same as their standard deviations in 7 out of 7 cases.

Despite the normal minor errors of omission and commission expected in a major tome, a book like this has been long overdue and herpetologists and natural historians alike owe a debt of grati-

tude to Dodd for compiling such a critical mass of information. I am struck by how even formerly common and "well-known" taxa like box turtles go for so long without a systematic synthesis of the state of our scientific knowledge. If you are a serious student of turtles or a lover of natural history classics, then this is a book that you must have and read.

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Herpetological Review, 2002, 33(4), 333–334.

The Anatomy of the Salamander, by Eric T. B. Francis, with an historical introduction by Francis J. Cole and a new introduction by James Hanken. Facsimile Reprints in Herpetology, Society for the Study of Amphibians and Reptiles. xiv + xxxi + 381 pp., Plates I–XXV, Color Frontispiece. Clothbound. US $60. ISBN 0-916984-50-8.

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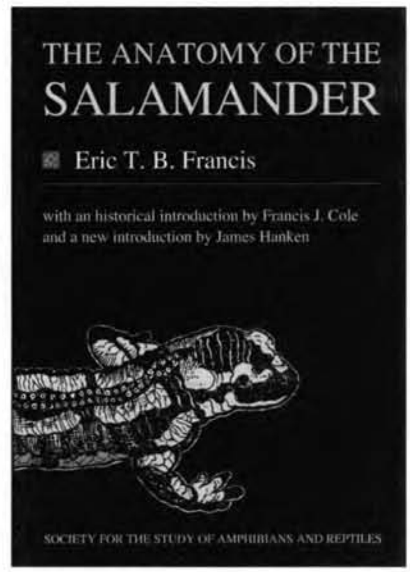

One of my most prized possessions is an original copy of this reprinted classic, purchased directly from Oxford University Press for 30 Shillings (then about $6.60) during my first year of graduate studies. It has been extremely well used, not only by me but by 35+ years of students who have repeatedly xeroxed parts of it. Amazingly, it is still in great shape, although its paper wrapper is in tatters and consists as much of tape as paper. The reason for the care with which it has been used is that everyone who borrowed it knew what a very special book it was to me. It taught me to be a salamander morphologist and introduced me to the arcane nature of morphological nomenclature. It is a wonderful book, still extremely useful, and I could not be happier with the decision to reprint it.

The production is outstanding. The color frontispiece seems better than my original, and the plates are superbly reproduced, on higher quality paper than in the original. The binding is designed to last. I especially like the very attractive paper wrappers, a vast improvement on the original.

This book will introduce the reader to all aspects of the visible morphology of *Salamandra salamandra*. The greatest strengths of the book are the excellent descriptions accompanied by lists of synonyms for sometimes confusing morphological nomenclature, and the excellent plates, which are of exceptional quality. The morphological descriptions are of lasting value even though much has been published on nearly every topic since the book appeared. Descriptions of the skeleton, musculature, peripheral nervous system, gross anatomy of the brain, the heart and vascular system, and the urogenital system are accurate and remain fully usable. Because so much recent research has expanded knowledge, information on respiration, internal anatomy of the brain, the endocrine system, the sensory systems, the skin, and some other sections are of less value, except with respect to generalizations and topography. Interspersed throughout the text are commentaries that

are often interesting and informative, and which continue to offer suggestions for additional research.

The bibliography is superb—essentially complete up through 1933. I have made extensive use of it in my own research and still refer to it with regularity. The long introduction by Professor Cole is historical and, to me, fascinating in its accounts of early work on *Salamandra* by great figures in the history of biology. Chapter I deals with taxonomy and life history. This has largely been superseded, but it is of historical interest.

A special feature of the reprint is a two-page introduction to the authors by Kraig Adler, Guest Editor of this volume. There is a delightful photo of Eric Francis, who lived until 1993 when he died at age 93, and a formal photo of Francis Cole.

A ten-page introduction to the new volume by James Hanken updates the most significant work on salamander anatomy published since 1934 and includes a very useful bibliography. I enjoyed this lively and informative feature.

I would like to think that every student of amphibian biology would want this book at hand, but I realize that not all herpetologists are interested in anatomy. The standard textbook on amphibians by Duellman and Trueb has excellent anatomical descriptions and figures. But for more in-depth coverage and for a magnificent intellectual accomplishment accompanied by figures of extraordinary value, this is a book that has no peer for amphibians. This is a book for beginning graduate students as well as more senior professionals, and I heartily recommend it.

Once again the Facsimile Reprints in Herpetology series has produced a book that will truly serve all herpetologists, and I congratulate Kraig Adler not only for conceiving the series but for establishing a high standard of quality production.

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TECHNIQUES

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Distance Sampling of Forest Snakes and Lizards

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How does one test the validity of a population enumeration technique? Most validation studies perform "soft" validation; they attempt either to correlate the counts from two or more methods (Fitch 1992) or to compare the economic costs, difficulty, time requirements, or non-economic costs of carrying out selected methods (Strong et al. 1993). Soft validation does not establish the accuracy of a method. "Hard" validation, in which population estimates are checked against the true values, is obviously desirable, but it is always difficult to do and might be impossible for some systems. Hard validation studies involving reptiles or amphibians are rare and usually involve the artificial stocking of a bounded plot (Henke 1998; Rose and Armentrout 1974).

Distance sampling is a relatively new technique (Buckland et al. 1993) that has gained considerable favor for certain herpetological sampling problems (Akin 1998; Thompson et al. 1998), but has yet to be subjected to hard validation tests for reptiles or amphibians. As with strip transect searches (Duellman 1987), distance sampling involves searching for animals within a certain distance from a transect centerline, but it differs from strip transects in requiring the measurement (or estimation) of the perpendicular distance from the centerline to each detected animal. Whereas strip transect searches make the implicit assumption that detection is complete for animals within the strip, distance sampling requires only that all animals *near the centerline* be detected. The distribution of sighting distances to animals off the centerline is used to model detectability in the vicinity of the centerline, but it is only the centerline density estimate that is used and extrapolated to the habitat at large.

Because the centerline density is extrapolated to the overall habitat, it is essential that the centerline conditions be representative of the habitat. Strip transects make a similar assumption about the representativeness of the entire strip, but the corresponding distance sampling assumption is more problematic in that the centerline of many transects is a road or trail, hardly representative of adjacent habitat. In addition to having different ground cover

and animal use patterns than surrounding habitat, trails in forested areas are associated with light gaps that alter the density and form of vegetation (hence visibility, basking opportunities, etc.). To be truly representative, a distance sampling centerline must be placed randomly in relation to animal position and habitat heterogeneity. These strictures dictate that trails or roads should not be followed, but this is impractical in most forested habitats.

The other key assumptions of distance methodology are that each animal is counted only once and that the perpendicular distance from the animal to the centerline is estimated without error and prior to any movement of the animal towards or away from the centerline/observer. Depending on the study species, these assumptions would not be troublesome for many reptiles and amphibians.

Distance sampling seems ideally suited for the many species of amphibians and reptiles that are rarely seen or hard to capture, because marking, recapture, or handling of animals is not required. One can sum rare detections over many sampling occasions, and there is no minimum number of detections needed for a sampling occasion to be useful. There is no uncertainty about the size of the area sampled, and one obtains an absolute population density estimate that is insensitive to habitat structure, species, or the capabilities of the searcher (Rodda 1993). The key disadvantages of distance sampling for reptiles and amphibians are that one *must* detect 100% of the animals on the unbiased centerline and that detections must be gathered over an amount of time and space sufficient to accumulate an adequate sample size. Thus one might have difficulty using distance sampling to answer a question such as, "Do rainbow snakes reach peak density in a particular wetland in May?"

We conducted a hard validation study of distance sampling for forest geckos and snakes on Guam. We compared the estimates produced by distance sampling to true local gecko densities based on subsequent total removal of all animals and vegetation from sealed 10 x 10 m plots (Rodda et al. 2001). For brown treesnakes (*Boiga irregularis*), we compared distance sample estimates to densities based on mark-recapture estimates that we had in turn validated in adjacent fenced 1-ha plots by comparing mark-recapture estimates to total removal of all snakes (Campbell 1996). The gecko comparison was done sequentially, as the total removal method alters vegetation and therefore could not be carried out concurrently with the distance sampling.

Methods.—We searched for forest geckos and snakes in a 6.5-ha patch of tangantangan (*Leucaena leucocephala*) forest north of the grenade range at Northwest Field, Andersen Air Force Base, Guam (N 13.6373–13.6399; E 144.8616–144.8643), 19 January 1993 to 29 November 1994. Within this patch were four 1-ha plots circumscribed by trails and penetrated by three parallel internal transect trails spaced 25 m apart. Sighting of forest squamates was facilitated because all searching was done at night when the many small leaflets of the dominant tree, *Leucaena leucocephala,* fold closed (mean percentage of tree basal area due to the species *L. leucocephala* = 61%, N = 7 removal plots). The forest canopy in this area is very low (mean = 5.4 m, N = 7 removal plots) and is unusually open (mean distance to daytime disappearance of a human = 15.7 m, N = 1000). Mean forest canopy cover was 69% (N = 7 removal plots). Because of this naturally incomplete canopy, creation of the transect trails did not greatly alter forest structure. Negligible movement towards or away from the observer was noted in sighted animals, which were illuminated by spotlight.

Distance estimates were obtained by two experienced observers who periodically checked sighting distance estimates against measured distances (a telescoping rod marked at 0.1 m intervals was extended perpendicularly from transect centerline to the sighting point). They walked each transect five times quarterly, for a total of 36.2 km of transect searched on both sides of the trail/centerline. Results from other transects (in manipulated or snake-controlled plots: Campbell 1996) were not included in the distance validation data presented here. Sightings > 4 m from the transect centerline were extremely sparse and were not used in the analysis. Because of uncertainty about the species identity of small geckos, all gecko species were pooled. Based on known identities (96% of sighted geckos were identified to species), the majority (88%) of these sightings were *Hemidactylus frenatus*, the remainder *Lepidodactylus lugubris*. It is possible that some individuals of *Gehyra mutilata* were present; none was definitely sighted, though one was found in a removal plot. The only other sighted squamate was the brown treesnake, *Boiga irregularis*. Snakes were analyzed separately from geckos.

Conventional distance analytical methods (Buckland et al. 1993) were used, with cut points for distance categories set at 0, 1, 2, 3, and 4 m (i.e., sightings grouped in the ranges 0–1.0 m, 1.01–2.00 m, etc.). Alternate cut points were investigated but did not appreciably affect density estimates. Model selection was guided by program DISTANCE; alternate models provided nearly identical density estimates. Estimated sighting distances were pooled over time for the four 1-ha study plots, providing sample sizes of effort (36.2 km), samples (4 plots), and observations (1853 geckos and 51 snakes).

Absolute population density measurements, by total removal, were obtained using the methods described by Rodda et al. (2001). Briefly, canopy separation and ground-level aluminum flashing were used to prevent the movement of lizards into or out of the sample plots while the vegetation was removed and all vertebrates identified, measured, and weighed. Plots were selected on the basis of representative canopy coverage and plant species composition. Four 5 x 5 m plots and one 10 x 10 m plot within the area surveyed using distance methods were censused 16 Feb–14 May 1995. Four 10 x 10 m additional samples from the same area were censused 28 Jan–11 Feb. 1999. Because the two series produced nearly identical mean gecko densities (3350/ha v. 3450/ha), these were pooled for comparison to distance estimates.

Mark-recapture was used only for snakes, following the methods described in Campbell (1996) and using program MARK (White and Burnham 1999). Through saturation removal of snakes from fenced plots, Campbell demonstrated that the true snake density was well within the 95% confidence limits of mark-recapture estimates made with this method on these plots at the time this work was carried out. Briefly, we captured brown treesnakes using snake traps (Rodda et al. 1999) and hand capture over six 15–22 day periods simultaneous with the distance sampling. All captives were double marked using PIT tags and paint markings. Exploration of the resulting capture history matrices with various open population models consistently indicated a best model (selected on the basis of Akaike's Information Criterion) that varied capture probability, p, in accordance with snake snout-vent length

(small snakes were less frequently captured), but with capture probability and apparent survivorship, ϕ, constant over time. "Apparent survivorship" quantifies the probability of a snake dying or moving permanently out of a study plot between daily trapping occasions. Emigration so measured was high enough (2.5–17.5%/day) to preclude analysis with closed mark-recapture models. Snake abundance in each plot was estimated as size-stratified n-bar/p-hat, where n-bar is the mean number of captures/day and p-hat is the maximum likelihood estimator of mean capture probability. Density was estimated by dividing estimated abundance by each plot's nominal trap grid area (1 ha). Twenty-four venues (four plots by six time periods) provided density estimates, but ten of these involved plots for which the snake density had been manipulated. The fourteen density estimates from unmanipulated plots were averaged for comparison to the one distance estimate obtained concurrently.

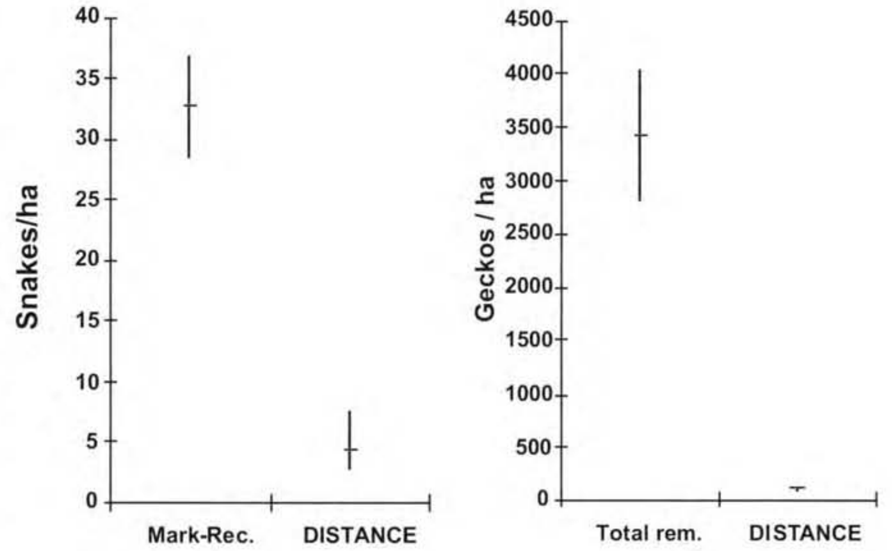

FIG. 1. Distance sampling estimates for brown treesnakes, *Boiga irregularis*, and geckos (*Hemidactylus frenatus*, *Lepidodactylus lugubris*, and *Gehyra mutilata*) on Guam in relation to mark-recapture (snakes) or total removal estimation (geckos). Distance estimates show maximum likelihood estimate with 95% confidence intervals. The other values are mean +/- SE.

Results.—The detection distances analyzed by DISTANCE showed the expected smooth decline with increasing distance from the transect centerline (geckos: 721, 602, 390, and 140; snakes: 29, 21, 7, and 9) and had excellent model goodnesses of fit (geckos: $\chi^2 = 0.71$, df = 1, P = 0.4; snakes: $\chi^2 = 1.39$, df = 1, P = 0.24). For both data sets, the selected model used the uniform key and cosine adjustment. However, the density estimate obtained for geckos was 100.1 geckos/ha (95% CL: 85.6–117.1), whereas the mean density estimate obtained by direct count (total removal) averaged 3416.7 geckos/ha (SE = 608). Thus the distance estimate for geckos was low by a factor of about 34 (Fig. 1). The distance density estimate for snakes was 4.4/ha (95% CL: 2.6–7.4), whereas the validated mark-recapture population estimates (N = 14) averaged 32.7/ha (SE = 4.0). Thus the distance estimate for snake density was low by about a factor of 7 (Fig. 1).

The gecko species composition estimated from sighted individuals was overwhelmingly *Hemidactylus frenatus* (88%), whereas subsequent total removal censuses indicated that less than half of the gecko individuals present (46%) were of that species. The majority (52%) were *Lepidodactylus lugubris*.

Discussion.—Does the discrepancy in gecko species composition between visual sightings (88% *Hemidactylus*) and census results (46%) reflect detection differences among gecko species or were geckos misidentified or often not-identified to species during visual searches? The percentage of unidentified geckos (4.1%) was small relative to the total sample, indicating that the large discrepancy could not be made up by more complete identification of geckoes sighted. The two observers gave virtually identical percentages of *Hemidactylus* in their visual samples (87.3 v. 87.7%), suggesting that few identifications were in error. It is likely, however, that detection differed between these species. *Lepidodactylus* is found mainly in foliage, where visibility is reduced, whereas *Hemidactylus* is most often found in more visible sites on branches, limbs, and trunks. Thus we expected that detection would be more complete for *Hemidactylus*. If one assumes that all visual identifications were correct and that the proportional representation of unidentified species was the same as for the identified geckos, the distance estimate for *Hemidactylus* would be 88/ha (CL 75–103/ha), which underestimated the true value of 1572/ha low by a factor of about 18. If one combines the small uncertainty associated with species identification with the distance sample confidence limits, the *Hemidactylus* uncertainty ranges 72–104/ha, implying an error factor of 15–22 fold. The corresponding values for *Lepidodactylus* are 12/ha (CL 10–14/ha), which underestimated the true density of 1777/ha by a factor of about 148. Adding in the identification uncertainty broadens the total uncertainty range for this species' estimate to 10–18/ha, implying an error factor of 98–181.

The population density estimates provided by DISTANCE in this case were severely biased in comparison to higher validity methods. As evidenced by the different gecko species composition of the contrasted methods, the bias was different for different species even within the same guild and body size range. Before concluding that distance sampling is inappropriate for this system, however, it is desirable to question possible sources of error in the higher validity methods. Each method makes assumptions, but the following seem to us to have the greatest likelihood of error.

Open mark-recapture analysis assumes negligible individual heterogeneity in capture probability. If this assumption is invalid for brown treesnakes, the true population densities would be higher than reported here, and the estimated bias of the distance estimates would be greater.

Open mark-recapture analysis also assumes the absence of either trap happiness or trap shyness. The existence of trap happiness would exacerbate the apparent bias of distance sampling for snakes, whereas trap shyness would have the opposite effect. Note that the mouse attractant used in the snake traps could not be eaten by captured snakes, so trap happiness would not be expected. In

closed model analysis of brown treesnake trap captures we have detected only limited evidence of either type of behavioral response (Rodda and Dean-Bradley, unpubl. data), suggesting that the observed difference between mark-recapture and distance sampling is not attributable to trap shyness.

The small sample plots used for total removal population density estimation might have been non-representative. The selection criteria seem unbiased, and extensive glueboard surveys and visual searches failed to document any evidence of non-representation. We expect that only random bias would be produced by failure of this assumption.

Which distance assumptions might be invalid? The use of trails rather than randomized unimproved transects for distance sampling centerlines violates a key method assumption, that transects be placed randomly in relation to habitat. In this specific case, the transect "centerline" is a 2-m wide band spanning the trail. If squamate sighting rates were lower on trails than when walking cross-country through the forest, our use of trails could produce the observed bias. It is our experience, however, that sighting rates are not higher when walking cross country through the forest on Guam, but drop to near zero, because of visual interference by vegetation. Furthermore, if trails have any effect on the distribution of these species we would expect that heliophilic squamates would seek out the sides of trails, as the light gaps created by trails produce more vegetation of a suitable height and these provide more basking and foraging opportunities. Thus, our expectation was that use of trails for transect centerlines would bias distance estimates upwards, not downwards as observed.

Violation of the assumption that all squamates present on the centerline were detected most likely produced the observed bias. It seems likely to us that vegetation concealed many active squamates, and that inactivity of others would account for their unavailability for detection. Intensive visual searches of brown treesnakes in finely-gridded areas on Guam produce an average detection probability of < 9% (usually < 5%; Rodda et al., unpubl. data). If one can see only 9% (or less) of the snakes that are present in a forest, it is unrealistic to expect distance sampling to produce unbiased estimates of forest squamate population density. Because of the ubiquitousness of visual barriers in a forest, we suggest that distance sampling is unlikely to be valid for absolute densities of forest vertebrates detected exclusively by sight.

Does the discrepancy in gecko species composition between visual sightings (86% *Hemidactylus*) and census results (46% *Hemidactylus*) reflect detection differences among gecko species, or were visually-sighted geckos unidentified or misidentified frequently enough to account for the discrepancy? The percentage of unidentified geckos (4.1%) was small relative to the number identified; this could not account for the discrepancy. Misidentification cannot be unequivocally ruled out, but we believe that the primary cause of the discrepancy is the different microhabitats used by these geckos: *Lepidodactylus lugubris* is found mainly in foliage, where visibility is reduced relative to the branch/trunk sites preferred by *Hemidactylus frenatus*.

Also, if detection on the centerline is not 100% and differs among species, distance estimates cannot be used as an index of abundance when comparing species. For example, the distance estimator for *Hemidactylus frenatus* cannot be compared to that for *Lepidodactylus lugubris,* even if used only as an index of abundance. However, it might be possible to make temporal comparisons within a single species. Validation studies among different seasons, species, and habitats would be needed to determine if the ratio of undercounting is consistent enough for distance sampling to have utility as a single species index.

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A Comparison of the Efficacy of Survey Methods for Amphibians Breeding in Small Forest Ponds

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Although researchers have studied amphibians for many years, status assessments have been hampered by a lack of standards and protocols for inventory and monitoring. Heyer et al. (1994) and Olson et al. (1997) provide a foundation in their reviews of methods used for measuring and monitoring amphibian biodiversity. It is clear from these reviews that no single method effectively assesses all species and that more information is needed on the efficacy of approaches for surveying and monitoring amphibians in differing geographic regions and habitat types.

Forests and associated wetlands are dominant components of glaciated landscapes of the Upper Great Lakes Region, including the states of Michigan, Minnesota, and Wisconsin, USA (Dahl and Zoltai 1997; Frayer 1997). Because timber harvest rates have increased in recent decades (Vasievich et al. 1997), disturbance from land management activities also has increased. These disturbances affect both wetlands directly and characteristics of the surrounding forest on which wetland communities depend (deMaynadier and Hunter 1995; Pauley et al. 2000; Semlitsch 2000). Wetlands are embedded in, and strongly linked ecologically to the surrounding forest (Palik et al. 2001). This is also true of amphibians in such habitats. They breed in small seasonal forest wetlands and live in the adjacent forest uplands during the remainder of the year (deMaynadier and Hunter 1999; Gibbs 1993; Hecnar and M'Closkey 1996, 1997; Wilbur 1980). In small seasonal forest ponds, water levels can fluctuate widely and the amphibian breeding season is short. There is a need to examine the efficacy of survey methods for assessing amphibians in such habitats.

In this paper, we assess amphibian survey methods in small seasonal forest ponds. Our objectives were to: 1) determine the efficacy of three amphibian survey methods (breeding call, dip net, and funnel trap surveys) for detecting four species (*Rana sylvatica*, *Pseudacris crucifer*, *P. triseriata*, and *Ambystoma laterale*); 2) compare the efficacy of these methods used singly and in combination for documenting species occurrence; and 3) determine the efficacy of two additional methods (egg and metamorph surveys) for *R. sylvatica*.

Materials and Methods.—We conducted the study from 1998 to 1999 at 76 seasonal forest ponds in north central Minnesota in the Sucker Lakes watershed, Cass County, and in the Rice River watershed, Itasca County. In these forested watersheds, ponds are abundant and their morphology, hydroperiods, and animal and plant communities are highly variable. Candidate ponds were identified on 1:15,840 scale color infrared photographs (Brooks et al. 1998). To maximize the likelihood of identifying ponds with seasonal hydroperiods (i.e., ponds in which water is seasonally present), wetlands that also occurred on the National Wetlands Inventory (Wilen 1990) were excluded from consideration. From the remainder, we randomly choose up to five ponds in each of 13 ecological Landtype Association - Landtype (Albert 1995) combinations found on the watersheds, mostly within undisturbed, mature forest stands. The 76 selected ponds ranged in size from 0.04 to 0.20 ha, 74 had seasonal hydroperiods in 1998, and they occurred within a variety of forest types.

We examined the efficacy of survey methods for four species of amphibians: wood frogs (*Rana sylvatica*); spring peepers (*Pseudacris crucifer*); western chorus frogs (*P. triseriata*); and blue-spotted salamanders (*Ambystoma laterale*). We used three primary methods to survey these species during 1998 and 1999: breeding call (C), dip net (D), and funnel trap (T) surveys.

A modified Wisconsin protocol (Kline 1998; Mossman and Hines 1985; Mossman et al. 1998) was used for the C survey, and was conducted once during each of two sampling periods in both years: 12–15 April to assess wood frogs and western chorus frogs; and 17–19 May to assess other calling amphibians. Each pond was visited between 1915 and 0135 h, and after about a minute of acclimation, one person recorded the presence of all species of amphibians calling during a 3-min period.

The D survey was conducted once each year from 24–28 May and 3 June in ponds containing water to sample amphibian larvae. Larvae were readily identifiable by this point in the season. Ponds were swept with aquatic D-shaped dip nets (30 cm width, 20 cm long canvas bag, 1 mm mesh bottom, with 10 cm long canvas skirt) for a total of 15 person-min, regardless of pond size, between 0800 and 1640 h. An effort was made to first sample all habitat elements in a pond, then habitat elements most likely to produce captures. Captured amphibians were held in buckets until the sampling period ended, then were identified, counted, and released. Although we captured both larvae and occasional adults, only larvae were included in the analysis.

T surveys also were conducted to sample amphibian larvae. We used unbaited metal traps of two different mesh sizes in 1998: four (6 x 6 mm) openings per 2.5 cm and eight (3 x 3 mm) openings per 2.5 cm [Cuba Specialty Manufacturing Co., Fillmore, New York; G-40 and G-48M]. Traps were spaced evenly around each pond in shallow water perpendicular to shore. They were placed in water deep enough to submerge the trap entrance, yet provide air for amphibians to breathe. We set two to six traps (one to three of each mesh size) around each pond, alternating mesh sizes from a random start. The number of traps was chosen to approximate an equivalent effort per unit of pond surface area, which averaged about 210 m^2/trap. T surveys were conducted once in each pond, for three consecutive days, from 3–25 June in 1998 between 0800 and 1600 h. Captured amphibians were identified to species, counted, and released. Although we captured both larvae and occasional adults in traps, only larvae were included in the analysis. In 1998, we determined that mesh size of traps was of no consequence to wood frog larvae capture rates, but the smaller 3 x 3 mm mesh size produced higher capture rates for the smaller-sized larvae of spring peepers and blue-spotted salamanders (Buech and Egeland 2002). Thus, in 1999, we again trapped each pond for three days between 8 June and 9 July using only 3 x 3 mm mesh traps. Summer precipitation was exceptionally low in 1998 and exceptionally high in 1999; consequently, we were able to trap in

more ponds in 1999. Additionally, because ponds contained more water in 1999 and we wanted to maintain a relatively constant effort per unit of surface area, we used more traps in 40% of ponds in 1999.

Wood frog egg masses are highly visible and often clumped in one location, which suggested that egg mass surveys might be effective for determining occupancy (Crouch and Paton 2000). Surveys for wood frog egg masses (E) (1998 and 1999) and wood frog metamorphs (1999) were conducted to determine if single-visit surveys for these life stages provide useful information. Each pond was visited within a week after the April breeding call survey to look for egg masses. We searched ponds thoroughly between 0800 and 1600 h without time limit, until we either found and recorded the number of egg masses, or were fairly confident that eggs were not present. Similarly, we visited ponds in mid-summer (12–23 July) to conduct a survey for recently metamorphosed wood frogs, and recorded the number observed during a 10 person-min search around the perimeter of each pond.

We summarized data by reducing it to presence-absence information and counted how many ponds a particular method or combination of methods recorded each species as being present for 1998 and 1999. The measure of efficacy was taken as the pond count for a method or combination of methods, expressed as a proportion of the number of ponds in which a species was recorded by all methods combined. For example, if we surveyed 50 ponds and heard wood frogs calling in 30, and we learned by looking at all survey methods that wood frogs were actually present in 40 of the 50 ponds, the efficacy of the calling survey for wood frogs in that year would be stated as 0.75. We combined years by summing the pond counts over 1998 and 1999. In addition to the four amphibian species already mentioned, one other taxon (gray treefrog, *Hyla versicolor*) was included in analyses of species richness. Log-linear and contingency table analyses were used in SYSTAT 8.0 (SPSS, Inc. 1998) to compare the efficacy of methods and where appropriate, Pearson's Chi-square statistic (χ^2) is reported.

Results.—We compared the efficacy of C, D, and T surveys for assessing reproductive activity of the three anurans most frequently found at our ponds (Fig. 1). For wood frogs, these methods yielded similar results in 1998 (Fig. 1a), but efficacies were not homogeneous in 1999 ($\chi^2 = 37.15$, df = 2, $P < 0.001$); C surveys recorded wood frogs in fewer ponds than recorded by either D or T surveys. For wood frogs, the combined-year efficacy of D and T surveys was better than for C surveys ($\chi^2 = 10.33$, df = 1, P < 0.001 and $\chi^2 = 9.39$, df = 1, P < 0.002, respectively).

Efficacy patterns of C, D, and T surveys for spring peepers (Fig. 1b) and western chorus frogs (Fig. 1c) were similar in both years. In 1998, 1999, and both years combined, efficacies of C, D, and T surveys were not homogeneous for both spring peepers ($\chi^2 = 70.94$, df = 2, $P < 0.0001$; $\chi^2 = 76.84$, df = 2, $P < 0.0001$; $\chi^2 = 134.85$, df = 2, $P < 0.0001$; respectively) and western chorus frogs ($\chi^2 = 35.40$, df = 2, $P < 0.0001$; $\chi^2 = 12.35$, df = 2, $P < 0.002$; $\chi^2 = 43.06$, df = 2, $P < 0.0001$; respectively). In both years combined, C surveys detected these frogs more frequently than either D (spring peepers $\chi^2 = 134.75$, df = 1, $P < 0.001$; western chorus frogs $\chi^2 = 31.16$, df = 1, $P < 0.001$) or T surveys (spring peepers $\chi^2 = 44.66$, df = 1, $P < 0.001$; western chorus frogs $\chi^2 = 31.16$, df = 1, $P < 0.001$). D and T surveys generally yielded similar results except the T survey recorded spring peepers in many more ponds than did the D survey (combined-years analysis: $\chi^2 = 37.36$, df = 1, $P < 0.001$), especially in 1999.

Combinations of survey methods, especially combinations that included a C survey, did a better job of detecting all three species (Fig. 1). Call plus dip net surveys (CD) and call plus funnel trap surveys (CT) yielded similar results. These combinations were better than dip net plus funnel trap (DT) surveys for spring peepers and western chorus frogs (χ^2 range in 4 comparisons: 30.00 to 62.45, df = 1, $P < 0.001$). For wood frogs, only CD surveys differed from DT surveys ($\chi^2 = 5.48$, df = 1, $P < 0.019$). C surveys detected spring peeper and western chorus frog reproductive activity almost as well as CD and CT surveys, however, C surveys detected spring peepers in fewer ponds than CT surveys ($\chi^2 = 7.27$, df = 1, $P < 0.007$). For wood frogs, the addition of either D or T

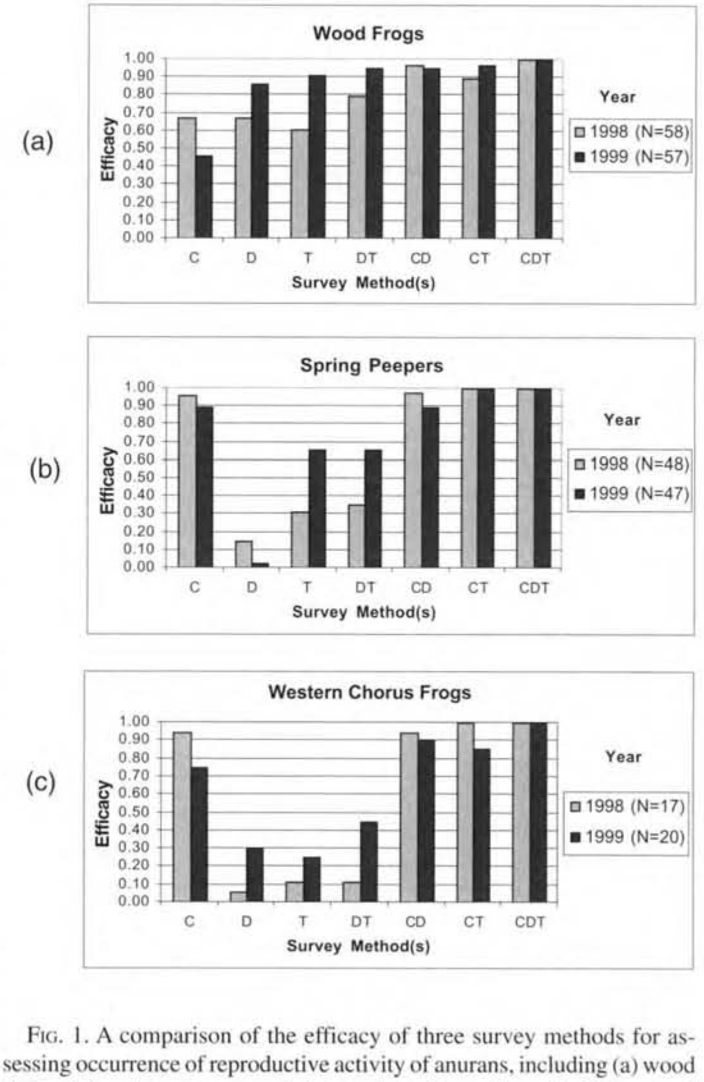

FIG. 1. A comparison of the efficacy of three survey methods for assessing occurrence of reproductive activity of anurans, including (a) wood frogs, (b) spring peepers, and (c) western chorus frogs, in 76 seasonal forest ponds in north central Minnesota in 1998 and 1999. Methods used were breeding call (C), dip net (D), and funnel trap (T) surveys, which were analyzed singly and in combination. The measure of efficacy was taken as the pond count for a method or combination of methods expressed as a proportion of the number of ponds in which a species was recorded by all methods combined. The sample size listed for each year is the total number of ponds in which reproductive activity was recorded for the species by any of the three methods.

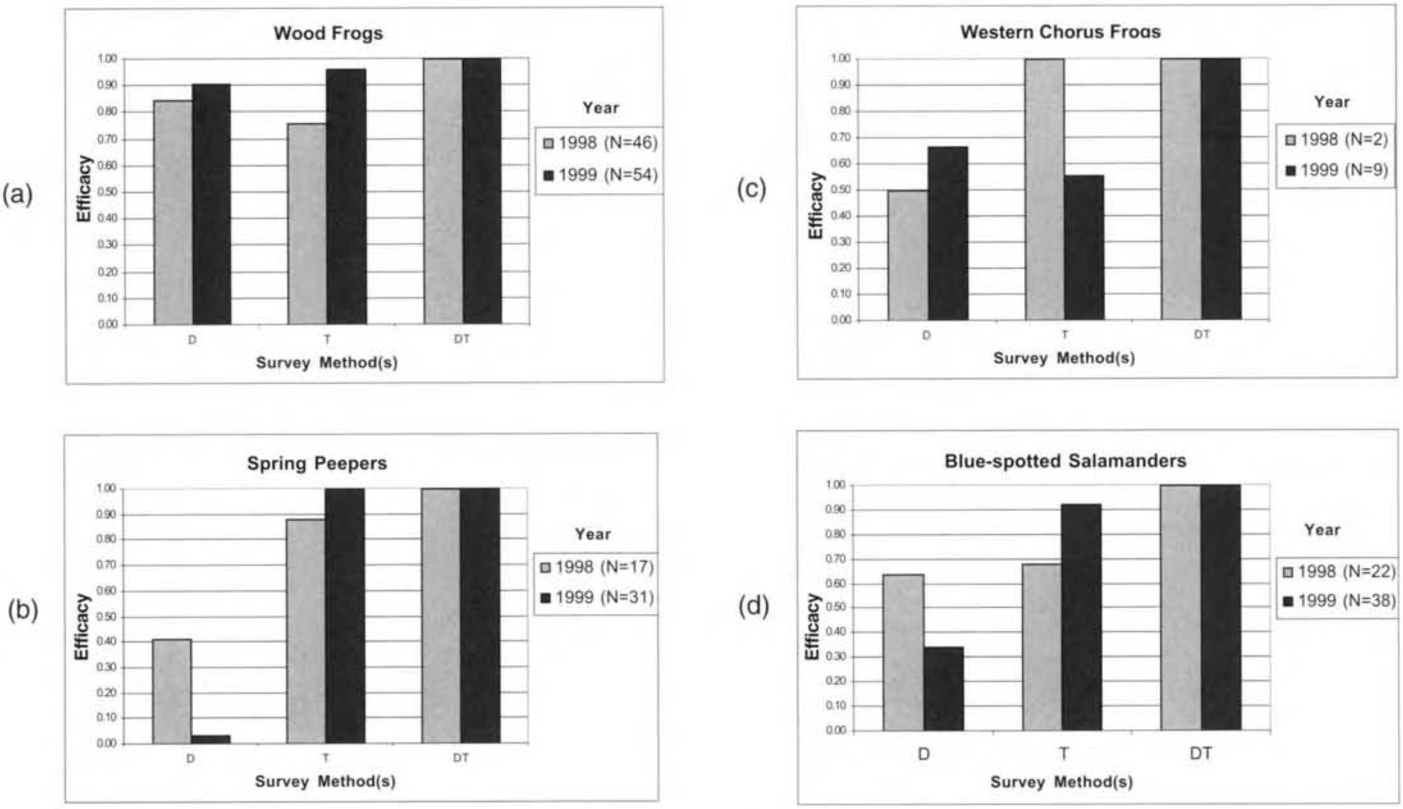

FIG. 2. A comparison of the efficacy of two survey methods for measuring the presence of (a) wood frog, (b) spring peeper, (c) western chorus frog, and (d) blue-spotted salamander larvae in 76 seasonal forest ponds in north central Minnesota in 1998 and 1999. Methods used were dip net (D) and funnel trap (T) surveys, which were analyzed singly and in combination. The measure of efficacy was taken as the pond count for a method or combination of methods expressed as a proportion of the number of ponds in which a species was recorded by all methods combined. The sample size listed for each year is the total number of ponds in which a species larva was recorded by either of the two methods.

surveys to C surveys detected their presence more effectively ($\chi^2 = 48.39$ and 40.67, df = 1, $P < 0.001$).

In a second analysis, we disregarded C surveys and reanalyzed data from D and T surveys for wood frog, spring peeper, western chorus frog, and blue-spotted salamander larvae (Fig. 2). These methods might be chosen to assess non-calling amphibians. T surveys did a better job than D surveys in documenting the occurrence of larvae for two of the four species (Fig. 2b and 2d) ($\chi^2 = 61.12$ and 19.17, df = 1, $P < 0.001$, respectively, for spring peepers and blue-spotted salamanders); however, the western chorus frog (Fig. 2c) sample size was low.

Multiple visits contributed to the efficacy of T surveys (Fig. 3). In both years combined, 94% of 86 ponds known to contain wood frogs were identified after only one day of trapping, and 99% after two days of trapping. However, we also captured a total of 9395 wood frog larvae in these ponds during both years. For less abundant species [blue-spotted salamanders (N = 48 ponds; 272 larvae) and spring peepers (N = 46 ponds; 377 larvae)], about 70% of ponds known to contain the species were identified after the first day and 90% after the second day. Results were similar for the chorus frog, which was found in only 6 ponds (10 larvae) that we trapped. The known complement of species in ponds also was identified in about 70% of ponds after one day and in 90% of ponds after two days of trapping.

Survey data for wood frogs were reanalyzed to include E surveys to document reproductive activity (C, E, D, and T surveys in Fig. 4a) and presence of only their eggs or larvae (E, D, and T surveys in Fig. 4b). Efficacy of E surveys tended to be more variable among years compared to other survey methods. Furthermore, with the exception of the 1999 C survey, E surveys documented the presence of wood frogs in fewer ponds than any of the other survey methods. In fact, E surveys identified only 40 and 70% of ponds known to contain either wood frog eggs or larvae, respectively, in 1998 and 1999. As in Fig. 1, the best two-method survey

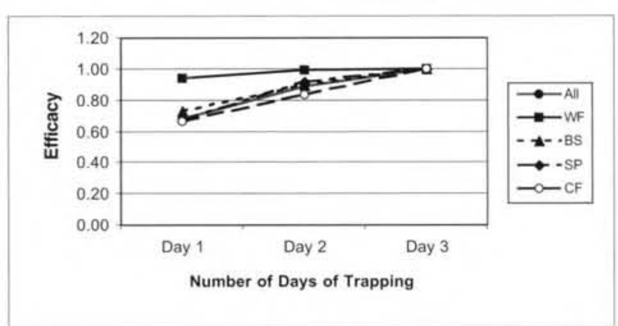

FIG. 3. Efficacy of T surveys for identifying ponds known to contain wood frogs ([WF]; N = 86 ponds), blue-spotted salamanders ([BS]; N = 48 ponds), spring peepers ([SP]; N = 46 ponds), chorus frogs ([CF]; N = 6 ponds), and the known-species complement ([All]; N = 91 ponds), in relation to the number of days trapped. The measure of efficacy is the cumulative proportion of ponds known to contain the species or the known complement of species after 1, 2, and 3 days of trapping.

sets for documenting reproductive activity of wood frogs were CD or CT surveys (Fig. 4a). Of these, only the CT survey combination was worse than the three-method, CDT combination ($\chi^2 = 3.84$, df = 1, $P < 0.05$). The efficacy of both D and T surveys was improved when combined as DT ($\chi^2 = 6.77$ and 7.66, df = 1, $P < 0.01$) (Fig. 4b). In contrast, efficacies of the two-method ED, ET, or DT survey sets for documenting wood frog eggs or larvae were similar.

During the post-metamorphosis survey, recently metamorphosed wood frogs were observed in 57 ponds (data not shown), including nine ponds in which there were no eggs or larvae documented by other methods.

The number of amphibian species recorded in ponds varied both among years and among methods (Fig. 5). In 1998, the C, D, and T surveys recorded a maximum richness of four species (Fig. 5a). Although the efficacy of these methods differed, the relative distribution of species richness among ponds did not differ ($\chi^2 = 15.35$, df = 10, $P < 0.12$). In 1999 (Fig. 5b), C and D surveys identified a maximum species richness of only three species in ponds, whereas T surveys identified four species. Although the overall efficacy of the C, D, and T surveys was similar, the relative distribution of species richness among ponds was different ($\chi^2 = 39.10$, df = 8, $P < 0.001$); D surveys documented fewer species in ponds relative to other methods. Results for the three methods in combination, were similar among years (Fig. 5). However, CD and CT surveys did a better job of documenting species richness in ponds than did DT surveys in 1998 ($\chi^2 = 11.96$ and 14.18, df = 5, $P < 0.035$). The CD and CT survey combinations identified one more species (gray treefrog) in ponds compared to the DT survey combination (in both years, only the C survey detected gray treefrogs).

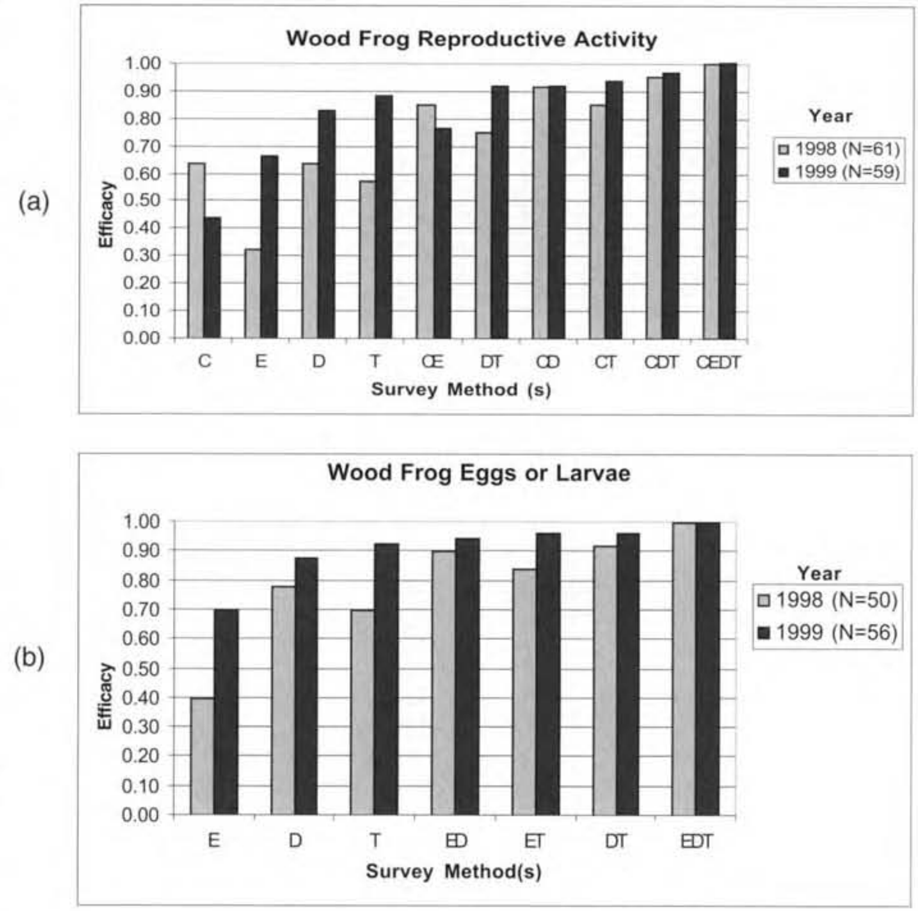

FIG. 4. A comparison of the efficacy of an expanded set of survey methods for measuring (a) reproductive activity of wood frogs and (b) presence of wood frog eggs or larvae in 76 seasonal forest ponds in north central Minnesota in 1998 and 1999. Wood frog reproductive activity was declared as occurring in a pond if it was recorded present during breeding call (C), egg mass (E), dip net (D), or funnel trap (T) surveys in that year. Wood frog eggs or larvae were declared present in a pond if they were recorded during E, D, or T surveys in that year. The measure of efficacy was taken as the pond count for a method or combination of methods expressed as a proportion of the number of ponds in which wood frogs were recorded by all methods combined. The sample size listed for 1998 and 1999 is the total number of ponds in which a) reproductive activity was recorded by any of the four methods, and b) eggs or larvae were recorded by any of the three methods.

Discussion.—Efficacy of the three primary methods was variable among species and years. Life history, reproductive phase, logistical factors, and environmental variation might account for much of this variation. For example, C surveys identified *Pseudacris* species in a much higher proportion of ponds than did D or T surveys. These species call often and over a relatively long period so they are likely to be noted when present. In contrast, C surveys identified wood frogs in ponds about as well as D or T surveys in one year but not the other. Wood frogs breed early in the season, but for only a short period, and breeding can be postponed by cold weather (Mossman et al. 1998). Consequently, it is difficult to time surveys to encompass consistently their breeding season, especially if there are large-program logistical constraints, such as the need to survey many wetlands over several days under variable weather conditions.

Several authors have suggested use of a combination of methods to meet objectives of documenting presence and relative abundance of species in amphibian communities (Heyer et al. 1994; Olson and Leonard 1997). Our results support this suggestion. A combination of a C survey with either D or T surveys documented the occurrence of calling species in more ponds than any one method alone. This is probably because of the similarity in results between D and T surveys, and the contrast between these methods and the C survey. Despite similarities between D and T surveys, there were instances in which results improved substantially by conducting both of these surveys. However, although results often improved by using multiple types of surveys, it is unknown how much of the improvement was because of adding another survey method per se, or simply because of an additional visit to the site or spending more time conducting surveys at the site.

Multiple visits to a pond clearly contributed to the efficacy of funnel trap surveys. Although a single day of trapping identified nearly all ponds known to contain wood frog larvae, this species

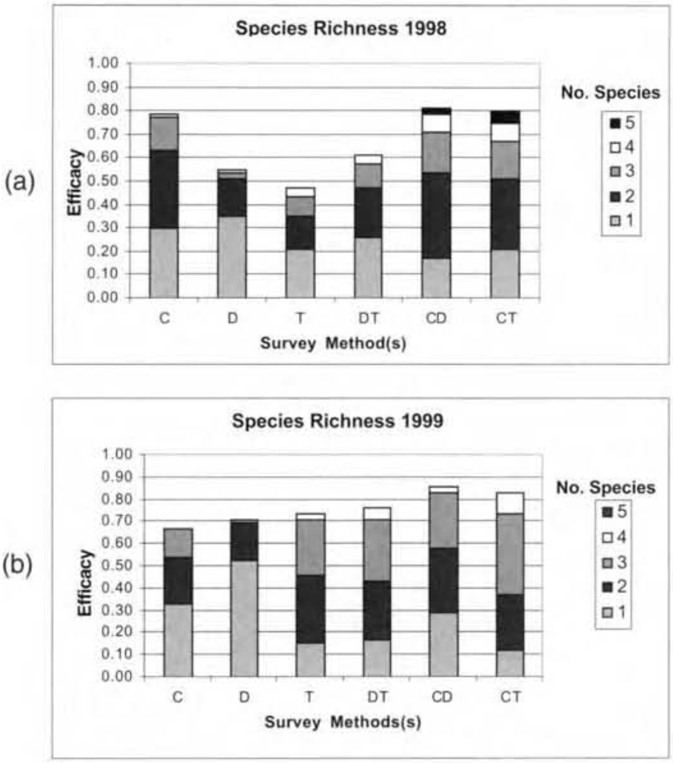

FIG. 5. A comparison of the efficacy of three survey methods for documenting the richness of amphibian species (wood frogs, spring peepers, western chorus frogs, gray treefrogs, and blue-spotted salamanders) breeding in (a) 1998 and (b) 1999 in a collection of 76 seasonal forest ponds in north central Minnesota. Methods used were breeding call (C), dip net (D), and funnel trap (T) surveys, which were analyzed singly and in combination. The measure of efficacy was taken as the pond count for a method or combination of methods expressed as a proportion of the number of ponds in which a species was recorded by all methods combined.

was very abundant. In contrast, two additional days of trapping continued to yield improvements in detection of less abundant amphibian species whose abundance was, on average, three to four percent of wood frogs. For chorus frogs, additional days of trapping might have increased the number of ponds in which they were detected. Overall, it seems that three days of trapping, as recommended by Adams et al. (1997), did a reasonable job of identifying the species composition of amphibians in small seasonal forest ponds.

A comparison of our egg survey results to those of Crouch and Paton (2000) also demonstrates the value of multiple visits. We obtained poor results from a single visit to survey wood frog eggs in 76 ponds. In 1998 and 1999, respectively, our E surveys identified only 40 and 70% of ponds known to contain wood frog eggs or larvae. In contrast, Crouch and Paton (2000) visited 15 ponds at 3 to 6 day intervals from early March to mid-April. They observed that $\geq 85\%$ of wood frog egg deposition was completed in < 8 days, but it took an average of 17.4 ($\pm$ 4.8) days for all egg masses to be deposited. Thus, they recommended that egg surveys be conducted over a three-week period and concluded that egg surveys can provide accurate information for monitoring abundance of wood frogs. Taken together, our results and those of Crouch and Paton (2000) suggest that while egg surveys can provide accurate information on wood frog reproduction, under our protocols, a single visit was not adequate to document presence. Two likely reasons for the false negatives that we recorded are failing to see communal egg masses that were present and surveying ponds before egg masses were laid. We believe the latter explanation is especially appropriate to our 1998 results; our timing was too early for a single-visit survey.

Methods differed in regard to effort required to conduct surveys under the protocols we used. E and D surveys were easiest to conduct because they only required a single visit each year and the survey itself required about 10–20 and 30–60 min at each pond, respectively. C surveys required relatively more effort. Although it took less time to conduct the survey at the site, two visits (each about 5–10 min) were required each year during nocturnal hours to assess the amphibian species that use seasonal forest ponds. T surveys required the most effort, primarily because our protocols stipulated that each wetland be surveyed once each year, and the survey itself took about 15 to 60 min for each of 4 days. Cost of equipment was zero for the C and E surveys, about US \$70 for a dip net, and about US \$8 and \$20 for one funnel trap (depending on mesh size).

As others have reported (Heyer et al. 1994; Mossman et al. 1998), methods also differed in their sensitivity to weather conditions. For one, it can be difficult to schedule surveys to cover a large number of study sites to accommodate seasonal and daily weather effects on amphibian activity. For example, we experienced difficulty in timing C and E surveys of a large number of ponds to consistently survey an explosive breeder like wood frogs. In contrast, scheduling D and T surveys is less sensitive to short-term effects of weather.

Surveying amphibians in seasonal forest ponds adds another dimension. We encountered instances of water levels that were too low to conduct surveys, concentrations of larvae in small residual puddles, ponds that prematurely dried up, and ponds that dried up and subsequently rehydrated. Such vagaries in the hydroperiods of seasonal ponds can induce daily and annual variation in data. In most cases, the consequence was inability to conduct a survey because of inadequate water. Although we tried to maintain a constant effort based on pond surface area, we suspect that high water might have diluted, and low water might have concentrated captures of amphibian larvae.

Finally, it is important to choose parameters and methods of measuring them that are congruent with objectives (Heyer et al. 1994). Although we observed differences in efficacy among methods, the fact that C, E, D, and T surveys document occurrence of species at different stages in ontogeny might affect choice of survey method. This was especially true of metamorph surveys. Metamorph surveys detected wood frogs at ponds in which no eggs or larvae were found, suggesting those surveys might have detected dispersers from other ponds. Thus, we do not recommend metamorph surveys as a tool for inventorying specific ponds.

Overall, our results suggest that while single surveys might provide representative presence-absence data for some species, we encountered biases across species and years. Use of multiple survey types improved the detection of species reproductive activity in ponds and produced less variation among years. Thus, depending on survey objectives and resources, our results support the use of multiple types of surveys (e.g., toolbox approach of Olson et al. 1997). Our results also suggest that efficacy of a survey might

improve by extending its duration or repeating it more frequently. The protocols that we used seemed appropriate for small seasonal forest wetlands in our region. If we had more resources available or fewer ponds to monitor, we would have chosen to conduct breeding call surveys for a longer period than 3 minutes, and visit ponds more frequently than once to conduct wood frog egg surveys. For seasonal forest wetlands of the upper Great lakes region, we generally recommend a combination of breeding call followed by either dip net or funnel trap (3 x 3 mm mesh) surveys conducted prior to metamorphosis.

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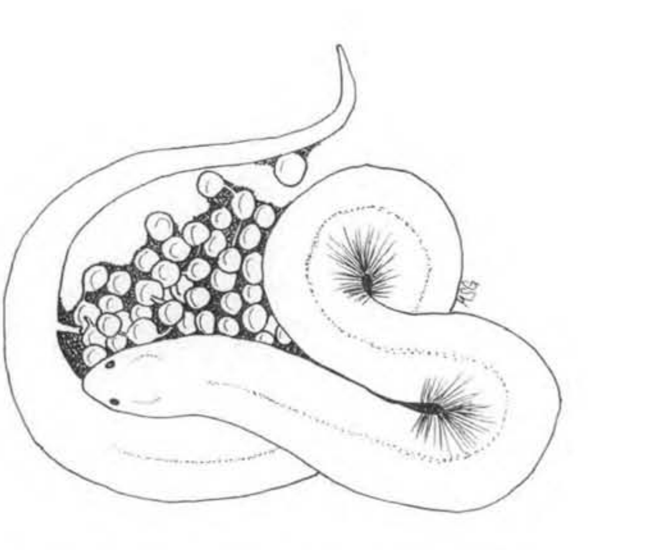

Amphiuma means (Two-toed Amphiuma). USA: Florida, Leon Co., Lake Iamonia. Adult with eggs. Illustration by Margaret Gunzburger.

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A New Method of Sampling Arterial Blood from Large Sea Turtles

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Some of the largest nesting sea turtle populations in the world are located in the Arabian Sea in the vicinity of the Sultanate of Oman. Green turtle (*Chelonia mydas*) nesting grounds occur along the shoreline of the Ras Al-Hadd Turtle Reserve, while olive ridley (*Lepidochelys olivacea*), loggerhead (*Caretta caretta*), and hawksbill (*Eretmochelys imbricata*) nest on Masirah Island. In the past two years, we have been involved in research projects requiring sampling of arterial blood for physiological parameters. To collect arterial blood samples, we have developed a procedure for rapid location of an arterial puncture site for large green turtles (N = 150; body weight 100–155 kg; curved carapace length 110–115 cm). Previous measurements, based on >10,000 green turtles (1980–2000) from the same area for curved carapace length (100–115 cm; Omani Government records, the Ministry of Regional Municipalities and Environment), were in close agreement with our measurements.

Many procedures have been described for blood collection in turtles. Stephens and Creekmore (1983) described a procedure for cardiac puncture in freshwater turtles but this procedure is risky in the sea turtles because of their large size. Even in small turtles, it is a difficult and risky (Dessauer 1970; Gandal 1958). In addition, cardiac puncture can cause pericardial contamination (Frair 1977). The most popular and most successful procedure of venous blood collection from the lateral cervical sinuses (Owens and Ruiz 1980).

Some logistical problems in the use of cervical sinus.—Problems were not encountered when blood was collected from moderate-sized hawksbill, olive ridley, loggerhead, and green turtles (≤100 kg). However, in large green turtles (>100 kg) we faced logistical problems in obtaining blood from the dorsal cervical sinuses. Stretching the neck through a slit of a tilted platform or on the ground as suggested by Owens and Ruiz (1980) was difficult as these large turtles have powerful retracted neck muscles and are hard to stabilize on the platform or the sand. In most cases, one person encountered extreme difficulties in pulling the neck forward and keeping it in a stretched and tilted position. In addition, each of the front flippers must be held by one person, while a fourth person held the turtle in a stable position for the fifth person to perform the sampling.

After several attempts, we abandoned use of the platform because it was impractical to lift a large turtle onto the platform. Transferring the platform from one location to another was also difficult and time-consuming. Most importantly, the platform method caused the head to tilt downward, below the plastron level. Frequently, it was very difficult to keep the neck extended in this position long enough to collect a blood sample. Furthermore, the turtle struggled to move forward to retract its head. The turtle cannot be subjected to conditions interfering with its breathing movements, as the turtle quickly exhibits outward signs of disturbance and stress. When placed in a stressful condition, a significant change in plasma hormone levels from natural conditions is commonly observed in reptiles (Cree et al. 1990; Lance and Elsey 1986; Mahmoud and Licht 1997).

Procedure.—The following procedure, involving arterial blood sampling from the common carotid artery, can be useful in a variety of research projects. The sampling of arterial blood is preferred to venous blood because of the wider variability of parameters which might be investigated. The evaluation of arterial blood parameters can be studied under a specific set of physiological conditions, both *in vivo* and *in vitro*. Information about the status of parameters which can change rapidly in arterial plasma include pH, plasma lactate, total protein, urea, uric acids, and iron. Also, studies of mean corpuscular hemoglobin concentration, partial pressures of gases including Po_2 and Pco_2 and other hematological indices in arterial blood could be monitored.

We propose the following steps for a less stressful arterial blood sampling in large turtles (specifically green and loggerhead sea turtles) of different sizes (50–150 kg or larger), compared to cardiac or caudal punctures.

1. With a four-person team, turn the turtle on its back (ventral side up) and immediately have each front flipper restrained, one per person. A third person stretches the neck forward very gently. When the turtle in this position, the neck is easy to pull forward by one person because the retracted neck muscles lose their strength. The turtle also has limited mobility when placed ventral side up.

2. The fourth person will take the blood sample. Palpate the trachea and larynx along the mid-ventral line and insert a needle (1.5 inch–21 gauge) about 4.0–4.5 cm on either side of the lateral border of the trachea (Fig. 1). It is important to insert the needle lateral to the trachea by palpating the lateral outline of the trachea and the larynx to avoid injury to these organs. Adjust the depth of the needle between 2.0–3.0 cm with an angle of the needle entry perpendicular to the surface of the neck. Insert the needle into the common carotid artery about 7–10 cm from the angle of the jaws as the best source of blood collection. If this is not successful, try to insert the needle about 2–3 cm from the angle of the jaws, where the common carotid divides into the external and internal carotids

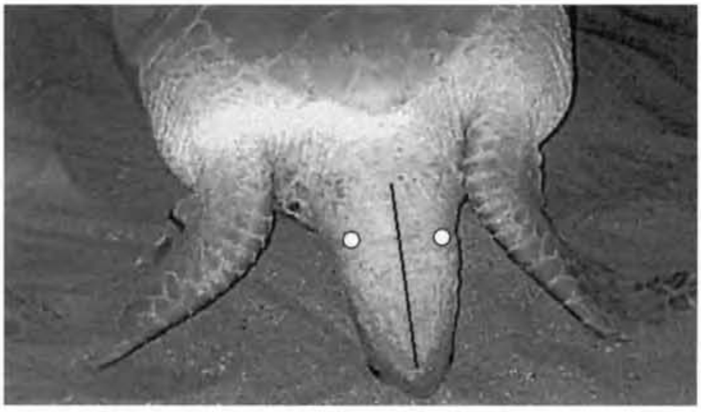

FIG. 1. Ventral aspect of the green turtle showing the mid-ventral view (line). The two circles on both sides of the neck represent the best points of entry into the carotid arteries.

(Hildebrand 1974, p. 292) or at other sites as long as a distance of 4.0–4.5 cm from the lateral outline of the trachea is maintained. Before the needle is inserted, retract the plunger slightly upward (about 0.5 cm) to make a slight air gap in the body of the syringe. This will allow for ease of blood flow entry into the syringe. The needle should be held in place when the blood starts to flow. At this point, move the plunger very slowly upward to maintain a continuous gentle suction until the required sample is obtained. If more than one sample is needed, vacutainer with evacuated blood collecting tubes should be used.

3. If there is a failure to draw blood within two minutes, the operation must stop immediately and the turtle must be allowed to withdraw its neck to its natural position so it can relax and breath normally. This procedure should not be repeated more than three times, as any blood collected in subsequent attempts could have distorted plasma constituent levels because of the onset of stress conditions. The turtle should be immediately released.

In summary, if the study requires arterial blood, our new method of blood collection is relatively unstressful and any volume of blood can be collected easily. If the study does not require arterial blood, the procedure of Owens and Ruiz (1980) using the cervical sinuses should be used, which is ideal for sea turtles under 100 kg. However, above this weight difficulties were encountered in the field. We suggest that if insufficient personnel are available in the field (four minimum), then the carotid method should be used as a less stressful procedure.

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Effects of Placing Sticks in Pitfall Traps on Amphibian and Small Mammal Capture Rates

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Pitfall traps associated with drift fences are a common method of capturing amphibians to determine relative abundance (Bury and Corn 1987; Corn 1994; Gibbons and Semlitsch 1982), but they also capture and kill small mammals as non-target species. When a study is being conducted at the same site over multiple years it is desirable to reduce mortality and leave the local faunal communities as undisturbed as possible to prevent confounding effects from sampling methodology. Pitfall traps can keep most amphibians alive if the cans are kept moist and checked frequently, and have not been found to decrease amphibian populations (Bury and Corn 1987; Corn 1994). However, pitfalls frequently result in the death of small mammals, and consequently can decimate small mammal populations (Bury and Corn 1987). This mortality could affect the results of the study, particularly when species (e. g. shrews) are predators of the target organisms. For ethical reasons animal use and care committees have sought to reduce mortality in ecological studies. Permitting agencies have also been reluctant to issue collection permits for researchers using pitfall traps because of high incidental mortalities of non-target species.

Karraker (2001) significantly reduced small mammal captures without a significant reduction in amphibian captures in pitfall traps by attaching jute twine to a coverboard over the pitfall trap. However, in some pitfall traps the twine was removed, or the end in the pitfall trap was eaten resulting in high small mammal mortality. Sticks have been placed in pitfall cans to reduce small mammal captures by giving them a ladder for escaping (S. Billig, L. Lichko, pers. comm.). It is possible that this ladder might also allow some amphibian species to escape. In addition, it is unlikely that small mammals will carry a stick the length of the pitfall trap away from the trap, and the stick method is less labor intensive than using jute twine. To our knowledge this practice and its effects on different species does not appear in the literature. We sought to measure the capture rates and subsequent mortality of amphibians and small mammals by placing sticks in the cans to allow small mammals to escape.

This study was done in conjunction with a larger project studying the effects of different riparian forest management practices on headwater streams. We conducted fieldwork in west-central Maine (latitude 45°25', longitude 70°35'). We sampled three streams in 2000 and eight streams in 2001. Nine streams were located in a mature second growth stand, and two streams had a 23 m buffer on either side of the stream with a clearcut adjacent to the buffer.

At each site we sampled the area from the stream bank out to 33 m with pitfall arrays. Each array consisted of two 3-m sections of fence with a pitfall placed at each end of the fence, for a total of

TABLE 1. Results of Wilcoxon rank-sum tests between years in stick and no stick treatments for amphibian and small mammal captures in June and July of 2000 and 2001 in western Maine.

Species	Stick S-Value	Stick P	No Stick S-Value	No Stick P
		Amphibians		
American Toad	12.0	1.00	15.0	0.40
Redback Salamander	13.0	0.71	10.0	0.57
Wood Frog	17.0	0.11	17.0	0.11
		Small Mammals		
Shorttail Shrew	8.0	0.25	10.0	0.54
Shrews[1]	8.0	0.25	17.0	0.11
Mice[2]	13.0	0.71	11.0	0.86
Redback Vole	11.5	0.97	13.0	0.86
Woodland Jumping Mouse	9.0	0.43	12.0	1.00

[1]Smoky shrews (*Sorex fumeus*), masked shrews (*S. cinereus*), and pygmy shrews (*Microsorex hoyi*).

[2]Deer mice (*Peromyscus maniculatus*) and white-footed mice (*P. leucopus*).

four pitfalls per array. We placed one fence in each array perpendicular to the stream and one fence parallel to the stream forming a t-configuration. There were four transects with three arrays per transect, resulting in 12 arrays and 48 pitfall traps per stream.

We constructed drift fences of partially opaque polyethylene supported by mason string, attached to hardwood stakes 40–50 cm high. We made pitfalls out of two #10 tin cans (36 cm each) taped end to end and we placed a funnel made from a plastic bowl in the top of the pitfall. Fencing went through the middle of the pitfalls to capture movement from both sides of the fence. We covered the bottom of each pitfall with 2–5 cm of water to keep amphibians from desiccating and force small mammals to swim, thus encouraging them to escape the pitfall. Traps were checked 2–3 times per week. Amphibians were identified and marked with a visible implant elastomer tagging method (Northwest Marine Technology, Shaw Island, Washington) (Davis and Ovaska 2001; Marold 2001; Nauwelaerts et al. 2000). We identified small mammals to species or genus and discarded them.

To evaluate the effect of sticks on amphibian and small mammal capture rates we placed sticks in selected cans. Sticks were obtained at each study site and were between 0.6 and 1.5 cm in diameter. One end of the stick was placed at the bottom of the can and the other end was approximately 5 cm above the top of the pitfall trap. In 2000, we removed sticks from two of the cans in each array from late June to early July for a total of 792 trap nights in both the stick and no stick treatment. In mid June 2001, we removed sticks from all cans within selected streams and compared them to streams with sticks remaining in all cans for a total of 1824 and 1488 trap nights in the stick and no stick treatment respectively.

Using a Wilcoxon rank-sum test, we found no significant year effects for any species or any treatment (Table 1), therefore we pooled data from 2000 and 2001 to increase sample size. We tested for differences between cans with sticks and cans without sticks with a Wilcoxon rank-sum test for each taxon.

We captured three species of amphibians totaling 181 individuals, and five species of small mammals totaling 466 individuals. We classified smoky shrews (*Sorex fumeus*), masked shrews (*S. cinereus*), and pygmy shrews (*Microsorex hoyi*) as shrews, and we classified white-footed mice (*Peromyscus leucopus*) and deer mice (*P. maniculatus*) as mice because of difficulties in identification of these species in the field.

We did not detect any significant differences between traps with sticks and traps without sticks for American toads (*Bufo americanus*), redback salamanders (*Plethodon cinereus*), or wood frogs (*Rana sylvatica*) (Table 2). Overall amphibian mortality was 8.6% and 9.7% in the cans with sticks and without sticks, respectively. We captured significantly more shrews, shorttail shrews (*Blarina brevicauda*), woodland jumping mice (*Zapus insignis*), mice, and southern red-backed voles (*Clethrionomys gapperi*) in traps without sticks than traps with sticks placed in them (Table 2). Capture rates of all small mammals combined were 14.5 times higher in pitfall traps without sticks than pitfall traps with sticks. Small mammal mortality was 100% for both years.

Our results show the placement of sticks in pitfall traps can dramatically reduce the number of small mammal captures and subsequent mortalities without affecting amphibian capture rates. The method is very inexpensive and requires very little extra labor. Future research involving the same study sites over multiple years should use sticks to reduce small mammal mortality and to reduce the potential effects that can result if an entire class of animals is eliminated in a study area.

We cannot rule out the possibility that our results from 2001 are a result of differences among study sites. However, we think this is unlikely because of the highly significant results, and the locations and habitats were similar for all sites. In addition, we continued to capture amphibians and small mammals at these streams through September 2001 with sticks placed in all pitfalls. Capture rates for small mammals were similar for streams that were previously in the stick or no stick treatment (D. Perkins, unpubl. data). We also did not test for differences among different sizes of sticks, and there is a potential that larger sticks than the ones used in this

TABLE 2. Results of Wilcoxon rank-sum test on the differences between traps with a stick and traps without a stick for amphibian and small mammal captures in June and July of 2000 and 2001 in western Maine.

Species	Stick #/100 TN	No Stick #/100 TN	S-Value	P
Amphibians				
American Toad	1.98	1.07	56.0	0.69
Redback Salamander	0.51	0.42	49.5	0.67
Wood Frog	1.52	1.80	59.0	0.56
Small Mammals				
Shorttail Shrew	0.29	1.76	34.0	0.01
Shrews[1]	0.51	11.62	28.0	<0.001
Mice[2]	0.08	1.11	28.0	<0.001
Redback Vole	0.29	1.49	34.0	0.02
Woodland Jumping Mouse	0.08	0.69	31.5	0.005

[1]Smoky shrews (*Sorex fumeus*), masked shrews (*S. cinereus*), and pygmy shrews (*Microsorex hoyi*).

[2]Deer mice (*Peromyscus maniculatus*) and white-footed mice (*P. leucopus*).

study could allow some amphibians to escape.

After this study period was over we continued to capture amphibians throughout the summers of 2000 and 2001 with sticks in all cans. In subsequent sampling with sticks in all cans we caught the amphibians mentioned previously, as well as green frogs (*Rana clamitans*), blue-spotted salamanders (*Ambystoma laterale*), spotted salamanders (*A. maculatum*), two-lined salamanders (*Eurycea bislineata*), dusky salamanders (*Desmognathus fuscus*), spring salamanders (*Gyrinophilus porphyriticus*), and red-spotted newts (*Notophthalmus viridescens*). Although we do not have data for cans without sticks these individuals could not escape the cans with sticks in them. Placing sticks in the size range used in this study in pitfall traps made of two #10 tin cans can reduce small mammal capture, and does not seem to affect amphibian capture rates in forests in the northeastern United States.

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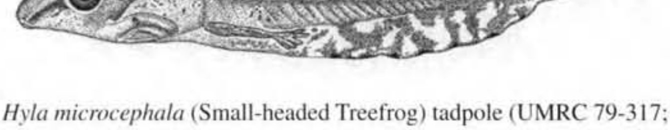

Hyla microcephala (Small-headed Treefrog) tadpole (UMRC 79-317; 31 mm TL). México: Yucatán, 15.8 km N Panabá. Illustration by Julian C. Lee.

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A Subterranean Camera Trigger for Identifying Predators Excavating Turtle Nests

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Predation is the predominant source of nest mortality for most North American turtle species, including populations that are in decline (Brooks et al. 1992; Congdon et al. 2000). The identification of nest predators—crucial to understanding predator-prey relationships—has been previously accomplished largely by use of techniques that rely on the availability of physical evidence, such as animal sign (predominantly tracks) and nest/egg remains at depredated nests (e.g., Standing et al. 2000). Such techniques, however, are subjective and might preclude the identification of those species actually responsible for nest predation for numerous reasons, including: nesting substrates seldom retain identifiable tracks (Burger 1977; MacIvor et al. 1990), more than one species of predator might visit nests (Burger 1977; Larivière 1999; Leimgruber et al. 1994), and numerous predator species might leave similar nest remains (Hernandez et al. 1997a; Larivière 1999; Pietz and Granfors 2000). Further, the behavioral and temporal patterns of predators are rarely discernible via animal sign or nest remains. Therefore, comprehensive quantitative evaluations of turtle nest predation and predators have been infrequent (Burger 1977), although such detailed studies are clearly required (Tinkle et al. 1981).

The use of remote photography has allowed detailed evaluation of predation at artificial and natural avian nests (Maier and DeGraaf 2000; Pietz and Granfors 2000), yet there have been few applications of this technology in herpetofaunal studies (Cutler and Swann 1999). Preliminary efforts have indicated that remotely-triggered cameras might be used to study turtle nest predators (Doody and Georges 2000; Tuberville and Burke 1994); however, triggering devices (e.g., infrared beam) might be misaligned by animals, require frequent monitoring, and are often conspicuous (Hernandez et al. 1997b; Sadighi et al. 1995; see Fig. 2 in Doody and Georges 2000). Furthermore, such triggers often might be unduly activated by wind-blown vegetation, heavy precipitation, and by animals other than predators (Buler and Hamilton 2000; Rice et al. 1995; TJM, pers. observ.). To circumvent such limitations, we developed a small, simple, subterranean camera trigger that is relatively

FIG. 1. Raccoon (*Procyon lotor*) tripping subterranean camera trigger while excavating artificial turtle nest on 26 June 2000 at 0202 h in central Massachusetts.

easy to install, requires no maintenance, and is designed to activate only when the nest is excavated or otherwise greatly disturbed (Fig. 1).

Methods.—This trigger consists of a non-mercury tilt switch (manufactured by Assemtech Europe, part no. CW1300-1; distributed by Farnell Components [U.K.], part no. 540614; available from Newark Electronics® [USA]), 4.7 mm in diameter and 22.2 mm in total length, that contains two hermetically-sealed, non-toxic contact spheres (Fig. 2a). Each switch was soldered to the exposed doubled-leads at one end of a 4 m length of 24-gauge, solid telephone wire (Fig. 2b); with a modular plug crimped on the other end of the wire (Fig. 3). To re-insulate and waterproof the switch's soldered-connection, we dipped switch-ends of trigger wires in black Plastidip® (manufactured by PDI, Inc.; Circle Pines, Minnesota, USA), shaking off excess fluid and hanging them to dry. Plastidip® (previously used in field studies; e.g., Haskell 1999) provides a tough, flexible coating that has no apparent scent after being aired a few days. The modular plug of each trigger wire was connected to a modified 35-mm camera ("point-and-shoot" with 35-mm lens [f/3.5], ISO 200 color negative film [24 exp.], and a time-date function). The camera was enclosed in a camouflage-painted, weatherproofed wooden box with screened anti-condensation ports and glass windows (adapted from Danielson et al. 1996).

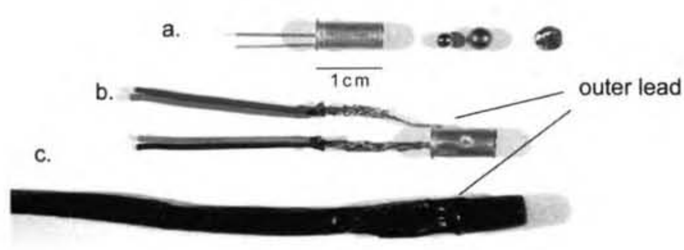

FIG 2. a) Non-mercury tilt switch showing contents, b) example of soldered switch, c) subterranean-end of trigger wire coated with black Plastidip®.

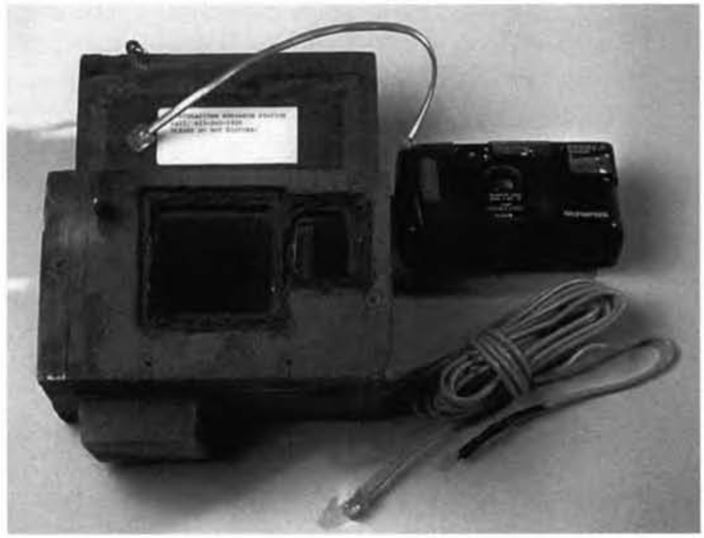

FIG. 3. Camera box assembly with trigger wire.

Switches cost \$2 each (all costs approximate U.S. dollars), a 4 m length of telephone wire costs \$1, a 429-ml can of Plastidip® costs \$8, the camera box with modifications costs \$15 to construct, a wood stake to support cameras set up in open areas costs \$1, and cameras with modifications cost \$105 (cost based on Danielson et al. 1996); totaling \$125 per assembly.

We tested triggers by monitoring a total of 111 artificial turtle nests with remotely-triggered cameras at known turtle-nesting habitats in southern New Hampshire and central Massachusetts during May–July 2000. Each nest contained several eggs of either snapping turtle (*Chelydra serpentina*) or northern bobwhite (*Colinus virginianus*). Camera triggers were positioned horizontally (similar to that illustrated in Fig. 2c) and buried 5–10 cm below the soil surface (within nest chambers) with moist soil repacked over the nest. Preliminary trials indicated that shallower trigger placement often resulted in their activation during heavy rain or when non-target animals, such as wild turkey (*Meleagris gallopavo*), stepped on nests. Trigger wires were buried in a thin slit between nest and camera at similar depth to triggers using a trenching shovel. Camera triggers were most sensitive to disturbance when the switches' outer lead (i.e., lead originating off switch casing [see Fig. 2b], easily seen under the Plastidip® coating [see Fig. 2c]) was placed downward. Cameras were mounted 1–1.5 m above ground on wooden stakes or trees at a distance of 1.5–2.5 m from nests (Fig. 4). While installing artificial nests and camera equipment, we wore clean gloves, clean rubber boots, and placed our equipment on clean plastic drop-sheets to minimize human scent and disturbance at the sites (Whelan et al. 1994).

Results and Discussion.—Our use of subterranean camera triggers enabled us to photograph several species of "turtle nest" predators without experiencing many of the problems associated with other triggering devices. Raccoons (*Procyon lotor*) were the most frequently photographed predators both in New Hampshire and Massachusetts. We also identified striped skunks (*Mephitis mephitis*) in Massachusetts, gray fox (*Urocyon cinereoargenteus*) in New Hampshire, and fishers (*Martes pennanti*) in New Hampshire as nest predators. To our knowledge, fishers have not previously been reported to depredate turtle nests. Red squirrels (*Tamiasciurus hudsonicus*) sporadically disturbed nests in New

Hampshire sufficiently to trigger cameras but did not destroy nests, suggesting either that they may be sensitive to our cameras' activity or that they are not turtle nest predators. Cameras also were occasionally triggered by moose (*Alces alces*) and white-tailed deer (*Odocoileus virginianus*) that stepped directly on turtle nests. Other apparent false-triggers (i.e., nothing visible in photograph) may have been caused by unidentified burrowing animals as posited by Congdon et al. (2000).

We also photographed multiple predators at the same nest in a number of cases, occasionally simultaneously. For example, a gray fox was photographed 4 June at 0150 h, just prior to a raccoon at 0201 h. At a second nest, a raccoon was photographed 9 July at 0442 h and 0609 h, followed by a fisher at 1806 h the same day. Additionally, we photographed multiple raccoons simultaneously at the same nests. Photographing subsequent visiting predators was possible after nests and camera triggers were either partially or completely excavated because our camera units remained active as long as unexposed film was available. Camera triggers proved extremely sensitive when uncovered, often repeatedly firing the camera at any slight disturbance such as raindrops or another predator. As used in our tests (i.e., without time-delays on cameras), trigger sensitivity also resulted in multiple exposures of individual predators engaged in prolonged digging activity, bouts often lasting at least 5 min. Such series of photographs occasionally provided useful behavioral insights; this, however, at the expense of photographs of any subsequent visitors when all film was exposed. Thus, even more nests may have had subsequent visitors than we were able to detect.

Further use of subterranean camera triggers, along with the time-date function of the cameras, may allow researchers to quantify patterns of turtle nest predation. For example, an association between precipitation events and predation on older nests has been reported (Congdon et al. 2000; Wilhoft et al. 1979); however, heavy precipitation has been reported to depress predation rates by inhibiting predators (Burger 1977; Hammer 1969; Legler 1954). Unfortunately, all reports have been incidental observations and the potential association has never been investigated systematically (Brooks et al. 1992). Confirmation of turtle nest predators and nest predation times, along with on-site precipitation-humidity data (and perhaps soil moisture gradients), would allow the quantitative evaluation necessary to establish not only the association between predation and precipitation but potentially underlying mechanisms as well.

FIG. 4. Field installation of camera and buried trigger at artificial turtle nest.

The presence of remote photography equipment (e.g., triggering mechanisms) may affect animal behavior (Cutler and Swann 1999; Maier et al., unpubl. data). As such, our inconspicuous subterranean triggers provide a more objective and effective means by which researchers may quantitatively examine turtle-nest predators and patterns of predation. Field trials yielded numerous detailed photographs of various potential predator species, their behavior, and time of activity while depredating artificial turtle nests. Additionally, multiple predator species were detected at the same nests, highlighting the shortcomings of subjective identification methods that rely on physical evidence such as animal sign or remains at depredated nests. These observations and others afforded by use of this inexpensive remote-recording device may prove useful in understanding many factors affecting the reproductive success of turtles.

Acknowledgments.—We thank M. Breen for field assistance; D. Small for assistance locating nesting sites; T. French and D. Pence for assistance collecting turtle eggs; the McIntire-Stennis Cooperative for financial support; L. Higgins, T. Fuller, and A. Whitlock for their comments on the manuscript; W. Zinni for access to nesting sites on private land; the Massachusetts Metropolitan District Commission, Division of Watershed Management, Quabbin section, for access to their management areas; and M. Sheremeta for proofing the manuscript.

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RECENT POPULATION CHANGES

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Status and Distribution of Two Species of *Bufo* in the Northeastern Bonneville Basin of Idaho and Utah

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In light of recent amphibian declines and local extirpations (Pechmann and Wake 1997; Stebbins and Cohen 1995), there has been renewed need to update and verify the continued persistence of local populations. Hovingh (1997) summarized biogeographical patterns and occurrences of amphibian species in the eastern Great Basin, USA. The extreme northeastern Great Basin is characterized by discrete valleys, which are remnant sub-basins of ancient Lake Bonneville. After surveying in 1987 and 1993, Hovingh (1997) was unable to verify continued presence of *Bufo woodhousii* and *B. cognatus* in some of these valleys and sub-basins. In this note, we report new records that augment and clarify Hovingh's (1997) results on the distribution of these two bufonids in the eastern Great Basin. We also present a new county record for *B. woodhousii* in southeastern Idaho, extending the reported range of this species.

Published range maps of *B. woodhousii* show a continuous distribution along the Wasatch Front and into southern Cache Valley, stopping at the Utah–Idaho state line (Stebbins 1985; Tanner 1931). Disjunct populations also occur along the Snake River Plain of Idaho and the Columbia River between Oregon and Washington (Nussbaum et al. 1983; Stebbins 1985). Hovingh (1997) stated that *B. woodhousii* does not occur in southeastern Idaho and failed to verify continued persistence of populations in Cache Valley (Fig. 1, Locality A) and the Blue Spring Sub-basin (in northern Utah; Fig. 1, Locality B) during field surveys in 1987 and 1993. He also questioned the validity of a record from upper Blacksmith Fork Canyon (which drains into Cache Valley; Fig. 1, Locality C), but did not give an opinion on the status of a record from Dry Lake, Cache Co. (BYU 542, Fig. 1, Locality D). Supplementing Hovingh's field surveys, our recent work in these areas produced the following records for *B. woodhousii*: USA (the following numbers correspond to locality numbers in Fig. 1): **UTAH:** CACHE CO.: (1) near Bear River, 5.1 mi (8.2 km) W of US Hwy 91 on Utah State Route 142, 1360 m elev. (41°55.10'N, 111°54.60'W). 14 July 1999. Paul C. Ustach and Daniel G. Mulcahy. UTA A-54480; (2) Cache Valley, Hwy 142, 0.9 mi (1.4 km) S of Clarkston, 1450 m elev. (41°54.39'N, 112°02.73'W). 29 July 1999. Daniel G. Mulcahy. UTA A-53937; (3) near Clarkston, Short Divide Rd., 1.0 mi (1.6 km) E of County line, 1490 m elev. (41°54.41'N, 112°04.22'W). 29 July 1999. Daniel G. Mulcahy. UTA A-53938; (4) Morton, 0.1 mi (0.2 km) S junction 1200 St/Center on 1200 St, 1360 m elev. (41°56.25'N, 111°56.62'W). 10 August 1999. Paul C. Ustach. UTA A-53939; (5) 1.4 mi (2.3 km) E junction 1200 St/Center on Center, 1360 m elev. (41°56.33'N, 111°54.98'W). 10 August 1999. Paul C. Ustach. UTA A-53940; BOX ELDER CO.: (6) Blue Spring Sub-basin, E Promontory Rd., 4.5 mi (7.2 km) S of 7200 N, 1295 m elev. (41°34.83'N, 112°29.39'W). 26 August 2000. Daniel G. Mulcahy and Becky L. Williams. UTA A-54640; (7) **IDAHO:** FRANKLIN CO.: Cache Valley, 3.6 mi (5.8 km) W of Franklin on 4800 S, 1380 m elev. (42°0.79'N, 111°52.54'W). 5 September 2001. Michelle R. Cummer. UTA A-54639.

Hovingh (1997) addressed only one record of *B. woodhousii* (UU 5484, Blacksmith Fork River, Cache Co., Utah), which he considered suspect due to elevation; however, Pack (1922a) reported an abundance of *B. woodhousii* in Benson (Cache Co.) after an outbreak of sugar-beet webworms. In addition to the specimens collected (see above), we observed other individuals of *B. woodhousii* at localities 4, 6, and 7 (Fig. 1) that were not collected. The individuals found in Cache Valley, Utah, were observed and collected over a period of two years (males were heard calling over a period of three years; PCU 1997–2000), and UTA A-53940 (Locality 4, Fig. 1) was a sub-adult collected amidst 10–15 conspecifics. Additionally, an individual *B. woodhousii* was observed at Locality 8 (Fig. 1; UTAH: BOX ELDER CO.: Blue Spring Sub-basin, E Promontory Rd., 9.2 km S of 7200 N, 1295 m elev. [41°34.01'N, 112°29.27'W]) and a chorus of males was heard at

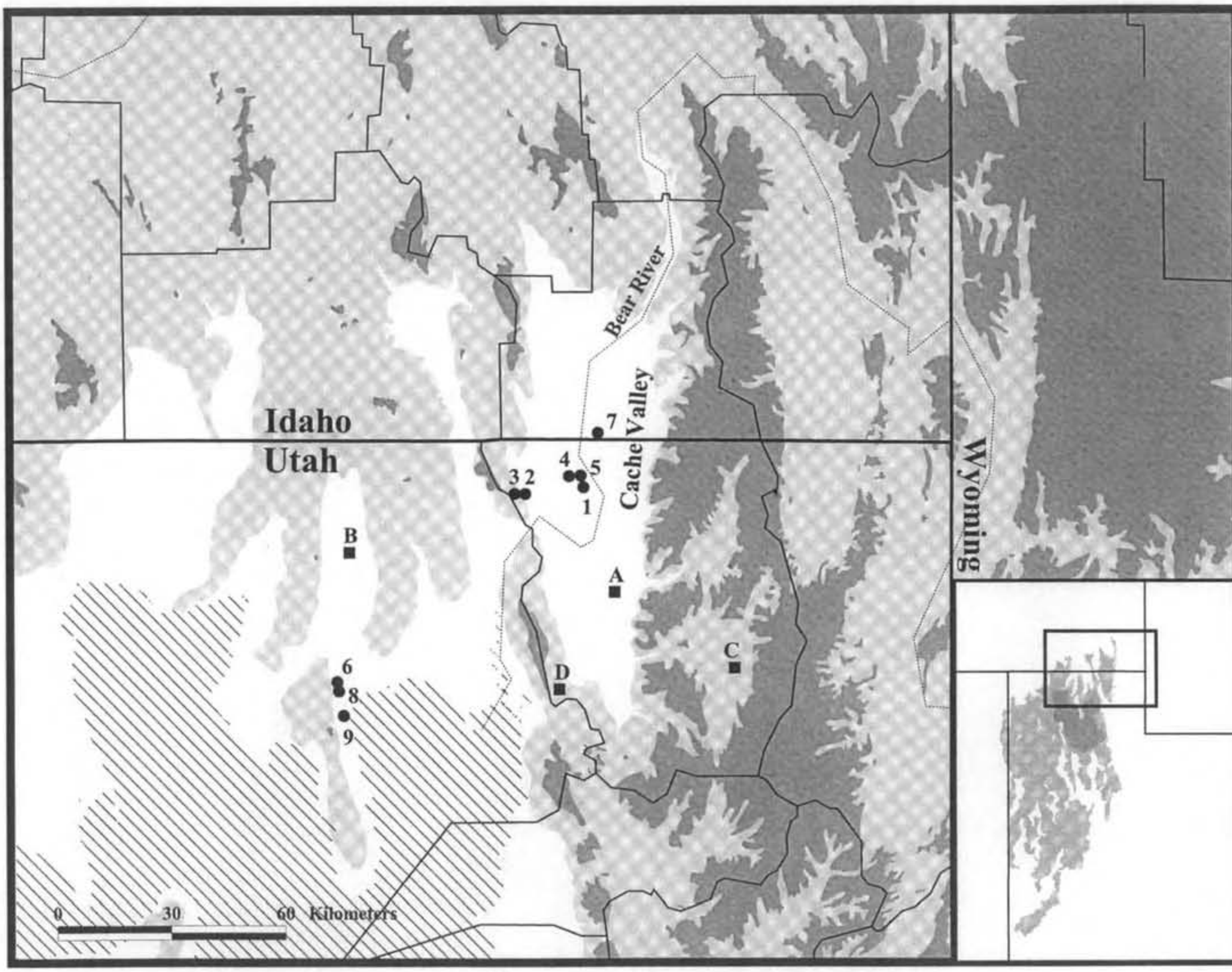

FIG. 1. Map showing the northeastern corner of Bonneville Basin, showing localities for *B. woodhousii* mentioned in the text. Squares represent records from the literature (records A and C were verified by us), and dots represent new locality records presented in this study. White area represents historical margins of Lake Bonneville at its greatest extent (modified from Currey et al. 1984). Crosshatched area represents current margins of the Great Salt Lake. Pale gray area represents elevations between 1525–2135 m, dark gray represents elevations above 2135 m. Thin lines represent county borders. Inset map indicates area enlarged and entire Bonneville Basin.

Locality 9 (Fig. 1; UTAH: BOX ELDER CO.: Blue Spring Sub-basin, E Promontory Rd., 12.9 km S of 7200 N, 1295 m elev. (41°32.05'N, 112°28.75'W) on 30 May 2002. Therefore, we believe viable populations of *B. woodhousii* still exist in these areas of the northeastern Bonneville Basin. The Utah records confirm the continued persistence of *B. woodhousii* in Cache Valley and the Blue Spring Sub-basin, while the Idaho record represents the northernmost record in Cache Valley and a new county record for Franklin Co., Idaho. Cache Valley is a continuous geographical feature that straddles the state line between Utah and Idaho. Based on this, we suspect that *B. woodhousii* occurs throughout Cache Valley and therefore further into Idaho than is represented by our observations.

The occurrence of *B. cognatus* in the eastern Great Basin has also received attention recently. A distribution map of *B. cognatus* presented by Krupa (1990) showed locality records from the eastern Bonneville Basin in the Salt Lake City, Bountiful, and Cache Valley areas and illustrated the range of the species to extend southward along the Wasatch Front through southwestern Utah (although no records are indicated in this latter region). Hovingh (1997) dismissed all records from the Great Basin as either being misidentified or introduced. Nevertheless, we are aware of museum records of *B. cognatus* from the eastern Great Basin of Utah and address these individual records for specific clarification. We have examined most of these specimens and verified their identifications. A specimen from Salt Lake City (TNHC 11593; 5 mi S on 14th S St, Salt Lake City) is an adult female *B. cognatus*. A specimen from Provo (USNM 13993) has been reidentified as *Spea intermontana* by the institution (S. Gotte, pers. comm.). A specimen from Payson (USNM 13995) is a juvenile *B. cognatus*. A specimen from Ogden (CU 10193) is unavailable for study at this time, so its identity remains uncertain. An additional specimen from SaltAir (UU 2855) is missing from that collection, therefore its identity also remains uncertain. Pack (1922b) reported two specimens of *B. cognatus* from Benson, Cache Valley. We have located one of these specimens (CAS 63924) and confirmed its identity as

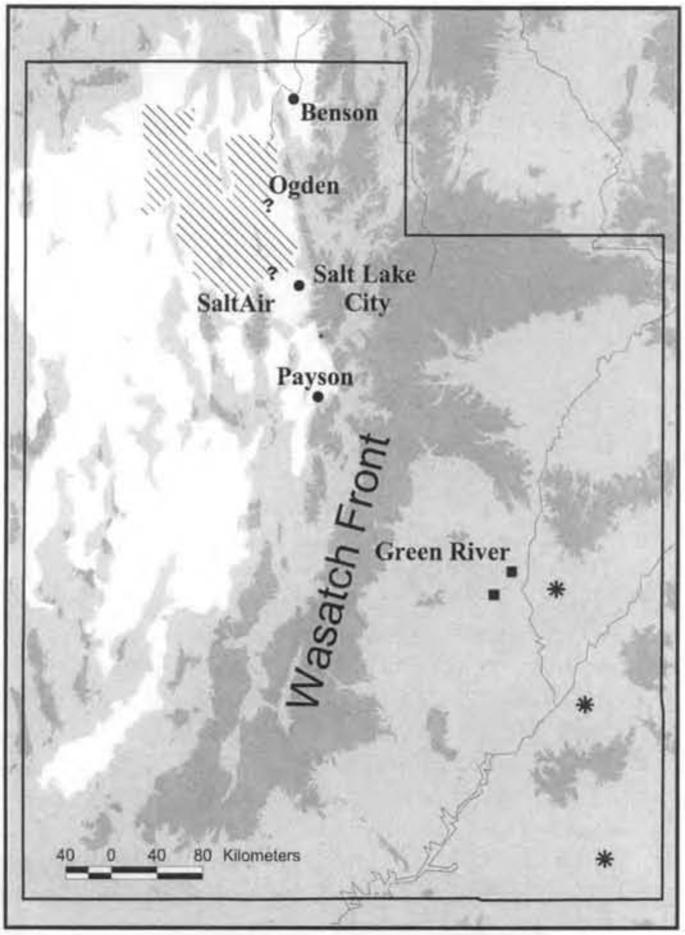

FIG. 2. Map showing the state of Utah, showing localities for *B. cognatus*. Dots represent verified, but suspect, voucher specimens (see text). Question marks represent museum specimens missing or unavailable for identification. Squares represent legitimate, verified records. Stars represent dot localities presented by Krupa (1990) for which we were unable to locate voucher specimens. White area represents historical margins of Lake Bonneville at its greatest extent (modified from Currey et al., 1984). Crosshatched area represents current margins of the Great Salt Lake. Pale gray area represents elevations between 1525–2135 m.; dark gray represents elevations above 2135 m.

a juvenile *B. cognatus*. We find it noteworthy that the largest collection of Utah amphibians (Monte L. Bean Museum, BYU) has no records of *B. cognatus* from the western Wasatch Front.

During our surveys in the field and of museum records, we have verified the identifications of only three voucher specimens of *B. cognatus* along the western Wasatch Front in the Great Basin (Fig. 2). The record from Salt Lake City (TNHC 11593) is suspect because the date of collection (23 June 1950; collected by Jameson) corresponds with the date of other specimens collected by the same individual in Texas (T. LaDuc, pers. comm.). The second record is from the town of Payson (USNM 13995), having been sent by Yarrow to USNM in 1884 (collection date unknown; S. Gotte, pers. comm.). A major human transportation route over the Wasatch Front exists between the towns of Green River and Payson. Because *B. cognatus* has been documented near the town of Green River on the Colorado Plateau (MVZ 29835; BYU 764; UMMZ 62155–60), the record from Payson could represent a rare dispersal event, human transport, or incorrect locality data. The Benson specimen (CAS 63924; only existing specimen of the two individuals reported by Pack 1922b) was found on a beet farm in 1921, and no others have been reported or collected in Cache Valley, Utah. We have verified the identification of this specimen (a subadult) and we have no *a priori* reason to doubt the authenticity of the locality record, but we do suspect that this represents a one-time human introduction event. Finally, we also note that the most recent of the three existing specimens was collected in 1950; we are not aware of any collected since that time. After considering these three geographically and temporally separated records, as well as the lack of any recent records of *B. cognatus* from this area, we do not believe that the natural range of this species extends north along the western side of the Wasatch Front.

We therefore confirm and detail the findings of Hovingh (1997) on *Bufo cognatus*. However, we were able to verify the continued persistence of *B. woodhousii* in the eastern Great Basin. Intense intermittent surveys can be augmented with continued surveillance of amphibians by qualified local observers and the deposition of voucher specimens in appropriate institutions. Recurrent records such as these can ameliorate problems in documenting amphibian declines, allowing a more thorough evaluation of this phenomenon.

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Expansion of *Eleutherodactylus johnstonei* in Northern South America: Rapid Dispersal Through Human Interactions

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Among amphibians, *Eleutherodactylus johnstonei* (Fig. 1) is rivaled in its propensity for range expansion only by the toad *Bufo marinus* (Kaiser 1997). However, whereas *B. marinus* made its biggest expansion jump, from South America to Australia, through purposeful human intervention and for a presumed agricultural benefit, *E. johnstonei* seems to move from one urban center to another continuously, at irregular intervals, both with and without the deliberate help of *Homo sapiens*. A compelling reason for carefully documenting the expansion of *E. johnstonei* is that it has been shown (Ovaska 1991; Pough et al. 1977; Stewart and Martin 1980) that its behavioral ecology and physiology allow it to colonize successfully where few other anurans can live, and that it may itself be a catalyst for the disappearance of other species (Hardy and Harris 1979). As a species with direct development, *E. johnstonei* does not require standing water for reproduction and is therefore all the more capable of settling into novel habitats. At this time, with reports of amphibian declines circling the globe, the example of this highly successful invader is instructive. We here detail the progress this species has made recently in South America, a region where dozens of native species have been impacted by human developments and the introduction of exotics, and where any additional environmental pressure on a delicately balanced frog fauna may become a tipping point (Gladwell 2000) for further declines of native frogs.

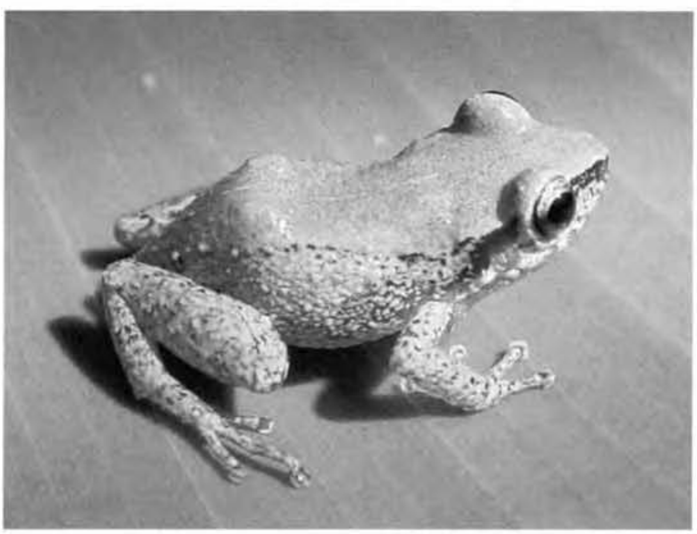

FIG. 1. *Eleutherodactylus johnstonei* from an empty lot in Irapa, Estado Sucre, Venezuela. This specimen is voucher LSUPC F-1388, a male of 27 mm snout–vent length that was photographed on 4 September 2001.

Eleutherodactylus johnstonei is a species endemic to the Lesser Antilles, though its exact island of origin has become obscured by centuries of presumably repeated human-mitigated introductions (Kaiser 1992, 1996). There have been many reports on the vectors by which these frogs move from one island to another, and conclusive evidence for both deliberate (e.g., Bequia—Lazell 1994; Bermuda—Pope 1917; Jamaica—Barbour 1910) and accidental (e.g. Dominica—Kaiser and Wagenseil 1995; Panama City—Ibáñez and Rand 1990; Trinidad—Kenny 1980) introductions is available. The first documented introduction into the South American mainland occurred prior to 1919 when a specimen was collected in Georgetown, British Guyana (Hardy and Harris 1979). This introduction was most likely accomplished by the same trade-related mechanism that carried the species throughout most of the other British dependencies in the Eastern Caribbean region (Kaiser 1992). A similar, trade-linked scenario was invoked by Lescure and Marty (1996) who encountered *E. johnstonei* in 1993 near the city center of Cayenne, the capital city of French Guiana. In surveys during the early 1970s (reported in Lescure 1981, 1983), Lescure had not heard the species in French Guiana. The most likely conduit for *E. johnstonei* into French Guiana is the trade in ornamental plants from Martinique (Lescure and Marty 1996).

An introduction of the species into Caracas, Venezuela, in the late 1950s (Juan Rivero, quoted in Hardy and Harris 1979), perhaps deliberately to introduce acoustic entertainment for a garden in the upscale suburb of Altamira, laid the foundation for its spread throughout that country and into neighboring Colombia, as detailed below. It is noteworthy that the species must have been highly restricted initially in its distribution in Caracas, as it is still absent from the thorough list published by Rivero (1961).

For verification of records, one would normally consider as confirmed only those localities for which voucher specimens or voucher photographs have been deposited in public institutions. However, in the case of "weed species," such as *Bufo marinus* or *E. johnstonei*, we realize that sightings verifiable through more than one source should also be considered. With species such as these, their presence may be duly noted by scientists yet no material might be collected because the species is so common and encountered all the time. Thus, after a species has become established at a locality for a certain period of time and becomes an integral part of that environment, voucher specimens are unlikely to be collected unless someone were interested in specifically documenting for science what has become common knowledge locally. In Venezuela, species for which this might be the case include *B. marinus*, *E. johnstonei*, *Leptodactylus fuscus*, *Hyla crepitans*, and *H. microcephala*. Our list of localities (Table 1) therefore includes a variety of places without voucher specimens. Institutional abbreviations used are as follows: CVULA—Colección de Vertebrados, Universidad de Los Andes, Mérida, Venezuela;

EBRG—Estación Biológica de Rancho Grande, Maracay, Venezuela; EDELCA—Departamento de Ecología, Corporación Venezolana de Guayana, Electrificación del Caroni C.A., Guri, Venezuela; ICN—Instituto de Ciencias Naturales, Museo de Historia Natural, Universidad Nacional de Colombia, Bogotá; LSUPC—La Sierra University Photographic Collection, Riverside, California; MNHN—Muséum National d'Histoire Naturelle, Paris, France; RMNH—Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands; SCN—Museo de Ciencias Naturales 'La Salle,' Caracas, Venezuela; UIS—Universidad Industrial de Santander, Bucaramanga, Colombia; ULABG—Universidad de Los Andes, Instituto de Geografía, Colección de Anfibios, Mérida, Venezuela; UVC—Universidad del Valle, Calí, Colombia; USNM—U.S. National Museum, Washington, D.C.

Expansion in Venezuela.—The Venezuelan capital of Caracas is a center for international trade and a crossroads for transportation across northern South America. Its shipping port and airport are both located along the coast just north of Caracas, in the cities of Catia La Mar, La Guaira, and Maiquetía. Among the most significant population centers in coastal northeastern Venezuela are Barcelona, Puerto La Cruz, and Cumaná. If a species is indeed transported both deliberately and accidentally, then these traffic centers would be logical places to find that species after an initial Caracas introduction.

Specimens of *E. johnstonei* from Caracas were deliberately released in Cumaná in 1967 (Hardy and Harris 1979), preempting a likely accidental introduction. By the mid-1970s, the species had spread throughout the city and along the coast near Cumaná (Hardy and Harris 1979). Its presence at Puerto La Cruz and for the coastal cities near Caracas was reported by Kaiser and Grismer (2001), though without vouchers.

Reports from local residents indicate that *E. johnstonei* has been in residence at Simón Bolívar International Airport for over a decade. Thus, the initial spread of the species from the site of introduction in Caracas occurred by both deliberate (Cumaná) and accidental (elsewhere) means. Additional records of the species' spread in Venezuela (Table 1) were published by Gorzula (1989), Kaiser and Grismer (2001), and La Marca (1992), and a cumulative listing appeared in Barrio-Amorós (1998). Yústiz (1977) mentioned the occurrence of an exotic *Eleutherodactylus*, possibly related to *E. portoricensis*, in his list of the frogs of the city of Barquisimeto that is clearly referable to *E. johnstonei*.

A specimen of *E. johnstonei* in the collections of the EBRG in Maracay that was collected on 01 June 1998 in Naguanagua, Carabobo State, a town close to Valencia on the far side of Lago Valencia from Maracay, represents the first specimen from that state. EBRG 3681 verifies the presence of *E. johnstonei* in the city of Maracay, Aragua State. The presence of *E. johnstonei* in Miranda State, the state surrounding the Distrito Federal in which Caracas is located, is ascertained by specimen EBRG 1756. This specimen is notable because it was collected at an altitude of 1300 m which we believe to be near the limit for the species (see below).

Reports of *E. johnstonei* from Bolivar State were made by Gorzula (1989). His list included Ciudad Bolívar, Ciudad Guayana, Upata, and Campamento Guri. Whereas museum vouchers are available for Guri (SCN 10919), the records for Ciudad Bolívar and Upata were based on the observation of calling males (Gorzula, in litt.). In listing the records for Ciudad Guayana, Gorzula (1989) used the name Ciudad Guayana as it is commonly used locally, encompassing two individual cities (Puerto Ordaz, San Félix). However, voucher specimens exist only for Puerto Ordaz town (e.g. RMNH 18488, EDELCA 5898), the western half of the Ciudad Guayana conglomerate separated from San Félix by the Caroni River.

Kaiser and Grismer (2001) reported *E. johnstonei* from Maturín and Caripe, cities in Venezuela's easternmost part. Unbeknownst to us, the species had been observed in Maturín a few years earlier and vouchered via photograph on the website of a hobby herpetologist (http://www.meos.ch/terra-typica/amphibia/amphibia.htm; Thomas Haag, pers. comm.). During their trip in the year 2000, Kaiser and Grismer also visited the city of Irapa, where *E. johnstonei* was not heard. During a visit in September 2001, we heard *E. johnstonei* in several localities in Irapa and conducted audio transects along all of the streets criss-crossing the downtown area (Fig. 2). It appears that the species was not present in large numbers where choruses were heard, and, at this time, its distribution throughout the city is discontinuous. Habitats for *E. johnstonei* in Irapa currently are gardens, empty lots, and construction sites, though it was still absent from the three parks in the downtown area during our survey. We also determined, through additional driving transects, that the species was not present during this period in either the downtown or surrounding areas of Güiria, the main port city on the Península de Paria, although this city is a logical next colonization locale for *E. johnstonei* after colonization of Irapa.

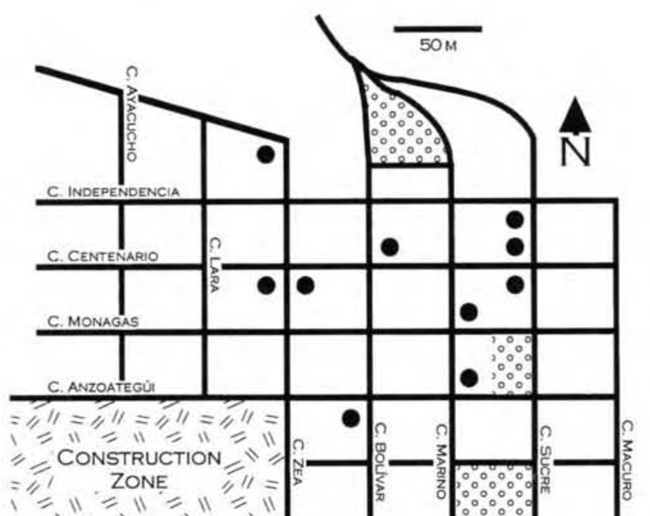

FIG. 2. Map of downtown Irapa, Estado Sucre, Venezuela. This map illustrates the distribution of *Eleutherodactylus johnstonei* in Irapa's downtown area shortly after its introduction between September 2000 and September 2001. In order to facilitate the description of localities, we considered the city's streets a grid, each of whose blocks represents four quarter squares. Filled circles indicate the quarter square in which audio transects revealed the presence of calling *E. johnstonei* males.

Expansion in Colombia.—Accounts of the invasion of *E. johnstonei* into Colombia (Table 1) have mostly been anecdotal (e.g. Kaiser 1997). Recent collecting has confirmed several localities, such as Bucaramanga (Ortega et al. 2002). Although reports supported by voucher specimens are few, the species is now also confirmed for Barranquilla and Cali (Table 1). It has apparently become established in Cartagena, but no voucher specimens are available.

The distribution of *E. johnstonei* across northern South America (Fig. 3) remains restricted to population centers. Within these locales, key habitats for *E. johnstonei* are private residences and areas where transportation of goods (such as construction materials, wood, or ornamental plants) is centered. It has been noted (Gorzula and Señaris 1998) that the occurrence of *E. johnstonei* in a residential area is generally an indicator of an elevated socioeconomic status of the residents, since the purchase of ornamental plants and the requirement of year-round watering requires considerable financial resources. This has earned the species the nickname "la rana burguesa" in some areas (Gorzula and Señaris 1998). This species has never been reported to cross from city habitats (e.g., parks, gardens, empty lots etc.), into native habitat. This is a key observation with respect to the species' competitive capacity and expansion pattern and may allay some fears about the potential impact of this species on local endemics. In Guyana, where *E. johnstonei* has existed for over 80 yrs, it has remained confined to the capital city of Georgetown, despite the proximity of agricultural land and disturbed forests, and the location of an international airport ca. 20 km to the south. Based on this pattern it is unlikely that there will be significant consequences for local endemics based on the mere presence of the species. However, if an endemic is negatively impacted by some form of human disturbance, such as short-term cutting of vegetation or residential construction in new forest tracts, *E. johnstonei* will likely move into that habitat before the native species has the opportunity to recover.

It is an interesting feature of *E. johnstonei* that its expansion seems to be limited by the availability of disturbed habitat. In collecting on all Eastern Caribbean islands with *E. johnstonei* populations, one of us (HK) found the species in seemingly undisturbed habitat in the southern Lesser Antilles only on the island of St. Lucia and in the northern part of that island chain on some of the Netherlands Antilles (Saba, St. Eustatius) and on the volcanic slopes of St. Kitts and Nevis. In all of these cases, *E. johnstonei*-populations in primary habitat exist in noticeably lower densities than populations in adjacent disturbed habitats. Although this is an anecdotal observation at this time, it allows us to hypothesize

TABLE 1. Current localities for *Eleutherodactylus johnstonei* in South America. Photographic vouchers are italicized. Institutional abbreviations are listed in the text.

Locality	Voucher	Reference
Colombia		
Barranquilla	ICN	Ruiz-Carranza et al. 1996
Bucaramanga	UIS-A-0346-0350	Ortega et al. 2002
Cali	UVC 13885, *LSUPC F-1389*	F. Castro, in litt.
Cartagena	none	this paper
French Guiana		
Cayenne	MNHN 1996.1003	Lescure and Marty 1996
Guyana		
Georgetown	USNM 194416–28	Hardy and Harris 1979
Venezuela		
Distrito Federal		
Caracas	USNM 194429–41	
La Guaira	none	this paper
Maiquetía	none	Kaiser and Grismer 2001
Edo. Anzoátegui		
Puerto La Cruz	none	Kaiser and Grismer 2001
Edo. Aragua		
El Castaño, Maracay	EBRG 3681	Manzanilla et al. 1995
El Limón	none	Barrio-Amorós 1998
Río Güey	none	Manzanilla et al. 1995
Edo. Bolívar		
Ciudad Bolívar	none	Gorzula 1989
Ciudad Guayana	none	Gorzula 1989
Guri	SCN 10919	Gorzula 1989
Puerto Ordaz	RMNH 18488	Barrio-Amorós 1998
Upata	none	Gorzula 1989
Edo. Carabobo		
Naguanagua, Valencia	EBRG 2090	this paper
Edo. Lara		
Barquisimeto*	none	Yustíz 1977
Edo. Mérida		
La Parroquia	CVULA 5032	Barrio Amorós 1998
Mérida	none	La Marca 1992
Edo. Miranda		
San José de los Altos	EBRG 1756	this paper
Edo. Monagas		
Caripe	*LSUPC F-555*	Kaiser and Grismer 2001
Maturín	*LSUPC F-556*	Kaiser and Grismer 2001
Edo. Sucre		
Cumaná	USNM 194442–46	Hardy and Harris 1979
Irapa	*LSUPC F-1388*	this paper
Edo. Trujillo		
Trujillo	ULABG 1158	La Marca 1992

*This population was listed as "*E. portoricensis* (= cooki)" by Yústiz (1977). We believe that Dr. Yústiz was trying to refer the observed individuals to a frog similar to the Puerto Rican coquí, now known as *E. coqui*. It is unlikely that he was trying to imply a synonymy of *E. portoricensis* and *E. cooki*, a distributionally highly restricted cave dweller.

FIG. 3. Map of northern South America (Colombia, Venezuela, Guyana), indicating locations for which *Eleutherodactylus johnstonei* has been confirmed.

that the capacity of *E. johnstonei* to expand into new habitats, and to survive at great densities, is optimized by habitat disturbance. The fact that all other populations of *E. johnstonei* are apparently linked to some abiotic disturbance (e.g., volcanism, degradation of native habitat by grazing and establishment of plantations, residential construction etc.) and exist at higher densities than in the forests of the islands mentioned above validates such an hypothesis. Assuming that any abiotic disturbance reduces, or at least temporarily rearranges, the complexity of a primary habitat, this might be what allows *E. johnstonei* to quickly move into ecological niches vacated temporarily or permanently by other species.

It is apparent that *E. johnstonei* is dispersed by a variety of means. Accidental introductions occur most likely through the ornamental plant trade, as evidenced by the species' appearance in upscale residential areas. With this vector, it is impossible to differentiate whether the species arrived through plants in one residence and was subsequently distributed by the owner of that residence to friends who enjoyed the frogs's vocalizations, or whether multiple plant introductions via plants occurred. In the suburbs of Caracas, Venezuela the species is now widely spread, and its escape from gardens of select barrios in other cities (such as Bucaramanga or Cali, Colombia) is only a matter of time. Purposeful introductions in South America are unequivocally documented only for Cumaná, Venezuela, and are apparently a simple matter of releasing a few *E. johnstonei* males and females in any area with disturbed vegetation.

One of the potential barriers to the spread of *E. johnstonei* is altitude. The population of *E. johnstonei* in Mérida occurs at the highest reported altitude for the species (up to 1400 m), followed by the populations in the town of La Parroquia near Mérida (ca. 1300 m) and near Caripe (ca. 1200 m). It seems that this altitude is the maximum possible for the species in this area of the Andes. At these altitudes, the species is tightly linked to gardens in south Mérida; no expansion from these localities has occurred at least over the last six years.

The pattern established by the spread of *E. johnstonei* in northern South America leads us to believe that the species will continue to expand its range by chance, and that there is no realistic possibility of stopping that expansion. If our current range map (Fig. 3) is considered a base map for the year 2001, predicted further points of introduction include all major cities in Colombia and Venezuela, as well as communities connected by trade and/or people movement south along the Andes into Ecuador, Peru, and Chile. It remains to be seen whether this species is capable of inhabiting higher altitude areas of the Andes (>3000 m), or disturbed sites in primary rainforests in the Orinoco and Amazon basins.

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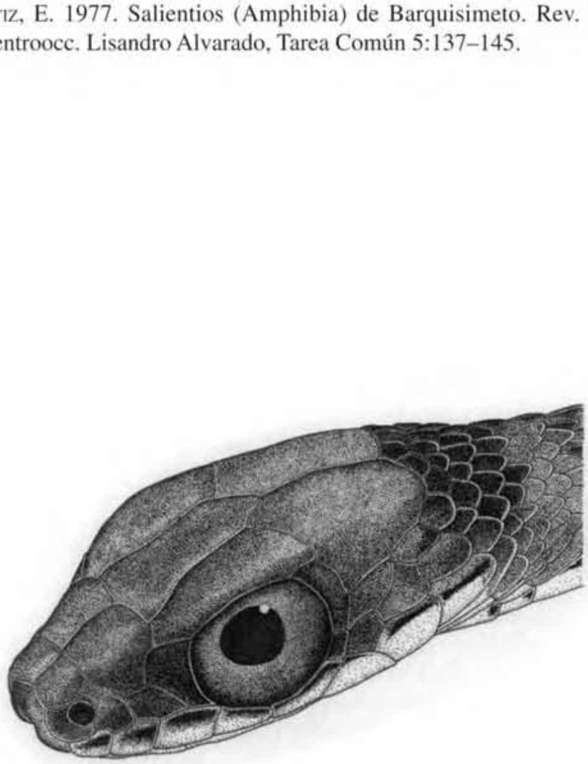

Dendrophidion nuchale (Black-naped Forest Racer; CRE 8832). Costa Rica: Las Cruces, 4 km S San Vito. Illustration by Julian C. Lee.

HERPETOLOGICAL HUSBANDRY

Herpetological Review, 2002, 33(4), 294–296.

A New Technique for the Safe Capture and Transport of Crocodilians in Captivity

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The capture of crocodilians involves a certain amount of stress to both the animals and handlers. A variety of methods are currently employed to capture crocodilians. Specimens deemed too large to be captured safely by hand are typically noosed with ropes or catchpoles (Fowler 1995; Jones and Hayes-Odum 1994). Noosed specimens may thrash and twist about violently and/or roll in an attempt to free themselves, which risks injury to the individual, nearby crocodilians, and/or the handler (Fowler 1995). Minor injuries (e.g., abraded snouts, broken teeth) to display animals are aesthetically undesirable. Extensive physical exertion also leads to the accumulation of lactic acid in the blood, which can have negative and even fatal consequences in larger specimens (Seymour et al. 1987). The use of cylinders for trapping and/or restraining crocodilians has been previously described. Jones and Hayes-Odum (1994) used an open PVC pipe for securing large noosed Ameri-

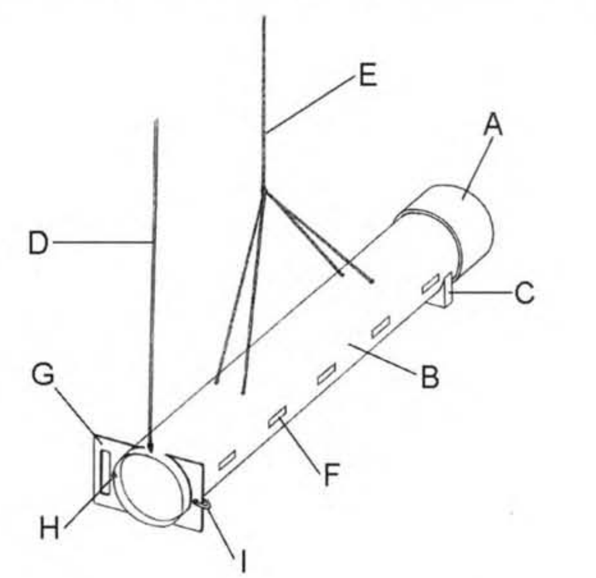

Fig. 1. Schematic diagram of the Crocodilian Capture Tube: (A) PVC cap; (B) PVC pipe; (C) stabilizer foot; (D) capture rope; (E) load bearing ropes; (F) drainage slits; (G) door; (H) door stopper bolt; (I) carabiner door latch.

can alligators (*Alligator mississippiensis*). This technique, however, still requires that the crocodilian be noosed with ropes, pulled into, and secured to the pipe. Wright (1999) advocated a similar approach, but with a corrugated metal sewer pipe. The objective of this paper is to describe a simple crocodilian capture method that provides an alternative to noosing in clear water pools possessing distinct corners and/or edges.

A piece of lime-green drainage pipe was used as the basis for our Crocodilian Capture Tube (Fig. 1). Although the effects of pipe coloration on trapping efficiency were not tested, it was felt that green was a more natural color than white. Pipe dimensions corresponded to the size of the crocodilians being captured. At Shark Reef, the tube is used to capture 5 year old captive bred *Crocodylus porosus* x *siamensis* with total body lengths ranging from 1.62 to 1.92 m and maximum abdominal diameters of 0.17–0.20 m. The pipe is 1.83 m in length, with a diameter of 0.36 m, thickness of 0.01 m, and mass of 34 kg (14-inch schedule 40 PVC pipe). As captive specimens are sometimes obese, pipe diameter should be carefully considered. A ratio of crocodilian girth to pipe diameter of $\geq$ 1:1.8 proved sufficient for our juvenile specimens. A commercially available white PVC cap (Fig. 1) was secured to one end of the pipe with PVC glue. A PVC stabilizing foot (Fig. 1), comprised of a U-shaped cradle, was then glued to the bottom of the pipe to ensure the trap would not roll once deployed on a relatively flat surface. This foot was affixed closest to the cap end of the pipe. This ensured that the entrance to the pipe would be almost flush with the bottom of the exhibit. Five holes were drilled into the top of the pipe in order to attach both capture and load-bearing ropes (Fig. 1). Drainage grooves were also cut along both sides of the pipe at intervals ranging from 0.15 to 0.35 m. In order to reduce stress to the captive animal, some water is allowed to remain in the pipe by cutting the grooves 0.13 m up from the bottom of the pipe. The remaining water, however, slowly seeps out from around the pipe's door. The entrance end of the pipe was modified to accommodate a sliding door (Fig. 1). The door is constructed as follows: A groove is cut around the end of the pipe, except for two 0.09 m sections on the top and bottom of the round pipe, in order to allow the insertion of a gray PVC door panel. Attached to the door is an imbedded stopper, comprised of a protruding stainless steel nut and bolt (Fig. 1).

A hole is drilled into the opposite end of the door that permits the clipping of an aluminum mountaineer's carabiner for a secure, tight-fitting, door that cannot be pushed out by the captive crocodilian's tail (Fig. 1). As a wet PVC door has the potential to be difficult to hold and maneuver quickly, the door also has a large integrated handle (Fig. 1). The total cost for the in-house manufacture of the Crocodilian Capture Tube with all new components is < US$ 400 at the time of writing. The most expensive component was the PVC cap at US$ 212. A new 6 m length of PVC pipe costs US$ 170. Such an expense is justifiable because of the safety afforded to the staff and the crocodilians.

The Crocodilian Capture Tube is used as follows: The tube is submerged to the bottom of an exhibit pool and up against an edge (Fig. 2A). Pool edges help to guide the crocodilian into the mouth of the tube. The trap is then left in place without further disturbance for ± 15 minutes, thus allowing crocodilians the opportunity to settle onto the bottom of the tank. The target crocodilian is then gently nudged with a smooth ended pole in the direction of

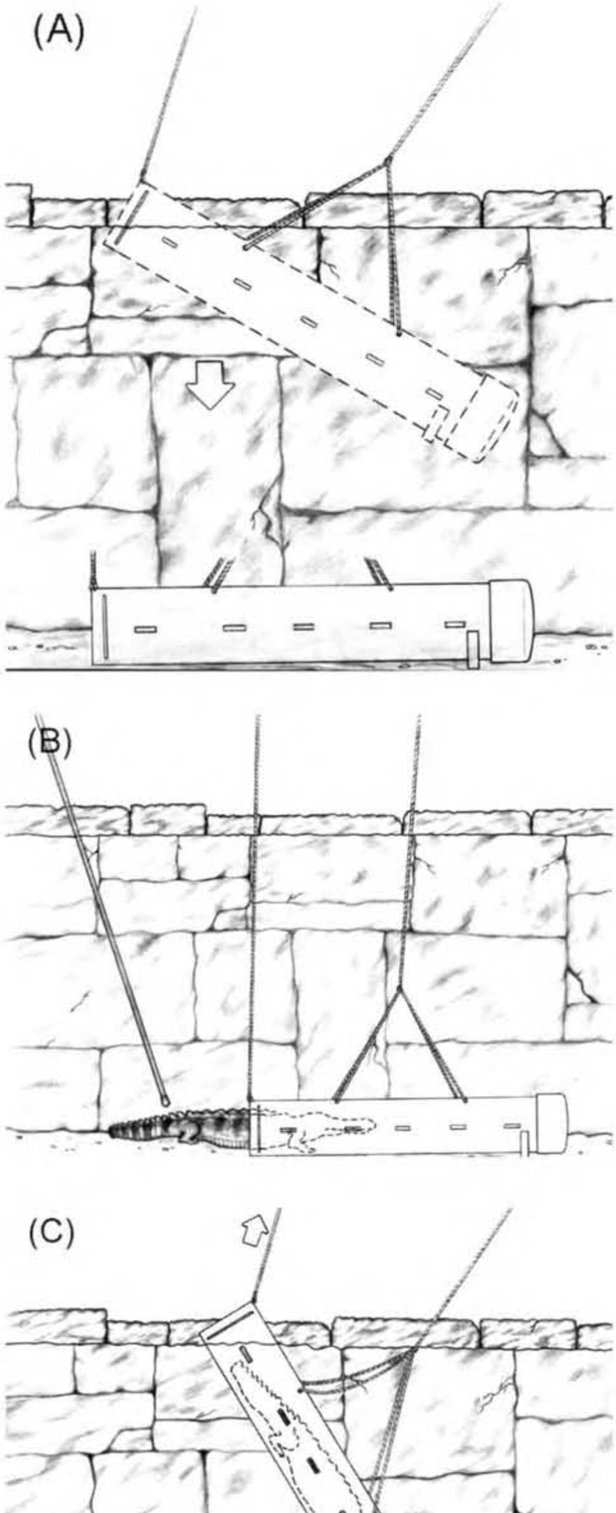

FIG. 2. Deployment and use of the Crocodilian Capture Tube from the edge of a deep concrete exhibit pool with clear water: (A) positioning tube at bottom of exhibit along an edge; (B) prodding crocodilian into the tube; (C) quickly retrieving entrance end of pipe by pulling up on the capture rope.

the tube entrance (Fig. 2B). To elicit movement in the desired direction, prodding is best directed towards a crocodile's posterior (e.g., base of tail, thigh) (pers. obs.). Our crocodilians bite at poles that approach or come in contact with their heads, rather than move in the desired direction. Juvenile *Crocodylus porosus* x *siamensis* entered the pipe readily, and most captures were accomplished in < 5 minutes. Once a crocodilian enters the pipe, the entrance side is quickly pulled up and out of the water by means of an attached capture rope (Fig. 2C). The crocodile is thus momentarily in an inverted vertical position and is unable to back out of the smooth, water-filled, pipe. The entrance is quickly sealed with the sliding door and secured. Finally, the pipe is pulled completely out of the water by means of the second load bearing rope handle (Fig. 1; Fig. 2C). Drainage slits allow water to quickly drain from the pipe (Fig. 1). The crocodile is then safely contained in a dark, wet, and smooth pipe. We believe that these characteristics provide a relatively non-stressful environment for the animal and prevent physical injury. A minimum of two people are required to trap a juvenile crocodilian in this fashion, although more may be required to lift and transport the pipe and its occupant. At Shark Reef, the entire process takes place with staff standing along the edge of an eight-foot deep exhibit pool. Although this technique reduces stress during capture and transport, confined crocodilians should not be exposed to excessively warm areas and/or direct sunlight, as thermal stress can also be fatal. To release a crocodilian, the pipe entrance is simply oriented towards a body of water and the door is removed. Tilting the pipe causes the crocodilian to slide out tail first into the water.

The Crocodilian Capture Tube has many advantages over current capture methodologies: (1) No direct physical contact is required between the crocodilian and handlers; (2) there is no need for securing the crocodilians jaws; (3) specimens can be captured underwater with ease; (4) no stressful thrashing or rolling behavior is exhibited by captured crocodilians; (5) there is no longer a need to cover a crocodilian's eyes, as it is in a dark tube; (6) the device serves as a safe short-term holding and on-site transport container; (7) no sedatives are required to capture and/or transport an animal; and (8) the crocodilians body is evenly supported during transport.

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NATURAL HISTORY NOTES

Instructions for contributors to Natural History Notes appear in Volume 33, Number 1 (March 2002). However, please take note of the updated information below.

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CAUDATA

AMPHIUMA MEANS **(Two-toed Amphiuma). OVERLAND MIGRATION.** *Amphiuma means* is a large aquatic salamander with reduced limbs and an eel-like appearance. Amphiumas inhabit relatively shallow, lentic water habitats and water levels in these habitats often fluctuate seasonally and/or annually. During periods of drought, amphiumas are known to aestivate in burrows within organic sediment of dry lake bottoms (Knepton 1954. Copeia 1954:68; Mount 1975. The Reptiles and Amphibians of Alabama. Auburn Printing Co., Auburn, Alabama). There are no published accounts of *A. means* traveling overland, although the possibility of overland migration/dispersal has been suggested (Snodgrass et al. 1999. Copeia 1999:107–113). Here, I report overland migration of an adult amphiuma from a drying lake during a drought.

Lake Jackson in Leon County, Florida, USA is a 1620 ha sinkhole lake that dried to 10% of normal surface area in 1999–2000 during a prolonged drought in northern Florida. In order to monitor the mass migration of reptiles and amphibians from the drying lake, I constructed an 853-m drift fence along U.S. Highway 27N adjacent to the northwest part of Lake Jackson. Animals were migrating to a 7-ha lake (Little Lake Jackson) that did not dry located immediately to the west of U.S. 27. On 10 June 2000 at 1100 h, I found a dead, partially desiccated adult male *A. means* (SVL 40 cm, TL 79 cm) at the drift fence. The body was positioned perpendicular to the fence with the snout touching the fence. The amphiuma apparently moved during the previous night as it was not observed at the fence at 2030 h on 9 June. There were no signs of injury that might suggest it was carried there by a predator. There were clear skies 9–10 June and full sunshine on the morning of 10 June; the only moisture was morning dew on dense vegetation.

There are two possible scenarios to describe the terrestrial movement of this amphiuma: either it migrated from a drying lake pool or it emerged from an aestivation burrow. The latter is unlikely as there was no rainfall since 5 June 2000 (0.05 cm) and, therefore, probably no trigger mechanism that might stimulate emergence from aestivation in an area of lake bottom that was dry for 1–2 years and covered with terrestrial vegetation. Although most amphiumas probably aestivate under organic sediment in the littoral zone of drying lakes (Aresco 2001. Herpetol. Rev. 32:32–33), some individuals may remain active in slowly receding water with little or no aquatic vegetation. Under these conditions, the increased